renewable energy progress and biofuels sustainability

Report for the European Commission
Submission September 2012
Tender Number: ENER/C1/463-2011-Lot2

Disclaimer: This report has been produced for the European Commission (Tender ENER/C1/463-2011-Lot2) by the consortium indicated below headed by Ecofys. The views represented in the report are those of its authors and do not represent the views or official position of the European Commission.

ECOFYS – sustainable energy for everyone

Carlo Hamelinck (project leader)
Isabelle de Lovinfosse
Michèle Koper
Christina Beestermoeller
Christian Nabe
Matthias Kimmel
Arno van den Bos
Ismail Yildiz
Marieke Harteveld

Fraunhofer

Mario Ragwitz
Simone Steinhilber

BBH Becker Büttner Held

Jana Nysten
Doerte Fouquet

Energy Economics Group

Gustav Resch
Lukas Liebmann
Andre Ortner
Christian Panzer

Winrock International

David Walden
Rocio Diaz Chavez
Bruce Byers
Silvia Petrova
Emily Kunen

Guenther Fischer

Executive summary

Progress in renewable energy

- A large majority of MS reached or exceeded their **2011/2012 minimum trajectory** in 2009 or 2010 already. Only Latvia, Malta, the Netherlands and the UK did not reach the 2011/2012 minimum trajectory in 2010, with for Malta, the Netherlands and the UK a significant gap still to fill. The projections from the Green-X model show that only Latvia, Malta and the Netherlands are expected to miss their 2011-2012 minimum trajectory, with a gap ranging from about 10% (NL, LV) to 28% (MT). This means that the prospect for the achievement of the 2011/2012 minimum trajectory is expected to improve, at least in Cyprus, Ireland and the UK if they maintain their current policy initiatives;
- A large number of MS need to speed up RES developments in order to fulfil their **2020 minimum trajectory target**. The projections from the Green-X model for 2020 confirm this and show that almost all MS will fail to meet their 2020 minimum trajectory target **if no further policies and measures** are implemented. Twelve out of 27 countries may even end up with a lower RES share in 2020 than in 2012. For the EU-27 overall, a gap of 4.6% to 5.7% is expected in 2020 in the absence of additional policies;
- The prospects on the achievement of the RES **2020 minimum trajectory target** improves if the impact of **planned RES policy initiatives** as reported in the MS progress reports is modelled, and at for EU-27 overall the gap decreases, ranging from 4.6% to 3.4%;
- The findings from the analysis of the progress on the **RES-E, RES-H&C and RES-T NREAP targets** show that: **in 2010** in EU-27 overall the targets for RES-E and RES-H&C sector were met and even exceeded (even if only about half of the MS actually met their targets), but the RES-T target was not met; **in 2012**, only the RES-H&C target is expected to be met at EU-27 level (even with a majority of MS not meeting their national targets), while the RES-E and RES-T targets are expected to show a deviation of -2.8% and -7.8%; and eventually **in 2020** none of the sectors are expected to meet their targets at EU-27 level, with deviations ranging from -15% to -35% depending on the scenarios. Only very few countries are expected to reach their RES-E, RES-H&C targets (4 MS) and even less their RES-T targets (2 MS) by 2020;
- The assessment of the **MS policies and measures** shows that the current economic crisis has affected the reliability of RES support in a number of M S. Most but not all MS have fulfilled (fully or partially) their NREAP policy commitments, but the progress in RES deployment observed so far and expected by 2020 shows that significant efforts are still needed for almost all the MS if they intend to reach their RES target;

- Our analysis shows that there are two major tendencies in the implementation of the **guarantees of origin** in the MS. On the one hand, there are MS with a quite advanced system in place (e.g. Lithuania, Romania) that often also allow the GoOs as some form of evidence in their national support system (e.g. the Netherlands, Sweden or Romania). On the other hand, some MS have so far not really taken up on the idea of GoOs and they often have only quite rudimentary systems in place which in the course of the implementation of Directive 2009/28/EC are now being updated and improved (e.g. Germany, Bulgaria, Italy, Estonia). An electronic register for RES-E is or is expected to be in place in all countries, but only in very few MS for RES-H&C;
- Most of the countries have made important progress in tackling the barriers to **electricity grid integration** since the NREAP. Many countries had not addressed or even acknowledged certain barriers in the NREAP but have adopted quite effective measures to reduce them recently;
- The overall progress made by the MS in improving their **administrative procedures** since the NREAP has been limited.

The biofuels market place

- In 2010, the use of renewable energy in transport was 4.70%, consisting of:
    - 13.0 Mtoe of sustainable biofuels or 4.27%;
    - 1.3 Mtoe of renewable electricity, or 0.43%;
- Between 2008 and 2010, the volume of *biofuels* consumed in the EU increased by 39%, whereas the volume of petroleum fuels consumed in road transport decreased with 3.5%;
- In 2010 about 75% of the biofuels used in the EU concerned “bio-diesels” (mainly methyl esters), 21% concerned “biogasoline” (mainly bioethanol) and about 4% resided in “other liquid biofuels”;
- Five Member States (Germany, France, UK, Italy and Spain) still represent more than 70% of the European biofuels market, both in production and consumption. Their majority is only slowly decreasing over time;
- Only 1.4% (177 ktoe) of all EU consumed sustainable biofuels (13 Mtoe), or 0.11% points of the 4.70% RES-T share, were produced from wastes, residues, non-food cellulosic material, and ligno-cellulosic material (double counting according to Article 21.2 of Directive 2009/28/EC);
- Initiatives for double counting biofuels production in Europe are located in a limited number of Member States and focus on a broad range of conversion technologies. The amount of double biofuels produced in 2010 was still small in comparison with conventional biofuels. The lion’s share concerns biodiesel on basis of waste oils, produced in several Member States, and biomethanol, produced in the Netherlands. Cellulose ethanol is commercially demonstrated at a small but

significant scale in Denmark. End 2012, a larger cellulose ethanol plant will come online in Italy;

- More than half of the installed biofuels production capacity in the EU is not used. After years of declining capacity use, EU biodiesel production is now stabilising at 40% of its capacity in 2010. The capacity use in the EU bioethanol industry is hovering between 50% and 60%. This unused capacity does indicate that there is sufficient conversion capacity available for several years to come;
- Most of the EU produced biodiesel in 2010 was produced from rapeseed (56%), followed by soybean (13%) and palm oil (9%);
- More than half of the EU produced ethanol is on basis of starch crops (30% from wheat, 23% from maize and smaller contributions from barley and rye). Sugar beet represents another 30%;
- About 83% of all EU consumed biodiesel in 2010 is produced in the EU, about 17% is imported from third countries, primarily from Argentina (10%), which has replaced the USA as the largest biodiesel exporter to the EU;
- About 80% of all EU consumed bioethanol in 2010 is produced in the EU, about 20% is imported from third countries, primarily from Brazil and the USA, although the fraction from Brazil almost halved in comparison to 2008;
- The role of the EU in the global biofuel market has remained constant in the last years. The EU remained in 2010 by far the largest producer of biodiesel in the world with 8.5 Mtoe (55% of global market share) compared to global production of 15.5 Mtoe. Brazil and Argentina have significantly increased the production of biodiesel in recent years, whereas the production of biodiesel in the USA decreased almost by more than half compared to 2008. In the rest of the world, bioethanol plays a much larger role. World bioethanol production reached 43.8 Mtoe in 2010, of which only 2.0 Mtoe or 5% were produced in the EU. The USA is the world's largest ethanol producer since 2006 (24,929 Mtoe produced in 2010), followed by Brazil. Net EU trade in the global biofuels market is therefore fairly insignificant;
- Eventually, the most important feedstock for biodiesel is rapeseed originating from the EU, followed by Argentinean soy, Indonesian and Malaysian palm oil, and rapeseed from Canada and Ukraine. EU produced biodiesel is partially produced from imported feedstock (palm oil, soy and part of the rapeseed);
- On the contrary, the EU produced bioethanol is mainly produced from EU feedstock, with only small shares of wheat and maize originate from Switzerland, Ukraine and a few other countries. Sugar cane and maize play a role via the bioethanol supplying countries Brazil and the USA mainly.

Measures to safeguard the sustainability of biofuels

- Member States deem the impact of the production of feedstock for biofuels on water and air quality low. Most countries have simply not performed an evaluation, with the exception of Belgium, Romania and Germany, which have taken concrete steps to analyse the impacts. Several countries assume impact should be minimal based on existing legislation and codes of practice;

- Outside the EU, several countries have improved their regulation related to sustainable agriculture, but this is rarely targeted at the sustainability of biofuel feedstock production;
- An increasing amount of feedstock in main supplying countries is covered by voluntary programs. The main voluntary programs which increased their coverage in 2010 are RTRS, RSPO and ISCC. Expansion of coverage was largest in Argentina, Brazil, Indonesia, Malaysia and the USA.

Biofuels sustainability

- Member State progress reports provide little conclusive evidence about the impact of and increased biofuel production on the national land use patterns;
- Back-casting analysis reveals that EU biofuels production in 2010 lead to about 2.2 Mha additional land use (compared to 2000), an increase of about 1.1 Mha compared to 2008. The additional land used per additional unit of biofuel in 2010 is 0.18 Mha/Mtoe for the EU-27 biofuel production;
- Statistical analysis reveals that the total land use worldwide, to produce the feedstock for EU-consumed biofuels in 2010, is about 5.7 Mha. Of this, 3.2 Mha (57%) is within the EU and 2.4 Mha (43%) resides outside the EU. True valuation of co-products would yield a lower figure;
- In most of the non- EU countries, the land dedicated to the production of feedstock for EU biofuels is less than 1% of the cropland. Notable exceptions are Argentina and Paraguay, where 3% and 4% of the total cropland produces soybean for EU biodiesel in 2010;
- Within the EU, several countries used a relatively large percentage of the land used for the total crop for the EU biofuel feedstock, like France (6%), Germany (5%), Czech Republic (6%) and Poland (2%);
- Tot total estimated greenhouse gas emission savings from the use of biofuels in the EU in 2010 without land use change quantification, ranged between 22.6 Mtonne CO_2 equivalent, which represents a saving of 53% compared to the situation where only fossil fuel would be used, and 25.5 Mtonne CO2 equivalent or 60% savings;
- Biodiversity risks resulting from EU biofuel consumption are estimated to be the highest in Brazil and the USA, mainly concerning the conversion of shrubland and grassland, followed by Argentina, Canada and Russia;
- Water stress as result of feedstock production for EU biofuels consumption, mainly occurs in the EU, especially in Belgium, where a significant fraction of the total agriculture water footprint seems to be related to biofuels. Further large

contributions are seen in Germany, France and Hungary. Outside the EU, the largest impacts are seen in Argentina and Paraguay;

- No conclusions can be drawn on risks to soils, although the expansion in crop area, the likely increase in fertilisers and pesticides, the use of machinery and irrigation correlates to increased risks for soils, especially in non-EU countries;
- The production of soybean, palm oil, maize, and sugarcane have the highest overall potential risks for air quality, largely due to the presence of burning as part of their production (land preparation and post harvest), but also as a result of volatization of fertiliser and other agrochemicals;
- Back-casting scenario analysis of the global agricultural market development clearly shows that EU-27 expanding biofuel use has contributed only little to the historical cereal price increases in 2007 to 2010 resulting in a wheat and coarse grain price increase of about 1-2%. The impact was more substantial for price increases of non-cereal food commodities by about 4%, notably through its demand for vegetable oil in the production of biodiesel;
- The international markets have been influenced by many other factors such as weather, lower than average harvests, rising global demand for meat and other food and oil prices, to a much larger extent than biofuel production;
- The impacts of global food prices on local food prices and food security differ between countries, crops and circumstances. From local cases analysed in this section, no concrete indications could be found of biofuel production causing local food price increases;
- Given the time lapse between land deals and actual crop production, it is almost impossible to link these deals with the EU biofuel consumption. Based on scrutiny of the largest land deals in developing countries and on assumptions about how much land deals may have eyed the EU market, we estimate that between 0.05 and 0.16 Mha of land deals with concerns about socio-economic impacts and land-use rights could be linked to the EU market. We expect that in the future more information will come available about the source regions of biofuels as a result of sustainability reporting requirements. Attention needs to be paid to the developments and biofuel imports in the 2011-2012 and onwards period;
- Gross employment related to global biofuels production is estimated to be 3.5 million, of which 0.2 million jobs in the EU in the production of ethanol and biodiesel and along the biofuels supply chain;
- The impact of biofuels on other biomass using sectors was not very apparent in 2010, although the impact on the oleo-chemical industry was significant. As the emerging bio-economy sectors grow, competition for raw materials for the different biomass uses will increase.

Table of Contents

Glossary

RES	Renewable Energy Sources
RES-E	Electricity produced from Renewable Energy Sources
RES-H&C	Heat and Cold produced from Renewable Energy Sources
RES-T	Renewable Energy Sources applied in Transport
NREAP	National Renewable Energy Action Plan
MS	Member State
RSPO	Round table for sustainable palm oil
RTRS	Round table for responsible soy
ISCC	International sustainability and carbon certification
CBD	Convention on Biological Diversity
MDG	Millennium Development Goal
IUCN	International Union for Conservation of Nature
HCV	High Conservation value
PA	Protected Area
Potico	Palm oil, Timber, Carbon offsets
RUBICODE	Rationalising Biodiversity Conservation in Dynamic Ecosystems
WCMC	World Conservation Monitoring Centre
EU Member States	
AT	Austria
BE	Belgium
BG	Bulgaria
CZ	Czech Republic
CY	Cyprus
DK	Denmark
EE	Estonia
FI	Finland
FR	France
DE	Germany
EL	Greece
HU	Hungary
IE	Ireland
IT	Italy
LV	Latvia
LT	Lithuania
LU	Luxembourg
MT	Malta
NL	Netherlands
PL	Poland
PT	Portugal
RO	Romania
SK	Slovakia
SI	Slovenia
ES	Spain
SE	Sweden
UK	UK

1 Progress of Renewable Energy

1.1 Major Findings

- A large majority of MS reached or exceeded their **2011/2012 minimum trajectory** in 2009 or 2010 already. This is partly due to the fact that about half of the MS set their planned **RES target** values in the early phase (2010-2012) higher than the minimum trajectory values which were determined according to a standard formula given in Annex B of the RES Directive. Only Latvia, Malta, the Netherlands and the UK did not reach the 2011/2012 minimum trajectory in 2010, with for Malta, the Netherlands and the UK a significant gap still to fill. The projections from the Green-X model show that only Latvia, Malta and the Netherlands are expected to miss their 2011-2012 minimum trajectory, with a deviation ranging from about -10% (NL, LV) to -28% (MT). This means that the prospect for the achievement of the 2011/2012 minimum trajectory is expected to improve, at least in Cyprus, Ireland and the UK if they maintain their current policy initiatives;
- A majority of MS had a RES growth rate in 2009/2010 above the average annual growth rate required to achieve the 2020 minimum trajectory target and they are therefore on track if they keep this up. Still a large number of MS need to speed up RES developments in order to fulfil their **2020 minimum trajectory target**. The projections from the Green-X model for 2020 confirm this and show that almost all MS will fail to meet their 2020 minimum trajectory target **if no further policies and measures** are implemented (current policy initiatives scenario). Only three out of 27 countries, i.e. Sweden, Austria and Estonia, may succeed in (over)fulfilling their 2020 RES targets with already implemented RES policies under the current framework conditions. In the majority of countries currently implemented RES policies appear insufficient to trigger the required RES deployment. Generally this reflects deficits in both the financial support for RES and the required mitigation steps related to non-economic barriers that hinder an accelerated RES diffusion. Moreover, the success in improving energy efficiency and consequently reducing overall energy demand growth is another key factor for achieving RES targets. Twelve out of 27 countries may even end up with a lower RES share in 2020 than in 2012. These are generally countries that already hold a significant RES share and where consequently a strong overall energy demand growth would negatively affect RES target achievement. For the EU-27 overall, a gap of 4.6% to 5.7% is expected in 2020 in the absence of additional policies;
- The prospects on the achievement of the RES **2020 minimum trajectory target** improves if the impact of **planned RES policy initiatives** as reported in the MS progress reports is modelled, and at for EU-27 overall the gap decreases, ranging

from 4.6% to 3.4%. With the impact of the planned policies and measures Bulgaria and Slovakia are also expected to meet their 2020 RES targets. But overall, current planned policy initiatives are expected to trigger only moderate improvements in the majority of MS;

- The analysis of the **NREAP 2010, 2012 and 2020 RES targets** leads to similar conclusions: most of the countries reached or exceeded their 2010 target (19), still a majority are expected to meet their 2012 NREAP targets (17), but only a few will reach their 2020 NREAP target and only if the energy efficiency measures are implemented successfully. At EU level a deviation of 2.3% to 3.9% compared to the EU-27 NREAP target is predicted in 2012, but a deviation ranging from -30% (CPI with high demand growth) to -19% (CPI+PPI with low demand) is expected in 2020;
- The findings from the analysis of the progress on the **RES-E, RES-H&C and RES-T NREAP targets** show that: **in 2010** in EU-27 overall the targets for RES-E and RES-H&C sector were met and even exceeded (even if only about half of the MS actually met their targets), but the RES-T target was not met; **in 2012**, only the RES-H&C target is expected to be met at EU-27 level (even with a majority of MS not meeting their national targets), while the RES-E and RES-T targets are expected to show a deviation of -2.8% and -7.8%; and eventually **in 2020** none of the sectors are expected to meet their targets at EU-27 level, with deviations ranging from -15% to -35% depending on the scenarios. Only very few countries are expected to reach their RES-E, RES-H&C targets (4 MS) and even less their RES-T targets (2 MS) by 2020. At technology level the following technologies will require the most urgent policy efforts in order to play their expected roles by 2020: wind energy, CSP and ocean technologies for the RES-E sector; heat pumps, solar thermal collectors as well as mid/large-scale geothermal heating systems for the RES-H&C sector; and biofuels mandates for the RES-T sector;
- The assessment of the **MS policies and measures** shows that the current economic crisis has affected the reliability of RES support in a number of M S (e.g. Portugal, Spain, Bulgaria, Latvia, Czech Republic, the UK). Most but not all MS have fulfilled (fully or partially) their NREAP policy commitments, but the progress in RES deployment observed so far and expected by 2020 shows that significant efforts are still needed for almost all the MS if they intend to reach their RES target. Efforts in additional policy support is especially needed in the RES-H&C and RES-T sector, while in the RES-E sector the focus should be on maintaining and improving the effectiveness and efficiency of existing policies. A number of countries made abrupt changes to their RES-E support schemes in 2010 and 2011 to keep up with the rapid price developments on the PV market (e.g. Spain, Czech Republic, the UK, Latvia, Portugal), but these changes undermined the confidence of the investors which is a serious threat to the success of RES policies in the future. As more MS are moving towards mandate schemes for

biofuels and the level of the mandates are progressively increased, higher and more reliable biofuels deployment can be expected in the future;

- Our analysis shows that there are two major tendencies in the implementation of the **guarantees of origin** in the MS. On the one hand, there are MS with a quite advanced system in place (e.g. Lithuania, Romania) that often also allow the GoOs as some form of evidence in their national support system (e.g. the Netherlands, Sweden or Romania). On the other hand, some MS have so far not really taken up on the idea of GoOs and they often have only quite rudimentary systems in place which in the course of the implementation of Directive 2009/28/EC are now being updated and improved (e.g. Germany, Bulgaria, Italy, and Estonia). An electronic register for RES-E is or is expected to be in place in all countries, but only in very few MS for RES-H&C;
- Most of the countries have made important progress in tackling the barriers to **electricity grid integration** since the NREAP. Many countries had not addressed or even acknowledged certain barriers in the NREAP but have adopted quite effective measures to reduce them recently. This shows that the development of RES integration is evolving quickly and that policies are dynamic. Moreover, our assessment shows that adopting effective cost regulation measures aiming at a clear distribution and level of costs as well as setting incentives for investments seems to be less of a priority than accelerating and facilitating grid development;
- The overall progress made by the MS in improving their **administrative procedures** since the NREAP has been limited. Regarding the introduction of one-stop-shops, a few MS had it in place before the NREAP, but only Greece and Portugal recently introduced it while all MS are encouraged to do so. So generally, the uptake of this idea has been rather slow;

1.2 Past Progress in 2009 and 2010

Introduction

This chapter presents the Member State progress in deploying RES-E, RES-H&C and RES-T in 2009 and 2010. We are comparing the progress achieved by the Member States in 2010 with two targets set out in the NREAP: their non mandatory 2010 NREAP target and the mandatory 2011/2012 minimum trajectory.

The different figures provided in this chapter aim to provide an overview of the progress made in RES deployment in 2009 and 2010, compared to the progress planned in the NREAPs.

For RES overall, three figures are presented:

(1) Overview figure comparing MS RES deployment in 2009 and 2010 with 2011/2012 minimum trajectory and 2010 NREAP targets;

(2) MS deviation from 2010 NREAP target in %;
(3) MS annual growth rate between 2009 and 2010 compared to the annual growth rate required between 2010 and 2020 to achieve the 2020 target.

For the three sectors RES-E, RES-H, and RES-T, we present figures (1), (2), and (3) as well. In addition, an overview figure (4) of the development of the most important technologies since 1990 is provided.

For each of the three sectors we present the deviation from 2010 target (figure (2)) for the main technologies in the report and for the other technologies in the annex (see Table 1).

Table 1. Overview RES technologies presented in the report and in the annex.

RES-E		RES-H&C		RES-T	
Offshore wind	Report	Solar thermal	Report	Bioethanol/Bio-ETBE	Report
Onshore wind		Solid biomass		Biodiesel	
Solid biomass		Biogas		Electricity in transport	
Biogas		Heat pumps		Other biofuels	
Photovoltaics		Geothermal	Annex	Hydrogen	Annex
Small hydro		Bioliquids			
Large hydro					
Mixed hydro					
Geothermal	Annex				
Bioliquids					
Concentrated solar power					
Tide, wave and ocean energy					

Methodology and data sources

The trajectories planned for each RES technology until 2020 are publicly available in the National Renewable Energy Action Plans (NREAPs) submitted to the European Commission by every Member State in 2010. Member States also submitted their first Progress Reports to the Commission in 2011 and 2012, to monitor compliance with their planned trajectories and measures.

Actual technology progress in 2009/2010 is measured using the data provided in these Progress Reports. In addition, EUROSTAT provides RES overall shares and sector shares calculated according to the methodology stipulated in Directive 2009/28/EC. These shares were used in the RES overall and RES sector analysis. EUROSTAT furthermore supplies data for individual RES technologies. This data is not directly used in the calculations, but serves as background information.

We encountered some gaps and inconsistencies in the data. Where applicable, assumptions were made to handle them:

- Wind data: in the NREAPs and the Progress Report, Member States were asked to give data for wind on- and offshore, and an overall figure for wind. Some Member States only gave the overall figure. In such a case, it was assumed that the Member State was exactly on track in offshore wind, and the remaining generation was assumed to be onshore wind. If Member States reported installed capacities, but not generation, for the subcategories, then generation was estimated according to the given capacities;
- Biomass data: similarly to wind, some Member States did not provide values for the sub-categories solid biomass, biogas, and bioliquids in their NREAP and their Progress Report. If only an overall biomass figure is given, it is assumed that the Member State is exactly on track in biogas and bioliquids. The remaining generation is assumed to be solid biomass;
- Hydropower: for Member States who did not report on hydro subcategories, the same approach as for wind and biomass was used;
- Upon comparing Progress Report deployment data with EUROSTAT data, inconsistencies were discovered for some technologies and countries. This is in part due to the fact that in some Member States different institutions are responsible for compiling the national data used in the Progress Report and for providing data to EUROSTAT. The Progress Report data on technology level are more consistent with the NREAPs than is EUROSTAT. In this report, deployment data on technology level is taken from the Progress Reports – with the exception of the Czech Republic, who did not provide data in the Progress Report, and Slovenia, who did not provide consumption data on the RES-T sector. Overall RES share data and sector share data is taken from EUROSTAT in order to ensure that the correct share calculation methodology was used for all countries.

Description of the different figures presented in this chapter to analyse the MS progress in deploying RES in 2009 and 2010 compared to their target and trajectory.

(1) An **overview** displaying the achieved RES-Share in 2009 and 2010 together with the minimum 2011/2012 trajectory and 2010 indicative target shares is given for RES overall. For the three sectors RES-E, RES-H, and RES-T, this figure is provided with the 2010 indicative target share only, as the minimum 2011/2012 trajectory was adopted for RES overall but not for individual sectors.

(2) The **deviation from trajectory** figure shows the percentage deviation of actual deployment in year n compared to the planned deployment in year n (year n=2010). It is provided for RES overall, for the three sectors, and for each technology. For the sector shares, NREAP table 3 was compared to Progress Report table 1. For the technology graphs, NREAP tables 10, 11, and 12 were compared to Progress Report tables 1b, 1c, and 1d. For the actual overall share, the figures provided by EUROSTAT were used.

(3) The **annual growth rate** figure shows the percentage progress in deployment in the last available year (growth rate between 2009 and 2010) demonstrating the most recent trend of effort and it compares it with the average annual growth rate required between 2010-2020 to achieve the 2020 target. It will be presented for RES overall, and for the three sectors RES-E, RES-H, and RES-T. Comparing last year's growth rate with the necessary average growth rates by 2020 gives a feeling for the additional efforts required by each Member State, even those that are currently (over)achieving their trajectory.

Past Progress in RES overall

(1) Overview of 2009-2010 deployment vs. 2010 NREAP target and 2011/2012 minimum trajectory

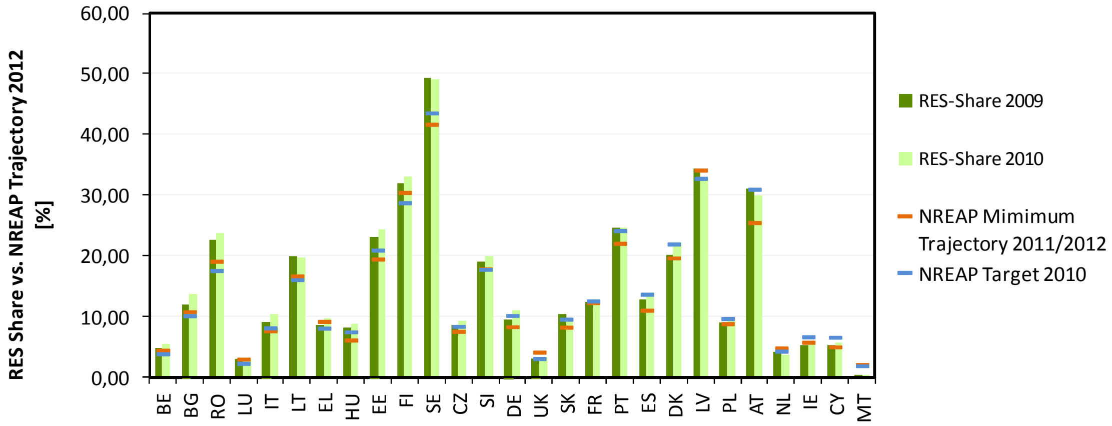


Figure 1. Actual RES Share in 2009 and 2010 vs. 2011/2012 minimum trajectory and 2010 NREAP target (%).

Member States appear in the order of their deviation from 2010 target (see Figure 2).

About half of the MS set their planned target values in the early phase higher than the minimum trajectory values which were determined according to a standard formula given in Annex B of the RES Directive. This leads to the majority of countries reaching or exceeding their 2011/2012 minimum trajectory target in 2009 or 2010 already. Only Latvia, Malta, the Netherlands and the UK did not reach the 2011/2012 minimum trajectory in 2010, with for Malta, the Netherlands and the UK a significant deviation still to fill (respectively -78%, -20% and -19%).

Except Austria, Cyprus, France, Ireland, Latvia, Malta, the Netherlands and Poland, most countries reached their 2010 target and a large majority of them already as soon as in 2009. Austria is an odd case as it reached the 2010 target in 2010 but not in 2010 due to a drop of RES shares, but the 2011/2012 target was reached in 2010 because it was set lower than the 2010 target.

Most countries except Austria, Latvia, Lithuania, the Netherlands, Slovakia, Portugal and Sweden increased their share of RES between 2009 and 2010. Except in the case of the Netherlands and Latvia who are not on track with their minimum trajectory, the other countries with a decrease of RES share in 2010 have already reached their 2010 target and 2011/2012 minimum trajectory in 2010.

Table 2. Actual and planned RES Shares.

Member State	EUROSTAT actual RES-share 2009 [%]	EUROSTAT actual RES-share 2010 [%]	NREAP indicative target RES share 2010 [%]	NREAP minimum trajectory RES Share 2011/2012 [%]	Deviation of actual 2010 share from planned 2010 share [%]	Deviation of actual 2010 share from minimum trajectory 2011/2012 share [%]
Belgium	4,90	5,38	3,80	4,36	41,58	23,39
Bulgaria	11,88	13,79	10,06	10,72	37,11	28,67
Czech Republic	8,67	9,35	8,30	7,48	12,70	25,06
Denmark	20,23	22,22	21,90	19,60	1,44	13,34
Germany	9,54	11,00	10,10	8,24	8,94	33,53
Estonia	23,01	24,32	20,90	19,40	16,36	25,36
Ireland	5,31	5,83	6,60	5,68	-11,71	2,60
Greece	8,57	9,69	8,00	9,12	21,12	6,25
Spain	12,84	13,83	13,60	10,96	1,71	26,21
France	12,43	12,86	12,50	12,20	2,90	5,43
Italy	9,13	10,43	8,05	7,56	29,55	37,95
Cyprus	5,31	5,65	6,50	4,92	-13,01	14,92
Latvia	34,34	32,57	32,70	34,08	-0,39	-4,42
Lithuania	19,96	19,72	16,00	16,60	23,23	18,78
Luxembourg	2,93	2,95	2,20	2,92	33,98	0,94
Hungary	8,18	8,79	7,40	6,04	18,76	45,50
Malta	0,26	0,43	1,80	2,00	-76,37	-78,73
Netherlands	4,17	3,77	4,20	4,72	-10,32	-20,20
Austria	30,97	30,05	30,90	25,44	-2,75	18,12
Poland	8,93	9,49	9,58	8,76	-0,99	8,28
Portugal	24,59	24,57	24,10	22,00	1,96	11,69
Romania	22,58	23,64	17,50	19,04	35,07	24,14
Slovenia	18,99	19,90	17,70	17,80	12,41	11,78
Slovakia	10,42	9,80	9,50	8,16	3,13	20,07
Finland	31,95	33,00	28,70	30,40	14,97	8,54
Sweden	49,36	49,07	43,50	41,64	12,81	17,85
UK	2,99	3,26	3,00	4,04	8,80	-19,21

Table 2 presents the data underlying Figure 1 and Figure 2. The deviation of the actual 2010 share from both the 2010 indicative target share and the 2011/2012 minimum trajectory share are presented.

(2) Deviation from 2010 NREAP target

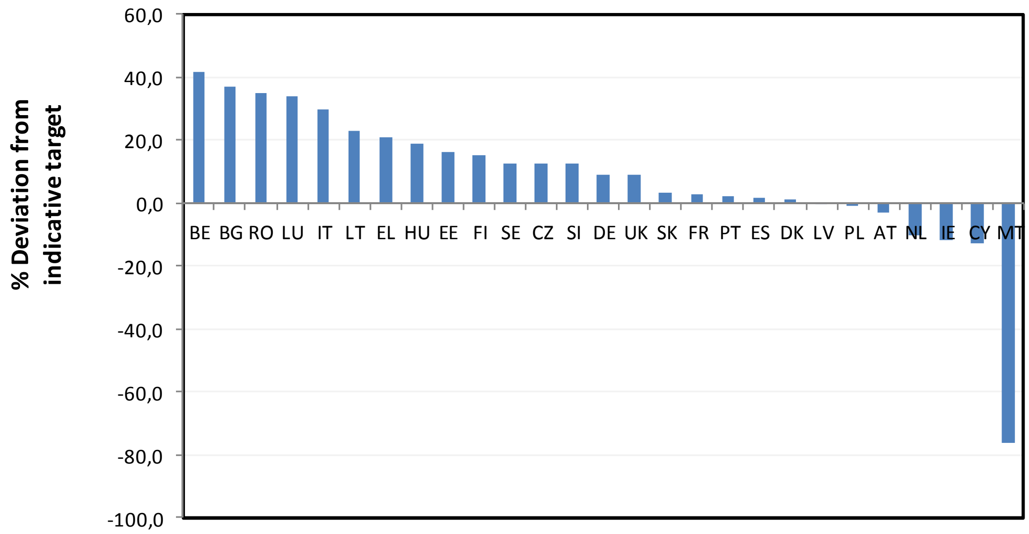


Figure 2. Deviation of actual 2010 RES Shares (EUROSTAT) from NREAP 2010 target.

Most of the countries exceeded or just achieved their NREAP 2010 target. For most of them the 2011/2012 minimum mandatory targets are also achieved already in 2010 and unless their share drops in 2011 and 2012 they can be seen as on track with their trajectory towards 2020. But for some of them it does not mean that they are on track with their 2011/2012 minimum trajectory, e.g. the UK and Luxemburg.

A few countries deviate from their 2010 NREAP target, though only Malta significantly. But some of them are still on track with their 2011/2012 minimum trajectory, like Austria, France or Poland.

(3) Annual growth rate

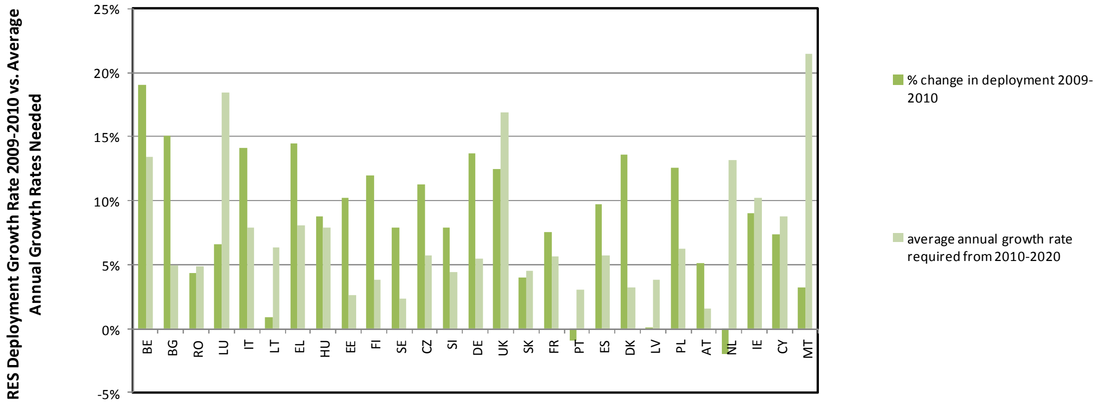


Figure 3. RES growth rate between 2009-2010, and average annual growth rate required between 2010-2020 to achieve 2020 target.

Figure 3 indicates whether the growth rates displayed by Member States during the first year of the reporting period, 2009-2010, will be enough to achieve the 2020 target, or whether accelerated growth is necessary. Member States appear in the order of their deviation from the 2010 NREAP target. This graph (as well as all the similar graphs below for RES-E, RES-H&C and RES-T) is not based on RES shares, but on absolute figures (ktoe). Growth rates therefore reflect only real growth in RES consumption and are not influenced by variations in gross final energy demand.

Sixteen Member States had a growth rate in 2009/2010 which is above the average annual growth rate required to achieve the target. All these Member States had equal or higher RES production (ktoe) than was planned in the NREAP, so they are in a good situation if they are able to keep this up: Bulgaria, Belgium, Italy, Hungary, Estonia, Greece, Finland, Slovenia, Czech Republic, Sweden, Germany, Spain, Denmark, France, Poland, Austria. Romania, Luxembourg, Lithuania, Slovakia, the UK, and Latvia had lower growth rates in 2009/2010 than required on average, and need to speed up RES development, or else further decrease their final energy demand in order to keep the RES Share above trajectory. Portugal has produced more ktoe than planned in 2010, but had a negative growth rate, which obviously requires additional efforts in the future. Malta, Cyprus, Ireland, and the Netherlands have a lower RES production (in ktoe) than was planned in the NREAP, and the growth rate is lower than the average growth rate needed until 2020.

Past Progress in RES-E

RES-E sector overview

(1) Overview of deployment vs. 2010 NREAP RES-E target

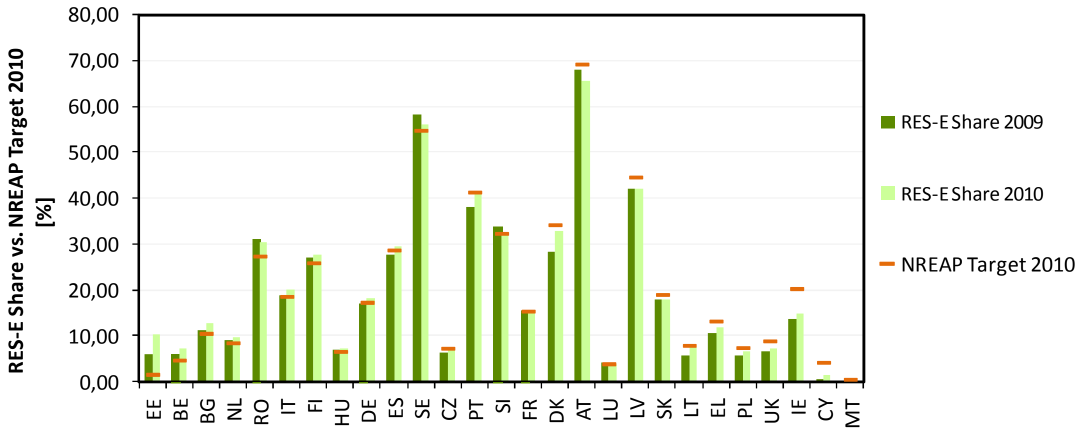


Figure 4. RES-E actual share vs. NREAP indicative target 2010 (%).

Member States appear in the order of their deviation from 2010 RES-E target (Figure 2).

Between 2009 and 2010, 20 MS were able to increase the share of RES-E, although Malta, Latvia, and Hungary did so only slightly (less or equal to 0.1 percent points). The RES-E shares of Austria, Sweden, and Slovenia, on the other hand, dropped in 2010, just as well as those of Romania, France, Luxemburg, and Slovakia even though the decrease of the latter was slight: the 2010-share in these MS was only 0.4 percent points or less below the 2009 share.

12 MS exceeded their respective NREAP targets for RES-E in 2010: Estonia, Belgium, Bulgaria, the Netherlands, Romania, Italy, Finland, Hungary, Germany, Spain, Sweden, and the Czech Republic. The majority (15) of the countries, however, missed their targets although 4 only did so slightly (5% or less behind the target).

Many of the countries that achieved the 2010-target did so already in 2009 (Estonia, Belgium, Bulgaria, Netherlands, Romania, Italy, Finland, Hungary, and Sweden); Germany, Spain, and the Czech Republic fulfilled the 2010 target for the first time in 2010. Slovenia and Luxemburg exceeded their target in 2009 but missed it in 2010 after the RES-E shares decreased in both countries.

(2) Deviation from 2010 NREAP target

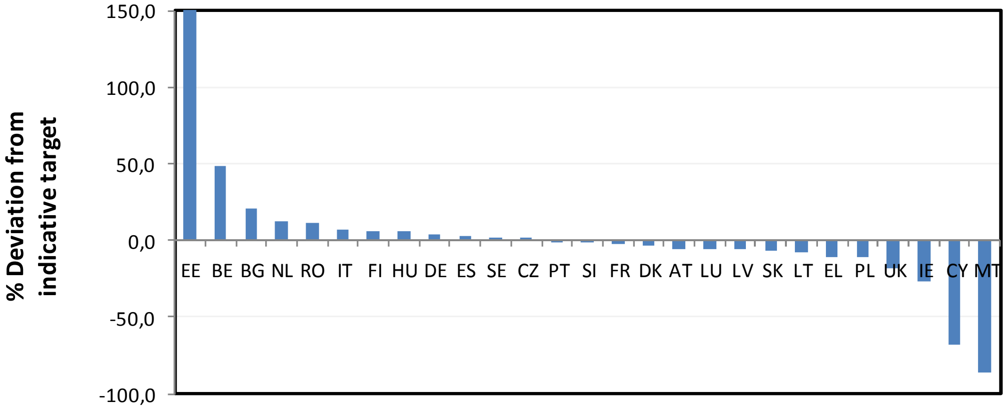


Figure 5. Deviation of actual 2010 RES-E Shares (EUROSTAT) from 2010 target share (NREAP).

Member States appear in the order of their deviation from 2010 NREAP RES-E target.

Less than the half of the MS (12) were able to exceed its individual NREAP 2010-target for RES-E. Among them are Estonia (511% above target), Belgium (49% above target), and Bulgaria (21% above target), who are leading the group. The Netherlands, Romania, Italy, Finland, Hungary, Germany, Spain, Sweden, and the Czech Republic performed better than targeted too.

15 MS did not achieve their respective targets, including 6 MS (Greece, Poland, United Kingdom, Ireland, Cyprus, and Malta) which missed them by more than 10%. Cyprus and Malta deviated the most strongly with 68% and 86% respectively below their targets. However, the group also includes 4 MS that only missed their individual targets slightly: Portugal's, Slovenia's, France's, and Denmark's actual RES-E share in 2010 lagged less than 5 percent behind. Deviations of the rest of the countries (Austria, Luxembourg, Latvia, Slovakia, and Lithuania) vary between -5.5% and -7.5%.

(3) Annual growth rate

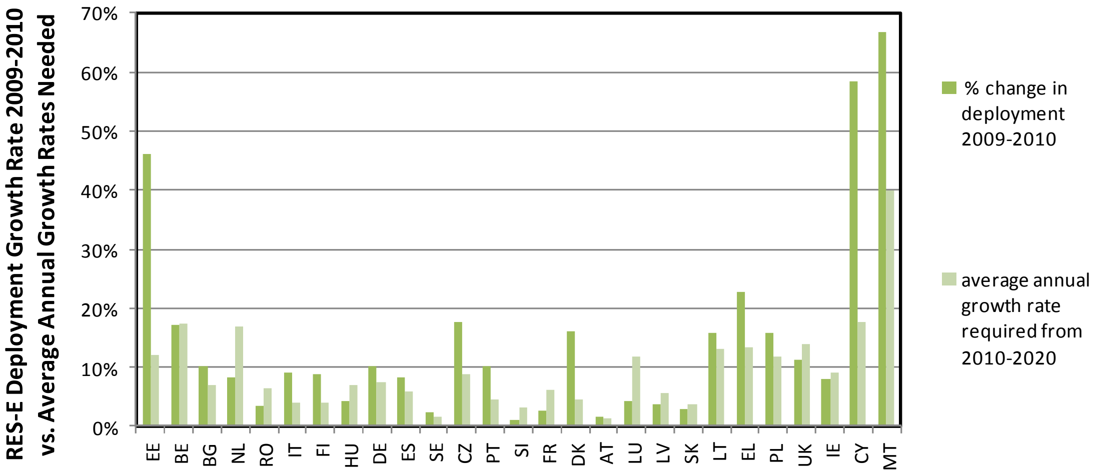


Figure 6. RES-E growth rate between 2009-2010, and average annual growth rate required between 2010-2020 to achieve 2020 target.

Figure 6 indicates whether the growth rates displayed by Member States during the first year of the reporting period will be enough to achieve the 2020 target, or whether accelerated growth is necessary. Member States appear in the order of their deviation from the 2010 NREAP RES-E target.

Sixteen Member States achieved a growth rate which was higher than the average growth rate needed to move from the NREAP 2010 RES-E target to the 2020 RES-E target. Among them, for those Member States which achieved the GWh planned in the NREAP for 2010, this means that they would be on the safe side if they maintained their current growth rate. This was the case for Denmark, Sweden, Czech Republic, Spain, Portugal, Italy, Germany, Finland, Bulgaria, Greece, and Estonia in 2010. Unfortunately, as will be shown in more detail in Chapter 1.4, unfavourable changes to support policies after 2010 will probably cause a drop in the RES-E growth rate for some of these countries. Other countries, such as Luxembourg and Slovenia, have growth rates which are substantially too low. Malta, Cyprus, Lithuania and Poland show good growth, but are also currently underachieving against their planned GWh consumption in 2010 and need higher-than-average growth rates to catch up again.

(4) Development since 1990

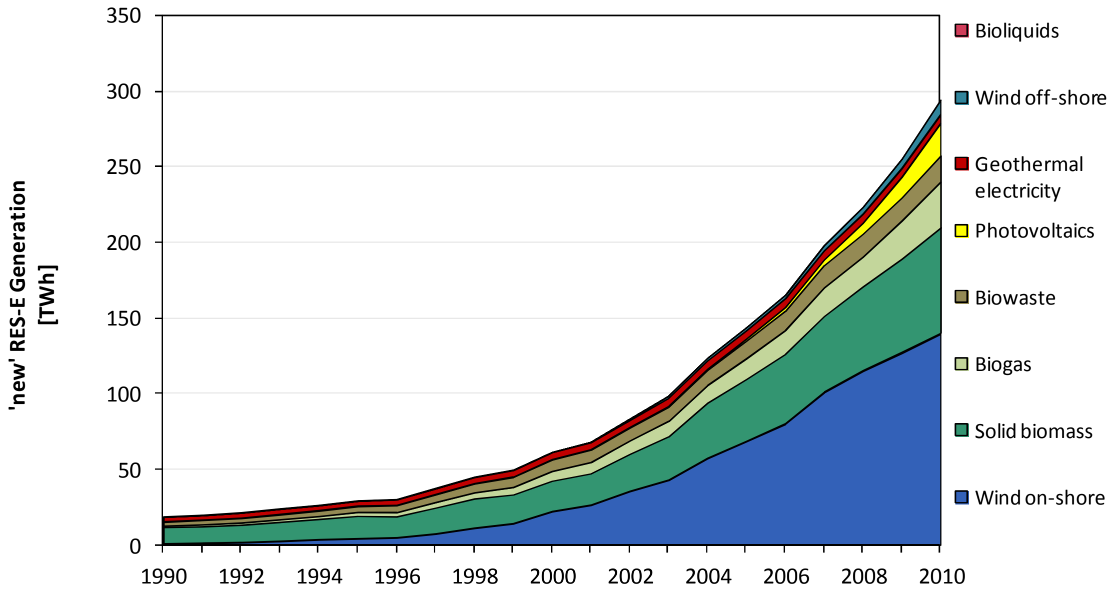


Figure 7. Electricity generation from 'new' RES-E technologies (excluding hydro) in the EU-27 in TWh. Data source: EUROSTAT, complemented by Eur'ObservER.

Figure 7 shows that 'new' RES-E technologies using wind, solar, and geothermal energy as well as biomass have undergone a steep increase in recent years. They are catching up on the established hydropower, accounting for 293 TWh of electricity produced in 2010, compared to 321 TWh in large hydro. Onshore wind is the largest new RES-E technology with 140 TWh produced in 2010, followed by solid biomass (waste and non-waste) with 87 TWh, biogas with 30 TWh, PV with 21.64 TWh, offshore wind with 9.15 TWh and geothermal electricity with 5.6 TWh (all EUROSTAT/Eur'ObservER data). Table 3 shows the growth of the main RES-E technologies between 2009-2010 for the 27 Member States, as visualised above in Figure 6. PV experienced the highest growth rate, followed by offshore wind and biogas.

Table 3. Growth of RES-E technologies between 2009-2010. Data source: Progress Reports, EUROSTAT for Czech Republic.

Member State	RES-E [%]	Offshore wind [%]	Onshore wind [%]	Solid biomass [%]	Biogas [%]	Photo-voltaics [%]	Small hydro [%]	Large hydro [%]
Belgium	17.15	56.75	27.78	8.61	18.66	69.61	-1.04	1.78
Bulgaria	10.16	-	65.20	-	75.00	80.00	25.05	33.71
Czech Republic	17.67	-	16.76	7.86	30.66	85.55	4.38	0.00
Denmark	15.96	29.28	3.65	29.50	3.90	33.33	0.00	-
Germany	10.26	80.95	3.96	1.88	22.22	43.59	0.00	7.10
Estonia	45.98	-	17.41	58.08	30.00	-	-13.64	-
Ireland	8.13	0.00	9.26	33.33	11.11	6.67	5.65	-1.28
Greece	22.66	-	6.15	-	-0.93	67.66	12.73	30.58
Spain	8.25	-	10.38	8.73	18.84	7.05	-31.28	7.75
France	2.60	-	22.97	5.41	12.64	67.46	-2.26	-1.11
Italy	9.01	-	22.27	-3.16	18.94	64.53	3.48	2.27
Cyprus	58.37	-	100.00	-	24.51	40.06	-	-
Latvia	3.69	-	-2.04	55.56	21.05	-	12.00	1.57
Lithuania	15.71	-	28.69	25.00	51.61	-	0.00	0.00
Luxembourg	4.17	-	-14.55	10.71	5.36	4.76	1.85	-
Hungary	4.25	-	34.75	-7.16	14.29	0.00	0.00	-0.65
Malta	66.67	-	-	-	-	69.28	-	-
Netherlands	8.23	6.01	-0.67	14.07	10.54	23.33	0.00	1.04
Austria	1.57	-	0.54	2.80	5.86	44.94	3.17	-0.56
Poland	15.88	-	31.53	16.95	19.87	20.57	-0.71	2.30
Portugal	10.28	-	16.62	17.94	17.00	20.40	1.71	4.54
Romania	3.49	-	96.74	92.84	-0.82	85.00	6.14	1.27
Slovenia	1.02	-	-	0.80	28.87	69.23	2.83	-5.17
Slovakia	2.86	-	0.00	19.03	31.25	100.00	3.40	0.07
Finland	8.93	-	11.15	1.59	64.04	20.00	5.63	-0.79
Sweden	2.39	40.89	27.29	7.27	5.56	22.22	4.95	0.57
UK	11.14	35.51	10.66	11.06	-	39.39	4.94	-4.04
EU-27	7.47	32.37	11.03	8.22	20.31	37.39	0.15	2.32

Table 4 shows the generation as reported by Member States for the RES-E sector and for the main technologies individually for 2010.

Table 4. RES-E generation in the EU-27 in 2010 from main technologies. Data source: Progress Reports. EUROSTAT for Czech Republic.

Member State	RES-E [GWh]	Offshore wind [GWh]	Onshore wind [GWh]	Solid biomass [GWh]	Biogas [GWh]	Photo-voltaics [GWh]	Small hydro [GWh]	Large hydro [GWh]
Belgium	6934.15	189.60	1399.70	3575.90	568.20	557.50	220.60	151.80
Bulgaria	4465.92	0.00	681.00	0.00	16.00	15.00	1002.00	3328.00
Czech Republic	5239.93	0.00	344.82	1527.00	636.00	616.00	598.56	1517.55
Denmark	12385.95	1622.00	6106.00	4299.00	333.00	6.00	23.00	0.00
Germany	112136.46	210.00	42900.00	16000.00	16200.00	11700.00	7900.00	15500.00
Estonia	1011.81	0.00	247.00	730.00	10.00	0.00	22.00	0.00
Ireland	4291.47	75.00	3153.00	9.00	18.00	0.45	124.00	625.00
Greece	10571.67	0.00	2714.00	0.00	216.00	167.00	754.00	5843.00
Spain	85294.42	0.00	42732.00	3241.00	653.00	6413.00	3315.00	28230.00
France	80572.64	0.00	10499.00	3863.00	1013.00	676.00	7241.00	56643.00
Italy	68896.12	0.00	8787.00	4308.00	2054.00	1906.00	9321.00	31935.00
Cyprus	72.92	0.00	31.37	0.00	35.13	6.39	0.00	0.00
Latvia	3151.73	0.00	49.00	9.00	57.00	0.00	75.00	3445.00
Lithuania	814.10	0.00	244.00	116.00	31.00	0.00	94.00	325.00
Luxembourg	279.12	0.00	55.00	28.00	56.00	21.00	108.00	0.00
Hungary	3012.17	0.00	518.00	2179.00	112.00	1.00	58.00	153.00
Malta	1.74	0.00	0.00	0.00	0.00	1.73	0.00	0.00
Netherlands	11723.04	765.00	3737.00	5961.00	1044.00	60.00	5.00	96.00
Austria	45915.24	0.00	2035.00	2674.00	649.00	89.00	5020.00	29627.00
Poland	10397.22	0.00	1700.29	5905.21	398.38	1.67	674.86	1715.40
Portugal	23190.22	0.00	8395.00	2804.00	100.00	201.00	997.00	10779.00
Romania	17707.78	0.00	299.06	69.23	0.25	0.02	880.00	16444.00
Slovenia	4547.33	0.00	0.00	125.00	97.00	13.00	389.00	4122.00
Slovakia	5291.65	0.00	6.00	636.00	32.00	11.00	265.00	4347.00
Finland	25144.06	0.00	314.00	10859.00	89.00	5.00	1491.00	12392.00
Sweden	84294.24	450.00	3052.00	11976.00	36.00	9.00	3798.00	62600.00
UK	27981.78	2847.00	8392.00	11914.00	0.00	33.00	809.00	3981.00
EU-27	655324.88	6158.60	148391.24	92808.34	24453.96	22509.76	45185.02	293799.75

Table 5 shows the deviation of RES-E production in 2010 from the NREAP 2010 indicative target. For the individual technologies, the calculation is based on the generation [GWh] provided in the Progress Reports. The deviation for the RES-E sector is not based on absolute figures but on sector shares provided by EUROSTAT vs. NREAP planned shares. While a RES-E share of 19.41% had been planned for the EU-27 overall, 19.6% were actually achieved, leading to a positive deviation of 1.1%.

Table 5. Deviation from NREAP 2010 indicative target for the RES-E sector and its main technologies in the EU-27. Data source: Progress Reports for technology data (except Czech Republic), EUROSTAT for RES-E sector shares.

Member State	RES-E [%]	Offshore wind [%]	Onshore wind [%]	Solid biomass [%]	Biogas [%]	Photo-voltaics [%]	Small hydro [%]	Large hydro [%]
Belgium	48.90	0.00	74.77	38.61	44.47	83.39	0.00	7.20
Bulgaria	21.02	-	12.56	-	700.00	25.00	0.00	47.39
Czech Republic	1.60	-	-24.05	16.92	1.92	6.57	-42.94	43.17
Denmark	-4.07	-34.73	-0.25	20.15	71.65	200.00	-25.81	-
Germany	4.06	-22.51	-3.37	-8.56	17.15	23.17	24.41	33.05
Estonia	511.38	-	-26.71	216.02	0.00	-	-15.38	-
Ireland	-27.25	-35.34	-32.93	-67.86	-94.38	-	0.00	8.32
Greece	-10.47	-	-13.26	-100.00	19.34	-30.99	6.95	36.42
Spain	2.37	-	4.28	-12.85	-18.27	-0.06	-42.88	-2.02
France	-2.03	-	-9.79	-14.27	8.34	10.28	-2.94	-7.99
Italy	7.39	-	4.63	-9.46	-3.52	-3.10	1.36	-3.07
Cyprus	-68.45	-	-0.10	-	17.10	-1.08	-	-
Latvia	-5.93	-	-15.52	12.50	-10.94	-	20.97	21.13
Lithuania	-7.51	-	-17.85	18.37	-38.00	-	18.99	-7.93
Luxembourg	-5.59	-	-8.33	12.00	27.27	5.00	1.89	-
Hungary	6.01	-	-25.14	16.52	31.76	-50.00	62.01	-3.29
Malta	-86.34	-	-100.00	-	-100.00	-72.04	-	-
Netherlands	12.73	-4.73	1.91	-0.23	19.72	-17.81	0.00	-21.95
Austria	-5.51	-	0.05	-35.27	17.36	4.71	-9.21	-10.26
Poland	-11.36	-	-26.39	3.60	21.46	67.20	-24.26	23.59
Portugal	-0.53	-	-17.81	156.78	-23.08	-12.61	20.56	20.90
Romania	11.10	-	-34.99	44.22	-98.71	-	22.39	3.76
Slovenia	-0.56	-	-100.00	-16.67	-34.46	8.33	-14.32	10.10
Slovakia	-6.81	-	-14.29	17.78	-54.29	-63.33	10.88	-5.40
Finland	6.12	-	-12.78	176.31	122.50	-	3.54	-3.04
Sweden	1.96	116.35	-33.44	13.92	-32.08	542.86	8.98	-7.52
UK	-18.33	-38.51	-11.85	116.62	-100.00	-17.50	0.00	-7.22
EU-27	1.10	-29.23	-4.79	19.20	-14.92	11.76	-3.14	-1.75

The deviation from the 2010 NREAP target was assessed in more detail on technology level. The following paragraphs present the results for offshore and onshore wind, photovoltaics, solid biomass, biogas, and large and small hydro. Details on currently still minor technologies such as geothermal, bioliquids, concentrated solar power, and tide, wave, and ocean energy can be found in Appendix I. The technology graphs are based on targeted generation in GWh in the NREAP vs. actual generation in GWh as reported in progress report.

Offshore Wind

Figure 8. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for offshore wind.

Only seven Member States report any offshore wind, namely Sweden, Belgium, the Netherlands, Germany, Denmark, Ireland, and the UK.

Belgium reports 189.6 GWh in 2010. As it provided only overall wind but no wind subcategory data in its NREAP, we assume that the planned offshore generation equals actual offshore generation (exactly on track). The remainder of planned overall wind generation is assumed to be planned onshore wind. Sweden has the highest positive deviation from trajectory, with 450 GWh realised against 208 GWh planned. In Germany the development of offshore wind is lagging behind the original plans due to lengthy administrative procedures and uncertainties regarding the grid connection procedures.

Even though the UK has clearly done less than planned, in absolute numbers it has by far the highest offshore wind electricity generation with 2,847 GWh in 2010. It is followed by Denmark with 1,622 GWh.

Onshore Wind

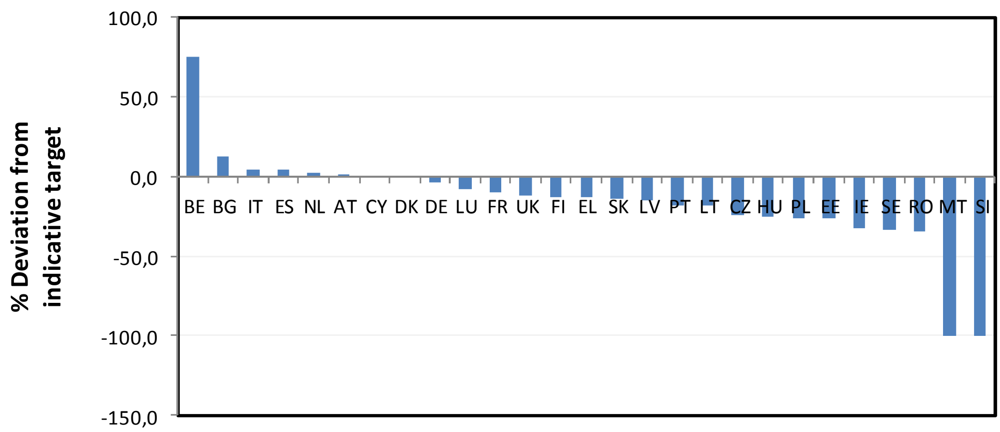


Figure 9. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for onshore wind.

Most Member States report less electricity production from onshore wind than they had originally planned. Germany and Spain were by far the biggest producers in 2010, with 42,900 GWh and 42,732 GWh, respectively. However, the installation of new capacities in both front runner countries slowed in 2010. This is in part due to the recession making the financing of large projects more difficult and to administrative barriers and spatial planning. The technology developed well under the FIT schemes of the two countries. Unfortunately, as will be shown in more detail in chapter 1.4, the Spanish FIT scheme is currently suspended, which means growth will slow down significantly.

Malta and Slovenia show very poor progress regarding the development of wind on-shore, due to insufficient support policies in Malta and difficult planning regimes including environmental permissions in Slovenia. In Sweden and Romania the level of remuneration combined with the certainty offered by the green certificate market were insufficient to stimulate the necessary growth of onshore wind.

Belgium has the highest positive deviation, reporting onshore wind electricity production of 1399.7 GWh in 2010, up from 1,010.8 GWh in 2009.

Solid Biomass

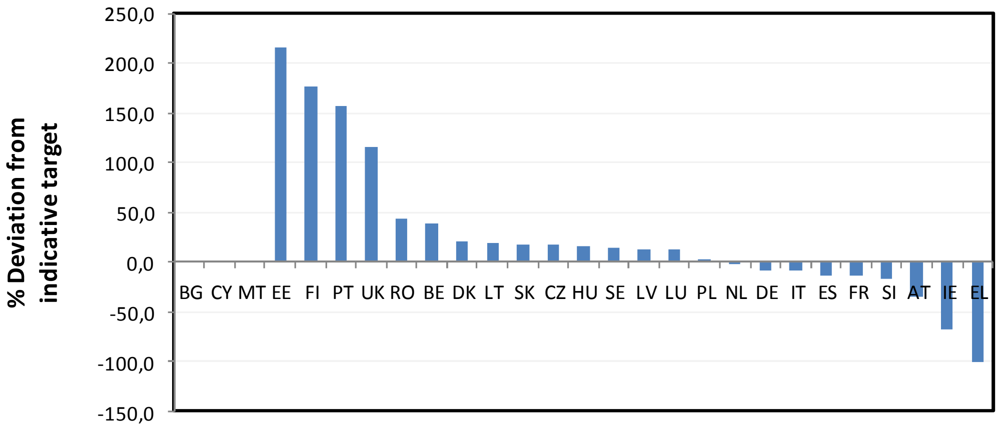


Figure 10. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for solid biomass.

In absolute numbers, Germany led electricity generation from solid biomass with 16,000 GWh in 2010, followed by Sweden with 11,976 GWh and the UK with 11,914 GWh. Sweden produces its biomass electricity exclusively in CHP plants. Its largest biomass CHP plant at Igelsta, running mainly on forest residues and waste, went online in 2010 with a capacity of 200 MW for heat and 85 MW for electricity. The relatively strong growth of solid biomass electricity in Finland, the UK, Romania, and Belgium were supported by strong development of co-firing of biomass in conventional power plants.

Estonia generally produced more energy from biomass than planned, and this is most pronounced for solid biomass electricity generation, where 730 GWh were produced in 2010, more than three times the planned value. According to EurObserv'ER (2011), the majority of this was produced in CHP plants.

Malta, Bulgaria, and Cyprus planned no solid biomass electricity generation for 2010, and did also not report any. Greece also reports no actual production, despite the 73 GWh planned in the NREAP.

Biogas

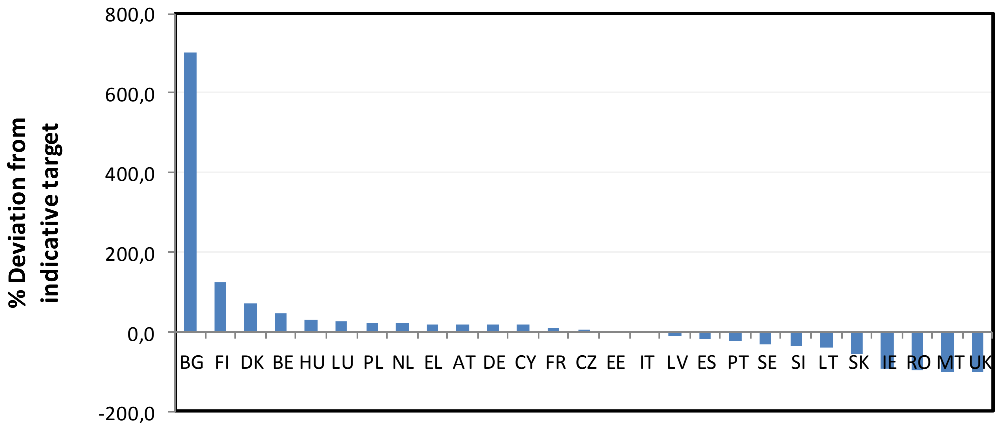


Figure 11. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for biogas.

Bulgaria produced considerably more electricity from biogas than foreseen, reporting 16 GWh instead of the planned 2 GWh. In absolute figures, the biggest producer by far was Germany with 16,200 GWh. The country is focussing on agricultural methanisation using energy crops such as maize, a strategy which has attracted some criticism from environmentalists. Germany is followed by Italy with 2,054 GWh and the Netherlands and France with 1,044 GWh and 1,013 GWh, respectively. In Ireland, Romania, Malta and UK the support given was insufficient for new generation especially from agricultural biogas.

In its Progress Report, the UK reports zero generation in 2010, which is inconsistent with both the NREAP target (6830 GWh) and EUROSTAT data (5740 GWh) that would make it one of the EU's top producers. The Irish Progress Report may also contain a data error, as it reports only 18 GWh in 2010, while 320 GWh had been planned, and EUROSTAT reports 206 GWh. Estonia provided only overall biomass figures in its NREAP. It is thus assumed that actual biogas production equals planned production (exactly on track), the remainder of planned overall biomass is assumed to be solid biomass.

Photovoltaics

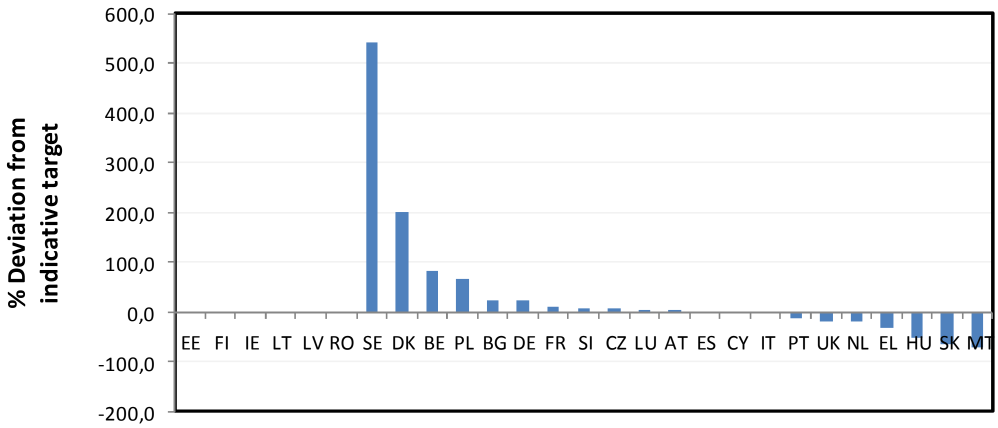


Figure 12. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for solar PV.

The development of PV was faster than expected especially towards the end of 2010, as installation costs for PV dropped sharply. Estonia, Finland, Ireland, Lithuania, Latvia, and Romania had not planned any electricity generation from PV in 2010, although only Estonia, Lithuania, and Latvia really did have zero deployment in 2010. Sweden realised 9 GWh in 2010. While this is far higher than the 1,4 GWh originally planned, it is still rather low in absolute figures. Support from Sweden's technology-neutral quota scheme is complemented by investment grants for PV to stimulate this deployment. The Czech Republic experienced the sharpest increase in PV electricity generation, from 89 GWh in 2009 to 616 GWh in 2010. This increase is the main reason for the current instability in the Czech support scheme, as will be explained in more detail in chapter 1.4. A number of countries opted for changes in their support level adjustment mechanisms in 2010 and 2011 to keep up with the rapid price developments on the PV market.

With 11.700 GWh in 2010, Germany remains by far the most important producer of PV electricity in Europe, followed by Spain and Italy. Together, the three countries report nearly 89% of PV electricity generation in the EU.

Small Hydro

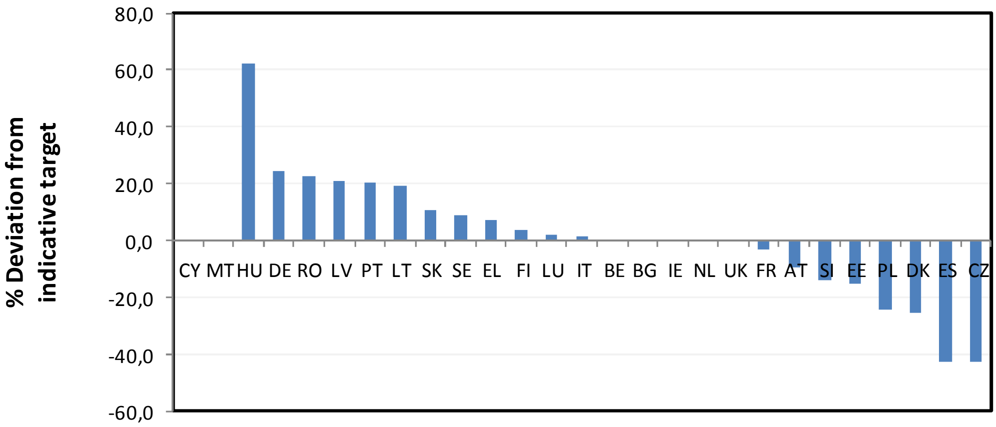


Figure 13. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for small hydropower.

The category small hydro combines two hydro subcategories used in the NREAP and Progress Reports: installations of less than 1 MW, and those of 1-10 MW. The leading producers in 2010, considering absolute figures, were Italy with 9,321 GWh, Germany with 7900 GWh, and France with 7,241 GWh. Hungary shows the highest positive deviation from its target. It had planned a modest production of 35.8 GWh, but actually realised 58 GWh.

Bulgaria, Belgium, the UK, the Netherlands, and Ireland do intend to expand overall hydropower production, but did not provide NREAP targets for the subcategories of hydropower. They all actually had some small hydro production in 2010. Their NREAP planned production for small hydro in 2010 is thus assumed to equal actual production (exactly on track), and the rest of the overall hydro planned production is assumed to be large hydro. In contrast, Malta and Cyprus really did not plan or produce any hydropower.

Large Hydro

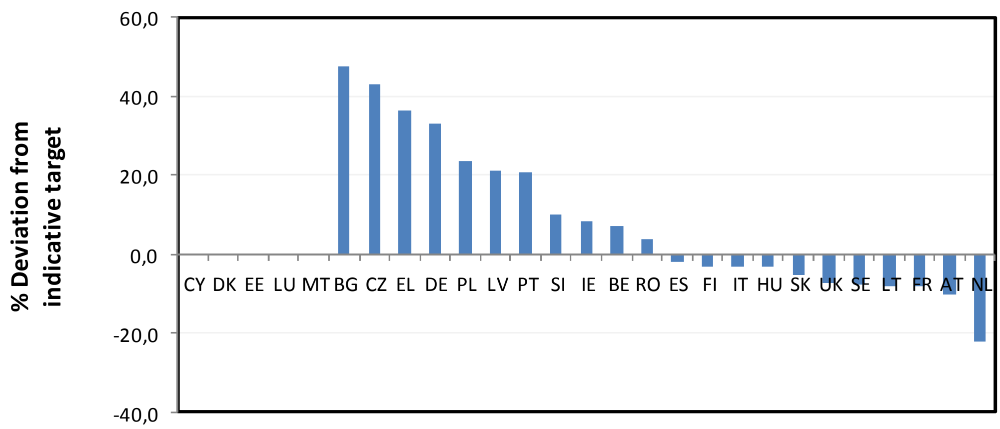


Figure 14. Deviation of actual 2010 deployment (Progress Report) from 2010 indicative target (NREAP) for large hydropower.

The category large hydro refers to installations of more than 10 MW. Large hydro is the most mature RES-E technology, with the lion's share of potentials already being exploited in most Member States. Most countries have thus planned for lower growth rates in this technology. Large hydro is also, for the time being, still the single most important RES-E technology, with Member States reporting a total of 289 TWh (normalised) produced in 2010. The leading producers in 2010 were Sweden with 62,600 GWh, France with 53,186 GWh, Italy with 31,935 GWh, and Spain with 28,230 GWh.

Some Member States did not differentiate between hydro subcategories in their NREAPs. See the section on small hydro for an explanation on how this problem was addressed in this analysis. Cyprus, Denmark, Estonia, Luxembourg, and Malta are not planning any electricity production from large hydro installations.

Mixed Hydro

While table 10 of the NREAP had only differentiated between the hydro subcategories "<1MW", "1-10 MW", ">10 MW" and "of which pumped", the Progress Report template introduced a new category called "mixed", which in accordance with new EUROSTAT methodology refers to the renewable portion of plants providing both non-pumped and pumped hydro-electricity. The idea is to normalise the "mixed" production differently from the "pure" renewable production.

Only Austria, Bulgaria, France, Greece, and Portugal report any mixed hydro in 2010, but the new category was obviously understood in different ways by the different countries. For Portugal and France, it seems this was understood as an additional amount (not included in the three non-pumped size categories), and for this analysis was therefore added to large hydro in the above graph.

Past Progress in RES-H&C

RES-H&C sector overview

(1) Overview of deployment vs. 2010 NREAP RES-H&C target

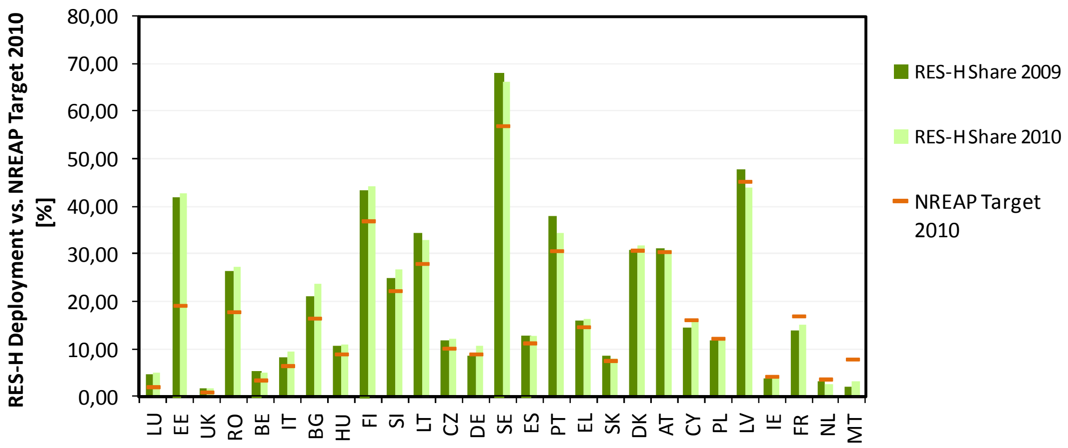


Figure 15. RES-H&C actual share vs. NREAP indicative target 2010 (%).

MS appear in the order of their deviation from 2010 NREAP RES-H&C targets (Figure 16).

21 MS exceeded their respective NREAP targets for RES-H&C in 2010: Luxembourg, Estonia, United Kingdom, Romania, Belgium, Italy, Bulgaria, Hungary, Finland, Slovenia, Lithuania, the Czech Republic, Germany, Sweden, Spain, Portugal, Greece, Slovakia, Denmark, Austria, and Cyprus. A minority of 6 countries, however, missed its targets although 2 only did so slightly (3% or less behind the target).

Most of the countries that achieved the 2010 target did so already in 2009 (Luxembourg, Estonia, the United Kingdom, Romania, Belgium, Italy, Bulgaria, Hungary, Finland, Slovenia, Lithuania, the Czech Republic, Sweden, Spain, Portugal, Greece, Slovakia, and Austria); Germany, and Denmark fulfilled the 2010 target for the first time in 2010. Only Latvia exceeded its target in 2009 but missed it in 2010 after the RES-H&C share dropped from 47.9% to 43.8%.

With regards to progress in deployment between 2009 and 2010, 18 MS were able to increase the share of RES-H&C, although in the United Kingdom, the Czech Republic, Poland, and Ireland the share rather stagnated (increases of less or equal to 0.1 percent points). The RES-H&C shares of Latvia, Portugal, Sweden, and Lithuania, on the other hand, dropped between these two years, just as well as those of Slovakia, Austria, the Netherlands, Spain, and Belgium even though the decrease of the latter was slight: the 2010-share in these MS was only 0.5 percent points or less below the 2009 share.

(2) Deviation from 2010 NREAP RES-H&C target

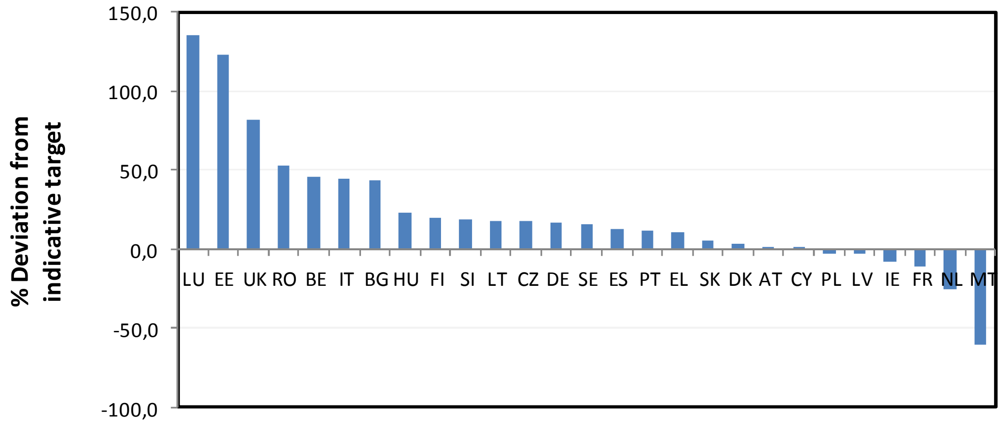


Figure 16. Deviation of actual 2010 RES-H&C Shares (EUROSTAT) from 2010 indicative target share (NREAP).

Member States appear in the order of their deviation from 2010 RES-H&C target.

More than two thirds of the MS (21) were able to exceed their individual NREAP 2010targets for RES-H&C. Among them are Luxemburg (136% above target), Estonia (123% above target), and the United Kingdom (81% above target), who are leading the group. Romania, Belgium, Italy, Bulgaria, Hungary, Finland, Slovenia, Lithuania, the Czech Republic, Germany, Sweden, Spain, Portugal, Greece, Slovakia, Denmark, Austria, and Cyprus performed better than targeted too (often in double-digit percent range).

6 MS did not achieve their respective targets, including 3 MS (France, the Netherlands, and Malta) which missed them by more than 10 percent. As in the RES-E sector, Malta deviated the most strongly with 61% behind its target. Poland, Latvia, Ireland missed their targets by between 3% and 8%.

(3) Annual Growth Rate

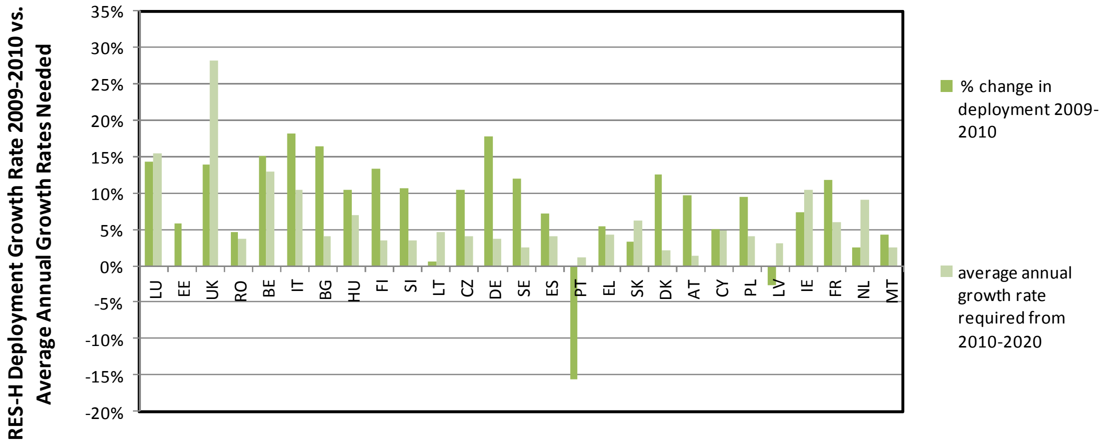


Figure 17. RES-H&C growth rate between 2009-2010, and average annual growth rate required between 2010-2020 to achieve 2020 target.

Figure 17 indicates whether the growth rates displayed by Member States during the first year of the reporting period will be enough to achieve the 2020 target, or whether accelerated growth is necessary. Member States appear in the order of their deviation from the 2010 RES-H&C target.

Nineteen Member States achieved a growth rate which was higher than the average growth rate needed to move from the NREAP 2010 RES-H&C target to the 2020 RES-H&C target. Among those, Malta and Greece have had less RES-H&C production (in ktoe) than planned in the NREAP, which means they need a higher than average growth rate to get back on track. The other 17 Member States are on the safe side if they manage to maintain their fast growth. Eight Member States had growth rates lower than the necessary average annual growth rate. Portugal had negative growth in 2009-2010, but this was already planned in the NREAP, which is why it still produced more ktoe than planned for 2010. The same applies to Latvia, which was planning to reduce its RES-H&C production (in ktoe) compared to 2005 levels, but reduced them less than planned and is therefore still on track. Obviously, both countries need to revert back to positive growth in future years to achieve the 2020 target. Ireland, Slovakia, Lithuania, the UK, and Luxembourg had a higher production (in ktoe) than was planned, but need to accelerate their growth.

(4) Development since 1990

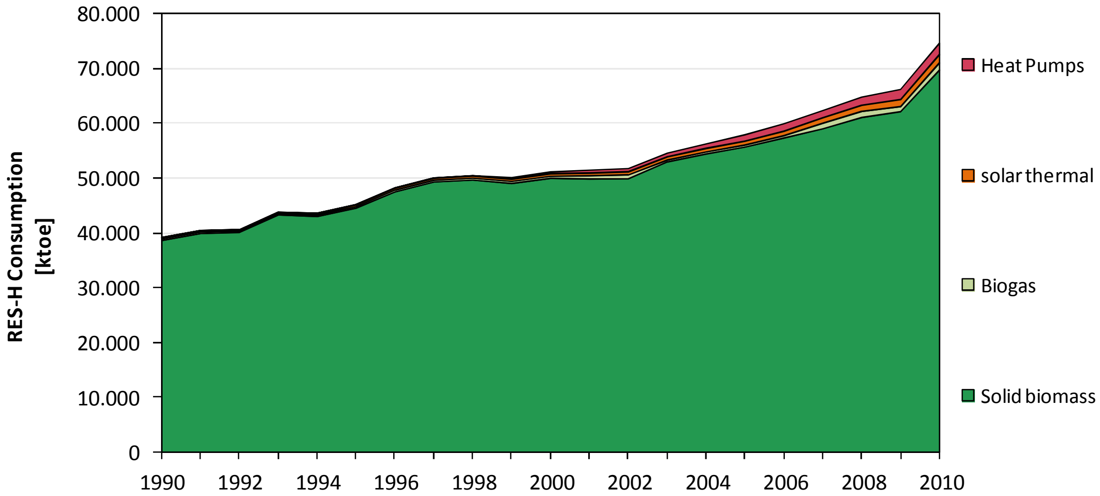


Figure 18. RES-H consumption from main technologies in the EU-27 in ktoe. Data source: EUROSTAT for solid biomass, biogas and solar thermal, Eur'ObservER for heat pumps.

Figure 18 presents the heat consumption from the four main RES-H technologies during the last two decades. Obviously, solid biomass is by far the largest contributor with 69873 ktoe in 2010, followed by heat pumps with 2049 ktoe, solar thermal with 1473 ktoe, and biogas with 1462 ktoe. Note that data for heat pumps is scarce, and that a preliminary estimation by Eur'ObservER was used for this figure. Member States provide a considerably higher total of 4297 ktoe for 2010 in their Progress Reports, mainly due to Italy and France reporting much higher figures. Total heat production from biogas reported in the Progress Reports is also considerably higher with 2007 ktoe, largely due to the figures reported by Germany. Table 6 shows the growth in each of the four technologies between 2009-2010, as visualised in Figure 17. Overall, biogas experienced the highest growth with almost 25%.

Table 6. Growth of RES-H technologies between 2009-2010. Data source: Progress Reports

Member State	RES-H [%]	Solar thermal [%]	Solid biomass [%]	Biogas [%]	Heat pumps[%]
Belgium	14.99	7.50	15.20	10.31	14.93
Bulgaria	16.36	100.00	15.97	100.00	-
Czech Republic	9.12	33.33	8.25	29.63	15.98
Denmark	12.57	6.67	13.07	2.04	10.00
Germany	17.84	8.95	14.46	33.26	12.50
Estonia	5.72	-	5.44	100.00	-
Ireland	7.42	20.00	7.77	7.89	4.35
Greece	5.34	0.55	5.28	35.00	18.84
Spain	7.07	14.75	6.60	17.95	11.76
France	11.76	12.36	10.34	8.53	25.60
Italy	18.14	36.57	25.75	26.92	2.09
Cyprus	4.94	4.70	-4.05	59.83	53.33
Latvia	-2.76	-	-2.86	25.00	-
Lithuania	0.57	-	0.46	40.00	-
Luxembourg	14.29	22.22	16.70	4.62	20.00
Hungary	10.43	0.00	11.25	11.11	-
Malta	4.28	6.88	-51.52	100.00	-
Netherlands	2.54	8.33	0.70	11.21	16.49
Austria	9.63	25.00	9.27	3.57	3.36
Poland	9.43	16.67	9.50	5.30	14.62
Portugal	-15.57	12.50	2.41	21.88	-
Romania	4.69	-	4.74	25.38	-
Slovenia	10.58	80.00	7.25	20.00	-
Slovakia	3.28	-	4.13	-42.86	-
Finland	13.23	-	13.15	-150.00	12.66
Sweden	11.99	0.00	13.27	1.20	0.00
UK	13.81	19.54	10.96	0.00	52.46
EU-27	11.10	14.55	11.08	24.86	10.79

Table 7 shows heat production in ktoe for the RES-H sector and for the most important technologies, as provided by the Member States in their Progress Reports.

Table 7. RES-H consumption in the EU-27 in 2010 from main technologies. Data source: Progress Reports. EUROSTAT for Czech Republic.

Member State	RES-H [ktoe]	Solar thermal [ktoe]	Solid biomass [ktoe]	Biogas [ktoe]	Heat pumps [ktoe]
Belgium	987.48	12.00	890.40	26.20	13.40
Bulgaria	923.00	10.00	883.00	3.00	0.00
Czech Republic	1780.50	9.00	1685.00	60.00	24.40
Denmark	2626.00	15.00	2387.00	49.00	170.00
Germany	12441.00	447.00	9537.00	1293.00	456.00
Estonia	682.00	0.00	680.00	2.00	0.00
Ireland	229.00	5.50	193.00	7.60	23.00
Greece	1160.00	183.00	890.00	2.00	69.00
Spain	4258.00	183.00	4015.00	39.00	17.00
France	12356.00	89.00	10711.00	129.00	1008.00
Italy	5497.00	134.00	3721.00	26.00	1195.00
Cyprus	81.25	61.07	17.04	2.39	0.75
Latvia	1158.00	0.00	1153.00	4.00	0.00
Lithuania	881.00	0.00	874.00	5.00	0.00
Luxembourg	56.00	0.90	47.90	6.50	1.00
Hungary	1055.00	5.00	942.00	9.00	0.00
Malta	3.04	2.47	0.33	0.15	0.00
Netherlands	827.00	24.00	569.00	116.00	97.00
Austria	4070.00	164.00	3734.00	28.00	119.00
Poland	4636.00	2.40	4554.20	45.30	21.20
Portugal	2241.00	40.00	1699.00	32.00	0.00
Romania	3975.40	0.00	3950.16	0.86	0.00
Slovenia	586.00	5.00	552.00	5.00	0.00
Slovakia	548.00	0.00	533.00	7.00	0.00
Finland	6480.00	0.00	6203.00	8.00	229.00
Sweden	9752.00	10.00	8713.00	83.00	793.00
UK	1115.00	87.00	949.00	18.00	61.00
EU-27	80404.67	1489.34	70083.03	2007.00	4297.75

Table 8 shows the deviation of RES-H consumption in 2010 from the NREAP 2010 indicative target. For the individual technologies, the calculation is based on the consumption [ktoe] provided in the Progress Reports. The deviation for the RES-H sector overall is not based on the absolute figures but on sector shares provided by EUROSTAT vs. NREAP planned shares. While a RES-H share of 12.51% had been planned for the EU-27 overall, 14.1% were actually achieved, leading to a positive deviation of 12.88%.

Table 8. Deviation from NREAP 2010 indicative target for the RES-H sector and its main technologies in the EU-27. Data source: Progress Reports for technology data (except Czech Republic), EUROSTAT for RES-H sector shares.

Member State	RES-H [%]	Solar thermal [%]	Solid biomass [%]	Biogas [ktoe]	Heat pumps [%]
Belgium	46.13	-58.62	33.09	194.38	-74.33
Bulgaria	43.84	66.67	20.30	-	-
Czech Republic	17.51	28.57	-1.23	13.21	-45.78
Denmark	3.51	36.36	9.60	-16.95	-19.05
Germany	16.68	1.59	26.89	41.78	-1.94
Estonia	123.05	-	11.11	-	-
Ireland	-7.93	37.50	2.66	-24.00	27.78
Greece	10.31	-15.28	-12.06	-	305.88
Spain	12.33	15.09	13.10	18.18	-2.30
France	-10.96	-31.54	8.52	55.42	13.77
Italy	44.83	18.58	68.68	0.00	-6.13
Cyprus	0.40	3.47	-6.89	-	120.59
Latvia	-3.23	-	13.82	-42.86	-
Lithuania	17.84	-	33.03	-16.67	-
Luxembourg	135.91	28.57	154.79	41.30	-28.57
Hungary	23.13	-16.67	16.01	-	-100.00
Malta	-60.82	-1.98	-	-85.15	-
Netherlands	-25.30	20.00	-0.70	4.50	-26.52
Austria	0.92	29.13	9.82	86.67	23.96
Poland	-2.54	-88.57	18.41	-30.31	-15.20
Portugal	12.22	-20.00	12.22	220.00	-
Romania	52.50	-	-	-	-
Slovenia	19.38	0.00	33.01	-	-100.00
Slovakia	5.06	-100.00	20.32	75.00	-
Finland	19.87	-	128.89	-73.33	-0.43
Sweden	16.12	66.67	11.71	374.29	127.22
UK	81.45	155.88	211.15	0.00	-
EU-27	12.88	2.84	30.35	36.16	12.17

The deviations for solar thermal installations, solid biomass, biogas, and heat pumps are assessed in further detail below. More details on geothermal energy and bioliquids in heat production can be found in Appendix I. The technology graphs are based on 2010 NREAP targets in ktoe vs. actual production in 2010 in ktoe.

Solar thermal

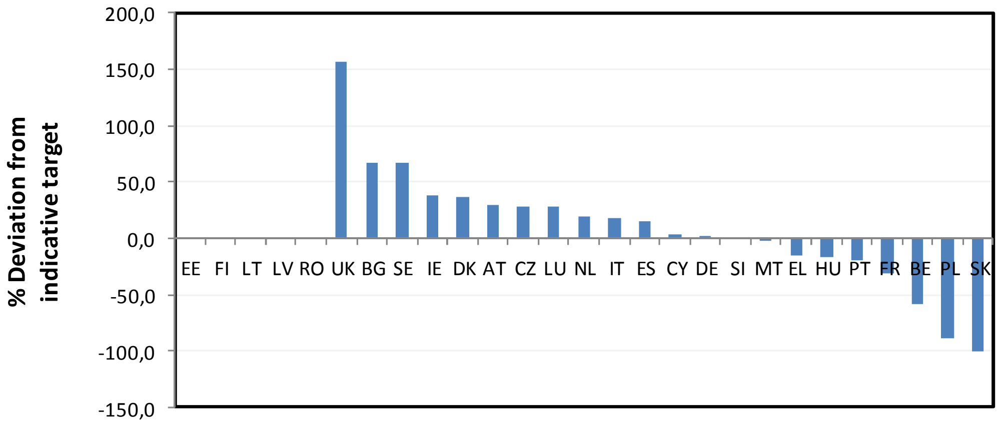


Figure 19. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for solar thermal installations.

Estonia, Finland, Lithuania, Latvia, and Romania neither planned nor realised any heat production from solar thermal installations. The UK shows the highest positive deviation with 87 ktoe realised instead of the 34 ktoe planned. The top producers were Germany with 447 ktoe, Greece and Spain each with 183 ktoe, and Austria with 164 ktoe. For Germany, EUROSTAT data suggest that even though solar-thermal energy production was still slightly above the 2010 NREAP value, growth had slowed in comparison to the two previous years. This may have been due to investor insecurities caused by the market incentive programme and has probably improved again after 2010.

Solid Biomass

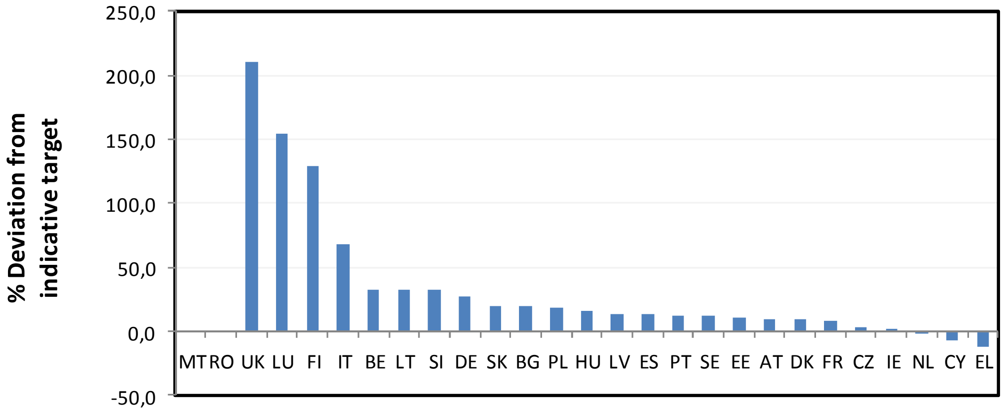


Figure 20. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for solid biomass.

Heat production from solid biomass was above trajectory for the majority of Member States. This can in part be explained by the particularly harsh winter of 2009/2010 which drove up heating demand. The UK fulfilled its plan more than threefold with 949 ktoe realised instead of the 305 ktoe planned. Finland, which has the highest per capita solid biomass consumption in the EU (EurObserv'ER, 2011), had actually planned a decrease of solid biomass heat production compared to 2005 levels, but in reality reported an increase from 5,450 ktoe in 2005 to 6,203 ktoe in 2010.

Just as in electricity generation from solid biomass, with respect to absolute figures, Germany and Sweden are also in the leading group in solid biomass heating with 9,537 ktoe and 8,713 ktoe, respectively. The first place, however, is occupied by France which reports 10,711 ktoe.

Malta and Romania were not planning any solid biomass heating in 2010, but actually report 0.33 ktoe and 3,955.16 ktoe, respectively.

Biogas

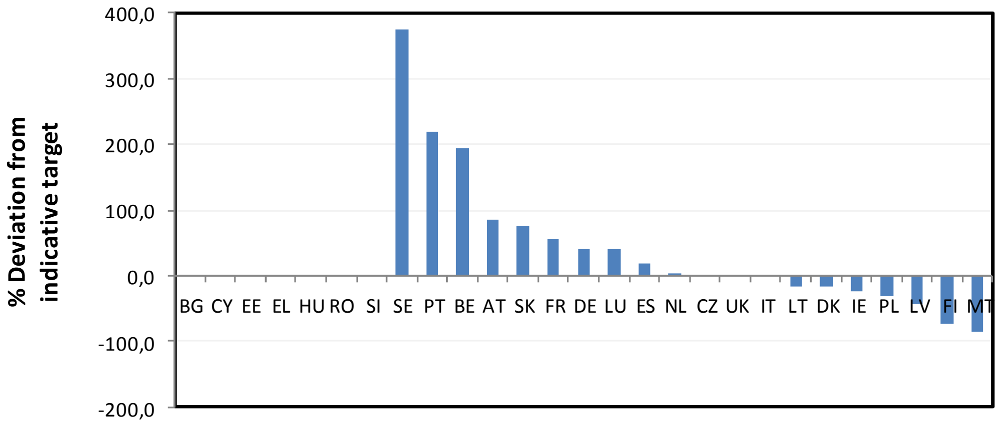


Figure 21. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for biogas.

Bulgaria, Cyprus, Estonia, Greece, Hungary, Romania, and Slovenia had not planned any biogas heat production in 2010, but all reported some small amounts in their Progress Reports. Sweden had planned for only 17.5 ktoe in 2010, but reports 83 ktoe of actual production.

The main producer, just as in biogas electricity production, was Germany with 1,293 ktoe of biogas heat. Next comes France with 129 ktoe, followed by the Netherlands with 116 ktoe.

The UK provided no biomass subcategories in their Progress Report, only an overall biomass figure. It is thus assumed that actual biogas heat production equals planned production (exactly on track), and the remainder of actual biomass production is assumed to be solid biomass.

Heat Pumps

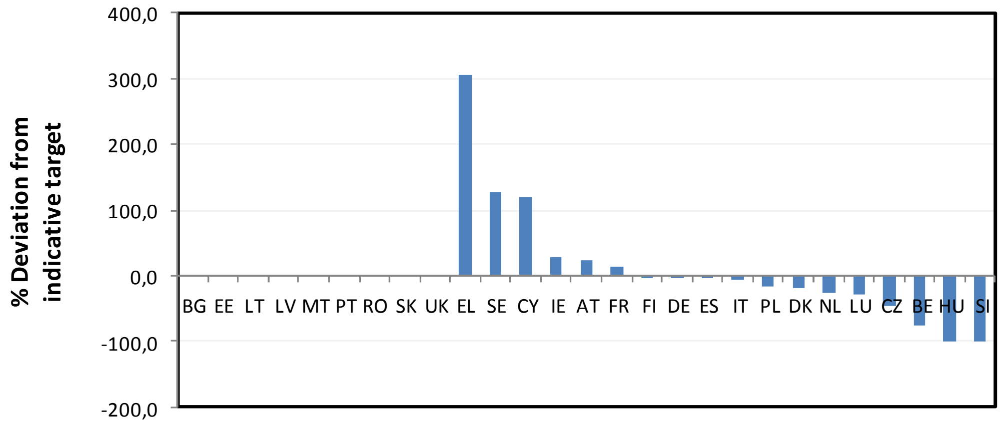


Figure 22. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for heat pumps.

A number of Member States did not plan any heat pump deployment in 2010, as can be seen on the left-hand side of the graph. The UK nevertheless reports 61 ktoe. Greece had the highest positive deviation with 69 ktoe realised vs. 17 ktoe planned. Hungary and Slovenia had planned small amounts, 8 ktoe and 6 ktoe respectively, but both report zero production.

The main producers in 2010 were Italy with 1,195 ktoe, France with 1,008 ktoe, and Sweden with 793 ktoe.

Past Progress in RES-T

RES-T sector overview

In most EU Member States, RES-T deployment mainly consists of biofuels, as seen from the green bars in Figure 23 below. In a few countries, renewable electricity plays a significant role in transport, especially in Austria, Romania and Sweden. In most cases, this renewable electricity is applied in rail transport.

A few countries claim to have significant levels of renewable electricity in road transport, most notably in Latvia where much electricity is used in trams and trolleybuses. This is – to a smaller extend – also the case in Bulgaria, Estonia, Lithuania and Portugal. Use of renewable electricity in cars is still insignificant in 2010, compared to the overall RES-T deployment.

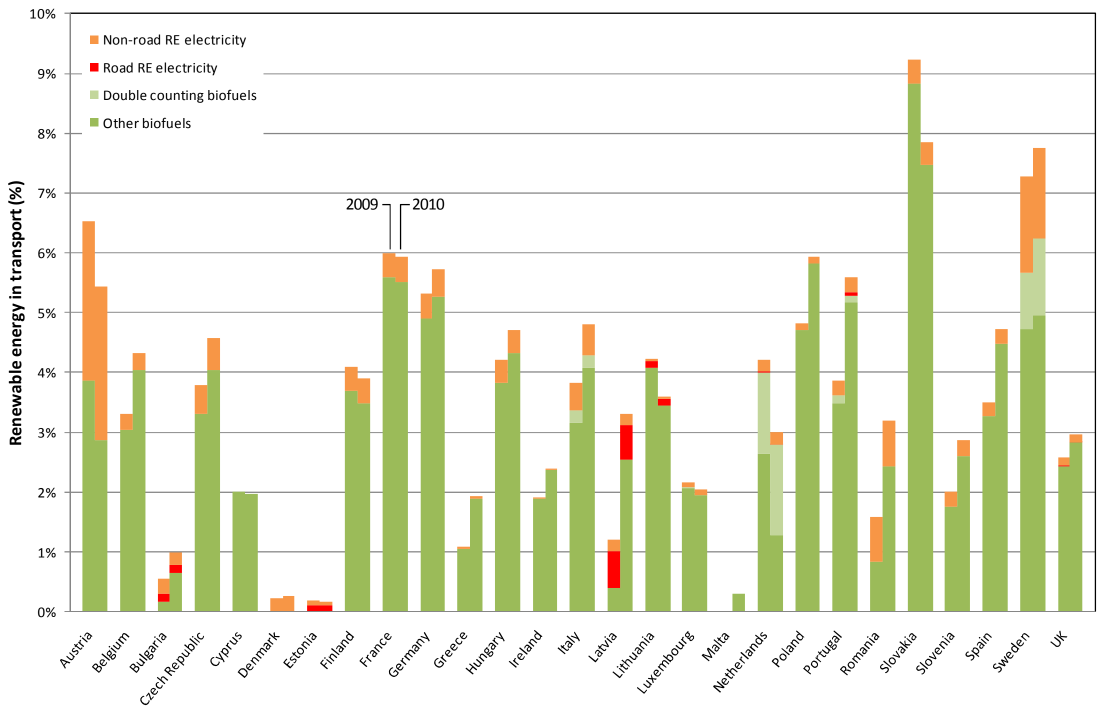


Figure 23. RES-T actual share, split out in the four contributing categories [Eurostat personal communication, 2012].

This implies that RES-T achievements are partially directly dependent on the progress in RES-E, which is discussed earlier in this section. Therefore, we focus here on the achievements in biofuels deployment. In the stimulation of RES-T in 2010, all EU Member States focus on biofuels. Apart from a few subsidy schemes on electric vehicles and battery charging infrastructure, the instruments are almost completely aimed at biofuels deployment.

As can be seen from Figure 23, the deployment of biofuels resides principally in two categories: Double counting biofuels (according to the Article 21.2 definition of the Renewable Energy Directive 2009/28/EC) and those biofuels that are not double counting. Double counting biofuels are so far only found in the Netherlands, Sweden, Italy and Portugal. In Sweden the double counting biofuels are largely based on biogas, in the other countries on used cooking oil, with smaller amounts originating from animal fat.

Contrary to most other renewable energy sources, the application of biofuels is hardly related to the installed production capacity, because biofuels are increasingly sourced on the international market, within the EU, but also on the world market (for more information see Chapter 2 about the development of the EU biofuels marketplace). This implies, amongst others, that the installed capacity is by no means a guarantee, or even an indication for the deployment in future years. More than is the case with solar or wind energy, the deployment of biofuels could suddenly go down depending on the market conditions.

Overall, the 2010 potential supply of biofuels is larger than the demand. The eventual availability and deployment of biofuels in the EU market depends on the attractiveness of that market. More specifically, in each Member State, the deployment of biofuels depends on the strength of the incentive compared to the price gap between fossil and biofuels. Sometimes, it depends on the attractiveness of one Member State market vis-à-vis the attractiveness of neighbouring markets.

Although biofuels deployment policies in the EU Member States in 2010 are in principle framed by the Renewable Energy Directive 2009/28/EC, in many cases they are a continuation of policies from the period of the Biofuels Directive 2003/30/EC.

(1) Overview of deployment vs. 2010 NREAP RES-T target

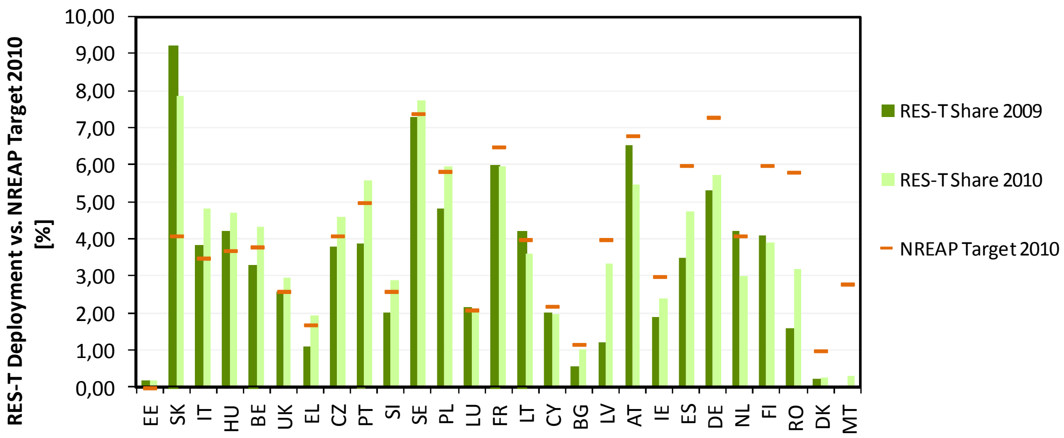


Figure 24. RES-T actual share vs. NREAP indicative target 2010 (%).

In Figure 24, the deployment of RES-T in 2009 and 2010 is compared with the targets that Member States had formulated in their NREAP for 2010. The countries are ordered according to deviation of actual deployment from the RES-T target in 2010, with countries that exceeded their targets on the left and those that underperformed (in comparison with their target) on the right.

EUROSTAT data was used to assess Slovenia's performance in the RES-T sector, as they did not fill in table 1d of the Progress Report.

(2) Deviation from 2010 NREAP target.

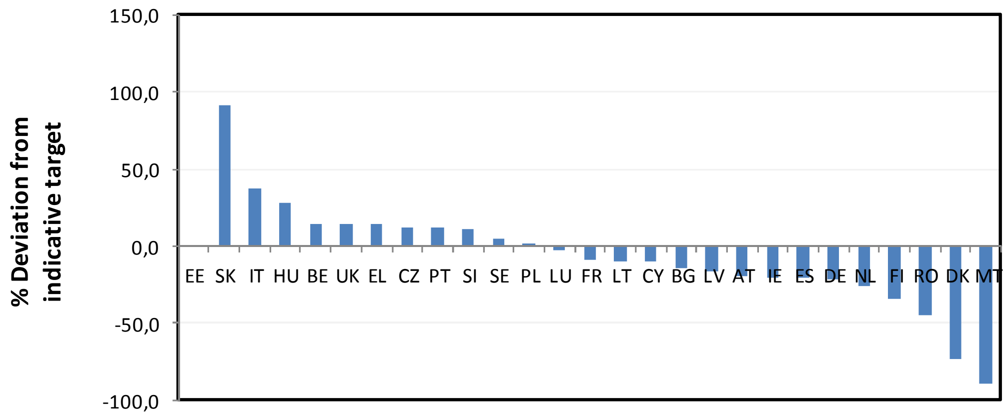


Figure 25. Deviation of actual 2010 RES-T Shares (EUROSTAT) from 2010 target (NREAP).

The actual deviation is shown in Figure 25. If a country expected 4% RES-T, but achieved 8%, then the deviation is +100%; this is more or less the case for Slovakia. In most countries the deployment deviates less than ±30% from the NREAP trajectory. These countries can be considered to be on track.

The largest negative deviations are found in Romania, Denmark, Malta, i.e. these countries are behind their 2010 target. In Romania, the 2010 4% biofuels mandate does not match its NREAP ambition to achieve 5.75% of biofuels. In Denmark, the original 0.75% biofuels mandate was amended by a 0.55% blending mandate and has not lead to any biofuels deployment in 2010, although it is expected that the biofuels deployment in 2011 takes off. Malta installed a 1.5% biofuels mandate, which is lower than the expected RES-T contribution of nearly 2%, and the mandate is not yet successful. Possibly, the consequences of non-compliance for operators in 2010 in these Member States are smaller than the biofuels deployment costs.

Estonia had formulated a very modest RES-T 2010 targets in its NREAP (1 ktoe) and reported a deployment of 1 ktoe in 2010. This tends to demonstrate the Estonia is on track in 2010, but Figure 26 shows that it needs to speed up its growth of RES-E in the future to reach the 2020 target.

The deviations are largely caused by the incentive instruments that do not (yet) fully match the "expectation" that was explored in the NREAPS. As more Member States are enacting the necessary instruments, it can be expected that the deviations become smaller in future years. Biofuels policies are moving from excise reduction schemes towards mandates in most EU Member States. These instruments and their efficiencies are discussed in more detail in Section 1.4.

In general, mandates are a much stronger instrument, provided that non-compliance is strongly penalised, or that the buy-out price is sufficiently high. In case of mandates, the application is not or less hindered by price fluctuations or by competition from more successful instruments in neighbouring countries. Although most countries have biofuel mandates, they also still operate excise schemes and several mandates

(3) Annual Growth Rate

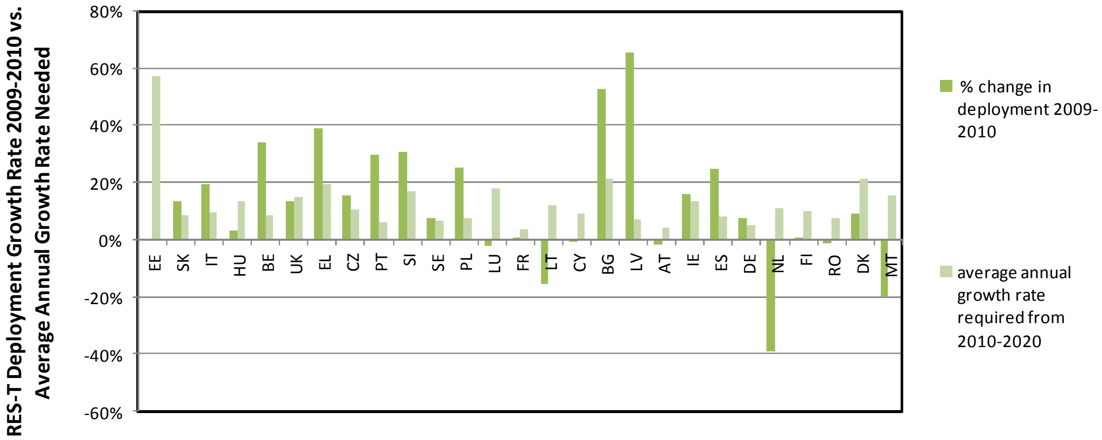


Figure 26. RES-T growth rate between 2009-2010, and average annual growth rate required between 2010-2020 to achieve 2020 target.

Figure 26 shows the annual growth rate in 2010 compared to 2009 and the average annual growth rate that is required between 2010 and 2010 to achieve the 2020 target of 10% RES-T. MS appear in the order of their deviation from 2010 NREAP RES-T target. This graph is not based on RES-T sector shares, but on absolute figures (ktoe). Growth rates therefore reflect only real growth in RES-T consumption and are not influenced by variations in overall energy demand in transport.

In the past, the deployment of biofuels was strongly dependent on the biofuel (feedstock) price, the resulting price gap with fossil diesel and gasoline and on whether an excise reduction was capable of bridging the gap. The deployment within Member States varied enormously between consecutive years. By now, with most countries opting for mandates, the deployment of biofuels is more linearly depending on the height of the mandate, provided that the compliance is strongly enforced. This would mean that from 2010-2011 onwards, it should be expected that the annual growth rates will generally be positive (or zero if multiple years have a same mandate). It is still possible that negative growth rates are encountered, for example when the few remaining excise instruments are being phased out. For 2010, it does not yet make much sense to analyse the RES-T actual growth rate in comparison with the required growth rate, but it could make more sense in future years.

Nevertheless, two extremes from Figure 26 are worth discussing:

- Estonia needs a considerable annual growth rate when expressed as a percentage, as it comes from virtually zero biofuels. Obviously, it is a modest growth when expressed in volume, especially when compared to the volumes deployed in other countries. Estonia should progress in coming years;
- The Netherlands are the country with the strongest decreasing biofuels consumption in 2010 compared to 2009. Despite the potentially strong enforcement of the mandate (non-compliance is an economic offence), the 4% mandate was not achieved. This is explained by the possibility for operators to capitalise on performance above the mandate in 2009 and earlier. The fall can thus be regarded as incidental [Progress report on energy from renewable sources in the Netherlands, 2009-2010].

(4) Development since 1990

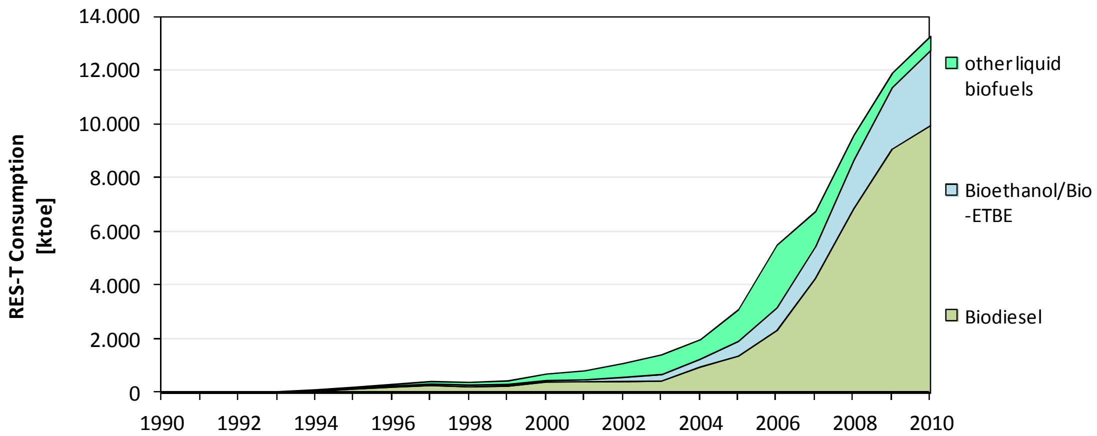


Figure 27. RES-T consumption from bioethanol/bio-ETBE, biodiesel, and other liquid biofuels in the EU-27 in ktoe. Data source: EUROSTAT

Figure 27 shows the development of bioethanol/bio-ETBE, biodiesel, and other liquid biofuels since 1990, according to EUROSTAT data. Biodiesel is by far the most commonly used biofuel with 9938 ktoe in 2010, followed by bioethanol with 2799 ktoe, and other biofuels with 536 ktoe. The biodiesel total over all Progress Reports is higher (10539 ktoe) than the EUROSTAT figure, mainly due to the higher figures reported by Germany and Poland. However, both these countries instead report lower figures for other biofuels, so the sums of all three fuel types are similar in the Progress Reports and EUROSTAT. Table 9 provides an overview of the growth of bioethanol/bio-ETBE, biodiesel, renewable electricity in transport, and other biofuels between 2009-2010.

Table 9. Growth of RES-T consumption between 2009-2010. Data source: Progress Reports, EUROSTAT for Czech Republic and Slovenia.

Member State	RES-T [%]	Bioethanol/Bio-ETBE [%]	Biodiesel [%]	Renewable electricity [%]	Other biofuels[%]
Belgium	33.86	19.37	35.82	20.83	-
Bulgaria	52.94	-	63.64	0.00	-
Czech Republic	15.31	-1.72	21.39	13.28	-
Denmark	9.26	-	-	9.26	-
Germany	7.63	23.36	3.88	11.73	-63.64
Estonia	0.00	-	-	-	-
Ireland	16.13	23.33	11.67	0.00	50.00
Greece	39.06	-	39.06	0.00	-
Spain	24.62	34.63	23.50	5.66	-
France	0.57	-3.05	1.39	-1.29	-
Italy	19.51	24.52	18.92	7.61	-
Cyprus	-0.53	-	0.60	-	-
Latvia	65.71	62.50	89.47	0.00	-
Lithuania	-15.56	-40.00	-8.57	0.00	-
Luxembourg	-2.38	0.00	0.00	0.00	-
Hungary	3.14	19.30	-3.36	-6.67	-
Malta	-20.00	-	-20.33	-	-
Netherlands	-39.23	-2.99	-147.37	8.00	-
Austria	-1.68	7.35	5.08	0.52	-48.05
Poland	25.37	-3.17	32.95	15.79	-
Portugal	29.51	-	30.67	21.05	-25.00
Romania	-1.24	25.51	-4.33	-1.24	-
Slovenia	30.84	33.33	33.33	-2.46	-
Slovakia	13.48	3.97	16.82	6.33	-
Finland	0.60	-5.31	6.33	-	-
Sweden	7.69	2.46	8.99	21.43	26.53
UK	13.47	49.22	0.12	7.14	-
EU-27	11.01	17.23	10.54	7.33	-31.56

Table 10 shows the consumption in absolute figures for the EU-27 and individual Member States in 2010, as provided in their Progress Reports.

Table 10, RES-T consumption in the EU-27 in 2010 from main technologies. Data source: Progress Reports. EUROSTAT for Czech Republic and Slovenia.

Member State	RES-T [ktoe]	Bioethanol/Bio-ETBE [ktoe]	Biodiesel [ktoe]	Renewable electricity [ktoe]	Other biofuels [ktoe]
Belgium	345.49	38.20	304.60	2.40	0.00
Bulgaria	17.00	0.00	11.00	3.00	0.00
Czech Republic	261.84	58.00	173.00	30.84	0.00
Denmark	10.80	0.00	0.00	10.80	0.00
Germany	3209.00	749.00	2244.00	162.00	55.00
Estonia	1.00	0.00	0.00	0.00	0.00
Ireland	93.00	30.00	60.00	0.57	2.00
Greece	128.00	0.00	128.00	3.00	0.00
Spain	1466.00	231.00	1183.00	53.00	0.00
France	2635.00	394.00	2086.00	155.00	0.00
Italy	1466.00	155.00	1311.00	184.00	0.00
Cyprus	15.05	0.00	14.96	0.00	0.00
Latvia	35.00	8.00	19.00	4.00	0.00
Lithuania	45.00	10.00	35.00	1.00	0.00
Luxembourg	42.00	1.00	41.00	2.00	0.00
Hungary	191.00	57.00	119.00	15.00	0.00
Malta	0.55	0.00	0.55	0.00	0.00
Netherlands	339.00	134.00	95.00	25.00	0.00
Austria	716.00	68.00	374.00	194.00	77.00
Poland	887.00	189.00	698.00	19.00	0.00
Portugal	349.00	0.00	326.00	19.00	3.60
Romania	33.13	110.90	142.43	33.13	0.00
Slovenia	50.52	3.00	42.00	5.02	0.00
Slovakia	89.00	15.10	66.00	7.90	0.00
Finland	167.00	71.50	60.00	0.00	0.00
Sweden	429.00	203.00	178.00	140.00	49.00
UK	1203.00	321.00	827.00	56.00	0.00
EU-27	14224.38	2846.70	10538.54	1125.66	186.60

Table 11 shows the deviation of RES-T consumption in 2010 from the NREAP 2010 indicative target. For the individual technologies, the calculation is based on the consumption [ktoe] provided in the Progress Reports. The deviation for the RES-T sector is not based on the absolute figures but on sector shares provided by EUROSTAT vs. NREAP planned shares. While a RES-T share of 4.81% had been planned for the EU-27 overall, 4.7% were actually achieved, leading to a negative deviation of 2.44%.

Table 11. Deviation from NREAP 2010 indicative target for the RES-T sector and its main technologies in the EU-27. Data source: Progress Reports for technology data (except Czech Republic and Slovenia), EUROSTAT for RES-T sector shares.

Member State	RES-T [%]	Bioethanol/ Bio-ETBE [%]	Biodiesel [%]	Renewable electricity [%]	Other biofuels [%]
Belgium	13.99	2.74	4.36	-89.93	-
Bulgaria	-14.48	-	-63.33	-	-
Czech Republic	11.79	16.00	-10.36	340.52	-
Denmark	-73.10	-100.00	-100.00	-1.82	-
Germany	-21.56	17.21	-19.57	-26.03	-46.08
Estonia	-	-	-100.00	-100.00	-
Ireland	-20.41	-25.00	-36.17	-43.00	122.22
Greece	13.59	-100.00	100.00	25.00	-
Spain	-21.16	-0.43	-19.58	-46.52	-
France	-8.63	-28.36	-3.65	-15.30	-
Italy	37.43	4.73	51.04	8.24	-100.00
Cyprus	-10.51	-	-4.71	-	-
Latvia	-17.02	-42.86	-24.00	33.33	-
Lithuania	-10.16	-23.08	-16.67	233.33	-
Luxembourg	-3.01	-78.72	11.41	5.26	-
Hungary	27.43	67.65	8.18	150.00	-
Malta	-89.19	-	-	-100.00	-
Netherlands	-26.52	-20.24	-31.65	108.33	-
Austria	-19.92	25.93	35.51	13.45	22.22
Poland	1.71	-32.26	1.60	26.67	-
Portugal	11.77	-	16.01	-5.00	-
Romania	-45.23	-	-	-	-
Slovenia	10.42	-23.08	14.75	-6.99	-
Slovakia	91.37	0.67	-1.49	-1.25	-
Finland	-34.99	2.14	-60.00	-100.00	-
Sweden	4.71	-19.12	100.00	-4.76	22.50
UK	13.92	137.78	-3.95	-58.82	-
EU-27	-2.44	1.89	-2.44	-10.90	-11.52

In the following sections, the deviations for bioethanol/bio-ETBE, biodiesel, renewable electricity, and other biofuels are described more closely. The technology graphs are based on 2010 NREAP targets in ktoe vs. actual consumption in 2010 in ktoe.

Bioethanol/Bio-ETBE

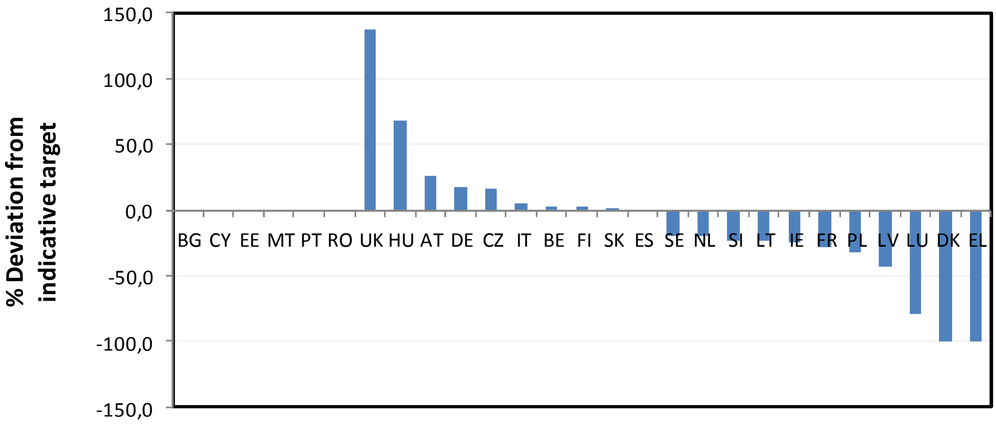


Figure 28. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for Bioethanol/Bio-ETBE.

Six countries did not specify any target for the deployment of ethanol/ETBE in transport. It is clear that most of the countries that did specify the deployment of this biofuel, most have overestimated the contribution in 2010.

Greece strongly overestimated the 2010 contribution of ethanol/ETBE, but also strongly underestimated the contribution of biodiesel in the same year (Figure 29 below), which indicates that where they expected a rather equal contribution of both fuels, the market operators instead choose to fulfil the entire mandate in the form of biodiesel. As will be discussed in Chapter 1.4, the Greek mandate is depending on the Greek national biofuel production which only consists of biodiesel.

The expectations on the application of either biodiesel or ethanol/ETBE in the NREAPs have not been followed up by legislation that steered towards that same deviation. This means more flexibility for the economic operators to choose the type and form of the biofuels they put on the market. It is therefore logical that some countries overestimated the contribution in one sector while they simultaneously underestimated the contribution in the other sector (Greece, Sweden, Slovenia, Luxembourg, UK).

Biodiesel

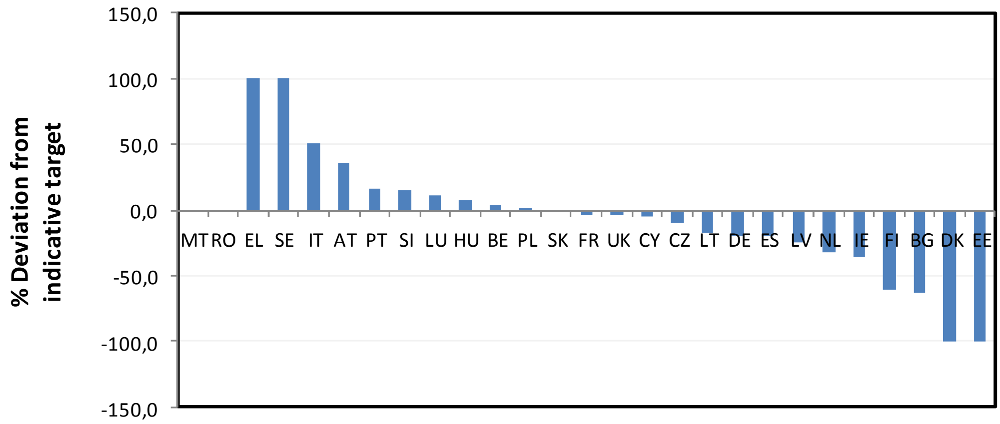


Figure 29. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for biodiesel.

Two countries did not specify any target for the deployment of biodiesel in transport. Most of the countries that did specify the deployment of this biofuel, have overestimated the contribution in 2010.

Two countries did not achieve any biodiesel deployment at all: Denmark and Estonia. In Denmark, the original 0.75% biofuels mandate was amended by a 0.55% blending mandate and has not lead to any biofuels deployment in 2010. In Estonia, the very modest target for RES-T is completely met by electricity in road and non-road transport, the excise exemption on biofuels is not effective, as is discussed in Chapter 1.4.

Greece strongly underestimated the deployment of biodiesel, which is rather unexpected. The government has a strong control over the deployed volumes, since they specify the quantities of biofuel that oil companies have to sell. The biofuels deployment in Greece completely depends on the production of biofuels in Greece, which only concerns biodiesel. Also Sweden strongly underestimated the biodiesel deployment, but this can be explained by the incentive which leaves much freedom to oil companies.

In general, as already mentioned in the section on ethanol/etbe, it should be noted that expectations on the application of either biodiesel or ethanol, as reported in the NREAPs have not been followed up by legislation that steered towards that same deviation.

Electricity in Transport

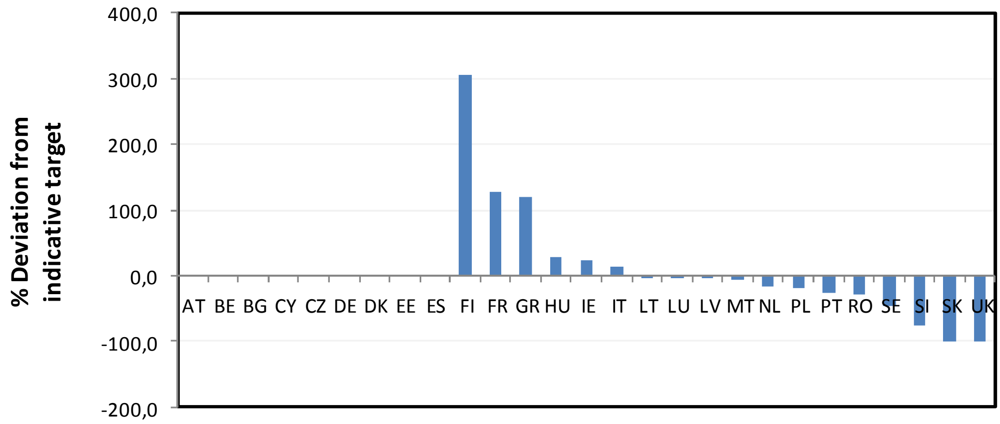


Figure 30. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for electricity in transport.

Nine Member States did not expect any contribution from renewable electricity in transport. Surprisingly, this includes Austria, where in 2010 almost half of the realised RES-T consisted of renewable electricity (see Figure 22 above). Small contributions of renewable electricity in Finland and France are still considerably larger than expected which led to a seemingly large deviation. We should consider these deviations not relevant, as the ambitions for 2010 were rather low.

Other Biofuels

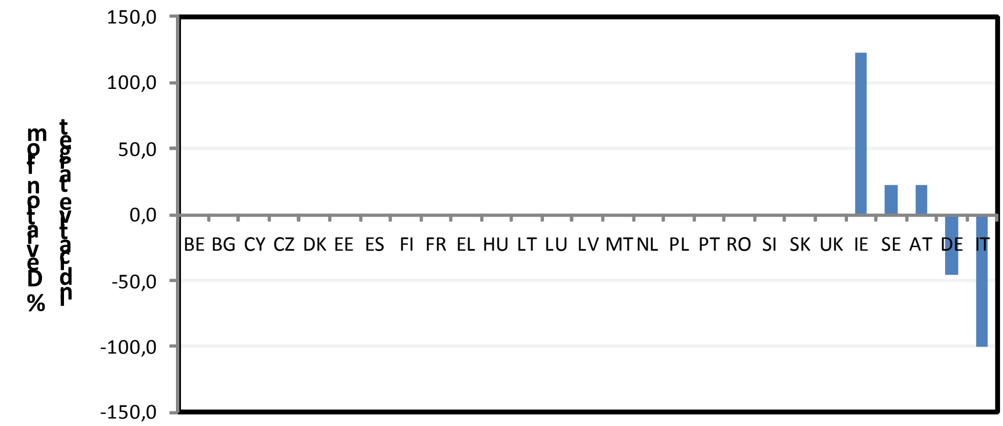


Figure 31. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for other biofuels.

Most Member States foresee zero deployment of other biofuels in transport in 2010 in their NREAP. Since the volumes are small, especially compared to the volume of regular biofuels (ethanol/etbe and biodiesel) the deviations found are not very interesting.

1.3 Projected future progress by 2020

Introduction

This chapter is looking forward, dedicated to provide a model-based assessment to what extent currently implemented RE policies (Current Policy Initiatives (CPI)), complemented by Planned Policy Initiatives (CPI+PPI) appear sufficient to trigger the targeted RE deployment in subsequent years up to 2020 at the Member State level.

The scenario calculation is done by application of the Green-X model, a well established simulation tool for policy instruments in the European RE market indicating consequences of policy choices on deployment and cost of RE technologies in a comprehensive manner.

Results show projected future progress in the short term (2012) and for 2020, indicating by MS the likeliness of delivering as targeted (i.e. indicative NREAP trajectory targets, in total, by sector and by technology) or as required (i.e. binding minimum targets for overall RES deployment set by the RE directive).

The modelling work performed is closely linked to other parts of this study. Thus, the assessment of future progress builds on the analysis of historic RES deployment (section 1.2) and reflects findings gained with respect to achieved progress in mitigating non-cost barriers (section 1.6 and 1.7). Obviously, this quantitative assessment is also closely linked to the overall qualitative RE policy assessment (section 1.4), building on the collected policy information and providing input to the overall policy analysis.

Methodology and data sources

The method of approach and the related key assumptions for the prospective assessment undertaken are discussed in detail subsequently. We start with a description of the modelling tool used for performing the quantitative assessment, followed by a clear characterisation of the approach applied for evaluating on progress. Finally data sources are named.

The policy assessment tool: the Green-X model

As in previous projects such as FORRES 2020, OPTRES or RE-Shaping the ***Green-X*** model was applied to perform a detailed quantitative assessment of the future deployment of renewable energies on country-, sector- as well as technology level. The core strength of this tool lies on the detailed RE resource and technology representation accompanied by a thorough energy policy description, which allows assessing various policy options with respect to resulting costs and benefits. A short characterization of the model is given below, whilst for a detailed description we refer to www.green-x.at. Note that key assumptions on potentials and cost for RES in MSs are taken from the Green-X database as discussed recently in Resch et al. (2012).

Short characterisation of the Green-X model:

The model Green-X has been developed by the Energy Economics Group (EEG) at the Vienna University of Technology under the EU research project "Green-X–Deriving optimal promotion strategies for increasing the share of RES-E in a dynamic European electricity market" (Contract No. ENG2-CT-2002-00607). Initially focussed on the electricity sector, this modelling tool, and its database on renewable energy (RES) potentials and costs, has been extended to incorporate renewable energy technologies within all energy sectors.

Green-X covers the EU-27, and can be extended to other countries, such as Turkey, Croatia and Norway. It allows the investigation of the future deployment of RES as well as the accompanying cost (including capital expenditures, additional generation cost of RES compared to conventional options, consumer expenditures due to applied supporting policies) and benefits (for instance, avoidance of fossil fuels and corresponding carbon emission savings). Results are calculated at both a country- and technology-level on a yearly basis. The time-horizon allows for in-depth assessments up to 2020, accompanied by concise outlooks for the period beyond 2020 (up to 2030).

The Green-X model develops nationally specific dynamic cost-resource curves for all key RES technologies, including for renewable electricity, biogas, biomass, biowaste, wind on- and offshore, hydropower large- and small-scale, solar thermal electricity, photovoltaic, tidal stream and wave power, geothermal electricity; for renewable heat, biomass, sub-divided into log wood, wood chips, pellets, grid-connected heat, geothermal grid-connected heat, heat pumps and solar thermal heat; and, for renewable transport fuels, first generation biofuels (biodiesel and bioethanol), second generation biofuels (lignocellulosic bioethanol, biomass to liquid), as well as the impact of biofuel imports. Besides the formal description of RES potentials and costs, Green-X provides a detailed representation of dynamic aspects such as technological learning and technology diffusion.

Through its in-depth energy policy representation, the Green-X model allows an assessment of the impact of applying (combinations of) different energy policy instruments (for instance, quota obligations based on tradable green certificates / guarantees of origin, (premium) feed-in tariffs, tax incentives, investment incentives, impact of emission trading on reference energy prices) at both country or European level in a dynamic framework. Sensitivity investigations on key input parameters such as non-economic barriers (influencing the technology diffusion), conventional energy prices, energy demand developments or technological progress (technological learning) typically complement a policy assessment.

Within the Green-X model, the allocation of biomass feedstock to feasible technologies and sectors is fully internalised into the overall calculation procedure. For each feedstock category, technology options (and their corresponding demands) are ranked based on the feasible revenue streams as available to a possible investor under the conditioned, scenario-specific energy policy framework that may change on a yearly basis. Recently, a module for intra-European trade of biomass feedstock has been added to Green-X that operates on the same principle as outlined above but at a European rather than at a purely national level. Thus, associated transport costs and GHG emissions reflect the outcomes of a detailed logistic model. Consequently, competition on biomass supply and demand arising within a country from the conditioned support incentives for heat and electricity as well as between countries can be reflected. In other words, the supporting framework at MS level may have a significant impact on the resulting biomass allocation and use as well as associated trade.

Moreover, Green-X was recently extended to allow an endogenous modelling of sustainability regulations for the energetic use of biomass. This comprises specifically the application of GHG constraints that exclude technology/feedstock combinations not complying with conditioned thresholds. The model allows flexibility in applying such limitations, that is to say, the user can select which technology clusters and feedstock categories are affected by the regulation both at national and EU level, and, additionally, applied parameters may change over time.

General approach and scenario definition

The general approach used for this analysis of expected MS's future progress is to conduct a model-based quantitative assessment of future RES deployment in absolute (i.e. GWh produced, MW installed) and relative terms (i.e. RES shares on gross demands), reflecting assumptions also on future energy demand. This includes both short term expectations, illustrating the expected deployment for the year 2012, and an illustration of trend expectations for 2020. In order to illustrate uncertainty adequately, for 2020 two policy tracks are taken into account, complemented by a set of sensitivity investigations on expected demand (growth).[1]

From the policy perspective assessed cases include:

- Current Policy Initiatives (CPI): This scenario assumes a continuation of currently implemented RE support policies, commonly specified also as "business as usual" case. Note that it also reflects a "business-as-usual" world with respect to non-economic RES barriers as currently applicable in the different MSs;
- Current Policy Initiatives complemented by Planned Policy Initiatives (CPI+PPI): In addition to above planned measures as proposed by the MSs in their Progress reports are taken into account. The list of planned measures includes incentives to either improve the support framework or to mitigate currently applicable non-economic barriers.

Data sources:

- Information on *Current (RE) Policy Initiatives (CPI)* was originally based on "RE country profiles" as developed throughout the RE-Shaping study (with its last update in December 2011, see Rathmann et al. (2011)). Within this study a cross-check of the derived database with policy information reported by MSs in their Progress reports submitted at the end of 2011 and throughout the first half of 2012;
- Information on *Planned Policy Initiatives (PPI)* was collected from MS's Progress Reports.[2] Since MSs reported on planned improvements in a non-homogenous manner a comprehensive reassessment of the originally provided information was needed. As a first step, only information related to planned improvements was taken into account. In other words, existing measures as partly described by MSs were not considered (since they are already incorporated in the CPI case). Next, reported country-specific planned measures were grouped into:
    - Measure dedicated to *improve the financial support* framework for RES;
    - Measures for *mitigating non-economic barriers* that hinder an accelerated RES deployment at present.

  For *financial support* any lack of sufficient information as needed for subsequent model-implementation needed to be filled by applying adequate assumptions on the detailed implementation of envisaged measures. In this context, the assumption was taken that MSs apply support in similar magnitude as currently implemented on average at EU level.

  In the case of *mitigation measures related to non-economic barriers* a pre-evaluation of the expected impact was of need, indicating the degree of improvement to move from the current ("business-as-usual") situation to a "best practice" world.

[1] Demand expectations reflect MS plans as reported in their NREAPs, contrasted by actual data (for 2010) reported by EUROSTAT (i.e. the file indicating historic RES shares "EU27 shares acc to directive").

[2] For further details on the applied approach we refer to Appendix III of this report.

For the exceptional case that measures were described in such a vague manner that does not allow to draw any assumptions those measures were excluded from the assessment;

- Expectations on future energy demand reflect MS's plans as reported in their NREAPs (i.e. according to a "business-as-usual" and an "energy efficiency" scenario), contrasted by actual data (for 2010) reported by EUROSTAT.

Technology categorisation and result depiction

Complementary to chapter 1.2 this chapter is dedicated to indicate expectations on the Member State progress in deploying RES-E, RES-H&C and RES-T in forthcoming years. We are comparing both short term expectations, i.e. the expected deployment for the year 2012, and trend expectations for 2020 with two targets set out in the NREAP: their planned progress for 2012 and 2020 (i.e. subsequently named as indicative NREAP targets) and the mandatory 2011/2012 and 2020 minimum trajectories.

For RES overall, two figures are presented for 2012 as well as for 2020:

(1) Overview figure comparing MS's expected RES deployment with minimum trajectory (i.e. required deployment) and indicative NREAP targets (i.e. planned progress);

(2) MS deviation from planned deployment, i.e. the indicative NREAP target as set for 2012 and 2020.

Complementary to above, technology insights are discussed at EU level, comparing the expected with the planned deployment by RES technology at EU level for 2012 and for 2020.

All data on expected RES deployment stems from Green-X modelling, in particular the "Current Policy Initiatives (CPI)" and the "CPI plus planned measures (CPI+PPI)" scenarios. While for 2012 currently implemented policy initiatives (CPI) are taken into account, for 2020 also planned policy initiatives (CPI+PPI) as reported by the MS's in their progress report. In order to illustrate uncertainty adequately, the policy variation is complemented by a set of sensitivity investigations on expected demand (growth).

For the three sectors RES-E, RES-H&C, and biofuels in transport, we present figures (1) and (2) as well but since no minimum targets are prescribed at sector or technology level expected deployment is only compared to the planned one (i.e. the indicative NREAP target).

For each of the three sectors we present the deviation from indicative NREAP targets (figure (2)) for the main technologies in the report and for the other technologies in the annex (see Table 12 and Appendix II, respectively). As indicated in Table 12, RES technologies are categorised in a similar way as done in the assessment of past progress (chapter 1.2). A few deviations were however indispensable due to limitations of the Green-X model and its database, respectively:

- "Bioliquids" are summarised under "Biomass", including solid and liquid fuels as well as the biodegradable fraction of municipal solid waste;
- Hydropower is split only into large- (i.e. above 10 MW) and small-scale, applying the default distinction as used in statistical accounting;
- For the transport sector Green-X is only capable to model biofuel deployment but not electro-mobility.[3]

Table 12. Overview RES technologies presented in the report and in the annex.

<table>
<tr><th colspan="2">RES-E</th><th colspan="2">RES-H&C</th><th colspan="2">RES-T (biofuels only)</th></tr>
<tr><td>Offshore wind</td><td rowspan="7">Report</td><td>Solar thermal</td><td rowspan="4">Report</td><td>First generation biofuels</td><td rowspan="2">Report</td></tr>
<tr><td>Onshore wind</td><td>Biomass (i.e. solid and liquid, incl. biowaste)</td><td>Second generation biofuels</td></tr>
<tr><td>Biomass (i.e. solid and liquid, incl. biowaste)</td><td>Biogas</td><td></td><td></td></tr>
<tr><td>Biogas</td><td>Heat pumps</td><td></td><td></td></tr>
<tr><td>Photovoltaics</td><td>Geothermal</td><td>Annex</td><td></td><td></td></tr>
<tr><td>Small hydro</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Large hydro</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Geothermal</td><td rowspan="3">Annex</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Concentrated solar power</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Tide, wave and ocean energy</td><td></td><td></td><td></td><td></td></tr>
</table>

Projected future progress in RES overall

Cross-country comparison

(1) Overview of expected deployment vs. indicative (NREAP) and minimum trajectory target for 2012 and by 2020

[3] For overall RES target accounting this does not represent any constraint, but for the sectoral minimum target (i.e. a minimum share of 10% for RES in the transport sector by 2020) only the contribution of biofuels can be assessed.

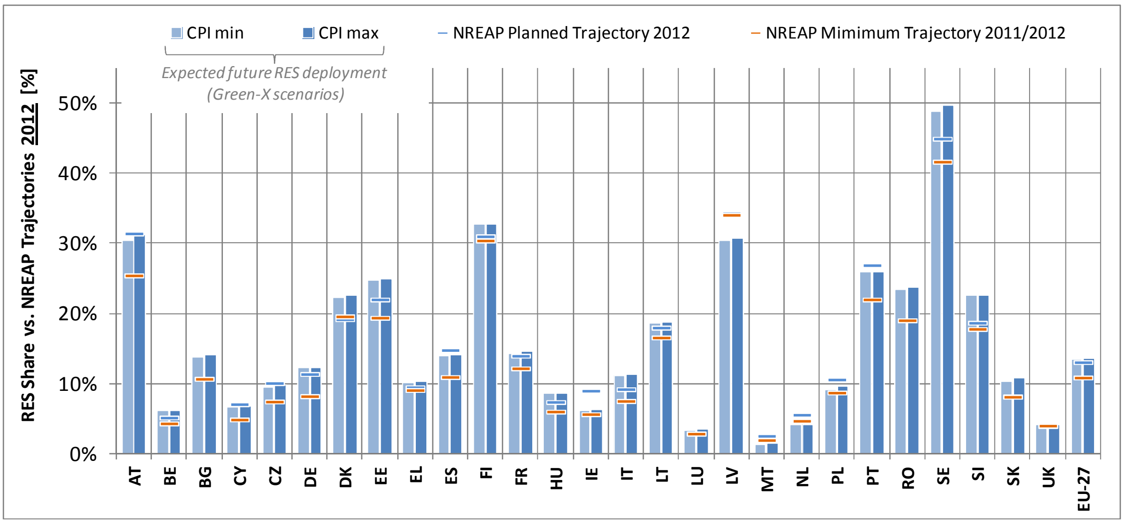


Figure 32. Expected RES Share in 2012 vs. 2011/2012 minimum trajectory and 2012 indicative (NREAP) target (%).

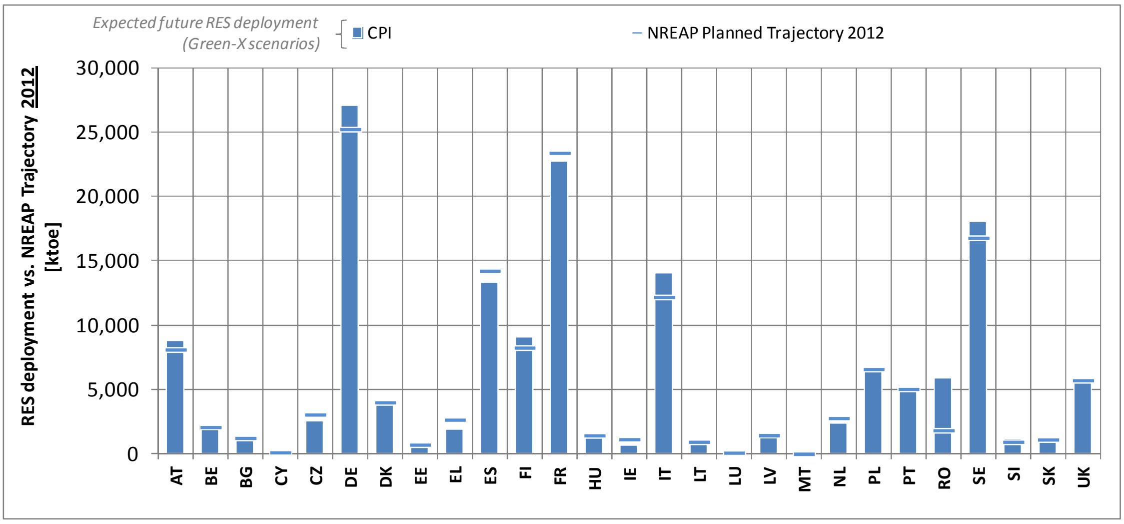


Figure 33. Expected RES deployment (in absolute terms) in 2012 vs. 2012 indicative (NREAP) target.

An illustration of the expected (according to Green-X scenarios), the planned (i.e. the indicative NREAP targets) and the required (i.e. the minimum trajectory) short-term progress in 2012 is given in Figure 32, showing RES deployment in relative terms, that is as share in gross final energy demand. The complementary data in absolute terms, that is the produced electricity, heat and transport fuels that stem from RES, is shown in Figure 33). The data on expected, planned and required RES shares in 2012 is expressed also in Table 13.

Table 13. Expected, planned and required RES Shares in 2012.

*RES share in gross final energy demand by **2012***	**Expected RES share 2012** (CPI scenario)		**NREAP indicative target - RES share 2012**	**NREAP minimum trajectory - RES Share 2011/2012**	**Deviation of expected from planned 2012 share**		**Deviation of expected from minimum trajectory 2011/2012 share**	
	Min.	Max.			Min.	Max.	Min.	Max.
Member State	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]
Belgium	6.1%	6.1%	5.2%	4.4%	17.8%	17.9%	40.4%	40.6%
Bulgaria	13.9%	14.1%	10.7%	10.7%	29.3%	31.9%	29.3%	31.9%
Czech Republic	9.5%	9.9%	10.1%	7.5%	-5.7%	-2.4%	27.3%	31.8%
Denmark	22.2%	22.6%	19.2%	19.6%	15.7%	17.5%	13.3%	15.1%
Germany	12.3%	12.4%	11.4%	8.2%	7.6%	8.5%	48.9%	50.1%
Estonia	24.8%	25.0%	22.0%	19.4%	12.6%	13.5%	27.6%	28.7%
Ireland	6.3%	6.4%	9.0%	5.7%	-30.4%	-29.4%	10.2%	11.9%
Greece	10.1%	10.3%	9.5%	9.1%	6.3%	8.1%	10.8%	12.6%
Spain	14.0%	14.1%	14.8%	11.0%	-5.2%	-4.4%	28.0%	29.1%
France	14.3%	14.6%	14.0%	12.2%	2.0%	4.4%	17.1%	19.8%
Italy	11.2%	11.3%	9.2%	7.6%	21.2%	22.7%	47.9%	49.8%
Cyprus	6.8%	6.8%	7.1%	4.9%	-4.8%	-3.8%	37.4%	38.8%
Latvia	30.4%	30.7%	34.3%	34.1%	-11.2%	-10.6%	-10.7%	-10.0%
Lithuania	18.6%	18.7%	18.0%	16.6%	3.3%	4.1%	12.0%	12.8%
Luxembourg	3.4%	3.5%	2.9%	2.9%	18.4%	19.3%	17.6%	18.5%
Hungary	8.7%	8.7%	7.4%	6.0%	17.5%	17.7%	44.0%	44.2%
Malta	1.4%	1.5%	2.6%	2.0%	-44.8%	-41.4%	-28.2%	-23.8%
Netherlands	4.2%	4.2%	5.6%	4.7%	-24.3%	-24.3%	-10.2%	-10.2%
Austria	30.3%	31.3%	31.4%	25.4%	-3.4%	-0.3%	19.3%	23.1%
Poland	9.2%	9.7%	10.6%	8.8%	-13.5%	-8.1%	4.7%	11.2%
Portugal	25.9%	25.9%	26.9%	22.0%	-3.9%	-3.8%	17.5%	17.6%
Romania	23.4%	23.7%	19.0%	19.0%	22.8%	24.5%	22.8%	24.5%
Slovenia	22.5%	22.6%	18.7%	17.8%	20.5%	20.7%	26.6%	26.8%
Slovakia	10.4%	10.7%	8.2%	8.2%	26.7%	31.1%	27.4%	31.7%
Finland	32.7%	32.8%	31.0%	30.4%	5.6%	5.8%	7.7%	7.9%
Sweden	48.8%	49.6%	44.9%	41.6%	8.6%	10.4%	17.1%	19.1%
United Kingdom	4.1%	4.2%	4.0%	4.0%	2.7%	5.0%	1.7%	4.0%
European Union	13.4%	13.6%	13.1%	10.9%	2.3%	3.9%	23.0%	24.9%

The majority of MS's set their indicative NREAP target, that is the planned RES deployment, in the early phase higher than the minimum trajectory values as determined according to a standard formula given in Annex B of the RES Directive. This leads to the fact that the almost all MSs are expected to reach and mostly significantly exceed their minimum trajectory target in 2012. Only for Latvia, Malta and the Netherlands it can be expected that a gap will arise, partly of significant magnitude, ranging from about 10% (NL, LV) to 28% (MT). Compared to historic data for 2009 and 2010 as discussed in section 1.2 this means that for some countries the situation may improve already (e.g. the UK).

Complementary to above Figure 34 (deployment in relative terms) and Figure 35 (deployment in absolute terms) provide a graphical illustration of the expected progress up to 2020 according to currently implemented and also planned RES policy initiatives. Table 14 lists all data on expected, planned and required RES shares.

Note that for both 2012 and 2020 a range is indicated for the share of RES in demand, reflecting the differences that arise from the two distinct demand projections used (i.e. the "business-as-usual" and the "energy efficiency" scenario of future energy demand as expressed in the NREAPs). Thus, the "energy efficiency" scenario was used as lower boundary for demand growth and, consequently, as upper boundary related to the resulting RES share (i.e. the max(imum) values, see Table 13 or Table 14). This optimistic view was contrasted by a "business-as-usual" (or "reference") scenario for the development of future energy demand, leading the lower boundary for the resulting RES share (i.e. the min(imum) values, cf. Table 13 or Table 14). In general, differences between both demand scenarios are more apparent by 2020 than in 2012 and, consequently, also the expressed range for the share of RES is larger by then.

A comparison of expected with planned and / or required RES deployment indicates a less optimistic picture. In contrast to the historic assessment or the short-term perspective (for 2012) almost all MSs will fail to deliver the required RES deployment in 2020 if no further measures or adaptations are taken. Only three out of 27 countries, i.e. Sweden, Austria and Estonia, may succeed in (over)fulfilling their 2020 RES targets with already implemented RES policies under the current framework conditions. In the majority of countries currently implemented RES policies appear insufficient to trigger the required RES deployment. Generally this reflects deficits in both the financial support for RES and the required mitigation steps related to non-economic barriers that hinder an accelerated RES diffusion.[4] Moreover, the success in improving energy efficiency and consequently reducing overall energy demand growth represents another important pillar for achieving RES targets since they are defined as RES shares, i.e. put in direct relation to demand (growth). In contrast to the above, many of the countries may end up with a significant gap in their 2020 RES target.[5] Thus, twelve out of 27 countries may even end up with a lower RES share by 2020 than in 2012. These are generally countries that already hold a significant RES share and where consequently a strong overall energy demand growth would reduce the future RES share and negatively affect RES target achievement. At EU level a gap of 4.6% to 5.7% (of gross final energy demand) occurs in the CPI case, whereby the range indicates the uncertainty related to future energy demand (growth) as discussed above.

The picture improves if planned RES policy initiatives as prescribed in the MS's progress reports are taken into account, and at EU level the gap decreases, ranging from 4.6% to 3.4%. Bulgaria and Slovakia now add up to the list of countries that are expected in being successful for meeting the 2020 RES targets. Generally planned initiatives may cause moderate improvements in the majority of Member States,

[4] The financial crisis as of today affects these developments also to a certain extent. EU countries face a different risk rating today that impacts also investments in RES partly in significant magnitude since such (country) risks are well reflected in the modeling approach used.

[5] Latvia, Portugal, Netherlands, Lithuania, France, Ireland, UK, Greece, Denmark and Spain are those countries with a gap higher than 7% (of gross final energy demand) under business-as-usual conditions.

while most significant changes will arise in Latvia, UK, Spain and Bulgaria, followed by Romania, Lithuania, Portugal, Poland, and Austria.

Table 14. Expected, planned and required RES Shares in 2020.

RES share in gross final energy demand by ***2020***	**Expected RES share 2020** (CPI scenario)		**Expected RES share 2020** (CPI+PPI scenario)		**NREAP indicative target - RES share 2020**	**NREAP minimum trajectory - RES Share 2020**	**Deviation of expected from planned 2020 share** (CPI and CPI+PPI scenario)		**Deviation of expected from minimum trajectory 2020 share** (CPI and CPI+PPI scenario)	
	Min.	Max.	Min.	Max.			Min.	Max.	Min.	Max.
Member State	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]
Belgium	7.9%	8.0%	8.2%	8.2%	13.0%	13.0%	-39.2%	-36.6%	-39.2%	-36.6%
Bulgaria	12.5%	14.5%	15.3%	17.8%	16.0%	16.0%	-22.0%	11.2%	-22.0%	11.2%
Czech Republic	9.1%	9.4%	9.3%	9.5%	13.5%	13.0%	-32.4%	-29.4%	-29.8%	-26.7%
Denmark	22.5%	24.7%	22.8%	25.0%	30.0%	30.0%	-24.9%	-16.7%	-24.9%	-16.7%
Germany	15.4%	16.4%	15.8%	16.8%	19.6%	18.0%	-21.3%	-14.5%	-14.3%	-6.9%
Estonia	24.3%	25.2%	24.2%	25.1%	25.0%	25.0%	-3.1%	0.9%	-3.1%	0.9%
Ireland	8.1%	8.7%	8.6%	9.1%	16.0%	16.0%	-49.2%	-42.9%	-49.2%	-42.9%
Greece	10.3%	10.6%	10.3%	10.6%	18.0%	18.0%	-42.8%	-41.4%	-42.8%	-41.4%
Spain	12.6%	13.8%	15.4%	17.1%	22.7%	20.0%	-44.6%	-24.6%	-37.2%	-14.4%
France	14.9%	16.9%	15.8%	17.9%	23.0%	23.0%	-35.1%	-22.1%	-35.1%	-22.1%
Italy	13.1%	14.0%	13.1%	13.9%	17.0%	17.0%	-23.1%	-17.8%	-23.1%	-17.8%
Cyprus	8.7%	9.1%	8.9%	9.3%	13.0%	13.0%	-33.0%	-28.5%	-33.0%	-28.5%
Latvia	21.6%	24.2%	26.1%	29.2%	40.0%	40.0%	-46.0%	-26.9%	-46.0%	-26.9%
Lithuania	14.1%	14.6%	15.6%	16.0%	24.0%	23.0%	-41.4%	-33.2%	-38.8%	-30.3%
Luxembourg	5.8%	5.9%	5.9%	6.1%	11.0%	11.0%	-47.7%	-44.4%	-47.7%	-44.4%
Hungary	8.6%	9.0%	9.2%	9.6%	14.7%	13.0%	-41.1%	-34.7%	-33.6%	-26.4%
Malta	4.0%	4.0%	4.0%	4.0%	10.2%	10.0%	-61.0%	-60.6%	-60.2%	-59.8%
Netherlands	5.0%	5.0%	5.1%	5.1%	14.5%	14.0%	-65.3%	-64.5%	-64.1%	-63.2%
Austria	32.0%	35.7%	33.2%	36.6%	34.2%	34.0%	-6.5%	7.0%	-5.9%	7.6%
Poland	8.2%	9.6%	9.0%	10.7%	15.5%	15.0%	-47.1%	-30.7%	-45.4%	-28.4%
Portugal	20.5%	21.1%	21.7%	22.3%	31.0%	31.0%	-33.8%	-28.0%	-33.8%	-28.0%
Romania	19.5%	21.0%	21.2%	22.7%	24.0%	24.0%	-18.9%	-5.5%	-18.9%	-5.5%
Slovenia	21.8%	21.8%	22.0%	22.0%	25.3%	25.0%	-13.8%	-12.9%	-12.8%	-11.9%
Slovakia	11.7%	12.9%	13.1%	14.3%	14.0%	14.0%	-16.1%	1.8%	-16.1%	1.8%
Finland	34.8%	34.9%	34.8%	34.8%	38.0%	38.0%	-8.5%	-8.2%	-8.5%	-8.2%
Sweden	46.1%	49.4%	46.2%	49.5%	50.2%	49.0%	-8.2%	-1.5%	-6.0%	1.0%
United Kingdom	7.3%	7.5%	11.1%	11.5%	15.0%	15.0%	-51.5%	-23.4%	-51.5%	-23.4%
European Union	14.5%	15.5%	15.6%	16.7%	20.6%	20.2%	-29.7%	-18.7%	-28.3%	-17.1%

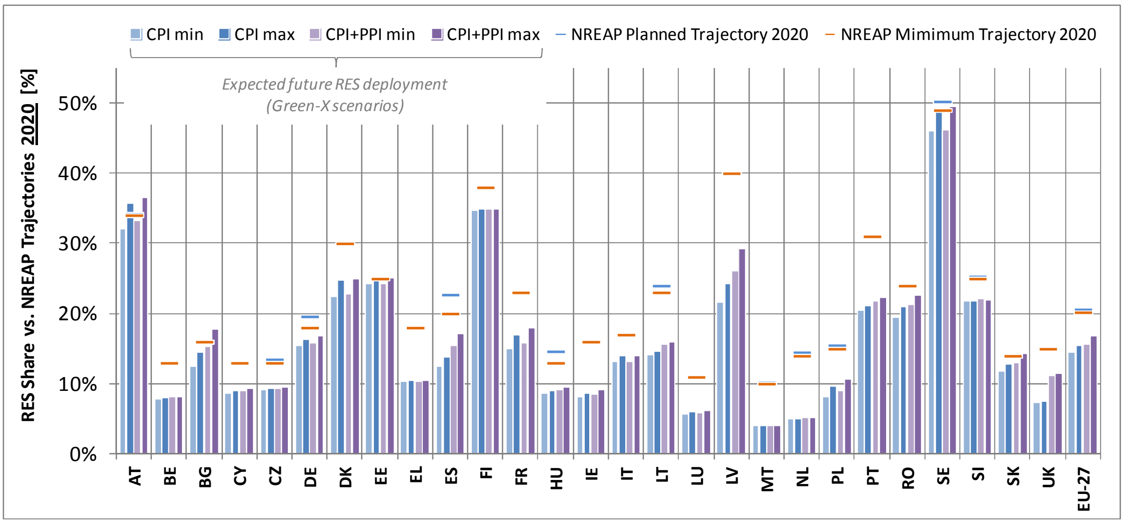


Figure 34. Expected RES Share in 2020 vs. 2020 minimum trajectory and 2020 indicative (NREAP) target (%).

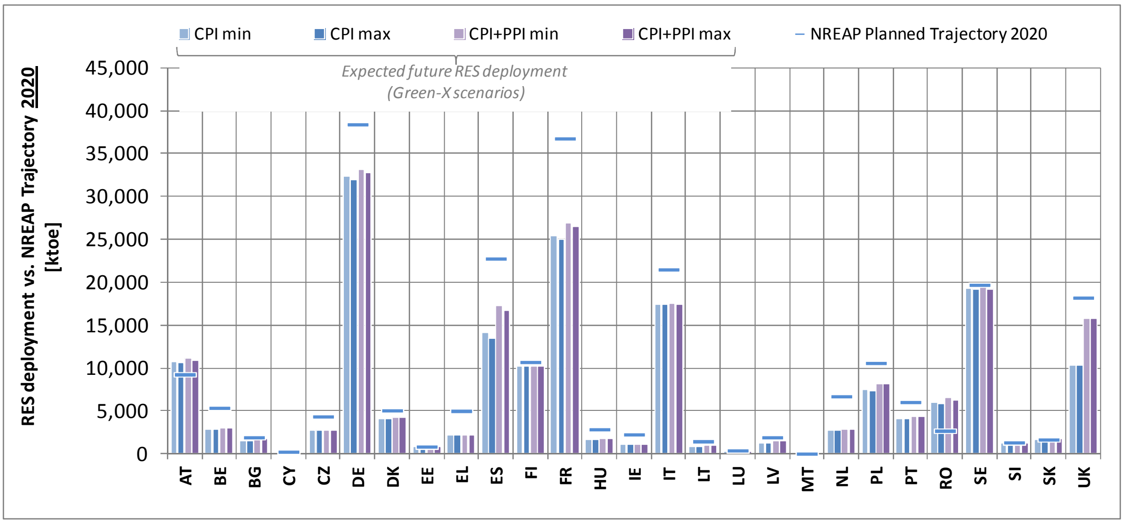


Figure 35. Expected RES deployment (in absolute terms) in 2020 vs. 2020 indicative (NREAP) target.

(2) Deviation from 2012 and 2020 NREAP targets

Figure 37 and Figure 37 illustrate the deviation of expected RES deployment from the indicatively targeted one, that is the planned progress as prescribed in the MS's progress reports. More precisely, Figure 36 shows for 2012 the deviation under business-as-usual conditions, taking into account only currently implemented RES policy initiatives. The complementary depiction for 2020 is given in Figure 37, whereby also planned improvements are taken into consideration. In both figures uncertainty related to the development of future energy demand is reflected, illustrating lower (i.e. CPI min, CPI+PPI min) and upper levels (CPI max, CPI+PPI max) of expected RES shares in energy demand.

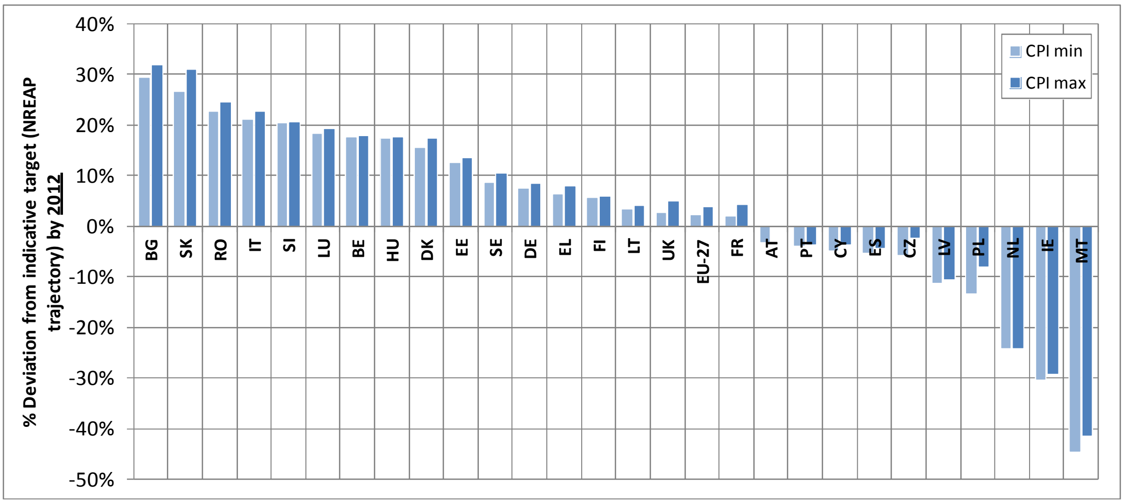


Figure 36. Deviation of expected RES Shares (Green-X scenarios) from indicative (NREAP) target by 2012.

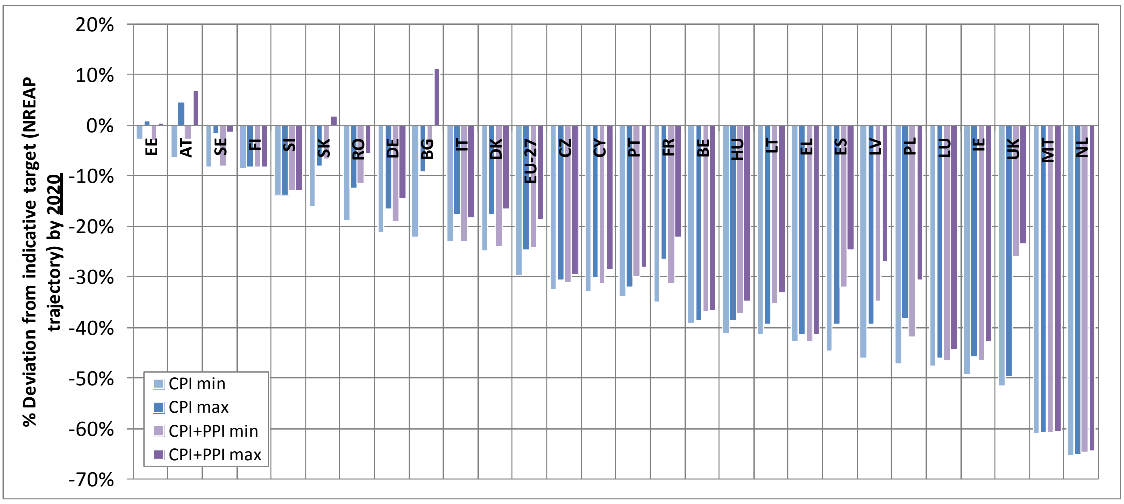


Figure 37. Deviation of expected RES Shares (Green-X scenarios) from indicative (NREAP) target by 2020.

Most of the countries will exceed their NREAP 2012 target. At EU level a surplus of 2.3% to 3.9% can be expected. On the one hand, with deviations above 20% most significant surpluses occur in Bulgaria, Slovakia, Romania, Italy and Slovenia. On the other hand, a few countries face already in 2012 a high gap compared to their planned deployment. Expected RES deployment is significantly lower compared to the targeted one in Malta, Ireland and the Netherlands.

The picture changes for the worse until 2020. Only very few countries are expected to meet their plans by 2020, and only if complementary energy efficiency measures are implemented successfully. Estonia and Austria are top on that list if only currently implemented policies are taken into consideration, and also Sweden can be grouped under that since the according to Green-X modeling expected gap of 1.5% is well within the default uncertainty range. Slovakia and Bulgaria need to be added if also planned initiatives are taken into account. At EU level a significant gap occurs, ranging from 30% (CPI with high demand (growth)) to 19% (CPI+PPI with low demand). A negative ranking, sorting countries according to their gap to their planned deployment in 2020, lists the Netherlands and Malta on top (with a gap higher than 60%), followed by the UK, Ireland, Luxembourg, Poland, Latvia, Spain, Greece, Lithuania and Hungary (all showing a gap higher than 40%). For several of these countries the ranking changes if planned policy initiatives are taken into account. Most significant improvements can then be expected for the UK, Latvia, Spain and Poland.

Technology overview

Complementary to above, technology insights are discussed next. More precisely, Table 15 gives for each RES technology an overview on the expected and planned deployment at EU level by 2012 and by 2020. Moreover, also aggregates (by sector and for RES in total) as well as deviations (i.e. comparing expected and planned deployment) are indicated. Note that for 2020 a range is indicated with respect to RES deployment which stems from the sensitivity assessment related to energy demand and, consequently, the different scenarios calculated on future RES deployment under distinct demand projections (i.e. the "business-as-usual" and the "energy efficiency" scenario of future energy demand as expressed in the NREAPs).[6]

For 2012 a positive trend can be observed, where expected progress is above the planned one. The need for improvements in order to achieve planned 2020 targets is however becoming apparent. Of interest, the situation differs by sector and also by technology. While in the short term (2012) the heat sector appears most advanced among all energy sectors, scenarios show that in order to meet the 2020 NREAP targets significant improvements in the related policy framework are of need.[7] At technology level within the heat sector, heat pumps, solar thermal collectors as well as mid- to large-scale geothermal heating systems may most urgently require additional initiatives in order to let them play their role in meeting the 2020 RES obligations. The electricity sector shows a comparatively similar gap than RES-H&C by 2020, ranging from 16% to 26%. At technology level the need for improvements is highest for CSP and ocean technologies (incl. tidal stream and wave power), but most important for achieving RES targets appears to improve support and in particular

[6] In contrast to RES deployment in relative terms (i.e. the RES shares in demand) RES deployment in absolute terms (i.e. produced GWh of electricity, heat or transport fuels that stem from RES) is less affected from applying different demand projections and, consequently, the resulting ranges (i.e. min(imum) and max(imum) values of RES deployment) are of smaller magnitude.

[7] A comparison of expected and planned deployment indicates a gap ranging from 15 to 19% for RES in heating and cooling.

framework conditions for wind energy. Additional initiatives are required also for biofuels where deviations appear highest compared to the other sectors. In practice however this may only require an increase of the blending obligations in several countries.

Table 15. Expected and planned technology-specific RES deployment at EU level by 2012 and by 2020.

Technology-specific RES deployment at EU level	Status Quo 2010	Expected deployment 2012 (CPI scenario)	NREAP indicative target 2012	Expected deployment 2020 (CPI scenario)		Expected deployment 2020 (CPI+PPI scenario)		NREAP indicative target 2020	Deviation of expected from planned deployment		
				Min.	Max.	Min.	Max.		2012	2020 Min.	2020 Max.
Technology category	[Mtoe]	[Mtoe]	[Mtoe]	[Mtoe]	[Mtoe]	[Mtoe]	[Mtoe]		[%]	[%]	[%]
RES electricity	**56.2**	**62.5**	**64.3**	**77.3**	**77.9**	**87.1**	**87.9**	**104.5**	-2.8%	-26.1%	-15.9%
Biomass (solid and liquid)	8.53	9.60	8.73	12.04	12.15	14.24	14.53	14.45	9.9%	-16.7%	0.6%
Biogas	2.10	2.53	2.92	4.68	4.68	5.20	5.24	5.50	-13.3%	-15.0%	-4.8%
Geothermal	0.48	0.51	0.55	0.79	0.79	0.87	1.00	0.94	-6.9%	-15.5%	6.7%
Hydro large-scale	25.96	26.15	25.87	26.80	26.90	26.84	26.95	27.12	1.1%	-1.2%	-0.6%
Hydro small-scale	3.83	3.91	4.14	4.57	4.59	4.64	4.67	4.66	-5.5%	-1.9%	0.1%
Photovoltaics	1.94	3.01	3.00	6.82	6.82	6.97	6.98	7.17	0.2%	-4.9%	-2.7%
Concentrated solar power	0.06	0.08	0.40	0.12	0.12	0.73	0.74	1.72	-79.8%	-92.9%	-56.8%
Wind onshore	12.76	15.89	17.05	17.55	17.91	18.28	18.47	30.45	-6.8%	-42.4%	-39.3%
Wind offshore	0.53	0.81	1.61	3.66	3.66	9.09	9.10	12.00	-49.8%	-69.5%	-24.1%
Tidal/Wave/Ocean	0.04	0.04	0.05	0.23	0.24	0.18	0.20	0.52	-14.2%	-64.7%	-54.4%
RES heating & cooling	**80.6**	**81.0**	**70.6**	**84.3**	**84.6**	**88.1**	**88.9**	**104.7**	14.7%	-19.5%	-15.1%
Biomass (solid and liquid)	72.24	72.18	60.86	74.78	75.12	77.14	77.92	81.56	18.6%	-8.3%	-4.5%
Biogas	2.01	2.32	1.87	2.75	2.75	3.00	3.03	4.45	24.0%	-38.1%	-31.9%
Geothermal	0.53	0.59	0.86	1.13	1.13	1.32	1.32	2.55	-32.1%	-55.5%	-48.4%
Heat pumps	4.30	4.24	5.12	2.87	2.88	3.15	3.17	9.88	-17.2%	-70.9%	-67.9%
Solar Thermal	1.49	1.67	1.91	2.73	2.73	3.47	3.47	6.28	-12.2%	-56.6%	-44.7%
RES transport (biofuels only)	**13.6**	**15.0**	**16.2**	**18.9**	**20.6**	**19.1**	**20.8**	**28.9**	-7.8%	-34.8%	-28.0%
First generation biofuels	13.57	14.97	15.36	16.71	18.41	16.91	18.64	26.43	-2.6%	-36.8%	-29.5%
Second generation biofuels	0.00	0.00	0.88	2.16	2.18	2.16	2.18	2.50	-100.0%	-13.7%	-12.7%
RES total	**150.4**	**158.5**	**151.2**	**180.4**	**183.1**	**194.2**	**197.6**	**238.2**	4.8%	-24.3%	-17.0%

Projected future progress in RES-E

RES-E sector overview

(1) Overview of expected deployment vs. indicative (NREAP) target for 2012 and by 2020.

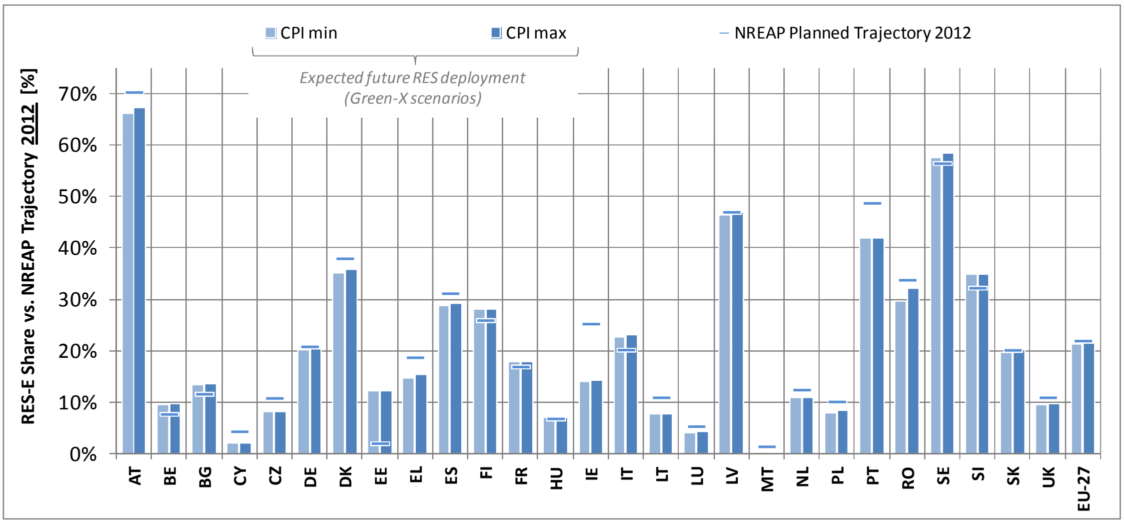


Figure 38. Expected RES-E Share in 2012 vs. 2012 indicative (NREAP) target (%).

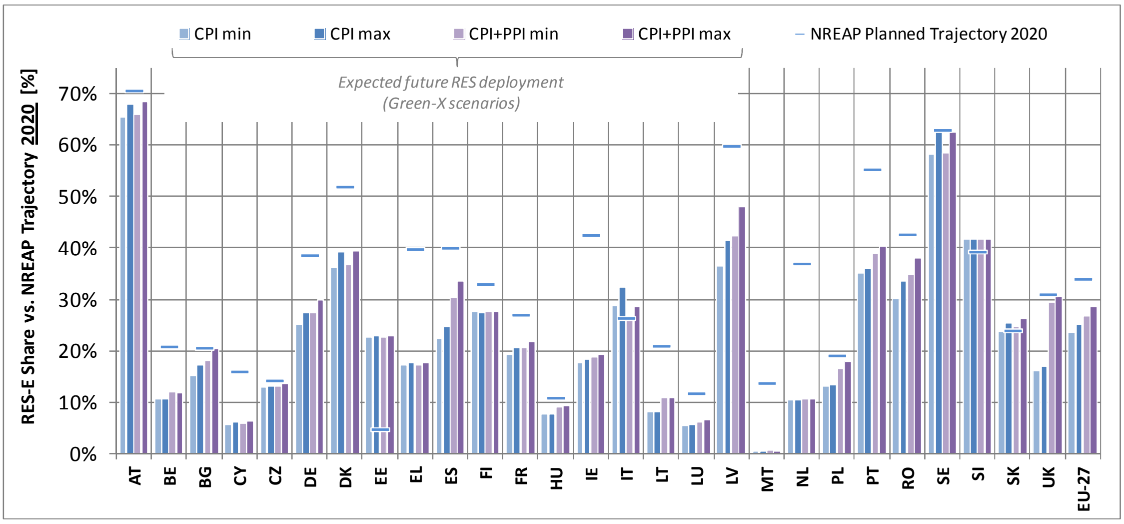


Figure 39. Expected RES-E Share in 2020 vs. 2020 indicative (NREAP) target (%).

The expected (according to Green-X scenarios) and the planned (i.e. the indicative NREAP targets) short-term (2012) progress of RES in the electricity sector is compared in Figure 38, showing RES-E deployment in relative terms, that is the RES-

E share in gross electricity demand. The corresponding depiction for 2020 is given in Figure 39.

Complementary to these graphs (above) subsequent figures illustrate the deviation of expected RES-E deployment from the indicatively targeted one (i.e. the planned progress as prescribed in the MS's NREAPs). More precisely, for 2012 Figure 40 indicates the deviation under business-as-usual conditions, taking into account only currently implemented policy initiatives. The complementary depiction for 2020 is provided in Figure 41, whereby also planned improvements are taken into consideration. In both figures uncertainty related to the development of future energy demand is reflected, illustrating lower (i.e. CPI min, CPI+PPI min) and upper levels (CPI max, CPI+PPI max) of expected RES-E shares in gross electricity consumption.

In the short-term, i.e. by 2012, nine out of 27 countries will be able to meet (and over-succeed) their RES-E deployment target. Top on that list is Estonia, followed by Belgium, Bulgaria, Italy, Finland, Slovenia, France, Hungary and Sweden. At EU-level an insignificant deficit occurs, ranging from 2% to 3%, depending on demand trends. Seven countries (e.g. Latvia, Slovakia, Germany, Austria, Denmark, Spain and Romania) show a comparatively small to moderate gap compared to their planned target (below a 10% threshold) and the remaining 11 countries can be classified as not successful in planning their short term progress with respect to renewable electricity. Top on that list (of negative ranking) is Malta, Cyprus and Ireland, followed by the Czech Republic, Poland, Luxembourg and Greece.

No surprise, the situation will generally not improve until 2020. The gap to the (indicatively) targeted RES-E deployment will rise to 26%-30% with currently implemented policy initiatives. If planned measures are also taken into consideration the gap can be reduced, ranging from 16% to21%. Four countries are expected to achieve more than targeted, whereby the strongest surplus will arise in Estonia, followed by Italy, Slovenia and Slovakia. Sweden, Austria and the Czech Republic are countries facing a small deficit that is with a deviation below a 10% threshold. Top on the list of countries that are expected to fail in delivering their planned deployment stands Malta, followed by the Netherlands, Cyprus, Lithuania, Ireland, Greece, Luxembourg, Belgium, the UK and Spain, all referring to a continuation of current trends (CPI scenario). The situation will improve strongly in several countries (e.g. Spain, the UK, Luxembourg, Lithuania) if planned RES policy initiatives are also taken into consideration.

(2) Deviation from 2012 and 2020 NREAP targets

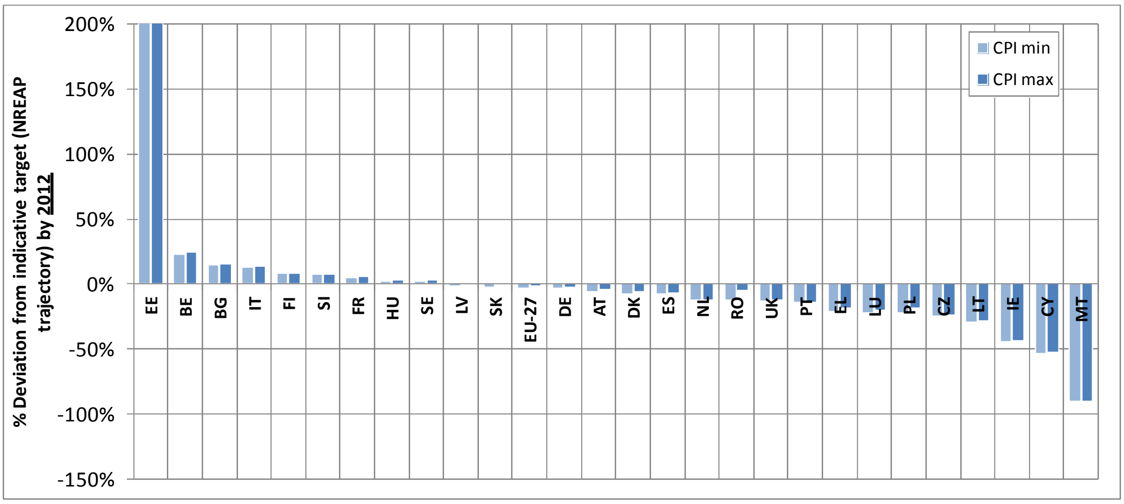


Figure 40. Deviation of expected RES-E Shares (Green-X scenarios) from indicative (NREAP) target by 2012.

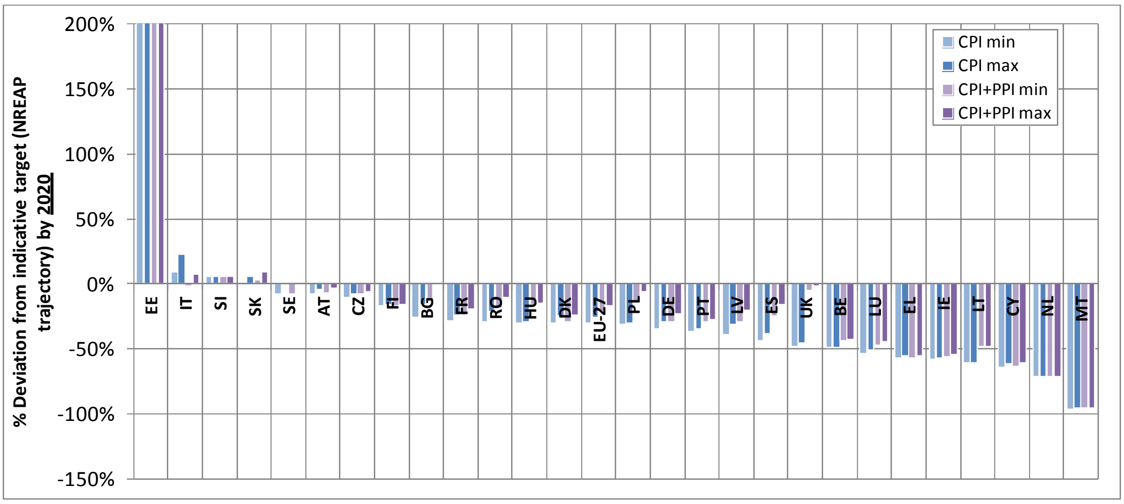


Figure 41. Deviation of expected RES-E Shares (Green-X scenarios) from indicative (NREAP) target by 2020.

Biomass electricity

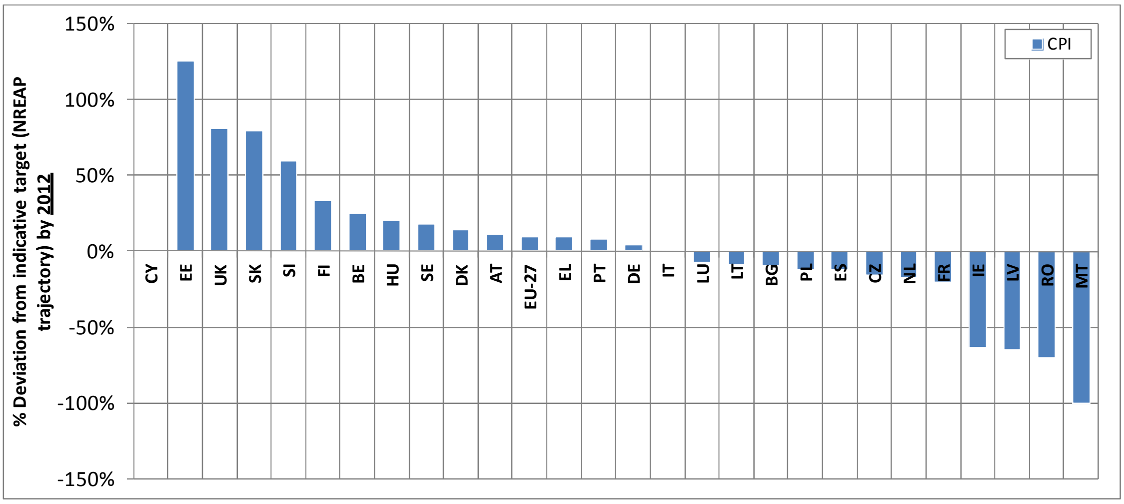


Figure 42. Deviation of expected deployment of biomass electricity (Green-X scenarios) from indicative (NREAP) target by 2012.

With respect to electricity production from solid and liquid biomass, Figure 42 highlights the deviations from the actually planned progress to the expected development according to the scenario for the year 2012 on MS level. Across MSs a broad deviation of plus/minus 100% occurs, whereas on EU level a slight overachievement of 9.9% is observed. However, countries showing the highest contribution of electricity generation form biomass in absolute terms, like the United Kingdom, Finland, Sweden and Germany are expected to perform very well on track. Generally, with the exception of Estonia, Slovenia and Hungary the new MSs of the European Union rather fail to meet their projections for the year 2012, compare for example Latvia and Romania.

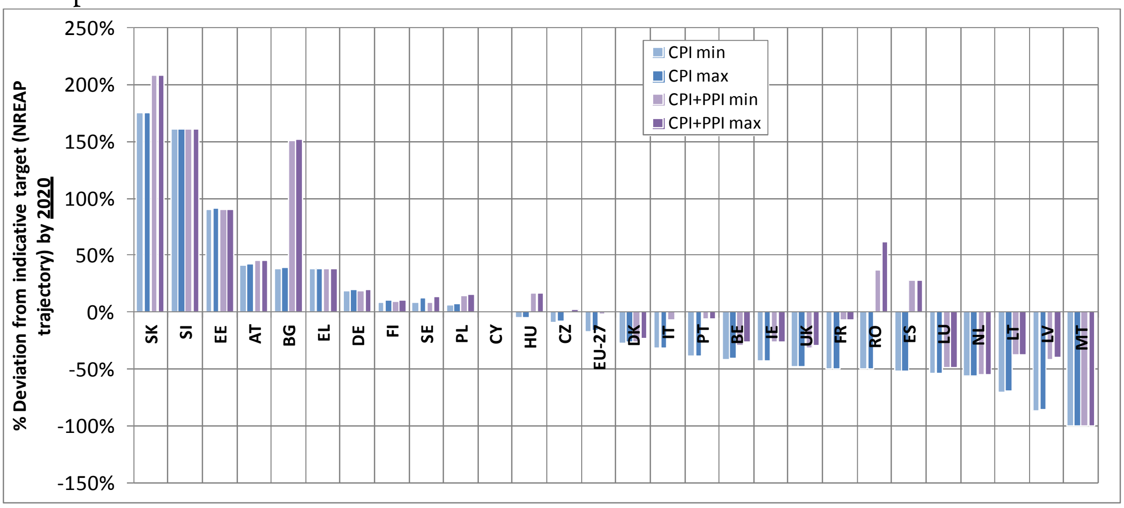


Figure 43. Deviation of expected deployment of biomass electricity (Green-X scenarios) from indicative (NREAP) target by 2020.

A different situation is expected for the time period until 2020. An overview on the impact of currently implemented and additionally planned policy initiatives on biomass deployment by MS in 2020 is given in Figure 43. With currently implemented support policies (CPI scenarios) the EU would fail the planned target by 15.9% (high demand) respectively 16.7% (low demand). Planned policy initiatives (CPI+PPI) improve the situation significantly. Thus, they would exactly compensate the policy gap and therefore help to meet the planned trajectory on EU level. Nevertheless, significant deviations are expected to occur on MS level. Especially, the United Kingdom which is likely to strongly over-perform in 2012 is expected to fail in meeting its trajectory in 2020 under all circumstances. Other important MSs like Finland, Sweden or Germany are still on track with its planned electricity production from solid and liquid biomass, but will only generate slight excess electricity. Romania and Spain react very sensitive to the demand expectations in 2020 in terms of exceeding or failing their trajectories.

Biogas electricity

In contrast to electricity production from solid and liquid biomass, biogas electricity production is expected to slightly underachieve the expectations for the year 2012, i.e. on EU-level by about 13%. A detailed overview on the deviations of the expected biogas electricity generation to the forecasted contribution on MS level is given in Figure 44 below. Among the largest three countries with respect to biogas electricity production in absolute terms, Germany is expected to overachieve its target whereas Italy and especially the United Kingdom will fail to meet its forecasted trajectory in 2012 by more than 80%. Additionally, a wide geographical spread appears with respect to the positive or negative deviation from the domestic trajectories of electricity generation from biogas.

Prolonging the time frame to the year 2020 results in a significant different situation, see Figure 45 below. Apart from Sweden, Austria, the United Kingdom and Germany all Member States will fail to meet their domestic projections of electricity production from biogas by 2020. Nevertheless, the latter are the MSs contributing most to the European electricity generation from biogas which compensates large parts from the lack in all other MSs. Hardly any difference is expected between the two demand scenarios whereas a slight difference occurs with respect to the implemented support policies. Apparently, additional policy initiatives as planned by the MSs would allow for an additional electricity generation from biogas by 9.5% and would contribute to meeting the deployment target at EU level.

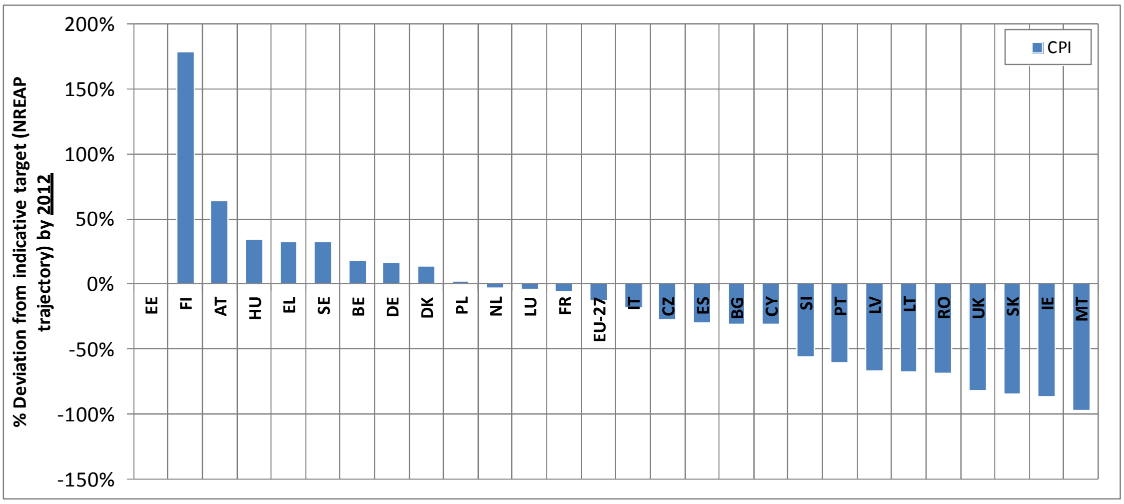


Figure 44. Deviation of expected deployment of biogas electricity (Green-X scenarios) from indicative (NREAP) target by 2012.

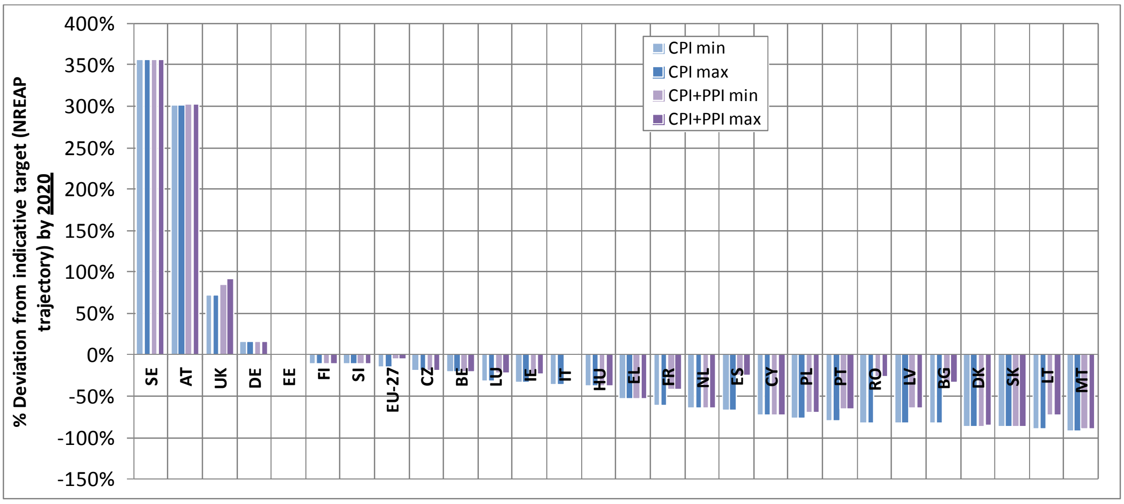


Figure 45. Deviation of expected deployment of biogas electricity (Green-X scenarios) from indicative (NREAP) target by 2020.

Large hydro

The category large hydro refers to installations of more than 10 MW. Large hydro is the most mature RES-E technology, with the major share of potentials already being exploited in most Member States. Thus, the scale of deviations between planned and actually generated electricity form large-scale hydro power, indicated in Figure 46, is relatively small compared to previous RES-E technologies. However, several countries, like Czech Republic and Germany are expected to overachieve their domestic forecasts in 2012 whereas the United Kingdom or the Netherlands will not meet their deployment targets in the year 2012. On EU level a very moderate overachievement of 1.1% is expected for 2012.

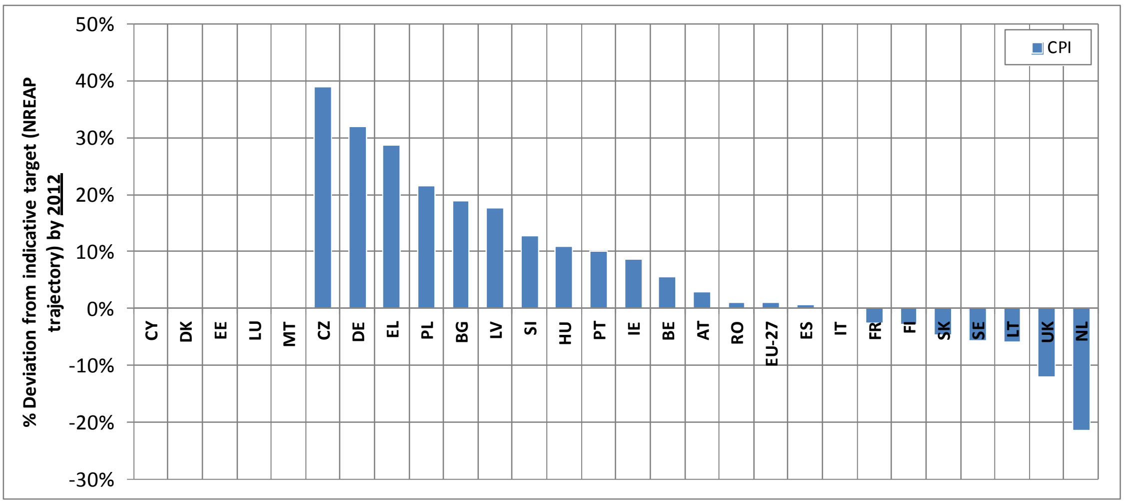


Figure 46. Deviation of expected deployment of large hydro (Green-X scenarios) from indicative (NREAP) target by 2012.

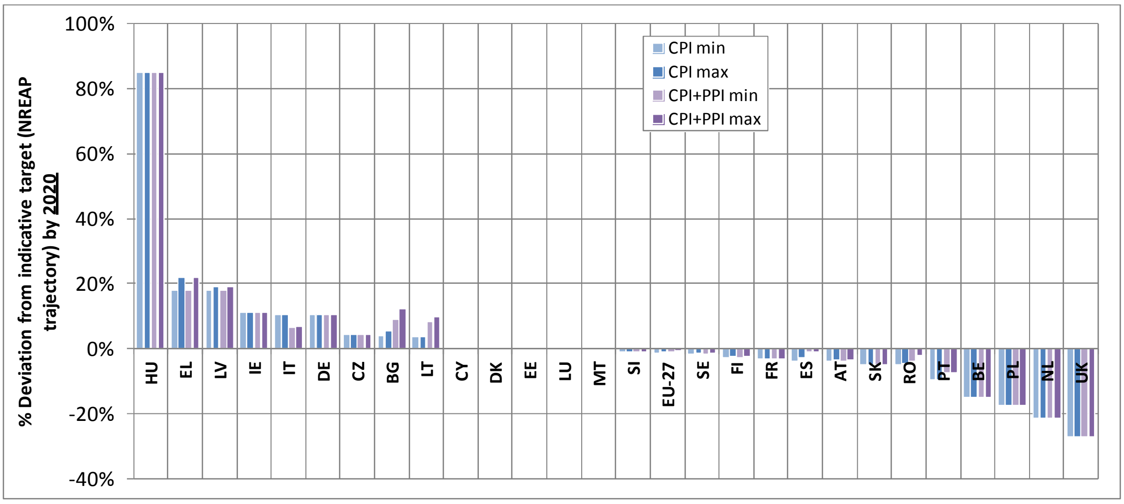


Figure 47. Deviation of expected deployment of large hydro (Green-X scenarios) from indicative (NREAP) target by 2020.

In the time frame up to 2020 a significant change is only observed for a few Member States. On the one hand, mainly Hungary is expected to increase its electricity generation from large-scale hydropower plants by 85.1% regardless the demand forecasts and regardless the support measures implemented. On the other hand, the United Kingdom and the Netherlands are expected to result in a more than 20% underachievement according to the scenarios. All other MSs will show only moderate deviations to their domestic projections of hydropower generation in 2020, being within the 20% interval. On EU level an insignificant underachievement of even below 1% is expected in 2020 within all scenarios. Generally, Figure 47 depicts only marginal sensitivities to demand forecasts and to implemented policy initiatives for electricity generation from large hydropower plants across all 27 MSs.

Small hydro

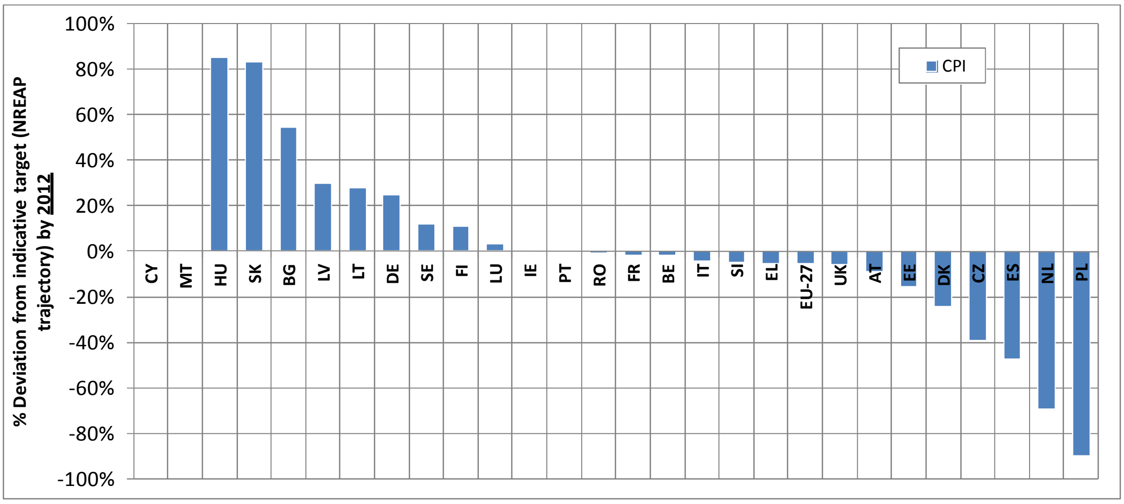


Figure 48. Deviation of expected deployment of small hydro (Green-X scenarios) from indicative (NREAP) target by 2012.

Observing the electricity production of the technology sector of small hydropower in Figure 48, it can be seen that in the short-term by 2012 a relatively small number of six MSs miss their indicative target by more than 10%. On top of the negative ranking is Poland, followed by the Netherlands, Spain, the Czech Republic, Denmark, and Estonia. Eight countries overfull fill their target significantly (more than 10%). The overall EU target for 2012 is missed by 5.5%.

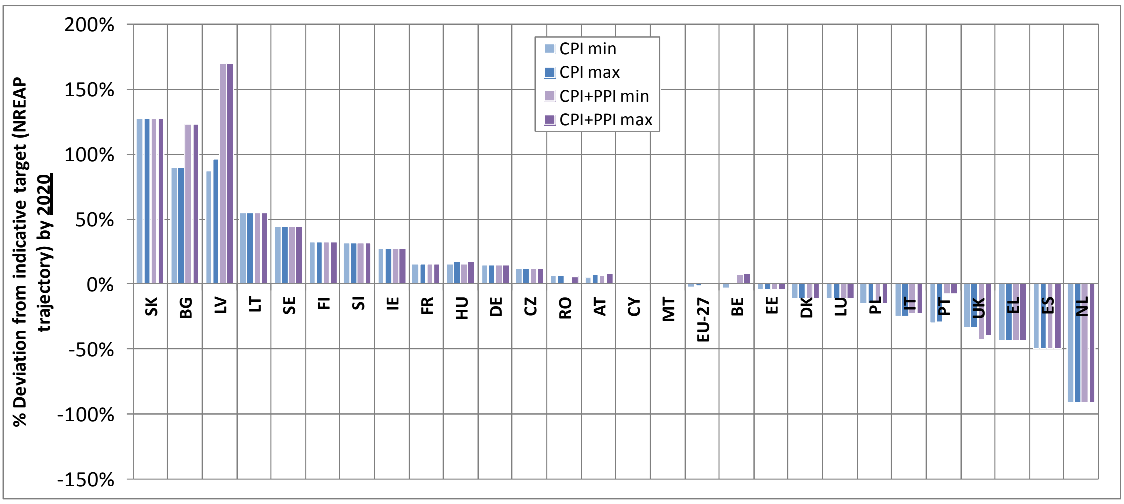


Figure 49. Deviation of expected deployment of small hydro (Green-X scenarios) from indicative (NREAP) target by 2020.

Until 2020 the EU target within the small hydro power sector is projected to be fulfilled with a deviation of 0.2% to -1.9% depending on the select scenario (Figure 49). This is an indicator for the technology to be quite well integrated in the actual electricity market as a proven technology. Significant differences between the CPI and the CPI+PPI scenarios are solitary noteworthy in Latvia and Bulgaria, which are fairly positive contributors in all cases. Additionally Belgium is expected to fulfil its indicative target in the CPI+PPI cases by 2020, and Portugal reduces its relatively large under achievement from -30% to -9%.

Onshore wind

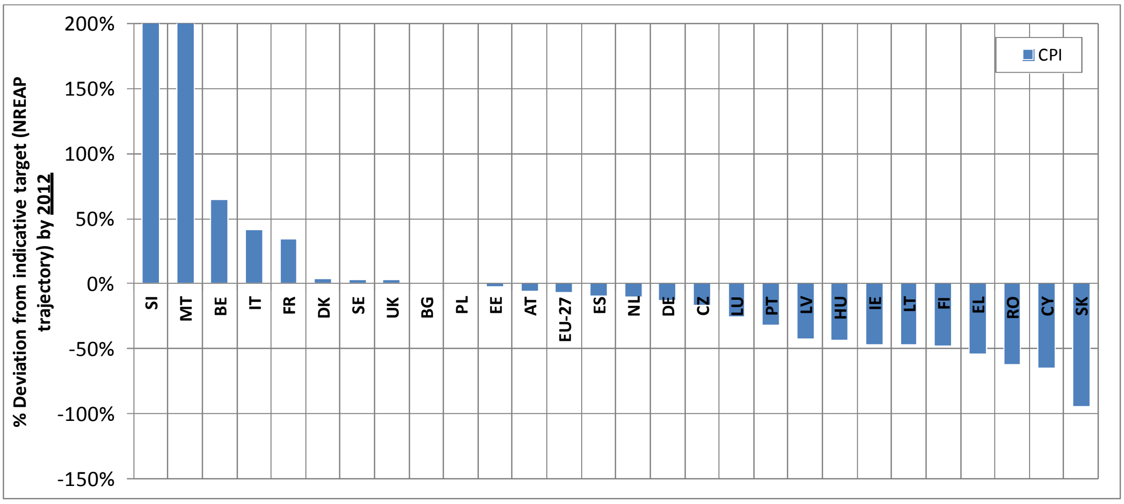


Figure 50. Deviation of expected deployment of onshore wind (Green-X scenarios) from indicative (NREAP) target by 2012.

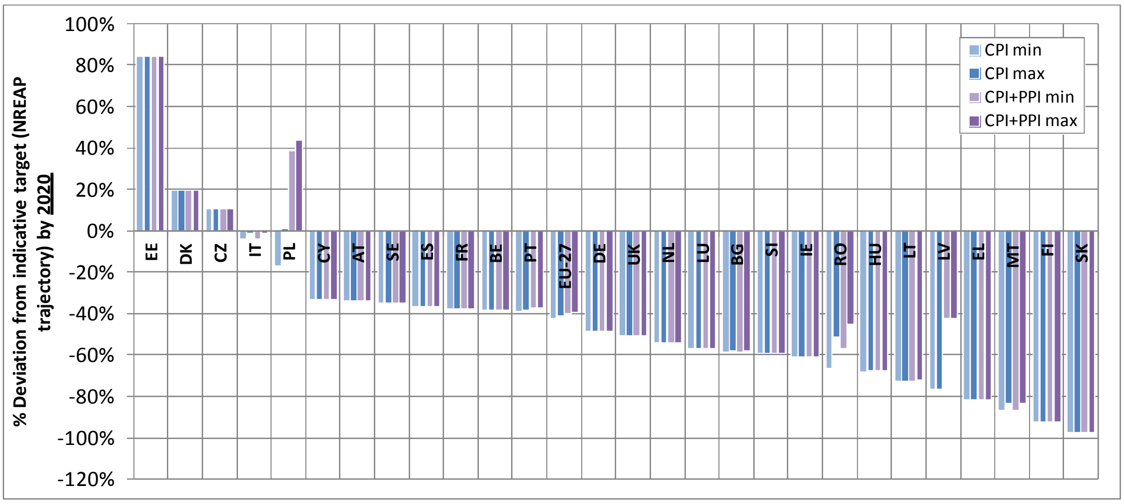


Figure 51. Deviation of expected deployment of onshore wind (Green-X scenarios) from indicative (NREAP) target by 2020.

In the technology sector of wind onshore electricity generation ten MSs achieve their indicative short-term target by 2012 (see Figure 50). The biggest overachievers are Slovenia, Malta, Belgium, Italy, and France. The overall EU target is missed by approximately 7%, because of 17 Member States failing to achieve their planned deployment trajectories.

The situation worsens in all assessed scenarios until 2020 (see Figure 51). The EU target is by then underachieved by -39% to -42%. Only three MSs over-fulfil their target significantly in all CPI and CPI+PPI cases – these are Estonia, Denmark, and the Czech Republic. Italy should by then meet their target exactly, as Bulgaria does in the CPI max case. In the CPI+PPI scenarios Bulgaria joins the countries that are expected to over-fulfil their expressed plans. All other EU MSs under-achieve their indicative target by 2020 significantly (from -33% to -97%). This indicates among others that onshore wind demands improvements related to support as well as to market integration.

Offshore wind

The offshore wind sector may still be classified as new technology sector in this assessment. Only eight EU MSs planned to implement this technology by 2012, compare Figure 52. For 2012 a significant gap (50%) to the planned target is becoming apparent at EU level since oonly Sweden is expected to perform better than planned, overachieving its indicative target by 179%. All other seven MSs are expected to miss their indicated targets.

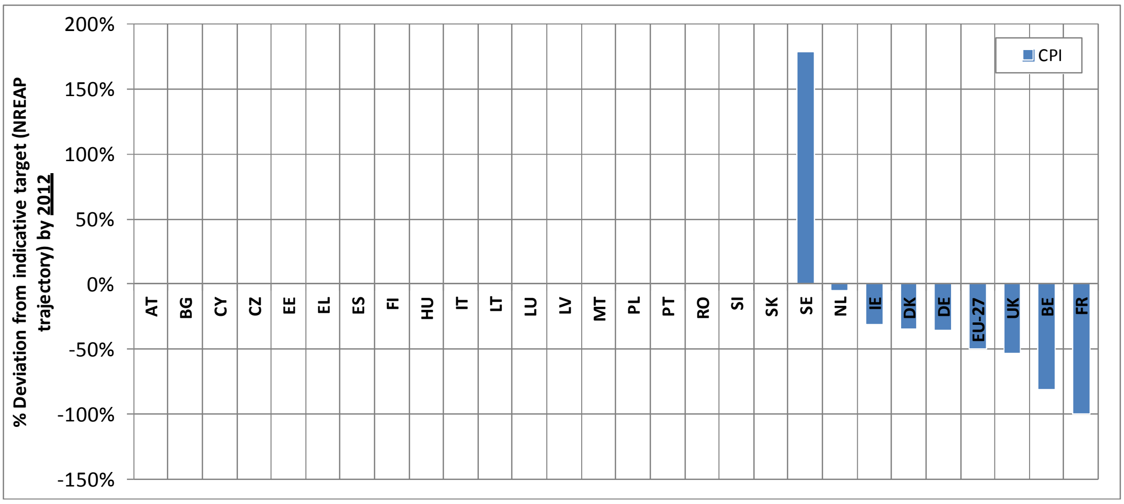


Figure 52. Deviation of expected deployment of offshore wind (Green-X scenarios) from indicative (NREAP) target by 2012.

Also for 2020 Figure 53 shows deficiencies in the CPI and CPI+PPI scenarios regarding the possible market penetration at EU level. But there is hope that planned policy initiatives, assessed with the CPI+PPI scenarios, may contribute to mitigate several of above mentioned deficits. The overall EU target by 2020 is missed by 70% in the CPI cases, while this gap is reduced to 24% in the CPI+PPI cases. Sweden is once again the model pupil in this technology sector, with a projected surplus of 56% in all scenarios by 2020.

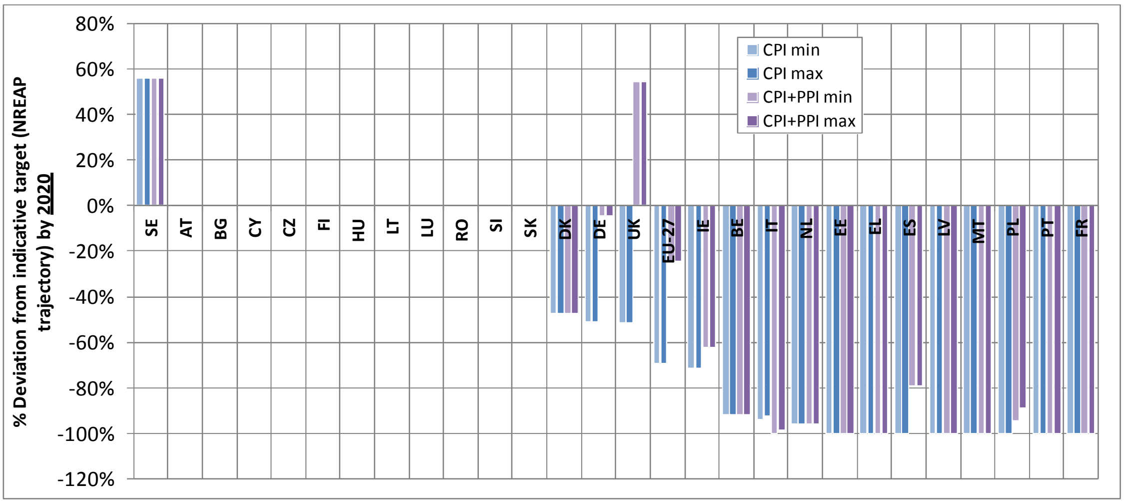


Figure 53. Deviation of expected deployment of offshore wind (Green-X scenarios) from indicative (NREAP) target by 2020.

Photovoltaics

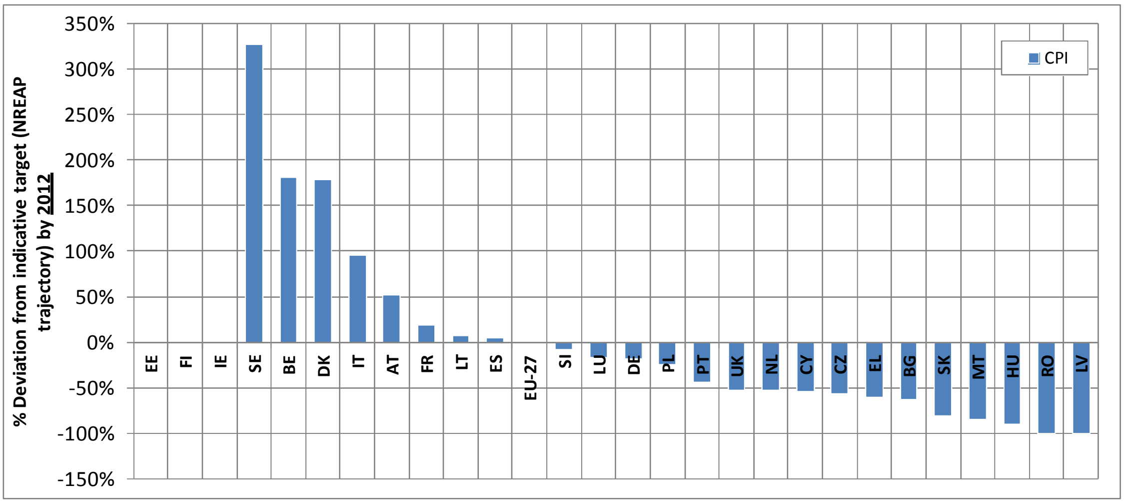


Figure 54. Deviation of expected deployment of photovoltaics (Green-X scenarios) from indicative (NREAP) target by 2012.

In the PV sector the EU target is exactly met in the short term by 2012 (Figure 54) and in the mid-term by 2020 in all scenarios (Figure 55). Noteworthy are the CPI+PPI scenarios, which show substantial differences to the CPI scenarios in some Member States, which plan to implement additional policies to improve market dissemination. By 2020 the deviation from the indicative target in Poland changes from a strong deficit to a significant surplus.

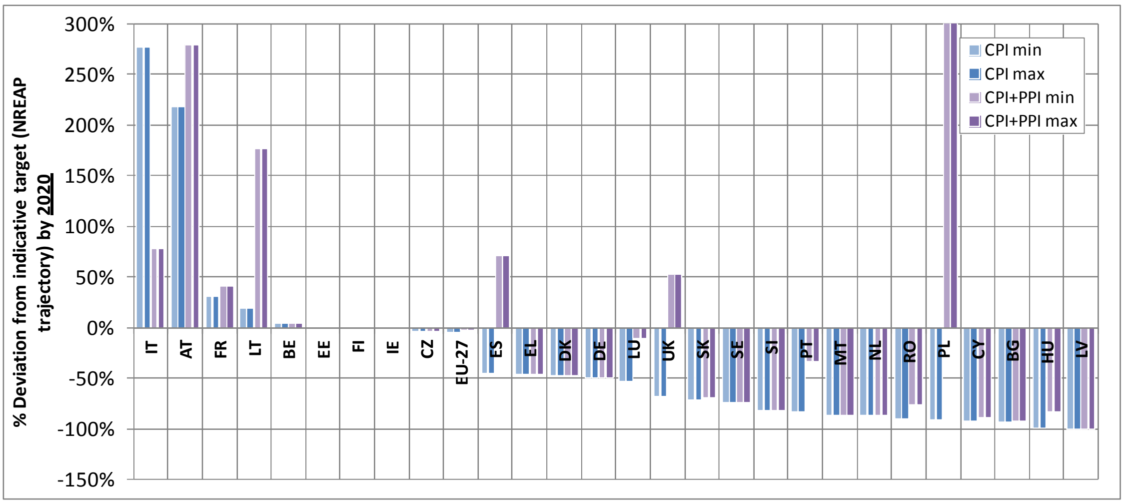


Figure 55. Deviation of expected deployment of photovoltaics (Green-X scenarios) from indicative (NREAP) target by 2020.

Projected future progress in RES-H&C

RES-H&C sector overview

(1) Overview of expected deployment vs. indicative (NREAP) target for 2012 and by 2020

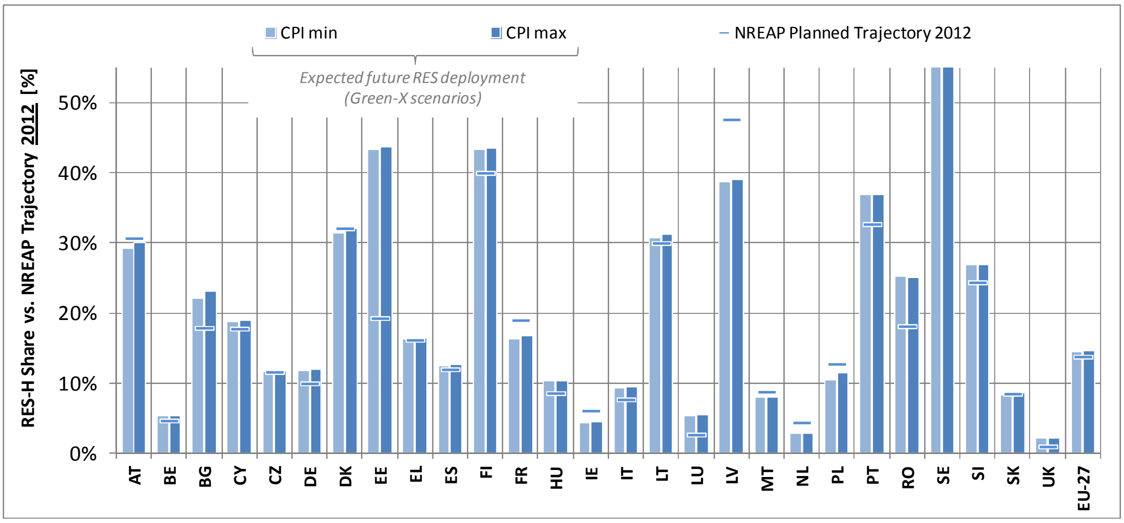


Figure 56. Expected RES-H Share in 2012 vs. 2012 indicative (NREAP) target (%).

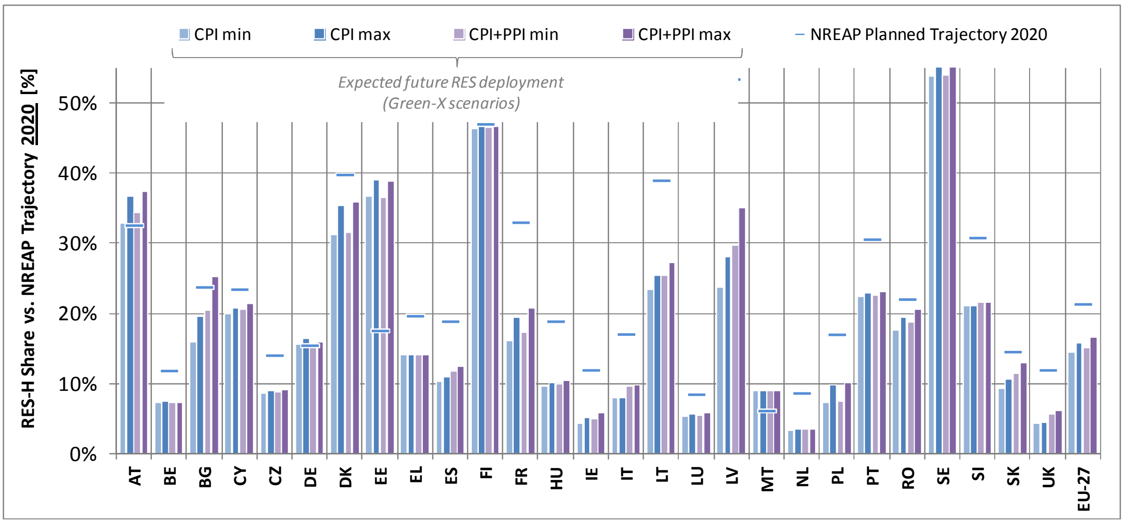


Figure 57. Expected RES-H Share in 2020 vs. 2020 indicative (NREAP) target (%).

Figure 56 shows a comparison of the expected (according to Green-X scenarios) and the planned (i.e. the indicative NREAP targets) short-term (2012) progress with respect to RES in the sector of heating and cooling. This depiction is done in relative terms, expressing the RES-H share in gross heat demand. The corresponding depiction for 2020 is provided in Figure 41.

(2) Deviation from 2012 and 2020 NREAP targets

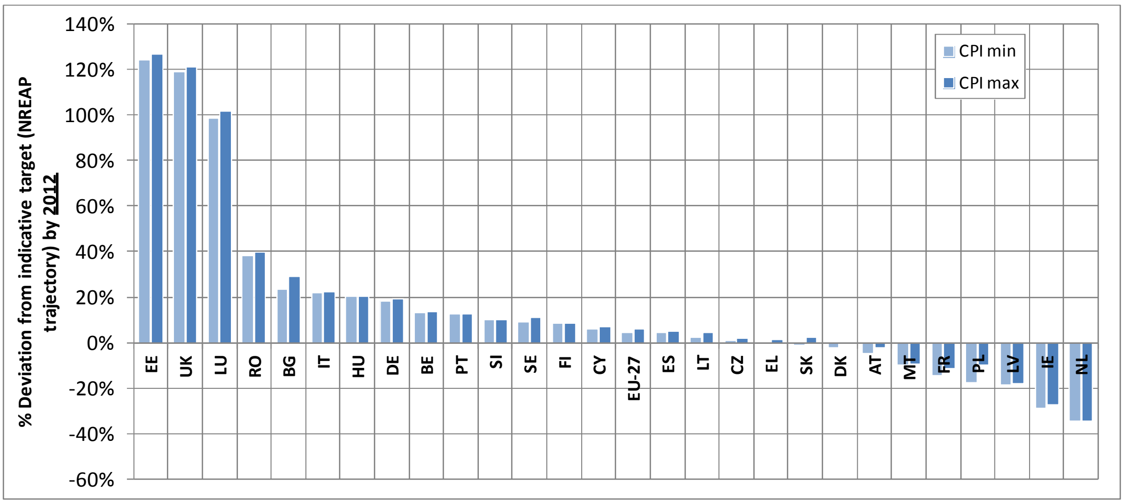


Figure 58. Deviation of expected RES-H Shares (Green-X scenarios) from indicative (NREAP) target by 2012.

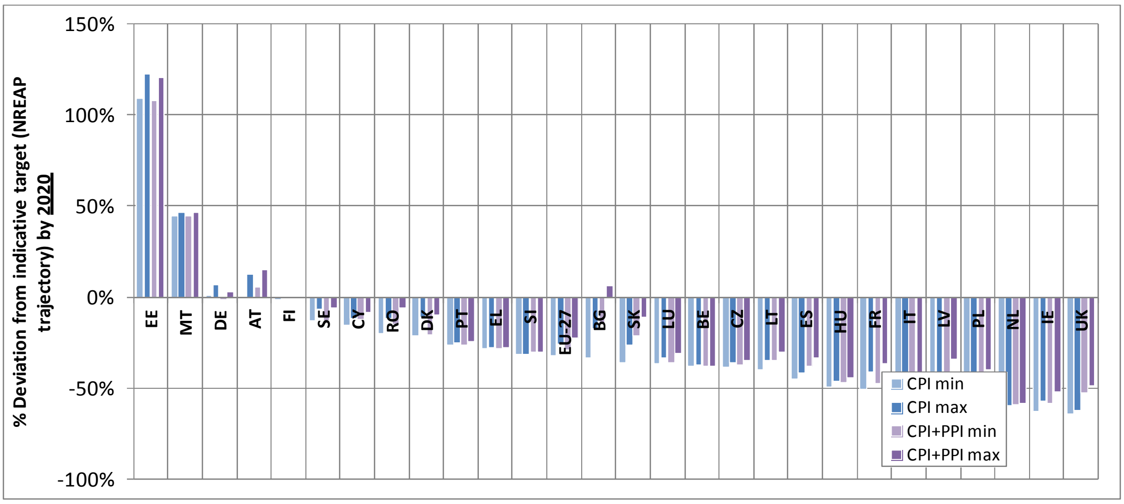


Figure 59. Deviation of expected RES-H Shares (Green-X scenarios) from indicative (NREAP) target by 2020.

Complementary to above Figure 58 and Figure 59 indicate the deviation of expected RES-H deployment from the planned one (i.e. the indicative targets as described in the MS's NREAPs). Figure 58 shows the deviation under business-as-usual conditions, taking into account only currently implemented policy initiatives (CPI case). Figure 59 provides the complementary depiction for 2020, whereby also planned improvements are taken into consideration. In both figures uncertainty related to the development of future energy demand is reflected, illustrating lower (i.e. CPI min, CPI+PPI min) and upper levels (CPI max, CPI+PPI max) of expected RES-H shares in gross heat consumption.

By 2012 the majority of countries will be able to meet (and over-succeed) their planned deployment target for RES-H. Similar to RES-E, top on that list stands Estonia, indicating the pessimism used in setting out plans for future RES deployment while drafting the NREAP. Other countries that significantly over-fulfil their plans (i.e. with a deviation higher than 20%) are the UK, Luxembourg, Romania, Bulgaria, Italy and Hungary. A long list of countries (incl. Germany, Belgium, Czech Republic etc.) were successful in defining realistic short-term targets for RES-H, where deviations between expected and planned deployment are (significantly) smaller than 20%. At EU-level an surplus occurs, ranging from 4% to 6%, depending on demand trends. Six countries (e.g. Denmark, Austria, Malta, France, Poland and Latvia) show a comparatively small to moderate gap compared to their planned target (below a 20% threshold) and the remaining two countries, that is Ireland and the Netherlands, can be classified as not successful in planning their short term progress with respect to renewable heating and cooling.

Similar to other sectors or technologies, the situation will become worse until 2020. The gap to the planned RES-H deployment will rise to 26%-32% with currently implemented policy initiatives. If planned measures as described in the progress reports are also taken into account the gap can be reduced, now ranging from 23% to 29%. According to Green-X scenario four countries are expected to end up with a higher deployment of RES-H in 2020 than planned, whereby the strongest surplus will arise, no surprise, in Estonia, followed by Malta, Germany and Austria. Finland, Sweden, Cyprus, Romania and Denmark are countries facing a comparatively small to moderate deficit that is with a deviation below a 12% threshold. Top on the list of countries that are expected to fail in delivering what is planned are the UK, Ireland, the Netherlands, Poland, Latvia and Italy – with a gap higher than 50% under business-as-usual conditions. Strong to moderate deficits are expected for a long list of countries, including France, Hungary, Spain, Lithuania, the Czech Republic, Belgium, etc… The situation will improve strongly in several countries (e.g. the UK, Ireland, Poland, Latvia, Bulgaria, Romania, or France) if planned policy initiatives, in particular those dedicated to RES-H&C, are also taken into consideration.

Biomass heat

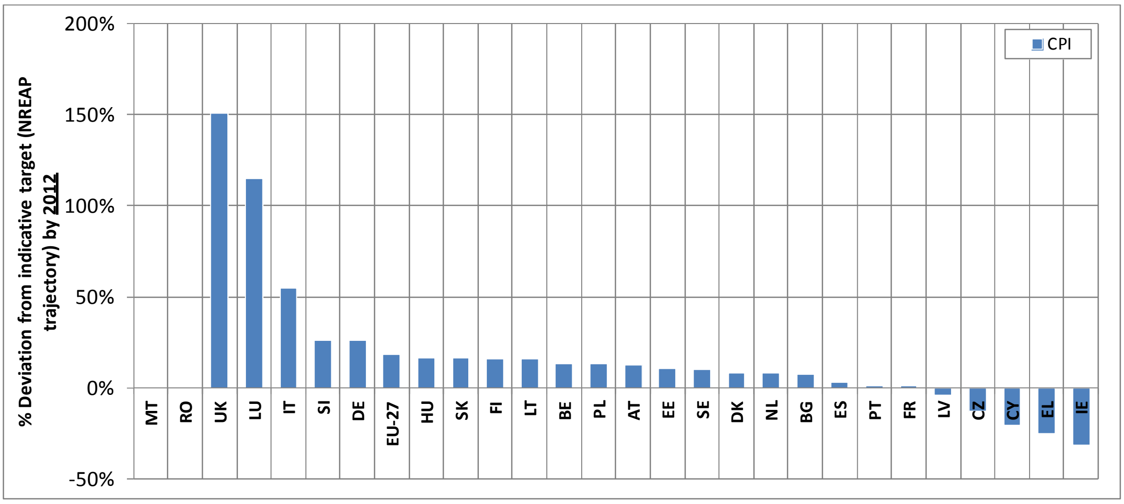


Figure 60. Deviation of expected deployment of biomass heat (Green-X scenarios) from indicative (NREAP) target by 2012.

The expected heat production from biomass is above the trajectory for the majority of Member States by 2012. The UK is the leading country and exceeds its planned 444 ktoe by far with an expected production of 1,112 ktoe. It is followed by Italy and Luxembourg which are expected to exceed their planned production rates by 1,450 ktoe and 28 ktoe (Luxembourg has generated 29 ktoe in 2010), respectively. These three countries are followed by a group of countries that slightly overshoot their targets and a number of countries, like Latvia, the Czech Republic, Cyprus, Greece and Ireland that fall short in meeting their targets for 2012.

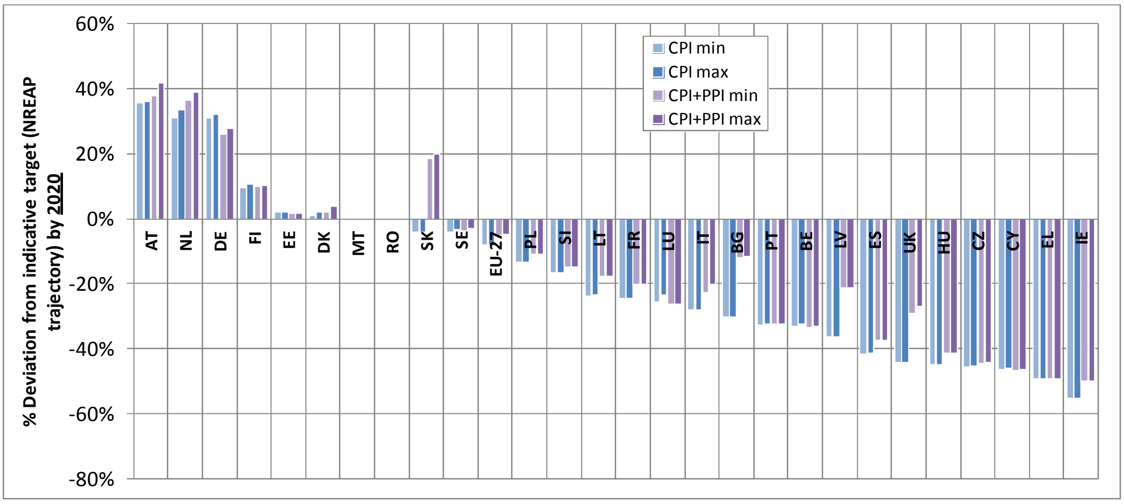


Figure 61. Deviation of expected deployment of biomass heat (Green-X scenarios) from indicative (NREAP) target by 2020.

A different picture is provided by the expected results for 2020. Besides Austria, the Netherlands, Germany, Finland, Estonia and Denmark all countries fail to meet their targets in nearly all scenarios. The overall target on EU level is not achieved within the scenarios carried out, although the implementation of planned policy measures reduces the overall gap from -8.2% to -4.8% by 2020. Especially in Slovakia, Bulgaria and the UK the planned policy initiatives are expected to show a great impact on the future heat generation from biomass. However, the countries Cyprus, the Czech Republic, Greece and Ireland are again on the bottom of the league.

Biogas Heat

Sweden had planned for 17.5 ktoe of biogas heat production in 2010 and is expected to reach 77.25 ktoe in 2012 and thus exceeds its indicative target for 2012 by 377%. It is followed by Austria and Bulgaria that also approximately overshoot their target by 200 per cent. Lithuania, Poland, Latvia and Malta already fail to achieve their indicative targets by 2012. Cyprus, Estonia, Greece, Romania and Slovenia hat not planned any biogas heat production in 2010, but all reported some small amounts in their progress reports. The EU in general will exceed its indicative trajectory by 24%.

The expected values in 2020 show that only Austria, Sweden, Belgium and with a certain probability also the UK will reach their indicative trajectories. Austria and Sweden are expected to strongly overshoot their 2020 targets with an absolute biogas heat generation of 169 ktoe and 30 ktoe, respectively. In the case of the UK, Italy and Bulgaria already planned policy measures are expected to lead to a significantly higher share of biogas heat generation by 2020. The overall EU target is not achieved within the considered scenarios and accounts for a gap of -38.1% in the CPI scenarios and ranges from -31.9 to -32.7% if planned policy measures are also implemented.

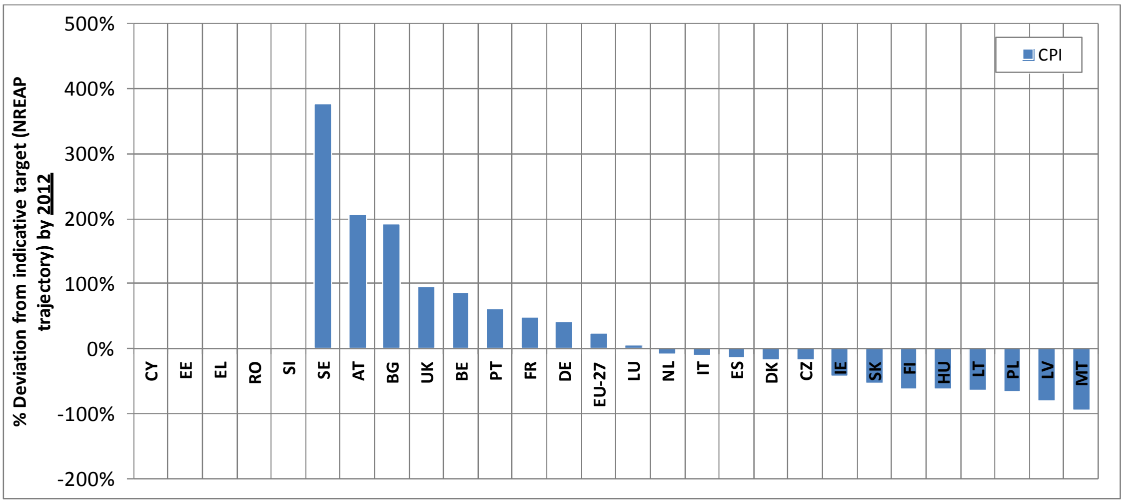


Figure 62. Deviation of expected deployment of biogas heat (Green-X scenarios) from indicative (NREAP) target by 2012.

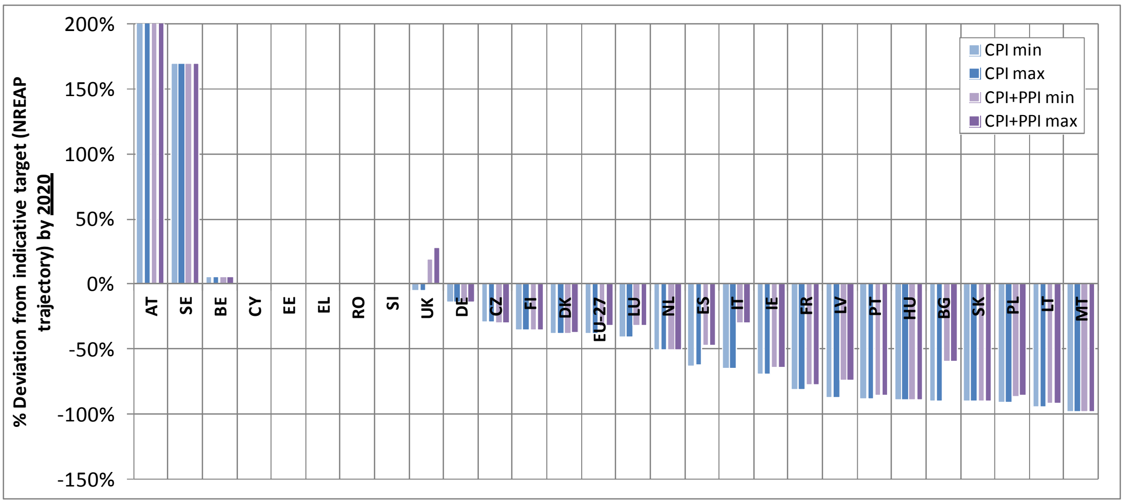


Figure 63. Deviation of expected deployment of biogas heat (Green-X scenarios) from indicative (NREAP) target by 2020.

Solar thermal heat

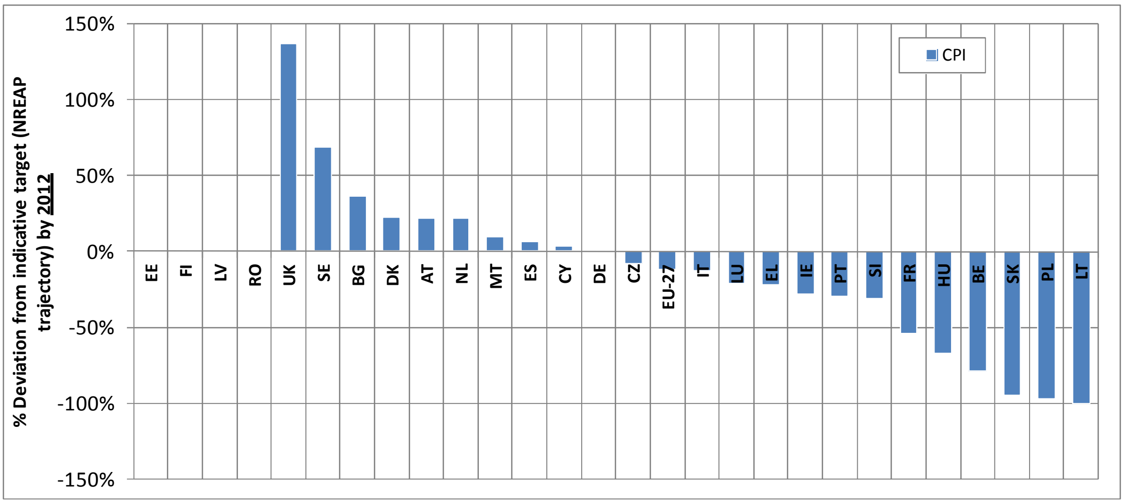


Figure 64. Deviation of expected deployment of solar thermal heat (Green-X scenarios) from indicative (NREAP) target by 2012.

Estonia, Finland, Lithuania, Latvia, and Romania neither planned nor realised any heat production from solar thermal installations by 2012. The UK shows the highest positive deviation with 80.6 ktoe expected compared to 34 ktoe planned in 2012. In absolute terms the top producers are Germany, Greece and Spain with an amount of 557, 181 and 210 ktoe heat produced from solar thermal. Between the indicated EU target and the expected production is a gap of -2.1%.

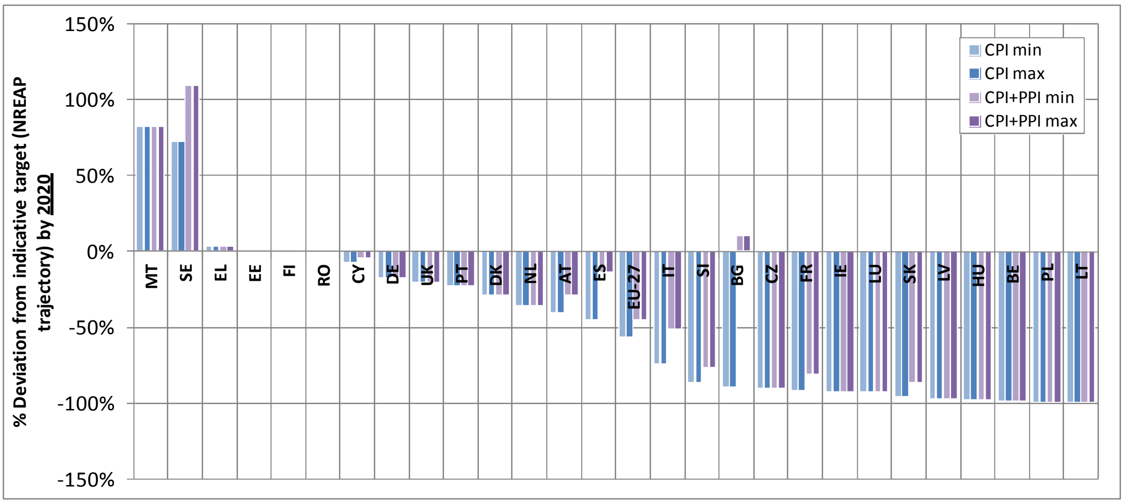


Figure 65. Deviation of expected deployment of solar thermal heat (Green-X scenarios) from indicative (NREAP) target by 2020.

In 2020 the scenarios show a strong overachievement of the national indicative targets of Malta and Sweden that corresponds to a production of 5.0 ktoe in the case of Malta and ranging from 10.3 to 12.5 ktoe in the case of Sweden. In absolute terms Germany leads with 1,033 ktoe followed by Italy with 781 and Spain with 560 ktoe heat produced from solar thermal in 2020. Most prominent are the positive effects of the planned policy measures in Bulgaria, Spain and Sweden that lead for example to a production of 23.3 ktoe compared to 2.3 ktoe without additional policy measures in the case of Bulgaria. The EU-wide target is however expected to be failed by -45 to -57% according to the scenario.

Heat pumps

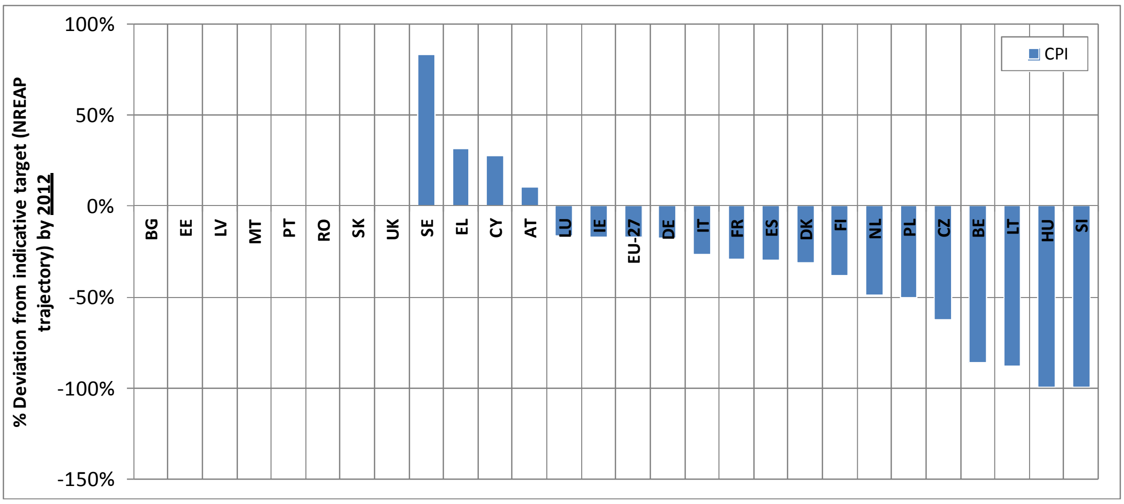


Figure 66. Deviation of expected deployment of heat pumps (Green-X scenarios) from indicative (NREAP) target by 2012.

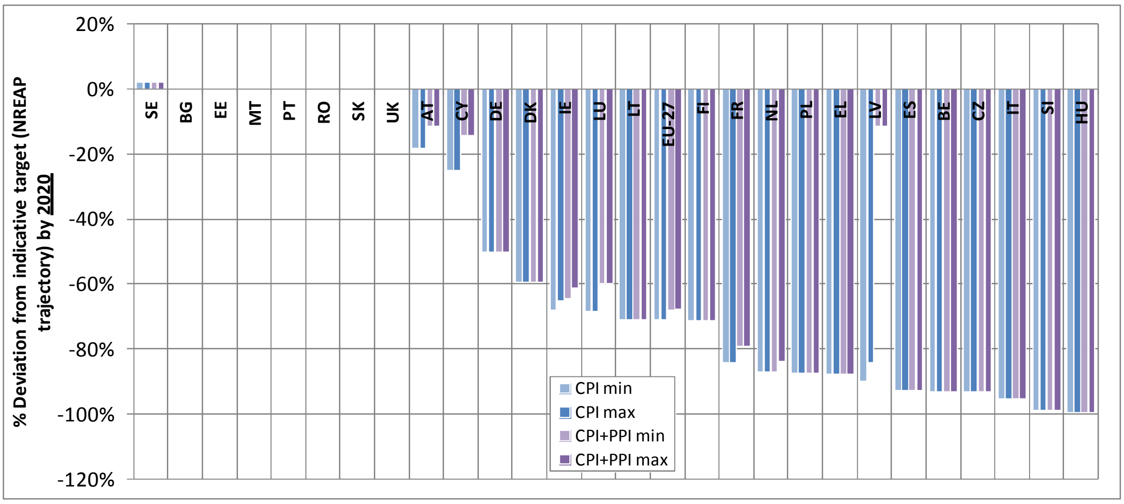


Figure 67. Deviation of expected deployment of heat pumps (Green-X scenarios) from indicative (NREAP) target by 2020.

A number of MSs did not plan any heat pump deployment in 2010, although small amounts of production have been reported, e.g. in the case of UK 61 ktoe. In 2012 the highest target overachievement is expected for Sweden with a projected production of 894 ktoe compared to 488 ktoe planned. It is followed by Greece, Cyprus and Austria that also exceed their indicative targets. The MSs lacking behind the targets most strongly are Hungary and Slovenia which have hardly achieved any progress by 2012. In absolute terms Italy with 1,077 ktoe and France with 920 ktoe are the top producers. The EU-wide target is missed by -17% in 2012.

According to the scenarios performed nearly all MSs will fail their indicative targets by 2020. Only Sweden achieves its target with an expected production of about 1,070 ktoe. Of particular interest is the strong effect of the planned policy measures in the case of Austria, Cyprus, Luxembourg and especially Latvia, which is expected to increase their generation from 0.4 ktoe to 3.5 ktoe by 2020 with additional policy measures implemented in forthcoming years. However, according to the underlying assumptions in the various scenarios the EU-wide gap between indicative targets and expected production of heat generated from heat pumps ranges from -71 to -68%.

Projected future progress in RES-T (biofuels for transport)

Biofuels sector overview

(1) Overview of expected deployment for 2012 and by 2020

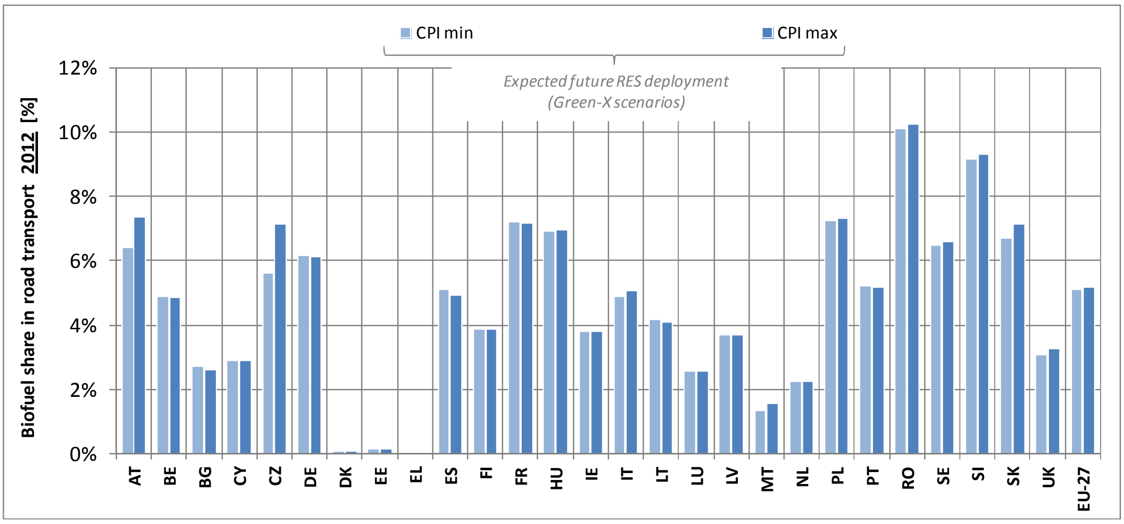


Figure 68. Expected Biofuel Share in 2012 (%).

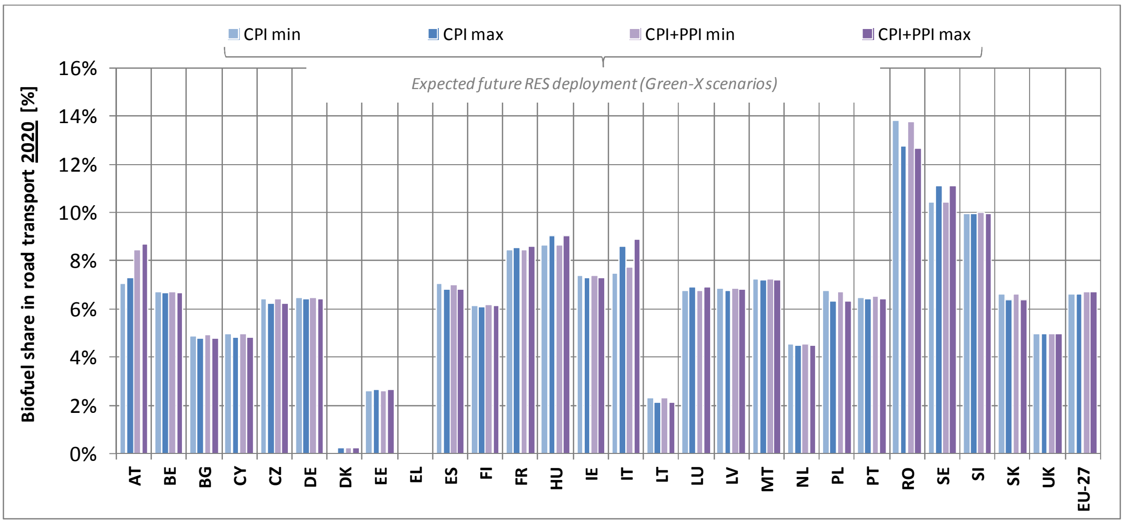


Figure 69. Expected Biofuel Share in 2020 (%).

The expected (according to Green-X scenarios) short-term (2012) progress with respect to biofuels in the transport sector is shown in Figure 68. This depiction is done in relative terms, expressing the biofuel share in road transport related energy demand. Figure 69 offers the corresponding depiction for 2020. Note that a comparison to MS plans as set out in the NREAPs with respect to the biofuel share is not feasible since MS's were not asked to specify demand trends in that detail in their NREAPs. In contrast to above, a comparison of biofuel deployment in absolute terms, that is produced diesel or gasoline of biomass origin, is feasible with data provided in NREAPs. Thus, complementary to above Figure 70 and Figure 71 indicate the deviation of expected biofuel deployment from the planned one (i.e. the indicative targets for biofuels as described in the MS's NREAPs). More precisely, Figure 70 shows the deviation under business-as-usual conditions for 2012, taking into account only currently implemented policy initiatives (CPI case). Figure 71 shows the complementary depiction for 2020, whereby also planned initiatives are taken into consideration. In this context, uncertainty related to the development of future energy demand is reflected, illustrating lower (i.e. CPI min, CPI+PPI min) and upper levels (CPI max, CPI+PPI max) of expected biofuel deployment that result from different demand developments.

(2) Deviation from 2012 and 2020 NREAP targets

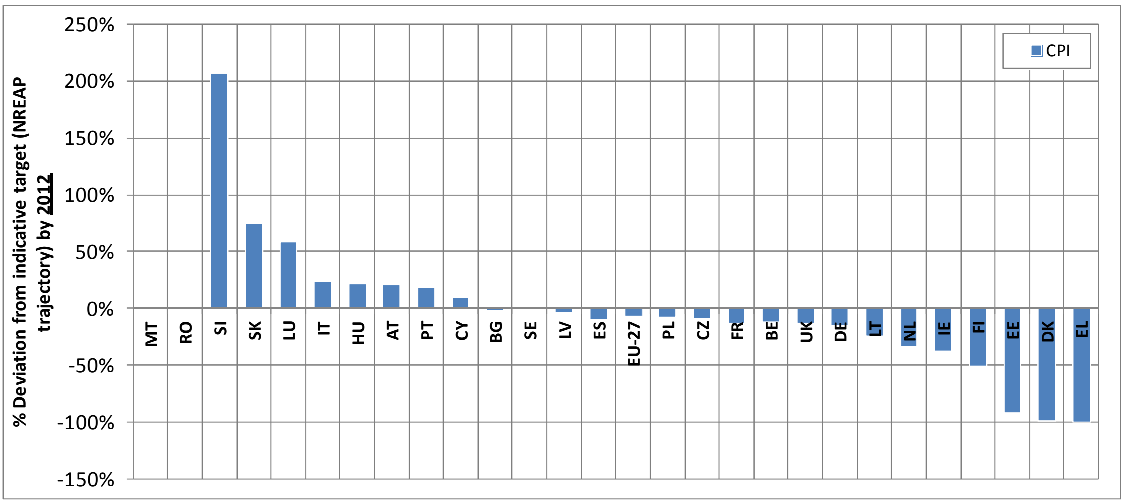


Figure 70. Deviation of expected biofuel deployment (Green-X scenarios) from indicative (NREAP) target by 2012.

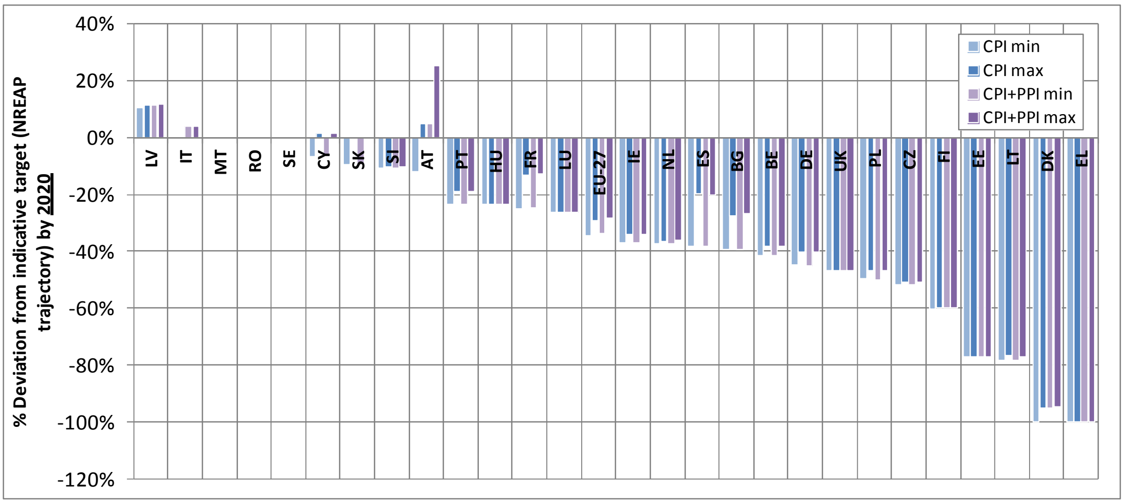


Figure 71. Deviation of expected biofuel deployment (Green-X scenarios) from indicative (NREAP) target by 2020.

By 2012 slightly less than half of the MSs will be able to meet (and over-succeed) their planned deployment target for biofuels in the transport sector. Slovenia, Slovakia and Luxembourg are countries with a strong likeliness to significantly over-succeed their plans. Italy, Austria, Hungary, Portugal and Cyprus show also a surplus, but of smaller magnitude than above (where deviations between expected and planned deployment are (significantly) smaller than 25%. On the contrary, a long list of countries is expected to face a small to moderate deficit, incl. for example Sweden, Latvia, Spain, Poland, the Czech Republic or France. A strong deficit is expected for Greece, Denmark and Estonia. At EU-level a deficit in the magnitude of 6% may arise.

Similar to other sectors and technologies, it can be expected that the situation will become worse until 2020. The gap to the planned biofuel deployment will rise to 29%-35% with currently implemented policy initiatives. If planned measures as described in the progress reports are also taken into account the gap can be reduced only insignificantly, now ranging from 28% to 34%. According to the CPI scenarios only three countries are expected to end up with a higher deployment of biofuels in 2020 than the planned one. The strongest surplus is expected to arise in Latvia, followed by Austria and Cyprus, but only if demand growth can be successfully reduced. Italy will overshoot its target if planned measures are also taken into consideration. A long list of countries (incl. Slovakia, Portugal, Hungary, France, or Luxembourg) may face a small to moderate deficit (of less than 40% compared to the planned one). The strongest deficits can be expected for Greece, Denmark, Lithuania, Estonia and Finland, where significant improvements are of need in order to bring biofuels back on track.

Biofuel, first generation

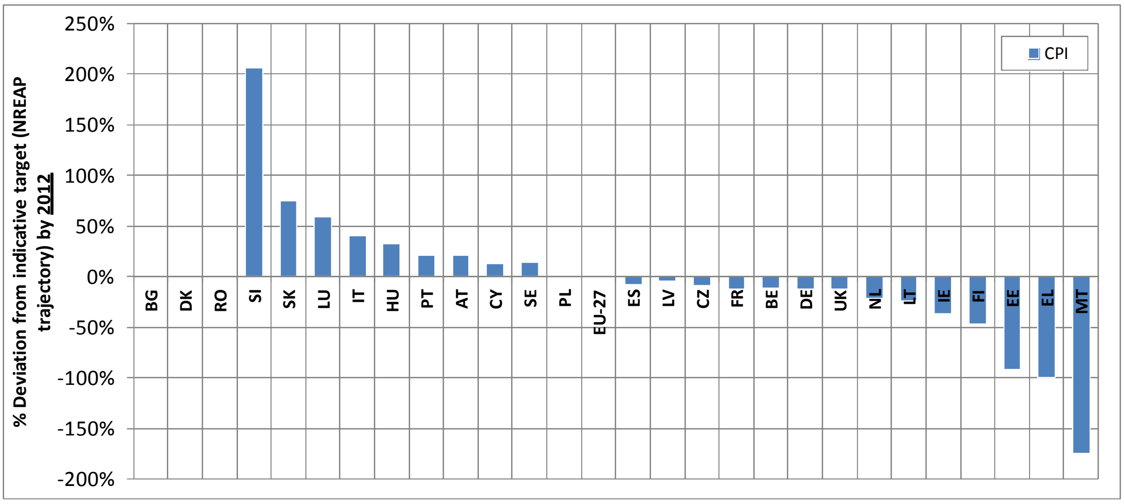


Figure 72. Deviation of expected deployment of first generation biofuels (Green-X scenarios) from indicative (NREAP) target by 2012.

As indicated in Figure 72, first generation biofuels are expected to progress as planned in the short-term (up to 2012) but until 2020 significant improvements are of need to achieve the planned deployment. Similar to biofuels deployment at the aggregated level, Slovenia, Slovakia and Luxembourg are those countries that show a strong likeliness to over-succeed their plans in significant magnitude. A few other countries like Italy, Austria, Hungary, Portugal and Cyprus show also a surplus, but of smaller magnitude. For a long list of countries it can be expected that a small to moderate deficit will occur by 2012. This list includes for example Sweden, Latvia, Spain, Poland, the Czech Republic and France. A strong deficit is expected for Malta, Greece and Estonia. At EU-level a deficit in the magnitude of 1% may arise.

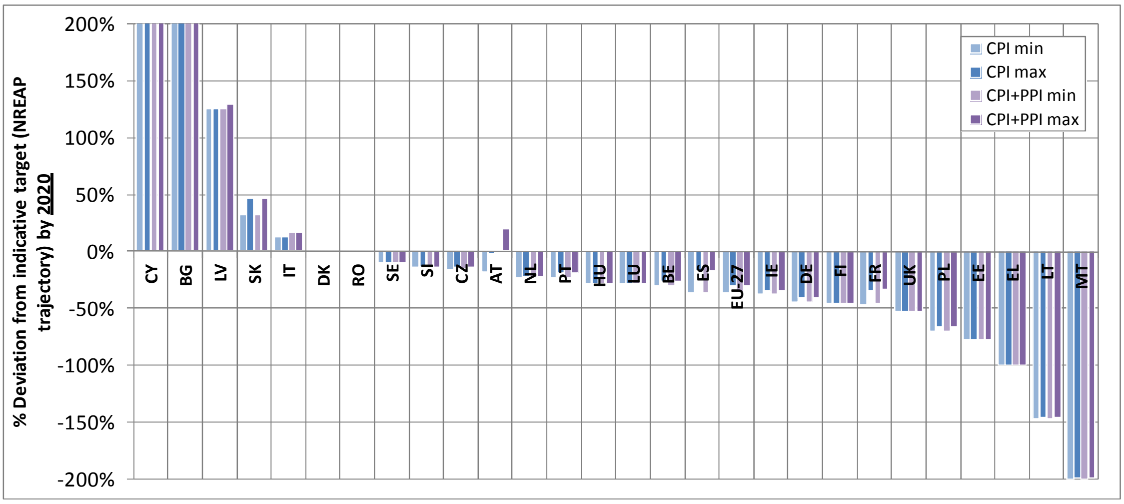


Figure 73. Deviation of expected deployment of first generation biofuels (Green-X scenarios) from indicative (NREAP) target by 2020.

The gap to the planned biofuel deployment will rise to 31%-37% until 2020 if only currently implemented policy initiatives are taken into account, compare Figure 73. If the impact of planned measures as described in the progress reports is additionally also taken into consideration the gap can be reduced only insignificantly (i.e. by 1%). According to the CPI scenarios five countries are expected to end up with a higher deployment of first generation biofuels in 2020 than the planned one. The strongest surplus is expected to arise in Cyprus and Bulgaria, followed by Latvia, Slovakia and Italy. Austria may be added to that list, but only if demand growth can be successfully reduced. A long list of countries (incl. Sweden, Slovenia, the Netherlands, Portugal, Hungary, Belgium and Luxembourg) may face a small to moderate deficit (of less than 30% compared to the planned one). The strongest deficits can be expected for Malta, Lithuania, Greece and Estonia where significant improvements are of need in order to achieve targeted deployment levels by 2020.

Biofuel, second generation

It appears likely that plans related to second generation biofuels are not met in the short-term. Green-X scenarios indicate that for 2012 all countries that have expressed their aim will fail in delivering their projected deployment of second generation biofuels. Up to 2020 the situation is expected to improve and several countries are projected to progress well (e.g. France, Poland, Hungary, Sweden and Ireland). For others related initiatives need to be planned and implemented – among these countries are for example the Netherlands, Denmark, Bulgaria, Slovakia, Belgium.

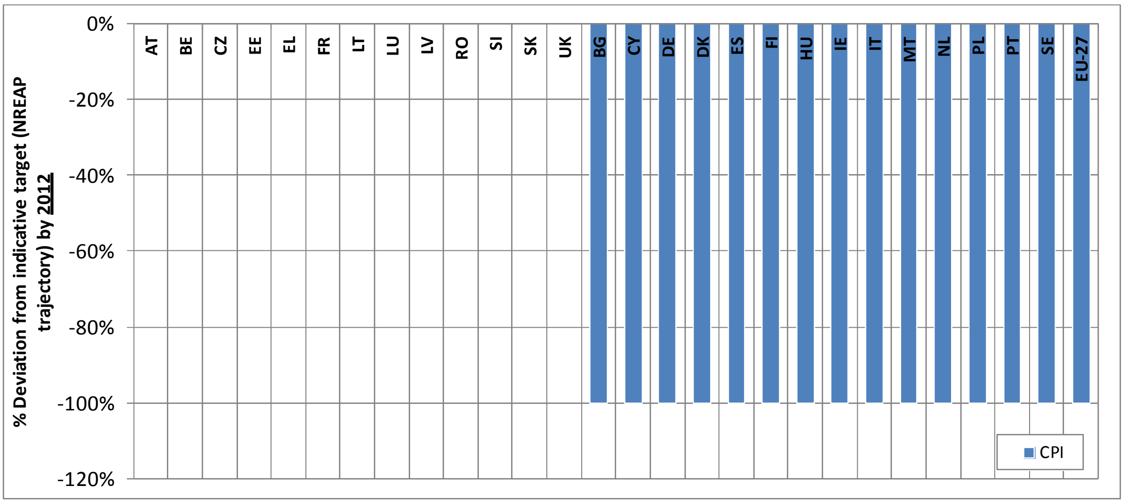


Figure 74. Deviation of expected deployment of second generation biofuels (Green-X scenarios) from indicative (NREAP) target by 2012.

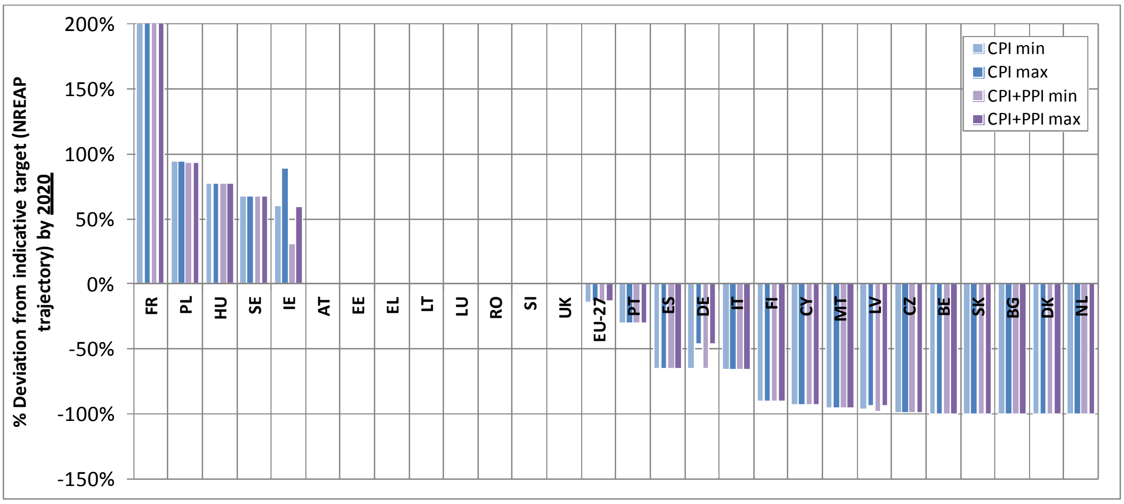


Figure 75. Deviation of expected deployment of second generation biofuels (Green-X scenarios) from indicative (NREAP) target by 2012.

1.4 Assessment of EU Member State policies and measures

Introduction

This objective of this chapter is to assess the Member States policies and measures to identify:

1. The progress of the Member States in adopting the policies and measures they committed to in the NREAP – Question 1. For this purpose we look at whether or not the Member States report in their Progress Report that they have actually adopted the planned measures they indicated in their NREAP;
2. The progress of the Member States in adopting policies and measures with adequate support levels for each technology and providing a sufficient long term security - Question 2 and Question 3. For this purpose we present the policy efficiency indicator that was developed in previous EC funded projects (e.g. RE-Shaping) comparing the economic incentives paid for RES-E, RES-H&C or RES-T with the cost of electricity and heat generation or for RES-T with the fuel cost gap.

Methodology for the assessment of MS policies and measures

The source of information we used for assessing the Member States policies and measures are primarily the progress reports submitted at the end of 2011 and beginning of 2012 (from table 2 and table 3 of the MS progress reports). When relevant the NREAPs were also used (i.e. table 5 of MS NREAP). The case studies of RE-Shaping have also been used to complement the information from the MS reports when necessary. Eventually we have conducted interviews on a selection of countries to validate our assessment or gain a deeper understanding of the policy context (e.g. Czech Republic, Spain, Lithuania, Latvia and Estonia).

Since the MS reported their policies and measures not always in a homogenous manner a comprehensive reassessment of the originally provided information was needed for this qualitative analysis. In addition, in order to answer question 1 on the MS fulfilment of their NREAP commitments, we had to compare systematically the policies and measures reported in the NREAP and in the progress reports. We have therefore developed a tool for comparing systematically NREAP and progress report policies and measures. This tool allows us to identify the changes in the status of the measures between the NREAP and the progress report: e.g. planned policies adopted, still planned or not reported anymore, existing policies revised or not reported anymore. Unfortunately, a number of MS didn't present a consistent list of policies and measures in their NREAP and in their progress report: measures were not reported anymore with no indication on what happened with them, new measures were reported with no indication on the link with the past existing or planned measures, etc. For these countries our assessment is based on other sources than the MS reports and interviews with country experts.

The qualitative assessment of the MS policies and measures is based on 3 evaluative questions. Each question is answered separately for the RES-E, RES-H&C and RES-T policies and measures.

Question 1: Has the Member State fulfilled its NREAP commitments to RES-E policies and measures?

The first assessment we made is to assess whether the MS have fulfilled the commitment they made in their NREAP on the policies and measures they planned to adopt in order to support the deployment of RES. To do so we compared the policies and measures the MS reported in the NREAP and in the progress report to identify measure by measure if the planned measures have been adopted or if existing measures planned to be revised have been revised. We also looked at whether existing measures have been cancelled or put on hold without notice. The source of information for this assessment is the NREAPs (table 5) and the progress reports (table 2), but as indicated above alternative sources have been used for some countries to complement the information presented in the reports.

The qualitative assessment leads to the answer 'yes', 'no' or 'partially' for RES-E, RES-H&C and RES-T policies and measures based not only on the list of measures reported, but also on an expert analysis of the progress of the MS over the last 2 years in putting in place the support schemes they committed to in 2010.

Question 2: Are the support levels adequate for each technology?

The efficiency of a Member State policy is measured by comparing the economic incentives paid to the supplier of RES-E or RES-H&C with the electricity and heat generation cost. When the level of support is significantly higher than the generation cost it means that the potential profit for the investors is high and the high policy cost could have been lowered. In such a case the policy is not efficient.

Comparing the actual **support levels** of different countries is not straightforward, since significant criteria including in particular the duration of support payments need to be considered. To make the remuneration level comparable, time series of the expected support payments or final energy prices respectively are created and the net present value is calculated. The net present value represents the current value of the overall support payments discounted. Finally, the annualised remuneration level is calculated.

Electricity and heat **generation costs** are calculated as the levelised generation cost over the lifetime of the plant. Different formulas are used for power plant producing only electricity, CHP plants and pure heat generation plants (details of formula in [Steinhilber et alii, 2011]). In general, minimum to average generation costs are shown because this range typically contains presently realisable potentials which investors would normally deploy in order to generate electricity at minimum costs.

Generation cost estimates for 2011 are provided by Green-X. Support levels are taken from the Progress Reports where possible, and from Winkel et al. (2011). Support levels are generally for end of 2011 – as this was also the original deadline for the Progress Reports – but some Member States also provide more recent support levels. For those Member States which have suspended their support for new installations in 2012, support levels from before the suspension are shown.

The methodology for assessing the efficiency of the RES-T policies is similar to the methodology used for RES-E and RES-H&C (comparing the level of support with the fuel cost gap), but the data used is different (e.g. no generation cost but market price). The following rules are used for the calculation:

- The level of support depends on the type of measure adopted in the Member State. Here is how we measure the level of support for the 2 main measures observed in the Member States:
    - In case of a tax exemption measure we take the weighted average of all biofuels;
    - In case of a quota obligation measure we take the buy-out price. Note that the penalty is less suitable, since it could be difficult to express in money (e.g. ultimately even imprisonment in the Netherlands).
- The fuel cost gap is the gap between market price of the biofuels and the market price of the fossil fuel;
- To identify the market price of biofuels we account for regional price differences, e.g. NW Europe, SE Europe, etc;
- For the market price of fossil fuel there is a European data base available;
- Data time series are very volatile (not smooth). Therefore we take annual averages (i.e. add 12 monthly prices and divide by 12).

Question 3: Is the long-term security of the support measures ensured?

Long-term security includes two aspects:
Firstly, in the case of production-based incentives, the duration and built-in predictability of support payments is relevant to investors. A longer support period offers higher security. At the same time, support levels should be predictable over the whole support duration. Support systems which foresee the adjustment of support for existing plants create uncertainty for investors. For all support instruments, built-in stop-and-go effects – for instance caused by annual capacity caps – are also detrimental to investor confidence.

Secondly, political changes may lead to unexpected adjustments of support schemes and severely affect investor confidence. This includes unplanned retroactive changes to the support of existing plants, sudden moratoria on support for new plants, and frequent switches between support instruments or instrument designs. Such changes do not even have to be implemented to have a detrimental effect. The perceived threat alone may negatively affect the investment climate.

A judgment on the first aspect is possible based on the Progress Reports and additional literature, where the duration and adjustment mechanisms for support schemes are described. The second aspect however can only be assessed using in-depth knowledge of the current political processes and likely developments in a given Member State. It is addressed in expert interviews or additional literature research for selected countries.

Additionally, we mention whether Member States demonstrate good efforts by having introduced RES obligation for buildings ahead of time, if this information was available in the Progress Report. These obligations are only mandatory for Member States from the end of 2014.

Summary of RES policies and measures assessment

Table 16 presents a summary of the policies and measures assessment described into more details in the sections below for each of the RES sectors: RES-E, RES-H&C and RES-T.

Overall, we can observe that the recent economic crisis has affected the reliability of RES support in a number of Member States. Portugal, Spain, Bulgaria and Latvia are currently not taking any support applications from new RES-E installations (or are not connecting them to the grid), and the Czech Energy Regulatory Office has voiced concerns that RES support may have to be put on hold from 2014 in order to reduce costs.

Table 16. Summary of MS policies and measures assessment in RES-E, RES-H&C and RES-T sectors.

	RES-E			RES-H&C			RES-T		
Member State	Fulfilment of NREAP policy commitments ?	Adequacy of support levels for each technology	Long-term security of support	Fulfilment of NREAP policy commitments ?	Adequacy of support levels for each technology	Long-term security of support	Fulfilment of NREAP policy commitments ?	Adequacy of support levels for each technology	Long-term security of support
Belgium	Yes	fair	poor	Yes	good	fair	Yes	good	poor
Bulgaria	No	poor	poor	Partially	fair	fair	No	poor	fair
Czech Republic	Partially	fair	poor	Partially	fair	fair	No	good	good
Denmark	Partially	fair	fair	No	fair	good	No	good	fair
Germany	Yes	good	good	Yes	good	good	Yes	good	good
Estonia	Yes	fair	fair	Yes	fair	fair	Yes	poor	poor
Ireland	Yes	fair	fair	Partially	fair	fair	Yes	fair	fair
Greece	Yes	fair	fair	Yes	fair	good	No	poor	fair
Spain	No	poor	poor	No	fair	fair	Partially	fair	fair
France	Partially	fair	fair	Partially	fair	fair	No	good	good
Italy	Yes	fair	poor	Yes	fair	fair	Yes	fair	fair
Cyprus	Yes	fair	fair	Partially	fair	fair	Yes	fair	fair
Latvia	Partially	poor	poor	Partially	fair	fair	No	fair	fair
Lithuania	Partially	fair	fair	No	fair	poor	Partially	fair	fair
Luxembourg	Partially	fair	good	No	good	good	Yes	poor	fair
Hungary	No	fair	fair	No	fair	fair	Partially	fair	fair
Malta	Partially	poor	fair	Partially	fair	fair	Partially	fair	fair
The Netherlands	Yes	fair	poor	Partially	fair	fair	Yes	fair	fair
Austria	Partially	good	fair	No	good	good	No	good	fair
Poland	Partially	poor	fair	No	fair	fair	n/a	fair	good
Portugal	No	poor	poor	No	fair	fair	No	fair	good
Romania	Yes	fair	fair	Yes	good	fair	Yes	fair	good
Slovenia	Partially	fair	fair	Partially	good	fair	No	good	good
Slovakia	No	fair	fair	No	good	fair	Yes	fair	good
Finland	Yes	fair	fair	Yes	fair	fair	Yes	fair	good
Sweden	Yes	fair	fair	Yes	good	good	Yes	good	good
United Kingdom	Yes	fair	fair	Yes	good	fair	Yes	good	good

Assessment of RES-E policies and measures

Apart from those countries which have put their support for new installations on hold, most Member States are continuously refining and their support systems to improve their effectiveness and efficiency. Six Member States (Italy, Poland, Sweden, Romania, Belgium and the UK) apply quota schemes with tradable green certificates (TGC), but most have introduced technology-specific support. Only the support schemes of Sweden, Poland, and Estonia are technology-neutral. Quota schemes are often accompanied by feed-in tariffs (FIT) or premiums (FIP) for smaller technologies. Italy and the UK are planning a transfer to feed-in laws in the future.

The following figures compare generation costs to remuneration for RES-E producers for selected technologies. Adequate financial incentives alone, however, do not guarantee the success of a support scheme, but must be combined with attractive framework conditions, for instance regarding spatial planning, grid connection, and other barriers in order to unfold their full potential. These figures are used for the assessment of question 2: Are the support levels adequate for each technology?

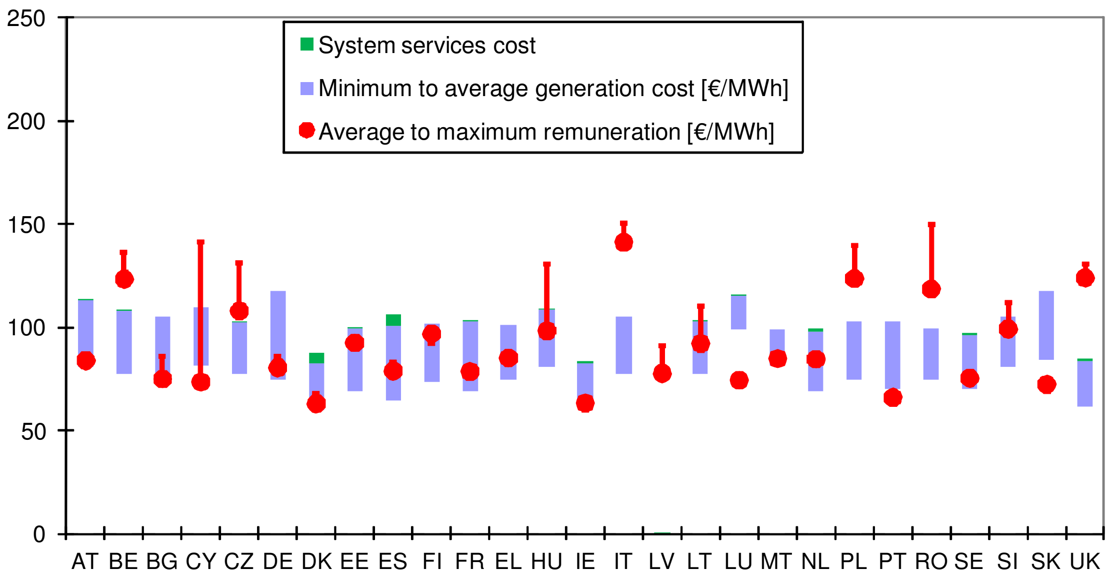


Figure 76. Remuneration ranges (average to maximum remuneration) for onshore wind in the EU-27 MS in 2011 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs). Note that support levels for Spain, Portugal, Bulgaria and Latvia are from before support was put on hold.

The above figure compares the minimum to average generation costs of onshore wind to the average to maximum remuneration (FIT or sum of electricity price and FIP or TGC, plus any investment grants or tax incentives). For onshore wind, cost decreases through learning effects have been counterbalanced by increases in steel price. Most

Member States offer adequate remuneration levels, with some rather high levels in Member States that apply quota systems, namely Belgium, Italy, Poland, Romania, and the UK.

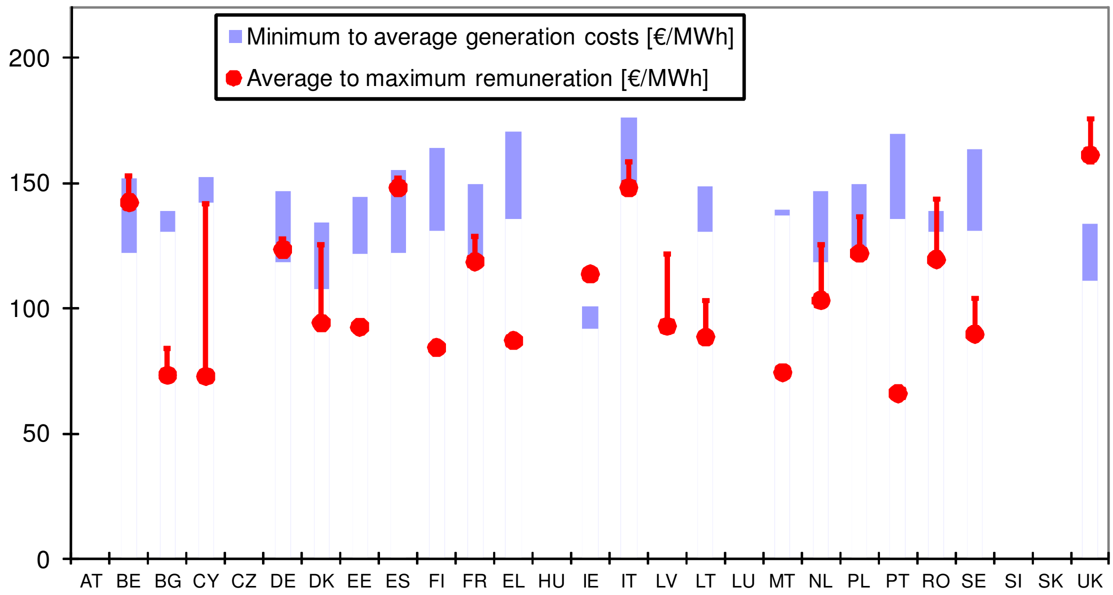


Figure 77. Remuneration ranges (average to maximum remuneration) for offshore wind in the EU-27 MS in 2011 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs). Note that support levels for Spain, Portugal, Bulgaria and Latvia are from before support was put on hold.

Cost data for offshore wind is scarcer and characterised by higher uncertainties, but generally it can be said that remuneration levels are too low to stimulate investment in many Member States. Offshore wind, with 2011 support levels, was financially attractive in Belgium, Germany, Spain, France, Italy, the Netherlands, Poland, Romania, and the UK.

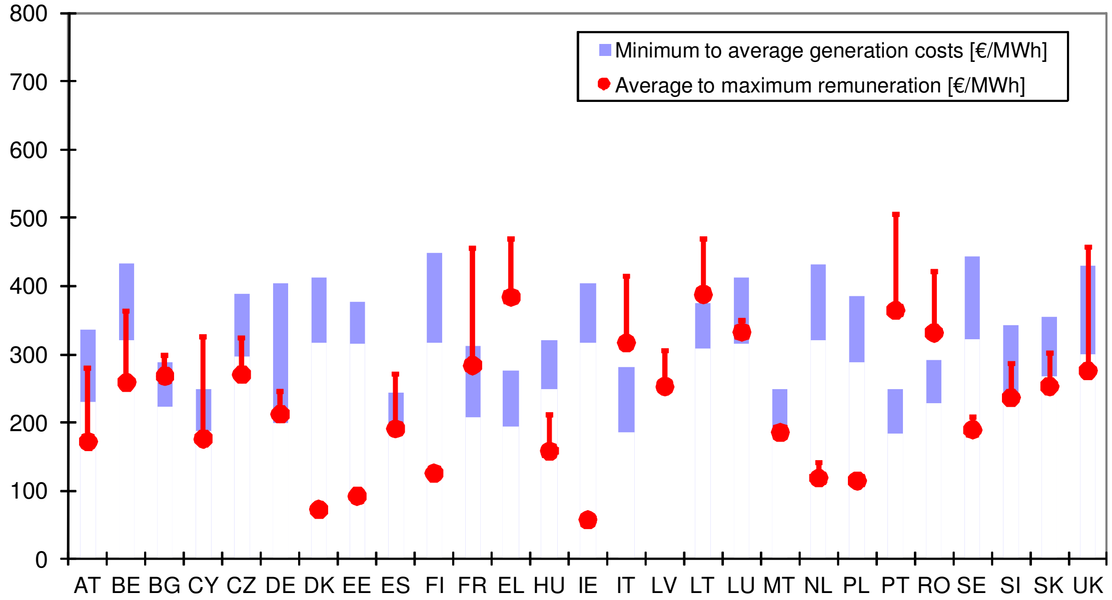


Figure 78. Remuneration ranges (average to maximum remuneration) for PV in the EU-27 MS in 2011 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs). Note that support levels for Spain, Portugal, Bulgaria and Latvia are from before support was put on hold.

PV is a main cost driver in the RES portfolio of many Member States, which is why it has substantially been reduced in a number of countries in 2011 and early 2012. Exploding PV support cost was also one of the more prominent reasons given for the suspension of support in Spain, Portugal, Bulgaria, and Latvia.

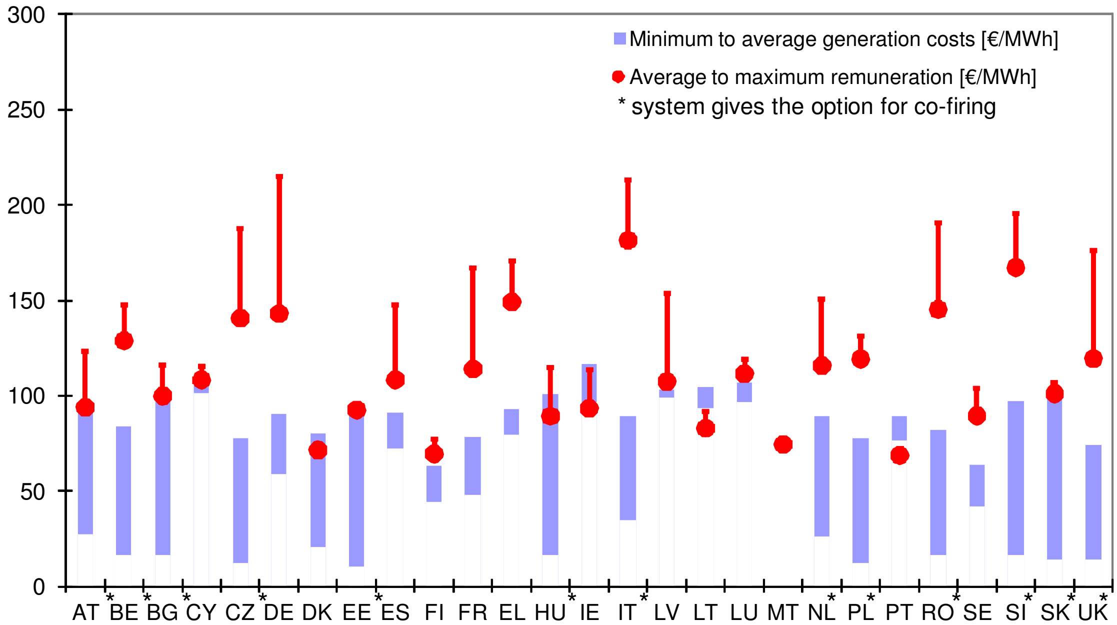


Figure 79. Remuneration ranges (average to maximum remuneration) for solid biomass in the EU-27 MS in 2011 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs). Note that support levels for Spain, Portugal, Bulgaria and Latvia are from before support was put on hold.

Figure 79 illustrates the current remuneration level and the generation costs of biomass electricity generation. Since both costs and the support level may vary strongly for the many different types of biomass resources, price ranges are shown for electricity production from forestry residues only. However, there are considerable differences in generation costs even within this option. This is partly due to the fact that the support systems of countries with comparatively low minimum generation costs allow the application of cost-efficient co-firing. Moreover, it should be added that the generation costs in the biomass sector are also heavily dependent on plant size. The overview shows that remuneration in many Member States is above generation cost.

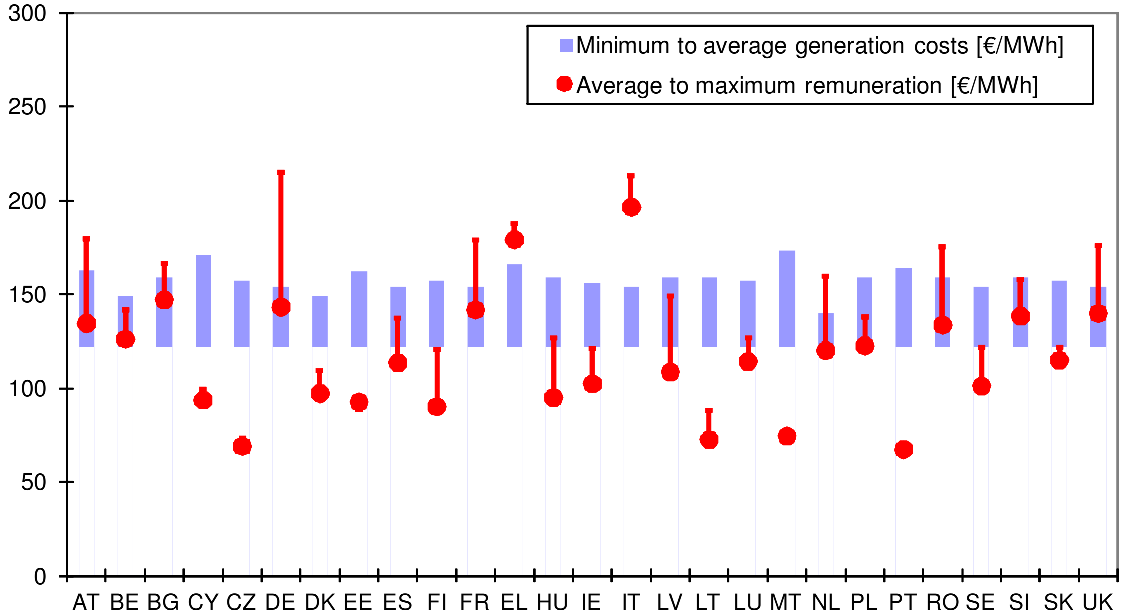


Figure 80. Remuneration ranges (average to maximum remuneration) for biogas in the EU-27 MS in 2011 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs). Note that support levels for Spain, Portugal, Bulgaria and Latvia are from before support was put on hold.

For biogas, remuneration varies strongly between countries and is often below cost level. The graph above is based on support levels for biogas-produced electricity. What is not shown here, however, is whether biogas electricity producers are able to sell the produced heat as well. With the additional revenues from heat, a biomass plant may well become profitable, even if the graph above shows a remuneration level below cost.

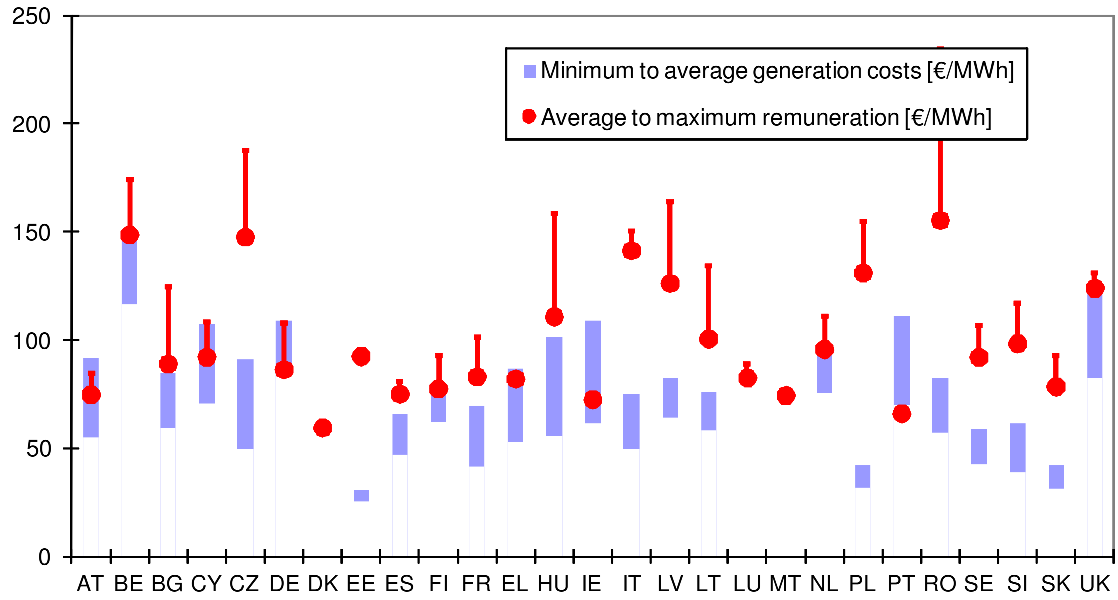


Figure 81. Remuneration ranges (average to maximum remuneration) for small hydro in the EU-27 MS in 2011 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs). Note that support levels for Spain, Portugal, Bulgaria and Latvia are from before support was put on hold.

Costs for small hydro (installations below 10 MW) vary strongly between Member States. In most countries, remuneration levels are adequate or even rather high.

The country paragraphs below explain the assessments presented in Table 14 and provide details on individual Member States RES-E policies and measures.

Austria

Fulfilment of NREAP policy commitments: Partially

Austria has achieved fair progress in adopting new RES-E measures between the NREAP and its first Progress Report. On the positive side, Austria revised its most important law for RES-E support, the Green Electricity Act (Ökostromgesetz, ÖSG); the amendment incentivises the reduction of the waiting list of RES-E projects that could not yet benefit from the feed-in tariff due to the annual budget caps; it increases the available annual budgets for support; and reduces tariff rates to reflect lower production cost. The Member State also adopted measures on the use of systems charges order and on the development of the Austrian transmission and distribution network. However, on the negative side, Austria has not adopted many of the policies it initially planned in the NREAP, particularly those which would have fostered the use of RES-E in buildings.

Adequacy of support levels for each technology: Good

The main support instrument for renewable electricity in Austria is a technology- and size-specific feed-in tariff. Total expenditures per technology and year are capped. An additional special budget is dedicated to reduce project waiting lists that had built up after FIT rate increases in 2009 and 2010. Hydro electricity is supported via investment grants. Austrian support levels are sufficient for all technologies.

Long-term security of support: Fair

The long-term security of the feed-in tariff is secured due to the long support period of 13 to 20 years. Furthermore, FITs are levy-financed. The cap of 21 million Euros per year was increased to 50 million Euros and specific sums were allocated for each technology. The level of support (for new installations) can still be amended on a yearly basis.

Belgium

Fulfilment of NREAP policy commitments: Yes

Belgium exceeded its commitments towards RES-E, primarily because the Member State had not planned great policy change in its NREAP and because the Belgian regions adopted a variety of measures, namely Wallonia and Bruxelles Capitale. Among others, Wallonia revised its PV support scheme (introducing stricter degression) and set more ambitious quotas for its certificate trading scheme for the years 2010-2012. The region of Bruxelles Capitale undertook measures to simplify access to receive the local energy premiums (capital grant) and adopted measures to improve PV support. The federal level did not adopt measures to develop smart grids in the country.

Adequacy of support levels for each technology: Fair

Three technology-specific TGC systems exist in Belgium, one each for Brussels, Flanders, and Wallonia. “Minimum prices” apply per technology. If minimum prices are consistently above certificate prices – as is the case for PV – the support effectively works like a FIT. On average, support levels are sufficient for biogas, small hydro and PV, and a bit high for biomass and onshore wind. Investment grant schemes exist as well.

Long-term security of support: Poor

The TGC scheme offers support for 10 years for all technologies, and 20 years for PV in Flanders. Minimum prices are adjusted in periodic reviews.

Bulgaria

Fulfilment of NREAP policy commitments: No

Several of the RES-E measures (and those partially affecting RES-E) that Bulgaria planned in its NREAP were scheduled to start in 2011. Only a very limited number of these measures have been adopted according to the Member State’s Progress Report (which was submitted to the European Commission in early 2012). Considering the multitude of measures that is still planned for adoption, it is questionable if Bulgaria's legislative authority is able to realize the Member State's plans in the short-term.

In 2011, Bulgaria adopted a new RES-E support law, the Renewable Energy Act (ZEVI). The implemented changes have been perceived negatively by many experts and RES-E investors. For instance, the ZEVI introduced high advance payments for grid connection and grid capacity reservation; tariff rates have been cut and can now be decreased without consulting the national parliament. This has lead to high investment insecurity. Moreover, Bulgaria has delegated the development of procedures to implement RES-E to local governments without setting up a national framework of recommendations.

Adequacy of support levels for each technology: Poor

The main support instrument used in Bulgaria is technology-specific and for some technologies highly differentiated feed-in tariff. Support levels in 2011 were sufficient for most technologies apart from offshore wind. However, in order to limit support costs, in mid-2011, changes were made to onshore wind support making profitability of new wind projects unpredictable. Investors went into the PV market instead, driving support costs even higher. As a result, in July 2012, FIT levels were slashed by 50% for PV and 20% for wind, and the regulator announced that the grid offers no capacity to connect any new RES plants until June 2013 (Yaneva, 2012). This is in effect a moratorium for the majority of RES.

Long-term security of support: Poor

Feed-in tariffs for solar, biomass and geothermal sources are guaranteed for 20 years. Hydro plants receive feed-in tariffs for 15 years, wind plants for 12 years. The above-mentioned changes to wind support and the current pause in grid connection for RES plants create a very insecure environment for investors. The changes were made because of rising consumer electricity prices, mainly due to PV. The Bulgarian Energy Ministry is even considering the abolition of support for PV plants > 30 kW (Yaneva, 2012).

Cyprus

Fulfilment of NREAP policy commitments: Yes

Cyprus did not planned the adoption/revision of any RES-E measures in its NREAP but eventually adopted new measures in 2011 and 2012, particularly such that improve the support of solar PV. The Member State set up a new program that finances 82MW of PV and simplified authorization procedures for small-scale installations (PV, wind, and biomass). In 2011, Cyprus also revised its major support scheme, the feed-in tariff. In terms of grants for RES-E (and H&C), Cyprus adopted positive as well as negative changes (max. grant increases and cuts). Overall RES-E support in Cyprus, however, is still relatively weak.

Adequacy of support levels for each technology: fair

The main support instruments are a FIT for large-scale projects and investment grants for small installations. Support levels are sufficient for small hydro, onshore wind, and PV, too low for biogas and offshore wind, and rather high for solid biomass.

Long-term security of support: fair

The FIT support is granted for 20 years.

Czech Republic

Fulfilment of NREAP policy commitments: Partially

The Czech Republic partly fulfilled its NREAP commitments towards RES-E: on the one hand, it adopted a new support for RES-E, the Act 165/2012 on the Promotion of Renewable Energy Sources, which replaces the old, dysfunctional feed-in tariff (Act 180/2005); the Member State also revised several other existing legislations in order to improve RES-E support. On the other hand, the Czech Republic introduced a harmful, 3-year retroactive tax (26-28%) on gross revenues from electricity produced by PV installations (>30kW) built in 2009/2010 in order to limit cost of the PV boom that occurred in 2009-2010.

Act 165/2012 sets (among other things) new rules for the support of RES-E starting in 2013. The new law relies more on premiums than on tariffs in order to adapt to the increasing cost of the RES-E support in 2009-2011. Nevertheless the implementation decisions are still expected and in the meantime a lot of uncertainties remain on the impact of the new legislation on actual deployment of RES-E in the future. The Member State also amended its Act on Energy Management and the Energy Act on business conditions and public administration in energy sectors.

Adequacy of support levels for each technology: fair

RES-E producers may choose between FIT or FIP support. Remuneration levels are sufficient for PV and onshore wind, rather high for solid biomass and small hydro, and too low for biogas.

Long-term security of support: poor

New legislation has been passed in May 2012, introducing significant changes to the RES support system. All plants starting operation until end of this year will still run under the old support scheme. The new support scheme foresees a FIP for all but the very small installations, who are covered under a FIT scheme. A number of sub-legislations are still under discussion, for instance regarding efficiency requirements for supported installations, or the exact categorisation of biomass. In addition, the regulatory office has made remarks about a possible interruption of support for new installations in the future, in order to minimise support costs. This makes for a very insecure environment for investors.

Denmark

Fulfilment of NREAP policy commitments: Partially

The overall assessment of Denmark's progress in adopting RES-E measures is positive, mainly since the Member State revised its feed-in premium scheme in 2011 (small changes). Nevertheless, Denmark has not yet adopted measures on increased biogas and energy crops production as planned in its NREAP (these measures are part of Denmark's Green Growth strategy). Denmark also planned a national test centre for large wind turbines and the exploration of areas for test turbines up to 2020 in its NREAP.

Adequacy of support levels for each technology: fair

The main support instrument for renewable electricity in Denmark is a technology-specific FIP. The support level is sufficient for onshore and offshore wind. Support levels seem to be too low for solid biomass, biogas and solar PV.

Long-term security of support: fair

For some technologies, the feed-in premium is provided for a fixed number of years, for others the support period is based on a defined number of full load hours. Long-term security of support seems to be guaranteed as these correspond typically to a support period between 8 and 20 years.

Estonia

Fulfilment of NREAP policy commitments: Yes

Estonia did not plan new RES-E measures in its NREAP but according to its Progress Report it adopted two measures to promote wind energy. Since 2010 Estonia has in place a feed-in premium scheme which does not provide technology-specific tariff rates; this scheme has not been revised after the NREAP; the Member State intends to revise the feed-in premium by 2013.

Adequacy of support levels for each technology: fair

The main support instrument in Estonia is a technology-neutral FIP. In addition, investment grants are available for wind and biomass generation. However, more detailed information regarding the grants is scarce. The support level is sufficient for wind onshore and biomass (high when the investment grant is considered), rather high for small hydro and needs to be increased for supporting solar PV, wind offshore and biogas. The premium is also paid for CHP installations using non-renewable fuels such as peat.

Long-term security of support: fair

Feed-in premiums are paid for 12 years, with an annual cap on wind energy. The Estonian government is planning to reduce premiums in 2013 and link them to the market price of electricity in order to control support costs.

Finland

Fulfilment of NREAP policy commitments: Yes

Finland has been ambitious in adopting new RES-E measures between the NREAP and the First Progress Report. Most importantly, the Member State adopted a feed-in premium, the Act on Production Support to Electricity from Renewable Energy Sources, which provides financial support to wind power, hydro power, biogas, other biomass sources, and CHP.

Adequacy of support levels for each technology: fair

Finland applies a technology-specific FIP scheme as its main instrument. Support levels are sufficient for onshore wind, small hydro, and solid biomass, just enough for biogas, and too low for PV and offshore wind.

Long-term security of support: fair

The scheme guarantees support for a duration of 12 years, financed from the state budget.

France

Fulfilment of NREAP policy commitments: Partially

France achieved fair progress in adopting new RES-measures between the NREAP and the Progress Report. On the one hand, it revised its feed-in tariff (obligation d'achat) for solar PV and several biomass technologies; opened tenders for purchase agreements for wind onshore, wind offshore and for large solar power projects; and in late November 2011 transposed the sustainability criteria for biomass of Directive 2009/28/EC into national law after admonition by the European Commission. On the other hand, France has not yet put in place transparent and clear administrative procedures to guarantee access of renewable energy to the grid as required by Directive 2009/28/EC. Moreover, it has not implemented GO trading as planned in the NREAP. France imposed a three-month moratorium on PV support before adopting its revised solar PV feed-in tariff.

Adequacy of support levels for each technology: fair

French technology-specific FITs (called buy-back prices) are sufficient for all technologies. The rates for biomass and small hydro are higher than necessary.

Long-term security of support: fair

Long-term security is given due to the payment duration of 15 to 20 years. Support for PV was however suspended from December 2010 to March 2011. The new regime quarterly tariff degression based on additional installed capacity is meant to minimize costs and thus contribute to the support schemes long-term security.

Germany

Fulfilment of NREAP policy commitments: Yes

Germany did very well in adopting new RES-E measures between the NREAP and the Progress Report, having implemented several new/revised existing measures that it had not planned in the NREAP. Among others, Germany made some important changes to its feed-in tariff law (Erneuerbare-Energien-Gesetz, EEG) and having adopted measures for accelerated grid expansion, the promotion of smart grids, the better integration of wind power, and a fund for offshore wind. In August 2011, Germany permanently shut down its eight oldest of the country's 17 nuclear power plants; the remaining reactors will be gradually switched off until 2022. Much of the lost capacity is and will be replaced by RES-E plants ("Energiewende").
Germany will need to adopt measures to accelerate the deployment of offshore wind power and to further improve grid expansion.

Adequacy of support levels for each technology: good

Since 2012, Germany uses a technology-specific feed-in tariff and an optional feed-in premium to support electricity from renewables. Support levels are sufficient for all technologies but quite high for biomass and biogas plants.

Long-term security of support: good

Tariffs are paid for 20 years. The program's long-term security might be endangered by increasing costs. Regular revisions and tariff adoptions are used to avoid this.

Greece

Fulfilment of NREAP policy commitments: Yes

Greece achieved great progress in adopting new RES-E measures between the NREAP and its First Progress Report. It initially planned the adoption/revision of 5 RES-E exclusive measures; it adopted/revised 16 RES-E exclusive measures. Among them are a feed-in tariff for offshore wind power, two measures facilitating the use of geothermal power, changes to the technical regulations for solar PV and small hydro, the reinforcement of interconnection capacity with neighbouring countries, the development of storage facilities, the further development of the distribution grid, and several guidelines. Apart from the adapting PV tariff rates, Greece's feed-in tariff (L.3851/2010) has remained unchanged since 2010.

Adequacy of support levels for each technology: fair

The main support instrument used in Greece is a technology-specific FIT. Support levels are very high for all technologies except for offshore wind.

Long-term security of support: fair

Long-term security of support is ensured by a FIT duration of 20 to 25 years. Stakeholder processes are ongoing regarding the long-term financing of the feed-in tariffs and some measures of temporary nature (until 2013) have already been implemented.

Hungary

Fulfilment of NREAP policy commitments: No

Hungary did not fulfil its commitments towards RES-E made in the NREAP, particularly since it did not revise its most important support mechanisms for RES-E, the feed-in tariff (METÁR). The revision was initially scheduled for 2011 and has now been ongoing for more than a year. While Hungary did adopt the general framework for the revision it has not yet made a final decision on tariffs and other important rules that would enable the law to take effect. In addition, the Member State stopped its feed-in premium for cogenerated fossil fuel based district heaters. Hungary has not been able to make full use of the budgets available from the EU'S co-financed structural funding schemes.

On the positive side, the Member State simplified administrative procedures, adopted its National Energy Strategy, and approved a grid development plan for 2010 and 2011.

Adequacy of support levels for each technology: fair

Hungary applies a technology-specific feed-in tariff as the main support scheme. The support measures appear sufficient for wind power, biomass, biogas and small-scale hydropower installations. Support for PV systems is insufficient.

Long-term security of support: fair

Feed-in tariffs are guaranteed for 10 years. A revised support scheme was supposed to be introduced by July 2012, but the Progress Report (English version from July 2012) states that the support system is still under revision.

Ireland

Fulfilment of NREAP policy commitments: Yes

Ireland did very well in adopting new RES-E measures between the NREAP and the Progress Report. Among others, the Member State adopted the REFIT 2 and REFIT 3 scheme (superseding REFIT) in early 2012, which are two improved feed-in tariffs for various technologies and biomass respectively. These two feed-in tariffs were introduced after more than two years of closed applications under the REFIT scheme. Ireland also enacted two measures related to the dispatch of RES-E that have important implications. Ireland has not reported on/not achieved progress it has achieved in promoting offshore wind power.

Adequacy of support levels for each technology: fair

Ireland uses a technology-specific FIT to support renewable electricity. Support levels are sufficient for supported technologies. PV and offshore wind are not part of the scheme (yet). In addition, the tax relief for investment in renewable electricity has been extended until 2014.

Long-term security of support: fair

The FIT are guaranteed for a period of 15 years. The current feed-in scheme will be in place until 2015 (REFIT 2 and 3). Before introducing this scheme, there was a considerable delay due to pending state aid clearance from the European Union. This process might lead to complications in the future as well.

Italy

Fulfilment of NREAP policy commitments: Yes

Italy fulfilled its commitment to develop the electricity grid and improve conditions of access to the grid, and to increase integration of RES in buildings (RES obligation in new and refurbished buildings). The solar energy systems premium system was reviewed in 2011 and from 2013 solar systems will be eligible for all-inclusive tariffs. The current support system for RES-E except solar systems (green certificate and all-inclusive tariffs) will be replaced by a new tariff-based support mechanism from 2013.

Adequacy of support levels for each technology: fair

Currently, Italy uses a tradable certificate scheme in combination with FITs for small systems (<1MW) and a FIP scheme for electricity from solar technologies. Support levels are rather high for most technologies, sufficient for solar PV and offshore wind.

Long-term security of support: poor

From 2013, the current support system will be replaced by a tariff system (FIP and/or FIT).

Latvia

Fulfilment of NREAP policy commitments: Partially

Latvia achieved moderate progress in fulfilling its commitments towards adopting new RES-E measures: it opened tenders to support RES-E projects in households and municipal buildings (as planned), and introduced a measure that supports technology conversion from fossil to RES in city/regional local governments and educational establishments, micro, small and medium-sized firms, and scientific institutions. However, it did not adopt its new Law on Renewable Energy that was already in the drafting stage in the NREAP. The new law would entail planned premiums for RES-E generation. The Member State did not revise the regulation on grid connection/
construction/ metering cost either.

Adequacy of support levels for each technology: poor

Latvia's main instrument is a technology-specific FIT allocated through a tendering procedure. However, no new tender rounds are being held between May 2011 and January 2013. For the plants that do already receive support, support levels are sufficient for biogas and quite high for solid biomass. Some plants receive both the FIT and capacity payments for CHP.

Long-term security of support: poor

FITs are paid for 20 years, with a tariff reduction after 10 years for all technologies but solar. There is no time limit on CHP support. Target shares of different renewable technologies have been defined until 2020. However, pausing the tender rounds as is currently done causes uncertainty for investors. For those plants which do already receive support, FIT levels fluctuate with natural gas prices and the exchange rate of EUR and LVL, and is therefore not completely predictable for investors.

Lithuania

Fulfilment of NREAP policy commitments: Partially

Even though Lithuania adopted a handful of new RES-E measures in the period between the NREAP and the Progress Report, the Member State did not report on over 65 measures (of which a great share covers RES-E, particularly with a focus on biomass/biogas etc.) that it initially planned in the NREAP. It is largely unclear from the Progress Report what progress Lithuania achieved in preparing/adopting these measures.

However, some of the planned measures were adopted in the framework of the new Renewable Energy Law in 2011 (decision No. XI-1375) which amends the existing feed-in tariff for RES-E and primarily continues the support of the past; it also introduces several other minor measures such as GO trading and simplified the construction permit issuance procedures for smaller and decentralized installations. It also introduced a measure to ensure power grid access and grid optimization and reduced rates for connecting RES-E power plants to the grid. For RES-E technologies >30kW the Member State replaced the guaranteed feed-in tariff with public tenders; however, there is no concrete regulation yet that implements the tendering scheme.

Adequacy of support levels for each technology: fair

Lithuania applies a technology-specific FIT scheme and investment incentives financed by EU structural funds as the main support instruments. The FIT is planned to be combined with a tendering procedure for plants >30kW. Tariffs paid appear to be sufficient for wind onshore, small hydro, and photovoltaic, whereas the biogas support may be a bit tight. For solid and liquid biomass the support level is insufficient. For offshore wind the same tariff as for onshore wind is applied, which is too low.

Long-term security of support: fair

The FIT is guaranteed for 12 years, the lifetime of the whole scheme is set until the end of 2020. The regulations for the tendering procedure for larger plants should have come into force by January 1, 2012, but no regulation has been adopted so far. A tendering procedure generally increases barriers, especially for small project developers. There is no reliable regulation regarding spatial planning for wind power plants.

Luxembourg

Fulfilment of NREAP policy commitments: Partially

Luxemburg only achieved limited progress in adopting new RES-E measures between the NREAP and the Progress Report: while it adopted a feed-in tariff for the production and processing of biogas and its integration into the natural gas grid, most of the other measures adopted are rather soft measures (studies, information dissemination etc.) without strong impact on RES-E. Moreover, the Member State planned several measures with start dates before and after 2011 in its NREAP; it did not report on the adoption or preparatory work that it is undertaking to implement these measures.

Adequacy of support levels for each technology: fair

Luxembourg applies a technology-specific FIT as the main instrument. Support for PV, solid biomass and biogas is sufficient, support for onshore wind is too low.

Long-term security of support: good

The FIT provides support for 15-20 years.

Malta

Fulfilment of NREAP policy commitments: Partially

Malta has done some progress in adopting RES-E measures between the NREAP and the Progress Report. The introduction of a feed-in tariff for PV installations has replaced the previous net-metering arrangement. Guidelines for micro-wind turbine installations have also been put in place. However, a tender for the installation of PV in public roofs, committed in the NREAP to start in 2010 and expected to have an impact >10MW, has not been implemented.

Adequacy of support levels for each technology: poor

Malta employs a FIT for PV which is rather low. It also applies investment grants. Remuneration for other technologies is also insufficient, except for onshore wind, where there may be some profitable projects.

Long-term security of support: fair

The FIT for PV has a duration of 8 years, grant programmes related to EU Structural funds end in 2013.

The Netherlands

Fulfilment of NREAP policy commitments: Yes

The feed-in SDE+ programme for the promotion of renewable energy production replaced the old SDE in 2011. As from 2013, SDE+ will be funded by a surcharge on the energy bills of citizens and businesses. Regulation to give priority to renewable electricity during grid congestion, which was planned in the NREAP, has been adopted.

Adequacy of support levels for each technology: fair

A technology-specific FIP scheme in combination with a stepped tendering procedure is the main instrument (SDE+). New installations using the cheapest technologies are signed up for support first, applications from costlier technologies are taken if there is still budget left. If a plant does get support, levels are generally sufficient for the most cost efficient plants for most technologies. An exception may be PV, where the level depends on the results of the tendering procedures.

Long-term security of support: poor

SDE+ support has a duration of 12-15 years for those installations which have been approved. The cap for new installations is set annually. The tender process with cap, in addition to frequent support scheme changes in the past, may lead to insecurities for investors.

Poland

Fulfilment of NREAP policy commitments: Partially

Poland only partially fulfilled its commitments towards RES-E that it made in its NREAP: On the one hand, it abolished the obligation of an entity applying for grid connection to submit an expert's opinion on the impact of the source on the grid and replaced it with a system that collects information on activities in the transmission and distribution grid. On the other hand, it did not adopt the Act on Renewable Energy Sources that it announced in its NREAP. This act would have addressed various issues related to RES-E support. Poland plans to optimise its quota system and foster electricity production in micro installations by 2012-2013.

Adequacy of support levels for each technology: poor

Poland applies a technology-neutral quota scheme with TGCs, along with investment grant and low-interest loans. Support for some technologies is therefore exaggerated, for instance small and large hydro, onshore wind, and solid biomass. Support for biogas and offshore wind seems adequate, for PV it is insufficient. A transition to technology-specific support is planned for 2012/2013.

Long-term security of support: fair

Grant programmes under EU Structural Funds will end in 2013. RES installations receive TGC for 15 years.

Portugal

Fulfilment of NREAP policy commitments: No

As a response to the financial crisis and agreements with the IWF and the European Commission, Portugal has initiated several measures that have stopped or reduced RES-E support. Among the most severe measures is a moratorium on its major support scheme, the feed-in tariff scheme that Portugal initiated in January 2012. The Member State also phased out the reduced VAT and other fiscal deductions for

renewable energy equipment. In May 2012 Portugal announced to cut feed-in tariff rates for existing wind power installations. Portugal has not adopted several RES-E measures that it planned in its NREAP either.
On the positive side, Portugal improved and simplified administrative procedures for mini- and micro-RES-E installations.

Adequacy of support levels for each technology: poor
Portugal applies a technology-specific FIT, with support levels rather low, but maybe just sufficient for solid biomass, onshore wind, small hydro. Support is rather high for PV, and insufficient for biogas and for offshore wind, which receives the same support as onshore wind. Support for very small installations had already been reduced more than originally planned due to the economic crisis. In addition, on January 5, 2012, the Council of Ministers voted to suspend any support to new installations.

Long-term security of support: poor
Depending on the technology, tariffs are granted for 15 to 25 years or until a certain amount of electricity output is achieved.

The economic crisis has led to some delays in installing new plants, especially wind and biomass. The suspension further adds to the insecurities investors are facing.

Romania

Fulfilment of NREAP policy commitments: Yes
Romania made more progress in adopting RES-E measures than planned: while the Member State did not commit the adoption of new measures in its NREAP, it adopted the revision of its most important RES-E policy, the quota system (Law No. 220/2008). Among others, the revision established technology-specific support (technology banding). In late 2011/early 2012 Romania also introduced a system of guarantees of origin, and certificates of origin for biomass used as fuel or raw material for RES-E production. In addition, Romania adopted a program that provides grants to companies that invest in RES-E or RES-H&C installations. The financing is granted in an amount of at most 50% of the total eligible value of the project. Romania also adopted the revision as promised (Law No. 220/2008).

Adequacy of support levels for each technology: fair
Romania applies a banded quota scheme with TGCs. Support measures are adequate for offshore wind, PV and biogas, and rather high for solid biomass, small hydro and onshore wind.

Long-term security of support: fair
New plants receive certificates for 15 years. Additional investment grants are financed through European Structural Funds and end in 2013.

Slovakia

Fulfilment of NREAP policy commitments: No

No new RES-E measures have been implemented since the publication of the NREAP. In particular, the establishment of a system of tenders for the construction of plants with fluctuations in electricity production, scheduled to start in 2011 has been postponed to 2013.

Adequacy of support levels for each technology: fair

Slovakia applies a technology-specific FIT scheme. Support levels are adequate for biomass, biogas, and onshore wind, and just enough for PV. Support for small hydro is rather high.

Long-term security of support: fair

Feed-in tariff is guaranteed for 15 years, and no annual production caps exist. Investment grant programmes are linked to EU structural funds and will expire in 2013.

Slovenia

Fulfilment of NREAP policy commitments: Partially

Slovenia has only partially fulfilled its commitments towards RES-E made in the NREAP. While it did adopt a measure on promoting RES-E as part of green public procurement, improved administrative procedures for installing facilities for decentralised electricity generation, and simplified procedures for the construction and operation of PV power plants, the Member State did not report on a series of measures that it initially planned. According to the Member State's Progress Report it did not adopt standardized regulations on tariffs for grid connection for installations <1MWe, and several minor policies that foster RES-E, e.g. through taxation, in buildings, or by integrating biogas into the natural gas network. In November 2010, Slovenia introduced an annual degression of 10% applicable on tariffs for solar power.

Adequacy of support levels for each technology: fair

Slovenia's main instrument is a technology-specific FIP for larger (>5 MW) installations. Small RES installations (<5 MW) may choose between the FIP or a fixed FIT. CHP installations can also receive a FIT or FIP, respectively. Support measures for most RES systems are appropriate or even rather high. Only the support for PV seems too low.

Long-term security of support: fair

Both the FIT and FIP provide support to RES installations for 15 years and to CHP installations for 10 years.

Spain

Fulfilment of NREAP policy commitments: No

In 2010 and 2011 a series of changes were made to the main RES-E instrument in Spain– the existing feed-in remuneration scheme for renewable electricity, then in January 2012 it was eventually suspended because of the burden on the public budget of the solar boom in 2009, 2010 and 2011. This means that there is no more financial support to new RES-E installations in Spain and none is forecasted. Regulation to promote renewable energy production for own use by implementing 'net balance' systems – scheduled for 2011 in the NREAP – has not been adopted. Other RES-E measures planned in the NREAP such as the specific planning of electricity transmission infrastructures linked to marine projects are not mentioned in the progress report.

Adequacy of support levels for each technology: poor

Spain has temporarily put all support for new installations on hold as of January 2012, in order to reduce the "tariff deficit", a government-backed debt accumulated by the big utilities as the real cost increases for electricity (including RES support) had not been passed on to consumers for years. Generally, Spain applies a combined FIT and FIP scheme as its main instrument. Support levels for plants starting operation in 2011 were sufficient for PV, onshore and offshore wind, small hydro, solid biomass, and biogas.

Long-term security of support: poor

In general 25 year of support is given in the main schemes within Spain. However, the temporary interruption of support creates insecurity for investors. Spain has a history of retroactive support cuts for RES as well.

Sweden

Fulfilment of NREAP policy commitments: Yes

Sweden made very good progress in adopting new/revising existing RES-E measures, primarily since it strengthened its principal RES-E support scheme, the quota system (Lag 2003:113). Among others, it raised the quota levels for 2013 and beyond and created a common certificate market with Norway (in force since 2012). The Member State also revised its Emissions Trading Act (ETS) and extended the Programme for Improving Energy Efficiency in Energy Intensive Industries (PFE). In terms of investment aid for solar PV Sweden allocated the same amount as for 2010 and 2011 (SEK 60 mill); the funding is going to be reviewed in 2012.

Adequacy of support levels for each technology: fair

Sweden applies a technology-neutral quota scheme with TGC as its main support scheme. In addition, investment incentives for PV are available. Funding for wind onshore and solid and liquid biomass is sufficient. Biogas funding could be optimized. Funding for PV and wind offshore is insufficient. Sweden and Norway agreed to establish a joint market for electricity certificates from January 2012.

Long-term security of support: fair

RES power plants receive certificates for 15 years under the TGC scheme. Financial support measures for solar PV and biogas are short time arrangements. The PV investment support scheme is scheduled for review in 2012.The biogas scheme has funds allocated until 2013.

United Kingdom

Fulfilment of NREAP policy commitments: Yes

The United Kingdom has fulfilled its commitments in developing and adapting a lot of key policies for RES-E. The planned measure for investments in large electricity capacity (ex-Renewables Obligation) has been changed to the Feed-in-Tariffs with Contract for Difference (CfD), which aims to support professional energy companies in building large power plants with low CO_2 emissions, incl. RES. The program of *Connect and Manage* simplifies the grid connection of RE-E plants, money from Green investment bank can help to overcome investment obstacles and activates private money for green infrastructure. In National Policy Statements, decisions on major E-projects will be decided. All accompanied by existing (even though reduced) FIT for RES-E (lower mainly for PV). The UK has already a lot of RES-E policies in place but reaching the 2020 target will require even further policy efforts.

Adequacy of support levels for each technology: fair

The UK applies a banded quota scheme with TGC as the main support instrument, supplemented by a FIT scheme for small installations. Support levels are sufficient or even a bit high for biomass, biogas, on- and offshore wind and for small hydro, through the Renewables Obligation.

Long-term security of support: fair

The FIT level for small-scale PV was originally set too high, leading to rapid deployment, and an emergency reduction in the FIT level for large and stand-alone installations in August 2011, bringing them closer to actual installation costs. Under the quota system, installations receive TGC for 20 years. However, changes in the support system such as the planned introduction of a FIP scheme ("Contract for Difference") lead to insecurity for investors.

Assessment of RES-H&C policies and measures

A summary of the MS assessment is presented in Table 16. Here we present the figures for the assessment of question 2 for the RES-H&C technologies as well as country paragraphs explaining the assessments on the 3 questions.

Most Member States apply investment grants as their main support instrument in the RES-H&C sector. Other common instruments are tax exemptions/reductions or soft loans. The UK has introduced a new instrument called the Renewable Heat Incentive, which works much like a FIT for heat. However, some RES-H&C technologies are already financially competitive in some Member States. Some Member States have already introduced RES quotas for new buildings or those undergoing major renovation, even though the RES Directive only makes this mandatory from 2014.

The following figures give an overview over the generation cost and remuneration for the owners of centralised and decentralised biomass heating plants, solar thermal installations and ground-source heat pumps. Adequate financial incentives alone, however, do not guarantee the effectiveness of a support scheme. They must be combined with favourable framework conditions that minimise administrative, psychological, and other barriers.

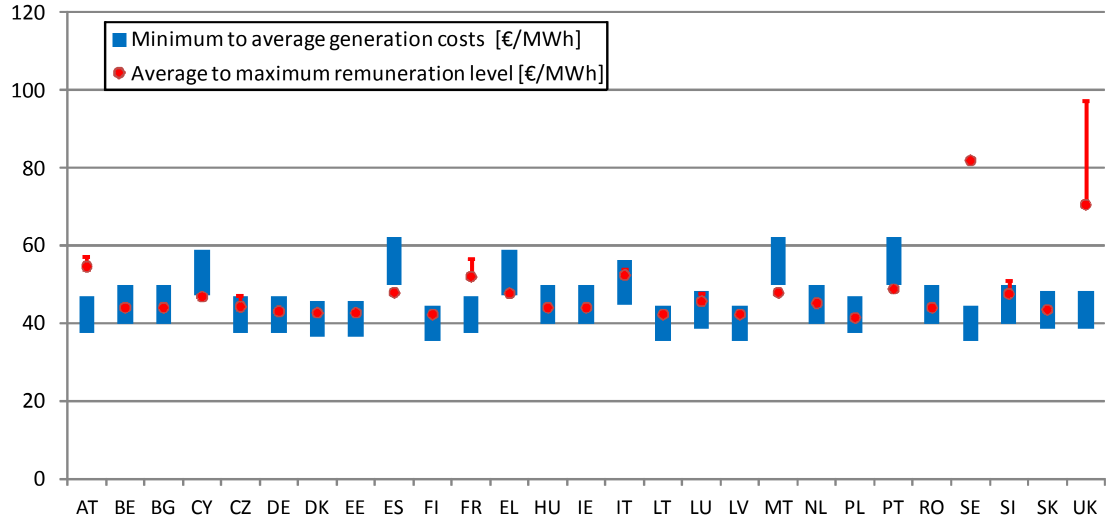


Figure 82. Remuneration ranges (average to maximum remuneration) for centralised biomass heating plants in the EU-27 MS in 2011 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs).

The above figure shows the range of remuneration levels compared to generation costs. District heating by RES in this section typically refers to large biomass plants, which produce centralised heat for a heating grid. Most Member States provide adequate remuneration, with rather high levels in Sweden, which applies tax exemptions, and the UK with its renewable heat incentive.

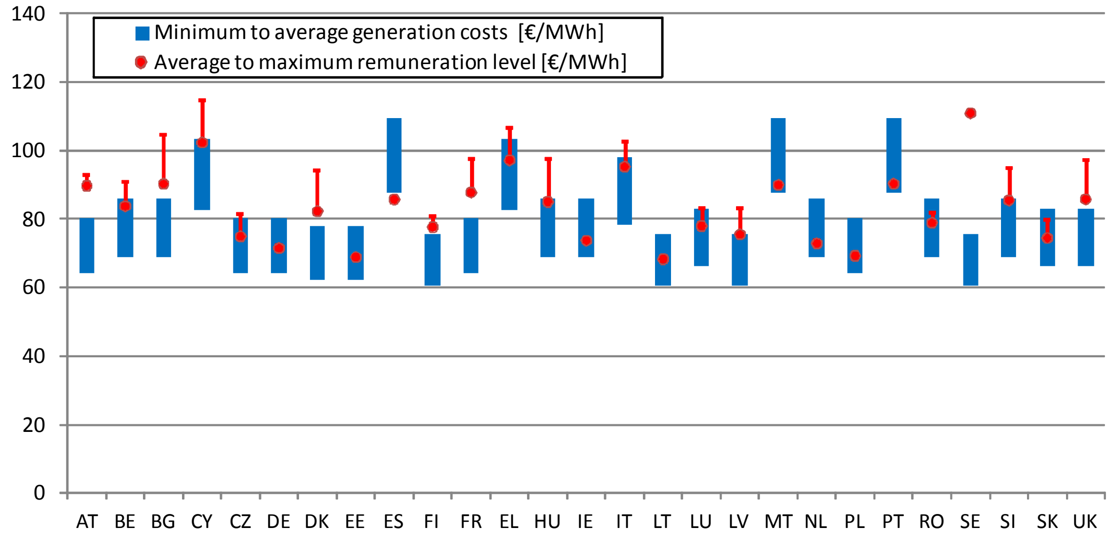


Figure 83. Remuneration ranges (average to maximum remuneration) for decentralised biomass heating plants in the EU-27 MS in 2011 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs).

Non-grid or decentralised biomass includes decentralised heating systems based on pellets, wood chips and log wood. In 2011, most Member States provided for adequate remuneration levels, with the exception of Spain, where remuneration was rather low. Levels were higher than necessary in Austria, Bulgaria, Denmark, Finland, France, and the UK.

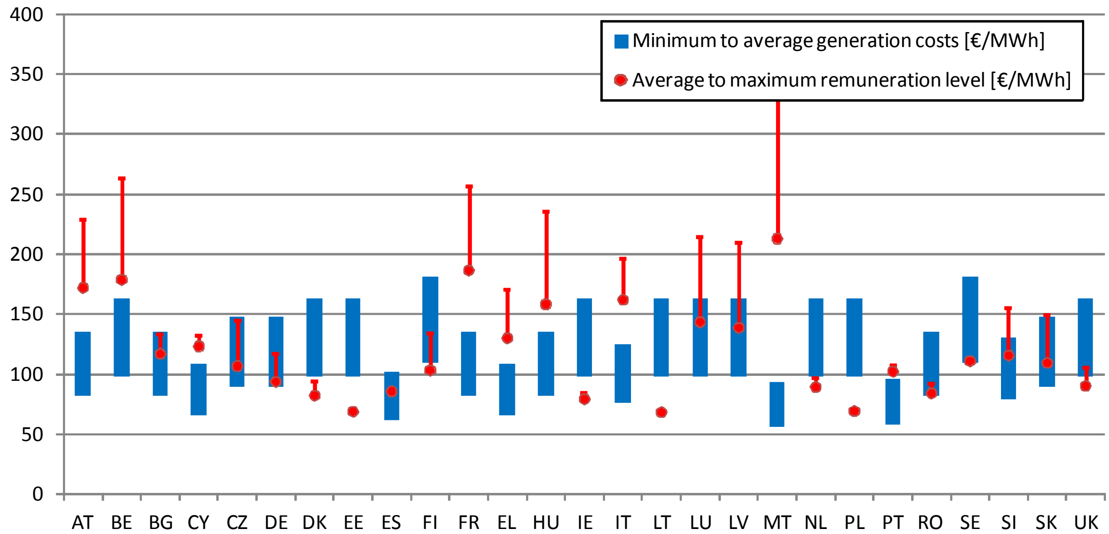


Figure 84. Remuneration ranges (average to maximum remuneration) for solar thermal heating plants in the EU-27 MS in 2011 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs).

The picture for solar-thermal installations is mixed, as some Member States apply rather high support leading to remuneration levels above generation cost, such as Austria, Belgium, Cyprus, France, Greece, Hungary, Italy, and Malta, while remuneration is too low in other Member States.

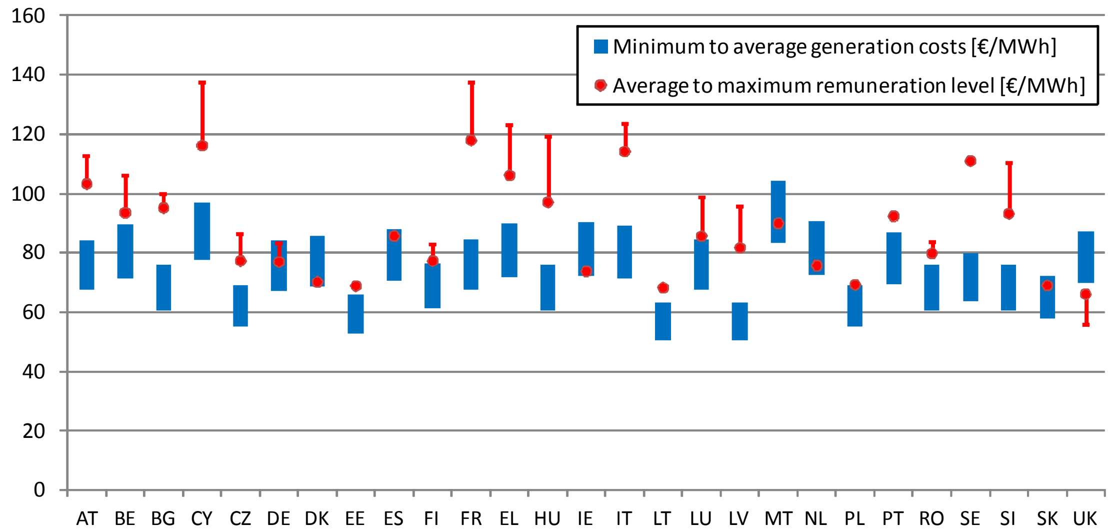


Figure 85. Remuneration ranges (average to maximum remuneration) for ground-source heat pumps in the EU-27 MS in 2011 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs).

Ground-source heat pumps are profitable in all Member States, with the exception of the Renewable Heat Incentive scheme in the UK, which provides slightly too little support. Remuneration is higher than necessary in a number of Member States.

The country paragraphs below explain the assessments presented in Table 16 and provide details on individual Member States RES-H&C policies and measures.

Austria

Fulfilment of NREAP policy commitments: No

Austria's progress in adopting new RES-H&C measures has been very limited in the time between the NREAP and the First Progress Report. While it adopted 3 measures that affect RES-H&C, none of them target RES-H&C only and none of them can be considered to have a large impact on RES-H&C support. At the same time, Austria has not implemented a large number of planned measures that would have promoted RES-H&C in buildings: among these are updated building regulations, an energy efficiency act or the increased use of district heating and cooling.

Adequacy of support levels for each technology: good

The support level is sufficient (rather high) for heat pumps, biomass, solar thermal heat and district heating. Investment grants are used as the main support instrument.

Long-term security of support: good

There is some support on the national level, but regional support schemes constitute the main pillar of RES-H&C support in Austria. Support schemes vary, but in general the system is very mature and may therefore be assumed to be stable.

Belgium

Fulfilment of NREAP policy commitments: Yes

Belgium did not plan measures for improved RES-H&C support, yet the regions adopted a handful of new measures in order to do so. Wallonia amended its support scheme for solar thermal energy (SOLTHERM) and adopted a two-year grant for biomass heaters; Flanders adopted the Green Heat Action Plan which offers financial aid to RES-H&C appliances (e.g. water heaters). Bruxelles Capitale only adopted informative measures for RES-H&C. The federal level did not further develop provisions to promote energy efficiency and renewable energy in public buildings.

Adequacy of support levels for each technology: good

Support levels are sufficient for centralised and decentralised biomass, solar thermal and heat pump installations. No RES obligation for buildings exists, but some large (>1000 m^2) new buildings have to conduct a RES feasibility study.

Long-term security of support: fair

Support measures are reviewed periodically.

Bulgaria

Fulfilment of NREAP policy commitments: Partially

Bulgaria's progress in adopting new RES-H&C measures has been limited, primarily since Bulgaria has not adopted many of the measures it had planned in its NREAP. As for RES-E, many RES-H&C measures were scheduled to start in 2011.

On the positive side, Bulgaria adopted a support scheme for RES-H&C in residential and public buildings, which obliges new and renovated buildings to use at least 15% of RES. It also extended a credit line and set up a fund for energy efficiency and renewable energy in buildings. However, with respect to the building obligation there is great doubt that Bulgarian authorities will observe, let alone enforce the law.

Adequacy of support levels for each technology: fair

Remuneration levels are sufficient for biomass, and solar thermal, and even rather high for heat pumps. Investment grants are used as the main support instrument. An obligation for RES in buildings was planned to be introduced in 2011. The measure is however still in the planning phase.

Long-term security of support: fair

The grants for biomass are given under the Rural Development Program which is implemented from 2007 to 2013. The Residential Energy Efficiency Line is guaranteed so far until July 2014.

Cyprus

Fulfilment of NREAP policy commitments: Partially

Cyprus did not plan the adoption/revision of any RES-H&C measures in its NREAP and did not adopt any important new measure. However, Cyprus amended some of its grant programs for RES-H&C: there were improvements as well as deteriorations (max. grant increases and cuts). According to its Progress Report the Member State intends to overhaul its buildings regulation in order to incentivize a stronger use of RES.

Adequacy of support levels for each technology: fair

Cyprus applies investment grants as the main support instrument. Remuneration levels are adequate for centralised and decentralised biomass, and higher than necessary for solar-thermal installations and heat pumps.

Long-term security of support: fair

RES-H&C support runs under the same subsidy frameworks as RES-E. No end date is mentioned for the frameworks.

Czech Republic

Fulfilment of NREAP policy commitments: Partially

The Czech Republic fulfilled its commitments towards RES-H&C, mainly because it did not plan the adoption of new major measures. The new Act 165/2012 on the Promotion of Renewable Energy Sources adopted in 2012 includes provisions for a new support for RES-H&C, but the impact remains uncertain since it relies on implementation decisions. The Czech Republic has no buildings obligation in place; much of the RES-H&C support is provided through grants (co-funded by EU fund).

Adequacy of support levels for each technology: fair

The Czech Republic currently supports mainly cogeneration (CHP) installations. Some investment grants are available for solar-thermal installations and heat pumps. Remuneration levels are adequate for centralised and decentralised biomass, solar-thermal and heat pumps.

Long-term security of support: fair

A new legislation on RES support has been passed in May 2012 which foresees extended coverage of support for RES-H&C installations. Some details are still unsure until the relevant sub-legislation has been passed.

Denmark

Fulfilment of NREAP policy commitments: No

The only RES-H&C measures that Denmark planned in its NREAP are those on increased biogas and energy crops production (apply for RES-E as well). Denmark has not adopted these measures.

Adequacy of support levels for each technology: fair

Denmark uses tax exemptions to support biomass heating. Investment grants for a broader range of technologies were abolished in July 2011. The support level (in combination with the costs of conventional heating) is sufficient for all technologies but solar thermal where the tariff is slightly too low. There is no obligation to use RES in buildings. However, Denmark has obligators standards for (fossil) energy consumption of new buildings. Furthermore, local authorities can require tighter standards for the use of RES.

Long-term security of support: good

The costs for conventional heating will probably not decrease substantially. Furthermore, the tax exemptions have already been in place since 1996. Thus, the support level seems to be very stable.

Estonia

Fulfilment of NREAP policy commitments: Yes

Estonia did not plan new RES-H&C measures in its NREAP and did not adopt any new H&C measures. Currently, there are no measures in place that provide financial support to RES-H&C. Estonia will need to be more committed in adopting new, effective RES-H&C measures.

Adequacy of support levels for each technology: fair

Estonia offers loans at special conditions for renewable heating projects. The price level for decentralised heat is sufficient for investments into heat pumps and lower cost decentralised biomass. It is far below solar thermal heat generation costs. Currently there is no RES Obligation for the building sector. Minimum energy performance requirements of buildings have been in place since 2007.

Long-term security of support: fair

The last application round for measures funded by ERDF was held in 2009. Further support for RES-H is based on the Green Investment Scheme according to article 17 of the Kyoto Protocol and depends on CO_2 quota sales. Special purpose loans are also available from the Environmental Investment Centre, sourced from the state budget.

Finland

Fulfilment of NREAP policy commitments: Yes

Finland's progress in adopting new RES-H&C measures between the NREAP and the First Progress Report is adequate: it adopted several new measures, even though most of them also cover the RES-E sector (among them is the new renewable energy law that provides support for CHP installations and the promotion of biomass). However, Finland is still lacking effective measures in RES-H&C such as a measure that mandates dwellings to use RES.

Adequacy of support levels for each technology: fair

Remuneration level for centralised and decentralised biomass heating, heat pumps and solar thermal installations are sufficient. The new energy regulations of 2012 impose a minimum 25% share of RES in the energy used for heating of new buildings.

Long-term security of support: fair

RES-H support measures are financed from the state budget.

France

Fulfilment of NREAP policy commitments: Partially

France achieved fair progress in the adoption of new RES-H&C measures: on the one hand, it adopted some important new measures but on the other hand it also phased out existing or did not adopt some that it initially planned.

In 2011 France adopted the Thermal Regulation 2012 (Réglementation Thermique) which replaced the Thermal Regulation 2005. The measure sets stricter standards for energy efficiency in public buildings (effective since October 2011) and residential buildings (effective by January 2013). France also adopted a measure that mandates the buyback of bio methane injected in gas networks and extended the duration of grants for heating/cooling installations. At the same time, however, France stopped allowing the combination between the the tax deduction benefits for investments in heating/cooling installations that use renewable energy ("Eco-Pret à Taux Zero") and the zero interest loan ("Credit d'Impot Developpement Durable").

Adequacy of support levels for each technology: fair

France uses investment grants (Fonds Chaleur), tax incentives and tax credits for supporting renewable heat projects. The support level is rather too high for all technologies even without considering the tax credits. No RES obligation for buildings is in place. So far, only a system of high energy performance labels is used to encourage low energy consumption and RES.

Long-term security of support: fair

According to the NREAP, support measures are planned to remain in place for the entire period until 2020. Tax credits were however reduced for most technologies due to the restricted state budget.

Germany

Fulfilment of NREAP policy commitments: Yes

Germany did well in adopting new RES-H&C measures between the NREAP and the Progress Report: it revised its law to promote renewable energy in heating and cooling (Erneuerbare-Energien-WärmeGesetz, EEWärmeG), which now mandates new public buildings or those that undergo major renovation to comply with higher standards; it did not, however, introduce stricter standards for private buildings. Germany also revised measures that provide financial support for energy efficiency in buildings.

Adequacy of support levels for each technology: good

Germany uses investment grants and credits with special conditions to support RES-H&C. Support levels are sufficient for all technologies. There is a RES obligation of 15% -50% (depending on the technology used) for new buildings. Existing buildings that are owned or rented by the public and renovated are required to source 15% (25% when gaseous biomass is used) of heating and cooling demand from renewable sources.

Long-term security of support: good

Long-term security is ensured by the fact that prices for conventional heating are unlikely to sink in the future.

Greece

Fulfilment of NREAP policy commitments: Yes

Greece has exceeded its commitments on RES-H&C made in the NREAP, having adopted more measures than planned. Among others, the Member State approved the Energy Performance of Buildings Regulation, adopted a measure on the inclusion of the use of solid biomass (pellets, woodchips, etc.) to the permitted fuels for heating purposes in urban areas, and introduced tax reliefs on the purchase and installation of RES systems for heating. There are several new measures that address RES-H&C indirectly.

Adequacy of support levels for each technology: fair

Greece uses investment grants and tax reliefs to support RES-. Support levels are sufficient for all technologies. In the case of heat pumps and solar thermal, support levels appear very high. According to the Energy Performance of Buildings Regulation (KENAK) new and refurbished houses are required to provide 60% of their hot water consumption with solar panels or other systems based on renewable sources.

Long-term security of support: good

RES-H&C are competitive when compared to conventional heating prices. In combination with the RES obligation for buildings, this seems to guarantee long-term development even if investment grants and tax reliefs were abolished.

Hungary

Fulfilment of NREAP policy commitments: No

Hungary was not able to fulfil its commitments towards RES-H&C, primarily because it did not adopt a planned support scheme for RES-H&C. This scheme was scheduled for adoption in late 2010. Additionally, the planned revision of the feed-in tariff (METÁR) would have introduced bonuses for RES-based H&C installations (biomass/geothermal) on top of the feed-in tariffs that had existed for cogeneration. These bonuses have not been introduced.

Adequacy of support levels for each technology: fair

The new RES-E support scheme (FIT) is currently still under revision but is expected to include a heating and cooling bonus for CHP installations. For now, RES-H&C is mainly supported by investment grants. Remuneration is adequate for centralised and decentralised biomass heating, and a bit high for solar-thermal and heat pump installations.

Long-term security of support: fair

Investment grants are partly linked to EU structural funds and therefore only run until 2013. Others are linked to the Green Investment Scheme which is dependent on sales of CO_2 emission rights.

Ireland

Fulfilment of NREAP policy commitments: Partially

Ireland has achieved fair to limited policy progress in RES-H&C between the NREAP and the Progress Report, mainly since the Member State closed several programs due to budgetary constraints. For instance, the Greener Homes Scheme has been unavailable for new applications since 2011 just as well as the Renewable Heat Deployment Programme and the Biomass CHP/Anaerobic Digestion CHP Call for Proposals. On the positive side, the REFIT 3 scheme is providing support for CHP in biomass plants and the Better Energy Homes allocates some limited funds to solar thermal installations (the latter is in place since May 2011). Ireland did not adopt a new Planning and Development Act as planned in the NREAP.

Adequacy of support levels for each technology: fair

Ireland expects that the biomass CHP feed-in tariff will also support renewable heat development. A number of grant programs were closed due to budgetary constraints. Solar thermal technology is supported by investment grants and some renewable technologies are eligible for tax reliefs. New buildings must provide either 4kWh/m²/year of renewable electricity or 10kWh/m²/year of renewable heating and cooling or a combination of both.

Long-term security of support: fair

Heating costs are sufficient to make renewable heating (except for solar thermal) economically viable. Due to budgetary constraints, grant programs were reduced. The

Irish Government plans to closely monitor the development in the RES-H sector and introduce additional support measures if necessary for reaching the targets.

Italy

Fulfilment of NREAP policy commitments: Yes

Italy fulfilled its commitment to reform existing support schemes for RES-H&C (e.g. white certificates, tax exemptions) and to adopt new incentives for district heating and the integration of RES in buildings. New support is also planned for the connection of bio-methane to the natural gas network and for the production of thermal energy from RE.

Adequacy of support levels for each technology: fair

Italy uses a White Certificate Scheme and tax rebates to support renewable heat. Support levels are sufficient for all technologies and rather high for solar thermal and heat pumps. New and refurbished building must cover 50% of their energy consumption for hot water and 20% (35% from 2014, 50 % from 2017) of total heating and cooling from renewable sources. For public buildings, obligations are increased by 10%.

Long-term security of support: fair

White certificates are valid for a period of 5 years, tax deductions must be spread over a period of 10 years. The tax deduction scheme must be renewed for every financial year. Targets for the White Certificate Scheme are set until 2020. Furthermore, heating costs make all renewable technologies but biomass heating almost competitive even without support measures.

Latvia

Fulfilment of NREAP policy commitments: Partially

Latvia partly fulfilled its commitments towards adopting new RES-H&C measures: on the one hand it opened (scheduled) tenders that support RES-H&C (and RES-E) projects; on the other hand it is still planning a variety of important measures as it already did in its NREAP (no progress observable).

These tenders support RES-H&C (and RES-E) projects in households and municipal buildings; Latvia also introduced a measure that supports technology conversion from fossil to RES in city/regional local governments and educational establishments, micro, small and medium-sized firms, and scientific institutions. However, the Member State did not adopt its new Law on Renewable Energy that would have contained support measures for RES-H&C. The Member state did not achieve progress in adopting measures that support installations that utilise biomass, biogas or bio liquids for heat generation, that provide aid for increasing efficiency of heat generation by reducing heat losses in transmission and distribution systems, or which support new or fossil-fuel-replacing biomass plants for heat generation with capacity above 10 MW. Latvia has no building obligation in place.

Adequacy of support levels for each technology: fair

There are no specific support instruments for RES-H apart from financial support from the Cohesion Fund and irregular tenders financed by revenues from selling GHG savings under the Kyoto mechanisms. No RES obligation for buildings is in place.

Long-term security of support: fair

Heating costs alone is sufficient to guarantee economic viability of district heating connections, biomass heating systems and heat pumps. Solar thermal heat generation is not viable without additional support. Investment grants are limited to available financing and thus not guaranteed to be available in the longer term. However, as most technologies are competitive at current heating costs, long term security of support is not necessary.

Lithuania

Fulfilment of NREAP policy commitments: No

As for RES-E, Lithuania did not report on a number of RES-H&C measures that it initially planned in the NREAP. While the new Renewable Energy Law (decision No. XI-1375) is important for RES-H&C support, most of the other RES-H&C measures adopted will likely not have great impact on RES-H&C in the country (e.g. a measure to increase the use of felling waste of an analysis of final energy in households).

Most of Lithuania's RES-H support is based on governmental budget or revenues from the sale of GHG allowances. This framework does not ensure a very stable environment.

Adequacy of support levels for each technology: fair

Market prices for decentralised heat seem to be sufficiently high to stimulate investments into heat pumps and lower cost decentralised biomass, but not enough for solar-thermal installations. The drafting of technical regulation regarding the construction requirements for low-energy buildings is underway. It was originally planned for 2012.

Long-term security of support: poor

Long-term security of support measures is doubtful. Structural funds and the Lithuanian Rural Development Programme expire in 2013. The Lithuanian Environmental Investment Fund was suspended between 04/2009 and late 2010 due to the economic crisis. It is now operating normally again, but such interruptions have an effect on investor confidence.

Luxembourg

Fulfilment of NREAP policy commitments: No

As for RES-E, Luxemburg achieved very limited progress in adopting new RES-H&C measures. No measure passed by parliament between the NREAP and the Progress Report will likely have a large impact on RES-H&C support in the country. Even though Luxemburg plans stricter standards for energy efficiency in buildings to be adopted in July 2012, there are several measures that it planned in its NREAP and which have not been adopted yet or concretized.

Adequacy of support levels for each technology: good

The support provided to RES-H&C installations via investment grants is sufficient for decentralised and centralised heat, solar-thermal and heat pump installations. There is currently no RES obligation for buildings. RES are considered in energy certificates for buildings, however.

Long-term security of support: good

Some grant programmes are equipped with an end date, other are regularly reviewed.

Malta

Fulfilment of NREAP policy commitments: Partially

Malta has done some progress in adopting RES-H&C measures between the NREAP and the Progress Report. During this period Malta has implemented measures for the use of bio-fuels in heating and generation, energy performance regulations in the building sector, as well as a programme for training and certification of installers; It did not, however, implement measures for the promotion of CHP that were committed in the NREAP.

Adequacy of support levels for each technology: fair

The main support for RES-H&C is provided via investment grants, which are generally sufficient for heat pumps and decentralised biomass, but rather low for decentralised biomass and very high for solar thermal applications.

Long-term security of support: fair

Support is almost always linked to the state budget. Grant schemes supported by European Rural Development Funds run out in 2013.

The Netherlands

Fulfilment of NREAP policy commitments: Partially

No new measures were planned in the NREAP. From 2012 onwards, RES-H projects are eligible for support under the new feed-in SDE+ scheme. However, subsidies for renewable heat in households were cancelled in February 2011, before the end of the scheme.

Adequacy of support levels for each technology: fair

RES-H&C is supported by tax exemptions. Remuneration levels are sufficient for solid centralised and decentralised biomass and heat pumps, and just barely enough for solar-thermal installations.

Long-term security of support: fair

Support schemes have experienced frequent changes in the past, leading to insecurities for investors.

Poland

Fulfilment of NREAP policy commitments: No

Poland did not fulfil the commitments made in its NREAP. The central measure planned to be adopted in order to promote RES-H&C was the Act on Renewable Energy Sources Poland. The Member State did not adopt this act or another RES-H&C measure according to its First Progress Report.

Adequacy of support levels for each technology: fair

Remuneration levels are sufficient for centralised and decentralised biomass and for heat pumps, but not for solar-thermal installations.

Long-term security of support: fair

Grant programmes under EU Structural Funds will end in 2013. RES installations receive TGC for 15 years.

Portugal

Fulfilment of NREAP policy commitments: No

As a response to the financial crisis and agreements with the IWF and the European Commission, Portugal has initiated several measures that have stopped or reduced RES-H&C support. The phase out of reduced VAT and other fiscal deductions for renewable energy equipment also affects RES-H&C, particularly solar thermal heating installations, heat pumps and other energy efficiency equipment. Since 2011, there is no fiscal support for RES-H&C anymore.

Portugal has not adopted several RES-H&C measures that it planned in its NREAP.

Adequacy of support levels for each technology: fair

Portugal supports RES-H&C by investment grants and tax incentives. There were no tender rounds for support in 2011, however. Even without only the tax incentives, remuneration seems still rather high for solar thermal installations and heat pumps, but not attractive for centralised and decentralised biomass installations.

Long-term security of support: poor

Financial support campaigns for solar panels in homes were run in 2009, another one for SME was conducted in 2010. Both were successful, however there is no long-term security. In 2011, there were no tendering rounds.

Romania

Fulfilment of NREAP policy commitments: Yes

Romania outmatched its pledges for RES-H&C: while in its NREAP it did not plan any measures, it adopted the "Green Home Programme" in 2010. This program provides grants for installation of heating systems for natural persons and legal persons without economic activities. An additional program provides grants for RES-H&C measures to companies.

However, Romania is missing other effective measures that would incentivize strong deployment of RES-H&C, such regulations for the mandatory use of RES-H&C in buildings, district heating, small scale heating or industrial applications.

Adequacy of support levels for each technology: good

Support levels are adequate for centralised and decentralised biomass, solar thermal installations and heat pumps. No RES obligation for buildings exists.

Long-term security of support: fair

Investment incentives under the environmental fund are not equipped with an end date. Incentives from the structural fund will end in 2013.

Slovakia

Fulfilment of NREAP policy commitments: No

No new RES-H&C measures have been implemented since the publication of the NREAP. Several RES-H&C measures scheduled to start in 2011 had not been implemented at the time of publication of the Progress Report. Among these are the support for cultivation of fast- growing woody plant and the support for RES in the construction sector.

Adequacy of support levels for each technology: good

Support for decentralised biomass and solar-thermal installations is sufficient. Heat pumps and decentralised biomass are attractive without additional support. A RES obligation for new buildings is planned from 2013.

Long-term security of support: fair

Support is financed from the state budget and planned until 2015.

Slovenia

Fulfilment of NREAP policy commitments: Partially

Slovenia partly fulfilled its NREAP commitments towards RES-H&C: on the one hand, the Member State revised an existing measure to increase the use of heat pumps in households, reinforced obligatory shares of RES in district heating systems, and adopted stricter standards for RES in new and renovated buildings (name of the law: PURES). On the other hand, Slovenia did not adopt other planned measures of which most are cross-sector (see RES-E). Slovenia intends to adopt a major feed-in support scheme for RES-H&C by 2014.

Adequacy of support levels for each technology: good

Heating systems are mainly supported by investment grants. Support for decentralized and centralised biomass, heat pumps, and solar thermal installations is adequate. In accordance with the EU directive on the energy performance in buildings, the Rules on the Efficient Use of Energy in Buildings (PURES, OGRS, No 52/10) entered into force in July 2010 and stipulate that 25% of energy in new buildings be provided from RES.

Long-term security of support: fair

Grant programmes for biomass boilers and for district heating run until 2015. No end date is mentioned for loan/financial incentive programmes for biomass boilers and solar collectors started in 2008.

Spain

Fulfilment of NREAP policy commitments: No

The development of a renewable heat incentive system (ICAREN) for thermal renewable energies – with an expected impact of 709 ktoe – expected to start in 2012, is not mentioned in the progress report. Similarly, the creation of a registry of 'Renewable Thermal Installations and other Renewable Energies not subject to the special Renewable Energy Regime' was planned for 2011 in the NREAP but progress has not been reported. However, the Spanish government has adopted a new financing scheme – GIT (Grandes Instalaciones Termicas) – to support the installation of large thermal installations in the building sector.

Adequacy of support levels for each technology: fair

RES-H&C in Spain is mainly supported under the Technical Building Code, which requires any new or renovated buildings to integrate a solar-thermal installation. RES-E support in CHP units supports renewable heating indirectly. Heat prices alone are enough to make solar-thermal installations and heat pumps competitive, but are a bit too low to incentivise district or decentralised biomass heating.

Long-term security of support: fair

New CHP units will also be affected by the moratorium on RES-E support. Overall, however, the sufficiently high heat prices and the Building Code provide a reasonably secure framework for RES-H.

Sweden

Fulfilment of NREAP policy commitments: Yes

Sweden adopted more RES-H&C measures than planned (most of them are not RES-H&C exclusive). The Member State extended its investment aid scheme for solar heating for another year until the end of 2011 but will abandon it afterwards. It also extended funds for the promotion of biogas and other renewable gases (affecting the RES-E sector as well). Revised and changed levels of energy taxes (part of the Energy Tax Act) are affecting RES-H&C as well.

Adequacy of support levels for each technology: good

Energy and CO_2 tax exemptions are the main RES-H support instrument in Sweden. Support levels for centralised and decentralised biomass and heat pumps are rather high. Support for solar-thermal installations is sufficient. The EU directive for energy performance in buildings has been implemented in Sweden and includes requirements to take RES into account.

Long-term security of support: good

No end date is given for the tax exemption scheme.

United Kingdom

Fulfilment of NREAP policy commitments: Yes

The United Kingdom has implemented a new system for supporting RES-H for industrial and commercial processes, the Renewable Heat Incentive (RHI; adopted in November 2011). This innovative feed-in tariff for RES-H will also support private sector investments from October 2012 onwards and is supplemented by a premium payment until March 2012. It will be necessary to evaluate the functionality of the RHI in the coming years. UK focuses on zero buildings to reduce the heating and cooling demand in the future. From 2016 (domestic) and 2019 (non-domestic), new buildings should not add extra carbon emissions to the atmosphere.

Adequacy of support levels for each technology: good

The Renewable Heat Incentive (RHI) provides per-kWh-support. It opened for applications at the end of November 2011. Phase 1 offers technology-specific support for non-domestic installations, phase 2 will include domestic installations as well. The support level for solar-thermal installations and for centralised biomass appears sufficient. Support for heat pumps is rather low, support for decentralised biomass is rather high. A building regulation exists already. New homes (from 2016) and new non-domestic buildings (from 2019) should not add extra carbon emissions to the atmosphere. Possible changes for 2013 will be published in 2012.

Long-term security of support: fair

Phase 1 of the RHI scheme grants support for 20 years. The scheme is innovative and promising, but still has to prove itself in practice.

Assessment of RES-T policies and measures

A summary of the MS assessment is presented in Table 16. Here we present the figures for the assessment of question 2 for the RES-T technologies as well as country paragraphs explaining the assessments on the 3 questions.

Although RES-T in principle also involves renewable electricity applied in transport, this is barely incentivised in Member States. Some countries do have a considerable application of renewable electricity in transport (see Section 1.2) but it concerns unmodified transport modes (existing trains, trams and trolley busses) sourcing from a grid that contains a large fraction of RES-E. The few incentives that specifically target the increased implementation of renewable electricity in transport are limited to subsidising supporting infrastructure, such as charging points and improving the attractiveness of electric vehicles.

The lion's share of RES-T instruments relate to biofuels. Often, but not always, the instruments make the distinction between application of biofuels in the gasoline sector and in the diesel sector. There is a patchwork of instruments in the EU, the most important being excise reduction measures and mandates. However, there are many variations. Germany combines an excise reduction scheme for some biofuels with mandates for other biofuels. France operates a hybrid between a mandate and an excise reduction. Sweden operates a mandate on gas station level, where each gas station is mandated to sell an alternative fuel, whereas all other mandates specify annual sales for oil companies as fractions of the annual petroleum sales. Bulgaria specifies that each oil company is obliged to offer low biofuel blends. Greece specifies that all biofuels produced within the country have to be sold by the oil companies. Excise reductions are often limited to a certain volume of sales (quota) or to a certain blend fraction.

In analogy with the analysis of the efficiency of RES-E and RES-H&C incentives earlier in this section, we have analysed biofuels incentives and derived a level of remuneration expressed in €/GJ. Although there are many instruments to subsidise specific stakeholders, technologies and/or parts of the biofuel supply chain, we have focused on the mandate and the excise reduction, which are the instruments that contribute most to the deployment of biofuels, and therefore in 2010 contribute most to the deployment of RES-T.

The mandate and the excise reduction instruments are placed perpendicular. The excise reduction instrument sets a price, from which a volume follows, which could in turn be maximised by e.g. a quota. The mandate instrument however sets a volume, from which a price follows, which could in turn be maximised by a buy-out price.

For the purpose of the analysis, we have derived a remuneration from the instrument:

- In case of an excise reduction measure, the remuneration follows from adding the excise reduction to the alternative fossil fuel price (gasoline or diesel) without taxes;
- In case of a mandate, the remuneration follows from adding the buy-out price to the alternative fossil fuel price without taxes;
    - In many Member States, mandates do not have buy-out prices. In that case, we suppose that non-compliance with the mandate has more severe consequences. Therefore we have assumed a virtual buy-out price considerably above the highest buy-out price found.

Technically, both an excise reduction, a buy-out price or a penalty are not really remunerations, but rather a price advantage compared to those who do not put biofuels on the market. This does not matter for the purpose of the analysis.

The generation costs of bioethanol and biodiesel have been assumed as the range of reported biofuel 2010 market prices in the EU. Contrary to generation costs in RES-E and RES-T above, we have not explored the future cost projections for biofuels, since they are mainly dependent on unpredictable agricultural commodity prices. Existing studies that explore the future biofuels production costs are focussing on cellulose biofuels, with production costs detached from common agriculture. It still takes at least several years until such fuels play a significant role in setting the biofuels market price. Over the past years, prices of agricultural commodities have increased strongly, with unexpected price spikes (see section 4.6 on food prices & affordability for some explanations).

We have not assumed geographical differences between biofuels prices, because price variations during the year are larger than differences between Member States.

The following figures compare generation costs to remuneration for RES-T biofuels as a whole and for ethanol and biodiesel separately.

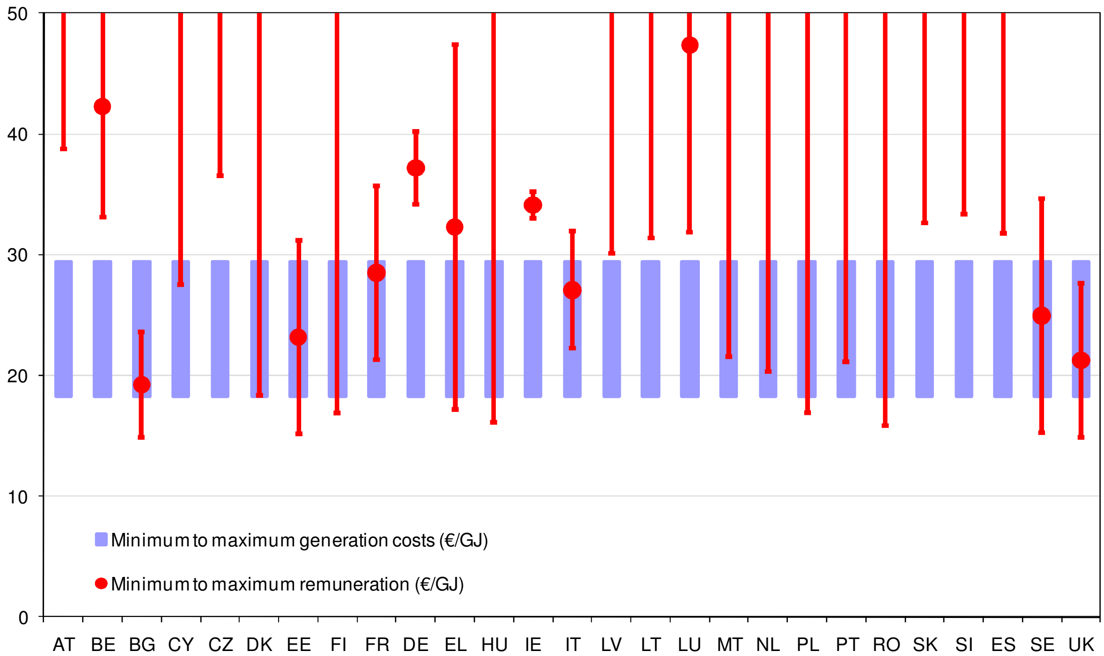


Figure 86. Remuneration ranges (minimum to maximum remuneration) for liquid biofuels for transport in the EU-27 MS in 2010 (average tariffs are indicative) compared to the 2010 marginal generation costs (minimum to maximum costs).

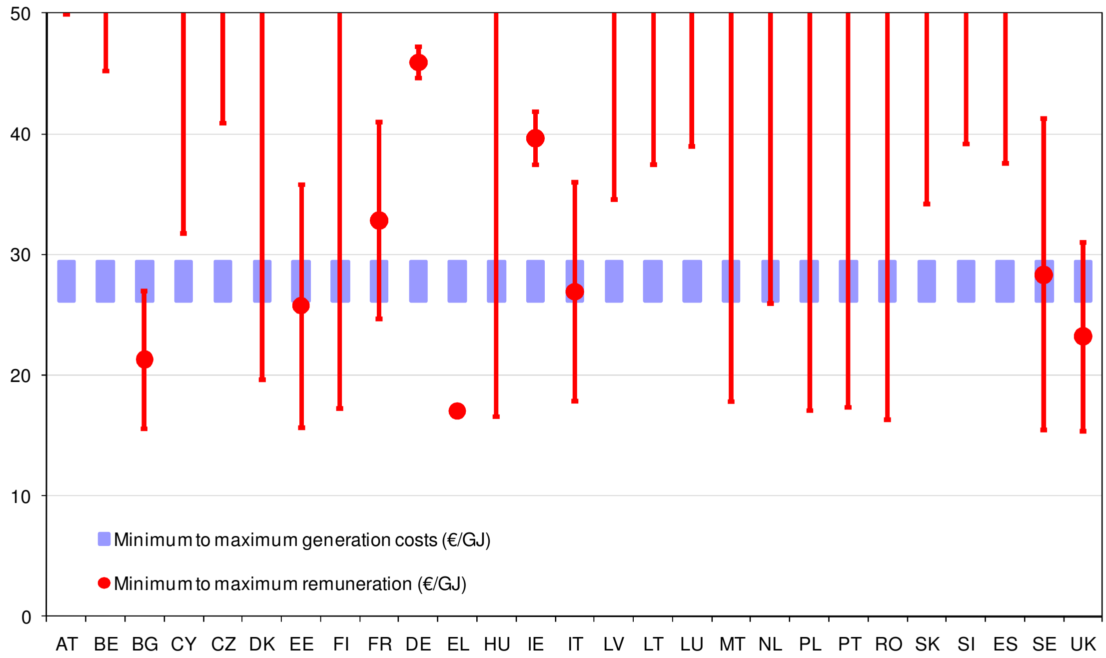


Figure 87. Remuneration ranges (minimum to maximum remuneration) for bioethanol for transport in the EU-27 MS in 2010 (average tariffs are indicative) compared to the 2010 marginal generation costs (minimum to maximum costs).

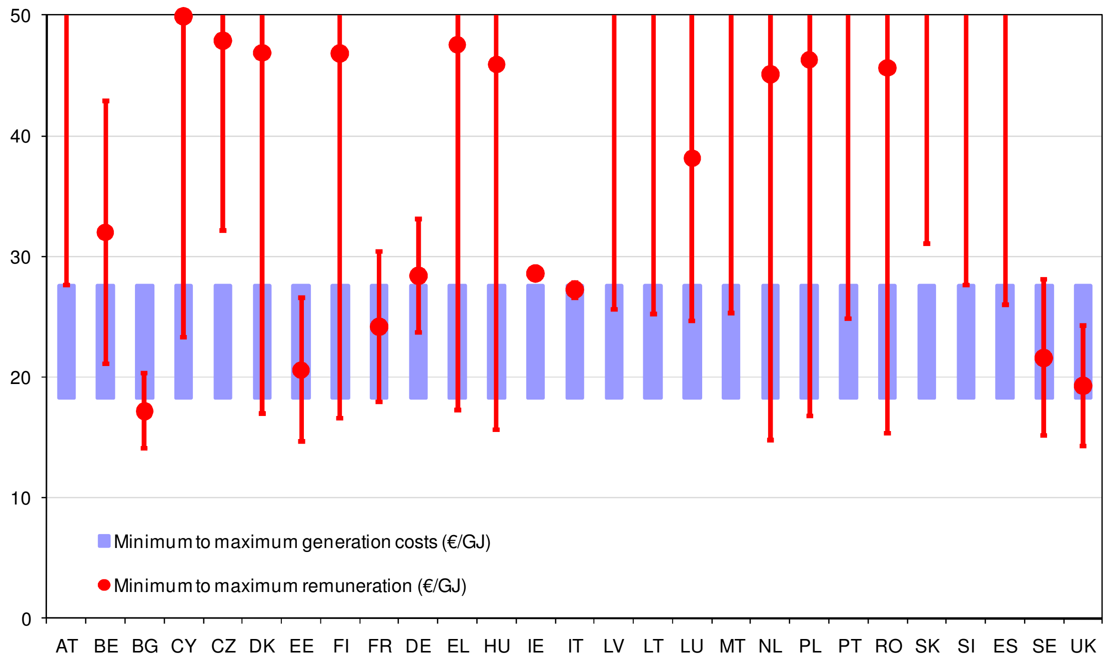


Figure 88. Remuneration ranges (minimum to maximum remuneration) for biodiesel for transport in the EU-27 MS in 2010 (average tariffs are indicative) compared to the 2010 marginal generation costs (minimum to maximum costs).

A few general conclusions can be drawn from the figures:

- In most countries the policy for stimulating biofuels could be expected to be quite "effective", as there are strong drivers to deploy biofuels, with remuneration on average being above the generation costs;
- In the frame of this section, a policy would be "efficient" if the remuneration is in the same range as the generation costs. Remuneration above the generation costs is regarded as over-compensation:
- This concept is not relevant for the evaluation of mandates;
- Excise reduction measures in Member States do not (structurally) overcompensate.
- The generation costs of biofuels are in the range of 20-30 €/GJ, this compares to 75 - 100 €/MWh (1 MWh = 3.6 GJ), which is comparable to the results found for other RE sources;
- In 2010, biodiesel was slightly cheaper per GJ, but the difference with ethanol is not much. The price, and therefore the "generation costs" is depending on market dynamics and not on real production costs;
- The low side of the remuneration is either defined by still existing excise measures, or by the price of the fossil alternative;
- The high side of the remuneration is defined by the buy-out price or penalty in case of a mandate. For most countries the maximum remuneration is far above the generation costs.

Mandates (also called obligation) are not just a cost-neutral instrument for the government, but above all a very efficient driver for the stimulation of biofuels usage. In case of a mandate, there can be a buy-out price, or there is no escape option (penalty). Several countries have specified a buy-out price in their NREAP or their 2009-2010 progress report: Belgium (900 €/m3), Czech Republic (1574 €/m3), France (about 520 €/m3, ingeniously depending on the price of the fossil alternatives), Germany (600 €/m3), Ireland (450 €/m3), Italy (380 €/m3), Luxembourg (1200 €/m3) and the UK (329 €/m3). A buy-out price well above the price of fossil gasoline and diesel is a strong incentive.

The buy-out price in the UK is on the low-end, which implies that the incentive is not very strong, especially if biofuel prices rise. This limits the costs for the operators, but could also limit the deployment of biofuels in that country.

In other countries, non-compliance is an offence. The price of an offence can vary, but is difficult to express in €/m3. It is often not explained in the reports. Sometimes, there is a fine per violation, regardless of the dimension. On top of this, the criminalisation of an oil marketing company has costs in terms of public relations. Therefore, we have assumed a virtual value of 2000 €/m3, considerably higher than the aforementioned buy-out prices. In the figures, this implies that those countries with an obligation without buy-out option, do not show the average or upper limit (these are above 50 €/GJ) – they are symbolically beyond the graph's boundary.

Only one country had not yet installed any form of biofuel sales mandate at all and fully relies on excise reduction: Estonia. This means on the one hand that deployment of biofuels has been costly to the government, and that the incentive was not very strong, the remuneration was in the same range as the generation costs. This is almost per definition the case, as the EC is very critical to avoid overcompensation when allowing excise reduction schemes for biofuels. The excise exemption scheme in Estonia ended in 2011 and the government plans to establish a 5–7% blended fuel obligation on liquid fuels.

Sweden has a sales mandate of a totally different form compared to other countries. All gas stations are required to offer a biofuel for sale at the forecourt. We have not expressed this in a monetary value, so that the resulting remuneration for Sweden entirely depends on the exemption of biofuels from carbon and energy tax. The incentive does not seem very strong, compared to incentives in the other Member States.

The country paragraphs below explain the assessments presented in Table 16 and provide details on individual Member States RES-T policies and measures.

Austria

Fulfilment of NREAP policy commitments: No

Austria did not make progress in adopting new RES-T measures between the NREAP and the First Progress Report. The Climate Change Act is the only adopted measure which affects RES-T support; Austria did not adopt a measure to promote the use of e-vehicles as announced in the NREAP.

Adequacy of support levels for each technology: good

Long-term security of support: fair

Austria has specified an overall mandate for biofuels, but also separate mandates for the gasoline and the diesel sector. On top of this, there are excise reductions for high blends, for pure biofuels, and for fuels used in the agricultural sector. Also, there are schemes to stimulate renewable electricity in road transport. All in all, the policy strongly supports different technologies Most measures have no end-dates. The mandate is limited to about 5.75% biofuels, the remainder to achieve 10% RES-T should result from excise and subsidy measures which are less strong / more vulnerable to market price fluctuations.

Belgium

Fulfilment of NREAP policy commitments: Yes
Belgium did not commit to any improvements in the NREAP but eventually implemented three major measures for RES-T support – all on the federal level. These include the adoption of the sustainability criteria for biofuels, tax reductions for electric vehicles and charging points, and extended the blending of fuel with biofuel for another two years.

Adequacy of support levels for each technology: good
Long-term security of support: poor
Belgium operates a combination of excise reductions, limited by quota, and mandates. Special excise tariffs hold for bioethanol, biodiesel and pure plant oil. Initially, the quota was not very successful, but the mandate achieves its target. The excise reduction is valid until September 2013. The mandate ceases in June 2013, but is can be prolonged (the previous period was until June 2011). Increases of the mandate are not specified. Long term outlook is uncertain.

Bulgaria

Fulfilment of NREAP policy commitments: No
As for RES-E and RES-H&C, Bulgaria's progress in adopting new RES-T has been limited, primarily since several of the measures planned in the NREAP have not been adopted. The Member State has not reported on the progress it has made in the legislative preparation of these and other planned measures either.

Bulgaria introduced revised obligations for gas blended with biofuel and transposed the sustainability criteria for biofuels of Directive 2009/28/EC into national law.

Adequacy of support levels for each technology: poor
Long-term security of support: fair
Oil companies in Bulgaria are obligated to offer low biofuel blends. There is no mandate to supply a certain fraction of the fuels as biofuels. There are excise reduction measures. There are no technology specific instruments. There is a new blending obligation from January 2012, substituting an excise duty reduction linked to a blending-quota. No end-date is specified.

Cyprus

Fulfilment of NREAP policy commitments: Yes
Cyprus did not plan the adoption/revision of any RES-T measures in its NREAP but adopted a biofuel quota in 2011. Since October 2010, there is also a scheme that promotes the replacement of old vehicles with new, low-emission cars.

Adequacy of support levels for each technology: fair
Long-term security of support: fair

The measures to support RES-T in Cyprus are: a biofuels mandate of 2%, which is moderate, but effective, subsidies for the construction costs of units for the production of biofuels for transportation, and a system of incentives for replacement of old vehicles with new, energy efficient ones. There are no technology specific measures. There is no end date given.

Czech Republic

Fulfilment of NREAP policy commitments: No

The Czech Republic was not able to achieve progress in RES-T support between the NREAP and the Progress Report: until June 2010 there was a quota obligation for biodiesel and bio ethanol (regulated in the Act on Air Protection No. 86/2002); however, no new mandates have been set for the years 2011 and beyond. While there is increasing production of rapeseed oil, biodiversity problems are emerging.

Adequacy of support levels for each technology: good

Long-term security of support: good

The two main RES-T support measures in Czech Republic are a biofuel mandate and excise reductions. Excise measures are technology specific. In addition, there is an aid for the cultivation of energy crops. These incentives are to stay in place under the new RES support legislation passed in May 2012.

Denmark

Fulfilment of NREAP policy commitments: No

The only RES-T measure that Denmark planned in its NREAP is a reform of road tax that promotes energy efficient cars and encourages more people to use public transport. Denmark has not yet adopted this measure. The Member State plans to extend its tax relief for electric vehicles for the period of 2012-2015.

Adequacy of support levels for each technology: good

Long-term security of support: fair

In Denmark there are CO_2 tax exemptions for biofuels and electric cars (currently the main supporting measure for RES-T), financial support for energy efficient transport solutions, and a mandate for biofuels. In 2010, the deployment of biofuels was disappointing (see Section 1.2), however, in 2011 biofuels consumption seriously increased. The exemptions for electric cars are up to 2016, after which they will pay reduced tax.

Estonia

Fulfilment of NREAP policy commitments: Yes

Estonia did not plan new RES-T measures in its NREAP but adopted a program to support the purchase of e-vehicles in 2011. There is no support scheme for the promotion of biofuels in Estonia; a tax exemption scheme expired in 2011. A biofuel blending scheme is planned for implementation in 2012.

Adequacy of support levels for each technology: poor
Long-term security of support: poor
There are plans for installing a biofuels mandate. The EC authorised the full excise exemption of biofuels until July 2011. This measure will not be prolonged.

Finland

Fulfilment of NREAP policy commitments: Yes
Finland's progress in adopting new RES-T measures was good in the last two years. Among others, the Member State reinforced its quota obligation for the consumption of biofuel for the years 2011 to 2020. These changes were not planned in the NREAP.

Adequacy of support levels for each technology: fair
Long-term security of support: good
The most important measurement for transport biofuels in Finland is a mandate, which is planned to be greater than 20% in 2020. From 2011 onwards biofuels also profit from carbon tax exemptions, with no end date specified. There is no specific support for different technologies.

France

Fulfilment of NREAP policy commitments: No
France will need to invest more effort in adopting measures in the RES-T sector in order to meet its targets. While in its NREAP France planned to adopt 4 measures for the transport sector, it did not fully disclose the progress that it has achieved in adopting them. According to its Progress Report, these measures are "being developed" since 2010. Moreover, the announced measures are relatively general in their wording and do not specifically disclose the role that RES should play within them. On the positive side, France reinforced its "Bonus/Malus Ecologique" which awards bonuses to/penalizes car buyers upon the CO_2 emissions of the vehicle.

Adequacy of support levels for each technology: good
Long-term security of support: good
In France the RES-T is supported through a quota and blending obligation, tax deduction for blended fuels and pure biofuels, a bonus malus system to encourage the replacement of inefficient vehicles with low-emission vehicles, and purchasing premium for electric and hybrid vehicles. Quota and blending obligations are obliged to include at least 7% of biofuels in the overall amount of fuel by the end of 2015.The tax exception rates established are until 2013.

Germany

Fulfilment of NREAP policy commitments: Yes
Germany's policy progress in RES-T is good but weaker compared to the electricity and heating & cooling sector. Germany increased the allowed blending of gasoline

with biofuel from 5 to 10%, adopted stricter sustainability criteria for biofuels, and started implementing its support program for electric vehicles. The latter, however, has not proven to be sufficient to incentivize a strong growth of such vehicles as seen in other Member States.

Adequacy of support levels for each technology: good
Long-term security of support: good
Biofuels are supported by a quota obligation and a tax exemption. The overall quota is set at 6.25 % annually until 2014. From 2015 this quota will rise to 7% by 2020. Second generation fuels and ethanol are exempted from taxes until 2015. The tax reduction for all other biofuels will gradually (in steps of approx. 6ect/litre and year) phase out until 2014.

Greece

Fulfilment of NREAP policy commitments: No
Greece has not adopted relevant RES-T measures in the time between the NREAP and the First Progress Report apart from the biofuel sustainability criteria of Directive 2009/28/EC. In its NREAP, Greece planned to undertake several measures to promote energy efficient vehicles. These measures have not been implemented yet.

Adequacy of support levels for each technology: poor
Long-term security of support: fair
In Greece the main supported instrument for RES-T is a biofuels mandate. However, it only specifies that all biofuels produced within Greece have to be sold to the market, which seems in contrast with EU competition rules. In practice, only biodiesel is produced and thus only biofuels sales are stimulated by the mandate. Biofuel quantities are allocated to stakeholders, importers, or producers in a tendering procedure each year. No end date is mentioned. A tax exemptions regulation for electric, hybrid, and low emission vehicles exists and is valid until 2020.

Hungary

Fulfilment of NREAP policy commitments: Partially
Hungary has partially fulfilled its pledges made towards improved RES-T support (it only planned a very few measures back in the NREAP). For instance, in mid 2011 the Member State raised the excise tax per litre to HUF 40 per litre (13 EUR cents) and then to HUF 70 per litre (23 EUR cents) based on tax regulation passed in November 21 2011. Hungary currently has no blending standards for biofuels in place.

Adequacy of support levels for each technology: fair
Long-term security of support: fair
Hungary installed modest mandates that are not yet foreseen to be increased. Also, there are tax reductions for blended fuels, a scheme to support the establishment of low and medium-capacity bioethanol factories, and subsidies for energy crops.

Preferential tax rates have become less favourable with a new tax regulation passed in November 2011.

Ireland

Fulfilment of NREAP policy commitments: Yes

Ireland's progress in adopting new RES-T measures is good: besides the Biofuel Obligation, which is in place since 2010, Ireland adopted a support scheme for electric vehicles in 2011. It did not plan these measures in its NREAP.

Adequacy of support levels for each technology: fair

Long-term security of support: fair

Ireland has implemented a national Biofuels Obligation Scheme (BOS) which is intended to be continued as the main instrument to achieve the 2020 RES-T target. It is not foreseen if and when the mandate increases. It also promotes behavioural change, increased vehicle efficiency, and the uptake of electric vehicles.

Italy

Fulfilment of NREAP policy commitments: Yes

Italy fulfilled its commitment to adopt sustainable criteria for bioliquids and biofuels; and it strengthened the biofuels quota system in 2011.

Adequacy of support levels for each technology: fair

Long-term security of support: fair

Incentives for biofuels in Italy are mainly represented by a mandates and excise reductions. The mandate gradually increases over the years until at least 2014.

Latvia

Fulfilment of NREAP policy commitments: No

Latvia only planned two measures for RES-T, of which it adopted one: the introduction of tenders for the increased use of RES in the transport sector. Latvia did not report on the promotion of biofuels complying with the sustainability criteria of Directive 2009/28/EC but transposed the criteria into national law. Latvia phased out its biofuel quota by the end of 2010; it has not yet replaced it with a new regulation.

Adequacy of support levels for each technology: fair

Long-term security of support: fair

In Latvia a there is a biofuels mandate, specified for the diesel and petrol sector separately. There are also excise reduction schemes for various biofuels types and blends. No end dates are specified for these measures.

Lithuania

Fulfilment of NREAP policy commitments: Partially

As for the RES-E and RES-H&C, Lithuania planned several measures for RES-T (incl. standards for biofuel blending >10%, standards for methane used as car fuel) in the NREAP that it did not report on in the First Progress Report. Notwithstanding, the Member State fulfilled some of its commitments, e.g. as it approved rules for trade of petroleum products, biofuels, bio-oils and other combustible liquid products. It also initiated support measures to promote the use of electric vehicles and cars running on 100% biofuel. Lithuania has in place an exemption of biofuel from excise tax, a tax exemption for biofuel cars, and funds for biofuel production. There is no biofuel quota.

Adequacy of support levels for each technology: fair

Long-term security of support: fair

Lithuania applies a biofuels mandate, excise reduction, exemption from pollution taxes and compensation for raw materials sold for production of biofuels, all with no end dates specified.

Luxembourg

Fulfilment of NREAP policy commitments: Yes

Luxemburg has fulfilled its commitments made in the NREAP for RES-T. It implemented the sustainability criteria of Directive 2009/28/EC for biofuels and other bio liquids, and revised its biofuel quota. Nevertheless, Luxemburg's biofuel quota is low and it will need to further improve its policies in order to achieve its targets in the future.

Adequacy of support levels for each technology: poor

Long-term security of support: fair

Luxembourg applies a tax exemption tied to a mandate. No end date is given in the Progress Report. In addition, there is a bonus model for low-emission cars, and a support for electric vehicles, which is tied to the use of renewable electricity.

Malta

Fulfilment of NREAP policy commitments: Partially

Malta had planned 4 new RES-T measures in the NREAP, 3 of which have been implemented. Regulation imposing a 1.5% bio-fuel mix obligation has been adopted. Malta has also taken soft RES-T measures for the promotion of public transport and electric vehicles. The promotion of auto-gas, included in the NREAP, is not mentioned in the Progress Report.

Adequacy of support levels for each technology: fair

Long-term security of support: fair

In Malta the main support policy for RES-T is a quota obligation, and an excise tax exemption to the biomass content in biodiesel. In addition, there is a capital grant scheme for electric cars. There is not end date given in the Progress Report.

The Netherlands

Fulfilment of NREAP policy commitments: Yes

No new measures were planned in the NREAP. In 2011, the Dutch government introduced a regulation – 'Renewable Energy (transport) Scheme' – establishing targets for biofuels in transport.

Adequacy of support levels for each technology: fair

Long-term security of support: fair

The key support instrument for RES-T in the Netherlands is the quota obligation for biofuels. There is no end date given. In addition, there is a subsidy scheme and an exemption from vehicle tax to stimulate the diffusion of electric vehicles.

Poland

Fulfilment of NREAP policy commitments: Not applicable (n/a)

Poland did not make any commitments in its NREAP towards RES-T and did not adopt any new RES-T measure according to its First Progress Report.

Adequacy of support levels for each technology: fair

Long-term security of support: good

There are three financial instruments to support biofuel production in Poland: excise duty reduction, reduction in fuel charges and reduction in company income taxes. The targets for biofuels are set until 2016.

Portugal

Fulfilment of NREAP policy commitments: No

As a response to the financial crisis and agreements with the IWF and the European Commission, Portugal has initiated some measures that have stopped or reduced RES-T support. Among others, the Member State abandoned tax exemption for major biofuel producers (it kept the exemption for small specialist producers); it introduced a penalty for missing the national biofuel blending target instead. The Member State's biofuel obligation is still in place. Portugal transposed the Renewable Energy Directive's sustainability criteria for biofuels into national law; compliance will be controlled by the beginning of 2013.

Adequacy of support levels for each technology: fair

Long-term security of support: good

Portugal applies a quota obligation. The targets for biofuels are set until 2020.

Romania

Fulfilment of NREAP policy commitments: Yes

Romania did not plan any RES-T measures in its NREAP but adopted a program in 2011 that provides financial help to buyers of electric and/or hybrid cars (it is part of the National Car Fleet Renewal Incentive Programme). Natural persons, territorial administrative units and public institutions receive either vouchers or discounts when buying such a car. In late 2011, Romania set the annual quotas for biofuel blending for the years 2011 – 2020 and transposed the sustainability criteria for biofuels into national law.

However, with regards to biofuels Romania's existing measures have been insufficient to achieve its pledges: its blending quota for 2011 and 2012 is set at 5% although the Member State committed to achieve 5.75% in its NREAP. Since March 2011 biofuels are not exempted from excise tax any more.

Adequacy of support levels for each technology: fair
Long-term security of support: good

The support mechanism to promote biofuels in Romania is a quota system. The targets are set until 2020.

Slovakia

Fulfilment of NREAP policy commitments: Yes

No new RES-T measures were planned in the NREAP. Regulations for mandatory blending of bio-fuels were already in place since 2006. No new measures have been planned after the NREAP.

Adequacy of support levels for each technology: fair
Long-term security of support: good

There are a quota obligation and an excise tax exemption for pure biofuels for transport purpose in Slovakia. The targets are set until 2020.

Slovenia

Fulfilment of NREAP policy commitments: No

Slovenia did not fulfil its commitments made in the NREAP, primarily since it did not adopt a planned measure to increase the share of RES in public transport nor introduced certification of biofuels in terms of criteria of quality and sustainability. Slovenia made a slight revision to its fuel blending mandate, yet did not increase the mandated annual shares.

Adequacy of support levels for each technology: good
Long-term security of support: good

There is a quota obligation in Slovenia. In addition, there are a number of financial measures for RES-T production: excise tax exemption, aids for growing energy crops and a motor vehicles tax. The purchase of electric vehicles is promoted through non-repayable financial assistance. The quota is set until 2015. The program to encourage the purchase of electric vehicles is until 2013.

Spain

Fulfilment of NREAP policy commitments: Partially

The existing biofuel obligation scheme was maintained and updated in 2011. There are however, a number of planned measures included in the NREAP whose progress is not reported. These include the implementation of a 'National Technological Development Support Programme' or the amendment of legislation to allow the use of biogas as transportation fuel.

Adequacy of support levels for each technology: fair
Long-term security of support: fair

The main tools to support RES-T in Spain are quota and blending obligation, tax deduction, tax benefit for investment in biofuel production. No end date is given for the quota.

Sweden

Fulfilment of NREAP policy commitments: Yes

Sweden made very good progress in adopting new/revised RES-T measures, implementing several unplanned measures. In terms of biofuels, the Member State extended the exemption of biofuels from the carbon tax, implemented the Renewables Directive's sustainability criteria on biofuels/bio liquids, and changed rules of procedure for accounting of alternative fuels. In terms of financial help for low emission vehicles, Sweden adopted a new act on environmental requirements in the procurement of vehicles and public passenger transport services and introduced vehicle tax exemption for green cars.

Adequacy of support levels for each technology: good
Long-term security of support: good

The support instruments for RES-T in Sweden are a tax relief system, and green taxes to promote environmentally friendly cars. There is focus on different types of biofuels and applications in different transport sectors. There is no end date given in the Progress Report.

United Kingdom

Fulfilment of NREAP policy commitments: Yes

The United Kingdom had early extensive sustainability criteria on biofuels comparable to the Renewables Directive. They increased the share of biofuels by the Renewable Transport Fuels Obligation (RTFO), but not focus on specific technologies or fuels (except for tax rebate for UCO). The UK aims to changing from mainly using biofuels at the moment to ultra low emission vehicles in the post 2014 period to meet their RES-T targets.

Adequacy of support levels for each technology: good
Long-term security of support: good

The primary support instrument for RES-T in the United Kingdom is a renewable transport fuel obligation (RTFO). The RTFO targets are until 2014, but are foreseen to be prolonged. There are special incentives for used cooking oil and biogas.

1.5 Progress in guarantee of origin systems

Introduction

According to article 15 Directive 2009/28/EC, the Member States have to implement a system of Guarantees of Origin (GoO) for renewable electricity. They may also arrange for a system for renewable heating and cooling.
To meet the requirements of the Directive, issuance, transfer and cancellation shall be electronic. One GoO shall be issued per 1MWh generated, and Member States shall ensure that the electricity represented is only taken into account once.

GoOs shall only be used for verification purposes towards the customer and have no role in the Member States' target accounting. As regards the role GoOs may play in the support system, the Directive leaves it to the Member States – GoOs do not by themselves give right financial support, and the Member States may provide that for electricity for which GoOs have been issued, no support can be claimed. To comply with the requirements of the Directive, each GoO needs to contain certain minimum information, harmonised and defined in article 15(6) a)-f). Further, and based on this harmonised electronic system, Member States have to mutually recognize each others' GoOs, unless there are "well-founded doubts about its accuracy, reliability or veracity". In such a case, the Commission needs to be notified.

Methodology

The following assessment of Member States' progress in implementing a GoO system focuses on the requirements of the Directive, and will look at the following criteria:

- First, whether the system for electricity GoOs is electronic;
- Second, whether there is also a register in place for heating and cooling, as voluntary under article 15(2) of the Directive but specifically asked for in the progress report template;
- The third criterion asks whether the GoOs are issued for free, and was added for practical considerations, assuming that in such a case they are more attractive to producers of renewable energy;
- Fourth, it will be looked at whether the format of the GoOs is in accordance with art. 15(2) of the Directive, so that one GoO represents 1 MWh, a criterion thus addressing the more technical requirements of the GoOs;
- Fifth, it is looked at whether Member States have some system in place to avoid fraud and double counting. Those systems may vary in their sophistication and it is referred to the Member State paragraph for more detail;
- The sixth criterion then finally looks at whether automatic recognition of the GoO from other EU countries is provided for.

Our analysis describes the GoO systems in the EU Member States (overview in Table 18 and details in MS paragraphs below) and also quantifies the MS progress towards the criteria using the following weighted scoring method (Table 17).
Firstly, the GoO systems are scored for each criterion using the following rules. All criteria get a score of 1 if the answer is yes and a score of 0 if the answer is no.

Secondly, the overall country score is the result of a weighted sum of the scores on each criterion. Different weighting are attributed to the criterion according to whether they refer to a mandatory requirement under the Directive 2009/28/EC (weight 2 points) or not (weight 1 point). This method doubles the scores for the criteria related to mandatory requirements.

Table 17. Scoring methodology for assessment of GoO systems in the Member States.

Electronic Register for electricity?	Electronic Register for heating and cooling?	Registration and Issuance for free?	1 GoO for 1 MWh?	Measures to avoid fraud in place?	Automatic Recognition of GoOs from other MS?
Yes=1 No=0	Yes=1 No=0	Yes=1 No=0	Yes=1 No=0	Yes=1 No =0	Yes=1 No=0
Weight= *2	Weight= *1	Weight= *1	Weight= *2	Weight= *2	Weight= *2

The scoring method results in the following MS progress assessment:
0-4 points = needs improvement
5-7 points = fair
8-10 points = advanced

Sources of information

According to Art. 22(3) and 27(2) Directive 2009/28/EC the Member States are obliged to report their progress with the implementation of the Directive. Consequently it can be assumed, that if no progress is reported it means that there has been none since the NREAP. Accordingly, the analysis is primarily based on what the Member States reported in their 2011 progress reports, supplemented - when necessary - and compared with information from the NREAPs. In general, the following steps have been taken:

- If a new scheme has been implemented and it was reported in the progress report, then those were the measures considered;
- If the report only sets out that a new scheme is planned and there was sufficient detail to consider those plans, then those measures have been considered but the score was made conditional “if plans implemented”;
- If the report only said that “revision” is planned, but without sufficient details to assess them, then the old scheme was considered, and it has been noted in the column for overall assessment that revision is planned;
- If there is nothing said or nothing reported, then only the old scheme according to the NREAP was considered.

Table 18. Assessment of the GoO systems in the Member States.

Member State	Electronic register for electricity?	Electronic register for heating and cooling?	Registration and issuance for free?	1 GoO for 1 MWh?	Measures to avoid fraud in place?	Automatic Recognition of GoOs from other MS?	Overall assessment
Belgium							
Flanders	Yes	No	Yes	Yes	Yes	No	Fair (7)
Walloon	Yes	No	No information	Yes	Yes	No	Fair (6)
Brussels	Yes	No	Yes	Yes	Yes	No	Fair (7)
Bulgaria	Yes	Yes	No	Yes	Yes	Yes	Advanced (9) - if plans implemented
Czech Republic	No information	No	No information	No information	Yes	Yes	Needs improvement (4)
Denmark	Yes	No	No	Yes	Yes	Yes	Advanced (8)
Germany	Yes	No	No	Yes	Yes	Yes	Advanced (8) - if plans implemented
Estonia	Yes	No	No	No	Yes	No information	Needs improvement (4) – but revision planned
Ireland	Yes	No	Yes	Yes	Yes	Yes	Advanced (9)
Greece	Yes	Yes	No information	Yes	Yes	No information	Fair (7)
Spain	Yes	No information	No information	No information	Yes	Yes	Fair (6)
France	Yes	No	No information	No information	Yes	No information	Needs improvement (4)
Italy	No	No	Yes	No	No	No	Needs improvement (1) – but revision planned
Cyprus	Yes	No	No information	Yes	Yes	Yes	Advanced (8)
Latvia	Yes	No	No information	No	Yes	No information	Needs improvement (4)
Lithuania	Yes	No	Yes	Yes	Yes	Yes	Advanced (9)
Luxemburg	Yes	No information	No information	Yes	Yes	Yes	Advanced (8)
Hungary	Yes	No information	No information	No information	Yes	No information	Needs improvement (4)
Malta	Yes	Yes	No	No	Yes	No information	Fair (5)
The Netherlands	Yes	No	No	Yes	Yes	Yes	Advanced (8)
Austria	Yes	Yes	Yes	Yes	No	Yes	Fair (6)

Poland	No	No	No	No	No	No	Needs improvement (0) – but revision planned
Portugal	Yes	Yes	No information	No information	Yes	No information	Needs improvement (3) – if plans implemented – but revision planned
Romania	Yes	No	Yes	Yes	Yes	Yes	Advanced (9)
Slovenia	Yes	No	Yes	No	Yes	Yes	Fair (7)
Slovakia	Yes	No	No	Yes	Yes	No	Fair (6)
Finland	Yes	No	No information	Yes	Yes	Yes	Advanced (8)
Sweden	Yes	No	Yes	Yes	Yes	Yes	Advanced (9)
United Kingdom	Yes	No	Yes	Yes	Yes	No	Fair (7)

Assessment and conclusions

From the assessment of the Member States' progress reports it becomes clear that there are two major tendencies. On the one hand, there are Member States, such as Lithuania or Romania, which have a quite advanced system in place, often based on the EECS standards and with the issuing body being a member of the Association of Issuing Bodies. Those Member States often also allow the GoOs as some form of evidence in their national support system, as for example in the Netherlands, Sweden or Romania.

On the other hand, some Member States have so far not really taken up on the idea of GoOs, although it had already been introduced with Directive 2001/77/EC. They often have only quite rudimentary systems in place which in the course of the implementation of Directive 2009/28/EC are now being updated and improved. In this respect, Germany and Bulgaria have progressed quite well in developing a system that is to be rated advanced, if implemented in the way it is suggested. Other countries, such as Italy and Estonia also understand the need and are working on improving their systems, so that the expectations for the future of GoOs in Europe seem quite positive.

A third category of Member States, such as France or Portugal, submitted progress reports which unfortunately lacked sufficient information about the planned reform, so that no rating can be given yet.

Notably, quite a few Member States say that they have introduced Guarantees of Origin in compliance with the Directive 2009/28/EC but do not go into any further detail. Again, two trends can be identified: Cyprus for example says that they fully transposed article 15 with reference to a new regulation from 2010, and directly refers to some of the requirements (e.g. unique identification number), so that has been assumed that their system complies with the Directive. Others, like the Czech Republic refers to implementation according to the Directive 2001/77/EC, and Directive 2009/28/EC, but it is unclear whether e.g. 1 GoO is issued per 1 MW, or whether the system is electronic or not, in particular as there is no new regulation mentioned that would have introduced those changes (accordingly, no assumption of compliance has been made).

Looking at the criteria in more detail, it seems that an electronic register for renewable electricity is or will be in place in all countries. However, only few Member States, such as Malta, Greece and Austria, so far have a register for heating and cooling. Bulgaria, according to the plans set out in the progress report, will also have one.

Whether the GoOs are issued free of charge differs and there seems to be no clearly identifiable explanation behind that, in the sense that this indicator seems to stand unrelated to the others. In fact, this is interesting, as it shows that even advanced systems such as in Ireland, Lithuania or Sweden, there need not necessarily be a direct fee imposed on users to finance the system, but costs can be recovered through other ways. Further, when looking at the fees that are charged in the countries where the GoOs are not for free, it turns out that most of the time, there is a fee for getting an account in the system, a fee for registering a plant and fees for the respective activities performed. In the context of other requirements of the Directive, one might question whether those fees are – in concreto - cost-related as is required by art. 13(2) e).

The requirement that 1 GoO should represent 1 MWh renewable electricity produced can be seen in a way as an indicator whether the system complies with the more formal/technical provisions of the Directive and whether Member States took over the exact wording. Surprisingly, it is not implemented in all countries. For example in Slovenia, the basic unit is still 1kWh and 1 GoO can be issued for multiple of those units, so that one GoO can represent any amount of renewable electricity. Similarly, in Estonia 1 GoO is issued per plant for all the electricity generated. In Spain, it is unclear from the wording of the progress report whether or not the 1 MW requirement is met, or not, and it appears that one is still working on the exact information content of the GoOs, which might thus in the end be different from what the Directive requires. For mutual recognition in the other Member States, as foreseen by article 15(9) of the Directive 2009, this constitutes a significant impediment, even though Member States - based on the wording of the provision - are only not required to recognize GoOs that do not comply with paragraphs 1 and 6 of that article. However, as the provision on the information content on the GoO does not refer to the amount of electricity, and as the logic of the Directive (making the 1MW per 1 GoO mandatory) presuppose compliance also with article 15(2), it follows that Member States could at least have the serious doubts so as to refuse recognition of those and thus refuse recognition of GoOs not being issued per 1 MWh.

On the information content of the GoO - even though not assessed in the table above and not reported on by most Member States - differences would have the same consequences, and non-recognition could then directly be based on article 15(9) referring to paragraph 6 a)-f). Deviations have been recognized for example for Austria, and have been mentioned in the Member State paragraphs.

Almost all Member States provide for some measures to avoid fraud. By exception, Austria, Italy and Poland (the latter not having a register at all) do not report to have any kind of verification mechanisms to ensure that the information provided with the application is correct. Portugal states that they will not issue GoOs in case any kind of support has been granted, which at least means that there is some way to avoid double counting. Interesting and quite advanced approaches can be found for example in Bulgaria, Cyprus, Germany or Lithuania where more or less regular on the spot inspections performed by the respective government agencies or the TSOs are foreseen. The Netherlands impose an annual audit obligation and in Denmark the obligation not to use a GoO twice is a contractual one. Also, linking and comparing different databases (e.g. in Sweden or Hungary) seems a good approach, or the Finnish measuring laws requiring hourly measuring and thus increasing the reliability of the data available. Hungary, where the so-called "certificates of origin" are also used in the course of the Feed-In support scheme, also reports in detail on the sanctions that will follow non-compliance and fraud, e.g. imposition of specific requirements under which the person will be allowed to continue to benefit from the Feed-In support, reimbursement and further penalties.

The mutual recognition of GoOs from other Member States seems to be possible almost EU-wide when all plans are implemented. While many Member States, such as in Belgium, refer to the EECS standards and say that they will recognize GoOs accordingly, it is presumed – as those standards are based on the requirements of the Directive – that this would in principle not stand in the way of mutual recognition as in accordance with article 15(9) of the Directive. The two – notable - exceptions are the UK, where the new law just increased the possibility for the agency not to recognize foreign GoOs based on their own assessment and doubts, and Slovakia, which has interpreted the Directive so as to mean that the regulator – in case of serious doubts – will take action and contact the applicant from the other EU Member State, and not the European Commission.

Finally, and as mentioned above, there seems to be a certain relation between the advanced nature of a system and the role GoOs play in the national support scheme. The Netherlands or Sweden, for examples, maintain two quite advanced schemes, and there the GoOs are linked to the support scheme. This explains the Member States' interest in making them fraud-averse. Other Member States, taking the opposite approach and excluding the possibility to receive support if a GoO has been issued, such as Germany, however, show similar interest in setting up a good system – and also with a view to protect their national support system from fraud. The Spanish also provide for detailed rules on how to avoid that financial support and the value of the GoO lead to overcompensation. On the other hand, systems such as in Italy, where the role of the GoOs is not determined in any kind of way, score quite badly in the assessment.

NB: the following Member State paragraphs provide a short summary of the main details of the country's GoO system.

Austria

Austria has set up an electronic renewable electricity register as well as a renewable heating and cooling register. GoOs are issued monthly by the grid operator based on the amounts of energy fed into the grid in the previous month. They are made available to an online account from where the holder of the GoOs can freely transfer them or otherwise use them. However, it seems problematic that the minimum information requirements for the GoOs (§10(6) of the Ökostromgesetz) as reported in the progress report do not correspond with the requirements in art. 15(6) of the Directive (in particular nothing on questions such as whether some form of financial support was received, date, issuing body and the specific code number). Neither does the Report suggest what measures are taken to avoid fraud – essential in particular if holders of the GoOs can freely transfer them.

Belgium

Flanders

In Flanders, the GoO issued by the Flemish regulator VREG can be used for the quota obligation within the renewables support scheme. They will be specifically marked in the register, if they have been used in such a way. Notably, for example the use of the certificate as GoO is restricted to a time period of one year, so as to comply with the Directive 2009/28/EC, but in the quota system, they can be used for 5 years. Foreign GoOs can only be imported if they have been issued by a member of the Association of Issuing Bodies (AIB) and according to EECS standards.

Walloon Region

In the Walloon Region, unlike in Flanders, two different certificates exist, one for meeting the national quota obligation and one GoO with the sole purpose of providing information. The regulator verifies the data with the TSO and DSOs. To avoid fraud and keep a balance between physical energy and number of GoOs issued, only licensed energy suppliers can take the GoOs in (that means to cancel them after use). Auto producers are by law obliged to take in the GoOs in accordance with their own consumption. Recognition of foreign GoOs is possible if they are issued according to EECS standards. The Report submits that there has to date not yet been a request from a non-EECS country.

Brussels

As the two other regions, the Brussels region also participates in the EECS system and regulator BRUGEL is the issuing body. The progress report in this respect entirely refers to the EECS system.

Bulgaria

Bulgaria previously maintained a system of so-called "certificates of origin" which were non-compliant with the requirements of the Directive: there was only one certificate issued to a producer or a supplier showing the entire amount of electricity generated over the past year (for production up to 1 MW) or six months respectively (for production exceeding 1 MW). Certificates were issued upon application, separate for each power plant, up to one month after the expiry of the period of production for which the certificate was sought. However, the progress report states that the Renewable Energy Act will defer to the Directive and will introduce a Guarantee of Origin System accordingly, correcting those discrepancies. The system will be implemented in 2012 and from then on producers will be issued the new GoOs, compliant with the Directive. The regulator will be able to carry out official checks on the information provided by the producers, for example by means of "on the spot" inspections. In case of (administrative) irregularities with the application for issuance, the applicant will be notified and have 7 days to remedy the problems. Recognition of foreign GoOs (or certificates) was possible under the previous system already and will remain possible under the new one. While this possibility is explicitly mentioned, no criteria are mentioned when recognition is refused or what procedures will be followed.

Czech Republic

The Czech progress report simply says that a system in accordance with Directive 2001/77/EC and Directive 2009/28/EC is in place, but that no GoOs for heating and cooling are issued. The reference to the old Directive, and the fact, that the (currently still applicable) Law dates from 2005 raise doubts on compliance. Unfortunately the progress report does not mention what the new law (adopted May 31st, 2012 and to enter into force January 1st, 2013) will say on the issue. However, the report sets out that – in particular as the GoOs can be used as evidence to apply for tax deductions, though they are not currently tradable in the FiT system but only contain evidence to the consumer – there are validation mechanisms in place and the market operator can e.g. compare different sets of data. Also, even in the old law, Act 180/2005, it was provided for recognition of foreign GoOs from other EU Member states.

Cyprus

Cyprus reports to have fully transposed article 15 of the Directive and further mentions some of the specific requirements contained in this article (e.g. unique identification number), so that it was assumed for the assessment, that the system complies. GoOs are issued by the TSO, which has issued a detailed Manual on all the procedures around the electronic register and the issuance procedure. Further, Cyprus describes quite some measures to protect against abuse and fraud: an electronic register for the actual measurements has been set up which are delivered by remote measurement with two meters (a main and a control meter) from the power plant and they report that they have measures in place to prevent the insertion of electricity from conventional sources at or rather through the renewable plants. The TSO also regularly inspects the plants.

Denmark

The Danish authority energinet.dk which issues the GoOs is the approved issuing body for Denmark in the EECS system and accordingly applies the EECS rules and procedures. Overall, the system is quite advanced and energinet.dk seems very active to gather information in order to avoid fraud and double counting. The electronic register managed by cmo.grexel is linked to the national data system and the individual disclosure obligations of the energy traders, to confirm the information provided. In addition, producers have a contractual obligation not to use the certificates twice. The progress report contains a detailed description of the system in the Annex which also includes data on how many GoOs have been issued, transferred and cancelled. Those show a significant increase in issuance between 2009 and 2010, from whereon numbers stay the same. However, between 2010 and 2011, while the overall numbers of GoOs issued did not show a similar increase, the amount of GoOs exported to other countries doubled. Denmark also recognizes GoOs from outside the EECS system,, though only in a manual, not an electronic way. The Danish GoOs are not issued free of charge, rather there is a registration fee both to get an account and to register a plant and certain fees for the actual issuance.[8]

Estonia

The Estonian Certificate of Origin System is currently not compliant with the Directive. In particular, one certificate is issued per plant, not per 1 MW green energy generated. However, there are certain protections against double counting, as the certificate at least contains information on the amount of electricity that benefited from support. The certificates are issued by the TSO.[9] However, while it seems there have been no changes as compared to the situation in mid-2009, the Estonian progress report foresees amendments and improvements to improve anti-fraud protection for

[8] Prices for registration in the system and issuance of GoOs can be found at: http://energinet.dk/DA/El/Vindmoeller/Oprindelsesgarantier/Sider/Oprindelsesgarantier-for-vedvarende-energi.aspx

[9] Information on the certificates issued to date is available on the TSOs website: http://elering.ee/information-regarding-the-certificates-of-origin-issued/.

2012. Still, the information in the progress report is not sufficient to evaluate the planned system.

Finland

The Finish progress report says that the system is working well and the requirements of the Directive are all implemented. This has been taken for granted in the assessment, as the report does not further specify. However, it sets out in detail the protections against fraud in place: the GoOs are issued by the grid operator, who verifies whether the plant produces from renewables and measures the electricity generated at the site. In this respect, the Finish measurement laws are mentioned, which require hourly measurement and remote reading for electricity production sites and large consumption sites. Further, a new law requires distribution grid operators to adopt hourly measurement, and it is estimated that this will cover about 80% of the places of electricity use by 2014. For ensuring the reliability of a GoO system, exact data is certainly an asset.

France

The French progress report admits that the current system needs improvement as it is not yet compliant with the Directive. While it says that there are plans for a new system, there is no other information but for the assurance that it will comply with the Directive. In particular, the agency responsible for the scheme is not even yet determined. On the other hand, the subrogation mechanism – already in place with the current system - ensures to some extent the avoidance of "double counting".

Germany

The current German system is not compliant with the Directive and can be seen as only minimum implementation of Directive 2001/77/EC, with more than 50 actors able to issue some kind of certificate of origin and no specific format. However, an electronic Guarantee of Origin Register run by the Environmental Agency (Umweltbundesamt) is under construction (the legal basis has been created in the revised Renewable Energy Act and the government is working on the implementing directives) and should become operational in fall 2012. In particular the disclosure requirements already determined by law, and thus the access to information the Federal Environment Agency in charge of managing the system, indicate the basis for good anti-fraud protection. It is planned that there will be an electronic control system, as well as on-site inspections. No issuance of GoOs will be possible for electricity fed into the grid in the course of the Feed-In Tariff support scheme. Recognition of GoOs from other Member States will be automatic, unless reasonable doubts, in which case the Commission will be informed and called to act. In this regard, it was asked which role the European Commission's Transparency Platform may play and whether the Commission could publish there which systems it considers reliable and/or which not.

Greece

Greece has recently introduced a new GoO system, compliant with the Directive. The law now also provides for a register for renewable heating and cooling. The GoOs are issued by three different issuing bodies, depending on where the plant is located: the TSO is responsible for the interconnected system, the historical power utility for the islands and the Centre for Renewable Energy Sources for autonomous systems not connected to the grid. The Greek Regulator oversees the system and has access to full electronic information as well as the right to intervene, while the three issuing bodies are limited to their own respective system. To ensure accuracy of the information, the issuing body can perform inspections, while in general the GoOs will be issued based on data submitted. However, though it was discussed beforehand that the GoOs will not be issued free of charge, the report does not say anything on this. Neither is there information on whether automatic approval of GoOs from other Member States is provided for, or on the role of the GoOs in the support system.

Hungary

Hungary has introduced so-called certificates of origin in 2009. They are used in the course of the Feed-In support scheme, as the producers have to prove with them that they comply with the requirements for eligibility for support for the respective year. After the financial Feed-In support has expired, the certificates can still be requested and can be used purely as evidence to the consumer, it seems. Certificates are issued yearly, and there is no information on whether they – for the rest – comply with the requirements of article 15 Directive 2009/28/EC. However, also due to the fact that they are used within the support scheme, the issuing body can verify the information by individual checks and comparison with other data and the Hungarian law also provides for "correction mechanisms" and sanctions in case of non-compliance and fraud, so that for example, the right to benefit from the Feed-In support may be restricted, or penalty payments imposed.

Ireland

The old GoO system was not compliant with the Directive, and based only on the minimum requirements of Directive 2001/77/EC. However, the progress report (via a link to the Decision introducing the new scheme) sets out the details of the new system. The new GoO system will be managed by the electricity market operator SEMO, based on information submitted by the applicants. Communication within the system to confirm the information is foreseen. Also, it is referred to technical and administrative ways to protect the electronic register (e.g. passwords) from fraud. A first round of new GoOs is said to be issued in early 2012, for the year 2011. After that issuance will be quarterly with the possibility to make it more frequent, in case this proves necessary. The Decision in this regard, as on the points of anti-fraud protection and recognition of GoOs from other Member States, refers to the lack of experience and the learning process over time. It thus foresees improvements in the future, based on practical experience gained. For the recognition of GoOs from other

Member States it specifically mentions that one will take into account the developments on EU level.

Italy

The current Italian GoO system is based on the minimum requirements from Directive 2001/77/EC. For all plants exceeding 100MWh yearly production, one GoO is issued, stating the amount of green electricity produced. Other plants with less annual production cannot get GoOs. The GoOs are issued by the regulator, AIB, which at the same time is also the issuing body in the RECS system. In principle, as RECS and GoOs coexist, there is nothing preventing the issuance of both certificates for the same amount of electricity. The GoO registry is internal and there is no record kept of the GoOs. This seems problematic as there is no defined role for the GoOs: in principle, they can be issued for all renewable energy, whether it has obtained financial support or whether it has already been RECS certified. The progress report foresees to amend the system and make it compliant with the Directive 2009/28/EC, but it lacks details. Assessment of the plans is thus not possible.

Latvia

Before December 3rd, 2011, Latvia's system of Guarantees of Origin was still based on the minimum requirements of the Directive 2001/77/EC. One GoO was issued per application, not necessarily per MWh. However, the new system entered into force and Latvia submits that this now fully implements article 15 of the Directive. The GoOs are issued by the Ministry of the Economy based on data submitted by the applicant. Data can be confirmed with the system operator. Further, GoOs can be printed or simply electronic. Unfortunately (for the evaluation) the progress report lacks more detailed information. The language is further quite misleading, in particular it is not clear whether there is now 1 GoO issued per MWh or not. This is the reason for the "needs improvement" rating. Still, as Latvia intends to join the EECS system, once legislation is in place, it is to be expected that the new legislation would respond to the Directive's requirements.

Lithuania

The Lithuanian law on the Guarantees of Origin repeats the main features of article 15 of the Directive and in particular the formulations on the avoidance of fraud and forgery, as well as on the recognition of GoOs from other Member States. The sole Transmission System Operator – unbundled since 2010 from energy supply activities – oversees the system and in particular controls that all GoOs of producers whose electricity was bought under the support schemes are marked as used (and thus cancelled). Issuance is thus in principle possible, but if support is received, the GoO will be cancelled, so as to avoid that the green electricity is supported twice. GoOs are issued based on data submitted by the applicant, but scheduled checks are foreseen as well as inquiries upon request of the TSO, performed by the State Energy Inspectorate. The legislation does not mention any costs for the issuance of the GoOs.

As the GoO system has been free of charge before (with the old law neither mentioning any fees) and absent any information to the contrary, it is to be assumed that stays the same.

Luxemburg

Luxemburg has established a system of GoOs issued by the regulator. The regulator has taken over the rules of the EECS system and is a member of the AIB. However, the progress report does not mention any other information about the system, for examples, relating to the measures to protect it against fraud, the costs or the recognition of foreign (possibly non-EECS) GoOs. It is thus, for the assessment, deferred to the EECS system, which contains some mandatory fraud protection.

Malta

Malta recently implemented Directive 2009/28/EC and set up an electronic register for both renewable electricity and heating and cooling. However, as the progress report states, no applications have been made yet, as there is no market for the GoOs and producers rather want to benefit from the Feed-In Tariff. In principle, GoOs would be issued by the Malta Resources Authority upon information submitted with the application. Correction would be possible, in case it appears that too many or too few GoOs have been issued and no GoOs are issued for plants outside Malta. Further, upon assessment of the Maltese Regulation itself (rather than the progress report), it appears that the requirement of one GoO being issued per MW has not been realized, and that there are no rules on recognition of foreign GoOs.

Netherlands

GoOs in the Netherlands are issued by CertiQ, which is also the Dutch issuing body in the RECS system. CertiQ applies the EECS standard both to own GoOs as well as to the recognition of foreign GoOs. Registration and issuance are based on information submitted by the applicant, but, this information is verified with the local DSOs. Further, there is an annual audit requirement for biomass plants and the system foresees in a correction possibility, in case too many or too few GoOs have been issued. To be able to export GoOs from the Netherlands, one needs to obtain a special "RECS" compliant mark on the GoO. Noteworthy in this regard, "pure RECS" (separate from the electricity) can theoretically be imported into the Netherlands, but they cannot be used as proof of delivery of green electricity there. Overall, the system is well advanced and in particular the strict verification requirements upon registration, as well as the yearly audits make it quite fraud-averse. The system has been in place and improved for more than 10 years now and is linked to the financial support schemes. The system is not free of charge; rather a registration fee has to be paid as well as charges for issuance of certificates. The charges for use of the GoO system differ for producers (for solar power, no registration and no annual fees are charged) and traders (registration and/or annual fee) and the amount of GoOs issued.[10]

Poland

In Poland, there is no law yet to implement Directive 2009/28/EC and there is no system of Guarantees of Origin. However, the progress report says that the Polish support system based on tradable property rights can be seen as something similar to certificates of origin. This argument seems inacceptable, in particular, as the Directive is quite explicit, that the GoO by itself is not the same as a tradable certificate for the purposes of a national support scheme.

Portugal

The Portuguese progress report only says that guarantees of origin have been introduced for electricity and heating, but does not mention whether the system is electronic or not. It is also unclear whether the issuing body (EEGO) is already set up; as it is said that first a handbook will be drawn. However, the progress report makes clear that GoOs will only be issued in case no support has been granted for either investment or production. This can – though it is yet unclear from the report how this will be checked – seen as a measure to avoid double counting and/or double marketing, and thus as a first – basic – measure to avoid fraud.

Romania

Romania changed its GoO system on January 4th 2012 with some further rules being adopted only in March 2012. With that change, an electronic register has been set up and the requirements for the certificates have been aligned with those in the Directive. GoOs are now issued by the regulator (ANRE) upon the producer's request every month, quarter or semester and are valid for one year. They are issued based on information provided by the applicant, but the regulator can verify and survey the information. The regulator has to report every two years on the implementation and functioning of the system. Romania is aiming for "full" fuel certification, meaning that energy from all sources needs a certificate. Interestingly, biomass is subject to a different scheme, run by the Ministries of Environment and Forests and Agriculture and Rural Development respectively.

Slovenia

The Slovenian electronic GoO system has been fully operational since 2007 and in most points complies with the EECS standards. GoOs are issued by the regulator, which is also a member of the Association of Issuing Bodies (AIB), based on the information provided by the applicant and on a monthly basis. In case the producer wants to use the GoOs within the support scheme, then however, reporting and

---

[10] Charges are available at: http://www.certiq.nl/pages/overcertiq/tarieven

issuance happens only once per year. The regulator can control and verify the information and GoOs which received support will be marked as used (cancelled). However, the basic unit for the issuance of certificates is 1kWh and for multiple basic units one certificate can be issued, meaning that the 1MWh = 1 GoO requirement in article 15(2) of the Directive is not met. Also, the GoOs are valid for five, rather than for one year as the Directive requires. The progress report does not indicate any planned changes to this non-compliance. While recognition of foreign GoOs is foreseen, it is also provided that recognition does not necessarily mean introduction into the electronic registry. A striking point is that the progress report does not refer to Directive 2009/28/EC for the grounds on refusal/recognition of GoOs from other MS but refers to the cogeneration Directive, Directive 2004/8/EC.

Slovakia

According to the country's progress report, Slovakia has implemented all the requirements of the Directive as regards Guarantees of Origin. GoOs are issued by the regulator, based on the information submitted which the regulator first verifies. Registration in the system is required before applications can be made. Though there is no concrete information on how the verification happens in practice and what the competences of the regulator in this respect are, the regulator is said to supervise all processes in the register. Interestingly, Slovakia has interpreted the provision of the Directive that Member States shall recognize GoOs from other Member States unless there are reasonable grounds for doubt, in such a way that the national regulator itself will become active: In case the regulator has those doubts, it will contact the applicant from the other Member State and give him time to settle the concerns within a certain time limit. Otherwise no recognition is granted and transfer prohibited. This could be an obstacle in the system of EU wide mutual recognition, envisioned in the Directive.

Spain

The Spanish progress report sets out in detail how the system of GoOs is supposed to work, and in particular explains the electronic book-entry system, which is used as one measure to avoid fraud. However, it leaves questions as to whether the provisions on the information content and the 1 MW requirement are met, due to unclear wording and the fact that the National Energy Commission may publish more detailed rules on this. For the mutual recognition in other Member States this might be problematic. However, Spain itself says that it will recognize GoOs issued in accordance with Directive 2009/28/EC and will otherwise – in cases of reasonable doubt – inform the Commission. When it comes to the avoidance of fraud and overcompensation, the progress report explains that for each different support scheme available in Spain (premiums/FiTs) there are rules in place to make sure that the producer does not get paid twice for the renewable energy quality. Rather they must waive the equivalent amount of the premium and the equivalent economic incentives for the exported GoOs or the difference between the remuneration received and the final sale price set in the organized market. In addition, the National Energy

Commission has extensive monitoring and control powers, which include for example access to the sites and the accounting of the producers.

Sweden

Sweden previously had two parallel systems: a national GoO system, which complied only with the minimum standards of the Directive 2001/77/EC (and for example had no cancellation periods, was not electronic etc.), run by Svenska Kraftnet and supervised by the Energy Agency and the international (RECS) system run by Grexel, a member of the AIB and thus according to EECS standards. However, the progress report shows that the national GoO system now has been adapted, that Svenska Kraftnät is now using the CESAR system (also used by Grexel according to EECS standards), and that overall compliance with Directive 2009/28/EC has been realized. In fact, the systems seem merged (unfortunately, there is no information in the progress report on whether Grexel still performs RECS certifications in Sweden or whether the national GoOs can nowadays also be transferred) , so that the national GoO system can now be said to be quite advanced. The application is made to the regulator, which can request further information, gain access to facilities and the like. The regulator can also revoke GoOs. In Sweden, all producers of electricity from all sources have a right to obtain GoO, so that there are GoOs also for non-renewable energy. However, each GoO sets out from which source the electricity has been generated. For renewable energy, they can then be used in the national support system.

United Kingdom

The British system has been criticized in the past especially for its various possibilities for double-counting, due to the fact that several different certificates exist in parallel. Concerning the GoOs in particular, import and export was possible, but not tracked in the system, as the registry in the UK is not linked to any other register in Europe. The progress report does not address this issue. Neither is the question of validity addressed (which is currently 16 months after issuance for Great Britain and 19 months for Northern Ireland). It only says that now 1 GoO is being issued for every 1 MWh, but does mention how often the GoOs are issued (monthly, yearly etc.). Generally, the GoOs are issued by the regulator Ofgem upon information from the applicants. Ofgem can ask for periodic audits and there are both automated as well as manual control procedures in place. Interestingly, renewable heating and cooling GoOs from other Member States can be and will then be published (though the report does not say where). Still, the UK does not itself have a system for heating and cooling. Concerning electricity, GoOs Ofgem's powers to refuse recognition have been strengthened so that now they will always first try to verify with the issuing body, it appears.

1.6 Progress in electricity grid integration

Introduction

To ensure transmission and distribution of electricity produced from renewable energy sources several measures have been adopted in the Member States that could be extracted from section 2.b of their progress reports. An analysis and evaluation of their progress in grid integration requires the understanding of their individual background concerning grid capacity limitations and other barriers to grid integration of RES. For this, the progress reports have been reviewed as well as the countries' barriers to grid integration detected in Eclareon et al. 2012, Annex III[11] The measures adopted and mentioned in the reports have been aggregated to 13 relevant measures. Those are either directly or indirectly related to the fields of grid development or costs. Subsequently, the measures are related to 8 selected barriers. The choice of these barriers was based on their occurrences as well as on their relation to the taken measures. Thus, the effects of the measures have been linked to the barriers assessing whether they can directly or indirectly target one or more of the barriers a country faces. Table 19 shows the barriers in relation to the relevant measures and their effectiveness. The evaluations being made are based on our expert's knowledge. Their connection is marked green when the measure is effective on the barrier.

[11] See Eclareon/RES INTEGRATION/Öko-Institut e.V. (2012): Integration of electricity from renewables to the electricity grid and to the electricity market – RES INTEGRATION, Final Report.

Table 19. Effectiveness of relevant measures connected to most common barriers.

	Barrier 1: lack of communication / conflicts between stakeholders / conditional connection (no security as regards full intake of electricity)	**Barrier 2:** Lack of grid capacity	**Barrier 3:** Limited accessibility to information (concerning electricity sector in general & especially concerning level of cost, time and procedure) / Limited exchange of information	**Barrier 4:** Long lead times / delays	**Barrier 5:** No obligation to connect / to expand	**Barrier 6:** Non-shallow cost	**Barrier 7:** Unclear cost regime (concerning distribution of costs)	**Barrier 8:** No compensation provided in case of curtailment
Measure 1: right of connection / equal treatment	■				■			
Measure 2: grid operator drafts network development plan / large investment programs		■						
Measure 3: grid expansion acceleration / facilitation / unification of connection requirements		■		■				
Measure 4: priority of RES-requests for connection				■				
Measure 5: obligation for TSO to optimize and expand / connect	■				■			
Measure 6: provision of cost estimates and necessary information by grid operator			■					
Measure 7: Take into account Europe (interconnection / interoperability)								
Measure 8: connection fee established, paid by producer								
Measure 9: non-shallow cost structure (new established or maintained)							■	
Measure 10: (establishing a) shallow cost structure (producer responsible up to a specific point)						■	■	
Measure 11: clarification of the distribution of costs for general development of the grid as required						■	■	
Measure 12: specific rights of construction for producer in case of inertia of the operator		■		■				
Measure 13: RES-priority in dispatch/ compensation for curtailment / reduced production								■

It is worth mentioning that we categorised a "non-shallow cost structure" (barrier 6 & measure 9) as both a barrier and a measure. This is due to the fact that a few countries (BE, BG, DE, ES, FR, LT, LV, MT, PL, PT, RO) have established a new non-shallow cost structure or explicitly maintained their existing non-shallow cost structure, although it was detected as a barrier in some other or even the same countries (AT, EE, ES, FR, LU, LT, LV, SI, UK). According to the selection methodology for barriers and measures explained above, this is therefore recorded for both categories.

Furthermore it is worth mentioning that measures 7 & 8 do not target at any specific barrier. Still, by adopting measure 7 ("Take into account Europe") many countries are integrating the European perspective into their grid development which is in line with the EU's ambitions towards an integrated European electricity market (Directive 2009/72/EC). Measure 8 ("connection fee established, paid by producer") does apparently not target at any barriers as it rather appears as an established investment barrier itself. Nonetheless, this was integrated into the 13 most relevant measures as a number of countries decided to adopt a measure to charge connection fees to the producer, which needs to appear in this analysis.

In this report, the progress of each country is being evaluated and rated. This is based on our expert's knowledge and is done in two different ways:

- Firstly, based on the information reported in the progress reports we can identify whether or not the measures the country adopted address one or more of the barriers the country is affected by;
- Secondly, we indicate to what extent the countries have already been able to reduce the barriers they targeted in their NREAP. The NREAP assessment is based on information from [Eclareon et al. 2012] and due to a different selection methodology of relevant barriers in this project the analysis was only partly possible.

Methodology and results

Mapping barriers and measures to each country show the extent to which existing barriers are addressed by effective measures to remove them (effective as according to Table 19). Table 20 shows what measures the Member States have adopted.

Table 20. Measures adopted in the Member States to improve the grid integration of RES.

	BE	BG	CZ	DK	DE	EE	IE	GR	ES	FR	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE	UK
Measure 1: right of connection / equal treatment						x	x							x					x	x		x	x	x	x		x
Measure 2: grid operator drafts network development plan / large investment programs		x			x		x		x	x		x	x				x				x	x		x			x
Measure 3: grid expansion acceleration / facilitation / unification of connection requirements			x		x	x	x		x				x								x				x		
Measure 4: priority of RES-requests for connection											x	x		x													
Measure 5: obligation for TSO to optimize and expand / connect														x				x							x	x	
Measure 6: provision of cost estimates and necessary information by grid operator			x	x	x											x				x		x					
Measure 7: Take into account Europe (interconnection / interoperability)		x		x					x								x					x					
Measure 8: connection fee established, paid by producer	x	x																	x						x		
Measure 9: non-shallow cost structure (new established or maintained)		x			x				x	x			x	x			x			x	x	x					
Measure 10: (establishing a) shallow cost structure (producer responsible up to a specific point)				x			x					x							x								
Measure 11: clarification of the distribution of costs for general development of the grid as required				x	x						x		x	x					x			x			x		x
Measure 12: specific rights of construction for producer in case of inertia of the operator	x							x			x											x					
Measure 13: RES-priority in dispatch/ compensation for curtailment / reduced production	x				x						x	x		x			x			x		x	x	x			

Based on this, Table 21 connects the detected barriers of each country to the adopted measures and assesses the effectiveness of the measures. It presents the overall results of the analysis of the measures' effectiveness. A country-specific analysis with more detailed information about the measures they have adopted can be provided in the annex of the final report. The concept of Table 21 is explained as follows:

- Green cells show barriers that have been addressed in the country with one or more effective measures (number in cell refers to the number of measures adopted);
- Yellow cells show barriers that have not been addressed with effective policies in the country so far.

Table 21. Relation between barriers and effectiveness of measures in the Member States.

	Barrier 1: lack of communication / conflicts between stakeholders / conditional connection	Barrier 2: Lack of grid capacity	Barrier 3: Limited accessibility or exchange of information for producers (level of cost / time / procedure)	Barrier 4: Long lead times / delays	Barrier 5: No obligation for TSO to connect / to expand	Barrier 6: Non-shallow cost structure	Barrier 7: Unclear cost regime (concerning distribution of costs)	Barrier 8: No compensation provided in case of curtailment
AT	1 (-)		x		1	10/11 (-)		
BE		12 (-)			x			13
BG		2 (-)			x			
CY				4 (0)				
CZ			6	3 (-)	x		x	
DE	x (-)	2/3	6	3 (+)			9/11	
DK								
EE	1 (-)	3 (-)		3 (-)		x (-)	x	
ES	x (-)	2/3 (-)		3 (-)		x (0)	9	
FI	1/5 (-)	3 (-)	x	3 (-)			11	
FR		2 (-)	x	x (-)		x (+)	9	
GR		12 (-)		12 (-)	x			
HU	x (-)	x (0)		x (-)	x			
IR		2/3 (-)		3 (-)	1			
IT		12 (+)		4/12 (0)				13
LT		x (-)	x			11 (-)		
LU			x			x (+)		
LV	x (-)			3 (+)	x	11 (0)		
MT		2 (+)						13
NL		x (-)						
PL	1 (-)	x (0)	6	x (-)			x	13
PT				3 (+)				x
RO	1 (0)	2/12 (0)	6	12 (0)			9/11	
SE				x (0)			x	
SI	1			1 (0)		x		
SK								
UK		2		x (0)		11 (-)		

Table 21 also presents the results of the NREAP progress analysis. To display whether a country has made progress today (as reported in their Progress Report) compared to what they indicated in their NREAP, we have used the information available on the NREAP in [Eclareon et al. 2012, p.69]. Unfortunately the barriers selected in [Eclareon et al. 2012] do not correspond exactly to the barriers selected in this analysis. Therefore, since we are taking their NREAP analysis as a baseline for our progress assessment, the progress assessment has only been realised for 4 barriers (1, 2, 4 & 6). The results of the NREAP progress assessment presented in Table 21 reflect the following scoring rules:

- (+) barrier that was already addressed by an appropriate measure in the NREAP;
- (0) barrier that the country acknowledged in the NREAP but without adopting a measure to address it;
- (-) barrier that the country did not acknowledge in the NREAP.

Most of the countries have made important progress in tackling their grid barriers since the NREAP as shown by the number of green cells with a (0) or (-) score. These show barriers that were not addressed in the NREAP but that are now address with effective measures in the Progress Report.

The assessment in Table 21 presents a clear connection between the country's grid limitations (whether it is affected by a certain barrier or not), the measures planned in the NREAP and the measures (and their effectiveness) adopted recently.

Interpretation of the results

Regarding the barriers that countries are affected by and shown in Table 21, most countries are affected by barrier 2 "lack of grid capacity" and barrier 4 "long lead times / delays". This leads to the conclusion that there is an urgent need for grid extensions and shorter approval procedures. Measures 2, 3 & 12 can solve the problem. Most of the countries decided for measure 2, thus a better structured approach to an increase of grid capacity with network development plans and a large investment program. Solutions to barrier 4 can be measures 3, 4 & 12. Here, most of the countries chose measures 3 and 12, which means they aim at facilitation and unification of connection requirements but also they establish specific rights for the producer to construct a connection in case of inertia of the TSO. On the contrary, barrier 8 ("No compensation provided in case of curtailment") is less evenly distributed. It proves that there is already a vivid promotion of RES-integration in the majority of countries. At least there are many legislations that might take into account rules concerning of compensation for curtailment / RES-priority of dispatch.

The measures presented in Table 20 can be distinguished between: measures 1-6 & 12 related to the issue of grid capacity development; and measures 6, 8-13 related to the issue of rules for bearing and sharing the costs of grid development and connection. Referred to the barriers it can equally be distinguished between barriers 1-5 as relevant for grid development and barriers 3, 6-8 as relevant for costs. Both issues are analysed into more details below but with a look at the fits between barriers and measures (green cells in Table 21) it appears that most fits between measures and barriers are observed in the issue of grid development rather than in the issue of costs. A first conclusion could be that adopting effective cost regulation measures aiming at a clear distribution and level of costs as well as setting incentives for investments seems to be less of a priority than accelerating and facilitating grid development. Measure 7 ("Take into account Europe interconnection /interoperability") does not target at a specific issue but contributes to improve the general convergence between the European and the adjacent countries' grid development integration.

With a more general look at taken measures in Table 20, on average, countries took 3,26 measures. What is striking here is that Romania took 8 measures which is far above the average. Since it was also affected by quite a number of barriers (5) it can be concluded that there are high dynamics in the transition of the Romanian energy system towards a RES-dominated system. Also, Germany and Lithuania (6 measures) can be highlighted with many activities recently.

The NREAP assessment presented in Table 21 shows that many countries had not addressed or even acknowledged certain barriers in the NREAP but have adopted quite effective measures to reduce them recently (e.g. barrier 2: BE, BU, ES, FI, FR, GR, IE). This shows that the development of RES integration is evolving quickly and that policies are dynamic.

In order to present a clear picture of the progress of the countries in improving RES electricity grid integration, we are rating each country based on the assessment of the effectiveness of the measures to address the barriers presented above. The rating is based on the ratio of green and yellow cells in Table 21 for each country.

- # of green cells < # yellow cells shows that there are more barriers not addressed in the country than barriers addressed through effective measures. The country is rated as 'need improvements';
- # of green cells > # yellow cells shows that there are more barriers addressed by effective measures than barriers not addressed. The country is rated 'advanced';
- # of green cells = # yellow cells, the country is rated as 'fair'.

Table 22. Member State rating on overall RES grid integration.

	# green / # yellow	Rating
BE	1 / 1	Advanced
BG	1 / 1	Fair
CZ	2 / 2	Fair
DK	0 / 0	Fair
DE	4 / 1	Advanced
EE	3 / 2	Advanced
IE	3 / 0	Advanced
GR	2 / 1	Advanced
ES	3 / 2	Advanced
FR	2 / 3	Need improvements
IT	3 / 0	Advanced
CY	1 / 0	Advanced
LV	2 / 2	Fair
LT	1 / 2	Need improvements
LU	0 / 2	Need improvements
HU	0 / 4	Need improvements
MT	2 / 0	Advanced
NL	0 / 1	Need improvements
AT	3 / 2	Advanced
PL	3 / 3	Fair
PT	1 / 1	Fair
RO	5 / 0	Advanced
SI	2 / 1	Advanced
SK	0 / 0	Fair
FI	4 / 1	Advanced
SE	0 / 2	Need improvements
UK	2 / 1	Advanced

Table 22 shows that the majority of the countries perform quite well in the whole procedure of RES grid integration, as there are 14 out of 27 countries rated 'advanced'. The reasons for Sweden or France being rated 'need improvements' can be explained.

For Sweden the rating gives a distorting impression because Sweden is actually not affected by many barriers (only 2) and therefore integrates RES very well overall. In France it might be connected to the market concentration.

Interpretation of results on grid capacity limitations and measures for grid development

There are five barriers extracted from Table 19 and displayed in Table 23 that are regarded as directly relevant for grid capacity limitations (barriers 1- 5). Related to them, there are 6 measures adopted by Member States that address these barriers, either directly or indirectly.

Table 23. Grid capacity limitations and measures for grid development.

Grid capacity limitations	Measures for grid development
Barrier 1: lack of communication / conflicts between stakeholders / conditional connection	**Measure 1:** right/guarantee of connection / equal treatment **Measure 5:** obligation for TSO to optimize and expand / connect
Barrier 2: Lack of grid capacity	**Measure 2:** grid operator drafts network development plan; large investment programs **Measure 3:** grid expansion acceleration / facilitation / unification of connection requirements **Measure 12:** specific rights of construction for producer in case of inertia of the operator
Barrier 3: Limited accessibility to information (concerning electricity sector in general & especially concerning level of cost, time and procedure) / Limited exchange of information	**Measure 6:** provision of cost estimates and necessary information by grid operator
Barrier 4: Long lead times / delays	**Measure 3:** grid expansion acceleration / facilitation / unification of connection requirements **Measure 4**: priority for RES-requests for connection **Measure 12:** specific rights of construction for producer in case of inertia of the operator
Barrier 5: no obligation for TSO to expand / connect	**Measure 1:** right/guarantee of connection / equal treatment **Measure 5:** obligation for TSO to optimize and expand / connect

Barriers 2 and 4 are widely spread among Member States and seem to be serious problems in the process of RES-integration. Therefore member states should further facilitate approval procedures and set incentives for grid investments, not only towards grid operators but also towards other stakeholders able to contribute financially.

Measures taken do not always target the specific barriers 1-5 and therefore they do not provide effective solutions to the integration issues. Following the same methodology as presented above, Table 24 presents the rating of the Member States in addressing specifically the issues of grid capacity limitations.

Table 24. Member State rating on addressing grid capacity limitations.

	# green / # yellow	Rating
BE	1 / 1	Fair
BG	1 / 1	Fair
CZ	2 / 1	Advanced
DK	0 / 0	Fair
DE	3 / 1	Advanced
EE	3 / 0	Advanced
IE	3 / 0	Advanced
GR	2 / 1	Advanced
ES	2 / 1	Advanced
FR	1 / 2	Need improvements
IT	2 / 0	Advanced
CY	1 / 0	Advanced
LV	1 / 2	Need improvements
LT	0 / 2	Need improvements
LU	0 / 1	Need improvements
HU	0 / 4	Need improvements
MT	1 / 0	Advanced
NL	0 / 1	Need improvements
AT	2 / 1	Advanced
PL	2/ 2	Fair
PT	1 / 0	Advanced
RO	4 / 0	Advanced
SI	2 / 0	Advanced
SK	0 / 0	Fair
FI	3 / 1	Advanced
SE	0 / 1	Need improvements
UK	1 / 1	Fair

Member States are performing quite well in addressing the grid capacity limitations. Seven countries still need improvements, but 14 countries are advanced. Reducing grid capacity limitations with measures 1-6 & 12 appears to be of high priority in the Member States. Poland is 'fair' but affected with quite a lot of barriers. On the contrary, the Netherlands 'need improvements' but is only affected by one barrier, thus their performance is probably not as bad as the rating suggests. This is connected to the remark of [Eclareon et al. 2012]: in case a country does not exhibit many or even any barrier(s) it must not be concluded that it really faces no barriers but, equally, that the field of RES-integration might not yet be very prominent enough and that there can be barriers not detected yet (e.g. SK).

Interpretation of results on the rules for bearing and sharing the costs of grid development

Adopting clear rules concerning cost regulation, in particular the level and the distribution of costs linked to grid development is crucial to make further progress in RES-integration. The weight of such clear rules in investment decisions is demonstrated by the wide spread of barriers 6 and 7 ("non-shallow cost" and "unclear cost regime") in Table 21 that confront investors with uncertainty in the members states. Barriers 3 and 8 are also relevant for the costs of grid development. Table 25 shows the barriers and measures relevant for the issue of sharing and bearing of costs of grid development.

Table 25. Barriers related to costs and measures for cost regulation.

Barriers related to costs	Measures for cost regulation
Barrier 3: Limited accessibility to information (concerning electricity sector in general & especially concerning level of cost, time and procedure) / Limited exchange of information	**Measure 6:** provision of cost estimates and necessary information by grid operator
Barrier 6: Non-shallow cost structure	**Measure 10:** shallow cost structure (producer responsible up to a specific point) **Measure 11:** clarification of the distribution of costs for general development of the grid as required
Barrier 7: Unclear cost regime (concerning distribution of costs)	**Measure 9:** non-shallow cost structure (new established or maintained) **Measure 10:** shallow cost structure (producer responsible up to a specific point) **Measure 11:** clarification of the distribution of costs for general development of the grid as required
Barrier 8: No compensation provided in case of curtailment	**Measure 13:** RES-priority in dispatch/ compensation for curtailment / reduced production

As the majority of countries (except FI, IR, IT, LT, PT, SK) did not make the distinction between transmission and distribution grid development in their report, we are therefore unable to provide this level of detail in the analysis. Thus, the explicit measures for the distribution grid development in the mentioned 6 countries have been integrated in the general 13 measures.

Looking at the distribution of the barriers in the field of cost regulations in Table 21 most countries are affected by barriers 6 and 7 which relates to an uncertainty about the level and distribution of costs. The majority of the countries concerned adopted measure 11 ("clarification of the distribution of costs for general development of the grid as required"). This seems to be an effective way to solve the problem.

Following the same methodology as presented above, Table 26 presents the rating of the Member States in addressing specifically the rules for bearing and sharing the costs of grid development.

Table 26. Member State rating on rules for bearing and sharing the costs of grid development.

	# green / # yellow	Rating
BE	1 / 0	Advanced
BG	0 / 0	Fair
CZ	1 / 1	Fair
DK	0 / 0	Fair
DE	2 / 0	Advanced
EE	0 / 2	Need improvements
IE	0 / 0	Fair
GR	0 / 0	Fair
ES	1 / 1	Fair
FR	1 / 2	Need improvements
IT	1 / 0	Advanced
CY	0 / 0	Fair
LV	1 / 0	Advanced
LT	1 / 1	Fair
LU	0 / 1	Need improvements
HU	0 / 0	Fair
MT	1 / 0	Advanced
NL	0 / 0	Fair
AT	1 / 1	Fair
PL	2 / 1	Advanced
PT	0 / 1	Need improvements
RO	2 / 0	Advanced
SI	0 / 1	Need improvements
SK	0 / 0	Fair
FI	1 / 1	Fair
SE	0 / 1	Need improvements
UK	1 / 0	Advanced

Adopting rules on bearing and sharing costs does not seem to be as common as adopting measures to improve grid capacity development since many countries have not adopted any of the relevant measures. The Member State rating shows 8 'advanced' countries, 6 'need improvements' countries and 13 'fair' countries. This is a quite positive overall performance, but slightly worse than in the field of grid development. Still, some countries seem to accelerate further grid reinforcements by a clarification of the distribution of costs for general development of the grid (measure 11) and, thus, reduce the barrier of an unclear cost regime. However, measure 9 ("non-shallow cost structure, new established or maintained") seems to have a counterproductive effect, because such a structure poses investment uncertainty to electricity producers from RES and is usually viewed as an important barrier. Even so, many countries (10) decided for maintain or establish non-shallow costs. To a certain extent, some uncertainty regarding the costs can be reduced, e.g. when there were no cost regulations at all before. This would need to be examined in detail. Another intention might be to make a decision that is more favourable to grid operators and/or to better control the development of RES-installations and avoid a geographical aggregation that burdens even more the grid already operating to full capacity (e.g. Bulgaria pointed out this argumentation). This shows that a further development of RES-installations needs to be planned from an integrated perspective and (among others) also needs to take into account grid capacity. An uncontrolled spread or geographical aggregation can rather lead to an increased lack of grid capacity and might be equally counterproductive. The assessment of the Member State's progress in administrative procedures is directly linked to that question.

1.7 Progress in administrative procedures

Introduction

According to article 13(1) of the Directive 2009/28/EC, Member States shall ensure that the procedures for authorisation, certification and licensing procedures for renewables are necessary and proportionate. In particular, the Directive addresses coordination between different administrative levels and agencies and asks for concrete time limits for decisions. Further, comprehensive information shall be made available. Administrative procedures shall be streamlined at the adequate administrative levels and requirements shall be objective, transparent and proportionate. The article also asks for transparency as regards the costs of the proceedings and potentially also for special facilitations for smaller projects or decentralized projects.

Article 22(3) then specifies the general reporting obligation and asks the Member States to report on their plans to have a so-called "one stop shop", thus one single agency for all authorisation, certification and licensing procedures (art. 22(3) a)), automatic permission in case of no response from the respective authority within a certain time frame (art. 22(3) b)) and measures to clearly identify geographical sites for the use of renewables and district heating and cooling.

Methodology

Based on those provisions, the following criteria have been chosen, according to which the Member States' progress in implementing article 13(2) will be assessed:

- First, as an indicator of whether the procedures have been streamlined and as specifically asked for in article 22(3)a), it will be looked at whether there is a so-called "one-stop-shop", meaning that a project developer can turn to one single agency. In the assessment, if there is a one-stop-shop, this will be considered the preferred option;
- Second, the question of whether a project can be implemented with one single permit will be looked at, and if there is not one, but more, then it will – where possible – be looked at how many permits are required. The assumption here is that the less permits required, the better;
- Then we look at whether permits can be applied for online, as this could facilitate the procedure as well and could further reduce the costs which seems relevant with a view to article 13(2)e) (the requirement that costs should be proportionate) as well;
- As article 13(2) a) specifically asks Member States to define time frames for decisions, another indicator will be whether there are such mandatory time frames within which a decision has to be taken. Although it appears that the deadlines are not always met, for the assessment the mere existence will be rated positively as it

provides the project developer with some certainty; where possible, the maximum time limits will be mentioned as well;
- Then, in the context of article 22(3)b) of the Directive, it is looked at whether - after a certain time period has elapsed during which the authority has not responded - permission is granted "automatically";
- Article 13(f) says that Member States may adopt facilitated procedures for small scale or decentralized plants, so that the existence of any kind of special procedure has been taken as another indicator;
- With article 22(3)c, the Member States had to report on their plans on the (better) identification of geographical sites for the deployment of renewables and district heating and cooling, so that it will be looked at whether the Member States have put in place some sort of accessible database or plan for projectors to consult and for authorities to rely on;
- Finally, the last indicator looks at whether there is another procedure required to get access to the renewables financial support schemes (e.g. FIT, FIP, quota), or whether this is automatic.

Our analysis describes the administrative procedures in the EU Member States (overview in Table 28 and details in MS paragraphs below) and quantifies the MS progress towards the criteria using the following weighted scoring method (Table 27).

Firstly, the administrative procedures are scored for each criterion using the following rules: score of 1 if the answer is 'yes', score of 0 if the answer is 'no' or 'no information' is available. Given the – detailed - reporting obligation in article 22 (2) and (3) of the Directive, awarding a score of 0 in case no information was provided in the report seems justified. If the answer is 'partly', meaning that there are local (e.g. in one part of the country, a one-stop-shop exists) or other differences (e.g. for some technologies or project sizes only one permit is required), then 0,5 points will be awarded. As regards the numbers of permits they will be considered as the less, the better, so that if there are not more than 2 permits, a score of 0,5 will be awarded. The length of procedures – if information was available – will not be considered in the scoring though, in particular as often the information on those limits related only to some part of the procedure (e.g. for one permit out of many permits required), and different limits can be accumulated as procedures are not being streamlined. Consideration of those limits would thus flaw the representation and the scoring in the table. However, a range of minimum and maximum limits may be indicated in brackets. Further, it is referred to the Member State Paragraphs for more detailed information.

As article 13 of the Directive refers strongly to the Member States appreciation of what is necessary and proportionate, no weighing of the indicators is introduced, as none of the provisions is strictly mandatory.

Table 27. Scoring methodology for assessment of administrative procedures in the Member States.

"One Stop Shop"? (Art. 22(3)a))	One permit? (Average number of permits?)	Online application for permit?	Maximum time limit for procedures? What is the max time (range of the limits for different decisions) ?	Automatic permission? (Art. 22(3)b))	Facilitated procedures for small-scale?	Identification / dedication of geographic sites? (Art. 22(3)c))	Automatic entry into financial support scheme?
Yes=1 Partly=0.5 No/No information=0	Yes=1 No but max 2 permits = 0,5 No >2 permits/No information=0	Yes=1 Partly=0.5 No/No information=0	Yes=1 Partly=0.5 No/No information=0	Yes=1 Partly=0.5 No/No information=0	Yes=1 No/No information=0	Yes=1 No/No information=0	Yes=1 Partly=0.5 No/No information=0

The scoring method results in the following MS progress assessment:
0-3 points = needs improvement
4-6 points = fair
6-8 points = advanced

Sources of information

According to Art. 22(3) and 27(2) Directive 2009/28/EC the Member States are obliged to report their progress with the implementation of the Directive. Consequently it can be assumed, that if no progress is reported there has been none since the NREAP. Thus the assessment will be a comparison of the progress from the NREAP to the situation reported in the progress report.

Accordingly, the analysis is primarily based on what the Member States reported in their 2011 progress reports, supplemented when necessary and compared with information from the NREAPs, as the last report submitted by the Member States. In general, the following steps have been taken.

- If a new law has been implemented and it was reported in the progress report, then those were the measures considered;
- If the report only sets out that a new law is planned and there was sufficient detail to consider those plans, then those measures have been considered;
- If there was only said that a revision is planned or the like and there was insufficient detail to properly assess the planned measures, then the old law was considered;
- If there is nothing said or nothing reported, then only the old law according to the NREAP was considered and it was put "no information" in the table. This approach is considered justified and particularly important for the three factors that article 22(3) specifically asked to report about.

Table 28. Assessment of the administrative procedures in the Member States.

Member State	"One Stop Shop"? (Art. 22(3)a))	One permit? (Average. number of permits?)	Online application for permit?	Maximum time limit for procedures? What is the max. time (range of the limits for different decisions) ?	Automatic permission? (Art. 22(3)b))	Facilitated procedures for small-scale?	Identification/ Dedication of geographic sites? (Art. 22(3)c))	Automatic entry into financial support scheme?	Overall assessment
Belgium	No	No (4)	No information	Partly (6 months – 1 year)	No	No	No information	No information	Needs improvement (0.5)
Flanders	No	Partly (2)	No information	Yes (15 days - 4 months)	No	Yes	Yes	No	Fair (3.5)
Walloon Region	No	Partly (2)	No information	Yes (90-140 days)	No	Yes	Yes	No	Fair (3.5)
Brussels	Yes	Partly (2)	No information	Yes (20-450 days)	No	Yes	No information	No information	Fair (3.5)
Bulgaria	No	No (?)	No	No	No	Yes	Yes	Yes	Needs improvement (3)
Czech Republic	No	No (3)	No information	Yes (60 days – 72 months)	No	Yes	No	No information	Needs improvement (2)
Denmark	Yes	Yes	No information	No	No information	Yes	No information	Yes	Fair (4)
Germany	Partly	Partly (2)	Partly	Partly (?-10 months)	No information	Yes	Yes	Yes	Fair (5)
Estonia	No	No (2)	No	No	No	No	Yes	No	Needs improvement (1.5)
Ireland	No	No (2)	No	Partly (6 – 8 weeks)	No information	Yes	Yes	No	Needs improvement (3)
Greece	Yes	No (3)	No	Yes (no information)	No information	Yes	No information	No information	Needs improvement (3)
France	No	No (3)	Partly	Partly (?-1 year)	No	Yes	No information	No	Needs improvement (2)
Italy	Yes	Yes	No	Yes (30-90/180 days)	Partly	Yes	No information	No	Fair (4.5)
Cyprus	Yes	No (5)	No	Yes (2-3 months)	No information	Yes	Yes	No information	Fair (4)
Latvia	No	No (8)	No	Partly (30 - 180 days)	No information	No information	No information	No	Needs improvement (0.5)
Lithuania	Partly	No (2)	No information	Partly (10-30 days)	Partly	Yes	No information	No	Needs improvement (3)
Luxemburg	No	No (2)	No information	Partly (3-5,5 months)	No information	Yes	No information	No information	Needs improvement (2)
Hungary	Yes	Partly	Partly	Yes (no information)	No information	Yes	No information	No	Fair (4)
Malta	No	Partly	No	Partly (4 weeks)	No information	Yes	No information	No	Needs improvement (2)
The	Yes	Yes	Yes	Partly (6	No	Yes	Yes	No	Fair (5.5)

Netherlands				months)	information				
Austria	Yes	No (?)	No	No	No	Yes	No	No	Needs improvement (2)
Poland	No	No (4)	No	Partly (30-65 days)	Partly	Yes	No information	No information	Needs improvement (2)
Portugal	Yes	Partly (2)	Partly	Yes (120-250 days + 30 days for network connection)	No information	Yes	Yes	No information	Fair (5)
Romania	No	No (7)	No information	Partly (30 days)	No information	No	No information	No	Needs improvement (0.5)
Slovenia	No	No (>5)	No information	No	No	Yes	No information	No information	Needs improvement (1)
Slovakia	No	No (3)	No	Partly (no information)	No information	Yes	Yes	No information	Needs improvement (2.5)
Finland	No	No (3)	No information	No information	No information	Yes	Yes	No information	Needs improvement (1.5)
Sweden	Partly	Partly (2)	Partly	Partly (no information)	No information	Yes	Yes	No	Fair (4)
United Kingdom	No	No (3)	No information	Partly (1 year)	No information	Yes	Partly	No	Needs improvement (2)

Assessment and Conclusions:

The progress made by the Member States in improving their administrative procedures as stipulated by article 13 of the Directive 2009/28/EC appears to be quite limited from the table presented above. As regards article 22 of the Directive 2009/28/EC and the specifics of the reporting obligation, many Member States do not even address at least one of the three topics specifically asked for – as the "no information" marks in the table above show – and most of them have not implemented any of the measures suggested.

Accordingly, it appears that most countries still have a lot of room for improvement: none of the countries got an "advanced" score.

On the other hand, what becomes apparent – in particular from the many "partly" entries - is that administrative procedures are not always national, but often subject to local/regional decisions and local authorities may differ significantly in how they work, even within one and the same country. An example of such a country would be Sweden, where different procedures exist for the different technologies, and deadlines for decisions on regional and local level differ in periods. Another, and quite drastic, example is Spain, where the Autonomous Regions are competent in most cases, and where the procedures widely differ.

While the Italian system scored "fair", and for example had time limits in place for some time now, this does not necessarily mean that the system works in practice.[12] In this regard, the Italians, which had to admit that in the past their time limits had normally not been kept, continue to work on their system. Now, they introduced the Enabling Simplified Procedure, applicable for small plants, which means that after 30 days without explicit response means permission.

Then, some countries such as Germany, report that there is no acute need for improvements, but that their systems are working. Considering the "fair" score Germany got, and the explicit mentioning in the report, that the country will continue nonetheless to further improve, this seems acceptable. It might thus be that even without the "advanced" score a system can work.

However, and now turning to the countries doing not so well, it is remarkable that a country like Estonia, with one of the worst scores, reported that no "quick" improvements were needed and suggests that one is working closely together with the industry. Here though, the industry suggests, that the government is wrong, and that the administrative procedures urgently need to be improved – and thus confirm the outcome of the assessment.[13] Another very frequent feature is that the reports identify a need but refer only vaguely or in an entirely inappropriate way to actions that may be taken. For example, in the Romanian report, the financing problem is assessed rather than to address administrative procedures, while Bulgaria explains that there is a problem with the share of renewable energy growing too fast.

Among those countries with the bad scores are then also the ones that announced big plans in their NREAPs and did not set them into practice, or at least did not report about them (which is considered to mean they did not realize them). An example is Ireland, where the law planned in the NREAP seems to have been stalled.

Turning to the indicators, it appears that only Greece and Portugal newly introduced one-stop-shop-systems since the NREAP. A few Member States had it in place before, at least for some technologies (wind) or at least in some parts of the country (e.g. in Germany or in Sweden). So generally, the uptake on this idea – and the response to article 22(3)a) – has been rather low (7 Member States have it, 4 partly – as the Brussels Region is part of Belgium, here the Belgian "no" has to be seen as a "partly").

Only Denmark, Italy and the Netherlands have a single permit system for all projects, while some Member States bundle permissions into one permit only for specific technologies or have such a system only in parts of the country. However, it turns out, that in only a few countries, more than 3 permits are required, with Central

[12] The Italian TSO Enel recently stated at the PV Legal Conference that the deadlines are usually not met – which is consistent with the situation reported in the NREAP, where the government admits, that the time limits are not met.
[13] As recently discussed with the Estonian Renewable Energy Association.

and Eastern European countries such as Latvia, Romania or Slovakia, where it does not even become clear how many permits are required, heading the list.

Online application – as another means to speed up and simplify proceedings, while keeping the costs low - is so far only possible in the Netherlands, and partly in France and Portugal (smaller projects), in Germany (parts of the country) and Hungary (to enter into financial support scheme). In Cyprus, while it is not mentioned that one can actually apply online, the internet is used to publish comprehensive information, including application forms, and the applicants can track the processing of their case by entering their ID number.

Many Member States have – at least for some parts of the procedures and/or for some technologies – time limits for decisions to be taken and most of them had them already mentioned in the NREAPs. However, those are often cumulative, in the sense that the limits for all the different decisions need to be added: Overall maximum limits for the entire procedure and to get all permits exist only in few countries (such as Italy or the Netherlands, in the latter, however, without submitting information on how long this deadline is). Rather, in most cases a range of different limits is presented which relate only to one permit, or to some permits and from what is heard in practice, this does not reduce the lead times at all (e.g. Ireland or Luxembourg). Hungary only states to have procedural deadlines, and already refers to them in the NREAP, but does not mention whether they apply to the entire procedure (so that this has been assumed) and how long they are. Also, one might question whether those time limits are being kept – for example in the Czech Republic, though it is said that the limit is 72 months for RES projects (this being without the building of the grid connection), the progress report also mentions that those are hardly kept. An interesting case is the Spanish one, where already in the NREAP it was set out that by default of deadlines set by the Autonomous Regions a three month limit applies per decision. While there are still numerous decisions to take and three months is fairly long compared to what other countries allow, the national (default) law specifically provides for automatic approval in case of no response within this time frame, however, without prejudice to differing provisions made by the Autonomous Regions.

This being said, only three Member States (Italy, Latvia and Poland) have some form of automatic approval (though for example in Poland, where several permits are required, this is only foreseen for one of them) as article 22(3) b) proposed. However, in none of the countries it applies for all technologies, but only for some and notably for smaller plants. For the rest, it is unclear what the sanction is in case time limits are not being kept, and it seems, in most Member States there simply is none. It should be mentioned here, that while they might not have automatic permission, some Member States simply apply a notification – rather than a permitting – requirement to some small scale projects, e.g. in Belgium, Hungary or Malta, so that no actual permission decision is needed.

On the other hand, almost all countries, with the exception of Estonia and Romania (and the Federal State Belgium, which is in charge, per definition, only of large scale projects while smaller ones are dealt with by the regions), have some facilitations for small scale projects. The exemption from certain permits – sometimes only notification – or the "automatic permission" procedures can be examples of those.

Similarly, many Member States have been working on plans for the deployment of some technologies as suggested in article 22(3)c) of the Directive, either designating areas or making clear where building certain plants is not possible. In Finland for example, one is working on location databases for wind, which consider for example flight obstacles and the defense forces' activities. Portugal has been very active in this respect as well and seeks to tie simplified procedures to the respective areas in question (pilot zone for offshore projects), which however had already been allocated at the times of the NREAP.

A thing only few Member States reported on, is the question of whether there are any extra procedures in order to get financial support, and it appears in most Member States such extra efforts are required (Exceptions: Bulgaria, Denmark, Germany). Hungary on the other hand would be an example of a country which reported to have recognized that exactly those procedures need to be simplified and recently introduced electronic application for support.

Generally, the concreteness and completeness of the measures intended and reported is very low in all reports. For example, the numbers of permits needed is often not mentioned, neither the number of authorities, so that one may get the feeling the countries themselves do not really know how many authorities or permits may in fact be necessary and how long it may take. Those problems were also apparent under the NREAP. It again shows a lack of coordination and thus a deficit in the implementation of the Directive 2009/28/EC which explicitly asked for coordination, and it explains why none of the Member States received an "advanced" score and only eight "fair" ratings (parts of Belgium, though two parts – if considered separately then 8).

Austria

Austria does not report any amendments or improvements. The progress report mentions that all permitting procedures for renewable energy installations are based on the principle of non-discrimination and renewables plants are thus not treated differently from any other power plants. They all need to follow a three permits approach which had been described in the NREAP already: First, approval according to electricity law, whereby - depending on the size of the plant several different permits, including the building permit and the spatial planning permit - may be required. Second, recognition as renewable energy plants by the respective regional authority. Third, the operators need to get approval to be eligible for support, meaning they need to register with and become members of the "Oekobilanzgruppe" and need to get a grid access contract. However, Austria has a one-stop-system, so that all permits are coordinated by the District Council Authority. Further, for smaller plants there is an exemption from electricity law approval.

Belgium

Only installations exceeding 25 MW and offshore wind installations need authorisation from the Federal Authority. Others only need to be notified to the Federal Regulator. Authorisation is thus mainly organized by the three different regions (Flanders, Walloon Region, Brussels), and granted locally or regionally. Depending on the nature and relevance of the environmental impact of a project, either there is only a notification requirement to the local authorities (category 3), or an environmental permit as well as a building permit (category 2) which can be issued locally need to be obtained. In category 1, projects need to be authorized by the region.

Flanders

Flanders, according to the progress report, is working on a "single permit" to replace the environmental and the building permit currently still needed for some plants. (Solar panels however have been almost in all cases exempted from authorisation anyways already under the NREAP, except in classified areas or protected landscape zones.) Further, the Flemish authorities are working on a better identification of suitable sites for wind power.

Walloon Region

In the Walloon Region, the government is now, in the course of the progress report, working in particular on frameworks for the local authorities as basis for their decisions on land use permits for biomethane, wind and geothermal projects, and thus trying to better identify suitable sites. A single permit already existed under the NREAP for some cases. For others, there was an exemption from one of the two permits or even from both (e.g. auto producers in solar energy).

Brussels

In Brussels, the procedures for photovoltaic and geothermal projects have been simplified, as the progress report says, and photovoltaic panels no longer need an environmental permit. Further facilitations relate to the support scheme for renewable, for example small photovoltaic plants below 10kVA the on the spot examination before certification has been dropped and they have to apply for their certificates only once a year, rather than 4 times a year as before.

Bulgaria

While the Bulgarian progress report shows that some evaluation has taken place, the administrative procedures have not significantly been improved. Rather, it is suggested that there was a problem with too much growth in renewables. The government clarified some provisions in the Agricultural Land Protection Act (where no plants may be build), and the Spatial Planning Act as amended facilitates the installation of small renewable systems and equipment up to 30kW. A further improvement reported on seems to be the exemption from forestry management requirements for biomass plantations. Most of those improvements had been promised in the NREAP – however it is not clear whether the new renewable energy act (mentioned in the NREAP so as to introduce the improvements) also keeps the other promises, as they are not reported on. The promised one-stop-shop, at least, seems not to be realized.

Cyprus

From the Cypriot progress report it appears that – when compared to the NREAP – only two of the measures are actually new: the exemption of PV systems of up to 20 kW[14] to obtain a town planning and a building permit and the decision of the TSO to no longer require those permits before starting to process interconnection requests, so that application can be in parallel and processed at the same time. However, Cyprus already in its NREAP stated that there were no acute problems. In fact, it appears that while a one-stop-shop has been in operation already under the NREAP and the responsible authorities are said to coordinate well, it appears that there are still about 5 to 7 licenses required for bigger projects, while smaller ones are normally exempt from one or other license.

Czech Republic

The Czech progress report sets out that in recent analysis a lot of problems have been identified and that those results recommend e.g. the centralization of permitting procedures (currently more than 30 authorities involved or at least have a right to appeal in case of the simplified procedure). However, it does not report any real progress in taking implementing measures, but only mentions vaguely that some amendments have been tabled and are in the course of legislative proceedings. It is expressly said, that while it may make sense, no one stop shop, automatic approval or dedication of sites has been introduced or is planned. Though, the current (and already under the NREAP) legislation allows for some simple buildings and structures, which may include respective installations of PV and solar, building permission only by notification.

Denmark

The Danish progress report contains little information on amendments to the administrative procedures. In fact, already in the NREAP, the Danish submitted that there was no need for and no plans for changes. Denmark already had a one- stop-

[14] It is assumed that the reference to 20 MW in the English translation and relating to the building permit is a mistake and that the correct value would here also be 20 kW.

shop for larger projects (notably offshore wind projects) on which different (local) actors could be interested in giving an opinion. However, this did not apply to onshore wind, for which – beyond 10MWh capacity – the approval of the Energy Agency and a permit from the local authorities was required. (For renewable heat the District Council had already been a one-stop-shop.) Now, according to the report, this "double-stop" was abolished, since the NREAP, constituting a significant improvement. For both large offshore wind, and large onshore wind there is now a one-stop-shop in operation. Smaller plants are exempted and need no approval from the Energy Agency.

Estonia

Estonia, relying on the results of the SUPPORT-RES study, in its report states that the country does not need any "quick changes" in their administrative procedures and "interviews did not reveal any unnecessary obstacles or non-proportional requirements", despite the negative grade the country gets according to the scheme above. Industry Associations though, seem to have different views on this[15]. Still, the government reports that it is working on county plans to identify suitable sites for wind onshore and legislation for wind offshore (likely to avoid competence problems between local authorities), thereby seeking input from the Estonian Wind Power Association. As clear from the NREAP, there have always been only two licenses required – one to participate in the energy market granted by the Competition Authority and one building permit by the local authorities. As regards small scale plants, there are no facilitations as there are no rules on installations on buildings.

Finland

The Finish progress tells only of improvements as regards wind. In compliance with article 22(3) (c) Finland mainly tried to improve the information system for suitable sites for wind power plants – new location databases allow to identify areas in which it is not possible to construct plants due to flight obstacles and a tool has been developed to provide information on where the radar impact of wind plants would interfere with the defense forces' activities. Thus what is facilitated is mainly the identification of suitable sites. Else, the report only repeats what has already been said in the (resubmitted) NREAP; that since 2011 the Land Use and Building Act has been amended to facilitate permitting for wind power. While it seems to refer to the same law (L134/2011), and the same procedure, it uses different wording, though.

France

The French progress report refers to the increased experience with renewable energy plants, so that wind and biomass can now benefit from specifically designated procedures rather than case to case decisions. For those (ICPE) classified projects and

[15] As the Estonian Renewable Energy Association stated in a recent conversation, they were even considering to write to the Commission in order to set right this statement of their government.

within the course of those procedures a maximum time limit of one year applies. As regards building permits for biogas plants in non-urban areas, facilitations have been introduced if the installation is necessary for agricultural use. Also, amendments have been introduced in particular to facilitate the procedures for (small) solar plants, e.g. the supply contract request is now merged with the grid connection request. Also, for those plants between 250kW and 4.5 MW, the application can be done online. However, to be eligible for the French renewables support scheme, a separate certification is required as well as a power purchase contract.

Germany

The German progress report states that there have been no major non-cost barriers identified in Germany. As a result, no detailed improvements or progresses were reported, while it is said that the existing procedures are constantly checked and if needed improved. On federal level, the German government reports that renewable energy projects have been given certain privileges in particular in the German Federal Building Code (BauG), where for example a climate protection clause was included ensuring that this aspect will be considered under planning law. Similarly, measures to speed up grid development have been taken, and a standardized procedure has been introduced. However, most other matters are within the competences of the Bundesländer. Accordingly, depending on the size and the location of the plant, there may be a one stop shop in place and there may be only one single permit needed. In the Bundesland Brandenburg, online application is possible, and in many of the Länder there are accessible plans identifying suitable geographical sites for renewables (in particular wind).

Greece

Greece introduced a new Renewable Energy Law in 2010, to implement the Directive. The law creates a one-stop-shop (though the progress report indicates that while it is in place, it does not yet fully operate as a one-stop-shop), whereto projectors can turn and which will coordinate the three permits required (production licensing, installation and operation permits) (from several different agencies). It appears that for each permit there are strict timelines; however there is no information on how long they are and whether they are cumulative or not. For PV installations a special "scaled" licensing procedure applies, depending on their size and where they should be built exempting them from the town-planning permit. Further, small scale projects (below 0.5/ for wind 0.2 MW) are exempted from the full Environmental Impact Assessment Procedure.

Hungary

The Hungarian progress report takes up the promises made in the NREAP and explains that – as the main improvement – a one stop shop has been introduced. While it seems that the administration within one organization is not yet available for all projects, the number of cases for which it applies, is said to be increasing. The

Hungarian government further submits to be working on the general facilitation for procedures for renewable energies, as the procedures took account of the different energy sources only to a limited degree before. In this context, the procedural deadlines, as they are indicated in both the report and the NREAP, shall also be shortened. However, it is unclear whether they apply to the entire procedure and how long they are and neither the progress report nor the NREAP provide any details on this. As regards access to financial support, Hungary newly introduced an electronic system. Facilitations for small scale projects, which sometimes only need to be notified, according to the NREAP, and where notably no distinction is made between technologies, have been in place before already.

Ireland

Ireland reports that the planning permits are granted for ten years now instead of five. This is claimed as a significant improvement "given the time it can take for projects to be brought to fruition". Then it appears that there is a development plan for offshore wind underway which could help identify project sites in the sense of article 22(3)c). Apart from that the report mainly sets out plans and measures to be taken in the future which are claimed to be simplifications. This is quite unsatisfactory as the NREAP already mentioned a Planning and Development Bill to address the alignment between spatial strategies and regionally planning guidelines and which was meant to be "just passing a legislative process". Now it seems the bill did not pass this process or at least did not remove administrative barriers. The procedure in Ireland consists of two major steps. First, the planning permission needs to be applied for at a local authority (this step might include the Environment Impact Assessment). In some cases renewables installations will also be required to have an Integrated Pollution Prevention and Control (IPPC) license or waste authorization. These and some other formal requirements fulfilled, it is possible to apply for "Authorization and License" at the Commission for Energy Regulation (CER). A person who constructs a generating station or generates electricity without this license is guilty of an offence and is liable for fines or even imprisonment of up to 12 month.

Italy

The Italian progress report shows that the government is still active and has simplified the existing three procedures. In particular the Enabling Simplified Procedure allows for automatic permission now, so that for smaller installations, if they do not get a response from the local authorities after 30 working days, then this is considered permission. For certain small plant activities, there is even only a notification requirement and one need not wait for 30 days to commence work. For larger plants the time limit has been shortened to 90 days for decision (from previously 180 days).

Latvia

Latvia – where several permits are required from several different authorities – already had fixed time frames for decisions, ranging between 30 and maximum 180 days. The NREAP also suggests that there would be coordination to ensure that the respective permits are being accepted by the different authorities and that the construction of a better information system was planned. However, the progress report does not mention such a system. In fact, the report does not state any improvements at all, but rather explicitly says that nothing has been changed, though amendments may come in the next reporting period. This is worrisome as the multitude of authorities involved is reported to be a problem, while the lead times seem to have improved with the introduction of the deadlines.[16]

Lithuania

According to the progress report, Lithuania undertook efforts to simplify the procedures for smaller-scale installations (wind, biogas and solar). Under certain circumstances they need not submit detailed plans to be approved by the municipality (no change in the land use designation is required) – and if they do, since 2009 there is a simplified procedure in place, with a time limit (20 days) within which approval/rejection by reasoned response has to occur, otherwise there may be a right to compensation of the resulting damages. Similarly, smaller scale installations benefit from simplified procedures as regards the permit to generate electricity, again with a time limit for decision (30 days). Wind power plants below 30 kW are further exempted from the construction permit. However, there are still several different authorities involved and some studies suggest transparency and attitude problems, while the lead time generally is not reported to be a problem.[17]

Luxemburg

Luxemburg reports that simplifications are planned and that a regulation is under way. However, the report does not go into the details of the plans, or explain whether since the NREAP any improvements have been made. As it stands, thus, and based on the NREAP, there is a national procedure for authorization and licensing of the projects. In the course of this procedure, time limits apply for decisions, and certain projects simply need to be notified and thus need no permit. However, the spatial planning and building permit is organized on local level, where no limits seem to apply. Still, it is said that smaller plants normally do not require such a building permit.

[16] (Compare ECORYS Assessment of the non-cost barriers to renewable energy growth in EU Member States; available for download at: http://ec.europa.eu/energy/renewables/studies/doc/renewables/2010_non_cost_barriers.pdf. with EWEA Wind Barriers http://www.windbarriers.eu/fileadmin/WB_docs/documents/WindBarriers_report.pdf.

[17] EWEA Wind Barriers, available at: http://www.windbarriers.eu/fileadmin/WB_docs/documents/WindBarriers_report.pdf.

Malta

While the Maltese progress report is quite detailed, it does not add much to what is known from the NREAP. One interesting measure reported is the training courses for the installers, which include training on the administrative procedures and are intended to reduce incomplete and incorrect applications. For the rest, and as set out in the NREAP, Malta has one agency being responsible for each of the three permits one may need. Larger plants need a Building Permit, which is issued by the Environment and Planning Authority, an authorization and a license from the regulator and finally need to apply for connection to the grid with the TSO. However, Malta has an exemption for small plants (below 16 Amps per phase) from authorization and licensing, as well as certain exemptions of smaller (wind and solar) installations from the building permit.

The Netherlands

According to their progress report the Netherlands optimized their system by introducing a single-permit procedure. Also, everything can be done online. For the rest, there is only little information in the report. A one-stop shop had been introduced before already, so have the time limits for permitting. With that, according to the report, the Netherlands managed to reduce the permitting time to about 1,5-2 years – from 10 years or more – for large scale projects.

Poland

Poland has not implemented the Directive 2009/28/EC and the Renewable Energy Act promised in the NREAP did not enter into force, yet. However, in the progress report, Poland submits that their procedures are sufficient and ensure safe development of the renewables sector, but that the Draft Act still promised for the future will bring some changes. Currently, the building permit has to be obtained from the respective department (normally local level), and a notification has to be submitted on the use of renewables equipment and installations to another authority (national level). Further it appears that the location has to be approved in another decision and the location of the grid connection has to be approved in a third decision. With the latter two, the NREAP already mentioned this could be an unnecessary obstacle, but the progress report does not mention any changes here. For the building permit, there are fixed decision time limits. In the notification procedure, 30 days of no response mean a permission to build (valid for two years), so that there is some form of automatic permission. The only facilitation for small-scale installations applies to stand-alone solar panels, which do not need a building permit and need not submit a notification.

Portugal

Portugal's progress report responds to the suggestions in the NREAP in the sense that in the past years a one stop shop procedure has been introduced for almost all projects (except hydroelectricity projects which require authorization to use water resources). Further, through a system of tendering, Portugal has lately managed to provide clarity on whether there is any available network reception capacity. For smaller plants, the costs of the licensing procedures are fixed, to allow for more certainty and better cost control. Generally, the Portuguese progress report mentions quite a few measures to facilitate communication – e.g. site inspection requests per sms for smaller plants or licensing applications online. However, the online licensing had already been in place, as well as other simplifications for smaller plants, and the dedication of the pilot zone for offshore projects. For small hydro, new zones have been identified and projects in those zones benefit from facilitated procedures (e.g. also a "one step" procedure).

Romania

The Romanian progress report only deals with problems relating to access to finance, rather than with administrative procedures. It does thus not provide any of the information referred to in article 22(3), so that for the evaluation it was relied on the NREAP. Romania focused on funding, since this seems to be one of the reasons why renewable progress in general is slow in the country. However, in the NREAP it had been suggested that in particular small-scale plants seem to face problems with the administration, but nothing is done (nor seems planned) to change this. A high number of permits from different actors (of which only the Regulator ANRE has clearly set-out time limits for taking decisions) lead to lack of transparency mainly, which is said to be the greatest problem, while the lead times are lower than EU average.[18]

Slovakia

In Slovakia, generally, three permits are required: the certification of the investment plan, which includes the Environmental Impact Assessment and is done on national level by the Ministry, the building permit issued by local authorities and the business license, again on national level. In particular, the local level had been identified as problematic in the NREAP and the progress report tells that for hydropower a plan has been adopted, e.g. setting out where and under which conditions such plants can be build, which seems to fall into the scope of measures article 22(3)c is aiming at. While there had been strict time frames for decision, it is not disclosed how long those are. Small plants up to 1 MW had been exempted from the national investment plan certificate before already, so that they only need the building permit and the business license. However, the report tells – without further specifications – that some streamlining has taken place for the procedures for roof-top and residential solar power.

[18] See also: EWEA Wind Barriers, available at: http://www.windbarriers.eu/fileadmin/WB_docs/documents/WindBarriers_report.pdf.

Slovenia

The progress report sets out that some facilitation has been adopted for all photovoltaic installations as well as for smaller-scale plants of other technologies and that a manual has been published to guide projectors through the procedures. It does not refer to the specifics set out in article 22(3) a) and c). The Slovenian system is very complex and no clear information was disclosed on how many permits are in fact necessary (e.g. there is no comprehensive list in either report) or how the various authorities involved coordinate – the NREAP in this respect only says the system is appropriate and that in 2015 proposals for a method of coordination will be formulated, while also computerization of the permitting procedures will be introduced then. While the lead times as suggested as "average" in the NREAP range between 2 to 24 months in total for all permits, there are no limits. Also, it needs to be stressed that according to the plan itself, the time started running with submission of a "complete" application, and the period does not reflect the overall time of all decisions, as e.g. the licenses and energy permits are not considered in there.

Spain

The Spanish progress report first refers to a scheme to promote the use of renewable transport fuels and the administrative procedures to be followed for sustainability certification and eligibility for support. However, the Circular 2/2009 was adopted February 26th 2009 and had already been mentioned in the NREAP, so that this cannot be seen as progress. Further, the report mentions some facilitation for small scale plants when it comes to grid access and says that there will shortly be a ew regulation to incentivize self-consumption as well. Some measures have been taken to improve information streams between the national authorities and the Autonomous Regions, and the entry into the Remuneration Pre-Allocation registry (application for support) has been facilitated. However, and based on what was said in the NREAP, there are still numerous different regimes with different procedures to be followed in the Autonomous Regions, some applying stricter rules than the national ones, others just different rules, and the progress report does not suggest what has been done or will be done to improve this situation.

Sweden

Sweden submitted a detailed progress report on administrative procedures in section 2(a) of the progress report template, however not really reporting on the administrative procedures as asked for by article 22(3) of the Directive. It is reported though, that some guidance document on the possibilities to build wind power in Natura 2000 areas is being worked on, which could mean some form of dedication plan in the sense of article 22(3)c. While for wind farms a "one-stop-shop" single permit like system had been introduced in 2009 already, wherein the environmental and the building permit have been merged, those two procedures still exist in parallel for other plants, with only limited coordination (for all but hydro). Overall, the Swedish system differs immensely depending on the location where the plant is build.

The NREAP suggested that a problem may lie in the lack of transparency due to the local differences (e.g. different decision time limits, different fees), and the progress report takes up that there is a need to make the procedures more efficient. However, it does not set out how this will be done or when. The respective section largely deals with grid connection and with the new common support system with Norway. However, generally, the Swedish system is said to work rather well, at least for wind.[19]

United Kingdom

At the time of the progress report, the final version of the National Planning Policy Framework (intended to bring in line the planning decisions of the local authorities responsible for small-scale plants and the national authorities) was not yet published and it thus is referred to in a lot of plans. However, some improvements have already been made, e.g. with the "Planning Guarantee" a maximum lead time of one year has already become effective for planning permits. Also, marine plans are prepared to provide certainty and clarity for developers on where installations are possible and where not. Generally, in the United Kingdom, spatial planning and permitting is a devolved competence, as is environmental permitting. Accordingly, there are (slight) differences between England, Wales, Scotland and Northern Ireland (for electricity generation licensing, the cut is between Great Britain and Northern Ireland only). A facilitation process has been going on in the previous years, trying to reduce and improve regulation and to make in particular spatial planning more business friendly. Overall, the UK system is getting quite good feedback.[20]

[19] EWEA Wind Barriers, available at: http://www.windbarriers.eu/fileadmin/WB_docs/documents/WindBarriers_report.pdf.
[20] (AEON study – nowhere in the "critical groups" – EWEA says its rather the hostile attitude than the system)

2 The biofuel market place

2.1 Major findings

In this chapter, the consumption and production of biofuels and other renewable energy sources for transport and the international trade related to biofuels are discussed. Focus year is 2010, sometimes using 2009-2011 as indication for trends. The major findings are:

- In 2010, the use of renewable energy in transport was 4.70%, in 2008, this was 3.53%;
- The 4.70% consists of:
  - 13.0 Mtoe[21] of sustainable biofuels or 4.27%;
  - 1.3 Mtoe of renewable electricity, or 0.43%. The far majority of this resides in non-road transport, mainly trains in countries that have high shares of renewable electricity in the grid. A negligible share (6 ktoe) resides in road transport (counts 2.5 times), the majority of which in trams and trolley busses, again in countries with high shares of renewable electricity in the grid;
- Between 2008 and 2010, the volume of *biofuels* consumed in the EU increased by 39%, whereas the volume of petroleum fuels consumed in road transport decreased with 3.5%;
- In 2010 about 75% of the biofuels used in the EU concerned "bio-diesels"[22] (mainly methyl esters), 21% concerned "biogasoline"[23] (mainly bioethanol) and about 4% resided in "other liquid biofuels"[24];
- Five Member States (Germany, France, UK, Italy and Spain) still represent more than 70% of the European biofuels market, both in production and consumption. Their majority is only slowly decreasing over time;
- Only 1.4% (177 ktoe) of all EU consumed sustainable biofuels (13 Mtoe), or 0.11% points[25] of the 4.70% RES-T share, were produced from wastes, residues, non-food cellulosic material, and ligno-cellulosic material (double counting according to Article 21.2 of Directive 2009/28/EC);

[21] The non-public Eurostat dataset SHARES 2010 reports 13.0 Mtoe of biofuels that are compliant with the sustainability criteria from Directive 2009/28/EC and 0.5 Mtoe of biofuels that are not compliant. The public Eurostat dataset nrg_1073a reports 13.3 Mtoe of biofuels, does not distinct between sustainable and non-sustainable biofuels, but does give more details on the types of biofuels, as well as insights in production, import and export.

[22] This category includes bio-diesel (a methyl-ester produced from vegetable or animal oil, of diesel quality), biodimethylether (dimethylether produced from biomass), Fischer-Tropsch (Fischer-Tropsch produced from biomass), cold extracted bio-oil (oil produced from oil seed through mechanical processing only) and all other liquid biofuels which are added to, blended with or used straight as transport diesel.

[23] This category includes bioethanol (ethanol produced from biomass and/or the biodegradable fraction of waste), biomethanol (methanol produced from biomass and/or the biodegradable fraction of waste), bioETBE (ethyl-tertio-butyl-ether produced on the basis of bioethanol; the percentage by volume of bioETBE that is calculated as biofuel is 47 %) and bioMTBE (methyl-tertio-butyl-ether produced on the basis of biomethanol: the percentage by volume of bioMTBE that is calculated as biofuel is 36 %).

[24] Liquid biofuels, used directly as fuel, not included in biogasoline or bio-diesels.

[25] The 0.11% points already account for the double counting rule, i.e. the physical share is only half of this: 0.06%.

- Initiatives for double counting biofuels production in Europe are located in a limited number of Member States and focus on a broad range of conversion technologies. The amount of double biofuels produced in 2010 was still small in comparison with conventional biofuels. The lion's share concerns biodiesel on basis of waste oils, produced in several Member States, and biomethanol, produced in the Netherlands. Cellulose ethanol is commercially demonstrated at a small but significant scale in Denmark. End 2012, a larger cellulose ethanol plant will come online in Italy;
- More than half of the installed biofuels production capacity in the EU is not used. After years of declining capacity use, EU biodiesel production is now stabilising at 40% of its capacity in 2010. The capacity use in the EU bioethanol industry is hovering between 50% and 60%. This unused capacity does indicate that there is sufficient conversion capacity available for several years to come;
- Most of the EU produced biodiesel in 2010 was produced from rapeseed (56%), followed by soybean (13%) and palm oil (9%);
- More than half of the EU produced ethanol is on basis of starch crops (30% from wheat, 23% from maize and smaller contributions from barley and rye). Sugar beet represents another 30%;
- About 83% of all EU consumed biodiesel in 2010 is produced in the EU, about 17% is imported from third countries, primarily from Argentina (10%), which has replaced the USA as the largest biodiesel exporter to the EU;
- About 80% of all EU consumed bioethanol in 2010 is produced in the EU, about 20% is imported from third countries, primarily from Brazil and the USA, although the fraction from Brazil almost halved in comparison to 2008;
- The role of the EU in the global biofuel market has remained constant in the last years. The EU remained in 2010 by far the largest producer of biodiesel in the world with 8.5 Mtoe (55% of global market share) compared to global production of 15.5 Mtoe. Brazil and Argentina have significantly increased the production of biodiesel in recent years, whereas the production of biodiesel in the USA decreased almost by more than half compared to 2008. In the rest of the world, bioethanol plays a much larger role. World bioethanol production reached 43.8 Mtoe in 2010, of which only 2.0 Mtoe or 5% were produced in the EU. The USA is the world's largest ethanol producer since 2006 (24,929 Mtoe produced in 2010), followed by Brazil. Net EU trade in the global biofuels market is therefore fairly insignificant;
- Eventually, the most important feedstock for biodiesel is rapeseed originating from the EU, followed by Argentinean soy, Indonesian and Malaysian palm oil, and rapeseed from Canada and Ukraine. EU produced biodiesel is partially produced from imported feedstock (palm oil, soy and part of the rapeseed);
- On the contrary, the EU produced bioethanol is mainly produced from EU feedstock, with only small shares of wheat and maize originate from Switzerland,

Ukraine and a few other countries. Sugar cane and maize play a role via the bioethanol supplying countries Brazil and the USA mainly.

2.2 Renewable energy use in transport

The use of renewable energy in transport in EU Member States in 2009 and 2010 is shown in Figure 89. This graph was analysed in detail in Chapter 1, where it is discussed how effective and efficient policies in all Member States have been in promoting renewable energy in transport until 2010.

The majority of renewable energy in transport concerns biofuels in road transport, which are the focus of the remainder of this chapter. The contribution of renewable electricity in transport is limited to those countries that have higher shares of renewable electricity in the grid. In other words, there is, so far no dedicated directing of renewable electricity towards transport; the average of the grid also ends up in transport, if electricity is used in transport. As can be expected, most of this renewable electricity use is in trains (non-road transport), in almost all countries. The road use of renewable electricity concerns trolley busses and trams, in countries were these play a significant role in transport, in Bulgaria and the Baltic states Latvia, Lithuania and Estonia. Use of electricity in electric cars is negligible, let aside the use of renewable electricity in electric cars.

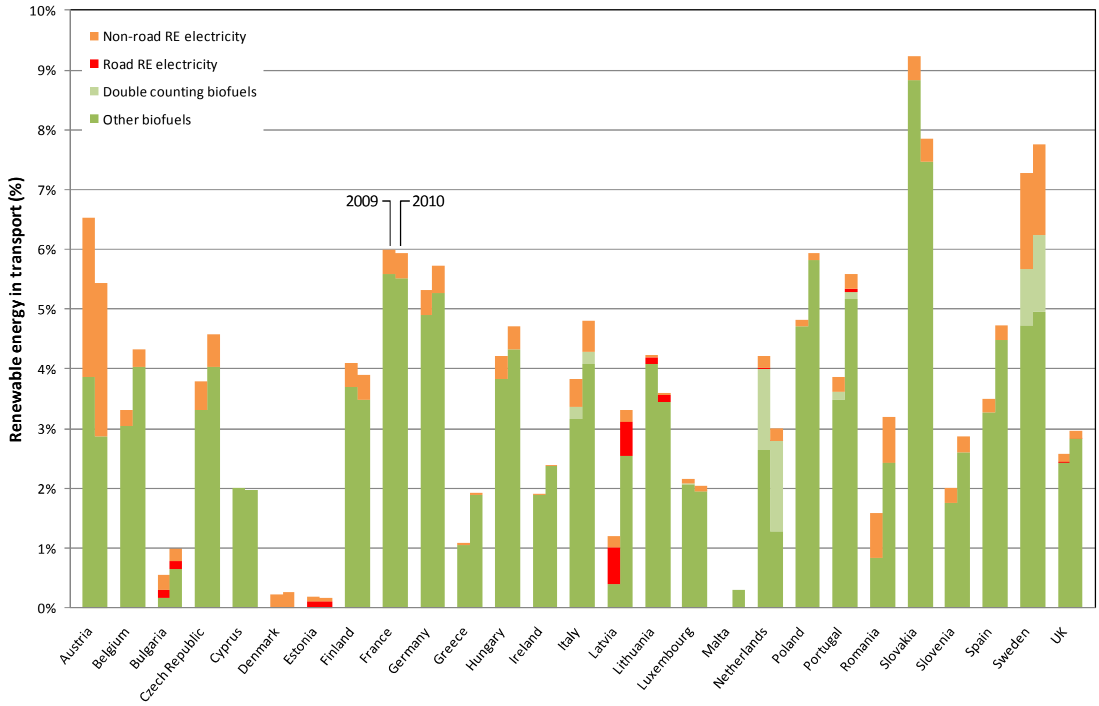


Figure 89. Development of renewable energy in transport in 2009 and 2010 in the EU. The categories and their accounting are according to methodology in Directive 2009/28/EC.

In 2010, the use of renewable energy in transport was 4.70%, according to the accounting methodology of the Renewable Energy Directive 2009/28/EC. This 4.7% consists of:

- 12.8 Mtoe in non-double counting sustainable biofuels (4.16% points);
- 177 ktoe in double counting sustainable biofuels (0.11% points);
- 1.3 Mtoe in non-road renewable electricity (0.42% points);
- 6 ktoe in road renewable electricity (0.005% points).

2.3 Biofuels use in EU transport

For the remainder of this chapter, we focus on biofuels, in order to understand the development of the biofuels market place and especially to understand which feedstock have been used for EU consumed biofuels and where that feedstock originates from.

In Table 29 the consumption of biofuels in all transport in the EU27 is depicted. In total, 13.3 Mtoe of biofuels were consumed in 2010 (13.0 Mtoe of this concerns sustainable biofuels, see footnote 21). This compares to 4.5% of all fuels consumed in road transport. Note that this is below the original indicative target of 5.75% for 2010 of the Biofuels Directive [2003/30/EC]; this target has been abolished with the adoption of the Renewable Energy Directive 2009/28/EC.

Table 29. Total biofuel and all fuel consumption in all transport in the EU from 2007 – 2010, in Mtoe [Eurostat nrg_1073a; nrg_102a; SHARES 2010].

	2007	2008	2009	2010
Biodiesel	4.3	6.8	9.1	9.9
Biogasoline	1.2	1.8	2.3	2.8
Other liquid biofuels	1.3	0.9	0.5	0.5
Total biofuels in transport	6.7	9.6	11.9	13.3
Total biofuels in road transport	6.7	9.6	11.9	13.3
Total fossil fuels consumed in road transport	301.5	295.2	287.6	285.1
Share of biofuels, calculated[1)] – for indication only	2.19%	3.14%	3.98%	4.45%
Total sustainable biofuels in transport	7.38	9.95	11.57	13.00
- Of which biofuels from waste (Article 21.2)	0.05	0.07	0.15	0.18
- Other	7.33	9.88	11.42	12.83
Non-road renewable electricity in transport	1.14	1.17	1.24	1.30
Road renewable electricity in transport	0.005	0.004	0.005	0.006
Share of renewable energy in transport (RES-T)	2.67%	3.53%	4.19%	4.70%
NREAPS expected share of renewable energy in transport				4.95%

1) The share of biofuels is calculated by dividing the volume of biofuels in all transport, by the volume of all fuels in road transport (i.e. the sum of petroleum fuels and biofuels in road transport).

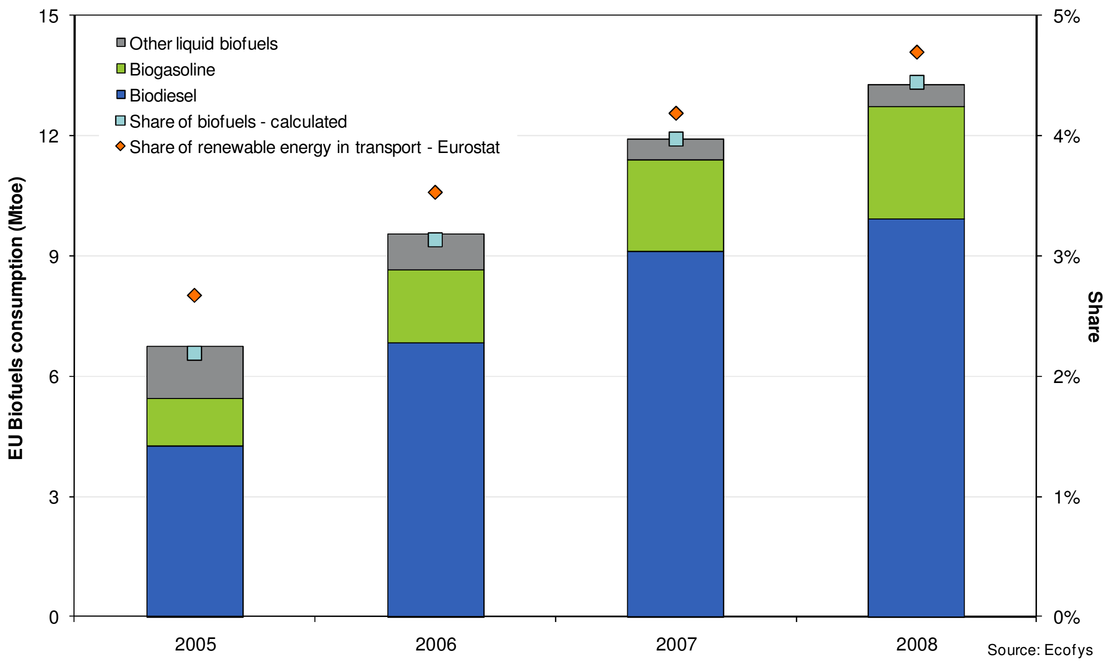


Figure 90. Consumption of biofuels in road transport in the EU. The bars represent the absolute volume in Mtoe (left hand scale). The squares represent the calculated share of

biofuels (compared to the total volume of biofuels and fossil fuels in road transport). The diamonds represent the RES-T share (Eurostat dataset SHARES 2010), thus including the fraction of renewable electricity in transport and using the accounting methodology of the Renewable Energy Directive.

Table 30 and Figure 91 give a detailed overview of the biofuel consumption per Member State in 2007 - 2010.

Since the take off of the biofuels market in the early 2000's, Germany is the largest consumer market for biofuels. In 2010, still 22% of all biofuels in EU transport are consumed in Germany. Five of the twenty seven countries, Germany, France, United Kingdom, Italy and Spain constitute by far the largest proportion the EU27 market throughout 2005 – 2010, although this share has been slowly decreasing from 92% in 2005, to 73 in 2008 and 71% in 2010 (see Figure 91).

In Germany, the consumption of biofuel decreased in 2008, recovered in 2009, and further grows in 2010. The French market halted in 2010. Over the 2008-2010 period, the Latvian market experienced the strongest percentage growth (more than tenfold), though its total market is still tiny in comparison to the German market. A more significant growth is seen in Poland, which is rapidly approaching the top-5 markets. The already small Danish biofuels consumption seems to have stopped completely in 2010 and still no activity is seen in Malta and Estonia.

Table 30. EU Biofuel consumption in *all* transport in 2005 - 2010 expressed as absolute volume (ktoe). Ranked according to 2008 market size [Eurostat nrg_1073a].

	2007	2008	2009	2010
Germany	2,807	2,569	2,697	2,960
France	1,447	2,271	2,454	2,420
United Kingdom	346	790	970	1,127
Italy	141	754	1,180	1,466
Spain	385	619	1,073	1,436
Poland	106	441	663	886
Austria	311	388	485	472
Sweden	285	344	361	380
Netherlands	277	287	373	229
Hungary	29	165	169	175
Portugal	133	127	220	300
Slovakia	91	126	168	164
Czech Republic	30	110	195	231
Romania	40	107	163	115
Belgium	87	101	286	362
Finland	1	81	145	142
Greece	85	69	78	128
Lithuania	53	61	52	45
Ireland	22	54	75	90
Luxembourg	43	43	41	41
Slovenia	14	25	30	45
Cyprus	1	14	15	15
Denmark	6	5	9	0
Bulgaria	2	4	4	13
Latvia	2	2	4	27
Malta	0	0	0	0
Estonia	0	0	0	0
Total EU	6,744	9,557	11,910	13,269

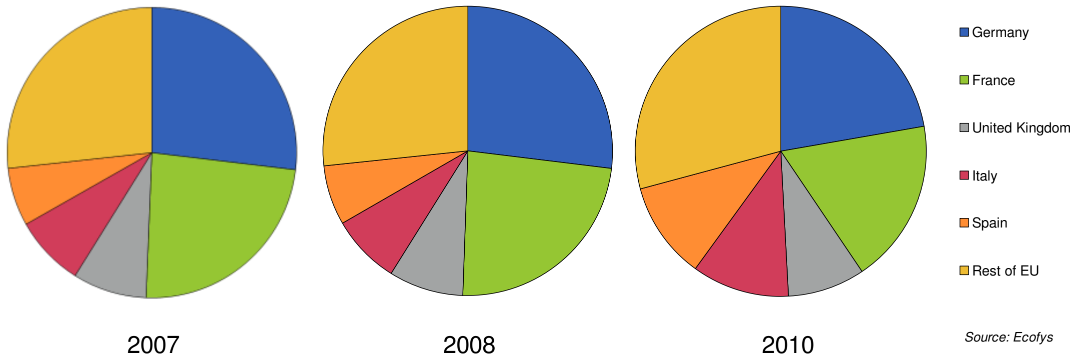


Figure 91. Share of Member State markets in the total EU biofuels consumption in transport.

As can be seen in Figure 92, Germany, Poland and Austria have a relevant contribution of other liquid biofuels, which presumably includes pure plant oil used in diesel engines, although this is not in line with Eurostat category definitions[26].

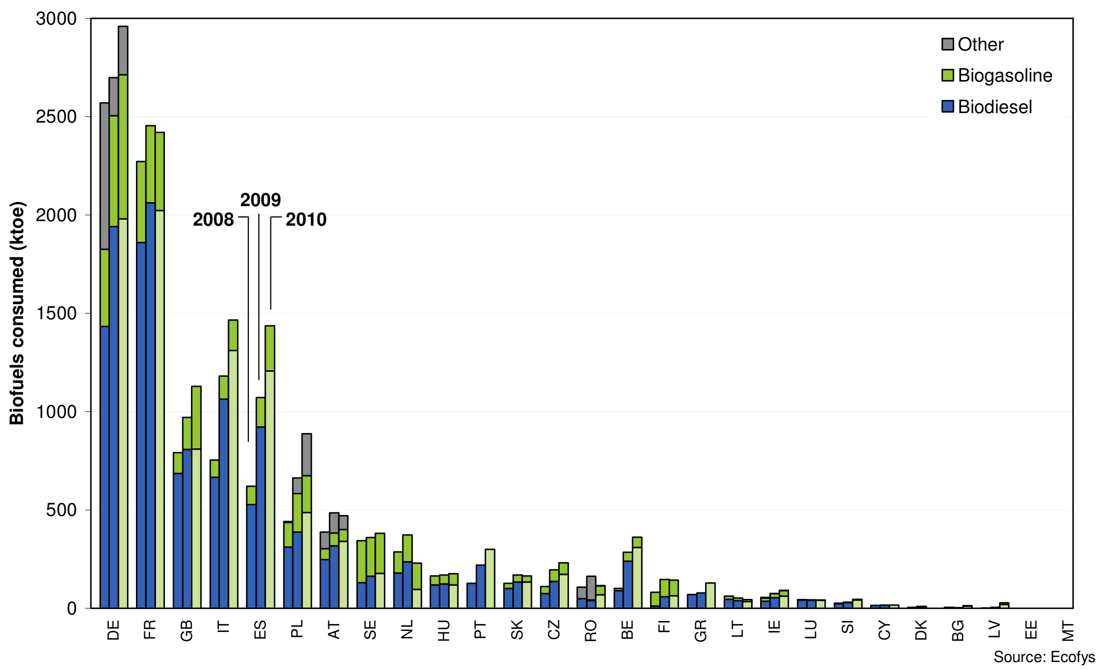


Figure 92. Amounts of liquid biofuels[27] consumed in EU Member States, ranked according to 2008 market size [Eurostat nrg_1073a].

[26] Explanation on what is included in the different Eurostat biofuels categories can be found in Footnotes 22, 23 and 24.

[27] Eurostat categories have been used. It is not clear what is included/excluded in the categories mentioned. We assume that the biodiesel category contains FAME biodiesel, hydrotreated bio-oil and pure bio-oil, that the biogasoline category contains bioethanol, biomethanol, bio-ETBE and bio-MTBE and that the other liquid biofuels category contains biogas and bio-DME.

Although most Member States show a gradual increase in their biofuels consumption in transport over the recent years, several countries show a decrease or other pattern. The deployment of biofuels is very much dependent on the incentives per country, on surrounding and global markets and on the additional costs, which in turn depend on volatile agricultural feedstock costs. Therefore, the consumption of biofuels can rise or drop relatively rapidly.

Biodiesel and bio-oil

As can be seen in Figure 92 the majority of biofuels consumed in the European market concerns biodiesel. Figure 93 breaks down the development of increasing consumption of biodiesel in 2007-2010 for the most important Member States.

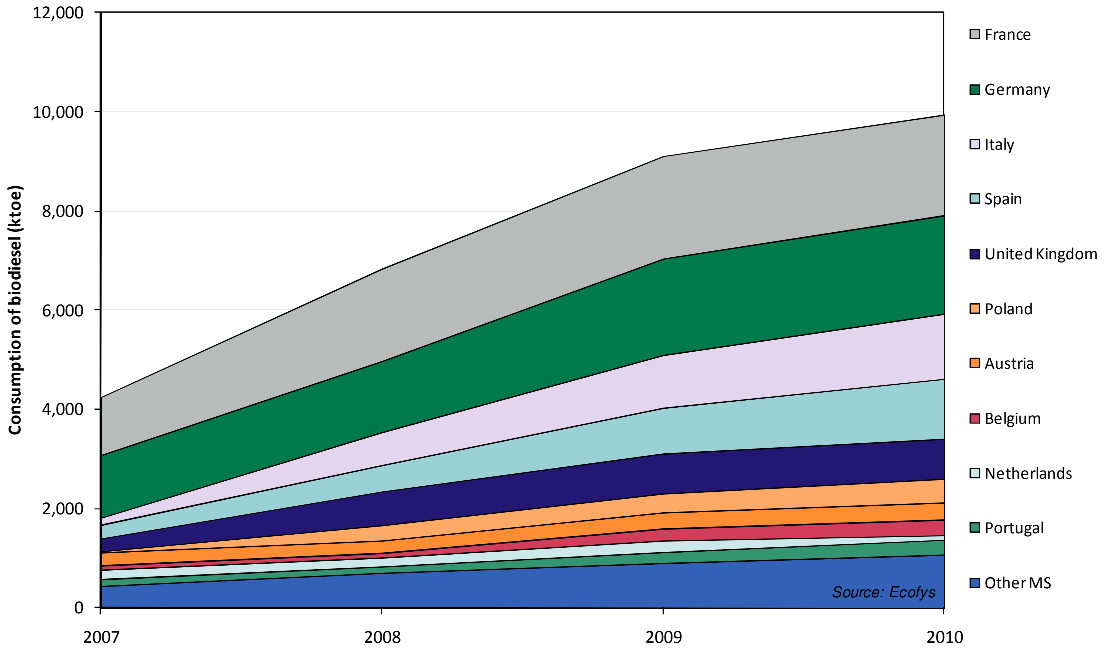


Figure 93. Consumption of biodiesel in the EU in 2007 - 2010. The consumption is shown for the 10 Member States with the largest production volume in 2009. The other 17 Member States are aggregated [Eurostat nrg_1073a].

Table 31. Consumption of biodiesel in the EU in 2007-2010. Underlying data.

Member State	2007	2008	2009	2010
France	1168	1860	2062	2022
Germany	1262	1432	1941	1981
Italy	141	665	1063	1311
Spain	272	527	921	1206
United Kingdom	268	686	808	809
Poland	23	310	387	486
Austria	254	248	318	339
Belgium	87	89	238	309
Netherlands	189	179	235	95
Portugal	133	127	220	300
Other MS	454	716	912	1079
Total EU	**4251**	**6839**	**9105**	**9937**

Germany and France remain the main consumers of biodiesel, followed by Italy, Spain and the UK. Until 2008, the general trend is an increase in consumption of biodiesel per Member State. However, the growth is clearly topping off in 2009-2010. The French, German and UK markets for biodiesel have barely grown in this period, as they already showed much growth in the preceding years.

Bioethanol and bio-ETBE

Figure 94 shows the consumption of bioethanol[28] in Europe in 2007-2010 for the main consuming countries.

[28] Actually, this section represents the contribution of all biofuels in the Eurostat category biogasoline. Although the far majority resides in bioethanol and its derivative bio-ETBE, a minority share resides in biomethanol (produced solely by the BioMCN facility in the Netherlands) and its derivative bio-MTBE.

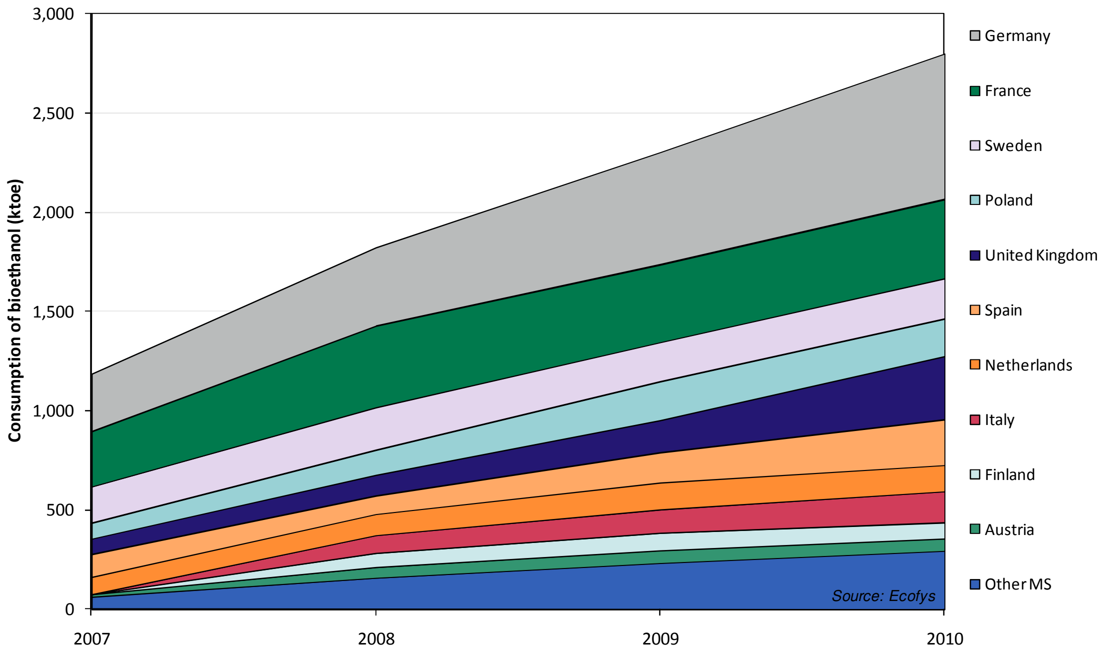


Figure 94. Consumption of bioethanol[29] in the EU in 2007 - 2010. The consumption is shown for the 10 Member States with the largest production volume in 2009. The other 17 Member States are aggregated [Eurostat nrg_1073a].

Table 32. Consumption of bioethanol[29] in the EU in 2007-2010. Underlying data.

Member State	2007	2008	2009	2010
Germany	289	394	564	732
France	279	411	392	399
Sweden	182	214	198	203
Poland	80	126	195	189
United Kingdom	77	104	162	319
Spain	113	92	151	230
Netherlands	88	108	138	134
Italy	0	89	117	155
Finland	1	71	87	80
Austria	13	54	64	62
Other MS	63	159	234	296
Total EU	1185	1822	2302	2799

The figure shows that France, Germany and Sweden are the main consumers of bioethanol in Europe.

[29] Eurostat presents its data in three categories: biodiesel, biogasoline and other liquid biofuels. The category 'biogasonline' according to Eurostat definition is shown in the graph/table. It will mostly contain ethanol.

Double counting biofuels

In 2010, only 1.4% (177 ktoe) of all EU consumed sustainable biofuels (13 Mtoe), were produced from wastes, residues, non-food cellulosic material, and ligno-cellulosic material. These are double counting according to Article 21.2 of Directive 2009/28/EC. Whereas the physical share is only 0.06% of the energy use in transport, these fuels count as 0.11% points of the 4.70% RES-T share. Figure 89 and Table 29 already showed the contribution of double counting biofuels in separate Member States (2009 and 2010) and for the EU as a whole (2007 - 2010).

Since the implementation of the RED was only achieved after 2010 in most countries, only very few Members States reported the production (and consumption) of double-counting biofuels for the period 2009-2010. Consumption of double counting biofuels are so far only found in the Netherlands, Sweden, Italy and Portugal (Eurostat dataset SHARES 2010). In Sweden the double counting biofuels are largely based on biogas, in the other countries on used cooking oil, with smaller amounts originating from animal fat.

Several countries did have capabilities for producing residue-based biofuels, and the UK reported biofuels production from 'by-product', whose definitions should be close to the RED 21(2) definition.

Table 33. Double counting biofuels produced and reported by Member States.

Member State	Biodiesel (ktoe)		Bioethanol (ktoe)		Comments
	2009	2010	2009	2010	
Denmark	0	0	0	0	The progress report mentions that "Inbicon produces around 5 million litres of bioethanol (2.g.) based on hay. Much of this fuel was exported between 2009 and 2010."
France	0	63	0	0	
Germany	43	86	0	0	According to the MS report, consumption of double counting biofuels was 17ktoe in 2009 and zero in 2010. Eurostat does not report any consumption.
Ireland	16.36	22.6		2.5	Biofuels that are produced and consumed in Ireland under Article 21(2) include those derived from used cooking oil (UCO) and category 1 tallow (to produce biodiesel) and whey (residue from dairy products production used for bio-ethanol production).
Malta	0.76	0.63	0	0	
Netherlands	242	338	(138 *)	(134 *)	* The production figures for double counting ethanol are confidential. Therefore, the consumption numbers are shown.
United Kingdom	0	0	0	0	Consumption of biofuels from 'by-products': 2009: 165 ktoe 2010: 298 ktoe

The largest contribution of double counting biofuels is seen in the Netherlands. In 2009 and 2010, such biofuels accounted for a share of approx. 33% and 50% e/e. In practice, this mainly concerned biodiesel made from spent deep-frying oil and animal fats from slaughterhouses. The feedstock comes from throughout the EU [Member State Renewable Energy Progress Report 2011]. The production of double counting "bioethanol" in the Netherlands actually concerns biomethanol from glycerine at the facility of BioMCN. The production capacity is 200 ktonne/year, but the actual production is confidential. This biomethanol is accepted on several Member States' markets, sometimes in the form of its derivative bio-mtbe.

Double counting measures were not implemented in the UK in 2009 or 2010 [Member State Renewable Energy Progress Report 2011]. Hence, the Member State and Eurostat report no consumption. Nevertheless, there was a significant increase in the amount of used cooking oil (UCO) reported from all sources in 2010 reflecting the removal of the duty differential for all biofuels except those derived from UCO in April that year. The UK Renewable Fuels Agency (the regulatory authority) reports that in the 2009/2010 obligation year, 12% (by volume) of biofuels stem from tallow and 3% from used cooking oil.

In Sweden, only biofuels that are produced in Sweden from waste, residues, non-food cellulosic material and ligno-cellulosic material have been reported as being double-counting biofuels. This includes biogas, HVO (hydrogenated vegetable oil) from crude tall oil, and ethanol from residues from sulphite pulp production.

Figure 95 gives an overview of operational "advanced"[30] biofuels initiatives in the EU until 2011. The majority of the volume stems from the BioMCN biomethanol facility in the Netherlands, which came on stream in July 2008 and was enlarged in 2009. Inbicon/Dong in Denmark commissioned a significant but still small cellulose ethanol plant at the end of 2009.

[30] With "advanced'" we indicate biofuels produced either from lingo-cellulose biomass, or from waste-residues via advanced technologies, that go beyond the technologies commonly used for biofuel production from sugar, starch or vegetable oils.

Finland
1. Chempolis (5 ktonne/yr cellulose ethanol demonstration, since 2008)
2. NSE Biofuels (0.7 ktonne/yr FT-diesel demonstration, since 2009)

Sweden
3. SEKAB (0.2 ktonne/yr cellulose ethanol pilot, 2004 – 2012 - Halted)

Norway
4. Borregaard ChemCell (16 ktonne cellulose ethanol, commercial, since 1930)
5. Weyland (0.2 ktonne/yr cellulose ethanol, pilot, since 2010)

Denmark
6. Inbicon/DONG (4.3 ktonne cellulose ethanol, demonstration, since 2009)

the Netherlands
7. BioMCN (20 ktonne biomethanol, pilot, since 2008)
   BioMCN (200 ktonne biomethanol, commercial, since 2009)

Germany
8. CHOREN (methanol and FT liquids, pilot, 1998 – 2004 - Halted)
   CHOREN (15 ktonne FT-diesel, commercial, 2009 – 2011 - Halted)

France
9. PROCETHOL 2G Futurol (0.2 ktonne bioethanol, pilot, since 2010)

Spain
10. Abengoa (4 ktonne cellulose ethanol, demo, since 2008)

Italy
11. Chemtex Mossi & Ghisolfi (0.2 ktonne cellulose ethanol, pilot, 2009)
    Chemtex Mossi & Ghisolfi (60 ktonne cellulose ethanol, commercial, 2012 Q4 expected)

Figure 95. Pilots and demonstrations of advanced biofuel production from residues and ligno-cellulose biomass.

Form of applied biofuels

Most of the biodiesel in the EU is used as a low blend of up to 10% by volume in diesel.

At local scale, pure biodiesel (B100) is used in several countries, most notably in Germany, but the market is declining as the tax advantages for B100 gradually disappear. In Germany, the application of B100 decreased from 1.8 Mtonne in 2007 to just 240 ktonne in 2009 [Biofuels International 2010 05].

Also at local and declining scale, pure plant oils are still used in Germany, Austria and Ireland. In Germany the application of pure plant oil decreased from 750 ktonne in 2007 to just 100 ktonne in 2009.

In earlier years (2005-2008), the markets for B100 and other higher blends of biodiesel (B20, B30) and for pure plant oil used to be much more attractive, but governments and car manufacturers have lost their interest in this market and focused on biofuels in the mainstream diesel market.

Biogas is used as a transport biofuel in Sweden and Denmark at a considerable scale. In Sweden, about 100 gas stations sell biogas, in the form of compressed natural gas.

Sweden has a consistent market for E85. This fuel is sold at 50% of its stations – 1,500 out of 3,000. Legislation ensures that E85 sells 25% cheaper than petrol; fl ex-fuel cars get free parking in many Swedish towns and cities, and are exempt from congestion charge in Stockholm [Biofuels International 2010 06]. France is the second largest market for E85 in the EU. Whereas the market for higher biodiesel blends is disappearing in the EU and hardly any manufacturer produces cars specifically for high biodiesel blends, more and more car makers produce flexifuel vehicles, addressing the global interest in bioethanol.

Furthermore, Sweden is practically the only Member State with considerable neat ethanol application, in busses in Stockholm and Örnsköldsvik.

2.4 Production of biofuels in the EU

Table 37 shows the EU biofuel production in 2007 - 2010. Note that the data refers to all EU biofuel production even if not all is used in transport but for other purposes (see note under table).

Table 34. EU Biofuel production in ktoe in 2007- 2009 and average annual growth of this production between 2007 and 2009. Ranked according to market size 2010 [Eurostat nrg_1073a].

Member State	2007	2008	2009	2010	Growth '08-'10
Germany	6,011	5,141	3,936	4,589	-6%
France	1,127	1,952	2,324	2,261	8%
Italy	180	703	1,119	1,457	44%
Spain	380	372	887	1,023	66%
Sweden	430	456	557	622	17%
Poland	110	296	429	457	24%
Belgium	161	288	353	378	15%
Netherlands	120	121	290	363	73%
Portugal	162	153	228	285	36%
United Kingdom	384	283	211	279	-1%
Czech Republic	90	107	195	236	49%
Austria	262	278	303	214	-12%
Slovakia	59	139	150	161	8%
Hungary	17	162	154	142	-6%
Greece	83	63	71	112	33%
Lithuania	32	68	108	102	22%
Denmark	63	89	78	69	-12%
Ireland	22	38	57	63	29%
Latvia	15	32	49	48	22%
Romania	20	82	75	46	-25%
Slovenia	4	7	6	16	51%
Bulgaria	2	11	11	11	0%
Cyprus	0	6	6	5	-9%
Finland	0	84	230	0	-100%
Luxembourg	0	0	0	0	0%
Estonia	0	0	0	0	0%
Malta	:	:	:	:	0%
Total EU	9,734	10,931	11,827	12,939	9%

Germany, France, Italy and Spain produced over 70% percent of the biofuels in the EU in 2010. Their dominance is declining slowly.

Figure 96 and Figure 97 present the development of biodiesel and bioethanol production over the years 2005-2010 for the Member States with the largest production.

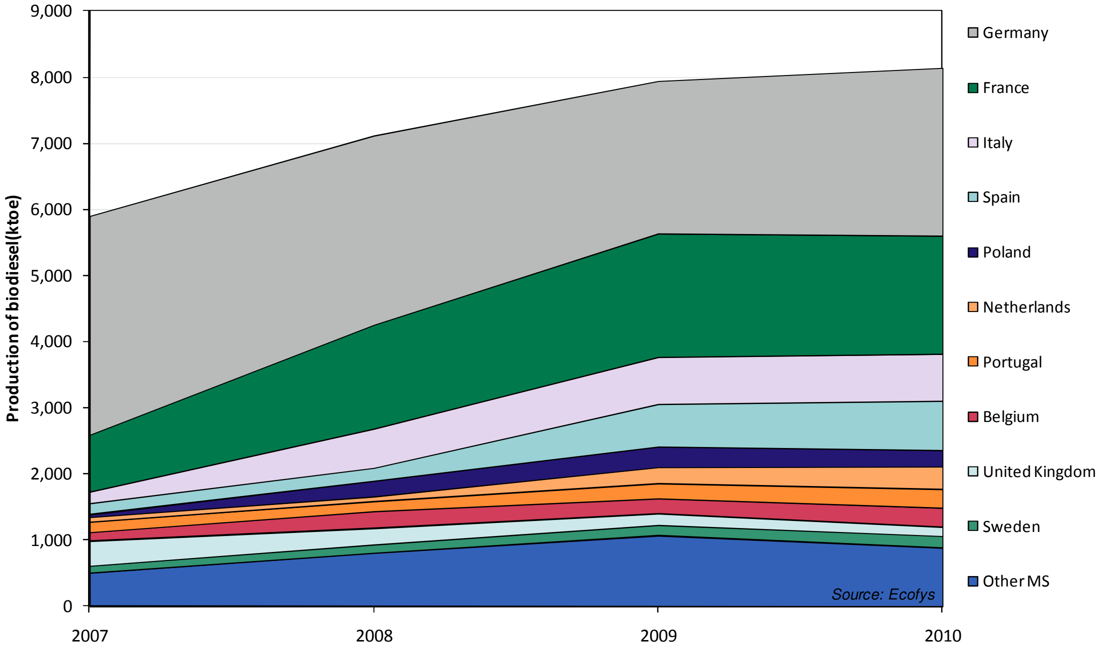


Figure 96. Production of biodiesel in the EU in 2007 - 2010. The production is shown for the 10 Member States with the largest production volume in 2010. The other 17 Member States are aggregated [Eurostat nrg_1073a].

Table 35. Production of biodiesel in the EU in 2007-2010. Underlying data.

Member State	2007	2008	2009	2010
Germany	3307	2857	2304	2535
France	863	1574	1866	1785
Italy	180	597	713	713
Spain	161	198	652	755
Poland	41	232	310	244
Netherlands	75	73	242	338
Portugal	160	148	224	281
Belgium	128	252	225	285
United Kingdom	375	248	172	137
Sweden	103	130	162	177
Other MS	513	811	1075	892
Total EU	5906	7120	7945	8142

Main biodiesel producers in the EU in 2008 are Germany, France and Italy. These countries are also the main consumers of biodiesel.

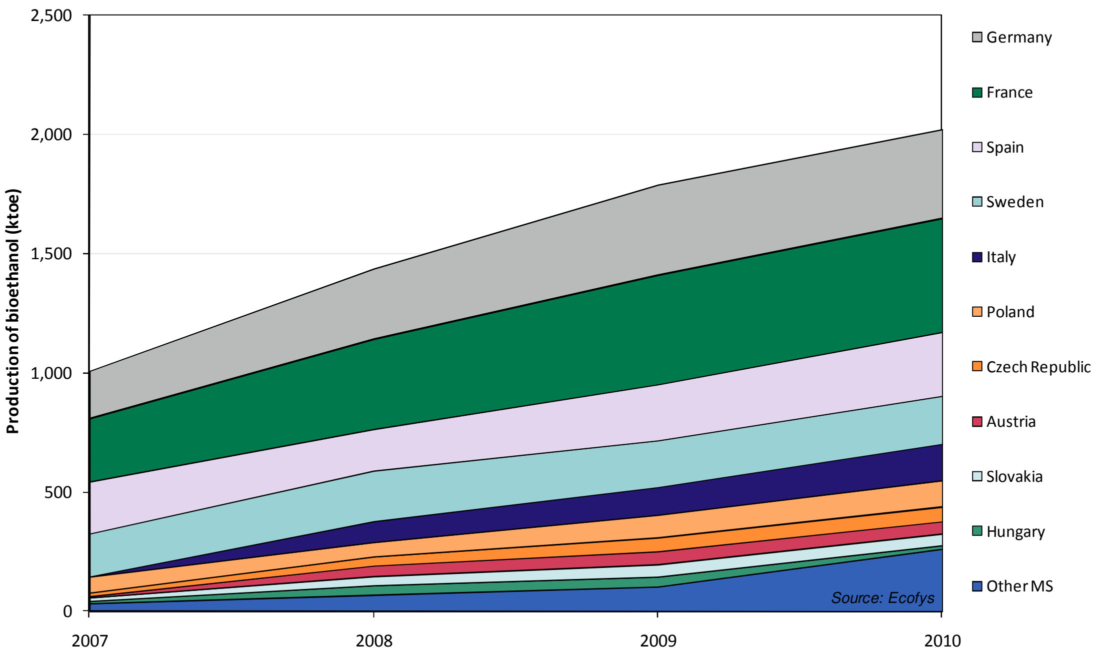


Figure 97. Production of bioethanol in the EU in 2007 - 2010. The production is shown for the 10 Member States with the largest production volume in 2010. The other 17 Member States are aggregated [Eurostat nrg_1073a].

Table 36. Production of bioethanol in the EU in 2007-2010. Underlying data.

Member State	2007	2008	2009	2010
Germany	197	293	376	371
France	264	377	458	476
Spain	219	174	235	268
Sweden	182	214	198	203
Italy	0	89	117	155
Poland	67	59	94	108
Czech Republic	17	39	58	61
Austria	5	45	56	52
Slovakia	14	38	51	49
Hungary	9	39	41	15
Other MS	33	69	104	263
Total EU	1007	1436	1788	2021

The main bioethanol producers in the EU in 2008 are Germany and France (also the main consumers of bioethanol), followed by Italy and Spain. Together these four countries represent more than 60% of the EU bioethanol production. The latter two countries are not in the bioethanol consumer top-5 (Sweden, Poland and the UK are).

The currently installed EU production capacity is not fully utilized. Table 37 compares installed capacity and actual production of biofuels to derive an apparent level op capacity utilisation. Biodiesel capacity decreased dramatically between 2005 and 2008, but since 2009 seems to stabilise at about 40%.

Bioethanol capacity utilisation amounted to around 50-60% all along the 2007-2010 period. As installed capacity has grown at the same pace as production and consumption, capacity utilisation has remained relatively stable. This may be considered surprising, as ethanol plants are capital intensive to construct and therefore very costly to operate at levels significantly below their stated capacity.

Table 37. Production of biofuels in the EU [Eurostat nrg_1073a] compared to the production capacity [EBB 2011, ePURE 2010] (both in Mtoe).

	Capacity	Actual production	Capacity factor
Biodiesel			
2007	9.16	5.91	64%
2008	14.24	7.12	50%
2009	18.61	7.95	43%
2010	19.49	8.14	42%
Bioethanol			
2007	1.98	1.01	51%
2008	2.75	1.44	52%
2009	2.92	1.79	61%
2010	3.60	2.02	56%

1) Note that the production of biodiesel and bioethanol does not add up to the totals reported in Table 34. The difference is in Eurostat category "other liquid biofuels".

In general the apparent overcapacity indicates that while sufficient conversion capacity is available for the coming years, instead, use and consumption are lagging behind.

The structure of the biodiesel sector is very diverse and plant sizes range from annual capacities of just 2 ktonne, often owned by a cooperative of farmers, up to 600 ktonne owned by large multi-national companies [USDA FAS 2011].

In the EU, the years of rapid expansion of biodiesel production capacity seem to be over. From 2005 to 2009 production capacity increased by 360 percent (over the complete period), while the increase from 2009 to 2010 was just 7.2 %. For 2011 and 2012, further marginal increases of two and one percent are forecasted. France, Portugal, and Spain reported the largest production capacity increases in 2010. The Spanish capacity increased despite the fact that in Spain the use rate remains below thirty percent of the total installed capacity. The Benelux, Sweden and Hungary are forecasting the largest increases for 2011 [USDA FAS 2011].

Already in 2007 and 2008, first cases of companies closing their operation or declaring insolvency occurred in the UK, Austria, and Germany. This development continued and spread to the Benelux in 2009 and to Italy in 2010. In addition, a number of plants all over the EU temporarily stopped production. Even with the projected increase in EU biodiesel consumption through mandates, one can expect to see a number of plants closing their operation or even having to file for bankruptcy in the coming years [USDA FAS 2011].

There are several reasons for the apparent underutilisation of production capacity:

- The market seemed very attractive when decisions for construction were taken and construction started at many places concurrently. Once the plants came into production there was an overcapacity;
- Changing legislation especially in Germany, meant an immediate decrease in demand, especially for biodiesel;
- Increasing imports to the European Union, led to lower use of domestically produced European biofuels. Amongst others, low-cost imports of biodiesel from the USA and Argentina were driven by favourable blending subsidies (USA) and export policies (Argentina) in those countries;
- Increasing oil and feedstock prices increased the biofuel production cost but did not raise the competing pump prices for diesel and gasoline at the same pace. The gap between biofuel production cost and value at the pump became too big to be bridged by the incentive schemes in place;
- The consumption increase has been lower than expected, partly related to sustainability concerns, and poor introduction of higher blends (E10 in Germany).

This overcapacity has already lead to a consolidation within the EU biodiesel industry; increasing competition has especially impacted smaller, less vertically integrated biodiesel plants e.g. in Germany, Austria, and the UK, since they are in general less efficient and more remote [UFOP 2011].

Similar developments with partially similar causes occur in the bioethanol sector, although this has less often lead to bankruptcy and closure. Most notable is the Ensus 400 million litre bioethanol plant, which opened at the beginning of 2010 in Wilton in North-East England. Insufficient profits forced the plant managers to close the facility for four months at the beginning of 2011, after only having been in business for one year. This ultra-modern plant, which produces ethanol from crops, has been hit by the sharp increase in wheat prices which have almost doubled in the space of twelve months [Eurobserver 2011]. Also in the UK, a bioethanol plant with a capacity of about 300 million litres temporarily stopped production in May 2011 [USDA FAS 2011].

2.5 Balance between domestic production and imports and its implications

The market is represented by supply (production + import) and demand (consumption + export). This balance[31] is shown for the EU as a whole in Figure 98 and for individual MS in Figure 99.

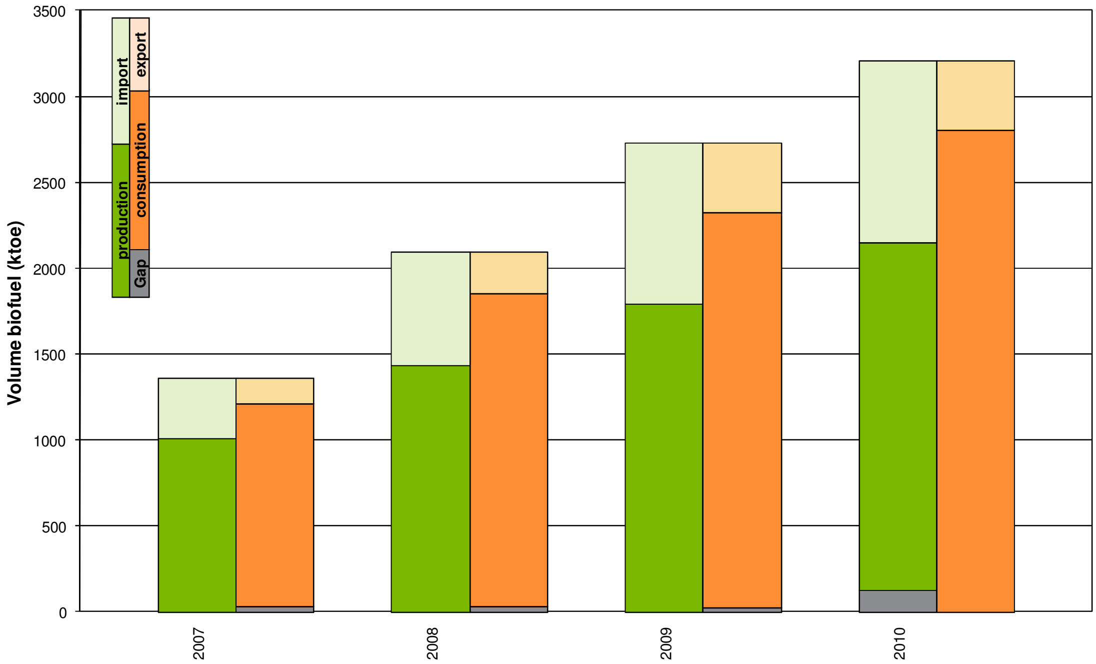


Figure 98. Biofuels market balance in 2007-2010. [Eurostat nrg_1073a]. Import and export both concern intra and extra EU trade (composite values of the trade of individual Member States).

[31] Supply and demand should be the same, however, there is often a gap between information on supply and demand. This gap can partially be explained by net stock changes, i.e. at the start or end of a year, there may be a stock. Probably there are also data inconsistencies between reporting and reality in each of the four other categories shown.

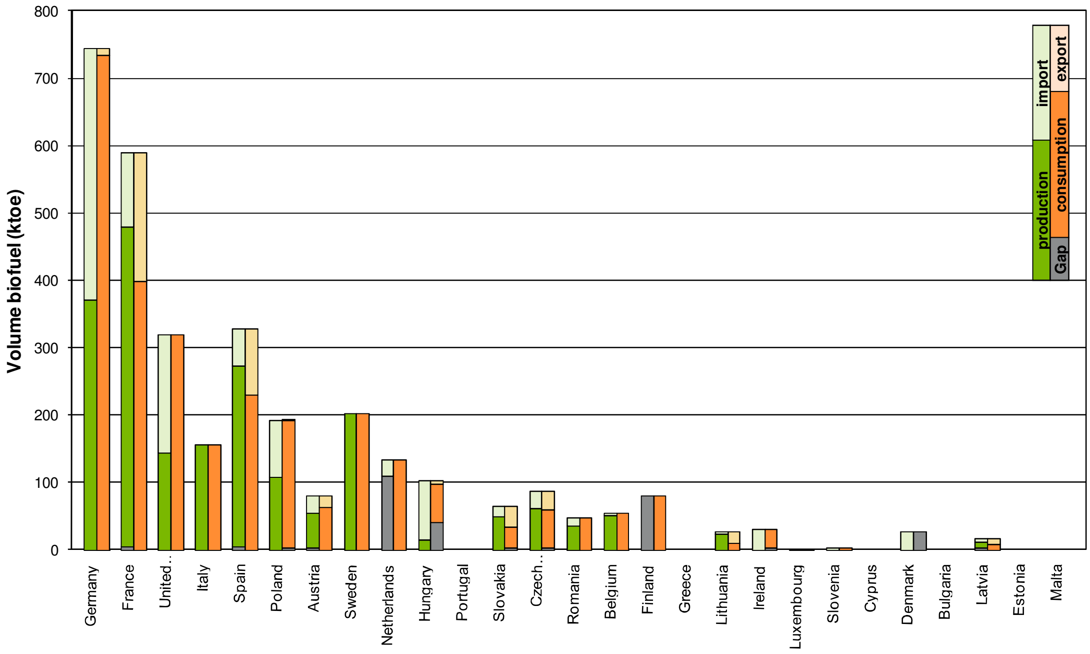


Figure 99. Biofuels market balance in individual Member States in 2010.

Overall, the (composite) import share in the EU has increased from 13% of the market in 2007 to 27% in 2010. Concurrently, the EU production is growing slower (33% growth between 2007 and 2010) than the total market (58%). Note that in the same time, the (composite) exported volume of biofuels declined with 18% and the EU consumption grew with 97%. While these import and export values include the intra-EU trade, much of it concerns extra EU trade (see below).

While the EU biodiesel market grew with 67%, the share of import grew from 16% to 30%. Export decreased from 36% to 15%, equalling a 29% decrease in exported volume. The largest bilateral flows of biodiesel in 2010 are [Eurostat trade statistics]:

- In the UK, 40% of the import stems from the Netherlands;
- In Italy, 30% of the import stems from Spain;
- In Spain, 50% of the import stems from Argentina;
- In Austria, 80% of the import stems from Austria.

The picture is rather different for the bioethanol sector. While the bioethanol market as a whole grew with 136%, the share of import increased only from 26% to 33%. Percentage-wise, export remained about the same (11% in 2007 to 13% in 2010), although the volume was (logically) about 2.5 times larger in 2010 compared to 2007. Germany imported even half of its ethanol in 2010. The largest bilateral flows of bioethanol in 2010 are [Eurostat trade statistics]:

- In the UK, 30% of the import stems from France, 30% from the Netherlands and 30% from Brazil;

- In the Netherlands, 30% of the import stems from France, 20% from Brazil and 15% from the USA;
- In France, 30% of the import stems from Spain;
- In Germany, 40% of the import stems from the Netherlands.

In Section 2.6 it is further analysed from which countries EU biofuels imports originate and where the feedstock of biofuels sold on the EU originate from.

Feedstock of biofuels produced in the EU

In Table 38, the feedstock for biodiesel in EU Member States is presented. More than half of the biodiesel is produced from rapeseed, with soybean, palm oil and used cooking oil each representing about 10% of the feedstock mix. Note that biodiesel in Finland in 2010 was produced uniquely from palm oil at Neste Oil's NexBTL plant.

In Table 39, the feedstock for bioethanol in EU Member States is presented. More than half of the ethanol is produced from starch crops (30% from wheat, 23% from maize and smaller contributions from barley and rye). Sugar beet represents another 30%. Small, but remarkable is the production of bioethanol from residual wine in Italy and Sweden.

The data presented in the tables are an estimation by Ecofys on basis of multiple information sources. The actual compositions per Member State are known to ePure and EBB, but kept confidential because the information is competition sensitive.

Table 38. Feedstock[1)] for biodiesel produced in EU Member States in 2010.

	Rapeseed oil	Soybean oil	Palm oil	Sunflower oil	Coconut oil	Tallow	RVO
Austria	71.0%						29.0%
Belgium	39.0%						61.0%
Bulgaria							
Cyprus							
Czech Republic							
Denmark	61.5%					38.5%	
Estonia							
Finland			100.0%				
France	48.0%	20.0%		23.0%			9.3%
Germany	88.0%	3.5%	1.5%				7.0%
Greece	35.0%	35.0%					30.0%
Hungary	49.0%						51.0%
Ireland							
Italy	43.4%	28.5%	27.1%	0.3%		0.7%	
Latvia	100.0%						
Lithuania	100.0%						
Luxembourg							
Malta							
Netherlands	68.0%					2.0%	30.0%
Poland	62.0%						38.0%
Portugal	41.0%	59.0%					
Romania	100.0%						
Slovakia	100.0%						
Slovenia	100.0%						
Spain	3.0%	42.0%	38.0%	3.0%		7.0%	7.0%
Sweden	100.0%						
United Kingdom	40.0%					20.0%	40.0%
EU	56.5%	13.1%	9.1%	4.9%		1.5%	12.4%

1) Ecofys estimation on basis of EBB information for the EU as a whole, Energy e-track information on individual biodiesel plants, USDA FAS GAIN estimates in individual Member States and dedicated biofuels newsletters.

Table 39. Feedstock[1)] of bioethanol produced in EU Member States in 2010.

	Wheat	Maize	Barley	Rye	Triticale	Beet	Wine	Cane	Cassava	Sorghum	Other
Austria	60.9%	29.8%	2.5%			6.7%					
Belgium	100.0%										
Bulgaria											
Cyprus											
Czech Republic	39.5%	2.5%				58.0%					
Denmark											
Estonia											
Finland											100.0%
France	28.2%	12.2%	1.8%			56.2%	1.6%				
Germany	20.5%	14.1%	8.4%	17.1%	4.3%	32.6%					2.9%
Greece											
Hungary		66.7%				33.3%					
Ireland											100.0%
Italy						36.4%	63.6%				
Latvia	100.0%										
Lithuania	4.2%			47.9%	47.9%						
Luxembourg											
Malta											
Netherlands											
Poland	24.2%	51.7%		24.1%							
Portugal											
Romania											
Slovakia		100.0%									
Slovenia											
Spain	31.7%	50.6%	15.1%				2.7%				
Sweden	66.9%		1.1%				26.3%				5.7%
United Kingdom						100.0%					
EU	30.3%	23.1%	4.4%	4.9%	1.3%	31.7%	3.4%				1.0%

1) Ecofys estimation on basis of ePURE data, Energy e-track information on individual bioethanol plants, USDA FAS GAIN estimates in individual Member States and dedicated biofuels newsletters.

2.6 EU biofuel imports

Biofuels production around the world

The production of biofuels around the world is shown in Figure 100 and Figure 101. There has been an exponential growth of global biofuel production over the last decade, although production has levelled off during the more recent years. In the EU, biofuel production has largely been focused on biodiesel. The EU is by far the largest producer of biodiesel in the world with 8.5 Mtoe in 2010 compared to global production of 15.5 Mtoe (55%). Brazil and Argentina have significantly increased the production of biodiesel in recent years, whereas the production of biodiesel in the USA collapsed.

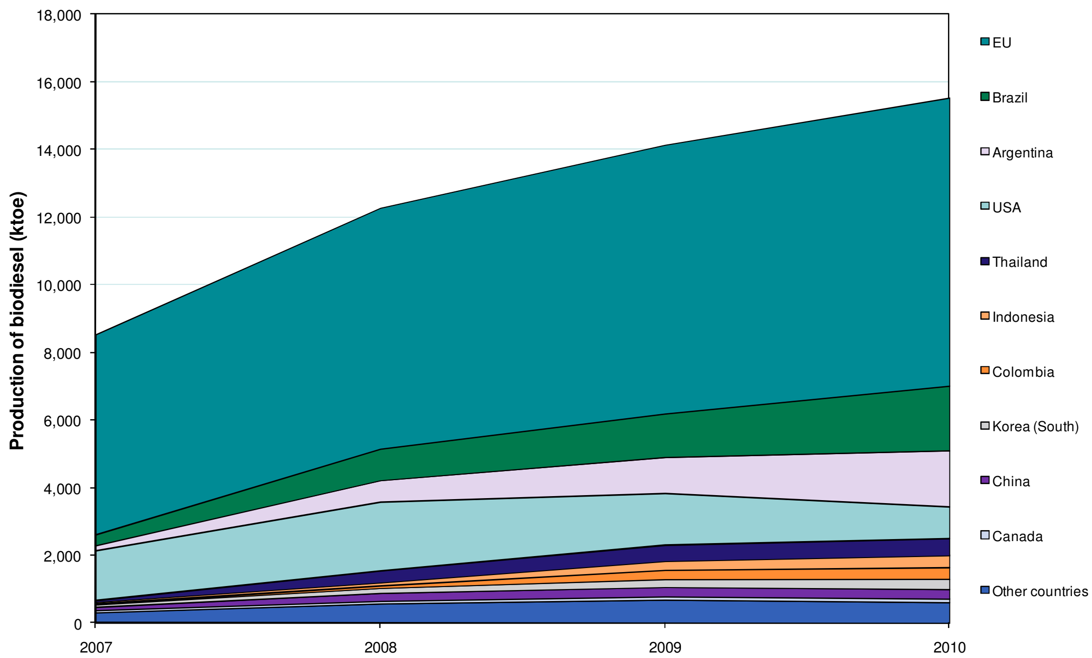


Figure 100. Production of biodiesel around the world in 2007 – 2010. The production is shown for the 10 countries with the largest production volume in 2010. The rest of the world is agregated [Eurostat; US EIA].

Table 40. Production of biodiesel around the world in 2007-2010 (ktoe). Underlying data.

Country	2007	2008	2009	2010
EU	5,905	7,121	7,946	8,517
Brazil	322	927	1,280	1,908
Argentina	166	642	1,067	1,663
USA	1,476	2,038	1,526	932
Thailand	55	356	485	508
Indonesia	46	92	277	370
Colombia	5	65	263	333
Korea (South)	79	148	231	300
China	92	231	277	277
Canada	74	79	97	111
Other countries	316	580	691	616

In the rest of the world, bioethanol plays a much larger role. Total global production was 43.8 Mtoe in 2008, of which only 2.0 Mtoe were produced in the EU (5%). Since 2006, the USA is the largest producer of ethanol, still followed by Brazil.

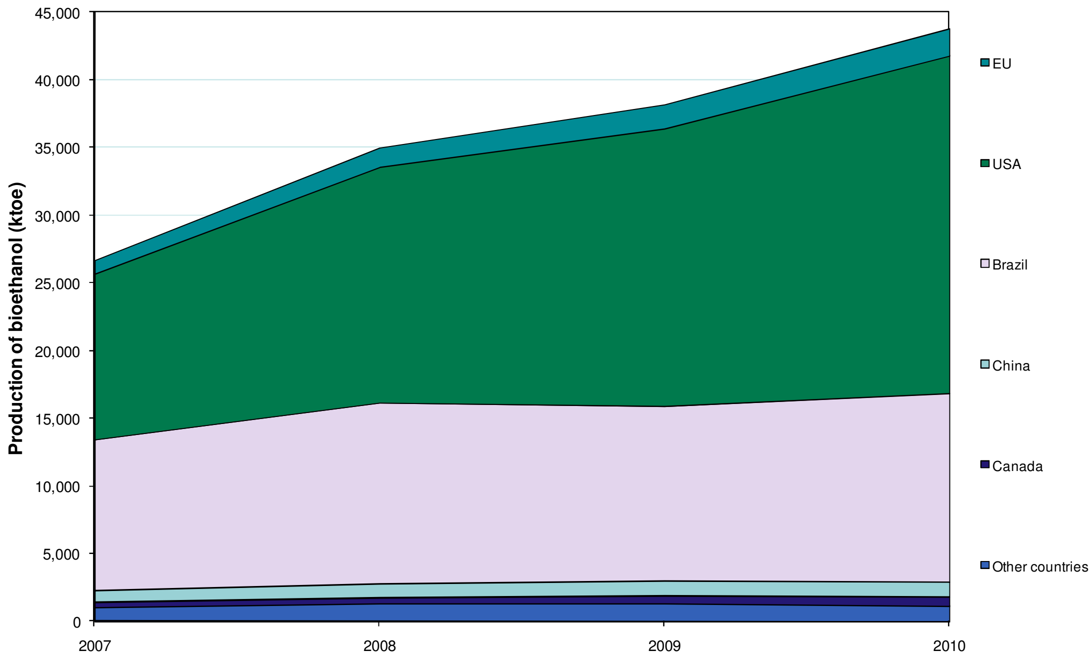


Figure 101. Production of bioethanol around the world in 2007 – 2010. The production is shown for the 5 countries with the largest production volume in 2010. The rest of the world is agregated [Eurostat; US EIA].

Table 41. Production of bioethanol around the world in 2007-2010 (ktoe). Underlying data.

Country	2007	2008	2009	2010
EU	1,007	1,434	1,787	2,018
USA	12,225	17,403	20,505	24,929
Brazil	11,171	13,401	12,927	13,967
China	825	989	1,063	1,063
Canada	397	431	575	690
Other countries	1,053	1,347	1,345	1,152

Origin of EU biofuels

In Section 2.5 above, the import of biofuels to the EU was compared with the production of biofuels in the EU. As can be seen from Table 42, most of the biofuels sold on the EU market, have been produced in the EU. Here, we further explore the origin of imported biofuels.

Table 42. Origin of biofuels[1,2] on the EU market as volume and as fraction [Eurostat, Comtrade].

	Biodiesel			Bioethanol	
	Volume (ktoe)	Fraction		Volume	Fraction
EU	8,270	83.2%	EU	2,243	80.1%
Argentina	1,003	10.1%	Brazil	234	8.4%
Indonesia	285	2.9%	USA	121	4.3%
Malaysia	123	1.2%	Peru	26	0.9%
China	67	0.7%	Kazakhstan	24	0.8%
USA	61	0.6%	Bolivia	20	0.7%
Other countries	129	1.3%	Egypt	15	0.5%
			Korea (South)	16	0.6%
			Other countries	101	3.6%

1) Trade of biodiesel and of bioethanol is analysed on basis of Eurostat trade statistics by CN8 (dataset DS_016890: code HS 3824.90.91 for biodiesel, codes HS 2207.20.00, HS 2207.10.00, HS 220890.91, HS 2208.90.99 and HS 2909.19.10 for ethanol) and Comtrade (code 382490 for biodiesel, codes 2207, 2208 and 2909 for ethanol).

2) Eurostat trade statistics in principle show the origin of the material, regardless of the trade route. However, several markets show both much import and much export and as sometimes more product is exported from a country than is produced in that country, it is likely that a re-export occurs that is not visible in the direct trade statistics. It seems that much biodiesel is traded even within the EU in multiple steps before reaching the final destination. We have corrected for such multiple-step trade routes by assuming that domestic production and import from again other countries are equally represented in the export from each country. The detailed methodology for this correction is explained in the report Biofuels Baseline 2008 [Ecofys 2011].

A significant share of biodiesel came from Argentina, while biodiesel contributions from other countries were negligible. Compare this to 2008 when about the same fraction came from the USA and Argentina only produced 2% of the biodiesel that was consumed in the EU market. In 2010, however, imports of biodiesel from the USA were limited by EU regulations imposed in 2009, to prevent biodiesel blends that receive very attractive tax credits (1US$ per gallon) to spoil the EU market [REN21 2010].

In 2010, Brazil was still the largest exporter of bioethanol to the EU, although the fraction halved from 15.9% (289 ktoe) in 2008 to just 8.4% in 2010 (still 234 ktoe as the total EU bioethanol market has grown). The highest sugar prices in years, combined with adverse weather conditions in a major producing region, resulted in a drop in Brazil's ethanol production from 27.1 billion litres in 2008 to 26.3 billion litres in 2009. Most Brazilian ethanol is used domestically, only the surplus is exported. This implies that much less bioethanol was available for export [REN21 2010].

A significant import of bioethanol originates from the USA, which is since 2006 the worlds largest ethanol producer (see Table 42 above). Nevertheless, the existing production capacity was not fully utilized in 2009 due to unfavourable market conditions. Producers faced large fluctuations in natural gas prices, corn prices, and ethanol sales value, along with the inability to raise new financing from both debt and credit markets [REN21 2010].

Feedstock in third countries

The insights in the origin of biofuels are combined with estimations of feedstock composition. For the most prominent supplier countries outside the EU, the feedstock composition is shown in Table 43. In most of these countries, a limited number of feedstock types is used in the production of either biodiesel or bioethanol. Most notably soybean in Argentina, palm oil in Indonesia and Malaysia, maize in the USA and cane in South America.

Table 43. Feedstock composition[1)] for biodiesel and bioethanol in main supplier countries.

Biodiesel feedstock					
	Rapeseed	Soybean	Palm oil	Tallow	UCO
Argentina		100%			
Indonesia			100%		
Malaysia			100%		
China					100%
USA	11%	51%	11%	19%	8%

Bioethanol feedstock		
	Maize	Sugar cane
Brazil		100%
USA	100%	
Peru		100%
Bolivia		100%
Egypt		100%

1) For most countries, only limited information is available about the feedstock used in the production of biofuels. Less commonly used feedstock may be missed in the table. Information on feedstock composition is drawn from national reports on the production of biofuels and from USDA FAS GAIN reports dedicated to biofuels production per country.

2.7 Origin of feedstock of EU consumed biofuels

The above analysis of feedstock usage in the EU and third countries combined with the origin of EU consumed biofuels results in understanding which feedstock have been used in all countries to produce the biofuels that were consumed in the EU in 2010. This does not yet however give the insight into the origin of feedstock for EU biofuels.

Therefore, for several feedstocks, international trade was studied in the same way as the biofuel trade earlier in this chapter. Feedstock types considered in the trade analysis are: rapeseed / oil, soybean / oil, palm oil, maize and wheat since these are traded on a large scale internationally. Other feedstock are not internationally traded (sugar beet, sugar cane) or less relevant in the overall biofuels feedstock profile (barley, rye, triticale, wine, sunflower/oil, tallow and RVO).

The origin of feedstock of EU consumed biodiesel in 2010, is given in Table 44 for the most important feedstock supplying countries. Logically, countries that are important biodiesel suppliers to the EU market play an important role in this table. The most important feedstock is rapeseed originating from the EU, followed by Argentinean soy - both in the biodiesel imported from Argentina as well as in EU produced biodiesel. Indonesian and Malaysian palm oil are feedstock to the biodiesel exported by those countries to the EU, but also play an important role in the EU biodiesel production. Similarly, soybean from Brazil, USA and Paraguay are converted in the EU to biodiesel. Significant rapeseed imports from Canada and Ukraine show up in EU produced biodiesel.

Table 44. Ultimate origin of feedstock for biodiesel consumed in the EU in 2010. Expressed in volume of biodiesel (ktoe).

	Rapeseed	Soybean	Palm oil	Sunflower seed	Tallow	RVO	Other	Total
EU	4,098	87	5	444	159	1,182	3	5,977
Argentina		1,191						1,191
Indonesia			814					814
Brazil		417			1			419
Canada	212	44			13	22		292
Ukraine	252	14						266
USA	7	221			12	5		245
Malaysia			212					212
Paraguay	3	185						188
Russia	80	45						124
China		1				67		67
Other	99	14	13			1		126
Total	4,751	2,220	1,043	444	184	1,276	3	**9,922**

The origin of feedstock of EU consumed ethanol in 2010 (Table 45) stems from a broader range of countries, compared with biodiesel feedstock, although about 80% stems from the EU itself. EU produced ethanol is mainly produced from EU produced feedstock, only small shares of wheat and maize originate from Switzerland, Ukraine and a few other countries.

Table 45. Ultimate origin of feedstock for bioethanol consumed in the EU in 2010. Expressed in volume of bioethanol (ktoe).

	Wheat	Maize	Barley	Rye	Triticale	Sugar beet	Wine	Sugar cane	Other	Total
EU	581	344	58	81	20	733	101		33	1,951
Brazil		8						234		242
USA	2	122								124
Peru								26		26
Switzerland	25									25
Bolivia								20		20
Ukraine	6	7				2				15
Egypt								15		15
Guatemala								14		14
Argentina		2						5		7
Cuba								6		6
Other	10	7						16	2	34
Total	623	490	58	81	20	735	101	336	35	**2,480**

3 Measures to safeguard the sustainability of biofuels

This chapter will report and analyse measures to respect EU sustainability criteria, including measures for soil, water and air protection and is split into a part reviewing measures in EU Member States and one part reviewing measures in main countries of production outside the EU.

3.1 Major findings

- Member States deem the impact of the production of feedstock for biofuels on water and air quality low. Most countries have simply not performed an evaluation, with the exception of Belgium, Romania and Germany, which have taken concrete steps to analyse the impacts. Several countries assume impact should be minimal based on existing legislation and codes of practice;
- Outside the EU, several countries have improved their regulation related to sustainable agriculture, but this is rarely targeted at the sustainability of biofuel feedstock production;
- An increasing amount of feedstock in main supplying countries is covered by voluntary programs. The main voluntary programs which increased their coverage in 2010 are RTRS, RSPO and ISCC. Expansion of coverage was largest in Argentina, Brazil, Indonesia, Malaysia and the USA.

3.2 Measures to safeguard sustainability in EU Member States

This has been done by reviewing the Member States reports for the following information:
- If legislation or regulation has been adopted in the relevant period (2009-2010) specifically focusing on guaranteeing the sustainability of biofuels;
- Furthermore planned legislations or initiatives for short term implementation will be indicated;
- Where mentioned, relevant legislation in the field of air, soil or water will be included in the overview.

Furthermore synergies have been sought with another current EC project for Art.18.2. And 18.9 in which implementation of the Renewable Energy Directive in the various EU Member States is analysed. In this section we rely mostly on information as presented in the EU Member States reports on 2010.

Transposition of the Renewable Energy Directive

During the period 2009-2010 only Austria (partially), Denmark (1st of January 2010), Estonia (22 December 2010), Germany (1s of January 2010), Hungary (end of 2010) and Malta (December 2010) have (partially) transposed the requirements on EU sustainability criteria for biofuels according. This resulted from the analysis of the statements made in the MS reports. Although some member states mention the Renewable Energy Directive as transposed in national legislation, in most of the member states this is actually only partially done. Only in the case of Germany the RES Directive has been completely and correctly implemented.

An overview of the status of each member state on transposition of the RES Directive is given in Table 78 in Appendix IV. Often the MS progress reports do not contain information on how the RED sustainability requirements are transposed in national legislation. They mostly only provide short references to instruments/measures to promote the used of renewable energy in general, and sometimes biofuels.

Measures taken for soil, water and air protection

In general, Member States deem the impact of the production of feedstock for biofuels on water and air quality low, either because the share of crops dedicated to biofuels is low compared to other uses or because no domestic land was used at all for the production of biofuel feedstocks. Most countries have simply not performed an evaluation, with the exception of Belgium, Romania and Germany, which have taken concrete steps to analyse the impacts. Several countries assume impact should be minimal based on existing legislation and codes of practice:

- In **Austria**, through compliance with the Alpine Convention (protection of animal and plant species) and the Ministerial Conference on the Protection of Forests in Europe (MCPFE) as well as Cross-Compliance, ÖPUL, GLÖZ and compliance with RED criteria;
- In the **UK**, the ACCS (now Red Tractor Farm Assurance) requires compliance with the UK Government code of practice: Protecting our Water, Soil and Air: A Code of Good Agricultural Practice for farmers, growers and land managers. It also requires compliance with the UK's Environmental Impact Assessment Regulations;
- In the **Czech Republic**, no impact is expected since biomass is covered by the same rules as other crops – compliance with the principles of good agricultural and environmental condition (GAEC);
- In **Italy** it is assumed that compliance with CAP obligations oblige producers to apply a crop rotation system such that the same crop cannot be rotated on the same land, thus favouring agricultural biodiversity;
- The report from **Poland** is a bit vague, and claims that "no assessment [has been] performed yet [but] necessary action will be taken in accordance with [...] the draft Act on renewable energy sources, which stipulate detailed monitoring of achievements of objectives and progress in the promotion of energy from RES in Poland. These provisions will take account of legal regulations under Common Agricultural Policy (CAP) and environmental policy."

Among the few countries that have taken steps to analyse the potential impacts. One can note the following actions:

- In **Romania**, a report was commissioned in accordance with the requirements of the Bulgarian environmental legislation and Decision No 1 EO-1/2009 of the Minister for the Environment and Water. The report on the environmental impacts of the National Renewable Energy Action Plan[32] was drawn up and made available for comments to the public. It commissioned to examine the possible impacts of the implementation of these renewable energy technologies, including technologies for the production of biofuels – bioethanol and biodiesel – for the transport sector, on the components of the environment;
- In **Belgium** a study is ongoing, carried out by the Belgian Royal Institute of Natural Sciences (interim report by Mr. H. Robert) on the impact of very short rotation coppice crops and of biofuels on biodiversity. A research project is ongoing on the lifecycle analyses, but the results are not expected until 2013;
- In **Germany** the following research projects have been conducted or started to gauge the impacts of biofuel and bioliquid production on biodiversity, water resources and water and soil quality over the last two years:
    - Basic information for sustainable use of agricultural waste for bioenergy production (Project 03KB021 of the biomass energy use support programme). This project looked at the potential of straw on a national basis, taking into account ecological and technical economic aspects;
    - Biomass crops of the future from a nature conservation point of view (2010 environmental research project of the Federal Agency for Nature Conservation);
    - Report of the German Parliament's Committee for Education, Research and Technology Assessment (18th Committee) under Section 56 of the rules of procedure. Technology assessment. Chances and challenges of new energy crops (German Parliament 2010): Growth in energy crop use and competition (for land) (also MAE-D-Scenarios), environmentally-responsible energy crop production;
    - Research and Development (R&D) project: Standards for environmentally benign production and use of renewable energies (FKZ 0325016): existing conflicts on bioenergy at large, standards, etc. (Peters 2011);
    - R&D project: Effective land use for bioenergy from a nature conservation standpoint (FKZ 3508 83 0300) (BfN 2009a).

32 http://www.mi.government.bg/bg/discussion-news/obshtestveno-obsajdane-na-nacionalniya-planza-deistvie-za-energiyata-ot-vazobnovyaemi-iztochnici-i-negovi-164-m270-a1-1.html

3.3 Measures to ensure compliance with EU sustainability criteria for imported biofuels and biofuel feedstock

A brief review of legislation and voluntary measures is done indicating the compliance of imported biofuels to EU sustainability criteria.

In Table 46 an overview is given on main changes in legislation regarding the sustainability of biofuels or preventing possible impacts on soil, air or water. An indication is also provided on the enforcement potential and mainly the changes in this enforcement potential between 2008 and 2010. In Table 110 in Appendix XII also a full overview is provided of air related legislation and regulation. Only changes between 2008-2010 are included in the table below.

Table 46. Overview of main changes in legislation regarding sustainability of biofuels, and impacts on water/soil/air for main 3rd countries.

Country	Main crop	New legislation 2010 regarding safeguarding sustainability or relevant soil/air/water	Enforcement potential change (increasing/decreasing/no trend) 2008-2010
Argentina	Soybean	-Decree 91: Implementation of native forests law (2009) - Implements Native Forests Law and creates National Fund for the Conservation and Enrichment of Native Forests -Resolution 554 (2010) - Mandates blending of biodiesel at 5-7%. Resolution from the secretary of energy.	-Global Integrity Index +17/100 Low enforcement potential, but increasing
Indonesia	Palm oil	-2009 Law 32 of 2009 on Environmental Protection and Management creates environmental planning procedures and control systems. Places responsibility for pollution, quality standards, strategic environmental assessments, etc. -Ministerial Decree No. 32 (2008) – Mandates 1% mixture of biofuel. Requires biofuel producers to ensure feedstock sustainability and prove no harm the environment by way of environmental impact analyses[33] -Ministerial Decree on Agriculture (14/Permentan/PL.110 /2/2009)(2009) – Provides guidelines for oil palm cultivation on peatlands	Only slight changes Medium enforcement potential and increasing
Brazil	Soy bean, Sugar cane	-2008 Sao Paulo State Law and 2009 Presidential Decree establishes agro-ecological zoning for sugarcane and ethanol mills, considering environmental risks. -Soja Plus program began in 2010 for environmental and social management -Moratorium on Soybean from Amazon extended past 2008	Only slight changes Medium enforcement potential with unclear trends for the future

[33] (Ariati, pers.comm. 2010).

United States	Soy bean, Maize	Food Conservation and Energy Act/US Farm Bill (2008) – Allows for retirement of land for environmental protection, as well as water and waste-water facilities.	High enforcement potential, but decreasing
Ukraine	Rapeseed	-	Only slight changes
Canada	Rapeseed		
Malaysia	Palm oil	-Environmental Quality (Industrial Effluents) Regulations (2009) – addresses effluent from the oil palm industry -Commitment to maintain 55.6% permanent forests for wildlife habitat and biodiversity conservation (2009)	-Global Integrity Index Increased by 6/100 -Democracy Index decreased by 0.6/10 Medium enforcement potential and decreasing
Paraguay	Soy bean	-	Only slight changes
Russia	Rapeseed	-2009 Environmental Quality (Industrial Effluents) Regulations adds additional regulation to palm oil industry effluents - Agreement on transboundary haze pollution among ASEAN Members which entered into force 2003, was ratified 2010.	-Corruption Perception Index decreases by 0.5/10
Peru	Sugar cane	-	Only slight changes

The table indicates that several countries have increased their regulation. However most are not specifically aimed at sustainability of biofuel feedstock production but are more generic.

Voluntary certification schemes

The table below indicates the coverage of voluntary programs in 2010 in the main countries outside the EU.

It shows that in the main countries supplying the biofuel feedstock in 2010 an increasing amount of feedstock is covered by voluntary programs. The main voluntary programs which increased their coverage in 2010 are RTRS, RSPO and ISCC. Expansion of coverage was largest in Argentina, Brazil, Indonesia, Malaysia and the USA. The other countries had a much lower increase in coverage of voluntary programs.

Voluntary sustainability certification increased in this time frame, however, in no country do the sustainability standards cover a significant proportion of the feedstock produced.

Table 47. Coverage of voluntary programs 2010 for main countries outside EU.

Country	Main crop	Coverage of voluntary programs 2010-2012
Argentina	Soybean	-RTRS certification covers additional 67,500ha and 163,267tonnes soy -ISCC certifies 1 farm, 6 oil mills, 1 refinery, and 4 biodiesel plants (2008 status unknown) -SAN/RA certifies 1 additional supply chain -Additional area certified by AAPRESID unknown (at least 2 entities), but increasing.
Indonesia	Palm oil	-ISCC certifies additional 17 oil mills, 14 refineries, 4 biodiesel plants. -RSPO certifies 38 additional growers, total coverage comes to 463,786ha and over 2 million MT CSPO.
Brazil	Soy bean, Sugar cane	-RTRS certification covers additional 78,273ha and 255,946 tonnes soy -Bonsucro certification covers additional 12 sugar mills -SAN/RA certifies 2 additional supply chains -Soja Plus program began in 2010 for environmental and social management -Moratorium on Soybean from Amazon extended past 2008
United States	Soy bean, Maize	-ISCC certified 13 additional ethanol plants and 3 oil mills.
Ukraine	Rapeseed	-ISCC certified 1 farm and 2 oil mills.
Canada	Rapeseed	-ISCC certified 3 oil mills (2010 status unknown)
Malaysia	Palm oil	-ISCC certifies 13 additional oil mills, 2 additional refineries, and 4 additional biodiesel plants. -RSPO certifies an additional 62 growers, total covered area comes to 513,730ha and 2.7million MT CSPO.
Paraguay	Soy bean	-RTRS certified 1 producing company, covering 2,765ha and 5,334 tonnes.
Russia	Rapeseed	-ISCC certified 2 farms (2010 status unknown)
Peru	Sugar cane	-

4 Impacts of increased EU biofuels deployment

4.1 Major findings

- Member State progress reports provide little conclusive evidence about the impact of and increased biofuel production on the national land use patterns;
- Back-casting analysis reveals that EU biofuels production in 2010 lead to about 2.2 Mha additional land use (compared to 2000), an increase of about 1.1 Mha compared to 2008. The additional land used per additional unit of biofuel in 2010 is 0.18 Mha/Mtoe for the EU-27 biofuel production;
- Statistical analysis reveals that the total land use worldwide, to produce the feedstock for EU-consumed biofuels in 2010, is about 5.7 Mha. Of this, 3.2 Mha (57%) is within the EU and 2.4 Mha (43%) resides outside the EU. True valuation of co-products would yield a lower figure;
- In most of the non- EU countries, the land dedicated to the production of feedstock for EU biofuels is less than 1% of the cropland. Notable exceptions are Argentina and Paraguay, where 3% and 4% of the total cropland produces soybean for EU biodiesel in 2010;
- Within the EU, several countries used a relatively large percentage of the land used for the total crop for the EU biofuel feedstock, like France (6%), Germany (5%), Czech Republic (6%) and Poland (2%);
- Greenhouse gas emission savings resulting from the domestic consumption of biofuels have been reported by the Member States to amount 25.5 Mton CO2 equivalent in 2010;
- Based on statistical analysis, the total savings related to biofuel consumption are estimated to be 22.6 Mtonnes CO_2 equivalent, which represents a saving of 53% compared to the situation where only fossil fuel would be used;
- Biodiversity risks resulting from EU biofuel consumption are estimated to be the highest in Brazil and the USA, mainly concerning the conversion of shrubland and grassland, followed by Argentina, Canada and Russia;
- Water stress as result of feedstock production for EU biofuels consumption, mainly occurs in the EU, especially in Belgium, where a significant fraction of the total agriculture water footprint seems to be related to biofuels. Further large contributions are seen in Germany, France and Hungary. Outside the EU, the largest impacts are seen in Argentina and Paraguay;
- No conclusions can be drawn on risks to soils, although the expansion in crop area, the likely increase in fertilisers and pesticides, the use of machinery and irrigation correlates to increased risks for soils, especially in non-EU countries;
- The production of soybean, palm oil, maize, and sugarcane have the highest overall potential risks for air quality, largely due to the presence of burning as part

of their production (land preparation and post harvest), but also as a result of volatization of fertiliser and other agrochemicals.

- Back-casting scenario analysis of the global agricultural market development clearly shows that EU-27 expanding biofuel use has contributed only little to the historical cereal price increases in 2007 to 2010 resulting in a wheat and coarse grain price increase of about 1-2%. The impact was more substantial for price increases of non-cereal food commodities by about 4%, notably through its demand for vegetable oil in the production of biodiesel;
- The impacts of global food prices on local food prices and food security differ between countries, crops and circumstances. From local cases analysed in this section, no concrete indications could be found of biofuel production causing local food price increases;
- Given the time lapse between land deals and actual crop production, it is almost impossible to link these deals with the EU biofuel consumption. Based on scrutiny of the largest land deals in developing countries and on assumptions about how much land deals may have eyed the EU market, we estimate that between 0.05 and 0.16 Mha of land deals with concerns about socio-economic impacts and land-use rights could be linked to the EU market. We expect that in the future more information will come available about the source regions of biofuels as a result of sustainability reporting requirements. Attention needs to be paid to the developments and biofuel imports in the 2011-2012 and onwards period;
- Gross employment related to global biofuels production is estimated to be 3.5 million, of which 0.2 million jobs in the EU in the production of ethanol and biodiesel and along the biofuels supply chain;
- The impact of biofuels on other biomass using sectors was not very apparent in 2010, although the impact on the oleo-chemical industry was significant. As the emerging bio-economy sectors grow, competition for raw materials for the different biomass uses will increase.

4.2 Land-use quantification

The discussion of the extent and kind of land required for biofuel production and of the impacts on cultivated land caused by expanding biofuel production, distinguishes two elements: first, direct land use changes, i.e. estimating the extent of land that is used for producing biofuel feedstock; secondly, the estimation of indirect land use effects, which can result from bioenergy production displacing services or commodities (food, fodder, fibre products) on arable land currently in production.

This section includes several elements regarding land use quantification, namely:

- Reported impacts on land-use from the Member States progress reports;
- Macro-economic analysis;
- Statistical analysis of land use.

Land use developments are discussed in 4.3.

Reported impacts on land use from the Member States progress reports

The Member State progress reports provide little conclusive evidence about the impact of and increased biofuel production on the national land use patterns. In some countries no land use changes could be allocated to biofuels (Austria, Denmark), changes were insignificant (Bulgaria, Netherlands), or land use of (potential) feedstocks had gone down (Estonia, Lithuania). Please note that if no land use changes could be allocated that does not mean that no impacts on land use were present. However the MS reports do not give indications on those possible impacts.

In some countries, the area occupied by (potential) biofuel feedstocks increased, but have not been directly be allocated to the production of biofuels (France, Slovakia, Slovenia).

In Romania, increase in land use for rapeseed grew from 50 to 420 thousand hectares from 2004 to 2009, but the MS reports states that this increase was not to the detriment of other crops (but supposedly comes from 'unused agricultural land'). Although the statement of no detriment to other crops is made in the MS report, the data presented indicates a reduced amount of wheat and corn produced. It is unclear if this relates to the increase in rapeseed produced. It is considered in the MS report that Romanian agriculture offers important opportunities for extensive and intensive development and "it is difficult to speak of limitations imposed on food production generated by the promotion of energy crops".

In some cases effects on land-use was reported for non-transport biofuels: Germany mentioned (negligible) effects due to biogas and fast growing timber, while the Netherlands mentioned the use for feedstocks for biogas production.

The UK progress report claims that in the UK there has been a small increase in the land used for oilseed rape and sugar beet as biofuel feedstocks between 2009 and 2010. Processing of wheat into ethanol came on stream in 2010 resulting in a large increase in the land used for wheat as a biofuel feedstock. The land used for wheat for ethanol production represented 2% of the total UK wheat crop in 2010.

Macro-analysis of land-use[34]

Back-casting scenario analysis with a world food system model has been used to quantify the impact of demand growth for biofuel feedstock in recent years on land use. The approach applies a general equilibrium framework that can capture both direct and indirect land use changes by modelling responses of consumers and producers to price changes induced by introducing competition with biofuel feedstock production. This approach accounts for land use changes but where relevant also

[34] The full analysis is discussed in Appendix VIII.

considers production intensification on existing agricultural land as well as consumer responses to changing availability and prices of agricultural commodities

An additional use of cultivated land in 2008 of about 7.4 Mha is attributed to biofuel feedstock demand when historical biofuel production figures are used for all countries, about 6.2 Mha when biofuel production is simulated for countries excluding EU-27, and 1.1 Mha when simulating for EU-27 alone. In 2010, the simulated changes in use of cultivated land are respectively 13.6, 11.0 and 2.2 Mha.

The additional land used per additional unit of biofuel is 0.18 Mha/Mtoe for the EU-27 biofuel production.

Quantification land use for EU biofuel consumption

The land use required for EU biofuels can also be estimated from statistical analysis:

- The ultimate origin of feedstock (as discussed in Chapter 2) provides the information on amount crops produced in a certain country for the EU biofuels consumed in 2009/2010;
- The amount of crops is combined with yield data from FAO to which assess the amount of hectares used for EU biofuels consumed in that specific country;
- A correction is made for co-products (i.e. hectares that can be allocated to co-products are subtracted);
- From the FAO database, information is obtained on total land use per country and total land area used for production of that certain crop;
- The information is combined in graphs to indicate the part of land area used for the production of EU biofuels & EU biofuels feedstock in relation to total land area and area used for that specific feedstock in general.

In this section an overview of main findings are presented as well as graphs for several countries important for EU biofuel production 2010. For other countries, graphs are presented in Appendix V.

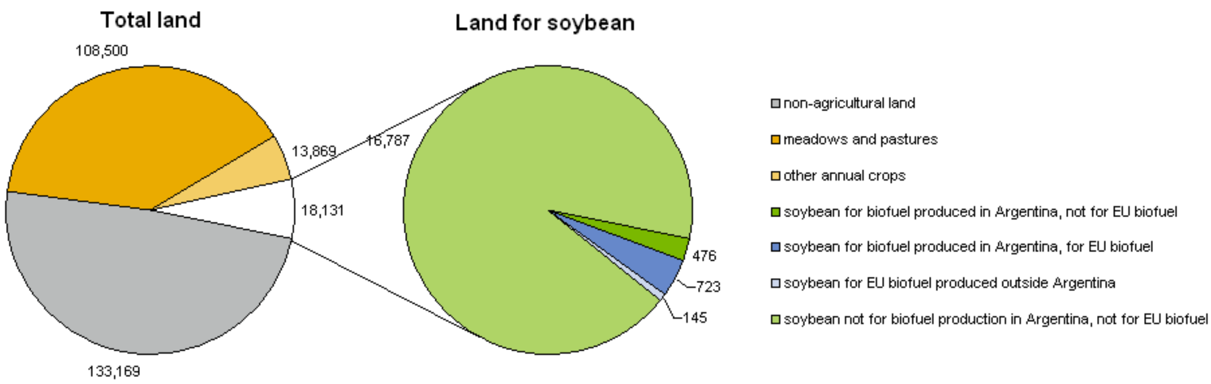


Figure 102. Land used for soybean in Argentina for EU biofuels, 2010.

Most of the soy production is for non-biofuel purposes. About 4.7% of the land used for soy production is used for EU 2010 biofuel feedstock. Among the non-EU countries, Argentina used the largest amount of hectares for production of EU biofuel feedstock.

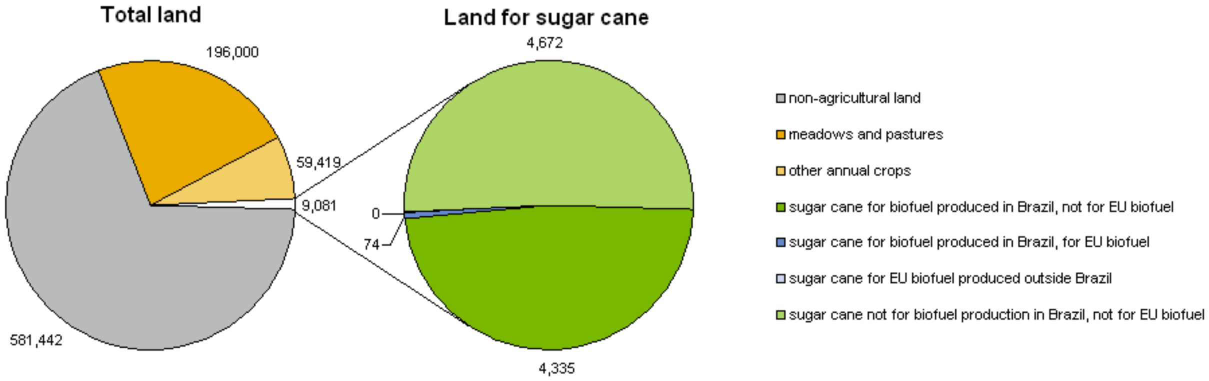


Figure 103. Land used for sugar cane in Brazil for EU biofuels, 2010.

About half of land dedicated to sugar cane production in 2010 is used for biofuel production. Only a very small amount (0.8%) of this sugar cane in the end is used for feedstock of EU biofuels.

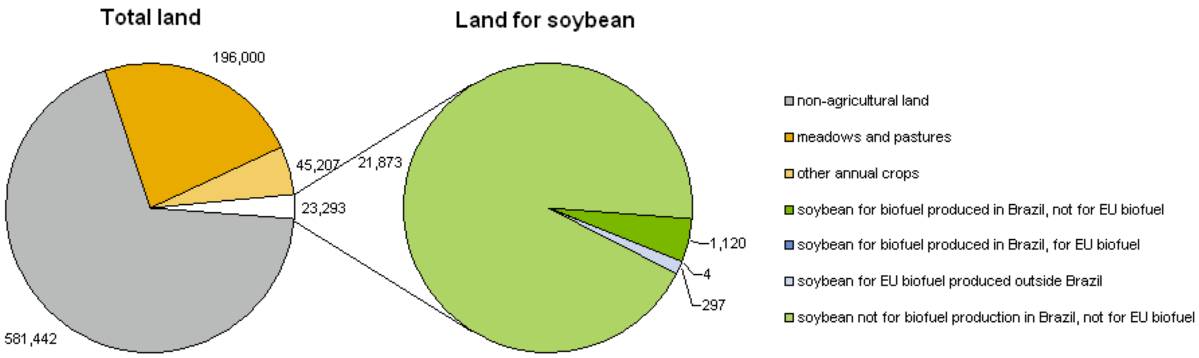


Figure 104. Land used for soybean in Brazil for EU biofuels, 2010.

The main part of the soy production in Brazil is not used for biofuel production. Only about 1% of the 2010 total land used for soybean production is used for feedstock for EU biofuels.

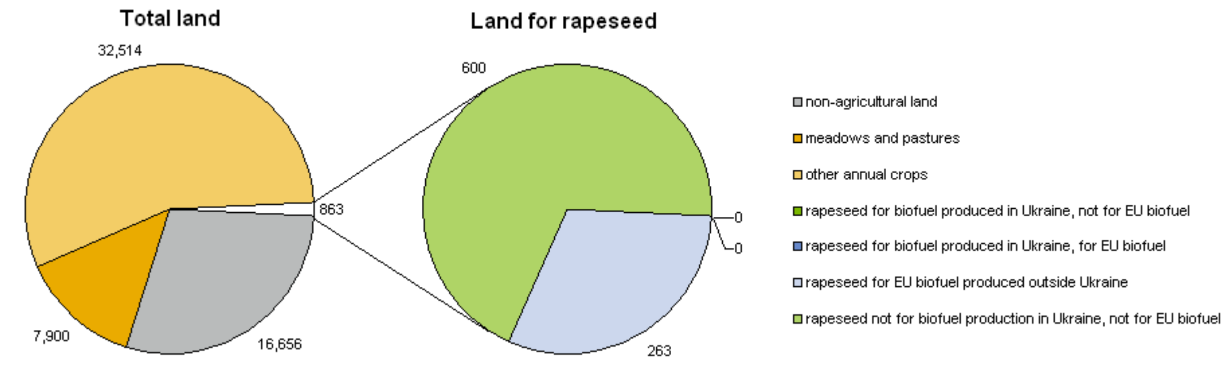


Figure 105. Land used rapeseed in Ukraine for EU biofuels, 2010.

The amount of land dedicated to rapeseed production in 2010 in the Ukraine is small compared to the use for other crops. From the total rapeseed production a considerable part, namely a third of the land used, ends up in EU biofuels.

Figure 106. Land used rapeseed in Canada for EU biofuels, 2010.

About 3% of the land used for rapeseed production in Canada produces rapeseed for EU biofuels in 2010.

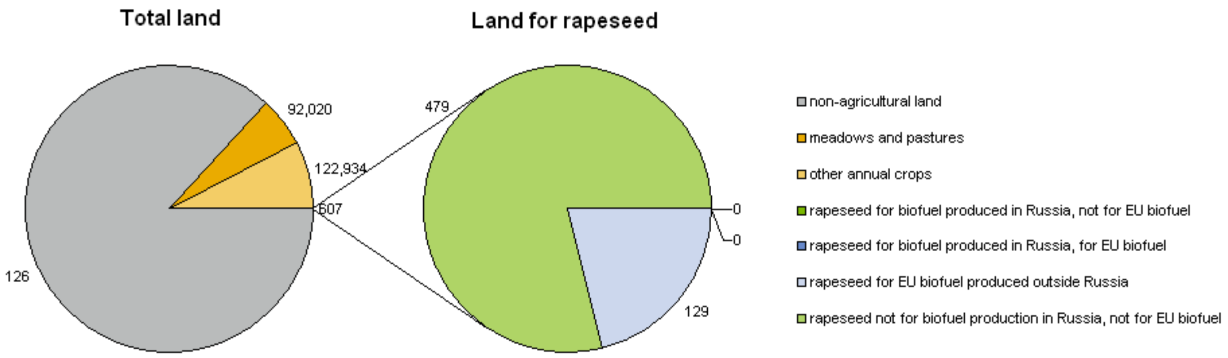


Figure 107. Land used for rapeseed in Russia for EU biofuels, 2010.

The land dedicated to rapeseed in Russia is minimal (0.4%), and all production is aimed for biofuel production. Over 20% of the land dedicated to rapeseed production, is used for the production of EU biofuels in 2010.

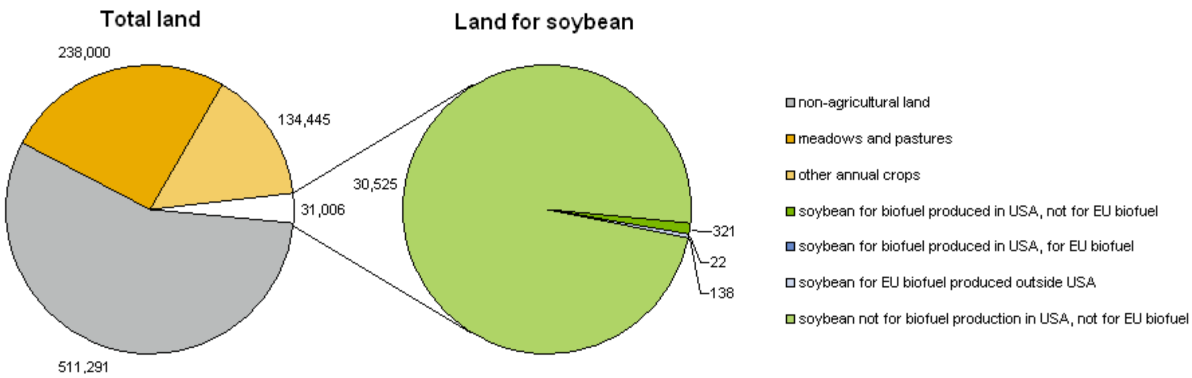


Figure 108. Land used for soybean in USA for EU biofuels, 2010.

Most of the soy production in the USA is not aimed for biofuel production. About half a percent of the land used for soy production in the USA was used for EU biofuel feedstock in 2010.

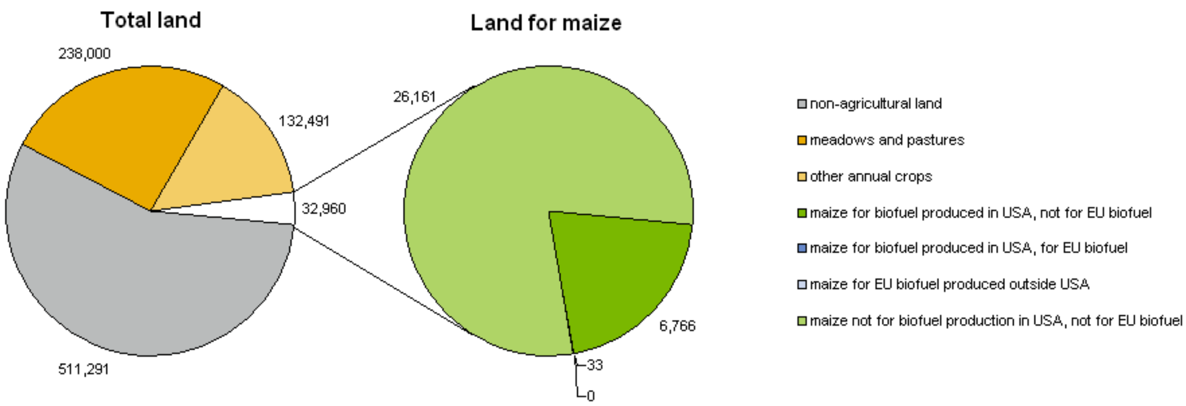


Figure 109. Land used for maize in USA for EU biofuels, 2010.

A considerable part of the maize production in the USA is aimed at biofuels. However the amount of land used for maize production as feedstock for EU biofuels is in comparison negligible (1%).

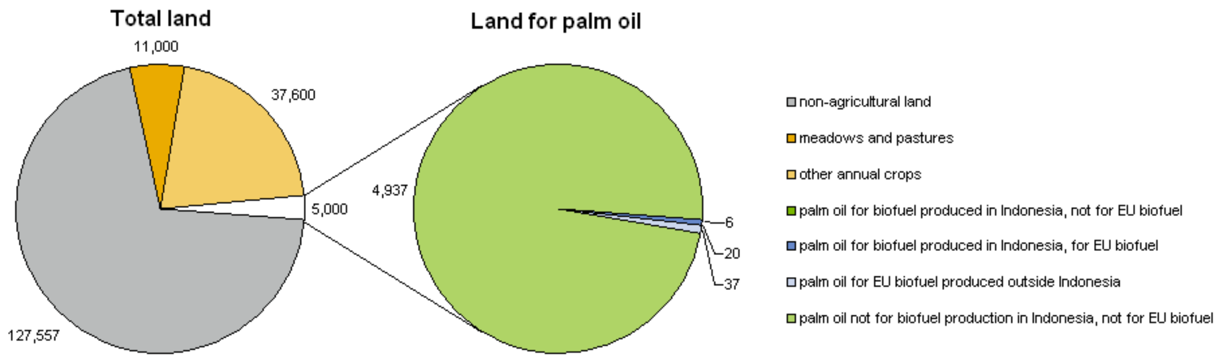


Figure 110. Land used for palm oil in Indonesia for EU biofuels, 2010.

Almost all palm oil is dedicated for other uses than biofuels. The amount of land dedicated to feedstock for EU biofuels in 2010 is around 1%.

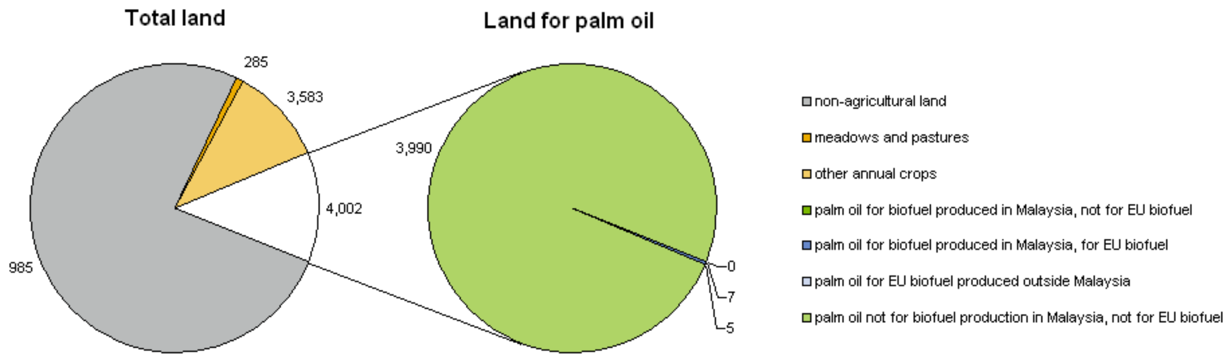


Figure 111. Land used for palm oil in Malaysia for EU biofuels, 2010.

A minimal amount of cropland used for palm oil production in Malaysia was used for the production of feedstock for EU biofuels in 2010, namely 0.3%. It is interesting to see that palm oil production takes up half of the land used for crops in Malaysia.

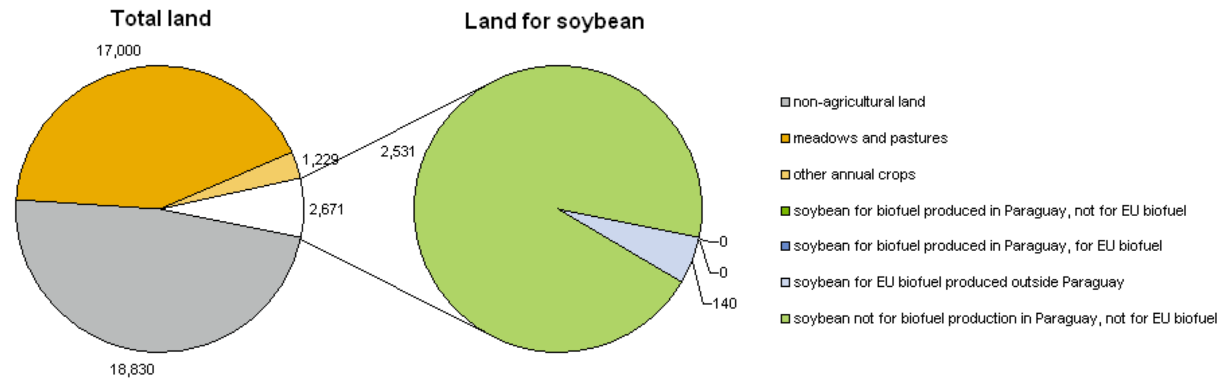


Figure 112. Land used for soybean in Paraguay for EU biofuels, 2010.

5% of the land used for soybean production in Paraguay was used for the production of the 2010 EU biofuels.

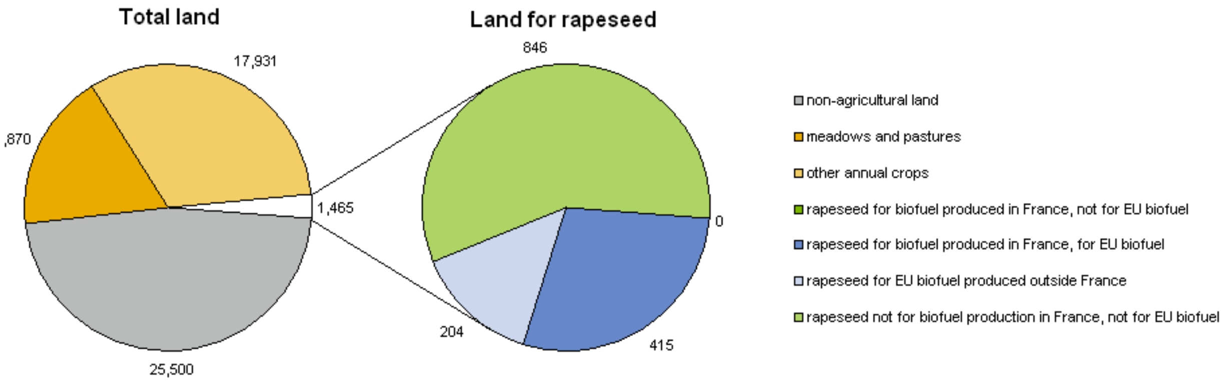


Figure 113. Land used for rapeseed in France for EU biofuels, 2010.

A considerable part of the land used for rapeseed production in France was used for the production of EU biofuels, namely over 40%. The land used for rapeseed prodcution is not a large part of the total land used for crop production in France (7.5%).

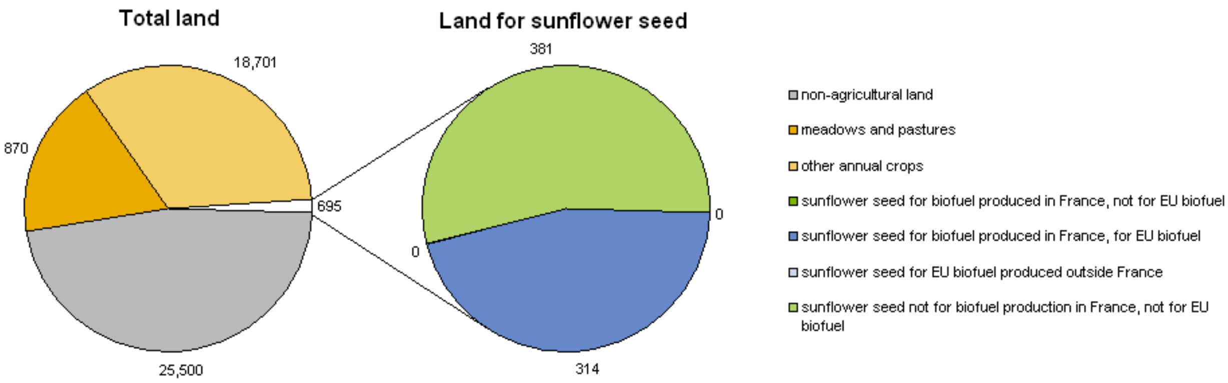


Figure 114. Land used for sunflower in France for EU biofuels, 2010.

Almost half of the land used for sunflower production was used for the production of EU biofuel feedstock in 2010. Sunflower production is a small part of the agricultural land use in France. All sunflower used for EU biofuel production was converted in France to biofuels.

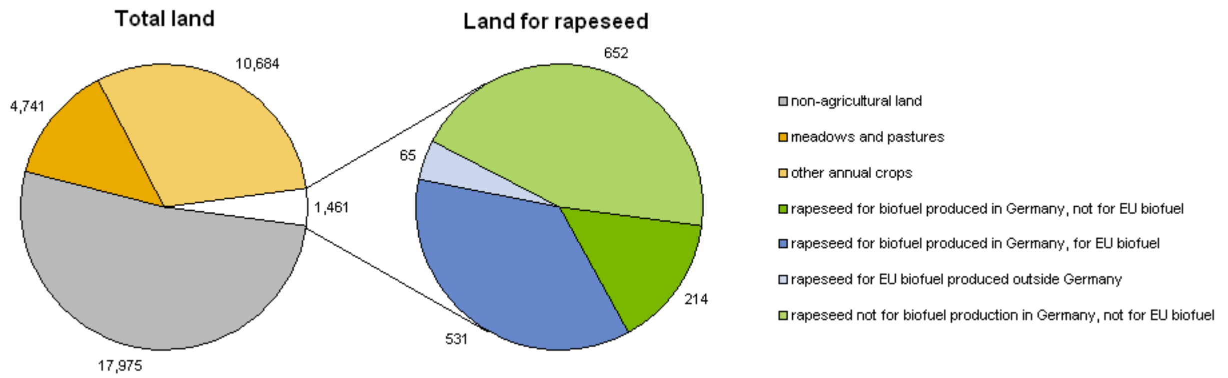


Figure 115. Land used for rapeseed in Germany for EU biofuels, 2010.

40% of the land used for rapeseed in Germany was used for the production of EU biofuel feedstock.

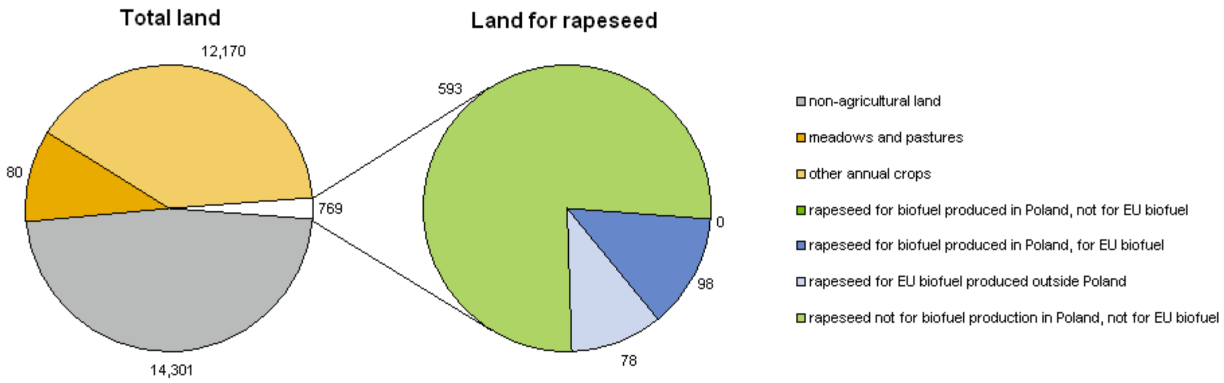


Figure 116. Land used for rapeseed in Poland for EU biofuels, 2010.

About a quarter of the land used for the production of rapeseed was used for EU biofuel production in 2010.

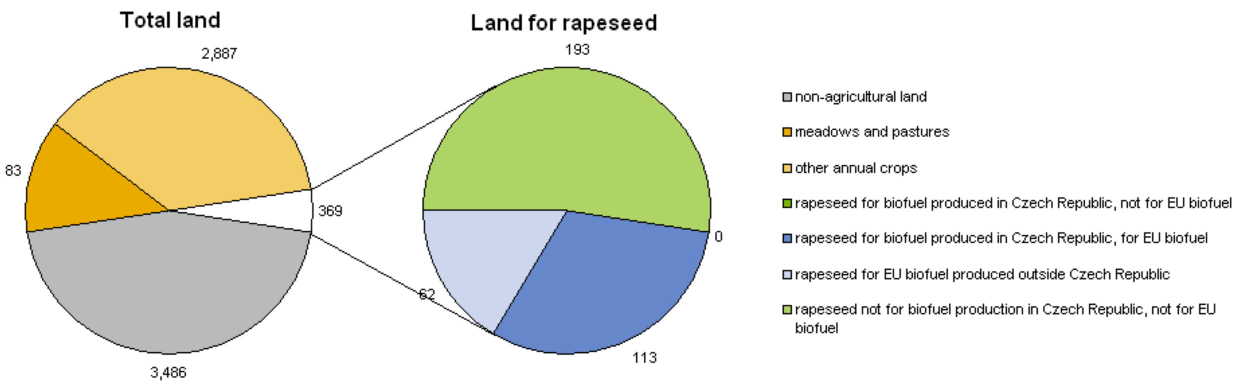


Figure 117. Land used for rapeseed in Czech Republic for EU biofuels, 2010.

Around 47% of the land used for rapeseed production in the Czech republic was used for EU biofuel produtcion.

Overview

Results for all feedstock crops in all countries are given in Table 48. The total land use worldwide, to produce the feedstock for EU-consumed biofuels in 2010, is estimated to be about 5.7 Mha. Of this, 3.2 Mha (57%) is within the EU and 2.4 Mha (43%) resides outside the EU.

This is considerable larger than the additional land-use as calculated through back-casting analysis above. The difference resides in the methodology of allocation. Here, the allocation principles of the EU Renewable Energy Directive (allocation by energy value) have been applied, which do not represent the nutritional or economic value of co-products. Co-produced electricity is not appreciated at all. A true valuation of co-products would result in a significantly lower figure.

Table 48. Land use per country for countries that supply feedstock to EU biofuels (kha).

		Total	To EU biofuels
Argentina	Total land	273,669	
	Total cropland	32,000	
	Soybean	18,131	868
	Sugar cane	355	2
	Maize	2,903	1
Brazil	Total land	845,942	
	Total cropland	68,500	
	Soybean	23,293	300
	Sugar cane	9,081	74
	Maize	12,815	5
Indonesia	Total land	181,157	
	Total cropland	42,600	
	Palm oil	5,000	57
USA	Total land	914,742	
	Total cropland	165,451	
	Soybean	31,006	160
	Maize	32,960	33
	Rapeseed	580	7
	Wheat	19,278	2
Canada	Total land	909,351	
	Total cropland	52,150	
	Rapeseed	6,514	207
	Soybean	1,477	32
Ukraine	Total land	57,932	
	Total cropland	33,376	
	Rapeseed	863	263
	Soybean	1,037	19
	Maize	2,648	4
	Wheat	6,284	7
	Sugar beet	492	1
Malaysia	Total land	32,855	
	Total cropland	7,585	
	Palm oil	4,002	12
Paraguay	Total land	39,730	
	Total cropland	3,900	
	Soybean	2,671	140

	Rapeseed	62	4
Russia	Total land	1,637,687	
	Total cropland	123,541	
	Rapeseed	607	129
	Soybean	1,036	80
Peru	Total land	128,000	
	Total cropland	4,440	
	Sugar cane	77	5
Switzerland	Total land	4,000	
	Total cropland	430	
	Wheat	91	14
France	Total land	54,766	
	Total cropland	19,396	
	Rapeseed	1,465	619
	Sunflower seed	695	314
	Sugar beet	383	60
	Wheat	5,426	101
	Maize	1,571	28
	Soybean	51	18
	Barley	1,582	5
Germany	Total land	34,861	
	Total cropland	12,145	
	Rapeseed	1,461	595
	Sugar beet	367	21
	Wheat	3,298	30
	Maize	464	9
	Barley	1,653	12
United Kingdom	Total land	24,193	
	Total cropland	6,092	
	Sugar beet	92	44
	Rapeseed	653	81
	Wheat	1,937	3
Poland	Total land	30,420	
	Total cropland	12,939	
	Rapeseed	769	176
	Maize	299	22
	Wheat	2,406	22
Czech Republic	Total land	7,725	
	Total cropland	3,256	
	Rapeseed	369	176
	Sugar beet	56	9
	Wheat	834	17
	Maize	105	2
Hungary	Total land	9,053	
	Total cropland	4,779	
	Rapeseed	259	159
	Maize	1,061	23
	Sugar beet	14	5
	Wheat	1,011	2
Belgium	Total land	3,028	
	Total cropland	862	
	Wheat	210	23
	Rapeseed	11	2
Netherlands	Total land	3,373	
	Total cropland	1,090	
	Rapeseed	3	3
Sweden	Total land	41,034	
	Total cropland	2,643	
	Wheat	404	56
	Rapeseed	109	64
	Barley	309	1
Spain	Total land	49,880	

	Total cropland	17,216	
	Maize	320	8
	Wheat	1,907	27
	Sunflower seed	698	32
	Barley	2,877	23
	Rapeseed	20	11
Slovakia	Total land	4,809	
	Total cropland	1,406	
	Rapeseed	164	147
	Maize	174	26
	Wheat	350	2
Austria	Total land	8,244	
	Total cropland	1,437	
	Rapeseed	54	30
	Wheat	303	18
	Maize	180	4
	Sugar beet	45	1
	Barley	350	3
Italy	Total land	29,414	
	Total cropland	9,485	
	Soybean	160	28
	Sugar beet	63	7
	Rapeseed	20	12
	Sunflower seed	101	2
Romania	Total land	23,006	
	Total cropland	9,151	
	Rapeseed	527	134
	Maize	2,094	3
	Wheat	2,153	4
	Soybean	63	2
Total			**5,650**

Concluding remarks

In most of the non- EU countries, the land dedicated to the production of feedstock for EU biofuels is minimal (less then 5%). The crops usually have another main 'purpose' for which it is produced.

Within the EU, several countries used a relatively large percentage of the land used for the total crop for the EU biofuel feedstock, like France, Germany, Czech Republic and Poland. The production of biofuels is a considerable stimulus for the agricultural production sectors of rapeseed and sunflower.

4.3 Land use developments

Land cover change

Land cover and land use data are derived from remote sensing images and verified with ground survey data to assure accurate representation of the land categories. The terms **land cover** and **land use** are easily and often confused; land cover is defined as "*the observed (bio)physical cover on the earth's surface*", while land use is "*characterized by the arrangements, activities and inputs people undertake in a certain land cover type to* *produce, change or maintain it*" [Di Gregorio and Jansen 2000[35]]). For example, forest, grassland, wetland and savannah are common categories for land cover, while agricultural land, forest preserve/conservation area and mining area are common examples of land use categories. Changes in land cover and land use category over a certain period can bring better understanding of land cover and land use dynamics.

To identify the land cover changes for the main third countries of supply and the EU 'main' countries[36] we used MODerate Resolution Imaging Spectroradiometer (MODIS) Global Land Cover Type datasets (MODIS). At the global scale, changes in land use cannot be quantified, however the closest land cover classes to the ones defined in the RES Directive (forests, grassland, cropland) are used to make observations about the magnitude of change which may be attributed to agriculture in general; i.e. at this scale "cropland" refers to any region that is likely associated with agriculture and is not specific to the type of crop.

The first part of this section presents the results of the analysis of land cover change between 2008 and 2010 using the MODIS data to illustrate our default approach to estimating land cover change globally. The second part of this section presents the results of an analysis of sugarcane expansion in South -Central Brazil as an illustration of a more detailed approach which in general is beyond the resources of the current work. Details on the datasets, methods and overall results are given in Appendix V.

Default approach for estimating land cover change

The area and type of change in land cover was calculated using the 2008 baseline data and 2009 MODIS land cover product.

Transitions showing expansion of cropland and grassland are the most relevant to the RES Directive because some of the area expansion might be linked to demand for biofuels in the EU. Using the default approach to examine land cover transitions between the baseline year (2008) and 2010, it was found that the **grassland** land cover category showed the **lowest persistence**, most commonly expanding on cropland and savannah/shrubland land cover category (Figure 151 and Figure 154 in Appendix V). **Cropland** persistence was **high** for Ukraine, Canada, Russia and the US (Figure 151 and Figure 154 in Appendix V).

The **grassland** category showed the greatest fluctuation between the baseline year (2008) and 2010. Grassland persistence identifies areas that stayed in grassland between 2008 and 2010. The percent area grassland persistence and gains from other land cover categories for non-EU countries is shown in Figure 151. From all non-EU countries, Peru showed the highest grassland persistence (90%), followed by the

[35] Di Gregorio, A. and Jansen, L., 2000, Land cover classification system, classification concepts and user manual, Food and Agriculture Organisation of the United Nations:Rome.

[36] Argentina, Brazil, Canada, Indonesia, Malaysia, Peru, Russia, Ukraine, United States, Paraguay, Czech Republic, France, Germany, Italy, Poland, Spain and United Kingdom

United States (86%), Russia (66%) and Ukraine (64%), with Malaysia showing the least grassland persistence (26%). In Malaysia the grassland in 2010 gained mostly from forest (29%) and mosaic (21%) category, followed by savannah/shrub and cropland category with 10%, each. Additionally, the grassland in 2010 expanded mostly on cropland for Ukraine (24%), and on savannah/ shrub for Argentina, Brazil, Canada and Indonesia, with 27%, 25%, 23% and 27%, respectively.

The percent area grassland persistence and gains from other land cover categories for the EU countries is shown in **Figure 154 in Appendix V**). .For the EU 'main' countries, the United Kingdom showed the highest grassland persistence (77%), while the grassland persistence for the other EU countries was below 50%, with Poland showing the least persistence (30%). The major expansion of grassland went on cropland and savannah/ shrub land cover category for France, Italy and Spain. In Poland and Germany, the major gain of grassland for 2010 came from mosaic (37% and 34%, respectively) and cropland (26% and 24%, respectively). Additionally, the majority of grassland in 2010 for Italy and France came from cropland (26% and 21%, respectively). In Spain, the majority of the grassland came from the savannah/shrub category (26%), followed by cropland (24%).

Table 49 shows the same data as reported in Figure 151 and Figure 154 (Appendix V) but shows the areas of grassland persistence and grassland gain from other categories at the national level between 2008 and 2010. Areas in persistence are reported in bolded blue and areas of gain from other categories are reported in black.

Table 49. Area of grassland persistence and area of grassland gain from other categories between the baseline (2008) and 2010. Areas are reported in 1,000 hectares.

Country	Grassland Persistence	Area grassland gain from						Total grassland in 2010
		Cropland	Forest	Mosaic	Savanna/ Shrub	Urban	Wetland	
	x 1,000 ha							
Non- EU countries								
Argentina	20,753	4,913	1,286	2,521	10,995	-	365	40,834
Brazil	10,237	1,991	139	1,319	4,568	-	48	18,303
Canada	19,985	3,576	940	159	7,232	-	98	31,990
Indonesia	112	32	36	49	87	-	8	324
Malaysia	7	3	8	6	3	-	1	28
Paraguay	1,150	204	98	624	1,265	-	159	3,500
Peru	19,405	57	155	131	1,888	-	3	21,639
Russia	37,644	5,661	1,794	936	10,586	-	71	56,692
Ukraine	219	82	3	6	29	-	0.3	340
US	194,609	9,827	1,086	2,009	14,802	-	36	222,368
EU 'main' countries								
Czech Republic	10	2	2	7	1	-	0.02	22
France	245	107	32	47	75	-	0.02	504
Germany	120	81	18	117	8	-	0.1	344
Italy	262	158	53	34	110	-	-	616
Poland	10	9	1	12	1	-	0.0	33
Spain	870	440	3	42	479	-	0.1	1,833
UK	5,680	965	331	358	76	-	1	7,410

Cropland category showed high persistence for both, non-EU and EU 'main' countries. From the non-EU countries, Ukraine (96%), Canada (93%), Russia (88%) and the US (86%) showed the highest cropland persistence for the period between baseline year (2008) and 2010, while Peru (22%) and Malaysia (36%) showed the lowest cropland persistence (Figure 152). In Peru, cropland expanded mainly on savannah/shrub (27%), grassland (26%) and mosaic land cover category (21%). In Malaysia, the cropland in 2010 gained mostly from mosaic (38%) and forest (18%). The MODIS land cover data does not reflect management practices for cropland. Therefore, large crop fields used in the mechanized agriculture are more easily identifiable on the satellite images (in case of Ukraine, Canada, Russia and the US), than the predominant small agriculture scale and shifting cultivation practices in Peru, Paraguay and Malaysia. Additionally, the MODIS land cover data do not distinguish between oil palm plantations and natural forest cover or between different stages of oil palm cultivation, therefore transitions to (1) cropland from mosaic land cover category and forest can be observed (in case of Malaysia) as well as (2) cropland from savannah/shrub and mosaic land cover category (in case of Brazil and Indonesia). Cropland category requires ground based or statistical observations, so it is necessary to further verify these findings with trade statistics to draw conclusions relevant to the impact of biofuels/bioenergy (see section 'Land displacement').

From the EU 'Main' countries France (93%), Poland (90%) and the UK (90%) showed the highest cropland persistence for the period between baseline year (2008) and 2010, while Spain (81%) showed the lowest cropland persistence (Figure 155). For most of the countries, the cropland gain in 2010 comes from the mosaic land cover category, except for Spain where it comes from savannah/ shrub (13%) and for the UK, where it comes from grassland (5%).

Table 50 shows the same data as reported in Figure 152 and Figure 155 but shows the areas of cropland persistence and transition from other categories at the national level between 2008 and 2010. Areas in persistence are reported in bolded blue and areas of transition from other categories are reported in black.

Table 50. Area of cropland persistence and area gain from other categories between the baseline (2008) and 2010. Areas are reported in 1,000 hectares.

Country	Cropland persistence	Area cropland gain from						Total cropland in 2010
		Forest	Grassland	Mosaic	Savanna/ Shrub	Urban	Wetland	
	x 1,000 ha							
Non-EU countries								
Argentina	38,191	200	2,973	2,649	1,321	-	97	45,431
Brazil	17,303	146	552	3,804	5,505	-	58	27,367
Canada	41,651	139	1,013	1,867	126	-	12	44,808
Indonesia	2,661	492	31	1,365	257	-	162	4,968
Malaysia	105	53	3	111	12	-	7	292
Paraguay	1,940	45	76	464	458	-	1	2,984
Peru	81	11	95	77	96	-	4	363
Russia	129,388	1,040	5,324	9,204	1,139	-	41	146,136
Ukraine	41,556	14	207	1,536	137	-	2	43,452
US	119,116	174	8,707	8,422	1,734	-	20	138,173
EU 'Main' countries								
Czech Republic	2,754	8	25	545	8	-	0.0	3,340
France	28,309	14	75	1,648	280	-	0.2	30,325
Germany	12,387	38	76	1,847	57	-	0.2	14,405
Italy	10,565	17	218	904	483	-	0.1	12,188
Poland	14,297	18	20	1,513	23	-	0.1	15,871
Spain	13,528	6	456	468	2,211	-	0.1	16,669
UK	7,608	40	381	310	75	-	0.3	8,415

Both, gains and losses, are important to understand the dynamics for the cropland category. Estimating the net change (gains - losses) per land category paints a better picture from what land cover category the cropland gained (in case of cropland increase in 2010), or to what category the cropland lost area (in case of cropland decrease in 2010) during the analyzed period . Table 51 reports the area of cropland net change (gains - losses) at national level for the selected countries. The positive values indicate gain of cropland from a particular category, while negative values indicate loss of cropland to a particular category. For example, the USA experienced decrease in total cropland areas with large part of this decrease accounted to conversion of cropland to grassland (1,120 thousand ha), followed by savannah/shrubland (266 thousand ha), forest (170 thousand ha) and wetland (52 thousand ha). During this period cropland in the USA gained 198 thousand ha of the mosaic category.

Table 51. Area cropland net changes of other land cover categories (2008-2010). Area of change is presented in thousands of hectares. Positive values show gain of cropland from a land cover category and negative values show loss of cropland to a land cover category.

Country	Cropland 'Net changes' of other categories					
	Forest	Grassland	Mosaic	Savanna/ shrub	Urban	Wetland
	x 1,000 ha					
Non-EU countries						
Argentina	34	-1,939	720	325	-	87
Brazil	-85	-1,439	-1,313	-4,541	-	-24
Canada	-456	-2,563	-185	-111	-	-26
Indonesia	235	-2	169	-191	-	96
Malaysia	14	-	3	-1	-	-1
Paraguay	13	-128	245	29	-	-
Peru	-2	38	28	38	-	-
Russia	-206	-338	-2,327	-353	-	-
Ukraine	-7	124	491	-16	-	-
United States	-170	-1,120	198	-266	-	-52
EU 'main' countries						
Czech Republic	1	22	467	2	-	-
France	-48	-32	664	83	-	-
Germany	-36	-4	925	3	-	-
Italy	-34	60	475	-116	-	-
Poland	-103	12	981	-52	-	-
Spain	-22	16	119	834	-	-
United Kingdom	-2	-583	74	-11	-	-

More details on the land cover change analysis, including details on absolute amount of hectares of area of change for all land cover categories can be found in Appendix V

Detailed approach for monitoring biofuel crop expansion

Since there are several limitations on the default approach for land cover change monitoring. Specific cropland data (e.g. land cultivated for sugarcane, soybean, maize, etc.) can be derived and monitored when medium (30 m) to high (<30m) resolution satellite images coupled with agriculture survey and field collected data for verification are used. This approach allows evaluating direct land use changes due to expansion of specific crop in more précised manner and presenting potential of linking the specific crop expansion to the EU biofuel demand if appropriate statistics are available.

The 'detailed' approach demonstrates that the current stage of science and technology, biofuels cultivated area could be monitored at country scale. Combining the area of biofuel crop cultivation and sufficient statistics can present an approach for monitoring the biofuel crop expansion due to the biofuel demand in the EU.

Land displacement

The displacement of current land use to produce biofuels can generate more intense land use elsewhere (Turner et al. 2007). Success of quantifying the displaced land in the non-EU and the EU 'main' countries due to biofuel feedstock demand depends on the details of the data available (e.g. spatial representation of land use and feedstock demand information) as well as the assumptions made. To meet the EU demand of biofuel a certain amount of feedstock is needed. According to Gnansounou et al. 2008 [37] "these feedstock quantities can be obtained by: a)biomass use substitution, b) crop area expansion, c) yield increment in the same land, and d) shorten the rotation length." Considering the 'crop area expansion' derived from the MODIS land cover data and the demand of the crop area that accounts for the biofuel consumed in the EU, we investigated whether it is appropriate to quantify the land displacement based on the EU biofuel consumption between 2008 and 2010 trade statistics.

Table 52 reports the area cropland for the baseline year (2008) and 2010 derived from FAOStat (presented also in Section 'quantification of land use' in 4.2) and the percent change of the initial cropland are compared to the area of cropland derived from MODIS land cover change analysis. Although both sources report different total cropland area per country for 2008 and 2010, the magnitude of the change, calculated as percent change of the initial cropland area (in 2008), for Argentina (-3% from the trade statistics vs. -2% from MODIS land cover change analysis) and the USA (-1% for both trade statistics and MODIS analysis) is similar. For the rest of the reported countries, the percent changes in cropland differ largely (in the case of Peru- 0% according to trade statistics vs. 40% according to MODIS derived data, and of Brazil – 0% according to trade statistics vs. -21% according MODIS derived data).

[37] Gnacsounou E., Panichelli, L., Dauriat, A., Vlleges, JD. 2008. Accounting for indirect land-use changes in GHG balances of biofuels:Review of current approaches. Working paper REF.437.101 (available online at http://www.eac-quality.net/fileadmin/eac_quality/user_documents/3_pdf/Accounting_for_ILUC_in_GHG_balances_of_biofuels.pdf)

Table 52. Comparison of the total cropland for the baseline year (2008) and 2010 derived from FAO statistics and MODIS land cover data for selective countries.

Country	FAO data			MODIS derived statistics		
	Total Cropland (*x 1,000 ha*)		Percent change of the initial cropland area	Total Cropland (*x 1,000 ha*)		Percent change of the initial cropland area
	2008	2010		2008	2010	
Argentina	33,000	32,000	-3%	46,426	45,431	-2%
Brazil	68,700	68,500	0%	34,768	27,367	-21%
Indonesia	41,000	42,600	4%	4,660	4,968	7%
USA	166,361	165,451	-1%	139,582	138,173	-1%
Canada	52,150	52,150	0%	48,149	44,808	-7%
Ukraine	33,374	33,376	0%	42,859	43,453	1%
Malaysia	7,585	7,585	0%	277	292	5%
Peru	4,430	4,440	0%	260	363	40%

The difference in methods of deriving these statistics explains the large difference of percent change shown in Table 52. The FAO data are derived from country reports to FAO, which are collected from each country and defer by methods of collection, ranging from precise agriculture census to estimation or repeatedly reporting the same amount of cropland for multiple years. Additionally, the cropland area reported by FAO includes cultivated and non-cultivated cropland, tiled land, harvested and land left for fellow, orchard or other crop tree land, based on the country's cropland definition. On the other hand, the MODIS data classify the cropland based (bio)physical characteristics of the observed land, therefore cropland that has been tiled and prepared for the next plantation season, might be classified as barren land, or land left for fellow might be classified as grassland, savannah/shrub or mosaic land category, depending on the stage of the fellow process. Given the different nature of collecting cropland information, the total cropland derived from FAO and MODIS data are not directly comparable and the link between the 'crop area expansion' derived from the MODIS land cover data and the demand of the crop area that accounts for the biofuel consumed in the EU is not easily established.

The sugarcane data provided by Adami et al. 2012 team combined with the land cover data for 2003 provide better understanding of the direct land use change dynamics in South-central region of Brazil. The data for South-central region show that about 65% of the sugarcane expansion came from pasture and 31% came from already cultivated agriculture land. As Adami et al. 2012 suggest some of the pasture land converted to sugarcane land could have been converted firstly to agriculture land. This gradually conversion to sugarcane is common management practice for improving the physic-chemical soil characteristics of the degraded pasture land.

4.4 Environmental impacts

This section attempts to provide an understanding of how changes in policy 2008-2010 changed the possible environmental impacts. In this section the following items are analysed:

- GHG emissions reductions;
- Biodiversity;
- Identification of areas of high conservation value;
- Impacts on water;
- Impacts on air;
- Impacts on soil.

GHG analysis

As indicated in Article 23.4 the GHG emissions savings will be evaluated based on the reported values by the MS. The reported values are presented in the following section. The section after estimates total EU GHG emission savings based on a calculation. A comparison between the two values is presented as closing part of this section.

GHG savings from MS reports

Greenhouse gas emission savings resulting from the domestic consumption of biofuels have been reported by the Member States, and summarised in Table 53. The total reported greenhouse gas emission reductions for 2010 as indicated in the MS reports is 25.5 Mton CO_2 equivalent.

Table 53. GHG emission reductions (in ton CO_2- equivalents, unless other unit is given).

Member State	2009	2010
Austria	No data	No data
Belgium	657,062	1,014,620
Bulgaria	11,857	24,443
Cyprus	18,376	20,656
Czech Republic		
Denmark	No data	No data
Estonia	Not calculated	Not calculated
Finland	300,000	300,000
France	6,270,000	5,920,000
Germany	5,000,000	5,000,000
Greece	175,000	276,000
Hungary	271,817	282,743
Ireland	216,650	259,020
Italy	1,628,944	1,977,833
Latvia	25,716	54,867
Lithuania	37,850	33,610
Luxemburg		141,000
Malta	1,674	1,391
Netherlands	730	518
Poland	2,323,037	3,112,589
Portugal	416	609
Romania	Not calculated	Not calculated
Slovakia	189,000	252,000
Slovenia	107,000	154,100
Spain	3,579,784	4,785,755
Sweden	800	900
UK	1,823,690	1,917,385
Total reported emission reductions (ton CO2)	**22,639,403**	**25,530,039**

Estimated GHG savings without land-use change

The greenhouse gas (GHG) emissions of the main biofuels supplied to the EU market in 2010 are calculated and disaggregated per feedstock and main production region. Through this an estimate of the GHG savings of the biofuel mix in 2010 can be made. The feedstock composition and country of origin are taken from the analysis done in Chapter 2.

Using the data in first four columns of Table 54 an estimate of the GHG emissions of the biofuels supplied to the EU market in 2010 can be made. This estimate makes use of the 'Typical' values presented in the Renewable Energy Directive[38]. The typical values were adjusted where it was clear that their use was not appropriate. This resulted in the GHG emission value for waste oil produced in the United States being updated from 10 gCO_2/MJ to 13 gCO_2/MJ (transport emissions were increased to take into account the shipping of the waste oil).

[38] Annex V of the Renewable Energy Directive provides 'Typical' values for a wide range of biofuels (disaggregated by Cultivation, Processing, Transport & Distribution GHG emissions).

The Renewable Energy Directive does not list typical values for both barley to ethanol and other grains. For these biofuel supply chains the conservative values provided in the UK Renewable Transport Fuel Obligation[39] were used. Typical values for supply chain emissions were estimated as being 23% lower than these (conservative) values[40]. It should be noted that the RTFO values are not completely in line with RED methodology. For the category of 'residues' as feedstock for ethanol the same value as wheat straw to ethanol is taken (11 gCO_2/MJ). For cassava no value is presented in the Renewable Energy Directive nor in the RTFO, therefore an average based on literature [FAO 2010] is taken of 40 gCO_2/MJ.

The Directive provides a range of typical values for both wheat to ethanol and palm oil to biodiesel. These take into account the different 'Processing' emissions resulting from the use of different process fuels or method. For these feedstocks an estimate of the relative split of each process type was made[41]. The process split for wheat used was: Natural gas as process fuel in conventional boiler – 75%, Natural gas as process fuel in CHP[42] – 20%, Straw as process fuel in CHP – 5%, Lignite as process fuel in CHP - 0% (expert assumption since exact split is unknown).
The process split used for palm oil used was: process not specified - 50%, with methane capture at the mill – 50% (expert assumption since exact split is unknown).

The table below indicates how the GHG contribution for each biofuel type will be estimated (i.e. using the typical GHG emissions and the % contribution of that biofuel supplied). This then enables the GHG savings for the total biofuels supplied to the EU market in 2010 to be estimated.

[39] UK Renewable Fuels Agency (2010), Annex G, Page 144: Refer to: http://www.renewablefuelsagency.gov.uk/sites/rfa/files/RFA_C_and_S_TG_%20Part_One_v3_2.pdf

[40] This estimate was based on the difference between the 'Typical' and 'Default' GHG emissions for a selection of biofuel supply chains specified in the RED.

[41] The estimate of the splits was based on Ecofys' expert insight. No data on actual split over the various techniques has been found. 'Overestimation' by assuming 5% of the palm oil production with methane capture and 'underestimating' by assuming no use of lignite (plants in East Germany used to use this) do not influence the results considerably.

[42] Combined Heat and Power

Table 54. Production data and GHG emissions[43] of ethanol and biodiesel supplied to the EU market in 2010, disaggregated by feedstock type and country of origin.

Feedstock	Country of origin	Biofuel supplied to EU market in 2010 (ktonne)	% of total biofuel supplied to EU market in 2010	Typical GHG emissions (g_{CO2e}/MJ_{fuel})	Weighted typical GHG contribution (g_{CO2e}/MJ_{fuel})
Biodiesel					
Rapeseed	EU	4604	41.3%	46	14.09
	Others	734	6.6%	46	2.25
Soybeans	EU	97	0.9%	50	0.32
	Others	2397	21.5%	50	7.97
Palm Oil	EU	5	0.0%	43	0.02
	Others	1167	10.5%	43	3.34
Sunflower	All	499	4.5%	35	1.16
Waste oils	EU	1507	13.5%	10	1.00
	Others	135	1.2%	13	0.12
Ethanol					
Wheat	EU	922	23.7%	44	2.67
	Others	66	1.7%	44	0.19
Maize	EU	546	14.1%	37	1.34
	Others	232	6.0%	51	0.78
Barley	EU	92	2.4%	64	0.39
Other grains	EU	161	4.1%	64	0.68
Sugar beet	EU	1,167	30.1%	33	2.56
Sugar cane	EU	0	0.0%	24	0.00
	Others	534	13.7%	24	0.85
Residues	All	160	4.1%	11	0.11
Cassava	All	3	0.1%	40	0.01
	Total	15,028	100%		
	GHG saving				39,88 gCO2e/MJ
					or 52.41%

From the data & results presented in Table 54, the total amount of GHG emissions reductions related to the biofuel consumption in 2010 can be estimated. The results are presented in Table 55. Emissions related to indirect land use change are not included in these values.

[43] Not including emissions from land use change.

Table 55. Overview of total GHG savings[44] related to EU biofuel consumption 2010.

	Total production 2010 (ktonne)	Total production 2010 (GJ)	Weighted typical GHG contribution (g_{CO2e}/MJ_{fuel})	Fossil fuel comparator (g_{CO2e}/MJ_{fuel})	GHG savings (Mtonne CO_{2e})
Bioethanol	3,883	98,265,870	37.2	83.8	4.6
Biodiesel	11,145	415,712,024	40.8	83.8	17.9
Total biofuels	15,028	513,977,893	39.9	83.8	22.6

The total savings related to biofuel consumption are estimated to amount 22.6 Mtonnes CO_{2e}, indicating a saving of 53% compared to the situation where only fossil fuel would be used.

Concluding remarks GHG savings

The emission savings as reported by the MS is 25.5 Mton CO2. The calculated emissions savings based on the types of feedstock and default emission values is 22.6. It would however be expected that the by MS reported savings would be lower then the calculated, since not all MS reported their savings.
It is unsure why these values would differ. Explanations could be rougher estimations by the Member States (e.g. using average value for biodiesel and bioethanol but not specifying more), more insight in the specific chains (if reported by entities within the MS this might give more details on variations compared to default values) or other uncertainties in the origin of the biofuels consumed in a member state.

Impacts on biodiversity

The assessment on biodiversity falls into two sections, namely:

1. Assessment of impacts on biodiversity caused by 2010 EU biofuels consumption;
2. Assessment if the current definitions as provided in Article 17 (3) in the Renewable Energy Direct are sufficient in covering the areas of high conservation value, which should be excluded from biofuel production.

To assess the impacts on biodiversity, the following methodology is followed.

The text of the 2009 Renewable Energy Directive (RED) specifies the criteria of concern for the biodiversity dimensions of sustainable sourcing of biofuels and their feedstocks. Those criteria are given mainly in Articles 17.3 and 17.4, although relevant references to biodiversity also are found elsewhere in the document. The biodiversity sustainability indicators adopted for this analysis combine land cover change and protected area coverage information to more closely and comprehensively reflect the biodiversity sustainability criteria given in the 2009 RED than the biodiversity indicators that were used in the Biofuels Baseline 2008 report (Ecofys, 2011). To measure changes from 2008 to 2010 in indicators for the biodiversity sustainability criteria given in the 2009 RED, land cover baseline information on the four categories

[44] Not including emissions from land use change.

of natural ecosystems detected by MODIS – forests, savannah/shrublands, grasslands, and wetlands – from the 2008 Biofuels Baseline[45] was compared against 2010 land cover, and changes in land cover categories were analyzed.

Table 56. Biodiversity Criteria from 2009 RED and Biofuels Sustainability Indicators.

2009 RED Biodiversity Criteria (Directive 2009/28/EC)	2008 Biofuels Baseline Biodiversity Indicator (Ecofys 2011)	2010 Biofuels Sustainability Assessment Biodiversity Indicator
Article 17.3.a. No production from converted native forest	• % forest cover by country	• Forest change 2008-2010 • Forest area converted to cropland 2008-2010 • % of forest ecosystems protected in PA system
Article 17.3.b.i. No production from protected areas designated by relevant competent national authorities	• Protected areas established • Percent of national land area within PA designation • Dedicated PA oversight institution named • Management plans exist for some PAs	• Protected area system established
Article 17.3.b.ii. No production from areas designated by international agreements or intergovernmental organizations	• CBD signatory • CBD report within past 5 years	• CBD member • CBD national report
Article 17.3.c.i. No production from conversion of natural grasslands	• % grassland cover by country, including % savannah/shrub in some countries (e.g. Brazil)	• Grassland change 2008-2010 • Grassland area converted to cropland 2008-2010 • % of grassland ecosystems protected in PA system
Article 17.3.c.ii. No production from conversion of anthropogenic grasslands	• % grassland cover by country	• Grassland change 2008-2010 • Grassland area converted to cropland 2008-2010 • % of grassland ecosystems protected in PA system
Article 17.4.a. No production from conversion of wetlands	• % wetland cover by country	• Wetland change 2008-2010 • Wetland area converted to cropland 2008-2010 • % of wetland ecosystems protected in PA system
Article 17.4.b.& c. No production from conversion of forested or wooded lands with more than 10% tree canopy cover	• % forested and wooded lands cover by country	• Savannah/shrubland change 2008-2010 • Savannah/shrubland area converted to cropland 2008-2010 • % of savannah/shrubland ecosystems protected in PA system

[45] Ecofys, 2011, pp. 97-98, Figs. 26 & 27; and Appendix J, pp. 482 and Fig. 177

New biodiversity sustainability and risk indicators used in this analysis are:

1. Change in area of the four categories of natural ecosystems detected by MODIS between 2008 and 2010;
2. Area of each of those natural ecosystems lost/converted to cropland in a given country between 2008 and 2010; and
3. Percentage of each of those natural ecosystems in the protected area system of a given country.

Focusing on loss of natural ecosystems as a proxy for unwanted biodiversity impacts follows the RED criteria of Articles 17.3 and 17.4 by emphasizing types of land to protect (natural biodiverse grasslands, primary forests, etc.) in order to maintain biodiversity. Because high-quality land cover data is available through satellite imagery, loss and conversion of natural ecosystems is much easier and cheaper to assess than conducting on-the-ground biodiversity surveys for multiple taxa of plants and animals. Assessing the loss of biodiverse, natural ecosystems in main biofuel feedstock-producing countries through satellite imagery is not a perfect tool for estimating biodiversity impacts, but it is the most feasible tool that can be used on a global scale to assess the most important threat to biodiversity – habitat conversion for agricultural production.

The area of natural ecosystems converted to cropland between 2008-2010 according to analysis of MODIS land cover data are shown in Table 79 (Appendix V) for all relevant production countries of EU biofuel feedstock 2010. When any natural ecosystem is converted to cropland, biodiversity is drastically reduced. An unknown fraction of this land conversion may be attributable to production of biofuel feedstock crops. Provided the chain of custody and sustainability provisions of the 2009 RED proscription against such conversion are being fully implemented, this should not be occurring to feedstocks for biofuels imported to the EU. However, feedstocks for biofuels imported to the EU could still be causing a part of the expansion of that feedstock in a specific country indirectly. It should be noted that the area of a natural ecosystem converted to cropland does not necessarily match the area of change in cropland over a given time period. For example, total cropland in Brazil and in the USA has decreased in the time period considered (see Table 79, Appendix V) of the land-use section). However, an area of natural grassland could be converted to cropland in a given year, while an even larger area of cropland could have been put in fallow. Even though MODIS may interpret the fallowed land as something other than cropland, it would not have been restored to a natural, biodiverse state. Thus, cropland change over a given period of time may not necessarily reflect conversion of natural ecosystems over that same period of time.

The results of the land cover change analysis will be combined with the amount of ecosystems in protected areas.

Table 58 and Table 57 below give the percentage of each ecosystem included in the country's protected area system as of 2010. According to current CBD guidelines (all countries on these lists except USA are Parties to the CBD), at least 10% of each ecosystem type should be protected (UNEP-WCMC, 2009a, p4); see also UNEP-WCMC, 2009b, 2011). The thinking about this somewhat arbitrary level of ecosystem protection is that even if 90% is lost/converted, the biodiversity of that ecosystem type should mostly be conserved in the 10% that is protected.

Table 57.Percentage of Ecosystem in Protected Areas in 2010, EU "main" Countries.

Land cover category / Country	Forest	Savanna/Shrubland	Grassland	Wetland
	%			
Czech Republic	25%	11%	26%	30%
France	31%	26%	51%	31%
Germany	64%	36%	35%	77%
Italy	18%	12%	24%	28%
Poland	2%	1%	15%	8%
Spain	11%	7%	4%	17%
UK	Not available	Not available	Not available	Not available

Table 58. Percentage of Ecosystem in Protected Areas in 2010, Non-EU Countries.

Land cover category / Country	Forest	Savanna/Shrubland	Grassland	Wetland
	%			
Argentina	6%	4%	2%	16%
Brazil	50%	8%	15%	28%
Canada	8%	9%	10%	8%
Indonesia	22%	12%	14%	21%
Malaysia	12%	2%	1%	7%
Paraguay	8%	5%	2%	7%
Peru	20%	9%	8%	13%
Russia	10%	12%	13%	11%
Ukraine	11%	11%	4%	12%
USA	18%	29%	7%	35%

Note: Highlighting in these tables calls attention to two levels of deficiency in PA coverage: countries in which only 0-5% of a given ecosystem are included in the PA system, and countries where 6-10% of that ecosystem are included.
Note: The UK is a Party to the Convention on Biological Diversity, and has a national system of protected areas. According to the World Database on Protected Areas, "Due to publishing restrictions on the UK protected areas data we are currently unable to include these sites in the WDPA. UNEP-WCMC are working with data partners and UK agencies to resolve this issue.[46]"

Table 59 compiles the land cover change information with the protected area information to provide an assessment of risk of biodiversity loss from EU biofuels consumption.

46 http://www.wdpa.org/FAQ.aspx#ctl00_MainContent_Faq7

Table 59. EU Biofuels Consumption and Biodiversity Risk Indicators, Non-EU Countries.

Country	Crop	Area to EU Biofuels (x1000 ha) (Source: Ecofys, 2012)	Source ecosystem	At Risk from Conversion to Cropland 2008-2010 (see Appendix V)	At Risk from Low % in PAs 2010 (see Table 58)
Argentina	Soy	868	Savannah/shrubland, Grassland	Medium	High
Brazil	Soy	300	Savannah/shrubland, Grassland	High	Medium
	Sugar	74			
Canada	Rapeseed	207	Grassland	Medium	Medium
	Soy	32			
Indonesia	Palm	57	Forest, wetland	Low	Low
Malaysia	Palm	12	Forest, wetland	Low	Medium
Paraguay	Soy	140	Savannah/shrubland, Grassland	Low	High
Peru		N.A., less than 10			
Russia	Rapeseed	129	Savannah/shrubland, Grassland	High	Low
	Soy	80			
Ukraine	Rapeseed	263	Savannah/shrubland, Grassland	Low	High
	Soy	19			
USA	Soy	160	Savannah/shrubland, grassland	High	Medium
	Maize	33			

Note: Only biofuel feedstock crops where more than 10,000 hectares of production area can be attributed to EU biofuels imports are shown in this table.

Table 59 suggests that Brazil and the US are roughly the same in being at highest risk to biodiversity from biofuels feedstock production for the EU. Argentina, Canada, and Russia are next in risk of biodiversity impact from EU biofuels. Paraguay and Ukraine are at some risk, because although the ecosystems where biofuel feedstock crops could be grown were converted to cropland only at low rates between 2008 and 2010, those ecosystems are afforded very poor protection in national PA systems. The low apparent risk for palm oil from Indonesia and Malaysia applies only to 2008-2010 and may be greater than indicated by the data in Table 59. Because Peru makes such a small contribution to EU biofuels (5,000 ha of sugarcane for ethanol according to Ecofys, 2012) it is considered at low risk.

It may come as a surprise to those used to thinking of “biodiversity” mainly in terms of species- rich tropical moist forests that the results of this analysis suggest that the current threat to biodiversity comes not from tropical deforestation but mainly from the conversion of natural savannah/shrubland and grassland ecosystems to croplands. An unknown amount of this conversion may be driven by demand for biofuels, some of which comes from the EU.

A similar table was not deemed necessary for EU countries because:

1 Table 79 (Appendix V) shows only Spain at a medium level of risk from conversion of savannah/shrubland to cropland, and
2 Table 57 shows only Poland and Spain with PA coverage of certain ecosystems below the CBD-recommended 10% level.

Spain could be considered at moderate risk of biodiversity loss from production of biofuels for the EU because 27,000 ha of wheat, 23,000 ha of barley, 32,000 ha of sunflower, and 11,000 ha of rapeseed are grown for biofuel production (Ecofys, 2012) and an unknown amount of these lands may have been part of the 2,211,000 ha of savannah/shrubland converted to cropland between 2008-2010 (see Table 79, Appendix V). Poland has the second highest level of risk for biodiversity loss linked to biofuels among EU countries. All EU countries, including Spain and Poland, appear from this analysis to be at much lower risk than all non-EU countries.

To provide some more insights to biodiversity risks and impacts, a couple of brief 'case studies' were done for main non-EU countries. These are presented in Appendix VII.

Conclusions

Overall, the current threat to biodiversity comes not from tropical deforestation but mainly from the conversion of natural savannah/shrubland and grassland ecosystems to cropland and pasture. An unknown amount of this conversion may be driven by demand for biofuels, some of which comes from the EU. More important drivers are considered to be meeting increased local and global demand for meat, animal feedstock and cereal production.

Identification of areas of high conservation value

This section analyses if the current definitions as provided in Article 17 (3) in the Renewable Energy Direct are sufficient in covering the areas of high conservation value, which should be excluded from biofuel production.

Avoiding biofuel feedstock production in areas of so-called "high conservation value" (or similar terms) has been proposed. Such an approach is mentioned in relation to grassland ecosystems in Article 17.3.c of the 2009 RED. However, because biodiversity has multiple dimensions (i.e., ecosystem-level, species-level, and genetic-level biodiversity), and because of issues of ecological scale and connectivity, and the mobility and migration of some species, it is not possible to define terms such as "high conservation value" precisely and scientifically (Campbell and Doswald 2009; Grantham, et al. 2010; Lourival, et al. 2009). For example, the "Important Bird Areas" proposed by BirdLife International as being of "high conservation value" are only such for birds. They would not necessarily be areas of high conservation value for grassland-dependent butterflies, mycorrhyzal fungi, orchids, tortoises, beetles, or any other taxon of plants or animals. "At the global scale, conservation scientists have used several different approaches to identify areas of importance for biodiversity conservation, such as Conservation International's biodiversity hotspots, or WWF's global 200 ecoregions, but these are generally not considered appropriate for decision making at the scale of biofuel production… There is little discussion in the literature of the relationship between the various standards and their varying levels of protection for 'high biodiversity' lands but it is clear that there is little consensus on how they should be defined and identified, and the identification of [high conservation value] HCV lands is open to interpretation." (Campbell and Doswald 2009, pp. 22-23).

All of the ecosystems listed in RED Articles 17.3 and 17.4 as being off-limits for conversion for biofuel feedstock production could appropriately be considered of "high conservation value." Since their direct conversion for biofuel feedstock production is already proscribed under the RED, there seems to be little or no benefit in trying to distinguish specific areas of so-called "high biodiversity" within those ecosystems, even if that were possible from a scientific point-of-view. Because of the scientific vagueness of the concept, it is best to avoid trying to designate areas of "high conservation value" within any remaining areas of relatively undisturbed natural ecosystems.

4.5 Impacts on water, soil and air

In the following part the possible impacts on water, soil and air of EU biofuel consumption will be analysed.

Water impacts

Global water footprint & water stress

Based on data about the share of specific crops in different countries that are used for biofuel consumption in the EU (Chapter 2), water risk analysis was made for the countries that were relevant to the EU biofuel market in 2010. The quantifications[47] were made on basis of the total water footprints per crop-country combination, as reported by Mekonnen and Hoekstra [2010]. Figure 118 shows that for some crops, the water consumption varies hugely between countries. Generally, Europe and North America show the highest values of bioenergy production per unit water, while South Asia and Sub-Saharan Africa have the lowest values, which is due to a combination of differences in climate and crop management.

[47] Initially, the quantifications were made using the physically based ecosystem model LPJmL.

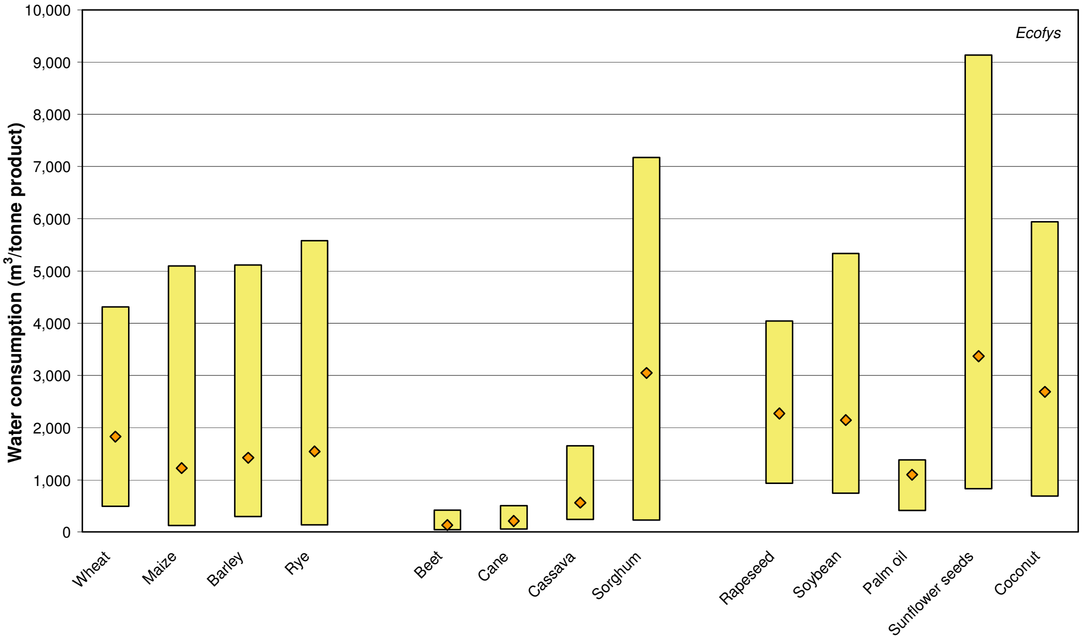


Figure 118. Total water footprint (green + blue + grey) for selected crops in the countries analysed (bars) and global average (diamonds)[48].

Compared with the total water use for agricultural production globally, water use associated with EU biofuel consumption in 2010 is low (less then 0.01% of total agricultural water use). However, as Table 60 shows, a few countries allocate a relatively large share of their total water consumption for agricultural production of the biofuel feedstocks. For those countries, it could be that also a large share of that crop is dedicated to EU biofuel production.

In Table 60, the included countries are classified into five bandwidths related to the current water stress situation as reported in the 2010 Environmental Performance Index [Yale University 2010], which indicates whether specific countries face a challenging water situation and even a relatively small water use may already create problems. Note that today's investments in biofuel (or biofuel feedstock) production may further influence the development of water demand in these countries.

[48] The graph shows only 90th percentile of the results which means that only the countries are included with a value below which 90 percent of the water consumption results are found. This is done in order to avoid countries with erroneous or inconceivable water consumption results. Examples of countries with erroneous water consumption values are Tajikistan (273917 m3 water per ton soybean), Azerbaijan (47844 m3 water per ton sorghum) and South Africa (35610 m3 water per ton rye).

Table 60. Water footprint as a result of EU biofuels consumption, in absolute volume (second column) and relative to the water footprint of all the country's crop production. Countries of feedstock origin are ranked by water stress score (last column)[49].

	Water footprint (km3/yr)	Fraction of total agriculture water footprint	Water stress score
Water stress score 0-20 (most stress)			
Belgium	0.21	14.53%	6
Spain	0.83	1.12%	13
Water stress score 20-40			
Hungary	1.51	7.03%	23
Ukraine	3.38	3.18%	23
Netherlands	0.02	0.70%	23
Argentina	16.20	9.71%	23
Paraguay	3.04	9.91%	24
USA	2.90	0.35%	26
Italy	0.63	1.20%	30
Romania	1.40	3.79%	31
Peru	0.08	0.45%	32
Germany	5.62	12.38%	33
Water stress score 40-60			
France	8.51	11.57%	47
United Kingdom	0.98	4.25%	47
Poland	1.73	3.55%	55
Water stress score 60-80			
Czech Republic	2.18	18.31	70
Brazil	6.77	2.06%	72
Russia	2.01	0.62%	73
Canada	2.41	1.72%	77
Water stress score 80-100 (least stress)			
Malaysia	0.22	0.25%	87
Sweden	0.70	8.30%	93
Indonesia	0.94	0.30%	95
Austria	0.49	9.77%	100
Slovenia	0.33	26.37%	100
Switzerland	0.12	6.14%	100

Figure 119 graphically shows the water footprint related to the feedstock for the 2010 EU biofuel consumption in comparison to the water footprint of the country's total crop production (the same value as in the third column of Table 60).

[49] The water stress score is an logarithmic indicator for the territory under water stress; a score less than 20 indicates that more than about 30% of the country's territory faces water stress

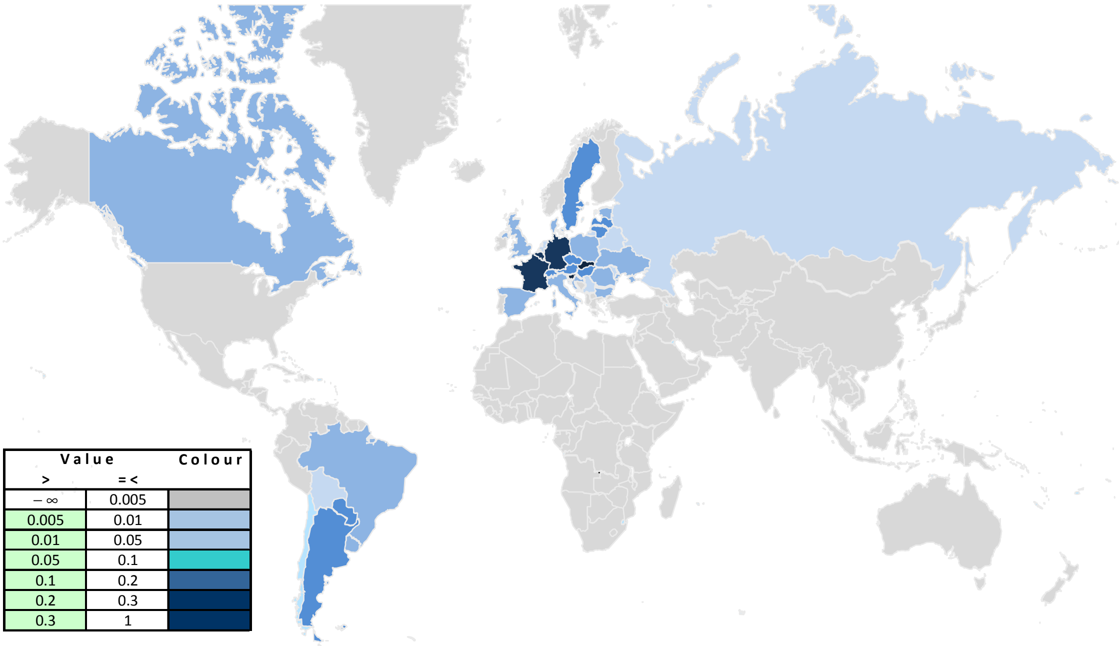


Figure 119. Water footprint of EU biofuels consumption relative to the country's total crop production.

To obtain more insights in the crop and country combinations of the EU biofuel feedstocks, an analysis was made for green, blue and grey water impacts for each relevant combination. More detail on the methodology applied can be found in Appendix XII.

Water impacts Crop/country combinations

Comparing green and blue water impacts for 2008 and 2010, several trends are apparent (see Figure 120 and Figure 121 below). First is that the highest risks for water availability impacts are located outside of the EU. In terms of gross cubic meters, biofuel crops have higher impacts for reducing natural water availability (i.e. green water) than impacts for impacts related to irrigation (i.e. blue water). Thus, green water impacts outside of the EU are of particular concern.

Brazilian sugarcane has the highest impacts in both the green and blue water categories, and has experienced a larger increase in impacts than other countries between 2008 and 2010. Two biofuel crops grown within the United States, soy and maize, also have significant green and blue water impacts, each of which increased between 2008 and 2010. Additional notable biofuel crop impacts include soybeans from Brazil and Argentina, and palm oil from Indonesia and Malaysia. Although these crops have between 70 and 150 billion cubic meters of green water impacts, they receive little or no irrigation, and so have minimal blue water impacts. Relative to Argentina and Malaysia (where the same crops are grown), Brazil and Indonesia had higher impacts.

Green and blue water impacts are much lower within the EU. Wheat tends to have the highest green water impacts, especially in France, Poland, and Spain, although German and French rapeseed cultivation results in some impacts. Maize in France and Spain has the highest EU blue water impacts, although impacts decreased between 2008 and 2010. Spanish sunflower cultivation also had relatively modest blue water impacts.

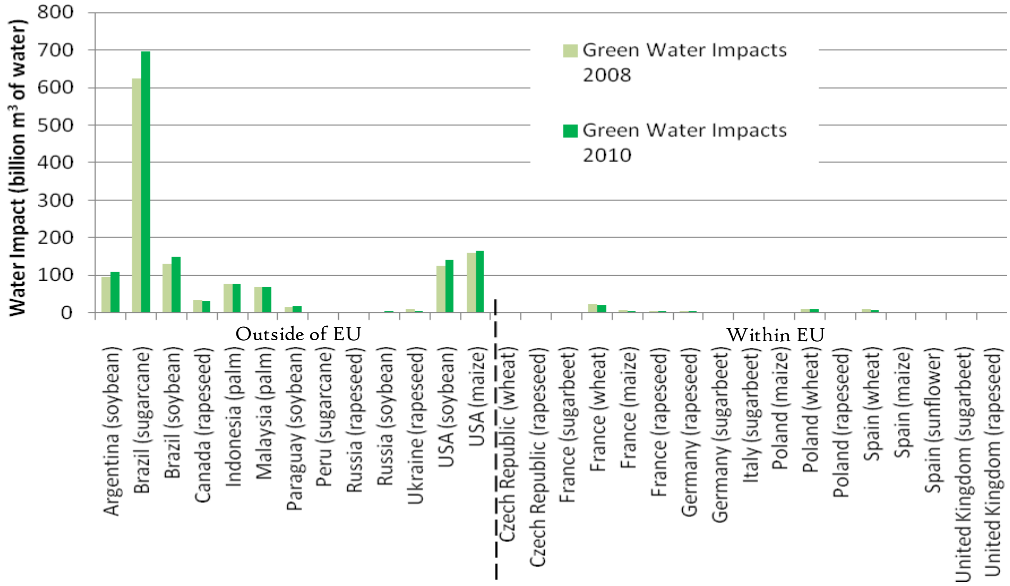


Figure 120. Total Green Water Impacts for 2008 and 2010.

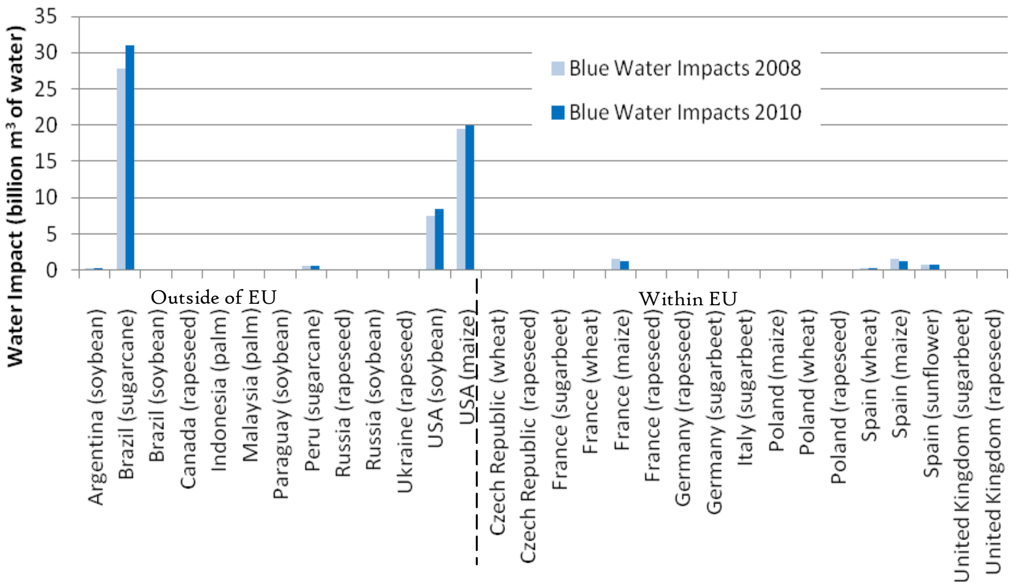


Figure 121. Total Blue Water Impacts for 2008 and 2010.

Similar to the green and blue water impacts, the highest risk for grey water impacts is located outside of the EU countries (see Figure 122). While grey water impacts increased between 2008 and 2010 for countries with the overall highest impacts, most countries analyzed experienced minimal or no increases in grey water impacts over this time period. Every country analyzed had some level of grey water impacts.

Brazilian sugarcane and United States maize have the highest grey water impacts. Although United States maize had the highest grey water impacts in 2008, it was surpassed by Brazilian sugarcane in 2010. Other notable crops included palm oil in Indonesia and Malaysia, as well as rapeseed in Canada.

Within the EU, Polish wheat had grey water impacts on nearly equal to palm oil from Indonesia (4.90 and 5.44 billion cubic meters, respectively). Spanish wheat and French maize also had modest impacts, as did rapeseed in 2010 from France and Germany.

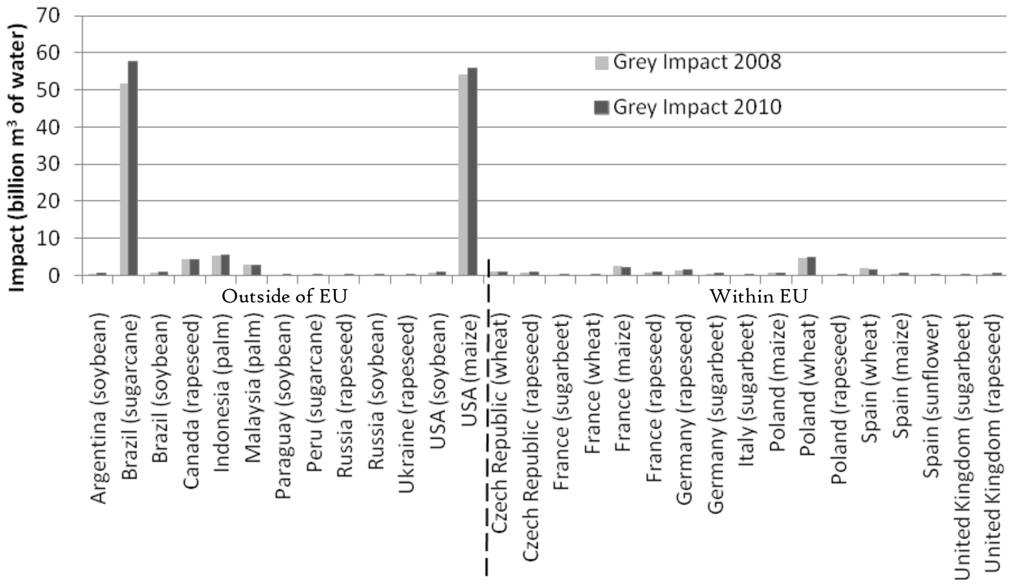


Figure 122. Total Grey Water Impacts for 2008 and 2010.

Fluctuations in the amount of biofuel crops bound for EU markets has implications for whether the EU renewable energy directive drives positive or negative change with regard to water availability and water quality. For example, although Brazilian sugarcane has the highest green, blue, and grey water impacts and may be considered high risk for water availability and water quality, EU-bound feedstock was reduced by nearly 12% between 2008 and 2010. Palm oil production in Malaysia and Indonesia was similarly reduced during this time period (by 86% and 67%, respectively).

On the other hand, EU-bound biofuel feedstock increased significantly within the United States during 2008 to 2010, with soybeans increasing by 62% and maize increasing by 167 times. Both Brazilian and Argentine soybeans increased over this same time period (by 17% and 300%, respectively). These trends indicate that water impacts from agricultural production of these crops may continue to grow. The changes between 2008 and 2010 in the analysis provided are due to changes in cultivation of the biofuel feedstock crops. Climatic or environmental conditions have an effect to the extent that they alter cultivation patterns for 2008 or 2010 in the countries analyzed.

Based on the analysis, Brazilian sugarcane has the highest green, blue, and grey water impacts and has increased significantly between 2008 and 2010. United States maize and soybean cultivation also accounts for billions of cubic meters of water impacts. Finally, palm oil from Indonesia and Malaysia stands out as having notable impacts for both water availability and water quality.

In the Appendix XII, these areas are therefore analysed in more detail. From this analysis we can result that areas of particular concern for feedstock produced for EU biofuel consumption include Southern Brazil (sugarcane), the Mid-Western United States (soybeans and maize), Malaysian Borneo (palm oil), and Indonesian Borneo and Sumatra (palm oil). The EU has been reducing consumption of biofuel feedstocks in some of these high risk areas, with the exception of the United States, where domestic feedstock production is quickly increasing. Current legislation in these high risk areas seems to indicate the governments' willingness to address some issues related to water quality, although additional legal and voluntary measures will be necessary to significantly mitigate risks.

For countries indicated as high risk in this analysis, recent legislation and other key measures may provide addition insights into future trends in countries producing biofuel feedstocks for consumption by the EU. Improved and new legislation may help reduce risk of impacts to water availability and quality. For example, the passage of a 2008 state law in Sao Paulo, Brazil addresses environmental risks of growing sugarcane in the high-risk southern portion of the country. This may indicate mitigation of water availability and quality problems in the future and has relatively an average potential for enforcement, given various indicators of democracy, corruption, and transparency. The United States also has a few measures that may mitigate impacts, with high potential for enforcement. In addition, both Malaysia and Indonesia have recently implemented laws dealing with effluent from palm oil plantations, increased use of environmental impact statements, and appropriate siting of use of plantations. Legal developments in these high risk areas generally indicate improvements in managing biofuel production for protection of water availability and quality, as well as long term sustainability.

Impacts on Soil

Agricultural systems need to maintain soil health to be sustainable in the long-term. However, in large scale farming the emphasis is generally on boosting production with management practices that include choice of high yielding varieties combined with tillage, use of heavy machinery, fertilizers, herbicides, pesticides, and irrigation.

Excessive use of these inputs may result in soil erosion, loss of organic matter, loss of biodiversity, negative impact on microbial population, soil contamination, groundwater pollution, salinity, and acidity. Crop production is also spread over soils of varying vulnerabilities, climatic conditions, sensitive ecosystems (e.g., wetlands and tropical forests), and marginal lands (e.g., steep slopes and shallow soils). Thus, negative impacts noted above are likely to vary with site conditions. The concern that biofuel market may have negative impact on soil health is based on the premise that increased demand for biofuel feedstock will encourage expansion of cropping area, shift from diversity to monoculture, and increased use of inputs. The connection appears logical, but there are no studies to establish a direct link between biofuels and soil health.

Soils are in their best potential health when they are preserved under natural vegetation - in equilibrium with their environment and not exposed to physical disturbance at the surface. However, once under cultivation soils' equilibrium with the environment is altered and they are subject to degradation. The type and degree of degradation varies from landscape to landscape depending on the landscape form, soil type, climatic conditions, and cultivation practices. Crop cultivation, regardless of location, involves similar practices, e.g., tillage, sowing/seeding, inter-row cultivation, weed control, fertilization, use of pesticides, irrigated or rain-fed production, harvesting, residue management, and use of machinery etc. Thus, soil degradation may result from mismanagement of any or all of these practices. For soils on similar landscapes and under similar climatic conditions, risks to soil attributable to crops should be similar for all crops involving similar field operations. Differences may be observed for crops with different planting pattern (e.g., closely planted grains vs. wide-row maize) and those differing in their harvesting requirements, e.g., sugar beet that requires extensive disturbance of the soil. Perennial and semi-perennial crops, such as oil palm and sugarcane are significantly different in their effect on soils. With these crops, negative impacts are limited to initial stages of land preparation, planting, and crop establishment.

A summary of factors that impact soil health/quality, probable impact on soils, and management practices to mitigate those risks are presented in the Appendix XII (Table 96 and Table 97). The risk factors and their impacts are general, and they exist everywhere, except deforestation, which is common in Southeast Asia and South America. Other exceptions include plantations that include perennial tree crops, pastures, and semi-perennial crop, such as sugarcane, where tillage effects are minimal and vegetative part is largely unaffected. Most of the other risk factors relate to cultivation practices common in raising field crops. Use of machinery and agricultural chemicals is common in the United States, Canada, European countries, and large farming operations in South America. Where large investments are made, farming is based on operational efficiency and practices designed to ensure targeted production level. Consequently, soil compaction, soil contamination, groundwater pollution, loss of organic matter, and loss of soil biodiversity are common where farming is based on machinery, tillage, and chemicals. Soil erosion is a problem that occurs everywhere to

some degree. However, it is serious on unprotected slopes, especially where rainfall is high, and fields that are subject to excessive soil disturbance due to tillage or harvesting operations, e.g., sugar beet and other crops that require deep disturbance of the soil. Irrigation is necessary where natural supply of moisture during the cropping season is inadequate. However, irrigation management is problematic. If not well controlled, it can cause erosion on the soil surface and leaching of nutrients.
Salinization, related to irrigation, is a problem in most dry areas due to activation of native salts and additions of salts from irrigation water. Soil acidity occurs where nutrients are leached due to excessive rainfall, or where vegetative biomass is constantly removed resulting in mining of base nutrient cations. It can also occur where acid-forming fertilizers are used.

The problems related to machinery and chemical inputs may not be as magnified in regions where farming is constrained by resource limitations, but, then, efficiency and productivity are also quite low, e.g., small farmers in Asia and Africa. In addition, because natural loss of fertility due to mining of nutrients from cropping still occurs, soil productivity may actually decline.

Judicious management, designed to optimize production while ensuring resource conservation, may minimize the most common risks, which means that although there may be a potential for degradation, in actuality, it may not be taking place or may not be serious (e.g., Webb et al., 2001). Proper crop rotation (e.g., cereals with legumes), cover crops, minimum tillage, and residue management along with proper amount of fertilizers can help maintain soil condition and productivity (e.g., FAO, 2000; Sullivan, 2001). In addition, degraded lands can be improved with proper management that includes deep rooting leguminous cover crops and soil amendments (e.g., Fairsurst and McLaughlin, 2009). On the other hand, poor management may degrade even the best of lands. Thus, the practices adopted by a farmer could well be more significant than the original state of the land.

Monitoring and assessment of soil condition is necessary. However, while identifying the risk factors and related impacts on soil quality may be relatively easy, quantification of the impacts is quite difficult. Results based on sampling, laboratory studies, and from small research plots are generalized to speculate on the impact of farming practices. However, given different soil types, landforms, cropping systems, and variable climatic conditions, assessments of soil quality on regional and global scale is much more difficult, except in cases where there are visually observable events, such as landslides and erosion in the form of rills and gullies. Steady maintenance of crop yields or steady increase/decline might serve as another indicator of soil condition, but may not be conclusive since factors, such as management and weather may be involved. In many cases, input levels may mask the negative impacts that may actually be taking place.

Biofuel production and soil impacts

The advent of bioenergy as an agro-industrial enterprise means increasing pressure on agriculture. Because feedstock for biofuel comes from many of the same crops that have been cultivated for traditional purposes (e.g., food), the additional demand can only be met through intensification and/or expansion of agriculture. Intensification implies changes in farm practices to boost output of a feedstock crop on the same acreage, possibly bypassing rotations, and making excessive use of fertilizers, chemicals, water, and machinery. The choice is most likely to result in undesirable effects on soil and the environment, e.g., soil toxicity, compaction, and groundwater pollution (e.g., Capel et al., 2004; Wuana and Okieimen, 2011; Cornell University, 2012). Expansion of crop production may entail deforestation, extension of production to fragile lands, or shifts in the choice of crops, e.g., conversion of pastures to croplands, which means consequences of agricultural practices spreading over larger areas. Deforestaton to make land available for crop production is one example. As another example, planting of oil palm on peatlands in Indonesia and Malaysia is likely to result in lowering of watertable, drying the peatland, and making them vulnerable to erosion. Expansion of soybeans on Cerrados in Brazil may have negative impact in the long term. These soils are acidic and low in fertility; however, soybean production is possible with heavy inputs of lime and fertilizers. Where pastures and orchards are converted to maize and soybean (as in the USA), loss of soil of organic matter and biodiversity is bound to occur. Expansion of crops that require large amounts of water and nutrients (e.g., sugarcane) on soils of low water and nutrient holding capacity (e.g., sandy soils) will require large applications of water and fertilizers, which may result in excessive leaching and alter the chemical and biological environment in the soil.

Besides the comments per crop/country combination, for all main region/crop combinations an assessment on main soil impact criteria is presented (in Table 98 in Appendix XII), combined with a brief description (Appendix XII).

The demand for biofuel feedstock creates both risks and opportunities (e.g., Worldwatch Institute, 2007). The increase in demand for agricultural commodities as feedstock for biofuel raises the concern that farmers may be induced to adopt unsustainable practices. However, there is also a consensus that, if best practices for socially and environmentally sound development are applied, biofuel feedstock crops could offer farmers enhanced employment and incomes (e.g., Hill et al., 2006; de Gorter and Rust, 2010; German et al., 2011).

Statistics on crop acreages and crop yield data for different countries as a function of time, as available in FAOSTAT (FAO, 1961-2010) provide some indications of the trends. Data on agricultural area for the years 2008 and 2009 show very little change or none at all. If anything, the total area under agriculture for most countries actually declined. Yet, the harvested area for most biofuel crops shows perceptible increases between the years 2008 and 2010. This indicates that increase in the area under biofuel crops most likely occurred at the cost of other crops. As expected, the total production for each of the crops increased accordingly, an exception being the sugarcane in Argentina. Data also show an increase in yield/ha for most crops, indicating possible increase in input levels. From the data it is not possible to reach definite conclusions on the level of inputs. However, while yields can be increased by choice of high yielding varieties, changes in planting pattern, favourable weather, and choosing the right planting time, these factors appear less likely for the non-EU countries. Thus, given the expansion in crop area and likely increase in input levels, one would expect an increased injection of fertilizers, herbicides, and pesticides in the agricultural area of the countries supplying biofuel to the EU. This coupled with the use of machinery and irrigation (where practiced) over larger crop area correlates with increased risk to soils. The FAO statistics indicate a trend toward expansion and/or intensification of biofuel crops. The trends may be interpreted as indicators of progress towards soil degradation; however, no definitive conclusion can be drawn.

Impacts on air

The biofuel supply chain can emit air pollutants in every stage from growing feedstocks (e.g., dust from clearing land, smoke from burnings, nitrogen from fertilizers), to transporting feedstocks and refined product (e.g., vehicle emissions and dust generation), to processing (e.g., industrial systems emissions), to use (e.g., combustion)[50]. The types and impacts of the emitted pollutants depend on the local context, including activity causing the emissions, proximity to population centres, sensitivity of ecosystems, concentrations of the pollutant, topography, and meteorology.

This analysis identifies the major pollutants in feedstock production and processing for biofuels in the EU and identifies the factors that affect the concentration of those pollutants in the atmosphere and which of those factors are present in the regions supplying significant amounts of EU biofuels. Additionally, existing provisions to mitigate those threats will be identified, and how the magnitude of the threats has changed since the baseline report will be discussed.

In Appendix XII the complete analysis can be found, while here only results of the main steps in the analysis are found and concluding remarks are presented. In the Annex also a brief description of methodology is given.

Preliminary results in key countries indicate that generally the greatest threats to air quality are associated with burning; there is burning of crop residues, of sugarcane pre-harvest, for clearing vegetation from land, or as a result of clearing lands. High threats are also associated with some applications of agrochemicals, areas highly vulnerable to wind erosion, and gaseous emissions from processing facilities. The results of the subjective threat assessment show that soybean, palm oil, maize, and sugarcane have the highest overall potential threats, largely due to the presence of

50 Note that biofuel combustion (tailpipe emissions) are considered outwith the scope since the current sustainability criteria are focused on cultivation and production.

burning as part of their production. In the cultivation stage, all of the crops have high or medium threats associated with the volatilization of nitrogen compounds from fertilizers, and in some countries air pollution from volatilization of other agrochemicals raise the threats. Air pollution from the processing stages presents a medium to high threat in all countries where processing occurs.

A detailed breakdown with explanations of the factors resulting in the specific threat characterization is included in the Appendix XII by country and region and addressing the amount that is used for biofuels in the EU.

Legislative and voluntary provisions in each country that may address the threats identified as high and medium are described in Table 110 in Appendix XII along with the potential to enforce the legislation based on a set of four governance indicators and indication of whether the existing legislative and voluntary measures reduce the high and medium threats as identified. The following table summarizes the level of threats in each country for each stage of the biofuel production chain. The arrows in the table indicate whether the existing measures as identified are likely to lower the threat (although not the extent of how much that threat is lowered). In many of the cases where it is indicated that these measures do lower the threat, there is the caveat that the threat is lowered to the extent that certain legislation is enforced. The details of this can be found in Appendix XII.

Table 61. Level of threats to air for country/production chain combinations.

	Key risk factors linked to practices and processes				
	Land Preparation & Post harvest	Cultivation	Harvest	Transport	Processing
Rapeseed					
-EU	Low	High ↓	Low	Unknown	Medium ↓
-Ukraine (262,779ha)	Low	Medium	Medium	Unknown	High
-Canada (207,393ha)	Low	Low	Low	Unknown	Medium ↓
-Russia (128,662ha)	Unknown	Medium	Medium	Unknown	Medium
Soybean					
-Argentina (867,795ha)	Low	High	Medium	Unknown	Medium
-Brazil (300,353ha)	High	Medium	Low	Unknown	Medium ↓
-United States (160,127ha)	High ↓	Medium ↓	Low	Unknown	Medium ↓
-Paraguay (140,276ha)	High	Medium	Unknown	Unknown	Low
Palm Oil					
-Indonesia (56,672ha)	High	Medium ↓	Very Low	Low	High

	Key risk factors linked to practices and processes				
	Land Preparation & Post harvest	Cultivation	Harvest	Transport	Processing
-*Malaysia* (11,954ha)	High ↓	Medium ↓	Very Low	Low	High ↓
Sugar Beet					
-*EU*	Low	High ↓	Medium	↓ Unknown	Medium ↓
Wheat					
-*EU*	Low	High ↓	Low	Unknown	Medium ↓
Maize					
-*EU*	Medium	High ↓	Medium	↓ Unknown	Medium ↓
-*United States* (33,342ha)	Medium ↓	High ↓	Medium	↓ Unknown	Medium ↓
Sunflower					
EU	Low	High ↓	Medium	↓ Unknown	Medium ↓
Sugarcane					
-*Brazil* (73,959ha)	Unknown	Medium ↓	High	Low	Medium ↓
-*Peru* (5,199ha)	Unknown	Unknown	High	Low	Medium
Rye					
-*EU*	Low	Medium ↓	Medium	↓ Unknown	Medium ↓

High threat = Without mitigation measures, the risk for air quality is unacceptable due to impacts that disrupt local ecosystems of significantly threaten human health (e.g., such that there are noticeable impacts on community health indicators and/or people are required to spend less time outdoors due to the air pollution that results.
Medium threat = Without mitigation measures, the factor may result in long term changes to ecosystems or community health; however, the impacts may go unnoticed if monitoring is not conducted.
Low threat = The threat posed is unlikely to cause noticeable changes to air quality above what is currently viewed as acceptable and would go unnoticed.

The results in Table 61 show that soybean, palm oil, maize, and sugarcane have the highest overall potential threats, largely due to the presence of burning as part of their production (land preparation and post harvest). In the cultivation stage, all of the crops have high or medium threats associated with the volatization of nitrogen compounds from fertilizers, and in some countries air pollution from volatization of other agrochemicals raise the threats. While information on the air pollution associated with the processing stage was not obtained for many of the countries, it is assumed from general knowledge that processing facilities have a medium or high threat, depending on the control of gaseous emissions and emissions associated with other waste streams at the facilities.

It is difficult to say the extent to which existing legislative and voluntary provisions successfully lower the overall threat associated with a specific practice or activity;

however, through consideration of the existing provisions and the potential to enforce legislation in each country, it was determined that in the EU[51], Canada, and Malaysia, and the United States, the high and medium threats are likely lowered by the existing provisions. Each of those countries has high potential enforcement, with the exception of Malaysia, which has medium. However, the greatest threat from Malaysia relates to burning, which was noted to have high enforcement of bans. In Indonesia and Brazil (two of the countries with the highest threats to air pollutions), some of the threats are lowered to the extent that legislation is enforced and some remain the same. Both countries are considered to have 'medium' potential enforcement and burnings in both countries are not sufficiently addressed; Brazil does have several measures to address burning but none are fully in effect or having sufficient coverage at this point.

Between 2008 and 2010, there has been limited change in threats to air quality from EU biofuel demand. There have been shifts in the supply that shift where the threats occur; for example supply from Argentina increased 388% and Peru 156%, US maize supply increased thousands of times but soy decreased by 62%, and palm oil from Indonesia and Malaysia decreased significantly (67% and 87%, respectively). Some new legislation was introduced in that time period, but they are too new to fully understand the impacts (e.g., Indonesia in 2009 introduced a significant new environmental legislation). Voluntary sustainability certification increased in this time frame, however, in no country do the sustainability standards cover a significant proportion of the feedstock produced.

Conclusions on water, soil and air impacts

Water:

- Areas of particular concern include Southern Brazil (sugarcane), the Mid-Western United States (soybeans and maize), Malaysian Borneo (palm oil), and Indonesian Borneo and Sumatra (palm oil).
- The EU has been reducing consumption of biofuel feedstocks in some of these high risk areas, with the exception of the United States, where domestic feedstock production is quickly increasing.
- Current legislation in these high risk areas seems to indicate the governments' willingness to address some issues related to water quality, although additional legal and voluntary measures will be necessary to significantly mitigate risks.

51 Within the EU, in order to ensure a minimum level of protection for the environment, the system of cross-compliance requirements was introduced where by farmers receiving the 'Single Farm Payment' scheme must comply with certain requirements or face a reduction/complete loss of payments. As part of these requirements there are Statutory Management Requirements (SMRs) and a set of standards of Good Agricultural and Environmental Condition (GAEC), which are additional requirements relating to soil erosion, soil structure, soil organic matter and the minimum maintenance of habitats but which are determined at the country level. Large scale EU biorefineries in the EU would be covered by the requirements of the Industrial Pollution Prevention and Control Directive51, to be replaced by the Industrial Emissions Directive51 as of January 2014. For smaller scale plants, the EU does not set direct regulatory requirements. However, air quality limit values established under the Air Quality Framework Directive51 have to be complied with by Member States. These regulations significantly lower the threat to air quality from all aspects of biofuel production.

Soil

- The FAO statistics indicate a trend toward expansion and/or intensification of biofuel crops. The trends may be interpreted as indicators of progress towards soil degradation; however, no definitive conclusion can be drawn;
- The concern that biofuel market may have negative impact on soil health is based on the premise that increased demand for biofuel feedstock will encourage expansion of cropping area, shift from diversity to monoculture, and increased use of inputs. The connection appears logical, but there are no studies to establish a direct link between biofuels and soil health.

Air

- Soybean, palm oil, maize, and sugarcane have the highest overall potential threats, largely due to the presence of burning as part of their production (land preparation and post harvest);
- In the EU[52], Canada, Malaysia, and the United States, the high and medium threats on air impacts are likely lowered by the existing regulations;
- Malaysia is the only one from the above mentioned with a medium enforcement potential (the others have high). However, the greatest threat from Malaysia relates to burning, which was noted to have high enforcement of bans;
- In Indonesia and Brazil (two of the countries with the highest threats to air pollutions), some of the threats are lowered to the extent that legislation is enforced and some remain the same. Both countries are considered to have 'medium' potential enforcement and burnings in both countries are not sufficiently addressed.

4.6 Economic and social impacts

In this section several economic and social impacts are analysed, namely:

- Food prices & affordability;
- Land rights & issues;
- Employment;
- International labour issues;
- Impacts on other biomass using sectors.

[52] Within the EU, in order to ensure a minimum level of protection for the environment, the system of cross-compliance requirements was introduced where by farmers receiving the 'Single Farm Payment' scheme must comply with certain requirements or face a reduction/complete loss of payments. As part of these requirements there are Statutory Management Requirements (SMRs) and a set of standards of Good Agricultural and Environmental Condition (GAEC), which are additional requirements relating to soil erosion, soil structure, soil organic matter and the minimum maintenance of habitats but which are determined at the country level. Large scale EU biorefineries in the EU would be covered by the requirements of the Industrial Pollution Prevention and Control Directive[52], to be replaced by the Industrial Emissions Directive[52] as of January 2014. For smaller scale plants, the EU does not set direct regulatory requirements. However, air quality limit values established under the Air Quality Framework Directive[52] have to be complied with by Member States. These regulations significantly lower the threat to air quality from all aspects of biofuel production.

Food prices and affordability

Biofuel policies are often indicated as one of the most important factors driving food prices. Several studies have look at this linkage and analysed the possible scenarios of food prices without (increasing) biofuel targets. The following steps are applied to assess impacts of biofuel consumption in the EU in 2010 on food affordability:

1 Results from macro analysis of impact EU biofuel consumption on food prices;
2 Factors influencing international/global food prices;
3 Understanding of main regional markets of importance to EU biofuels consumption;
4 Interaction between global and local food/agricultural markets;
5 Local food affordability and food prices.

1 *Results from macro analysis of impact EU biofuel consumption on food prices*

Backcasting scenario analysis[53] with a world food system model has been used to quantify the impact of demand growth for biofuel feedstocks in recent years on prices and conventional demand for food and feed uses of crops. The outcomes of scenarios with historical biofuel production levels were compared to a simulation for 2000 to 2010 where biofuel expansion was suppressed. The difference in results was interpreted as an estimate of the market impacts of historical biofuel development and policies. This approach was also used to quantify the impact of recent weather related factors by comparing simulation results for a model calculation with 'smooth' average weather (with and without biofuel expansion) to simulation results where historical production distortions due to specific historical weather events were included.

The results indicate that both factors, biofuel production expansion and crop production distortions from the decadal trend in 2006/07 to 2010/11, have contributed to widening the demand-supply gap in 2008 and 2010 and can explain a significant part of the observed historical price increases. The analysis suggests that the combination of the two factors caused a combined impact that was larger than the sum of the two individual impacts, i.e. there was a non-linear and mutually reinforcing interaction of the two stress factors.

The backcasting scenario analysis clearly shows that EU-27 expanding biofuel use has contributed only little to the historical cereal price increases in 2007 to 2010: by simulation of EU-27 historical biofuel use (with biofuels in rest of the world fixed to the 2000 situation), the wheat and coarse grain prices increase by about 1-2%, compared to a scenario without biofuel expansion in the EU-27 during 2000-2010.

The impact of EU-27 historical biofuel use was more substantial for price increases of non-cereal food commodities, notably through its demand for vegetable oil in the production of biodiesel: the price of other crops, including oil crops, increases by

[53] The full analysis can be found in Appendix VIII.

about 4% percent, compared to a scenario without biofuel expansion in the EU-27 during 2000-2010.

For comparison, LEI 2011 presents an overview of various studies indicating their found connection between biofuel policies and food prices. Some of the more quantified statements are:

- Rosegrant et al. (2008) argues that biofuels have been a major contributor to rapid price increases on the international grain markets in the 2000's; if biofuel production were to remain at its 2007 levels, maize prices would be 14% lower in 2015 and 6% lower in 2020;
- FAO and OECD (LEI 2011) concluded that vegetable oil prices would be 15-16% lower and wheat and coarse prices 5-7% lower in 2018 compared to a baseline scenario in which biofuel support policies would continue;
- Studies that found little direct evidence that the demand for biofuel feedstock caused the price increases are among other Gilbert (2010) and Baffes and Haniotis (2010). They both do not quantify the effect on prices.

In addition to the fact that most studies do not quantify the impact of biofuel policies on food prices, they also focus mostly on the period 2001-2009 (sometimes using forward projections), but none of the studies we found has looked specifically at the timeframe 2010.

2 *Factors influencing international/global food prices;*

Several studies indicate factors influencing global food prices. Especially with recent peaks in food prices on the global food prices, several studies have analysed underlying factors and causes. Main factors given in these studies are presented in Table 62.

Table 62. Overview of main factors influencing global food prices (LEI 2011, FAO et al 2011, FAO 2011, Headey and Fan, 2010, Brahmbhatt and Christiaensen, 2008; FAO, 2008; Nelleman et al 2009).

Factor	
Tight market	Growing and richer population (with changing food pattern). Biofuel demand ads to this tight market.
Weather induced elements	Droughts, flooding etc influencing harvests and thus availability of crops.
Low stocks	Historic results from harvest, export and market trends resulting in resulting stocks per country.
Export bans/restrictions	Regulation imposed by certain countries that distort international market
Weak US exchange range	International commodity markets us the US exchange rate as main currency.
High oil price	direct impact (use of fuels in agricultural production) and indirect (as input for fertilizers etc);

Speculation and increased influence from international financial markets is often indicated as a factor strongly influencing international commodity and food prices. On the other hand LEI 2011 indicates a direct relation between these factors can not be proven. They even indicate that the financial markets might sometimes have a positive impact due to balancing of markets and global trends.

DG AGRI 2011 furthermore indicates that the growth in yields for main crops like wheat or soy is declining (or static). In combination with continuous growth of demand for food and agricultural materials this will result in future even tighter markets. One of the contributing causes for the reduction in yield growths could be the lack of investment in agriculture. Despite agriculture being vital to the economies of countries in protracted crisis, it receives a small fraction of aid from the Overseas Development Agency (FAO, 2010c).

Heady (2010) argues that two of the most important causes of the food crisis in 2008 were government interventions on the supply side (e.g. export restrictions) and the demand side (e.g. government-to-government import deals).

FAO et al (June 2011) indicates some elements which were specifically different in the 2010/2011 situation compared to the 2008/2009 situation:

- Harvests in many food importing countries in Africa was above average or very good in 2010/11 causing regionally more stable prices
- Stocks were higher at outset;
- Price increase was differently distributed among commodities (mostly affecting meat, dairy and sugar, and less impacting the food of the most vulnerable crops like staples and rice).

Taking these additional elements into account FAO et al (June 2011) explains why the prices surges in 2010/2011 were lower compared to the 2008/2009 price surge.

As indicated in the previous element the exact extent of the impact of biofuel policies on food prices is not clear. However, it is stated in several studies (as those mentioned above), that biofuel policies and targets at least add to the demand for the oils and grains. Furthermore specific elements accompanied by the increase of biofuels produced from food feedstocks, are the increased interaction with the energy market and the in-elasticity of the biofuel demand. The latter (in-elasticity) indicates that since biofuel demand mostly comes from quotas or targets, it does not respond to changing market prices but does influence market prices (FAO et al 2011). It sets a volume that impacts the price, whereas in other markets prices impact volumes. This makes the markets less predictable and transparent. The increased linkage through biofuel market between energy and food markets causes food prices to be affected more rapidly and stronger by the fluctuations in energy prices (LEI 2011, DG AGRI 2011). Not only directly through the costliness of inputs (fertilizer, energy etc) in the agricultural production system but also through the fact that if energy prices increase, biofuels become more viable and this will increase the demand in agricultural markets for biofuel feedstocks.

Many studies also bring up the volatility of agricultural markets. However it is inconclusive if volatility is actually increasing (or just trend wise varying) or if this is always providing a negative impact on the food prices. What is conclusive is that increased volatile markets are a less interesting environment for investments by farmers and global companies.

3 Quick glance to main regional markets of importance to EU biofuel consumption

There are only a handful of main agricultural markets which relate to the EU biofuel consumption in 2010. namely wheat, rapeseed and sugar beet in the EU, soy in Argentina, sugar cane in Brazil, maize in the USA and palm oil in Indonesia and Malaysia. In the following section a brief description of each of the main agricultural markets is given[54]. As indicated in these sections, the impacts of biofuel production in the various agricultural markets on local food prices are quite limited. Increased prices in 2008 are shown for each of the agricultural markets and reflect international high commodity price surge.

In most cases, biofuel production was not the specific cause of the price surge. It did add to demand, but in most cases were not a considerable addition to demand on production. In many cases, other uses are influencing the price movement to a higher extent (for example the sugar or palm oil market).

Wheat in the EU

The EU 2010 wheat harvest had a good summer harvest, but a fall harvest of reduced size. Western EU countries reported problems with dryness while eastern countries had problems with wetness. EU exports of wheat to Africa and Asia increased among others due to a Russian ban on Ukrainian supplies. However since EU wheat balance is tight, increased exports also caused an increase of imports from the USA. Unrest in the beginning of 2011 halted the increase of wheat exports from the EU.

Within the EU there is an increase in the use of wheat in the Food, Seed & Industry sector and a reduction in feed applications of wheat. Feed applications of wheat were substituted by soy. The increase in the use of in the Food, Seed & Industry sector was indicated as mostly due to increase of wheat based ethanol production within the EU. However this increased demand did not deplete the additional EU stock of wheat in 2010.

Table 63. Average wheat prices in the EU 2005-2009 ((Producer Price (US $/tonne).

	2005	2006	2007	2008	2009	2010[55]
EU average	146	162	267	291	200	-
Southern Europe average	198	199	285	368	276	⇔
Northern Europe average	145	166	266	259	183	⇧
Western Europe average	159	179	285	266	185	⇧
Eastern Europe average	103	119	205	219	137	⇔

Variations in EU wheat prices are shown in the Table 63. 2009 prices have recovered from the 2007/8 price peak but have been increasing in 2010. Main reasons indicated

[54] The following sections on market descriptions are mostly based on USDA GAIN reports published on the 2010 markets and expert insights. Price information comes from FAOSTAT database. Where other sources were used they are mentioned.

[55] FAO price information (faostat.org.com); 2010 FAO price information data is not available yet, based on market insights expected price movement is displayed in table.

are Russia's bad harvests causing high demand on the international market and the unrest on the financial markets.
For Northern and Western Europe a small increase in 2010 wheat prices have occurred (EU 20120). For Eastern Europe 2010 prices were relatively stable, with a slight increase at the end of 2010, while for Southern Europe prices were stable, after a small dip in the beginning of 2010 (EU 20120).

Rapeseed in the EU
The 2010 production of rapeseed in the EU was lower then expected. This caused a reduced availability of rapeseed for biofuel production. It did not however affect the food use of rapeseed oil. To compensate for the lower 2010 production, imports of rapeseed were high in this year, mainly originating from the Ukraine and Australia.

Table 64. Average sugar cane prices in Brazil 2005-2009 (Producer Price (US $/tonne)).

	2005	2006	2007	2008	2009	2010[56]
EU average	235	274	356	484	354	⇧

Table 64. shows strong trends in the producer prices for rapeseed: a high increase in 2008, representing the first food price crisis, followed by a slight recovery in 2009. Low availability of rapeseed in Europe in 2010 probably caused an increase in rapeseed prices again.

Sugar beet in the EU
In general the sugar beet market and production in the EU is a risky crop, due to the uncertainties in the quota market, variations in production yields and a long harvesting and processing season. Many farmers opt for production of wheat, especially in the years since 2008 in which wheat price have been high.
The harvest of 2009 was a record breaking high harvest. Due to a high demand for sugar in the international market, 2010 quota was increased as to stimulate production. This changed the overall trend in the EU sugar beet market in a demand driven market. The additional demand for biofuel feedstock did not harm/ influence this regulated market strongly.

Table 65. Average sugar beet prices in the EU 2005-2009 (Producer Price (US $/tonne)).

	2005	2006	2007	2008	2009	2010[57]
EU average	55	45.8	47.6	51.6	48.1	⇔

Price variations in EU sugar beet market are not high, since production is strongly influenced by quota and sugar market.

Soy Argentina

[56] FAO price information (faostat.org.com); 2010 FAO price information data is not available yet, based on market insights expected price movement is displayed in table.
[57] FAO price information (faostat.org.com); 2010 FAO price information data is not available yet, based on market insights expected price movement is displayed in table.

The soybean harvest in Argentina in 2009 was a bad harvest. It improved a lot in 2010 giving higher yields and a higher production (due to favourable climatic conditions and increased land used for soy production). Due to the abundance in the market, soy bean prices dropped in 2010, causing relatively low export.
The drop in soy bean prices can be seen in the Table 66. However, this still indicate prices relatively high compared to the pre-2008 period.

Table 66. Soy bean prices in Argentina 2005-2009 (Producer Price (US $/tonne)).

	2005	2006	2007	2008	2009	2010[58]
Argentina	171	177	218	281	255	⇩

The production of biodiesel based on Argentinean soy beans represents about 5% of the total soy production in Argentina (see the land use quantification section in 4.2). This biodiesel production does not compete with the use of soy for feed purposes (since in those cases oil is extracted before the use as feed). However the production of soybean biodiesel could be a competing process with the production of soybean oil for food market.
In 2010, following the trend of the years before, the local food market (Argentina, but also surrounding countries) have transferred from soy bean oil for cooking purposes to the use of sunflower oil (mostly due to the increased prices for soy since 2007). It is expected that the use of sunflower oil will increase and surpass the use of soybean oil for cooking purposes. Expectations are that there will be less soy in coming production year, because of rotation and a reduction in land available. Furthermore it is indicated that there is fear on the GHG balance demands from EU market, which might reduce the options for exports to the EU.

Sugar cane market in Brazil
International sugar prices have been high for several years, caused by a high international demand for sugar (and lower sugar production in some countries like India due to harvest issues). For the 2010 sugar cane market in Brazil this resulted in high exports of sugar.

Sugar cane production in Brazil in 2010 was aiming for a good harvest, which due to heavy rainfall in the end of 2010 got reduced a bit. In the Brazilian sugar cane production, after effects of the financial crisis in 2007/8 can still be felt, causing lower investments and lower renewal of sugar cane fields. Also less new production plants came online in 2010 due to effects of financial crisis.

As mentioned, the high demand and price for sugar caused sugar cane mills in Brazil in 2010 to produce more sugar in stead of ethanol. Ethanol exports in 2010 were lower mostly due to a reduced consumption of Brazilian ethanol in USA and India. However a higher amount of ethanol was produced to satisfy local demand.

[58] FAO price information (faostat.org.com); 2010 FAO price information data is not available yet, based on market insights expected price movement is displayed in table.

Table 67. Average sugar cane prices in Brazil 2005-2009 (Producer Price (US $/tonne)).

	2005	2006	2007	2008	2009	2010[59]
Brazil	13.1	18.0	19.1	17.3	18.5	

The production of ethanol based on Brazilian sugar cane represents a considerable share of the total sugar cane production in Brazil, however in 2010 only a very limited amount of ethanol was exported to the EU. EU biofuel consumption as an influence on price fluctuations in the Brazilian market is therefore not expected. The market is mostly depending on the international sugar prices.

Maize in the USA

Compared to the record production in 2009, 2010 production of corn in the USA was lower, but around the same values as the years before 2009. The record production of 2009 was mostly due to high yields obtained, which in 2010 have returned to normal average levels of the past recent years. Corn export market from USA reduces throughout 2010.

Table 68.Average maize prices in USA 2005-2009 (Producer Price (US $/tonne)).

	2005	2006	2007	2008	2009	2010[60]
USA	79	120	165	160	146	⇧

USA corn stocks are low (compared to all previous years) causing a slight increase in 2010 prices. A considerable part of the USA produced maize is used as feedstock for ethanol production (see the land use quantification section in 4.2), however only a limited amount of these biofuels are used in the EU in 2010 (0.1%).

Palm oil in Indonesia

Main market for palm oil is food market & cooking oils (74%), which is thus the largest push behind the growing international palm oil market. Main consumers are in Asia and Africa. The other 24% of the palm oil production goes to industrial applications. The demand for palm oil on the international market is growing, because consumption of edible palm oil is growing and palm oil is cheaper then most other alternatives. The palm oil market and exports in Indonesia are therefore also growing, since most other possible producing countries have little room for growth, besides Indonesia and to a smaller extent Malaysia. Therefore reductions or problems in production Indonesia influence market prices palm oil strongly.

The Indonesian market is expected to being able to grow considerable in the coming years (good and young trees standing, proper infrastructure, stable government and good organisation of palm oil market). They experience less problems then Malaysia with aging tree stock, bad infrastructure and lack of land available for expansion. If this would not be the case and demand from the edible oil market will be growing, prices would go up and food insecurity would increase.

---

[59] FAO price information (faostat.org.com); 2010 FAO price information data is not available yet, based on market insights expected price movement is displayed in table.

[60] FAO price information (faostat.org.com); 2010 FAO price information data is not available yet, based on market insights expected price movement is displayed in table.

However the growth of production might slow done (from January 2011 onwards), since it became clear that a disagreement between Indonesian government and local governments on the zoning and special planning was hampering further expansion.
The increasing production did not only aim for the increased international demand, but also within Indonesia the availability of palm oil on domestic food market increased.

About 10% of the oil palm plantations in Indonesia are state owned, 50% by private investors and 40% by smallholders. Palm oil is a highly lucrative agricultural business for smallholders as well as commercial growers with considerable margins to be made at both levels. Due to this high profitability and increasing demand, there is large interest from smallholders as well as commercial investors to step into palm oil ventures.

Table 69.Average palm oil prices in Indonesia 2005-2009 (Producer Price (US $/tonne)).

	2005	2006	2007	2008	2009	2010[61]
Indonesia	238	287	319	442	403	⇧

Indonesian palm oil prices have seen a strong increase since 2005 towards 2008. 2009 showed a reduction in prices, while FAO 2010 prices are not yet known. The international palm oil price (mostly set by the Indonesian palm oil market) saw a slight increase over 2010 (IndexMundi 2012) after the drop in 2009.
As indicated in the land use quantification section in 4.2, the Indonesian palm oil used for EU biofuel consumption is minimal compared to the overall Indonesian palm oil production.

Palm oil in Malaysia

After period of long sustained growth, Malaysian market growth has been stagnated these last few years. Since Malaysia is one of the main suppliers of palm oil to the edible oil market (after Indonesia), it is worrying that while international demand is growing Malaysian production is not increasing. This will put pressure on the market and might even sustain current high prices. Reasons for stagnating market are government policies, declining availability of new land and recent stagnation of national yields (caused by weather conditions, declining fertilizer rates and low replanting rates). Many Malaysian companies have foreseen this and are investing in palm oil plantations in other countries (Indonesia or Liberia). Another mentioned factor for yield stagnation is the scarcity of skilled labour for harvesting.

Malaysia actually has policies in place to promote local biofuel (biodiesel) consumption, but due to international high prices for biofuels (and thus exported from Malaysia) and locally subsidized fossil fuel prices this local consumption is not rapidly gaining ground. Malaysian biodiesel production has been reducing, utilizing the installed capacity at a low rate. Furthermore, exports have also declined.

[61] FAO price information (faostat.org.com); 2010 FAO price information data is not available yet, based on market insights expected price movement is displayed in table.

Table 70. Average palm oil prices in Malaysia 2005-2009 (Producer Price (US $/tonne)).

	2005	2006	2007	2008	2009	2010[62]
Malaysia	368	417	330	318	326	⇧

Malaysian palm oil prices have not seen the same trend as Indonesian palm oil prices, probably due to the large growth of production in the past couple of years. Prices in 2010 were lower then Indonesian prices in 2009. Prices in 2010 remained relatively stable (at 2009 price level) for the larger part of 2010 but increased towards the end of 2010 (MPOB 2012).

As indicated the larger part of the Malaysian palm oil production is used on the edible oils market. The biofuel market is minimal compared to the palm oil use for non biofuel purposes (see the land use quantification section in 4.2).

4 *Interaction between global and local food/agricultural markets*

Transmissions of fluctuations on the global market to local markets are not straightforward. They vary a lot based on policies in countries, type of crops and local production characteristics. As AMIS 2011 shows transmission rates can even differ for the same crop in the same country due to changing market or global conditions. They analysed main cereal changes for the price peak in 2007/08 and 2010/11 and found that in the second price peak transmission of the peak to the local market was less then in the first price peak. Better preparedness, improved stock and the types of crops affected (less price rise in staple crops but more in meat and dairy) made transmission to developing countries lower for the 2010/11 period.

The availability and affordability of food within a specific country can be guaranteed in two ways: by food production in the country itself or by trade (Nelleman et al, 2009). Trade has become increasingly important due to better transport possibilities and storing capacities as well as the growing challenges faced by some countries in their domestic production, including limitations in available cropland (Nelleman et al, 2009).

In general AMIS 2011 indicates that the relation between global and domestic prices is strongly influenced by level of self sufficiency, natural barriers and policies that moderate transmission. This is supported by FAO 2011, who adds that some governments have policy options to close markets in times of high prices, making local impacts less profound.

FAO 2012 indicates that the type of economy within a country has high influence on the transmission of food price fluctuations and the eventual impact on food security. For example low developing countries and net importing developing countries are often more vulnerable for transmission of price fluctuations and in those countries

[62] FAO price information (faostat.org.com); 2010 FAO price information data is not available yet, based on market insights expected price movement is displayed in table.

also the impact on food security is more severe than for net importing developed countries. To reduce costs and impacts of international food prices FAO 2012 gives options like reducing applied tariffs, avoiding export restrictions, stockholding and domestic food assistance, regional market integration and investing in food production and resilience.

5 *Local food affordability and food prices*

Food security and affordability includes not only production and supply, but also availability, accessibility, stability of supply, affordability and the quality and safety of food. Alongside these factors, it is necessary to take into account socio-economic issues, particularly in developing countries where farmers are more affected.

Food prices affect a variety of stakeholders. Nevertheless, the impacts are not just due to the price changes. For instance, climatic fluctuations are known to affect post-harvest losses and food safety during storage (e.g. aflatoxines). Extreme weather events under climate change will damage infrastructure, with detrimental impacts on food storage and distribution, to which the poor will be most vulnerable (Vermeulen et al, 2010). Another report considers that cereal prices will rise significantly due to climatic changes leading to a fall in consumption and nutrition value and hence decreased calorie availability and increased child malnutrition (Nelson et al, 2009; Ziska et al.).

The way domestic and global price fluctuations impact the local consumers also differs for countries. With crops comprising a small share of the final cost of food in high-income countries, the impact of price effects on food consumers is smaller (WB 2011). To low-income countries, where expenditure on raw grains and vegetable oils comprises a much larger share of the household food budget, a given increase in crop prices will have a much larger impact on food consumers (WB 2011).
FAO et al (2011) indicates that developing country markets often lack the capacity to absorp domestic shocks (creating high local volatility). Climate shocks, pests or natural calamities might have an increased impact in these countries due to the fact that farmers have poor access to technologies and in general practice poor management of soil and water resources. Additional factors increasing shocks in domestic markets can be poor infrastructure, high transport costs, absence of credit/insurance markets and various policy and governance failures (FAO et al 2011).

Not only between countries or regions, but also between different groups in a country there can be different responses to high food prices. High prices can be beneficial for one group but negative for another, depending on their consumption/production pattern and their level of income. This is caused by the various dimensions underlying the concept of food affordability & security (FAO 2008a):

- Availability of food is determined by domestic production, import capacity, existence of food stocks and food aid;

- Access to food depends on levels of poverty, purchasing power of households, prices and the existence of transport and market infrastructure as well as food distribution systems;
- Stability of supply and access may be affected by weather, price fluctuations, human-induced disasters and a variety of political and economic factors;
- Safe and healthy food utilization depends on care and feeding, food safety and quality, access to clean water, health and sanitation.

Urban populations are mostly negatively affected by high food prices, since they are net consumers and can not profit from the higher income created by high food prices.

For rural population there are differences. The rural population is diverse, consisting of large producers, small holders, net consumers etc. Many smallholders and agricultural labourers are net purchasers of food, as they do not own sufficient land to produce enough food for their families. Empirical evidence from a number of sub-Saharan African countries shows that a majority of farmers or rural households (depending on the survey definition) are not net food sellers (FAO, 2008).
For the poorest, high food prices are most of the time negative although the creation of labour in agriculture might compensate that partially (FAO 2011).

On longer term however FAO (2011) indicates that high prices are regarded as beneficial since it provides opportunities and higher profitability for agricultural markets (which are most of the time also in developing rural regions). This besides the opportunities that could be created by biofuel production on the longer term as an income generating activity and as a boost to development of agriculture practices/technologies (BEFSCI 2012).

FAO et al (2011) presents a set of suggestions that could improve the position of small holders and rural populations in these price fluctuations and changing markets, since they expect that the volatility of these agricultural markets will not reduce on short term. Among these suggestions are indications to reduce volatility of the agricultural market like:
- Investments in agricultural R&D;
- Accessibility of technologies to small scale farmers;
- Better/reliable and up-to-date information on markets and prices;
- Set up of international food stocks which can absorp fluctuations in production better;
- Reduction of import barriers, trade distorting measures and all forms of export subsidies;
- Reduction of wastes as to increase production of feedstock.

Furthermore they provide ideas that would help smallholders to be more resilient, like improving of agricultural innovation systems and supporting smallholders to develop and invest technologies and practices.

Concluding remarks

The local and global food prices of 2010 and their height can not in all cases be directly and only related to biofuel production. The international markets have been influenced by many other factors then biofuel production which impacted food prices stronger, like among others weather, tightness in the market and oil prices. Biofuels do add to the demand and the inelasticity of the market, so it is not possible to exclude any impacts from biofuel production on global food prices.

Backcasting scenario analysis of the global agricultural market development clearly shows that EU-27 expanding biofuel use has contributed only little to the historical cereal price increases in 2007 to 2010 resulting in a wheat and coarse grain price increase of about 1-2%. The impact was more substantial for price increases of non-cereal food commodities by about 4%, notably through its demand for vegetable oil in the production of biodiesel.

Transmission of global food prices to domestic prices is less transparent and differs a lot between counties, crops and other circumstances. Finally, not all local population is impacted in similar manner by high local food prices. Overall these elements make it difficult to clearly and transparently state the impacts of biofuel production on local food prices and food security.

However, from the local cases analysed in this section, no concrete indications of biofuel production being a main cause of local food price increases could be found. In most cases, biofuel production did not seem the specific cause of the price surge. It did add to demand, but in many cases harvests of 2010 were improving compared to 2009, in some cases even leading to abundance of the feedstock on the market (like soy in Argentina or sugar beet in the EU). In other cases, other uses/applications of the feedstock were main drivers of the market and price movement (for example the sugar or palm oil market). Use for biofuel production might add to these movements, but is minimal compared to the existing and growing uses.
In cases where production was low in 2010 (like rapeseed in EU) market reports state that the use of this feedstock for biofuel production was reduced, while other applications of this feedstock were less affected.

Land use rights

During the last few years (2008 – 2012), several concerned civil society organizations have linked negative impacts in land use rights to the increased demand for biofuels (ILC 2012; Pisces 2011; Grain 2012; ActionAid 2012). UN Special rapporteur on the right to food Olivier De Schutter states that "biofuel crops often lead to land-grabbing".

The comprehensive global study about land deals by ILC (2012) concludes that from 2000 to 2010, worldwide about 71 million hectares of cross-referenced[63] land deals were closed. The ILC study is based on a 'Land Matrix', a database that includes deals reported as approved or under negotiation. The study concludes that 73% of the cross-referenced deals are for agricultural production, of which three-quarters are for biofuels. In other words, they conclude that over 50% of global land deals are for biofuels (comprising 40% of the hectares where the crop is known). ILC suggest that the rate of acquisitions remained low until 2005, whereafter it accelerated greatly, peaking in 2009 and slowing down somewhat in 2010. The surge of 2005–2009 can be related to the food price crisis and a range of factors that triggered new investor interest in land, including biofuels.

Pangea (2011)notes that "many now believe that biofuel production is one of the root causes of land grabbing in developing countries, even though statistics indicate that as much as three quarters of the land acquired is for crops other than for biofuels".

The ILC study stresses the risks for negative impacts from land deals, especially in developing countries, resulting in the loss of access to land, water and other natural resources by local communities, and eventually leading to poverty and hunger. The phenomenon of land deals with negative socio-economic impacts is generally called land-grabbing.

Information about the origin of EU consumed biofuels (in terms of countries and feedstock), as established in Chapter 2, cannot be used to understand the relation between land-grabbing and the EU biofuels demand in 2009-2010[64]. The lead time between the moment of land-grabs and the production of biofuels is at least 3-5 years. So, starting from the EU consumption in 2010, we would have to assess land-grabs in 2005-2007. And any land-grabs occurring in 2010, if even slightly stimulated by the projected future EU biofuels demand would not be covered by such an analysis.

It seems more useful to concentrate on the land deals in 2009-2010 and to find out their possible relation with the EU demand for biofuels. To understand in how far the demand for biofuels in the EU causes land-grabbing (in 2009-2010), it is should be understood:

- Which of the land deals classify as land grabs;
- Which of those land deals were aimed at biofuel production;
- What is the link with the EU biofuels demand.

[63] The Land Matrix is a database of large-scale land-based investments, that include transactions that entail a transfer of rights to use, control, or own land through sale, lease, or concession; Imply a conversion from land used by smallholders, or for important environmental functions, to large-scale commercial use; Are 200 hectares or larger. The database contains two sets of data: "reported" (from published research reports and media reports and government registers) and "cross-referenced" (deals that are referenced from multiple sources and triangulated for reliability with other information sources, and, in-country partners in some cases) The database and its details can be accessed online at http://landportal.info/landmatrix

[64] ActionAid [2012] expressed their concern about the scope of the assessment on land-use rights in our assessment. A focus on 2010 biofuels consumption, would not give any insights in any land grabbing practices resulting from the projected demand for biofuels created by the Renewable Energy Directive.

As will be discussed below, all of these links are difficult to establish.
Our focus is on the developments in 2009 and 2010, the focus of this report. In the next report, it should be analysed if, why and how land grabbing as a consequence of EU biofuels demand changes in the 2011/2012 reporting period.

Land grabbing within land deals

It is impossible to get definitive data on the scale of land-grabs especially because the definition of what might be considered a land-grab can vary significantly (Pearce 2012). Whether or not a transaction can be classified as land-grab depends upon the context. In most instances, land allocations do not violate domestic laws as the majority of large-scale land leases involve state-owned land, which may be leased to tenants. Pangea [2011] summarises that if the community has not been consulted properly and people lose resources that have supported their livelihoods for generations, without adequate compensation, then this could be considered a land-grab.

There are some international guidelines for compensation and livelihood-rehabilitation (IFC) and in many developing countries there is national legislation that details out the compensation methodology. Still, even when such guidelines and legislation is followed, the compensation may not be valued as being adequate. Furthermore, discontent can exist if expectations with regard to local socio-economic developments are not met (employment, infrastructure, social services, improved agricultural practices). For example, in Tanzania several biofuel feedstock investments failed and projects were abandoned in 2009-2011 (Pisces 2011; ActionAid 2012) before compensation was properly completed, or where the long term benefits from the investment did not materialise: people lost access to land but did not get employment in return. This illustrates that rules and guidelines are not sufficient, but that enforcement and grievance systems must also be in place, with the ultimate consequence that deals could be reversed if agreements are broken. It also illustrates that there can be a time lag between the land deal and the discontent. Land deals that are in principle appropriate at start can be perceived as grabs years later.

Pearce (2012) further states that many land deals will occur in the utmost secrecy, and only come to light when large projects are implemented, or never at all. However, if the land deal (in 2009/2010) is intended for the (future) production of biofuels for the EU market, it would come to light quickly, as the origin of feedstock needs to be certified. So, this problem is less relevant for biofuels for the EU market.

There are many media reports on land deals with negative consequences. In reality, not all those deals actually took place. Moreover, while there are many media reports on land deals that have gone sour, deals with positive results are barely covered. Also here, we will not search for positive examples.

As can be concluded from the above, it is very difficult to bring an absolute distinction between good and bad land deals. The topic is multi dimensional in issues, timing and responsibility.
While the extensive study by the ILC and the underlying database does distinct between good and bad land deals, it could be a good starting point for further research. Unfortunately, not all the deals reported by ILC in their report (203 Mha) are available in the database (48 Mha only). Since the database contains almost 700 entries on agriculture (representing a total of 40 Mha), it is impossible in the frame of the present project to analyse each entry. For regions of highest concern with regard to land grabbing, we have attempted to obtain more information on the five largest agriculture land deals for reported irregularities and discontent.

Table 71. Largest land deals in sensitive regions[1)].

Region	Total deals and area	Agriculture	Top-5 [2)]	Concerns [3)]	
Western Africa	98 deals 3.8 Mha	84 deals 3.2 Mha	1.4 Mha→ 1.0 Mha	220 kha	16%
Eastern Africa	260 deals 8.8 Mha	199 deals 6.9 Mha	1.6 Mha→ 0.9 Mha	470 kha	29%
Central Africa	27 deals 1.1 Mha	23 deals 0.7 Mha	0.5 Mha→ 0.2 Mha	0 kha	0%
North Africa	18 deals 3.1 Mha	15 deals 1.4 Mha	1.3 Mha→ 1.1 Mha	600 kha	46%
Southern Africa	5 deals 0.04 Mha	3 deals 0.02 Mha	0.02Mha→0.02Mha	0 kha	0%
South America	132 deals 6.4 Mha	89 deals 4.8 Mha	2.2 Mha→ 0.4 Mha	76 kha	3%
South Asia	114 deals 4.7 Mha	20 deals 3.1 Mha	2.9 Mha→ 0.1 Mha	14 kha	0%
South-East Asia	216 deals 17.3 Mha	196 deals 16.7 Mha	3.9 Mha→ 0.5 Mha	496 kha	13%
Total		629 deals 36.8 Mha	13.8 Mha→4.2 Mha	1876 kha	14%

1) Full details for this table are given in Appendix IX. For each region the Top-5 of projects were assessed, starting from references provided in the Land Matrix database and through brief internet searches.
2) The total acreage of the top-5 agricultural investments as found in the database, followed by the acreage corrected for errors, as explained in footnotes per region in Appendix IX.
3) The fraction is based on the corrected acreage of the top-5 of land deals in the Land Matrix per region. Only recent concerns (2009 – present) are taken into account, to establish an understanding of the present situation. The research was limited to examination of reports referenced by the Land Matrix and additional internet searches. As explained in the text, there are no simple guidelines to qualify land grabs. Initiatives, for which significant-major concerns were ventilated in media or research reports, are marked as "concern".

From the analysis it becomes clear that many entries in the database do not constitute actual, (properly) registered deals. Of the 13.8 Mha we examined, only 4.2 Mha could be be judged as signed deals (30%). Since we have not analysed the remainder of 23 Mha, we must assume that this could concern actual registered deals[65], which leads to an upper boundary of actual registered deals of 74%.

We conclude that a significant part of the land deals in the Land Matrix are surrounded by significant to serious concerns. We estimate that this concerns about 14% of the deals that are listed in the database, and part of these could probably be seen as land grabs. If the 23 Mha of not examined deals are all correct and would all be surrounded by concerns, then the upper boundary is 68% of the deals listed in the database.

[65] The remaining deals are smaller deals, which we think are more likely to concern real deals, less connected to announcements.

It must be noted that the Land Matrix database contains several serious flaws, which could be natural to this first attempt of reporting all the land deals in the world, but which should be corrected before the database becomes really useful. A policy brief by IIED (2012) stresses that the data must be treated with caution. The Land Matrix is based on reports from the media and NGOs which often overestimate scale:

- A reported 10 million hectare deal in Congo, for example, is in reality closer to 80,000 hectares [IIED 2012];
- Of a reported 2.8 million hectare deal in the Democratic Republic of the Congo, only a lease for 100,000 hectares has been verified [IIED 2012];
- An 800 kha deal in Mato Grosso do Sul in Brazil turned out to be a potential for which the NGO was worried, when in reality only 160kha had been planted cumulatively (and only 51kha in that year);
- A 490 kha deal in the State of São Paulo actually refers to 12,000 existing properties of mostly sugarcane;
- A 2Mha Jatropha deal in India, seems to be based on nothing more than the government's biodiesel ambitions, while a number of similar deals of varying but large acreage refer to the same source;
- Some of the largest agricultural deals in South East Asia are in fact forestry concessions (a seemingly large 2.39 Mha Papaya deal in Indonesia being in fact a forest concession of 760kha established for pulpwood).

Others comment that 6.4 Mha in the Land Matrix top-10 of land deals have never come to fruition. The database contains many duplicate entries and unverifiable entries (The Land Matrix 2012.

Many 'deals' references given in the LandMatrix database do not correspond to specific deals. Often, the areas quoted are mere stated objectives or potentials, or large multi-stakeholder government programmes. Many sources are reports or articles that cover large, multi-deal projects, countries or regions, thus very likely leading to overlap between sources and deals mentioned in the LandMatrix database. In many cases, the references given, do not allow to come to the large areas claimed to be affected by the deals. Based on our brief analysis of the top 5 deals from each region, we propose a few suggestions for improving the database:

- Check that the links to references are not broken (in particular all the references to the blog entries of the IDLC website are broken, which makes many claims untraceable);
- Make the distinction between 'potential deals' and 'actual (closed) deals';
- Make sure that the reported deals cover specific deals or projects, but not a large group of projects over a large region (which typically makes it difficult to distinguish which parts cause concerns);
- Where possible make the distinction between large 'main deals' (for example government concessions) and sub-deals (actual projects leading to an activity on the land);
- Show if and how a source has been triangulated.

Establishing the link with biofuels

Some land deals involve crops that almost uniquely serve as biofuel crops, such as jatropha or castor. Land deals involving rice or flowers are not intended to produce biofuels. However, biofuels are generally produced from crops that have multiple outlets: wheat, maize, edible plant oils, sugar cane. If biofuels are to be produced, they are often part of a product range, e.g. the AgroEcoEnergy project in Tanzania aims to produce sugar, energy and biofuel, biodiesel has usually animal feed as a co-product. Some land deals are clearly aiming at biofuels production (it is in the name or mission statement of the company involved). In other words, it is possible to establish a rough understanding of which land deals link to biofuels, but there is a considerable bandwidth of uncertainty.

Again, the ILC Land Matrix provides a very useful starting point, taking into account the notions on shortcomings discussed above.

Table 72. Land deals in the land matrix.

	Total agricultural	Possibly linked to biofuels[1]		Corrected	
Western Africa	3.2 Mha	0.4 - 1.8 Mha	(13% - 56%)	0.4 - 1.8 Mha	(13% - 56%)
Eastern Africa	6.9 Mha	2.5 – 4.4 Mha	(36% - 64%)	2.5 – 4.4 Mha	(36% - 64%)
Central Africa	0.7 Mha	0 – 0.3 Mha	(0% - 43%)	0 – 0.3 Mha	(0% - 43%)
Northern Africa[2]	1.4 Mha	0.6 – 0.6 Mha	(43%)	0 Mha	(0%)
Southern Africa[3]	0.02 Mha	0 – 0.02 Mha	(0 - 100%)	0 Mha	(0%)
South America[4]	4.8 Mha	0.1 – 2.5 Mha	(2% - 52%)	0.1 – 1.1 Mha	(2% - 23%)
South Asia[5]	3.1 Mha	3.1 – 3.1 Mha	(100%)	0.1 – 0.3 Mha	(3% - 10%)
South-East Asia	16.7 Mha	0.8 – 6.7 Mha	(5% - 40%)	0.8 - 3.0 Mha	(5% - 18%)
Total	36.8 Mha			3.2 – 10.9 Mha	(9% - 30%)

1) The link to biofuels is established for all the land deals reported in the Land Matrix, on basis of the primary feedstock per entry as mentioned in the database. To establish the lower boundary value, we took into account that some crops are uniquely grown as biofuels feedstock (only jatropha). The upper boundary takes into account the fraction of a crop that maximally ends-up in biofuels, using allocation principles from the Renewable Energy Directive. For example, maximally 60% of wheat relates to bio-ethanol, because animal feed is always co-produced). Co-production of electricity is not accounted for (e.g. when ethanol is produced from cane, electricity is not seen as a co-product) because it is not appreciated as such in the Renewable Energy Directive. Several crops are (almost) never used for biofuels (rice, rubber, eucalyptus, fruit, tomatoes, teak, cashew, etc.).

2) The possible link to biofuels in Northern Africa entirely relates to the plans of Nile Trading and Development in Sudan. Background information revealed that the project involves forestry, agriculture and mining, with an apparent focus on agrofuels. Since jatropha is mentioned as primary crop, the entire deal 600 kha could be linked to biofuels, which is the result in the table, although we deem this highly unlikely.

3) The 0.02 Mha in Southern Africa concerns two sugar cane projects by Illovo. As Illovo is a sugar producer, it is highly unlikely that the feedstock will end up in biofuel.

4) Of the 2.5 Mha that could be linked to biofuels in South America, 1.4 Mha relates to sugar cane plantations in Brazil and Peru, 0.4 Mha relates to oil palm, mostly in Brazil and Colombia, and 0.3 Mha in soybeans, mainly in Brazil. For a large part these land deals aim at the production of food and feed.

5) Most of the deals listed for South Asia concern Jatropha in India. As can be derived from Table 89 and its footnotes, the actual acreage in existing deals is rather between 0.1 and 0.3 Mha.

6) of the 6.7 Mha in South-East Asia, that could be linked to biofuels, 4.1 Mha relates to palm oil, which is primarily expanded to serve the food market.

Overall, looking at all deals in the database, between 9% and 30% of the deals in the database, on acreage basis, could be related to biofuels.

The crops concerned:
- About 2.9 Mha relates to maize and cereals, which can be used to produce biofuels;
- 7.5 Mha relates to jatropha and pongamia, which are only grown to produce biofuels;
- 7.5 Mha relates to palm oil, which can be used to produce biofuels;
- 1.5 kha relates to soya beans and other oilseeds, which can be used to produce biofuels;
- 2.5 Mha relates to sugar or sugar cane, which can be used to produce biofuels;
- The remainder relates to crops that are not used for biofuels production.

Link to EU

It is complex to establish which part of the biofuel related land deals link to the demand from the EU market, especially because there is a time lag between the closing of the deals and the final production and international market situations can change from year.

At present, there is insufficient information available to link even biofuels oriented projects to the demand in the EU market, even if projects often use the EU Renewable Energy Directive as part of their argumentation.

At present, about 21% of the world's biofuels are consumed in the EU and this fraction is projected to decrease in the coming decade, as more and more countries install policies to incentivise biofuels deployment. A large part of the EU consumed biofuels will always come from the EU, and significant contributions can be expected from the USA, both regions with no or less concerns on land-use rights. Nevertheless, EU imports of biofuel/feedstock will increase and it is probable that many projects in developing countries have been initiated because of the luring EU biofuels market. As a rough guess, possibly 10% of the biofuel production and new projects in regions with concerns on land-use rights could have eyed the EU market.

A better understanding of the link could be established on basis of:
- Only a few projects clearly advertise that they intend to sell to the EU market – even though this is no guarantee that they will do so eventually, one can still argue that such investments are motivated for a large part by the EU market;
- For some established producer countries (Brazil, Argentina, Malaysia, Indonesia) one could argue that the fraction of biofuel related land deals (acreage) linked to the EU is in line with the historical biofuel/feedstock exports to the EU;
- For new producer countries it can be assessed in how far the countries aim to create a domestic biofuels market, or primarily aim at biofuels export.

It is difficult to specify a certain amount related to the EU market, but it can be concluded that part of the deals might have been motivated by the EU market prospects. As the time lapse between these deals and actual production is at least a couple of years (involving possible failure of the project at the end), it is premature to link these deals directly with the EU biofuel consumption.

In summary

When the above analyses are combined, we see:

- Of the 48 Mha land deals that are reported in the Land Matrix, about 37 Mha occur in regions that have known concerns on land-use rights;
- Based on scrutiny of the top-5 deals in these regions, we estimate that about 30% of the acreage reported in the Land Matrix concerns actual deals, this equals 11 Mha;
- For about 14% of the acreage reported in the Land Matrix, significant to serious concerns are found, this equals 5.2 Mha, part of which will probably qualify as land grabs;
- Between 9% and 30% of the deals reported in the Land Matrix can be linked to current or future biofuels production. This implies that the biofuels (worldwide) could be linked to between 0.5 and 1.6 Mha of land deals with significant to serious concerns;
- Possibly about 10% of these deals eyed the EU market.

We conclude that between 0.05 and 0.16 Mha of land deals with concerns about socio-economic impacts and land-use rights could be linked to the EU market. This analysis is based on examination and extrapolation of the top-5 deals per sensitive region, which represents only 30% of the agricultural acreage in the Land Matrix.

If the not-examined deals registered in the Land Matrix would all be correct and worrisome (which we deem unlikely), and if all the biofuels in the EU (21% of global biofuels consumption) would originate from land deals in sensitive regions (although it is known from Section 2.7 that around 64% of the feedstock for EU biofuels in 2010 originates from the EU) then rather 0.4 – 1.5 Mha of land deals with concerns about socio-economic impacts and land-use rights can be linked to the EU market. Note that it is very difficult to establish how much land deals in the past decade have eyed the EU biofuels market.

Employment

In 2010, world gross employment was estimated at over 3.5 million (IRENA, RED) in biofuel for transport and renewable energy for transport, with an estimated 1.5 million in first generation ethanol and diesel biofuels (IRENA, 2011). In addition, in the EU 221,183 jobs were estimated in the sector for biodiesel and bioethanol for transport in 2010 (Urbanchuk 2012). Based on estimates and projections of the Global Renewable Fuels Association (Urbanchuk 2012), global ethanol and biodiesel production supports nearly 1.4 million jobs in all sectors of the global economy in 2010. These jobs include not only direct biofuels production, but also the jobs in agriculture, other supplying industries, and other sectors such as retail and wholesale trade that benefit from the economic activity generated by biofuels. The largest share of employment for ethanol occurs in the U.S. and Brazil although the fastest growth is projected to be realized in the developing Asian and African producing countries.25 As the biofuels industry evolves the employment impact is projected to grow to more than 2.2 million jobs by 2020 (Azevedo, 2010)[66].

A comparison of job creation attributable to biofuels in 2008 and 2010 for the main countries that export biofuel to, or produce it within, the EU is shown in Figure 123 where, according to the sources cited, there has been a noticeable increase in the number of jobs created in the biofuels industry over the two year period.

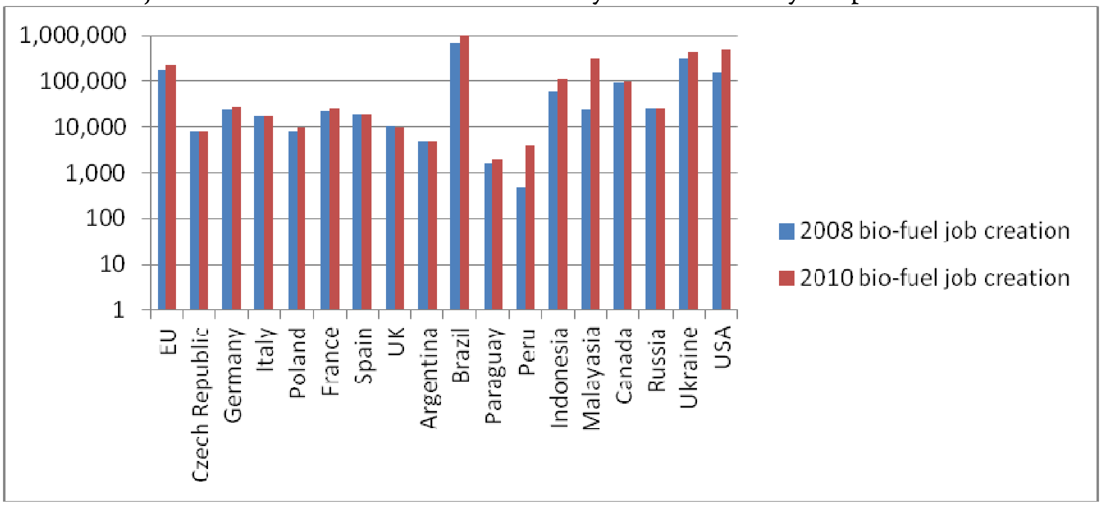


Figure 123. Biofuels for transport job creation 2008-2010 selected EU and non EU countries [67].

*Some data is extrapolated from estimated proportions of country % agriculture of GDP and levels of jobs known in selected EU and developing countries.

For the EU-27, EurobservER estimated employment due to biofuels at over 150,000 jobs covering the agricultural supply chain in the EU-27 (EurobservER 2011 p. 157). The same source also estimated € 13.3 billion in 2010 for biofuel turnover compared to €11.5 billion in 2009. This has occurred despite issues of fluctuations, dumping charges (on the US), concerns over biofuels and the food and fuel debate, and plant shutdowns. Even with these issues, the number of biodiesel and bioethanol plants in Europe has increased as indicated in Table 90. Of the selected EU countries included in Figure 123, Germany, Poland, and France all show small increases with other EU selected countries, Czech Republic, Italy, Poland, Spain, and UK remaining stable

Outside of the EU, it can be seen from Figure 123 that the U.S. continues to expand biofuels and job creation over Canada or Russia yet lower than non-EU less developed

[66] A check on their methodology is provided by a report that the Brazilian ethanol industry supports 465,000 jobs. See Thomas Alvares de Azevedo. "Fueling Brazil: The Effects of the Ethanol Cluster in the Local Community". P155. The Journal of Energy and Development. Vol 33, No 2. 2010. By comparison our estimate for Brazilian employment resulting from ethanol using more current data is 444,378.

[67] Sources: FAO Stat, Eurostat, Cardno Entrix 2012, World Bank Data, USDA

countries such as Brazil Malaysia, and Ukraine. Although this report focuses only data from 2010, due to the limited amount of sources, data from the National Biodiesel Board (Bioenergy 2011), was used as it projected by 2011 that the US biodiesel industry could support more than 74,000 jobs and US$4 bn by 2015. The study predicted the biodiesel industry would support more than 31,000 jobs in 2011, generate income of nearly US$1.7bn to be circulated throughout the economy, and create more than US $3bn in GDP. All the non-EU counties in Figure 123, with the exception of Russia, show increases in jobs created between 2008 and 2010. Malaysia has the largest increase followed by Peru and the USA.

A case study from Nuffield Council on Bioethics Ethics (2011) on production of palm oil in Malaysia for biodiesel indicates that as the second largest producer of oil palm, after Indonesia, has raised widely publicized concerns regarding the conversion of forests to palm plantations negatively impacting biodiversity and indigenous people who may not be benefiting from employment opportunities to offset impacts. The imbalance in access to jobs for indigenous people is a social factor that needs to be addressed as land tenure and access to inputs do not reach indigenous people.

Factors affecting Job Creation

Of prime importance, a number of studies indicate[68] that farmers benefit from engaging in feedstock production when the enabling environment (via tax incentives, land titles, subsidies, and land right policies) is profitable, equitable and there are built-in measures to diversify. Providing incentives (e.g. seeds and tax breaks) and expanding existing infrastructure creates opportunities for agents along the value chain.

Unlike fuel free technologies (e.g. wind and solar PV) which mainly create jobs distant from their point of application, biofuel production is more labour intensive at the point of feedstock growth and production (IRENA 2011). For developing countries or even developed countries that seek to promote investment in rural areas, this characteristic of biofuels is of value.

The majority of jobs are currently located in a small number of major economies – China, Brazil, Germany, India and the United States. Even though labour productivity evolves through time, studies have shown that renewable energy technologies are currently more labour-intensive than fossil fuel technologies (IRENA 2011).

[68] Macedo I.C., 2005. Sugar Cane's Energy: Twelve Studies on Brazilian Sugar Cane Agribusiness and Its Sustainability. São Paulo: UNICA (São Paulo Sugarcane Agroindustry Union) (2008 baseline) and APEC 2010, A Study of Employment Opportunities from Biofuel Production in APEC Economies. APEC EWG 07/2008A: "Biofuels not only create jobs in rural areas through new biorefineries and new feedstock harvesting, seeding, and transportation activities, but biofuels also provide a logical growth path into increased mechanization and higher productivity. Plant size and feedstock harvest areas can be justifiably increased over time in light of biofuels high-value product profile, and this means that rural areas can gradually increase their productivity and attendant potential incomes.

Data on jobs created and their characteristics is quite difficult to find in the literature. Furthermore, available data tends to be incomplete or limited. Table 90 and Table 91 (Appendix X) present some of the available data for EU and non-EU selected countries. Both tables concentrate on factors directly affecting employment including various incentive packages such as subsidies and tax credits and examples of stimulus packages for producing biofuels in efforts to meet demands to comply with biofuels mandates. Wages, as available, for certain work; seasonality and frequency, and types of jobs along the value chain are considered.

As shown in Table 90 (Appendix X), the United States in 2010 was considered the top producer of ethanol and by the end of 2010 half a million (500,000 jobs) were created, which is almost more than doubled since 2008 in which only 154,000 jobs were created. The incentives were for biofuel production such as Small Ethanol Producer Tax credit and Value Added Producer Grants. Energy Technology Loans provide Guarantee to projects that reduce air pollution and greenhouse gases, and support use of advanced technologies, including biofuels and alternative fuel vehicles; both biodiesel and ethanol. Argentina is the fifth largest producer of biofuels especially in the biodiesel capacity. Its main focus is biodiesel; however, soy is on the rise.

In 2010 Argentina produced a total of 30% of the world's biodiesel. Brazil employs as many as one million people in their biofuel sector. Brazil also is labelled as the most successful in job creation for biofuel sector as it focuses mostly on ethanol. In 2010 and remains to be one of the top producers in the world of ethanol. With the combination of US and Brazil it leads to be 88% of world production of ethanol. More research needs to be done to link private sector with job creation and skills training for ensuring qualified employees and job transitions in the biofuels sector.

Table 90 (Appendix X) illustrates the various types of incentives, farmer encouragement and private investment in production of biofuels in EU countries and types of job creation as a trend from 2008 to 2012. Job creation is more at the industrial and processing and service delivery level than non EU underdeveloped countries in with exception of Brazil who balances the crop production processing and shipments reflecting jobs along the value chain. Table 91 indicates the relation of job creation to the GDP and can be seen that in the exporting countries to the EU, GDP is increasing. It is often stressed that these two key energy policy objectives – security of supply and environmental sustainability – should be targeted without sacrificing the third one - economic sustainability. It is therefore important that increasing the share of Renewable Energy Systems (RES) does not harm the economy, rather benefits it by creating jobs and increasing GDP (Fraunhofer, Ecofys et al 2009). .

The GDP of each country can be attributed to agriculture in relation to level of development and industrialization. World Bank data indicates, as seen above, that the relation of agricultural contribution to the GDPis related to the level of development- the higher the GDP the lower the percent put toward agriculture proportionately. We can see that most countries have maintained the same percent agriculture between 2008 and 2010. Using Cardno Entrix study on *Contribution of Biofuels to the Global*

Economy (Urbanchuk 2012), we can consider this a proxy of relation of biofuels to the GDP. The global biofuels industry is making a significant contribution to the individual economies of producing countries and to the global economy as a whole.

Biofuels growth could come at a steep human and environmental price – the numbers of jobs may grow by the millions but they need to be interpreted carefully, wages, conditions, rights, and environmental impacts need to be considered. (UNEP World Watch 2008).

Concluding remarks employment

We find a significant increase 2008-2010 in biofuel production in EU countries most notably especially in developing countries. Taken as a whole, it may still be relatively nominal however, with the exception of Brazil (mechanization, relative enforcement of child labour and forced labour laws), there have been no significant concomitant interventions by policy makers in developing countries beyond tax breaks and incentives, to address labour conditions and standards in the countries from whom the product is being sourced.

International Conventions & Labour Standards

In total eight Fundamental Conventions per ILO[69] and two biodiversity conventions[70] are included in the RED and in this analysis. Various sources are reviewed like the websites of the conventions, US department of Labour and ILO SIMPOC indicators[71], GBEP reports and similar sources. The data obtained in 2008 is compared to current status 2009/2010.

Table 73 and Table 74 indicate the levels of ratification of international conventions for the main countries. In terms of ratifications, there have been no significant changes pertaining to the eight fundamental conventions; however, in terms of efforts to strengthen labour practices and non-discrimination, Poland and Indonesia are making efforts in equity and non-discrimination. Child labour and forced labour continue to be prevalent in Indonesia in oil palm.

69 Forced or Compulsory Labour (No 29); Freedom of Association and Protection of the Right to Organise (No 87);Application of the Principles of the Right to Organise and to Bargain Collectively (No 98); Equal Remuneration of Men and Women Workers for Work of Equal Value (No 100); Abolition of Forced Labour (No 105); Discrimination in Respect of Employment and Occupation (No 111); Minimum Age for Admission to Employment (No 138); Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labour (No 182).

70 Cartagena Protocol on Biosafety and Convention on International Trade in Endangered Species of Wild Fauna and Flora

71 Statistical Information and Monitoring Programme on Child Labour (SIMPOC) is a statistical body that collects information for the International Programme for the Elimination of Child Labour (see http://www.ilo.org/ipec/ChildlabourstatisticsSIMPOC/lang--en/index.htm).

Table 73. Ratification of international conventions as appear in the RED 2010 (changes from 2008 cited below) in main countries providing EU biofuels[72].

	ILO 29	ILO 87	ILO 98	ILO 100	ILO 105	ILO 111	ILO 138	ILO 182	CPB[73]	CITES[74]
Argentina	√	√	√	√	√	√	√	√	-	R
Brazil	√		√	√	√	√	√	√	ACS	R
Guatemala	√	√	√	√	√	√	√	√	ACS	R
Paraguay	√	√	√	√	√	√	√	√	R	R
Peru	√	√	√	√	√	√	√	√	R	R
Indonesia	√	√	√	√	√	√	√	√	R	A
Malaysia	√		√	√	√		√	√	R	A
Canada	√	√		√	√	√		√	-	R
Russia	√	√	√	√	√	√	√	√	-	C
Ukraine	√	√	√	√	√	√	√	√	A	A
USA					√			√	-	R
EU 27	√	√	√	√	√	√	√	√	(see table below)	

Abbreviations stand for the various administrative options: R= Ratified, A= Accepted, ACS = Accession, AP= Approval, S = Succession, C=Continuation. **√ stands for ratified.**

Table 74. Ratification of biodiversity conventions as appear in the RED 2010 for EU27[75].

Country	CPB[76]	CITES[77]	Country	CPB	CITES
Austria	R	A	Latvia	A	A
Belgium	R	R	Lithuania	R	A
Bulgaria	R	A	Luxemburg	R	R
Cyprus	ACS	R	Malta	ACS	A
Czech Republic	R	S	Netherlands	A	R
Denmark	R	R	Portugal	A	R
Estonia	R	A	Poland	R	R
Finland	R	A	Romania	R	A
France	AP	AP	Spain	R	A
Germany	R	R	Slovenia	R	A
Greece	R	A	Slovakia	R	S
Hungary	R	A	Sweden	R	R
Ireland	R	R	UK	R	R
Italy	R	R			

Abbreviations stand for the various administrative options: R= Ratified, A= Accepted, ACS = Accession, AP= Approval, S = Succession, C=Continuation.

72 Sources: ILO web site http://www.ilo.org/dyn/normlex/en/f?p=1000:11400:3969178755425480::NO:::, CPB website : http://bch.cbd.int/protocol/parties/ and CITES website: http://www.cites.org/eng/disc/parties/alphabet.php
73 Cartagena Protocol on Biosafety
74 Convention on International Trade in Endangered Species of Wild Fauna and Flora.
75 Sources: CPB website : http://bch.cbd.int/protocol/parties/ and CITES website: http://www.cites.org/eng/disc/parties/alphabet.php
76 Cartagena Protocol on Biosafety
77 Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Of the 27 EU countries, all have signed the eight ILO conventions as referred to in the RED. In terms of other EU enforcements, Convention 111, concerning equity and discrimination are noted in the CEACR[78] reports and observations as needing attention (e.g. in eastern European countries such as Poland).

While most of the non EU countries importing to the EU have ratified the fundamental conventions, the enforcement is persistently lower in the developing country set. While the US has declined to ratify many of the conventions, however, its enforcement of the same principles is stronger than in most other countries thus receive a high rank for implementation. It is the case the CEACR has long observed weak enforcement of hazardous child labour in the US pertaining to children working under 16 however with the family exemption laws, children can work in all facets of agriculture with parental supervision[79]. Ukraine's ratification and implementation is relatively strong with positive reports from ILO and a partnership with ILO in developing a strong Decent Work approach. With Ukraine's emersion to democratic rule, ILO conventions and guidelines seem to have been a strengthening factor. We note distinct drops in implementation for the developing countries, as child labour, forced labour and weak inspections characterize lower income countries and working conditions. In terms of relevant products for biofuels to the EU, the TVPRA[80] notes sugarcane in Brazil and Guatemala as possible risks. Furthermore child labour and forced labour for Indonesia are mentioned, as well as forced labour in Malaysian oil palm sector.

Child labour in small scale agriculture is a persistent problem in most of the developing countries which skews the labour economy and often deprives children of proper regular schooling. In the Argentine and Brazilian soy growing areas and in the Brazilian sugar cane areas, excluding those in the north-east, the progressive introduction of mechanized harvesting is reducing the risk of child labour. The sugar cane area in the Brazil north east has still not changed to mechanized harvesting. As a result, the risk of child labour in this area of sugar cane production is higher than in the rest of Brazil where increasingly farming is fully mechanised, in relation to biofuel production[81].

---

78 Committee of Experts on the Application of Conventions and Recommendations, http://www.ilo.org/indigenous/Conventions/Supervision/lang--en/index.htm

79 Refer to Fair Labour Standards Act)FLSA) and ILO CEACR on US Reporting http://www.ilo.org/dyn/normlex/en/f?p=1000:13100:0::NO:13100:P13100_COMMENT_ID:2309420:NO

80 TVPRA is the Trafficking Victims Protection Reauthorization Act which provides information and monitors forced labour and trafficking of purpose for this purpose. http://www.dol.gov/ILAB/programs/ocft/tvpra.htm

81 Most of the issues concerning child and forced labour are related to sugarcane harvesting. Brazil has introduced legislation to have 100% mechanized harvesting because of environmental and social concerns. The law 11,241 of the 19th of September 2002 in the state of Sao Paulo aims for 100% mechanized harvesting by 2021. Higher wages, higher benefits and a regularization of the contracts are increasing the cost of workers. All contributes to make mechanized harvesting less costly than manual harvesting. It is expected that this legislation will be supported by the federal government and applied also to the other states. This is expected to decrease substantially or even end forced and child labour. (INMETRO; UNICA; Brazilian Ministry of Labour 2010)

Discrimination in ethnic groups and gender is prevalent in Indonesia. In Indonesia, Land Rights and Access are below the median (MCC score[82]). Malaysia is cited as having problems with land issues and indigenous people, however not specifically related to palm oil production.

Record on Compliance Issues – EU countries

EU countries have overall a common record of ratification of the conventions and minimal issues with enforcement with the possible exception of Poland which has needed more attention to worker rights. Poland has improved inspection of work sites since 2008. Spain has introduced compulsory education for migrant workers. There is no indication of forced labour or child labour in the EU member states. It seems that overall, the CEACR takes more notice of how conventions that are ratified are being reported and implemented rather than focusing on conventions not yet ratified. Discrimination in ethnic groups and gender occur to some degree in Poland.

Record on Compliance Issues – non-EU countries

In oil palm production, Indonesia is listed in 2009 and 2010 (USDOL TVPRA 2009, 2010[83]) as using child labour and forced labour and Malaysia as using forced labour concerning oil palm imported to the EU (although it is difficult to make the difference between the palm oil produced for biofuels and that for other uses). An improvement from 2008 however concerns sugarcane in Brazil – in 2010 less sugarcane from Brazil was imported by the EU but overall sugar from Brazil puts importers of sugar and bioethanol at risk of sourcing from child labour. More research needs to be done to identify where the sugar ethanol is sourced to differentiate from high child labour sugarcane sectors (i.e. if all from mechanized farms.). This situation has perhaps been exacerbated by Brazilian issues with collective bargaining. For 2010, there are no other indications of exploitive child labour in products imported by the EU in the sample countries. Argentina, Brazil and Paraguay are cited as trafficking of persons across borders however not specifically for agriculture or the feedstock pertaining to biofuels. (ILO CEACR country observation Reports[84])

Significant child labour and forced labour in Palm Oil in Indonesia exists with efforts being made to address. Corn is cited in Brazil as having child labour however not on the TVPRA list as of 2010 (only sugarcane with respect to feedstock). Discrimination in ethnic groups and gender seems to be prevalent in Indonesia. In Indonesia, land Rights and Access are below the median (MCC[85] score). Malaysia is cited as problems with land issues and indigenous people however not specifically related to palm oil production plus, inequality of wages especially in Indonesia and Poland.

---

[82] MCC is the Millennium Change Corporation, US Government foreign aid agency providing scores per country to indicate progress on political rights, land rights, corruption etc. see www.mcc.gov
[83] Reports available at http://www.dol.gov/ILAB/programs/ocft/tvpra.htm
[84] Committee of Experts on the Application of Conventions and Recommendations, http://www.ilo.org/indigenous/Conventions/Supervision/lang--en/index.htm
[85] Millennium Challenge Corporation Score sheets for all countries on performance in governance, rights, and Equity.

According to the ILO CEACR, countries have reported and taken action in enforcing laws however in the US more on-site inspection is recommended by the CEACR. Project level monitoring is also recommended to be strengthened in Indonesia and more Inspections in the US and Poland. No indication of Forced labour or Child Labour in the US.

Impacts on other biomass using sectors

In this paragraph the impact of the EU biofuel sector on other biomass using sectors is analysed for the year 2010. The other biomass using sectors do not include biomass use for food and feed, but refer to "material use" following the definition of Raschka & Carus [2012]: *In "material use" the biomass serves as raw material for the (industrial) production of all kinds of goods as well as their direct use in products.*

The industries considered in this analysis are: the pulp and paper industry; the chemical industry (fermentation); the oleo-chemical industry and the food processing industry. These sectors are expected to be most impacted by the EU biofuel sector, mainly due to the fact that they are (partly) dependant on the same raw materials.

Besides wood, the main sources of biomass for industrial use are maize, wheat, sugarcane, oil palm, coconut, cotton and natural rubber. For biofuel production the most important crops are maize, sugarcane, oil palm and oilseed rape [Raschka & Carus, 2012].

The biotech industry generated 12% more revenues in 2010 compared to 2009 to reach a total of 13 billion € [Ernst & Young, 2011]. The biochemical sector is growing and according to the OECD the global value of biochemicals could increase from 1.8% off total chemical production to 12-20% in 2015 [OECD, 2009]. The knowledge based bio-economy (KBBE) got much attention in 2010 and several large EU funded projects started in this year concerning bio-refinery and bio-chemicals i.e. EUROBIOREF, BIOCORE and BIOCHEM.

On one hand the influence of the biofuel sector on the different biomaterial sectors relates to competition for raw materials and impact on prices. The most striking example in 2010 is that of the impact of the EU biodiesel production on the oleo-chemical industry. First of all the use of animal fats for the production of biodiesel increased the prices significantly which made it more difficult for the oleo-chemical industry to source this raw material at competitive prices [Ecofys, 2011]. Animal fats cover more than 50% of the raw material requirements in the European oleo-chemical industry and are an important enabler for the European industry to compete with Asia producers sourcing their raw materials from tropical oils. Secondly the oleo-chemical industry was negatively impacted by the increased production of glycerine due to biodiesel production. The downstream industries did not grow at the same pace which caused a strong decrease in glycerine prices [F.O. Licht, 2011] and decreased the income of the European oleo-chemical industry by 300 Mio/year [APAG, 2009]. Further interactions between biofuels and biomaterials regarding feedstocks can be found in Table 93 (Appendix XI).

A second important interaction between the EU biofuels sector and the biomaterials sector is related to policies and support. The developing biomaterial sectors claim that the development of their sector is hampered by current policies that favour bioenergy uses including biofuels. For example the EU sector organization for the chemical industry Cefic argues for a non-discriminatory approach for the different uses of renewable raw materials [CEFIC, 2011]. And the Advisory Group of the Lead Market Initiative for biobased products have recommended that policies should be balanced between bioenergy and biobased products to allow access to biomass feedstock for industrial uses [LMI Advisory Group Bio-based Products, 2011]. A Dutch study on conflicting interests in the biobased economy concluded that the promotion of the use of biomass for biofuels through the RED hampers the development of higher value uses of biomass and that there is a need for a level playing field for the different industrial biomass applications [Sira Consulting, 2011].

Conclusion

In general a distinction can be made between the more traditional uses of biomass for material use as the oleo-chemical industry and the emerging bio-economy sectors like the bio-plastics sector. In 2010 the new bio-economy sectors were still developing and therefore the interaction with the biofuel sector not yet that apparent, while the impact on especially the oleo-chemical industry was significant. However as the emerging bio-economy sectors grow competition for raw materials for the different biomass uses will increase. This calls for further development of bio-refinery concepts and 2nd generation feedstocks.

5 Literature references

Progress of Renewable Energy

Eclareon/RES INTEGRATION/Öko-Institut e.V. 2012, Integration of electricity from renewables to the electricity grid and to the electricity market – RES INTEGRATION, Final Report.

EurObserv'ER 2011, Solid Biomass Barometer. Available at http://www.eurobserv-er.org/downloads.asp [accessed 07.03.2012].

NREAP progress reports (section 2.b) of the Member States submitted to the European Commission according to Article 22(1)(f) of Directive 2009/28/EG.

Steinhilber, Ragwitz, Rathmann, Klessmann and Noothout 2011, Indicators assessing the performance of renewable energy support policies in 27 Member States, RE-Shaping D17 report, www.reshaping-res-policy.eu.

Winkel, T., Rathmann, M., Ragwitz, M., Steinhilber, S., Winkler, J., Resch, G., Panzer, C., Busch, S., Konstantinaviciute, I. 2011, Renewable Energy Policy Country Profiles - 2011 Version based on policy information available in November 2011. RE-Shaping Report, available at http://www.reshaping-res-policy.eu/.

Yaneva, Mariyana 2012, Bulgaria's renewables market goes from boom to bust, European Energy Review 19.07.2012. Available at http://www.europeanenergyreview.eu [accessed 19.07.2012].

Biofuel sustainability

AEBIOM 2011, Annual report 2010.

APAG 2009, Challenges and potential of biomass & biofuels for the European Oleo-chemical industry.

CEPI 2011, 2050 Roadmap to a low-carbon bio-economy.

CEFIC 2011, Discussion paper on renewable feedstock for the chemical industry – ambition and reality.

Ecofys 2011, Information sheet on RED double counting of wastes and residues.

Ernst & Young 2011, What Europe has to offer biotechnology companies.

FAO 2010, Key results and policy recommendations for future bioenergy development, ISBN 978-92-5-106647-8, Rome, Italy.

F.O. Licht 2011, 2010 statistics on sugar / glycerine.

IEA-ETSAP/IRENA 2012, Technology Policy Brief I13, production of bio-ethylene.

IRD 2006, Developing uses for sugar-cane bagasse: biotechnology applied to the paper industry.

KET Industrial Biotech, 2011, working group report.

LMI Advisory Group Bio-based Products, 2011, List of Priority Recommendations 2011.

OECD 2009, The Bioeconomy to 2030, designing a policy agenda.

Raschka & Carus 2012, Industrial material use of biomass, Basic data for Germany, Europe and the world.

Sira Consulting, 2011, Botsende belangen in de biobased economy.

Biodiversity

Campbell, A. and N. Doswald. 2009, The Impacts of Biofuel Production on Biodiversity: A Review of the Current Literature. UNEP-WCMC, Cambridge, UK. http://www.cbd.int/agriculture/2011-121/UNEP-WCMC3-sep11-en.pdf.

Ecofys 2011, Biofuels Baseline 2008, report for the European Commission.

Ecofys 2012, Land Use for EU Biofuels, table provided by D. Walden attached to email of 10 July, 2012.

Flaskerud, George 2003, Brazil's Soybean Production and Impact. North Dakota State University Extension Service. Fargo, ND, USA. http://www.ag.ndsu.edu/pubs/plantsci/rowcrops/eb79.pdf.

Grantham, et al. 2010, Effectiveness of Biodiversity Surrogates for Conservation Planning: Different Measures of Effectiveness Generate a Kaleidoscope of Variation PLoS ONE 5(7): e11430. doi:10.1371/journal.pone.00114. http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0011430.

Herrera, L.P., J.P. Panigatti, M.P. Barral, and D. Blanco 2012, Actual and potential environmental and social impacts of the biofuels industry on wetlands and people: Soy in Argentina. Wetlands International. Biofuels Quick Scan Project (draft report courtesy of L. Herrera).

Lourival, R., et al. 2009, A Systematic Evaluation of the Conservation Plans for the Pantanal Wetland in Brazil. Wetlands Vol. 29, No. 4, december 2009, pp. 1189–1201. http://www.uq.edu.au/marxan/docs/wetl-29-04-11ReinaldoLourival.pdf

Union of Concerned Scientists 2011, The Root of the Problem: What's Driving Tropical Deforestation Today? http://www.ucsusa.org/assets/documents/global_warming/UCS_RootoftheProblem_DriversofDeforestation_FullReport.pdf.

UNEP-WCMC 2009a, Progress towards the Convention on Biological Diversity's 2010 and 2012 Targets for Protected Area Coverage. http://www.unep-wcmc.org/medialibrary/2010/09/28/abfcdaf3/Towardprogress.pdf.

UNEP-WCMC 2009b, Coverage of Protected Areas: Guidance for National and Regional Use. http://www.unep-wcmc.org/coverage-of-protected-areas_541.html.

UNEP-WCMC 2011, National Indicators, Monitoring and Reporting for the Strategic Plan for Biodiversity 2011-2020. http://www.bipindicators.net/LinkClick.aspx?fileticket=2SmbtuLEOgM%3d&tabid=224.

Soil impacts

Capel, P. D., P. A. Hamilton and M. L. Erwin 2004, Studies by the U. S. Geological Survey on sources, transport, and fate of agricultural chemicals. U.S. Geological Survey Fact Sheet 2004–3098, 4 p., available at http://pubs.usgs.gov/fs/2004/3098/.

Cornell University 2012, Fact sheets Modern Agriculture: Its Effects on the Environment. http://psep.cce.cornell.edu/facts-slides-self/Factsheets.aspx.

Doran, J. W., A. J. Jones, M. A. Arshad and J. E. Gilley 1999, Determinants of soil quality and health. p. 17-38. *In* R. Lal (ed.) Soil Quality and Soil Erosion. CRC Press, Boca Raton, FL 33431, USA.

De Gorter, H. and D. R. Just 2010, The social costs and benefits of biofuels: the intersection of environmental, energy, and agricultural policy. Applied Economic Perspectives and Policy. 32(1): 4-32.

Fairhurst, T. and D. McLaughlin 2009, Oil palm development on degraded lands in Kalimantan. Consultancy report to World Wildlife Fund, Washington, D.C.. 45 pages.

Food and Agriculture Organization of the United Nations, FAOSTAT 1961-2010.

Food and Agriculture Organization of the United Nation 2000, Manual on integrated soil management and conservation practices. FAO bulletin 8, Rome, Italy. 228 pages.

German, L. G., C. Schoneveld and P. Pacheco 2011, The social and environmental impacts of biofuel feedstock cultivation: Evidence from multi-site research in the forest frontier. Ecology and Society. 16(3): Article No. 24. http://dx.doi.org/10.5751/ES-04309-160324.

Hill, J., E. Nelson, D. Tilman, S. Polasky and D. Tillany 2006, Environmental, economic, and energetic costs and benefits of biofiesel and ethanol biofuels. Proceedings of the National Academy of Sciences of the USA. 103(30): 11206-11210.

Sullivan, P. 2001, Sustainable soil management: A soil systems guide. National Sustainable Agriculture Information Center, USDA Rural Business-Cooperative Service, Washington, D. C. 32 pages. http://soilslab.cfr.washington.edu/Watershed_Stewardship/Sustainable_soil.PDF.

Worldwatch Institute 2007, Biofuels for Transport: Global potential and implications for sustainable energy and agriculture. Earthscan, London, UK. 452 pages.

Wuana, R. A. and F. E. Okieimen 2011, Heavy metals in contaminated soils: A review of sources, chemistry, risks, and best available strategies for remediation. International Scholarly Research Network Ecology. Vol. 2011, Article ID 402647. 20 pages.

Food Security

AMIS 2011, Enhancing Market transparency – Review of changes in domestic cereal prices during the global price peak by Ramesh Sharma, November 2011.

BEFSCI 2012, FAO BEFSCI project: Impacts of Bioenergy on Food Security Guidance for Assessment and Response, FAO, 2012.

Brahmbhatt, M. and Christiaensen, L. 2008, Rising Food Prices in East Asia. Challenges and Policy Options. Sustainable Development Department of the East Asia and Pacific region of the World Bank, Washington D.C.

DG AGRI 2011, Agricultural Markets Brief: High commodity prices and volatility, DG European Commission, Agriculture and Rural Development, June 2011.

EU 2012, Monthly EU market price developments for representative products from 2010, http://ec.europa.eu/agriculture/markets/prices/monthly_en.pdf.

FAO 2008a, The State of food and agriculture. Food and Agriculture Organisation. Rome. pp 138.

FAO 2008b, Food price fluctuation, policies and rural development in Europe and Central Asia. ASIA. FAO-UNDP Europe and Central Asia Regional Consultation. 5-6 December 2008, Budapest Hungary. Acessed July 2012. http://www.fao.org/docrep/012/i1059e/i1059e00.pdf,

FAO 2011, The State of Food Insecurity in the World 2011: How does international price volatility affect domestic economies and food security?, Rome Italy.

FAO et al. June 2011, Price Volatility in Food and Agricultural Markets: Policy Responses Policy Report including contributions by FAO, IFAD, IMF,OECD, UNCTAD, WFP, the World Bank, the WTO, IFPRI and the UN HLTF, June 2011.

FAO 2012, World Food Outlook – Global information and early warning system on food and agriculture, May 2012.

Headey D and Fan S. 2010, Reflections on the global food crisis: how did it happen? how has it hurt? and how can we prevent the next one? IFPRI research monograph 165. Washington.

IndexMundi 2012, Monthly palm oil prices for 2007 till 2012. http://www.indexmundi.com/commodities/?commodity=palm-oil&months=60.

LEI 2011, Price and prejudice: Why are food prices so high? (Gerdien Meijerink, Siemen van Berkum Gloria Solano, Karl Shutes), June 2011.

MPOB 2012, Website information on Malaysian palm oil prices http://www.mpob.gov.my/smnd/index.php?mobj=021&mact=yl&mtab=2010.

Nellemann, C., MacDevette, M., Manders, T., Eickhout, B., Svihus, B., Prins, A. G., Kaltenborn, B. P. (Eds) February 2009, The environmental food crisis – The environment's role in averting future food crises. A UNEP rapid response assessment. United Nations Environment Programme, GRID-Arendal, www.grida.nohttp://www.grida.no/files/publications/FoodCrisis_lores.pdf.

Nelson, G.C., M.W. Rosegrant, J. Koo, R. Robertson, T. Sulser, T. Zhu, C. Ringler, S. Msangi, A. Palazzo, M. Batka, M. Magalhaes, R. Valmonte-Santos, M. Ewing and D. Lee 2009, Climate change: Impact on agriculture and costs of adaptation. Food Policy Report #19. IFPRI, Washington, DC.

Vermeulen, S.J., Aggarwal, P.K., Ainslie, A., Angelone, C., Campbell, B.M., Challinor, A.J., Hansen, J., Ingram, J.S.I., Jarvis, A., Kristjanson, P., Lau, C., Thornton, P.K, and Wollenberg, E. 2010, Agriculture, Food Security and Climate Change: Outlook for Knowledge, Tools and Action. CCAFS Report 3. Copenhagen, Denmark: CGIAR-ESSP Program on Climate Change, Agriculture and Food Security.

WB 2011, World Bank Research Group: The Role of Inventory Adjustments in Quantifying Factors Causing Food Price Inflation, August 2011.

Ziska, L.H., O.S. Namuco, T.B. Moya and P.E. Quilang 1997, Growth and yield response of field-grown tropical rice to increasing CO_2 and air temperature. Agrononomy Journal, 89(1): 45-53.

Job Creation

Asia-Pacific Economic Cooperation (APEC) 2010, A Study of Employment Opportunities from Biofuel Production in APEC Economies. APEC EWG 07/2008A.

Bio Economic Research Associates 2009, Industrial Biotechnology. March 2009, 5(1): 40-52. doi:10.1089/ind.2009http://online.liebertpub.com/doi/abs/10.1089/ind.2009.5.40.

Bioenergy site 2010, Paraguay Biofuels Annual Report 2010. http://www.thebioenergysite.com/articles/726/paraguay-biofuels-annual-report-2010.

Bioenergy site, Oilseeds Update Czech Republic – Second Best Harvest of Rapeseed http://www.thebioenergysite.com/articles/1076/oilseeds-update-czech-republic-second-best-harvest-of-rapeseed.

Bioenergy site 2011, Italy crop update 2010. http://www.thebioenergysite.com/articles/739/italy-crop-update-2010.

Bioenergy site 2008, France is World's 4th Top Market for Biofuel Investment. http://www.thebioenergysite.com/articles/7/france-is-worlds-4th-top-market-for-biofuel-investment; http://www.thebioenergysite.com/articles/128/france-biofuels-update-2008. Accessed July 2012.

Bioenergy site 2010, Russian Federation Oilseeds and Products Annual Report 2010. http://www.thebioenergysite.com/articles/613/russian-federation-oilseeds-and-products-annual-report-2010.

Bioenergy site 2011, Ukraine Sugar Annual Report 2011. http://www.thebioenergysite.com/articles/932/ukraine-sugar-annual-report-2011.

Global Renewable Fuels Association 2012, Contribution of biofuels to the global economy, prepared for the Global Renewable Fuels Association, John M. Urbanchuk, Technical Director – Environmental Economics May 3, 2012. http://www.globalrenewablefuel.org/Global_Economic_Impact_of_Biofuels_FINAL.pdf.

EurObservER Report 2011, EurobservER 2020 Project, the State of Renewable Energies in Europe 2011. 11th. http://www.eurobserv-er.org/pdf/press/year_2012/bilan/english.pdf. Accessed July 2012.

FOCUS 2012, Biodiesel A Bright Spot in Job Creation 15 June 2011, Renewable Energy Focus. http://www.renewableenergyfocususa.com/view/18701/biodiesel-a-bright-spot-in-job-creation/.

ILO 2009, Skills for Green Jobs - A Global View, International Labour Organisation. http://www.sustainlabour.org/recurso.php?lang=EN&idrecurso=174.

IRENA (International Renewable Energy Agency) 2011, IRENA Working Paper: Renewable Energy Jobs: Status, Prospects & Policies.

Ismail, M., Rossi, A., Geiger, N. 2011, A Compilation of Bioenergy Sustainability Initiatives: Update, Rome, Food and Agriculture Organization of the UN (FAO).

Kammen M. and Engel D. 2009, Green Jobs and the Clean Energy Economy. Copenhaguen Climate Council. Thought leader series No. 4. http://climatechange.ca.gov/eaac/documents/member_materials/Engel_and_Kammen_Green_Jobs_and_the_Clean_Energy_Economy.pdf. Accessed July 2012.

Macedo I.C. 2005, Sugar Cane's Energy: Twelve Studies on Brazilian Sugar Cane Agribusiness and Its Sustainability. São Paulo: UNICA (São Paulo Sugarcane Agroindustry Union) (2008 baseline).

Meyer, Patrick E. PhD. 2010, Biofuel Review Part 6: Job Creation and Government Spending. http://www.todaysengineer.org/2010/Dec/biofuels-pt6.asp. Today's Engineer, Biofuels Review June 2010.

Nuffield Council on Bioethics 2011, Biofuels: ethical issues - A Guide to the Report. http://www.nuffieldbioethics.org/sites/default/files/Biofuels_ethical_issues_A5_Guide.pdf. Accessed July 2012.

Ragwitz, M., Schade, W., Breitschopf, B., Walz, R., Helfrich, N., Rathmann, M., et al. 2009, EmployRES, The impact of renewable energy policy on economic growth and employment in the European Union. http://ec.europa.eu/energy/renewables/studies/doc/renewables/2009_employ_res_report.pdf. Accessed July 2012.

REN21 2009, Renewables 2010 Global Status Report (Paris: REN21 Secretariat), Copyright 2010 Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH.
http://www.ren21.net/Portals/97/documents/GSR/RE_GSR_2009_Update.pdf . Accessed July 2012.

REN21 2010, Renewables 2010 Global Status Report (Paris: REN21 Secretariat). Copyright 2010 Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH. http://www.ren21.net/Portals/97/documents/GSR/REN21_GSR_2010_full_revised%20Sept2010.pdf. Accessed July 2012.

REN21 2011, Renewables 2010 Global Status Report (Paris: REN21 Secretariat), Copyright 2010 Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH. http://www.ren21.net/Portals/97/documents/GSR/REN21_GSR2011.pdf. Accessed June 2012.

UNEP, Climate Change Mitigation, Accessed 2012, http://www.unep.org/climatechange/mitigation/Bioenergy/Issues/RuraldevelopmentJobcreation/tabid/29469/Default.aspx.

UNEP 2009, Presentation S. Bringezu, H. Schütz, M. O´Brien, L. Kauppi, R.W. Howarth, J. McNeely.

UNEP 2009, Excerpt of the report Towards Sustainable Production and Use of Resources: Assessing Biofuels, International Panel for Sustainable Resource Management.

Urbanchuk, John M., 2012, Contribution of biofuels to the global economy, Cardno Entrix, prepared for Global Renewable Fuels Association, May 3, 2012.

USDA Foreign Agricultural Service 2011, GAIN Report NL 1013, EU27 Annual Biofuels Report, prepared by Bob Flach, et al.

USDA Foreign Agricultural Service 2009-2012, GAIN Reports, multiple countries. http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Forms/AllItems.aspx?Paged=TRUE&PagedPrev=TRUE&p_FSObjType=0&p_FileLeafRef=Bio%2dFuels%20Production%5fSeoul%5fKorea%20%2d%20Republic%20of%5f2%2d10%2d2010%2epdf&p_Created=20100308%2019%3a55%3a22&p_ID=1724&View=%7bCE460CDC%2d9581%2d4832%2dA97A%2d840CC53E9D68%7d&FolderCTID=0x012001&SortField=LinkFilenameNoMenu&SortDir=Asc&PageLastRow=600.

Land Use

EUROSTAT Regional Yearbook 2011, Land Cover and Land Use.

Farm Radio Weekly 20120, Land grabs put farmers at risk across Africa, April 16th, 2012 - Issue #197.

Fortin, Claude Joel 2011, The Biofuel Boom and Indonesia's Oil Palm Industry: The Twin Processes of Peasant Dispossession and Adverse Incorporation in West

Kalimantan Saint Mary's University Land Grabbing IndonesiacHalifax, NS Canada LDPI Conference 6-8 April 2011.

Maarten van den Berg 2012, Friends of the Earth International blog, May 03, 2012 Land Rights and the World Bank Group: Setting the Record Straight.

Natural Resources Defense Council 2008, Putting biofuels on the Right Track www.nrdc.org/policy April 2008.

OXFAM 2008, Another Inconvenient Truth - How biofuel policies are deepening poverty and accelerating climate change 2008. http://www.oxfam.org/en/grow/landgrabs.

Renewable Fuels Agency 2008, The Gallagher Review of the indirect effects of biofuels production 2008.

African Biodiversity Network 2011, The CDM and Africa: Marketing a New Land Grab, Excerpts from a briefing by the African Biodiversity Network, Biofuelwatch, Carbon Trade Watch, the Gaia Foundation and the Timberwatch Coalition, February 2011.

ILO 2012, World of work report 2010: Better jobs for a better economy, published by the International Institute for Labour Studies, International Labour Office, Geneva, 2012. http://www.rte.ie/news/2012/0430/ilo_report.pdf.

Renewable Fuels Agency 2008, The Gallagher Review of the indirect effects of biofuels production 2008.

Worldwatch Institute 2011, Food and Fuel: Biofuels Could benefit World's Undernourished.
http://www.worldwatch.org/node/5300.

Labour Conditions

ILO 2012, Conventions and Compliance by country, Report of the Committee of Expertson the Application of Conventions and Recommendations, articles 19, 22 and 35 of the Constitution.
http://www.ilo.org/dyn/normlex/en/f?p=1000:11110:661774372706672::NO:11110:P11110_COUNTRY_ID:102536.

ILO 2012, World of work report 2010: Better jobs for a better economy, published by the International Institute for Labour Studies, International Labour Office, Geneva, 2012. http://www.rte.ie/news/2012/0430/ilo_report.pdf.

Millenium Challenge Corporation (MCC), Score sheets for all countries on performance in governance, rights, and Equity. http://www.mcc.gov/.

US Department of Labour 2009 and 2010, List of Goods Produced with Child Labour or Forced Labour Trafficking Victims Protection Reauthorizaton Act.

US Department of Labour 2010, Findings on the Worst Forms of Child Labour 2010.

US Department of Labour 2005, List Required by the Trafficking Victims Protection Reauthorization Act of 2005, TVPRA Bibliography, see Brazil sugarcane, p. 22; Indonesia oil palm p. 80; Malaysia, oil palm, p. 93.

WebMils Monitoring International Labour Standards. http://webapps.dol.gov/webmils.

Raising the Global Floor, Adult Labour http://raisingtheglobalfloor.org/index.php.

Land rights & land grabbing

ILC 2012, Land Rights and the Rush for Land: Findings of the Global Commercial Pressures on Land Research Project, Anseeuw, W., L. Alden Wily, L. Cotula, and M. Taylor, ILC Rome 2012.

Pisces 2011, Working brief biofuels and sustainability: a case study from Tanzania, 3rd of May 2011, UK.

Grain 2012, The great food robbery, Barcelona Spain.

ActionAid 2012, Fuel for thought - Addressing the social impacts of EU biofuels policies, April 2012, Belgium.

Pangea 2011, Land Grab Refocus - Roots and possible demise of land grabbing, December 2011.

Pearce, Fred. 2012 The land Grabbers. The New Fight Over Who Owns the Earth. Boston.

IIED 2012, The global land rush: what the evidence reveals about scale and geography, April 2012, UK. http://pubs.iied.org/17124IIED.

The Land Matrix. Beta version. International Land Coalition (ILC), Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), Centre for Development and Environment (CDE),German Institute for Global and Area Studies (GIGA) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), April 2012. http://landportal.info/landmatrix/get-the-detail. Accessed July 2012.

Appendices

Appendix I Deviation from 2010 NREAP target for minor technologies

Additional RES-E technologies

Geothermal

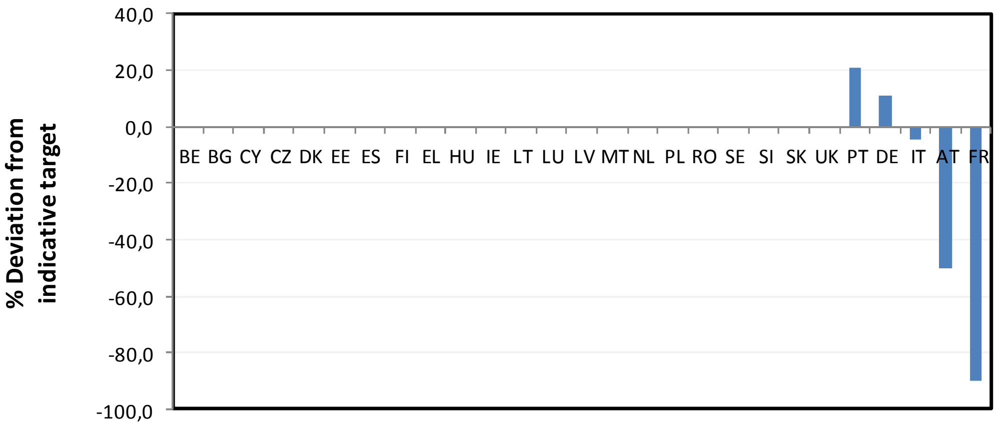


Figure 124. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for geothermal installations.

Only five Member States had any plans for geothermal electricity generation in 2010. Italy is by a long way the biggest producer with 5,376 GWh reported in 2010. Portugal has the highest positive deviation, reporting 197 GWh instead of the 163 GWh planned. Italy is at the same time also the biggest producer of heat from geothermal energy, as shown in Figure 128.

Bioliquids

Figure 125. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for bioliquids.

The majority of Member States did not plan any electricity production from bioliquids. Nevertheless, the Netherlands report an actual generation of 54 GWh in 2010. Austria produced 1,323 GWh, far more than the 36 GWh planned. This makes it the third biggest producer after Italy with 3,078 GWh and Germany with 1,700 GWh.

Concentrated Solar Power

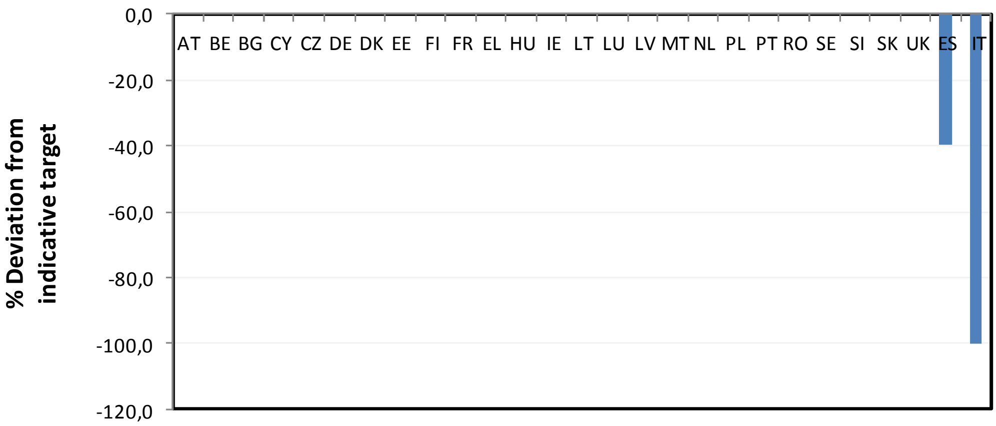


Figure 126. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for concentrated solar power.

Concentrated solar power (CSP) is virtually only existent in Spain, except for some small prototypes in Italy and France. Spain reports 692 GWh in 2010, mainly produced in parabolic trough installations. It is a steep increase from 103 GWh in

2009, but still less than the planned 1,144 GWh. Italy had planned 9 GWh for 2010, and reports none.

Tide, Wave, and Ocean Energy

Figure 127. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for tide, wave, and ocean energy.

Only France, home to Europe's first tidal power station, and Portugal had planned any electricity production from tide, wave, and ocean energy in 2010. While Portugal had only planned 1 GWh and produced none, France realised 476 of the 500GWh planned.

Additional RES-H&C technologies

Geothermal

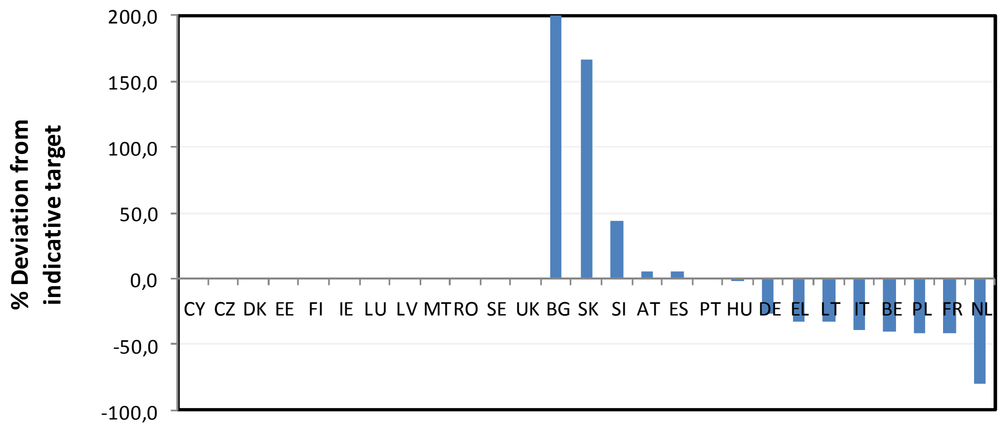


Figure 128. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for geothermal installations.

Only 15 Member States foresaw any production of geothermal heat in 2010. With 3200%, Bulgaria has by far the highest positive deviation from the trajectory. It reported 33 ktoe in 2010, while 1 ktoe had been planned. Romania reports 24,35 ktoe and the Czech Republic reports 2.1 ktoe[86], despite both of them having planned zero production. The top producers are Italy with 139 ktoe, Hungary with 99 ktoe, and France with 90 ktoe. The Netherlands, having planned 39 ktoe, only had an actual production of 8 ktoe.

Bioliquids

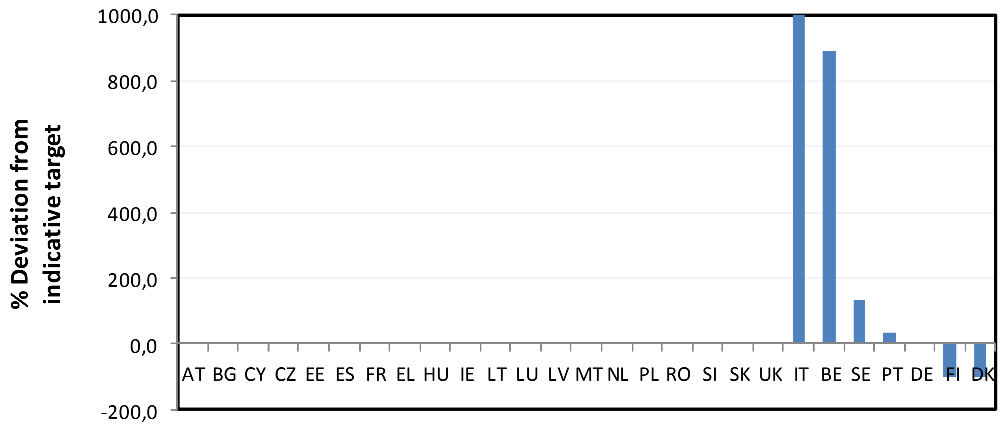


Figure 129. Deviation of actual 2010 deployment (Progress Report) from 2010 target (NREAP) for bioliquids.

Italy has by far surpassed its plan for 2010, by 3914%, reporting an actual 281 ktoe of heat production from bioliquids, while 7 ktoe had been planned. Italy was also one of the major producers, behind Portugal with 878 ktoe and Germany with 683 ktoe.

The majority of Member States did not plan any heat generation from bioliquids in 2010. Of these, however, Austria, Bulgaria, Malta, the Netherlands, and Poland do report minor heat production.

[86] EUROSTAT data, since the Czech Republic reported no production figures in their Progress Report

Additional RES-T technologies

Hydrogen

No EUROSTAT data is available for hydrogen from RES in transport. All NREAPs estimate zero deployment and all Progress Reports also report zero deployment. It can thus be assumed that an assessment of this technology is not necessary at this stage.

Appendix II Deviation from 2012 and 2020 NREAP targets for minor technologies

Additional RES-E technologies

Concentrated solar power

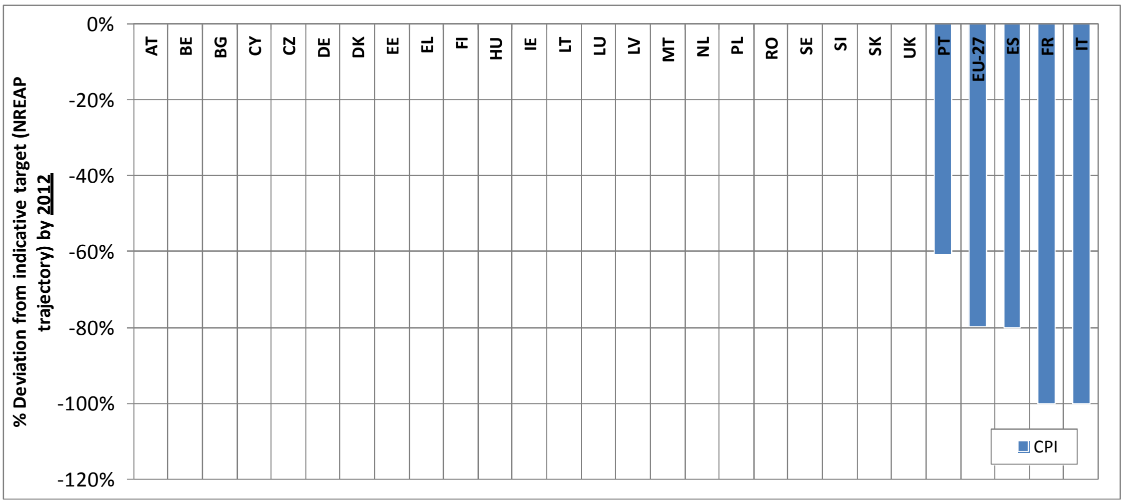


Figure 130. Deviation of expected deployment of CSP (Green-X scenarios) from indicative (NREAP) target by 2012.

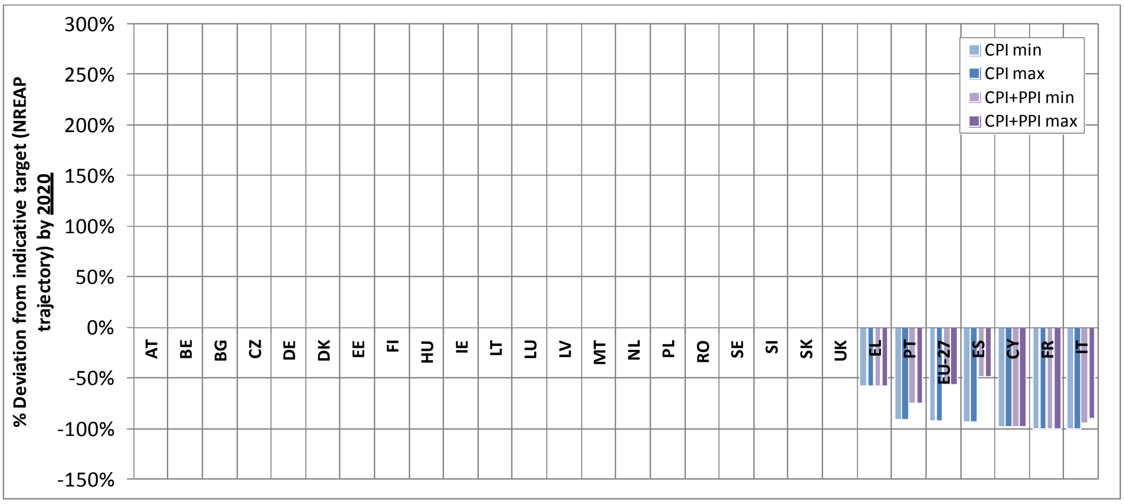


Figure 131. Deviation of expected deployment of CSP (Green-X scenarios) from indicative (NREAP) target by 2020.

The CSP technology is from the current perspective only realistically applicable in Southern Europe. Thus, Figure 130 shows that only 4 Member States planned to implement it in the electricity market by 2012. All Member States miss their target by then, which are Portugal with -60%, Spain with – 80%, and France and Italy with -100% (no installed capacities). This sums up to a -80% miss for the overall EU.

By 2020 in the CPI scenarios the situation gets even worse, with a missed target of -83% for the EU. The CPI+PPI scenarios show some improvement for the market penetration of CSP in Spain and Portugal (see Figure 131). The EU target in these scenarios is missed by -48%.

Tide, wave and ocean energy

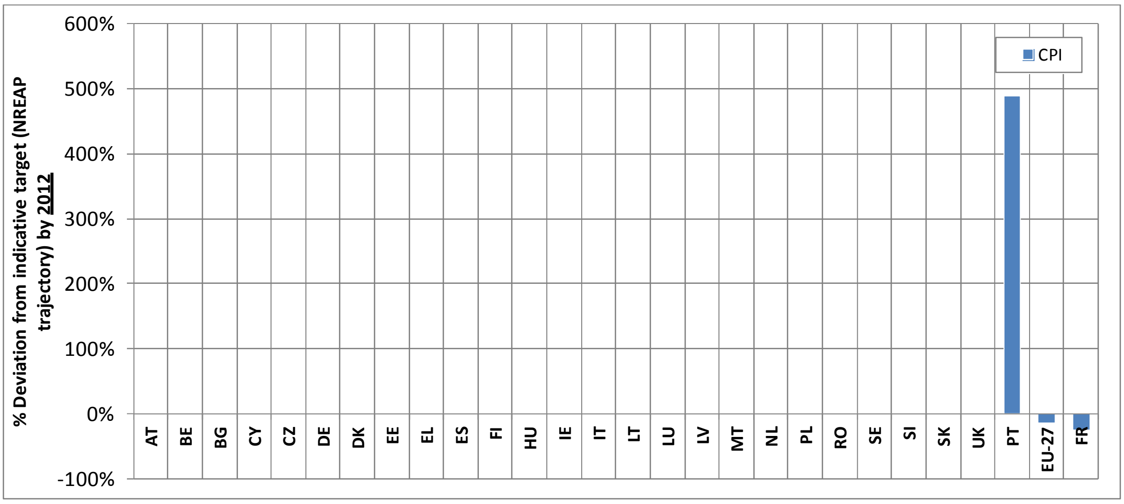


Figure 132. Deviation of expected deployment of tide, wave and ocean energy (Green-X scenarios) from indicative (NREAP) target by 2012.

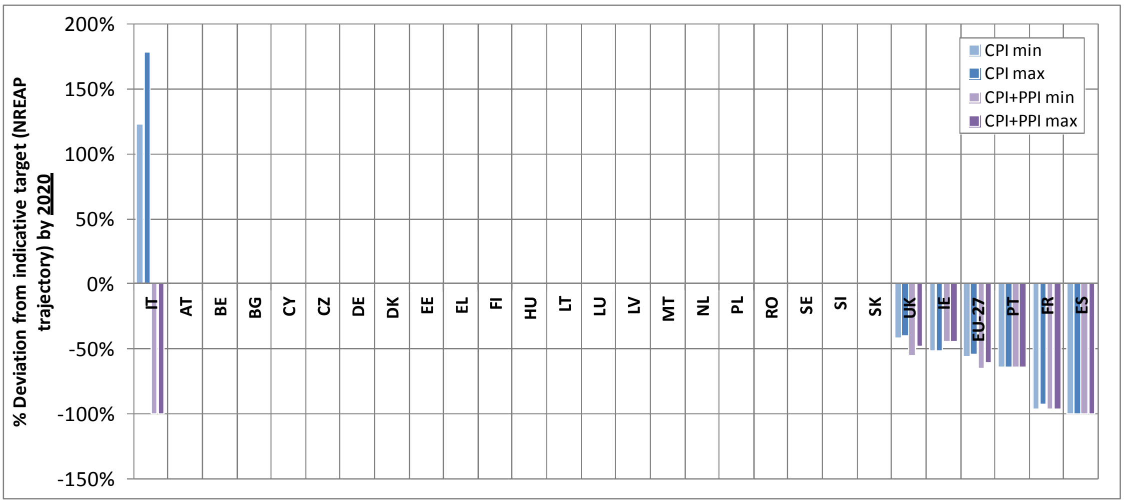


Figure 133. Deviation of expected deployment of tide, wave and ocean energy (Green-X scenarios) from indicative (NREAP) target by 2020.

Ocean technologies like wave power or tidal stream may still be classified as novel technology options in a non-mature market stage. Thus, only two countries planned to use that option already in the short-term, compare Figure 132. By 2020 a total of six countries have shown plans to use these technologies. From the current perspective it can however be expected that plans are not met, i.e. at EU level a deficit of about 50% will arise by 2020. This indicates that implemented and planned measures appear insufficient and further initiatives are of need.

Geothermal

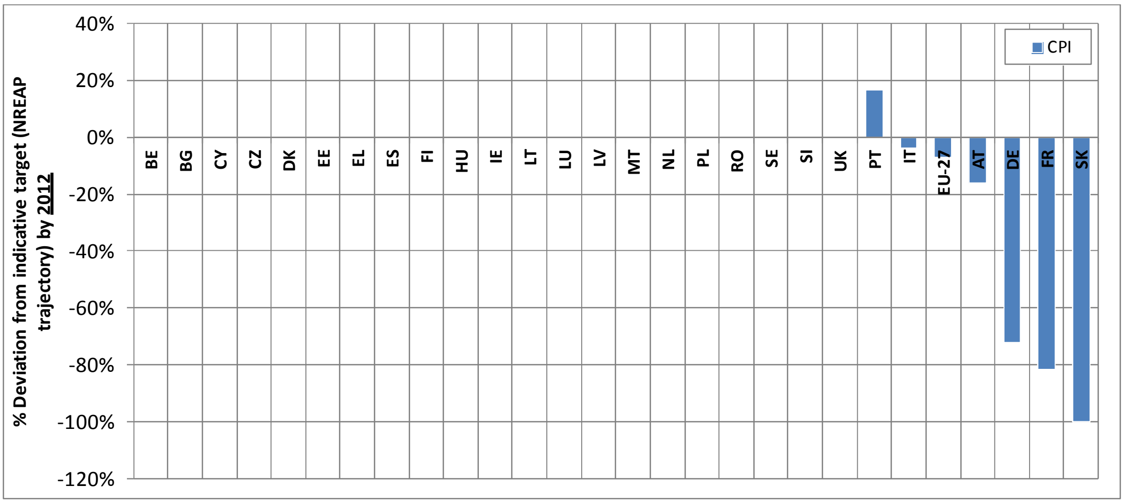


Figure 134. Deviation of expected deployment of geothermal electricity (Green-X scenarios) from indicative (NREAP) target by 2012.

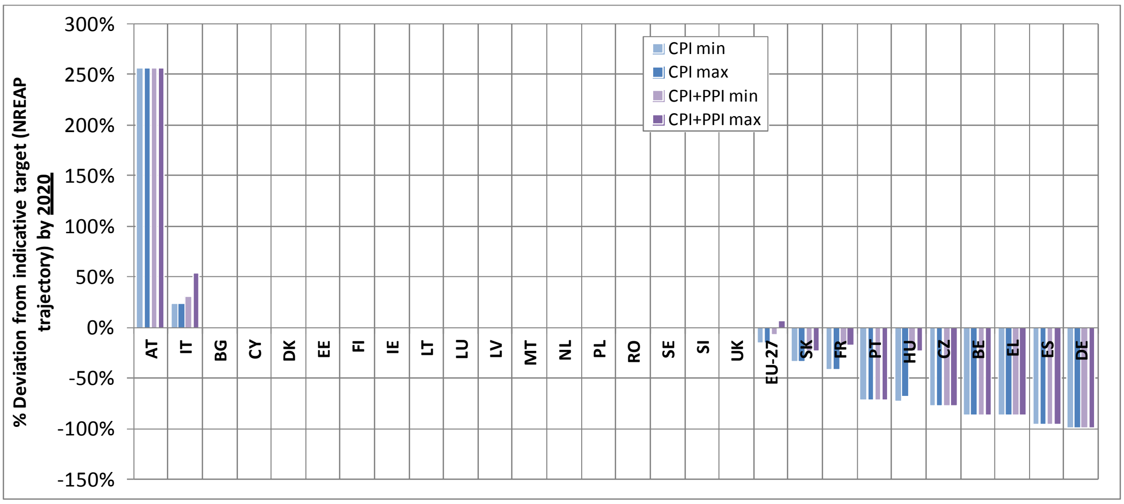


Figure 135. Deviation of expected deployment of geothermal electricity (Green-X scenarios) from indicative (NREAP) target by 2020.

At present geothermal electricity is well used only in Italy. A few countries have however indicated their will to use that technology in the short (2012) and mid-term

(2020). While short-term expectations are likely to be met only in Portugal, plans for 2020 may well be achieved at EU level due to the expected progress specifically in Italy.

Additional RES-H&C technologies

Geothermal heat

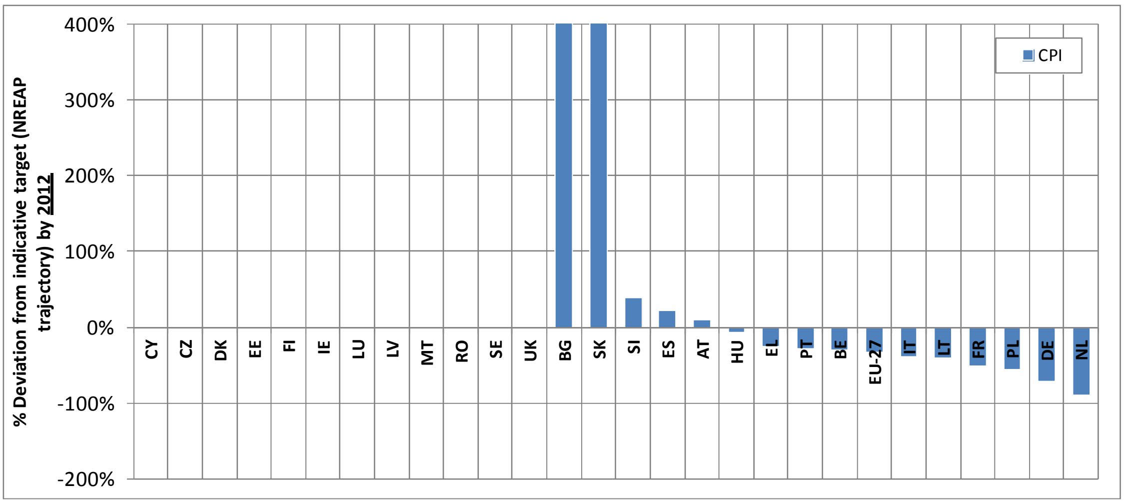


Figure 136. Deviation of expected deployment of geothermal heat (Green-X scenarios) from indicative (NREAP) target by 2012.

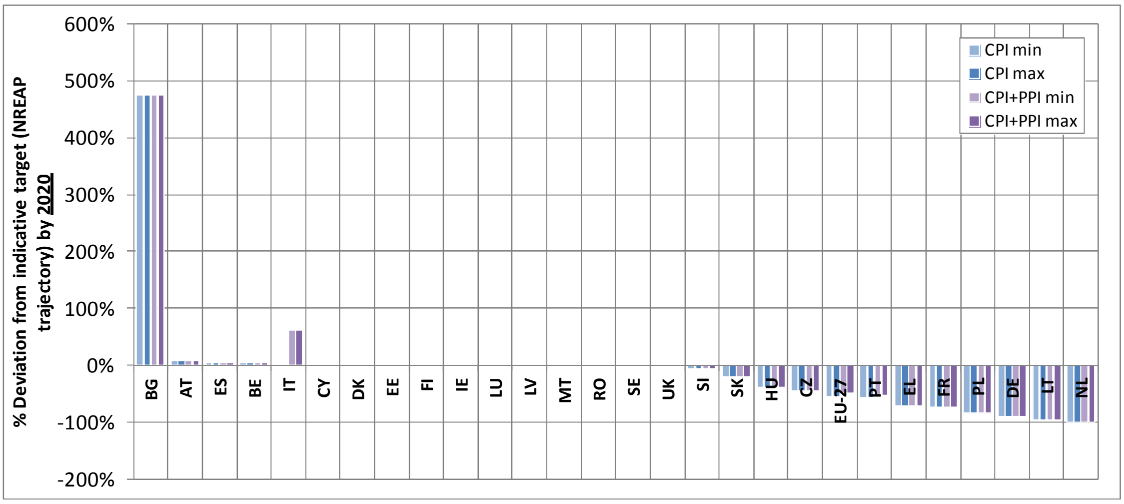


Figure 137. Deviation of expected deployment of geothermal heat (Green-X scenarios) from indicative (NREAP) target by 2020.

Bulgaria and Slovakia are expected to strongly overshoot their indicative trajectories in geothermal heat production by 2012. This accounts for a production of 35 ktoe in the case of Bulgaria and 15.22 ktoe for Slovakia. In absolute terms Italy and Hungary are by far the biggest producers of geothermal heat with an amount of 147.15 and 112.46

ktoe, respectively. The majority of the countries fail to meet their indicative trajectory by 2012 and on EU-scale the 2012 target are expected to be missed by –32.1 per cent.

In 2020, Bulgaria is even expected to exceed their indicative target by 475.4 per cent. Besides Austria, Italy and a view others all remaining countries fail to meet their targets by 2020. With the exception of Italy, where planned policy measures do show a great impact no significant additional effects can be seen in the case of all other countries. In all considered scenarios the EU-wide target are missed by -48.4 to -55.5 per cent according to the scenario.

Appendix III Assessment of Planned Policy Initiatives (PPI)

Information on Planned Policy Initiatives (PPI) was collected from MS's Progress Reports. Since MSs reported on planned improvements in a non-homogenous manner a comprehensive reassessment of the originally provided information was needed. As a first step, only information related to planned improvements was taken into account. In other words, existing measures as partly described by MSs were not considered (since they are already incorporated in the CPI case). Next, reported country-specific planned measures were grouped into:

- Measure dedicated to improve the **financial support framework** for RES
- Measures for mitigating **non-economic barriers** that hinder an accelerated RES deployment at present.

Details on the applied approach for both groups of measures are sketched below.

Assessment for the mitigation of non-economic barriers

Non-economic barriers affect the market penetration of new technologies. Technology diffusion is described in Figure 138. The curve describes penetration of the market by a new technology. At first diffusion for a new technology is very slow, increasing constantly till saturation effects enter so that the curve converges towards 100%. The shape of this curve is influenced the non-cost barrier situation of the corresponding market. Barriers can be grouped into following categories (Resch, 2005):

- Industry barriers: Growth rate of industry
- Market barriers: Growth rate of industry
- Administrative barriers: high bureaucracy
- Resource availability
- Social barriers: Social acceptance of additional RES-E generation
- Technical barriers: Technical feasibility

If barriers in the respective markets are strong, the shape of the S-curve correlates more with the blue-dashed graph beneath the blue graph in Figure 138. If non-cost barriers are mitigated by national authorities, the diffusion of new technologies will fasten, and the shape of the S-curve will lie above the blue graph in Figure 138.

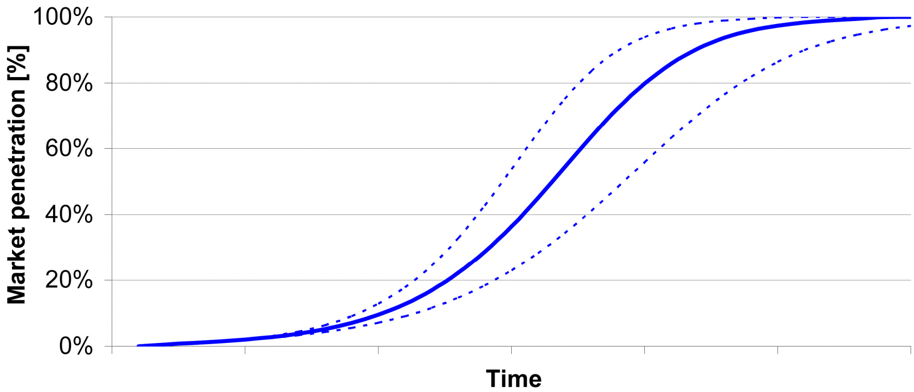


Figure 138. S-curve: Market penetration of new technologies. (Resch, 2005).

In a first step all measures were classified according to their sectoral coverage. In a second step all measures of the MS's progress reports were interpreted by their mode of action. On the one hand, measures can mitigate non-economic barriers of new technologies, and on the other facilitate a support mechanism in the form of financial aid to make the investment in new technologies more lucrative. Table 75 shows the assessment of planned measures from all EU MS Progress Reports, which contribute to the mitigation of non-economic barriers. The positive changes in per cent compared to the CPI scenario per technology category and country are the result of the added up values from the quality of mitigation column from Table 76. The column of Table 76 shows values from 0 to 4 for each mitigation measure, which equal from 0% to 100%. If for example a measure from Table 76 affects all energy sectors with a quality degree of 1, all energy sectors show a positive change mitigating non-cost barriers compared to the CPI scenario of 25%. This step is repeated for all measures of Table 76 to add up all positive changes for each country and energy sector.

Table 75. Planned measures as of EU Member States Progress Reports for the mitigation of non-economic barriers per energy sector.

Energy sector / Country	Positive change in percent of non-cost barriers per energy sector compared to BAU scenario																									
	Austria	Belgium	Bulgaria	Cyprus	Czech Republic	Denmark	Estonia	Finland	France	Germany	Greece	Hungary	Ireland	Italy	Latvia	Lithuania	Luxembourg	Malta	Netherlands	Poland	Portugal	Romania	Slovakia	Slovenia	Spain	Sweden	United Kingdom
RES-E																											
Biogas	13	0	100	0	25	25	0	0	25	0	0	0	25	75	100	100	25	25	25	25	0	75	0	0	100	0	75
Biomass forestry based	13	0	100	0	25	25	0	0	25	0	0	0	25	75	100	100	5	25	25	25	0	75	63	0	100	0	75
Biomass agricultural based	13	0	100	0	25	25	0	0	25	0	0	0	25	75	100	100	25	25	25	25	0	75	63	0	100	0	75
Biowaste	13	0	100	0	25	25	0	0	25	0	0	0	25	75	100	100	25	25	25	25	0	75	13	0	100	0	75
Geothermal electricity	13	0	100	0	0	0	0	0	25	0	0	0	75	75	50	100	25	0	25	0	0	75	13	0	100	0	75
Hydro power	13	0	100	0	0	0	0	0	25	0	0	0	25	75	50	100	25	0	25	0	0	75	13	0	100	0	75
Photovoltaic	13	0	100	25	0	0	0	0	25	0	0	0	25	75	50	100	25	0	25	25	0	75	13	0	100	0	75
Solar thermal	13	0	100	0	0	0	0	0	25	0	0	0	25	75	50	100	25	0	25	0	0	75	0	0	100	0	75
Tidal and wave	0	0	100	0	0	0	0	0	25	0	0	0	25	75	50	100	25	0	25	0	0	75	0	0	100	0	75
Wind	13	0	100	0	0	25	0	0	25	0	0	0	25	75	50	100	25	0	100	5	0	75	0	0	100	0	75
RES-H																											
Grid connect heat																											
Biogas	13	0	100	0	25	25	0	0	50	0	0	0	25	100	100	100	25	25	0	25	0	75	75	13	75	0	38
Biomass forestry based	13	0	100	0	25	25	0	0	50	0	0	0	25	75	100	50	25	25	0	25	0	75	100	13	63	0	38
Biomass agricultural based	13	0	100	0	25	25	0	0	50	0	0	0	25	75	100	50	25	25	0	25	0	75	100	13	50	0	38
Biowaste	13	0	100	0	25	25	0	0	50	0	0	0	25	75	100	100	25	25	0	0	0	75	75	13	100	0	38
Geothermal heat	13	0	100	0	0	0	0	0	50	0	0	0	75	75	50	50	25	0	0	0	0	75	75	13	50	0	38
Non-Grid connected heat																											
Biomass small scale	13	0	100	25	0	0	0	0	50	0	0	0	25	75	50	50	25	0	0	25	0	25	100	13	63	0	38
Solar thermal heating	13	0	100	25	0	0	0	0	50	0	0	0	25	75	50	50	25	0	0	25	0	25	75	13	63	0	38
Heat pumps	13	0	100	25	0	0	0	0	50	0	0	0	25	75	50	50	25	0	0	25	0	25	75	13	63	0	38
RES-T																											
Bio fuels	13	0	100	0	0	0	0	13	38	0	0	0	0	25	0	100	0	0	0	0	0	0	0	0	75	0	13

* The category of biofuels covers biodiesel, bioethanol, bioethanol plus, and biomass to liquid (BtL) fuels.

Table 76. All planned measures as of Member States Progress Reports mitigating non-cost barriers

	Measures Member states NREAP and Progress Reports			Assessment of non-cost barriers						
Country	Name and reference of the measure	Expected results	Targeted group and or activity	RES technologies covered	RES-E	RES-H	RES-T biof.	RES-T elec.	Quality of mitigation (0-4)[87]	NREAP - Initial start date
AT	Energy Efficiency Act	Statutory regulations to increase energy efficiency	End consumers, enterprises	RES-E & RES-H	yes	yes	yes	yes	0,5	unknown
BG	Setting up an inter-ministerial council at political level to coordinate the policy on the promotion of renewable energy	Developing policies and legislative actions to promote renewable energy	Public administration	all RES technologies	yes	yes	yes	yes	1	01.01.2012
BG	Setting up an advisory group to support the implementation of the NREAP	Installed capacity, energy generated, behavioural change, introducing high-efficiency technologies	Investors, energy companies, end users, public administration, associations and branch organisations, installers	all RES technologies	yes	yes	yes	yes	1	01.01.2012
BG	Developing a geographical information system (GIS) for Bulgaria	Installed capacity, energy generation	Investors, public administration, end users	all RES technologies	yes	yes	yes	yes	0,5	01.01.2013
BG	Methodological manuals outlining the steps to be taken in the investment process in renewable sources by types of sources	Investment process, installed capacity, behavioural change	Investors, public administration, end users	all RES technologies	yes	yes	yes	yes	0,5	01.01.2012

[87] The quality of mitigation indicator corresponds to a positive change mitigating non-cost barriers by 0% to 100% compared to the BAU scenario. All effects of measures are added up per country and energy sector and result in the positive percentage changes listed in Table 2.

BG	Enhancing the administrative competence and capacity of officials responsible for issuing licences and authorisations	Behavioural change	Authorisation bodies (all levels)	all RES technologies	yes	yes	yes	yes	1	01.01.2011
BG	Code/rules of conduct for installers	Behavioural change	Installers, suppliers of equipment, end users	RES-E & RES-H	yes	yes	yes	yes	1	01.01.2011
BG	Qualification requirements for installers	Behavioural change, energy generated	Installers, end users, investors, authorisation bodies, financial organisations	RES-E & RES-H	yes	yes	yes	yes	1	01.01.2012
BG	List of qualified installers	Behavioural change, energy generated	Installers, end users, investors, authorisation bodies, financial organisations	RES-E & RES-H	yes	yes	yes	yes	1	01.01.2012
BG	Public information campaign promoting the use of renewable sources	Behavioural change	Installers, end users, investors, authorisation bodies, financial organisations	all RES technologies	yes	yes	yes	yes	1	01.01.2012
BG	List of renewable energy generation facilities	Behavioural change	Investors, end users, public administration	all RES technologies	yes	yes	yes	yes	0,5	01.01.2013
BG	Transposing into the Bulgarian legislation the requirements of the amended directive 2002/91/EC, Directive 2009/28/EC, Directive 2009/29/EC and Directive 2009/30/EC	Installed capacity, energy generation	Construction organisations, public	all RES technologies	yes	yes	yes	yes	1	01.01.2012
BG	Applying or using the method of cost-benefit analysis	Improving the business environment Behavioural change	Investors, end users, planning authorities	RES-E & RES-H	yes	yes	yes	yes	1	01.01.2012
BG	One-stop shops	New installed capacity	Investors, end users	RES-E & RES-H	yes	yes			1,5	01.01.2015
BG	Replacing fossil fuels and electricity for heating in public buildings by biofuels and renewable energy	Energy generated from renewable sources	Energy suppliers, municipalities	RES-E & RES-H	yes	yes			1	01.01.2011
BG	Supporting the construction of new transmission and distribution infrastructure and attaching to it the status of a national infrastructure asset in view of the connection of new renewable energy producers	New installed capacity	Investors, end users	RES-E	yes				2	01.01.2011
BG	Utilising demand-side management and congestion response options [Exploiting the demand-side management and congestion response options]	Installed capacity (more efficient integration)	Scientific community, industry	RES-E	yes				1	01.01.2012
BG	Introducing/Enhancing competition between renewable energy technologies	Installed capacity, energy generation	Electricity companies, investors	RES-E	yes				2	01.01.2012
BG	Supporting the development of smart grids and storage facilities	Installed capacity (more efficient integration)	Network owners, investors, end users	RES-E	yes				2	01.01.2012
BG	Detailed up-to-date information on investor appetite and administrative and authorisation procedures	New installed capacity	Investors, end users	RES-E	yes				1	01.01.2012
BG	Mandatory use of renewable energy in new buildings	Energy generated from renewable sources	Investors, construction organisations, end users, public administration	RES-H		yes			1	01.01.2011
BG	Support scheme for the implementation of renewable heating and cooling technologies in industry	Behavioural change, installed capacity, energy generated	Investors, end users, public administration	RES-H		yes			1	01.01.2011
BG	Establishing assessment procedures requiring the obligatory marking of biomass incineration equipment	Energy generated from renewable sources	Energy suppliers	Biomass electricity and heat		yes			1	01.01.2012
BG	Gradual increase of the share of biomass fuels in the "energy benefits" programme	Energy generated from renewable sources	Energy suppliers	Biomass and Biofuels		yes	yes		1	01.01.2012
BG	Developing a programme for accelerated switchover to biofuels for the public and municipal transport	Energy generated from renewable sources	Energy suppliers	Biofuels			yes		0,5	01.01.2011

BG	Requiring distributors and retailers of petroleum-derived liquid fuels to have available pumps which sell pure biofuels	Energy generated from renewable sources	Energy suppliers	Biofuels			yes		2	01.01.2015
BG	Promotion and marketing programme for electric cars	Installed capacity (more efficient integration) Additional measures relating to the planned measures included in Table 5 (Annex 1) of the NREAP	Scientific community, industry	E-Mobility				yes	2	01.01.2011
CY	Increase of the building co-efficient applicable to new buildings	Promoting RES integration in new buildings intended for organised residential development, industrial development, etc.	Households, Contractors Industries, Undertakings	RES-E & RES-H	yes	yes			1	unknown
CZ	Implementation of measures to simplify authorisation procedures in existing legislation	Installed capacity	Public administration, investors, planners	RES-E & RES-H	yes	yes			1	01.10.2012
DK	National test centre for large wind turbines in Østerild and planning of areas for test turbines up to 2020	Testing of new wind power facilities	Industry and research	Wind	yes				1	01.01.2010
DK	Free choice of fuel for small power plants (Green Growth)	To promote the use of biomass	Power plants < 2 MW	RES-E & RES-H	yes				1	unknown
ES[88]	Integración de las energías renovables en edificios públicos	Conseguir la integración de las energías renovables en edificios públicos	Administraciones públicas	RES-E & RES-H	yes	yes			0,5	01.01.2012
ES	Mayor desarrollo de las interconexiones internacionales.	Incrementar la seguridad de suministro, facilitar la integración de una mayor producción de electricidad renovable no gestionable y eliminar el estatus de isla energética que califica hoy día a España	Operadores del sistema eléctrico, operadores y titulares de instalaciones de generación eléctrica	RES-E	yes				2	01.01.2012
ES	Establecimiento de un mecanismo de balance neto para instalaciones eléctricas renovables destinadas a autoconsumo.	Fomento de autoconsumo de energía eléctrica producida con fuentes renovables y aplanamiento de la curva de demanda. Desarrollo de un sistema eléctrico de generación distribuida	Instalaciones, promotores, productores de energía en régimen especial y consumidores	RES-E	yes				1	01.01.2012
ES	Tratamiento regulatorio específico para el desarrollo de centrales hidroeléctricas reversibles en infraestructuras existentes.	Incrementar la capacidad de almacenamiento de energía eléctrica, lo que facilitará la integración en la red de transporte y distribución de la energía procedente de fuentes renovables no gestionables. Las previsiones al 2020 3.500 MW adicionales	Inversores	RES-E	yes				1	01.01.2012
ES	Adaptación del Reglamento de Instalaciones Térmicas en la Edificación (RITE) a las tecnologías de energías renovables.	Aumento de la participación de las energías renovables en el abastecimiento del consumo de energía de los edificios. Mayor agilidad en la realización de los trámites para realizar el registro de instalaciones térmicas renovables en los edificios	Promotores de vivienda, constructores, arquitectos, instalaciones de energías renovables y ESEs	RES-E	yes				1	01.01.2011
ES	Propuestas para fomentar la profesionalización del sector	Mejora de calidad del conjunto de la instalación Cambio de actitud hacia la energía solar	Instaladores Promotores y usuarios finales.	Photovoltaic	yes				1	01.01.2011
ES	Análisis de acciones de optimización técnico-económicas del transporte de biomasa, en colaboración con las CCAA y la administración local	Disminución del coste del transporte	Empresas logísticas, empresas consumidoras	RES-H		yes			1	01.01.2013

[88] The Spanish Progress Report was not officially released translated to English. For the assessment the Spanish original Progress Report was used.

ES	Implantación de un sistema de aseguramiento de la calidad en los procesos de producción de CSR	Creación de un mercado de combustibles producidos a partir de residuos	Administración pública, empresas gestoras de residuos, empresas potenciales consumidoras	Biowaste		yes			1	01.01.2012
ES	Fomento del uso de digestatos de calidad en las prácticas de fertilización	Normalizar el uso de los digestatos como abonos o enmiendas orgánicas	Administración pública, sector ganadero y agroindustrial	Solid Biomass		yes			1	01.01.2012
ES	Creación del marco legal que permita la inyección de biometano en las redes de gas natural	Facilitar usos más eficientes del biogás	Administración pública, sector del biogás	Biogas		yes			1	01.01.2011
ES	Desarrollo de las metodologías de cuantificación de la fracción biodegradable y combustible de las distintas corrientes de residuos	Determinar con precisión qué parte de la energía procedente de los residuos es de origen renovable	Sector valorización residuos (tanto productores como consumidores)	Biowaste		yes			1	01.01.2012
ES	Desarrollo de un grupo de trabajo sobre valorización energética en el seno de la Comisión de Coordinación en materia de residuos	La correcta aplicación de la jerarquía de gestión de residuos	Sector valorización residuos (tanto productores como consumidores)	Biowaste		yes			1	01.01.2011
ES	Diseño e implantación de un esquema de control de la sostenibilidad para los biocarburantes y biolíquidos.	Con la implantación de este sistema se pretende avanzar en el control de la sostenibilidad de los biocarburantes y los biolíquidos producidos y consumidos en España, de acuerdo con los requisitos de la normativa europea.	Toda la cadena de valor de los biocarburantes	Biofuels			yes		2	01.01.2011
ES	Desarrollo armónico del mercado español de los biocarburantes	En función de los resultados de dicho análisis, se pretende desarrollar un mecanismo que permita al mercado español un desarrollo armónico de las variables de la capacidad de producción y consumo de biocarburantes. Con ello se contribuye a acrecentar la	Sector de hidrocarburos	Biofuels			yes		1	01.01.2011
FI	Sustainability criteria for biofuels and bioliquids (Government Bill for an Act on Sustainability Criteria for Biofuels and Bioliquids)		Biofuel producers and distributors, bio-based fuels and liquid fuels	Biofuels and Bioliquids			yes		0,5	01.11.2012
FR	Energy Air Climate Regional Schemes	Identification and valorisation of renewable energy potential	Territorial communities	RES-E	yes	yes			1	01.01.2011
FR	Renovation plan for social housing and public buildings	Thermal renovation for all of these homes by 2020	Low rent housing managers, the state and communities	RES-H		yes			1	01.01.2009
FR	Renovation of waterways and port installations	Substitute the transportation of goods by road with non-road transportation	Transport/distribution businesses	Biofuels & E-Mobility			yes	yes	0,5	01.01.2010
FR	Construction of 2000 km of railway lines	Substitute road transportation with rail service	Rail transport companies for both passengers and goods	Biofuels & E-Mobility			yes	yes	0,5	01.01.2010
FR	Construction of underground rapid transit in Ile de France	Increase public transport	Individuals	Biofuels & E-Mobility			yes	yes	0,5	01.01.2010
IE	Planning & Development (Amendment) Act 2010 (Planning & Development (Amendment) Bill 2009)	The Act provides for changes to the planning system., some of which have implications for the renewable energy sector (e.g. projects over a certain size will now automatically be treated as strategic infrastructure under the Strategic Infrastructure Act.	Developers who have to go through the planning process	RES-E & RES-H	yes	yes			1	01.01.2011
IE	Draft Geothermal legislation	Geothermal Energy Development Bill 2010 published	Industry, policy makers	Geothermal electricity and heat	yes	yes			3	unknown
IT	Qualification system for installers (Legislative Decree No 28/2011, Article 15)	Guarantee of quality in installation of RES systems	Installers	all RES technologies	yes	yes	yes	yes	1	01.08.2012
IT	International cooperation mechanisms (Legislative Decree No 28/2011, Article 35 and 36	Reaching the target. Possibility of international investments	Other States, Investors , TSO	RES-E & RES-H	yes	yes			1	01.01.2016

IT	Rationalisation measures (Legislative Decree No 28/2011, Article 12	Rationalisation of procedures	Investors / Final customers	RES-E & RES-H	yes	yes			1	01.01.2013
IT	Support for biogas integration in the natural gas network (Legislative Decree No 28/2011, Article 8)	Feed in of bio methane to the natural gas network	Operators	Biogas		yes			2	01.01.2011
IT	Conditions for connection to the natural gas network of bio methane plants. (Legislative Decree No 28/2011, Article 20)	Feed in of bio methane to the natural gas network	Bio methane producers and natural gas network operators	Biogas		yes			2	01.01.2011
LI	To develop and approve a procedure for the certification of installers of equipment and systems using renewable energy sources and installer training programmes, and to supplement these programmes with the topics of benefits.	Drafted Procedure for the training and certification of installers of renewable energy generation equipment	Installers of renewable energy generation equipment and systems	RES-E & RES-H	yes	yes	yes	yes	1	01.01.2012
LI	To develop and approve a methodology for the separation of the biodegradable part of municipal waste with regard to the renewable part of energy generated from municipal waste.	Development of the use of municipal waste for energy generation	Investors	Biowaste	yes	yes			2	01.01.2012
LI	Procedure for the promotion of the use of renewable energy sources in energy generation	Wider use of renewable energy sources	Producers of electricity from renewable energy sources	RES-E	yes				0,5	01.01.2012
LI	Rules on permit issuance for activities in the electricity sector	Improvement of the conditions of permit issuance for development	Producers of electricity from renewable energy sources	RES-E	yes				1	01.01.2012
LI	Preferential forwarding of electricity generated from renewable energy sources through the electricity transmission or distribution networks	Increase in electricity generation from renewable energy sources	Transmission system operator and distribution network operator, producers of electricity from renewable energy sources	RES-E	yes				2	01.01.2012
LI	To draft and approve a construction technical regulation setting the requirements for low-energy buildings	Increase in efficient use of energy resources	Designers, investors	RES-H		yes			1	01.01.2012
LI	To draft and publish technical provisions (rules) governing the connection of biogas supply systems to the natural gas network as well as the connection rates for biogas	Creation of conditions for the supply of gas from renewable energy sources to natural gas networks	Operators of gas transmission and distribution networks	Biogas		yes			2	01.01.2012
LI	Analysis of the promotion of the demand for energy from renewable sources	Collection of data on the consumption of renewable energy sources and incentives	Public and local authorities, investors	Biofuels			yes		0,5	01.01.2011
LI	Law of the Republic of Lithuania on the Market for Energy Resources	Improvement of transparency in biofuel trade, improvement of competitiveness, legal regulation of trade in renewable energy resources	Energy producers, sellers of biofuel	Biofuels			yes		0,5	01.01.2012
LI	Compulsory mixing of biofuel into mineral fuel	Growth of the use of renewable energy sources in the transport sector	Petroleum product suppliers	Biofuels			yes		1,5	01.01.2012
LI	Measures under the Programme for industrial biotechnology development in Lithuania for 2007-2010	Industrial biotechnology development	Technology developers	Biofuels			yes		0,5	01.01.2011
LI	To promote and support research into energy from renewable sources	Performance of a comprehensive feasibility study on the development of electric vehicle transport	Research institutions	E-Mobility				yes	0	01.01.2012
LU	The promotion of renewable energies in the context of the construction of residential property will be intensified as of July 2012 by tightening energy efficiency standards (tendency towards stricter requirements for overall energy efficiency rather than for heat insulation).	Increase in the installed capacity and the energy generation from RE	Consumers	RES-E & RES-H	yes	yes			1	01.07.2012

LV	The transmission system operator covers a part of the renewable energy producer's system connection costs, including the costs for reconstructing reconstruction of the existing transmission and distribution system in order to connect the plant to a connection point selected by the producer of renewable energy, as well as costs for metering equipment for the supplied and received electricity.	Promotion of RE utilisation and competitiveness of the energy generated from RES.	1) The transmission system operator shall fully reimburse the connection costs incurred to the renewable energy generation plants with installed capacity up to 500 kilowatts (inclusive); 2) The distribution system the renewable energy l	RES-E	yes				2	unknown
LV	Aid for introducing such energy-generation installations that utilise biomass, biogas or bio liquids for heat generation (draft Law on Renewable Energy). [Support for the implementation of energy generating installations using biomass, biogas or bioliquid fuels for generating heat energy (draft Law on Renewable Energy)]	Promotion of RE utilisation and competitiveness of the energy generated from RES.	It is planned to stipulate that the aid will be available for the energy producers, including the energy producers engaged in district heating or district cooling, or the energy producers utilising energy in a manufacturing any other products.	Biomass, Biogas, Bioliquids	yes	yes			3	unknown
LV	Aid for transition from energy-generation installations utilising fossil energy sources to energy-generation installations utilising renewable energy sources (draft Law on Renewable Energy). [Support for the implementation of energy generating installations using biomass, biogas or bioliquid fuels for generating heat energy (draft Law on Renewable Energy)]	Promotion of RE utilisation and competitiveness of the energy generated from RES.	It is planned to stipulate that the aid will be available for the energy producers, including the energy producers engaged in district heating or district cooling, or the energy producers utilising energy in a manufacturing cycle or for manufacturing of any other products.	Biomass, Biogas, Bioliquids		yes			2	unknown
LV	Aid for increasing the efficiency of heat generation by reducing heat losses in transmission and distribution systems (draft Law on Renewable Energy). [Support for increasing the efficiency of heat generation, reducing heat losses in transmission and distribution systems (draft Law on Renewable Energy)]	Promotion of RE utilisation and competitiveness of the energy generated from RES.	It is planned to stipulate that the aid will be available for the energy producers, including the energy producers engaged in district heating or district cooling, or the energy producers utilising energy in a manufacturing any other products.	RES-H grid-connected		yes			2	unknown
LV	Aid for new or fossil-fuel-replacing biomass plants for heat generation (for heat-generating installations) with capacity above 10 MW (draft Law on Renewable Energy). [Support for new or fossil-fuel-replacing biomass plants generating heat (for heat generating installations) with capacity above 10 MW (draft Law on Renewable Energy]	Promotion of RE utilisation and competitiveness of the energy generated from RES.	It is planned to stipulate that the aid will be available for the energy producers, including the energy producers engaged in district heating or district cooling, or the energy producers utilising energy in a manufacturing any other products.	Biomass		yes			3	unknown
MT	CHP promotion	behavioural change	investors & end-user	CHP	yes	yes			1	01.01.2012
NL	Energy Top Sector	Installed capacity, energy generated, energy innovation	Industry and research bodies, public administration	RES-E	yes				1	01.01.2011
NL	Structural vision for onshore wind (Designation of preferential areas for large- scale wind farms)	Installed capacity	Miscellaneous	Wind	yes				3	01.01.2012
PL	Introducing a definition of micro installations and stimulation of prosumer activity (prosumer activity consists in households and agricultural holdings producing energy from RES for their own needs and selling all potential excess energy to the grid)	sustainable supply of energy from RES to final customers, reduction of macroeconomic costs of supply, optimal use of locally available raw materials, increase in share of RES, increase in energy security, reducing the demand for regulatory services, limiting transmission losses	producers of electricity from renewable energy sources	RES-E	yes	yes			1	01.01.2012
RO	System of guarantees of origin for electricity and heating and cooling from RES	the development of the production of electricity/heating and cooling	producers of electricity/ heating and cooling from RES	RES-E & RES-H	yes	yes			1	01.01.2012

		from RES								
RO	The development of electricity transport and distribution networks in order to ensure the takeover of E-RES (Electricity Transmission Grid Roadmap drafted by TRANSELECTRICA)	ensuring the transport and distribution of electricity from RES, with the safe operation of the NES	- TRANSELECTRICA - E-RES producers	RES-E	yes				2	01.01.2011
RO	Certificates of origin for biomass used as fuel or raw material for the production of energy from RES (Emergency Government Order No 88/2011)	meeting the sustainable development principles	producers of biomass used as fuel or raw material for the production of energy from RES	Solid Biomass		yes			1	01.01.2012
SI	Introducing almost zero-energy buildings			RES-H		yes			0,5	01.01.2011
SK	Creation of a certification system for installers	Increase in quality of heat production facilities	Installers	all RES technologies	yes	yes	yes	yes	1	01.01.2012
SK	Minimum amount in new and renovated buildings	Production of heat and electricity	Designers	RES-E & RES-H	yes	yes			1	01.01.2013
SK	Support for cultivation of fast-growing woody plants	Increase in biomass availability	Agricultural undertakings	Biomass agricultural based	yes	yes			2	01.01.2012
SK	Increase in production of woody raw material	Increase in biomass availability	Forestry undertakings	Biomass forestry based	yes	yes			2	01.01.2012
SK	Support for RES in the construction sector	Production of heat	Investors	RES-H		yes			1	01.01.2012
SK	Mandatory use of RES in new and rebuilt buildings	Production of heat	Designers	RES-H		yes			1	01.01.2012
SK	Support for reconstruction of heat distribution infrastructure	Energy efficiency, promotion of central supply of heat	investors	RES-H grid-connected		yes			2	01.01.2014
SK	Support for the use of RES for heating and cooling in public buildings	Production of heat and cooling in public buildings	Public bodies	RES-H		yes			1	01.01.2014
UK	Business rate retention: renewable energy projects	Would allow business rates revenues from new renewable energy projects to be kept by the local authorities	Local Planning Authorities	all RES technologies	yes	yes	yes	yes	0,5	01.04.2013
UK	Community and Renewable Energy Scheme (CARES).	Installed capacity and energy generated. In 2009/2010 CARES supported renewable energy projects with a total annual generating capacity of 13.4GWh.	CARES provides advice to communities wishing to take forward renewable energy schemes. It also provided grants during the period in question.	RES-E & RES-H	yes	yes			1	01.02.2011
UK	Zero Carbon Homes	All new -homes in Northern Ireland to be low or zero carbon from 2017- to stimulate greater uptake of on-site renewables (under review)	Development of new housing	RES-E & RES-H	yes	yes			1	01.01.2017
UK	Zero carbon Non-domestic buildings	Ambition (under review) for all new non-domestic buildings in Northern Ireland from 2020 (2018 for public sector buildings) - to stimulate greater uptake of on-site renewables	Development of non-domestic buildings	RES-E & RES-H	yes	yes			1	01.01.2018
UK	National Planning policy Framework to set out planning policy for local development	The NRPF will, once published, set out the Government's planning policies, which local authorities and developers are expected to take into account in plan making or preparing and determining planning applications.	Local planning authorities Developers of renewable energy projects 50MW or under.	RES-E	yes				1	31.03.2012
UK	Electricity Market Reform	Package of measures to enable investment in low- carbon electricity generation - See separate entry in Item 2 for the Contract for Difference mechanism within this package.	Investors and developers in low-carbon electricity	RES-E	yes				1	01.04.2013

UK	Strategic Traffic Management Plan	Behavioural Change - The Plan will manage delivery of wind turbine components to development sites in Wales	The Welsh Government are working with the Wind Energy Industry, Welsh and English Local Authorities, Police and UK Highways Agency, all of which will need to agree the STMP before implementation	Wind	yes				1	01.01.2011
UK	Second national Planning Framework for Scotland	Behavioural change, installed capacity, energy generated.	Planning authorities, developers, Strategic and local planning policy, and planning applications, energy industry, applications under the Electricity Act 1989, Reporters for planning appeals and examinations.	RES-E	yes				1	01.01.2010
UK	Scottish Planning Policy	Behavioural change, installed capacity, energy generated.	Planning authorities, developers, strategic and local planning policy, and planning applications, applications under the Electricity Act 1989, Reporters for planning appeals and examinations, industry.	RES-E	yes				0,5	01.01.2011
UK	Scottish Renewables Infrastructure Plan (N-RIP)	Behavioural change	Developers, port authorities/owners, potential inward investors. The purpose of the National Renewables Infrastructure Plan (N-RIP) is to support the development of a globally competitive offshore renewables industry based in Scotland. Stage 1 sets out the first phase sites/locations which are expected to support the development of the Scottish offshore wind industry. Stage 2 sets out the investment that port owners estimate they would need to make to fully develop the 11 first phase sites identified in Stage 1 N-RIP Report for use for Offshore Wind manufacturing	Wind offshore	yes				0,5	01.02.2010

Assessment of financial support measures

For financial support measures any lack of sufficient information as needed for subsequent model-implementation needed to be filled by applying adequate assumptions on the detailed implementation of envisaged measures. In this context, the assumption was taken that MSs apply support in similar magnitude as currently implemented on average at EU level.

Table 77 indicates all planned measures form the EU member states Progress Reports which represent financial support mechanisms for specific technologies and support strategies.

Table 77. Planned financial support measures as according to the EU member states Progress Reports.

Country	Name and reference of the measure	RES technologies covered	Financial support strategy	Start date of measure	End date of measure	Excluded measures[89]
	List of planned or not finally adopted financial measures of Member States Progress Reports					
AT	Environmental tax reform	all RES technologies	Tax incentives	unknown		x
AT	Further development of eligibility criteria and tools in the building sector	RES-H	Investment incentives	01.01.2013		
AT	Austrian Action Programme for Mobility Management (klima:active mobil)	Biofuels & E-Mobility	Investment incentives	unknown	31.12.2020	
BG	Financing renewable energy and energy efficiency projects	RES-E & RES-H	Investment incentives	01.01.2011		x
BG	Developing rules and using financial resources from the Emissions Trading Scheme (ETS)	RES-E & RES-H	Investment incentives	01.01.2013	31.12.2020	
BG	Promoting the use of individual renewable energy systems	RES-E & RES-H	Investment incentives	01.01.2011		x
BG	Financial incentives for the use of local heating systems	RES-H (non-grid)	Investment incentives	01.01.2013		
DK	Various initiatives to promote biogas production (Green Growth)	Biogas	Investment incentives	unknown		
DK	Various initiatives to promote the production of energy crops (Green Growth)	Biomass	Investment incentives	unknown		
DK	Reform of road tax that promotes energy efficient cars and encourages more people to use public transport	Biofuels & E-Mobility	Tax incentives	unknown		x
IT	Contributions for the production of thermal energy from renewable sources and for small energy efficiency interventions (Legislative Decree No 28/2011, Article 28)	RES-H	unknown	unknown		x
IT	New incentive mechanisms (Decree No 28/2011, Article 24)	RES-E	FiPs	01.01.2013		
IT	Incentives for bio methane fed into the natural gas network	RES-H	unknown	unknown		x
IT	Guarantee fund for district heating (Legislative Decree No 28/2011. Article 22) [Support for the creation of district heating and district cooling networks]	RES-H	Investment incentives	01.01.2012		
IT	Interventions and measures favouring technological and industrial development (Legislative Decree No 28/2011, Article 32)	RES-E & RES-H	various	unknown		
HU	Mandatory off-take of electricity at a guaranteed price (METAR)	RES-E	FIPs	unknown		
LU	Assistance is being granted for the production and feed-in of biogas.	Biogas	Investment incentives	01.03.2011		
LV	Payment of premiums for generation of renewable electricity (draft Law on Renewable Energy).	RES-E	FiPs	unknown		

[89] Marked measures were excluded because of a very vague description or non-existing specification of the chosen financial support strategy.

LV	Payment of premiums to producers of thermal energy (draft Law on Renewable Energy).	RES-H	FiPs	unknown		
PL	Optimisation of the support scheme based on certificates of origin through diversification of the amount of support depending on the technology and installed capacity of the production unit.	RES-E	TGCs	01.01.2012	31.12.2013	
PL	Introducing premiums for prosuments for electricity generation in micro installations	RES-E	FIPs	01.01.2012	31.12.2013	
SE	Super green car premium	Biofuels & E-Mobility	Tax incentives	01.01.2012	31.12.2014	
SK	Introduce tender system for construction of sources with fluctuating electricity production	RES-E	Tender	01.01.2013		x
SK	Support for the use of RES in the business sector	RES-H	Investment incentives	01.01.2014	31.12.2020	
UK	Introduction of new Contract for Difference (CfD) support mechanism	RES-E	FIPs with CfD	01.01.2014	31.12.2037	
UK	Green Investment Bank	all RES technologies	Investment incentives	01.07.2012	31.07.2015	
UK	Offshore Transmission Operators Regime	RES-E	Tender	unknown		x

Appendix IV Measures to safeguard sustainability in EU MS

In the table below the full analysis is presented of all EU Member state reports regarding the transposition of the RES Directive into national regulation or legislation.

Table 78. Overview of transposition of RED sustainability criteria per Member State.

Member State	Transposition of RED sustainability criteria	Integrated with FQD?	Type of System
Austria	Austria is still in the process of finalising its RED-transposition. The two main legal transposing Orders are the (1) Verordnung Landwirtschaftliche Ausgangsstoffe für Biokraftstoffe und flüssige Biobrennstoffe, which contains the sustainability criteria and guidelines on how Austrian feedstocks can comply and the (2) Kraftstoffverordnung, which contains the obligations for fuel suppliers, imported feedstocks, RED GHG-threshold and calculation rules as well as details on double counting. While the first Order has been in force since December 2010, the Kraftstoffverordnung is still awaiting political approval.2	Unknown	Austria has a national system for biofuel feedstocks produced inside Austria. This means that economic operators can not only use voluntary schemes to demonstrate compliance with the sustainability criteria but in addition a national system (based on CAP) has been developed to demonstrate compliance.2
Belgium	The Belgian royal decree transposing the sustainability criteria came into force in December 2011. The decree designates a transitional period for 2011 and 2012 during which biofuels produced from raw materials harvested in 2011 and 2012 are deemed sustainable in the sense of the decree.[2]	Yes[2]	The system primarily relies on certification schemes as a way of demonstrating compliance. This includes the use of EC recognised voluntary schemes, as well as other certification systems developed in line with the EN 16214 standard and approved by the Belgian Ministry for Health, Food Chain Safety and Environment. It also recognises the CEN standard EN 16214. Differences exist in the requirements for domestic, EU and non-EU feedstocks.[2]
Bulgaria	While the Bulgarian Energy from Renewable Sources Act was transposed in May 2011, the secondary legislation under this Act concerning the transposition of the sustainability scheme is still under development by the Ministry of Environment and Water.[2]	Will be integrated.[2]	International and national voluntary schemes that are recognised by the European Commission (as well as eventually bi- and multilateral agreements) may be used to demonstrate compliance in the absence of national secondary legislation implementing the sustainability scheme.[2]
Cyprus	The transposition of the RED sustainability scheme in Cyprus was not completed at the time of writing the report.	Will be integrated[2]	It is anticipated that several routes of demonstrating compliance will be accepted, including the use of national systems of other Member

			States and voluntary schemes accepted by other Member States.[2]
Czech Republic	The sustainability requirements were transposed in the Czech Republic in January 2012. There was no transition period.[2]	Yea[2]	The Czech system is a voluntary scheme based system. Apart from voluntary schemes recognised by the EC, voluntary schemes accepted by other MS, as well as national systems of other MS are also accepted.[2]
Denmark	Denmark has transposed the RED and FQD sustainability criteria in the Sustainable Biofuels Law and the Order on Biofuels Sustainability. The transposition of the RED/FQD sustainability criteria entered into force on the 1st of January 2010.[2]	Yes[2]	The Danish implementation is a national system based on ex-post verification of actual data. This means that in addition of using voluntary schemes, Denmark allows economic operators to demonstrate compliance by gathering actual sustainability data from their supply chain and have those ex-post verified by an independent auditor.
Estonia	The Regulation of the Minister of the Environment on environmental requirements for liquid fuels, the sustainability criteria for biofuels and the procedure for certifying compliance was issued on 22 December 2010[1] Although no official transition period has been introduced, a de facto transition period exists during which economic operators do not have to report information to the authorities and not have to demonstrate compliance with the sustainability and chain of custody requirements. Reporting will be obligatory once a biofuel mandate has been introduced, which is scheduled for 2015 and possibly already in 2013.[2]	Unknown	Estonia accepts voluntary schemes recognised by the European Commission as well as national systems of other Member States. Estonia does not check other Member States' systems prior to accepting them.[2]
Finland	Legislation to transpose the RED and FQD sustainability criteria for biofuels is still under development in Finland. A legislative proposal is expected to gain approval in the summer of 2012 and could enter into force in 2013. [2]	Unknown	Fuel suppliers can use EC-recognised voluntary schemes to demonstrate compliance with the sustainability criteria. In addition, ex-post verification of actual reported data will probably be allowed as a way to demonstrate compliance. National systems of other MS will not automatically be accepted by the Finnish authorities.[2]
France	The sustainability requirements were transposed in France in November 2011. A transition period was in place until April 2012 during which economic operators must provide evidence that they intend to join a voluntary scheme or to use the services of independent auditors. They were granted time until 31 December 2012 to provide a posteriori evidence of	Yes[2]	The French system can be classified as a national system, given the option for economic operators to directly provide verified information to the French authorities apart from using EC recognised voluntary schemes.[2]

	independent certification of sustainability.[2]		
Germany	The German Federal Government transposed the RED and FQD sustainability requirements (Article 17) into national legislation through the Biofuels Sustainability Ordinance (Biokraft-NachV). The Biokraft-NachV entered into force the 2 November for all provisions excepting provisions §24 (partial proof of sustainability) and §34 (2) (about the procedures to recognise VS) which came into effect the 1 January 2010.[2]	Yes[2]	The German sustainability system is based primarily on the use of vs that have to be approved by the Federal Agency for Agriculture and Food (BLE). Germany also accepts VS approved by the EC or other EU MS well without any additional check.
Greece	The transposition of the RED is still ongoing in the spring of 2012. A draft law still had to be voted in Parliament and several more detailed implementing decisions were still outstanding, to be finalised by a Joint Ministerial Decision (JMD). The Greek government expects that a transition arrangement will be put in place until the end of 2012.[2]	Yes[2]	Unknown
Hungary	Hungary transposed the RED sustainability scheme by the end of 2010 as part of the Biofuel Act to support renewable energy in transport and a Government decree on the verification of sustainable biofuel production (as well as accompanying decrees and regulations specified below). There was no transition period with lighter requirements.[2]	Yes[2]	The Hungarian system can be classified as a national system based on land zoning. The national system focuses on ensuring the sustainability of domestically produced biomass. However, imported biomass or biofuels needs to be accompanied by alternative proofs of sustainability since the Hungarian system is tailored for domestic biomass only.[2]
Ireland	Ireland transposed the European Union (Biofuels Sustainability Criteria) Regulations 2012 on 2 February 2012, which became effective on 28 February 2012. A brief transition period has been introduced in the sense that biofuels contracted prior to February 2012 are exempted from the sustainability criteria until mid July 2012. [2]	Unknown	Yes, although not all details of the system have been fully defined. Ireland permits ex-post verification for demonstrating compliance with the sustainability requirements. Voluntary schemes recognised by other Member States are only accepted if they are also recognised by the EC, or if independently verified to ISAE 3000.[2]
Italy	The Italian decrees transposing the RED sustainability requirements and setting out the national certification schemes were adopted in January and March 2012. Since January 2012, biofuels counting towards the target need to comply with the sustainability criteria. However, biofuels produced in 2011 or produced in 2012 with raw or intermediate material produced in 2011 and are placed on the market until the end of August 2012 only have to comply with lighter transitional	Yes[2]	The Italian system can be classified as a national system , given the presence of a national certification system allowing for the verification of sustainability information provided to the Italian authorities by economic operators.[2]

	requirements.[2]		
Latvia	The Latvian Government Regulations regarding Sustainability Criteria for Biofuels and Bioliquids were adopted on 5 July 2011. A transitional arrangement was in place during 2011, according to which there were no strict compliance requirements during 2011 for biofuels consumed in Latvia, but requiring economic operators to do an independent (ex-post) audit by 1 April 2012 to demonstrate compliance with the sustainability criteria. The transposition of the RED and FQD sustainability criteria is integrated in Latvia.[2]	Yes[2]	In order to demonstrate sustainability, economic operators may use voluntary schemes approved by the EC or national systems of other MS (or bilateral or multilateral agreements). A Latvian national certification scheme is available and operated by the Rural Support Service.[2]
Lithuania	The RED mandatory sustainability requirements are transposed in Lithuania through the Law on Renewable Energy Sources which entered into force at the 23th of May 2011. There was no transition period in Lithuania with "lighter" requirements for economic operators.	Unknown	Mainly voluntary scheme based. It is unclear whether Lithuania accepts other Member States' national systems.
Luxemburg	RED Sustainability requirements for biofuels are transposed in the grand-ducal regulation which entered into force on the 5th of March 2011. The regulation establishing sustainability criteria for biofuels and bioliquids of 27 February 2011 (Règlement grand-ducal du 27 février 2011 fixant les critères de durabilité pour les biocarburants et bioliquides) governs both the sustainability criteria for biofuels and other bioliquids.[1]	Unknown	Unknown
Malta	Malta has transposed the RED and FQD sustainability criteria for biofuels in Biofuels Regulations, which entered into force in December 2010. No transition period with "lighter" requirements for economic operators was introduced.[2]	Yes[2]	The Maltese system for demonstrating compliance with the sustainability criteria can be classified as a voluntary scheme based system since voluntary certification schemes are the most important way to demonstrate compliance and no Maltese national system has been developed.[2]
Netherlands	The Netherlands have transposed the RED and FQD sustainability criteria in a single Government Decree and Ministerial Order which entered into force on the 1 January 2011 and which also contains the RED target for renewable energy in transport.	Yes[2]	The system is based on the use of EC recognised VS. The NL have recognised some VS on a national basis, but this was mainly aimed to bridge the period up to mid-2011, during which the EC had not yet recognised any VS. Acceptance of voluntary schemes that are recognised in other MS is possible following a quick-scan[2].
Poland	No information was available from either MS report, and no response was received from state agency.	Unknown	Unknown

Portugal	The transposition of the Portuguese system becomes effective in January 2013, until then sustainability requirements are not verified.[2]	Yes[2]	The system can be classified as a national system, given the option to provide verified information directly to the Member State. Portugal anticipates allowing the use of other Member States' national systems (if recognised by the EU) to demonstrate compliance with the sustainability criteria.[2]
Romania	The compliance with sustainability criteria was mandated in the Government Decision No 935/2011 on the promotion of the use of biofuels and bioliquids, published in the Official Gazette No 716/11 October 2011. Start date = 11 Nov 2011[1]. An Order to implement the certification of sustainability criteria was subsequently implemented in February 2012. A simplified system was in place in 2011.[2]	Yes[2]	The system can be classified as a national system, given the option for economic operators to provide verified information directly to the Romanian authorities. Romania accepts other MS national systems as a way of showing compliance with the sustainability criteria.[2]
Slovakia	The Slovakian system was implemented in May 2011. Prior to this, there was a transitional period during which biofuels could contribute to mandates without sustainability information required.[2]	Yes[2]	Unknown
Slovenia	The Decree on Promotion of the Use of Biofuels and Other Renewable Fuels for the Propulsion of Motor Vehicles (OGRS, Nos 103/07, 92/10, 74/11) is being implemented.[1]	Unknown	Implementation seems incomplete
United Kingdom	The UK transposed the RED on 15 December 2011, as an amendment to the RTFO (Renewable Transport Fuel Obligations Order) 2007.[2]	The FQD is not yet implemented[2]	A key aspect of the system is that the UK permits ex-post verification as a way of demonstrating compliance with the sustainability requirements. Voluntary schemes recognised by other Member States (but not recognised by the EC) are not automatically accepted.[2]

1) Information extracted from the MS progress report 2012 (Article 22 of the RED)

2) Information provided by interim report from Ecofys on Analysis of Member State RED implementation

Note on sources: Often the MS progress reports do not contain information on how the RED sustainability requirements are transposed in national legislation. They mostly only provide short references to instruments/measures to promote the used of renewable energy in general, and sometimes biofuels.

Appendix V Land use quantification

Below the land use quantification graphs for countries important for EU biofuel feedstock production in 2010 are given. Graphs already presented in section 4.2 'land use quantification' are not repeated below.

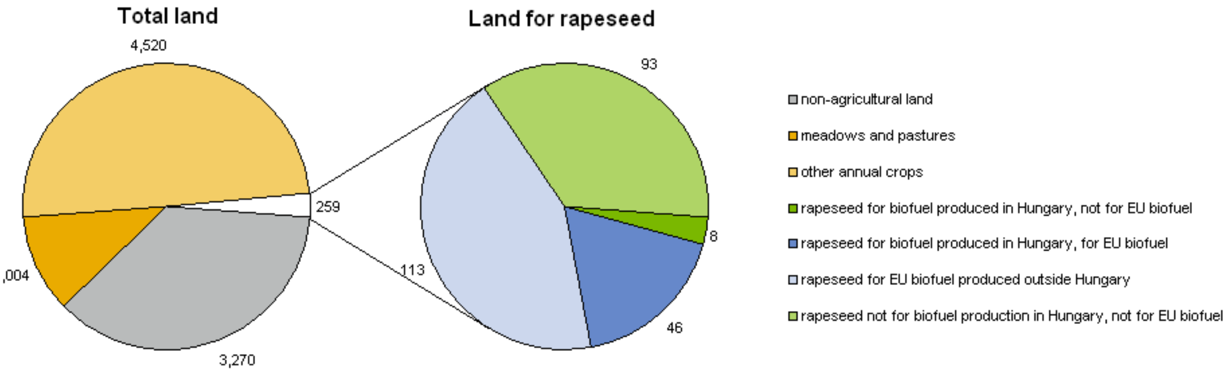


Figure 139. Land used for rapeseed Hungary for EU biofuels, 2010.

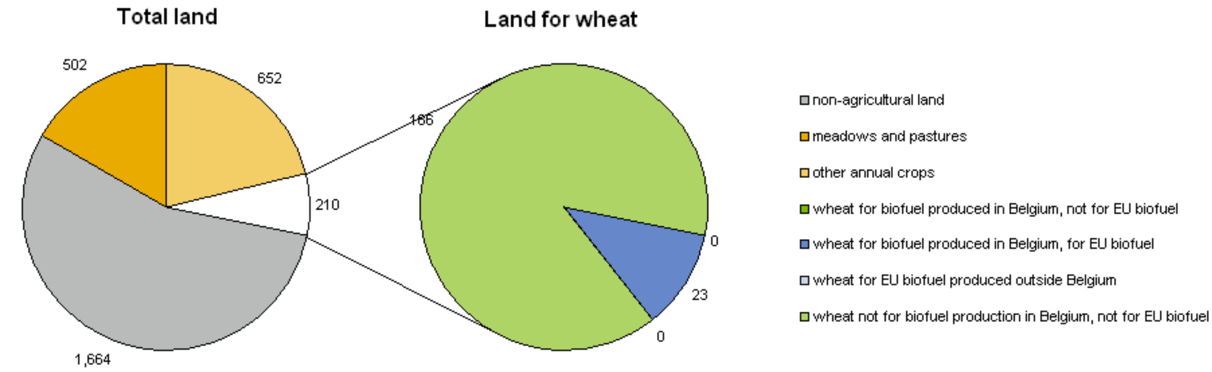


Figure 140. Land used for wheat Belgium for EU biofuels, 2010.

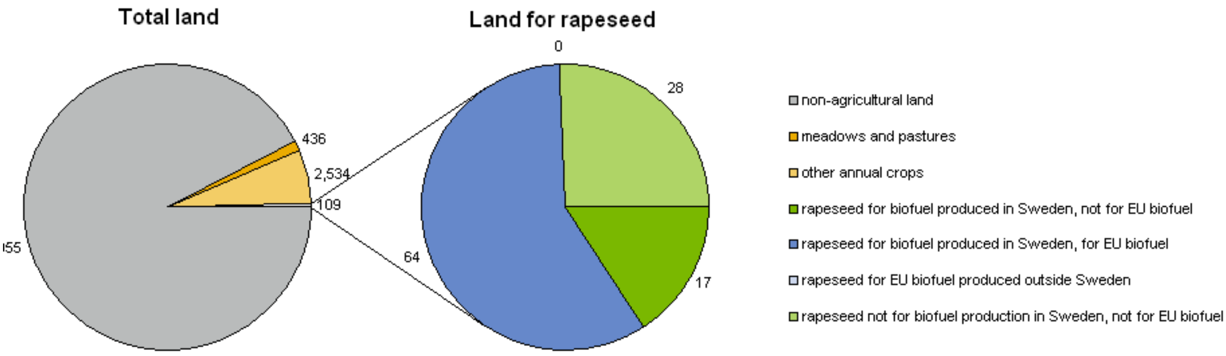


Figure 141. Land used for rapeseed Sweden for EU biofuels, 2010.

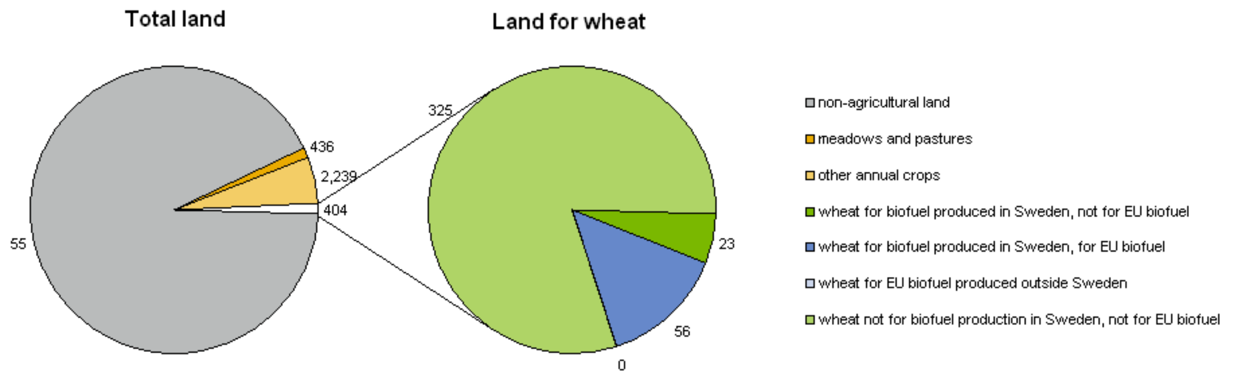


Figure 142. Land used for wheat Sweden for EU biofuels, 2010.

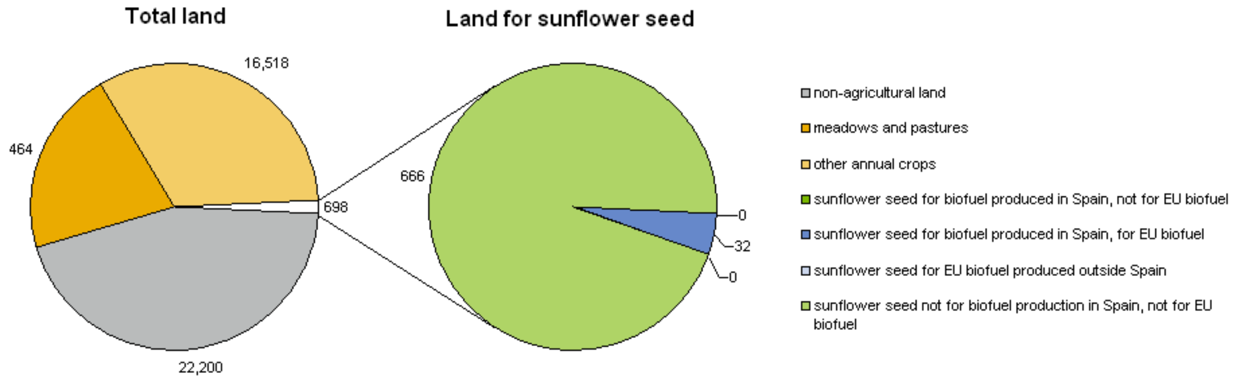


Figure 143. Land used for Sunflower Spain for EU biofuels, 2010.

Figure 144. Land used for wheat Spain for EU biofuels, 2010.

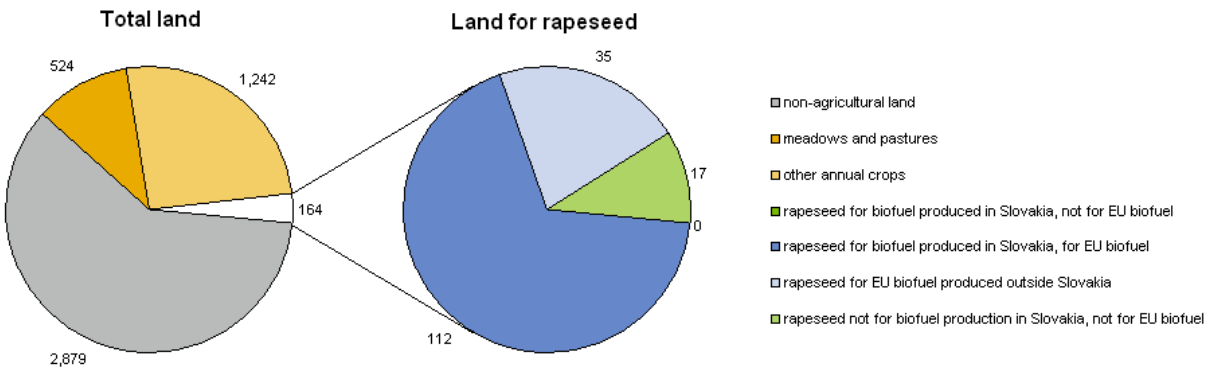


Figure 145. Land used for rapeseed Slovakia for EU biofuels, 2010.

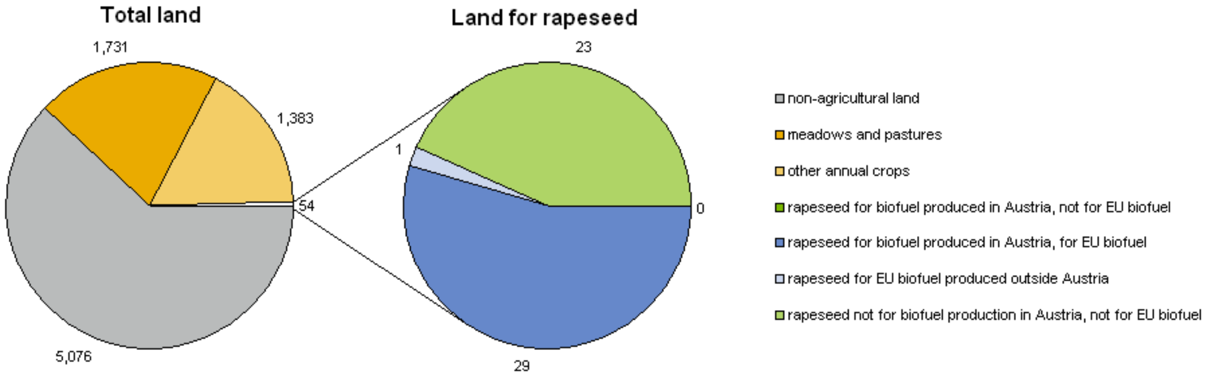


Figure 146. Land used for rapeseed Austria for EU biofuels, 2010.

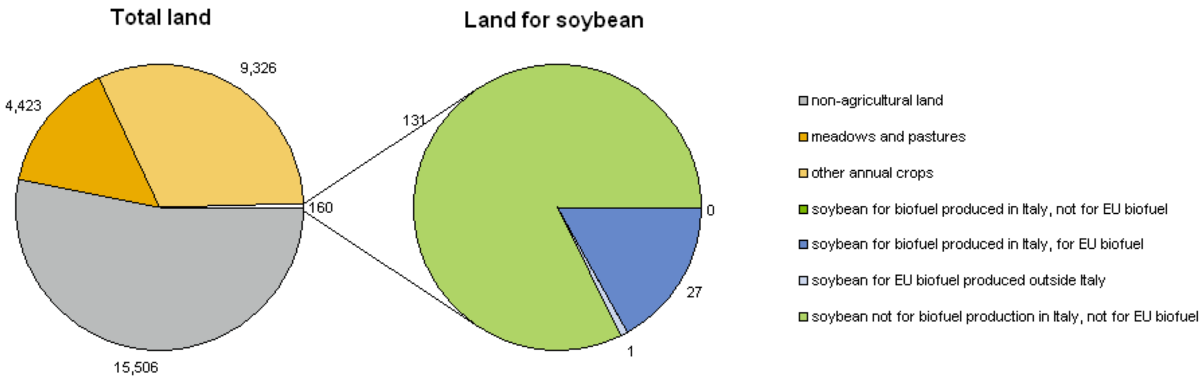


Figure 147. Land used for soybean Italy for EU biofuels, 2010.

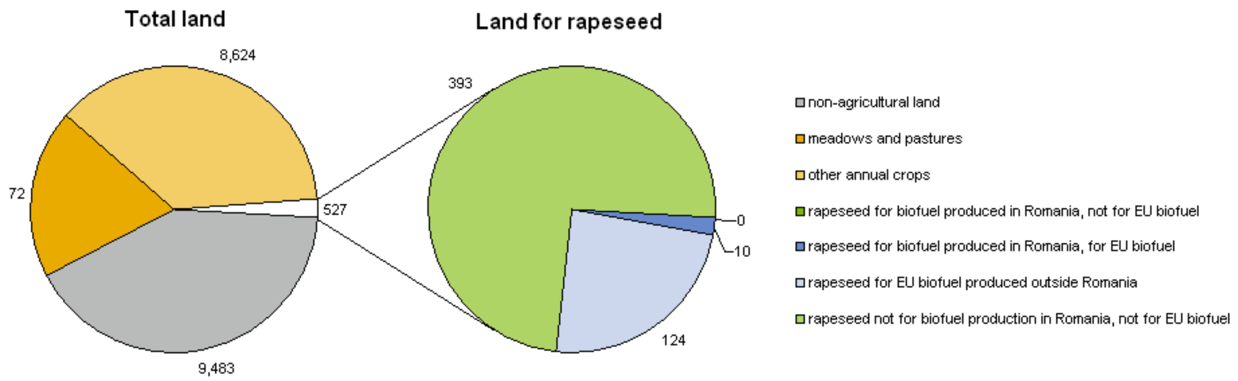


Figure 148. Land used for rapeseed Romania for EU biofuels, 2010.

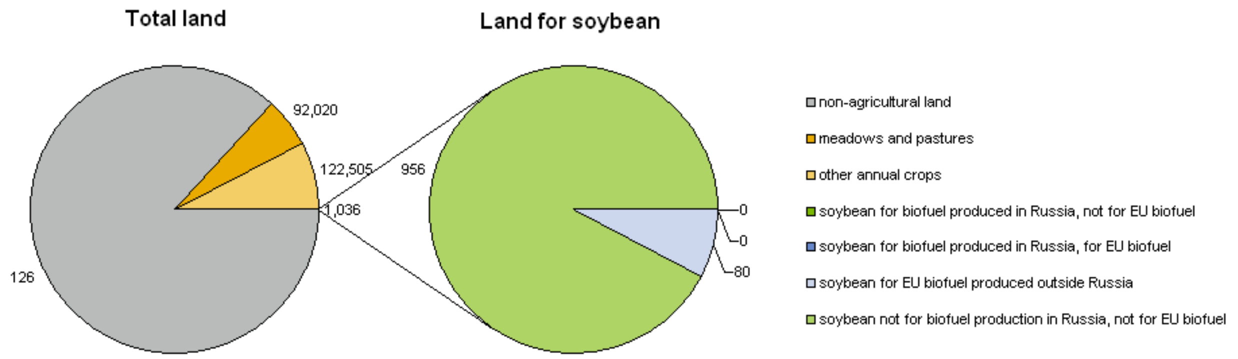


Figure 149. Land used for soybean Russia for EU biofuels, 2010.

Figure 150. Land used for soybean Canada for EU biofuels, 2010.

Appendix VI Land Cover analysis

Introduction

Traditionally the land cover and land use has been monitored at global, national and sub-national level through statistics from trade bureaus and agriculture agencies, where the capacity to do so exists. With the advancement of the remote sensing technology, mapping and monitoring the land cover though satellite images at varying scales has become common practice. More technologically advanced countries such as the EU, Brazil, and the USA have mapped their land cover and associated land use categories utilizing the remote sensing technology and have a records of trading and agricultures statistics. For developing countries, the only data available are on land cover, often satellite based, with little to no land use information incorporated. Although the agriculture trade statistics provide very detailed information on crop yields, they do not reflect the spatial nature of the changes in the landscape that are of concern for assessing biofuel sustainability.

Land cover and land use data are derived from remote sensing images and verified with ground survey data to assure accurate representation of the land categories. The terms **land cover** and **land use** are easily and often confused; land cover is defined as "*the observed (bio)physical cover on the earth's surface*", while land use is "*characterized by the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it*" [Di Gregorio and Jansen 2000[90]]). For example, forest, grassland, wetland and savannah are common categories for land cover, while agricultural land, forest preserve/conservation area and mining area are common examples of land use categories. Changes in land cover and land use category over a certain period can bring better understanding of land cover and land use dynamics.

The currently available land cover and land use data vary by scale, therefore the data need to be discussed in a scale specific way. Land cover categories are easily identified from satellite images and land cover maps exist at global (>300m resolution) to national/local scale (1 -100m). The land use is **not** easily distinguishable from satellite imagery. However, depending on the level of detail provided by satellite imagery **and** the contextual information available on the ground for verification, there are examples when land use can be inferred from satellite images for select types of land cover. For example, tilled lands for agriculture, crop circles, burned sugarcane fields and other signatures linked to agricultural land use are identifiable in some high resolution datasets (1-10 m data). Interpretation of these data is time consuming, expensive, and requires highly trained image analysts and still not available at global scale. Alternately, an area with land use defined as 'protected' forest will have no (bio)physical characteristic detectable by satellite imagery to suggest the appropriate land use category. Similarly, 'native' versus 'invasive' or 'artificial' grassland regions

[90] Di Gregorio, A. and Jansen, L., 2000, Land cover classification system, classification concepts and user manual, Food and Agriculture Organisation of the United Nations:Rome.

are largely undetectable with satellite imagery without the incorporation of on the ground observations.

To identify the land cover changes for the main third countries of supply and the EU 'main' countries[91] we used MODerate Resolution Imaging Spectroradiometer (MODIS) Global Land Cover Type datasets (MODIS). At the global scale, changes in land use cannot be quantified, however the closest land cover classes to the ones defined in the RES Directive (forests, grassland, cropland) are used to make observations about the magnitude of change which may be attributed to agriculture in general; i.e. at this scale "cropland" refers to any region that is likely associated with agriculture and is not specific to the type of crop.

Since land use maps are not available for all countries of interest, a study for Brazil, where more detailed remote sensing data and on the ground land use knowledge are available, is used to demonstrate the potential of properly designed methods for monitoring biofuel crop expansion. The sugarcane crop monitoring project (CANASAT) at the Instituto Nacional de Pesquisas Espaciais (INPE) [92] has provided spatially explicit data on cultivated sugarcane areas for the South-Central region in Brazil since 2003. Another example (not used in this report) is the Cropland Data Layer (CDL) developed since 2008 for the US (since 1997 for selective states) by the US National Agriculture Statistical Service (NASS). These data provide details on specific crop types (e.g. soy, corn, wheat) and also can be used to quantify expansion of bioenergy related crops over time and to identify the land cover/ use transitions (what land cover category (forest, wetland, etc.) cropland expansion is encroaching or replacing).

To quantify the land cover change since 2008 two approaches were applied: **default** and **detailed**. In both approaches, available trade statistics related to EU biofuel was considered when available.

Default Approach

The 'Default' approach utilizes the globally available MODerate Resolution Imaging Spectroradiometer (MODIS) land cover map for 2009[93] to quantify the state of the land cover classes in 2010 and to evaluate land cover change from the baseline date (2008). The MODIS land cover data identifies 17 broad land cover categories based on biophysical characteristics of the land (e.g. forest, cropland, grassland, woodland, etc.). Although this approach does not identify the specific land use categories, it provides the basis for comparison with trade and/or agriculture statistics.

---

[91] Argentina, Brazil, Canada, Indonesia, Malaysia, Peru, Russia, Ukraine, United States, Paraguay, Czech Republic, France, Germany, Italy, Poland, Spain and United Kingdom

[92] http://www.dsr.inpe.br/laf/canasat/en/tables.html

[93] The MODIS MOD12Q1 2009 product is the most recent one available. If 2010 data becomes available during the project lifetime, the 2010 data will be used.

The International Geosphere Biosphere Programme (IGBP) global land cover categories consist of a list of 17 cover classes, including 11 classes of natural vegetation, 3 classes of developed and mosaic lands, and 3 classes of non-vegetated lands. To be consistent with the 2008 baseline report to the EU[94], we grouped the 17 MODIS land cover categories into 7 general classes:

- Forest (MODIS classes 1-5);
- Savannas/Shrub (MODIS classes 6-9);
- Grassland (MODIS class 10);
- Wetland (MODIS class 11);
- Cropland (MODIS class 12);
- Urban (MODIS class 13);
- Mosaic (MODIS class 14).

Table 79 reports the area in thousand hectares for the 7 land cover categories: forest, savannah/shrub, grassland, wetland, cropland, urban and mosaic from the land cover change analysis for 2008 to 2010 for the non-EU countries. The land cover categories in 2010 are shown in the columns and the land cover categories in 2008 are shown in the rows of the table. The persistence of each land cover category for both years is shown in the diagonal of the table for each country (bolded blue numbers in the outlined cells) and the change is shown in the off-diagonal cells. The total area per land cover category in 2008 is shown in the last column and the total area per land cover category in 2010 is shown in the last row of the country table. This table present combined information on total area, persistence and change per land cover category per country.

The change in land cover category is given as gains and losses. The gains show the area of other land categories (e.g. forest, grassland, and wetland) that the land category of interest (e.g. cropland) is expanding into. The gains per land category are given in the table by the off-diagonal cells in the columns. For example, for the 2008-2010 period, the cropland in Argentina gained 200 thousand ha from forest, 2,973 thousand ha from grassland, 2,649 thousand ha from mosaic, 1,321 thousand ha from savannah/shrub and 97 thousand ha from wetland category (off-diagonal cells in the 2010 cropland column). The losses per land category are given in the table by the off-diagonal cells in the rows in the country tables. For example, for the 2008-2010 period, the cropland in Argentina gained 166 thousand ha from forest, 4,913 thousand ha from grassland, 1,929 thousand ha from mosaic, 996 thousand ha from savannah/shrub and 10 thousand ha from wetland category (off-diagonal cells in the 2008 cropland row). Figure 151 and Figure 154 present the persistence of grassland cover and the percent change (gains and losses) for the non-EU countries per land category.

Table 79. Area of land cover change and persistence per land category for each of the non-EU countries. The persistence is presented in the diagonal outlined cells (bold blue

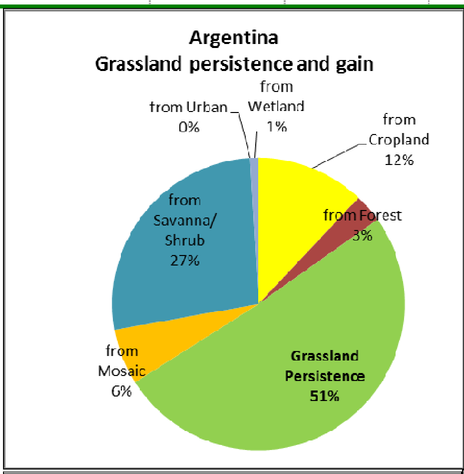
[94] 2008 Biofuels Baseline report available online from the following url: http://ec.europa.eu/energy/renewables/studies/renewables_en.htm

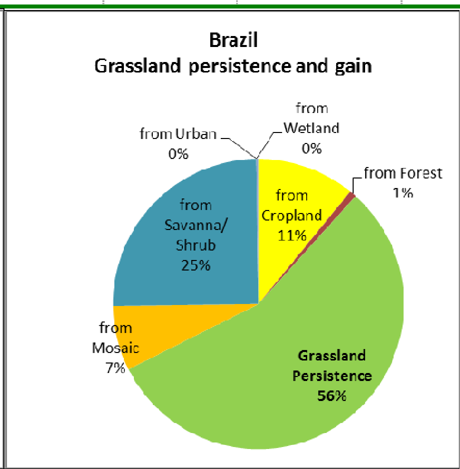
values) and the change is presented in the off-diagonal cells (gains in columns; losses in rows).

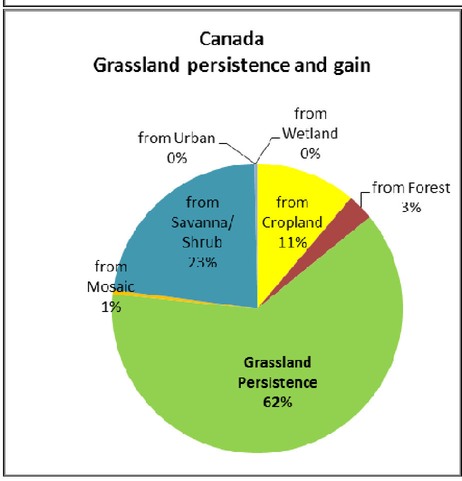
2008 land cover category	2010 land cover category							Totals in 2008
	Cropland	Forest	Grassland	Mosaic	Savanna/ Shrub	Urban	Wetland	
x 1,000 ha								
Argentina								
Cropland	38,191	166	4,913	1,929	996	-	10	**46,204**
Forest	200	22,715	1,286	226	1,220	-	223	**25,870**
Grassland	2,973	1,691	20,753	902	5,780	-	98	**32,198**
Mosaic	2,649	437	2,521	2,936	1,585	-	24	**10,153**
Savanna/ Shrub	1,321	3,257	10,995	990	123,654	-	211	**140,428**
Urban	-	-	-	-	-	1,734	1	**1,735**
Wetland	97	361	365	64	561	2	2,388	**3,837**
Totals in 2010	**45,431**	**28,628**	**40,834**	**7,047**	**133,796**	**1,736**	**2,955**	**260,426**
Brazil								
Cropland	17,303	231	1,991	5,117	10,046	-	81	**34,769**
Forest	146	360,802	139	4,119	5,734	-	2,324	**373,265**
Grassland	552	144	10,237	551	7,490	-	89	**19,064**
Mosaic	3,804	3,921	1,319	46,742	26,859	-	159	**82,803**
Savanna/ Shrub	5,505	5,588	4,568	20,355	281,613	-	935	**318,565**
Urban	-	-	-	-	-	3,943	10	**3,953**
Wetland	58	2,712	48	117	553	8	9,789	**13,286**
Totals in 2010	**27,367**	**373,399**	**18,303**	**77,001**	**332,296**	**3,951**	**13,388**	**845,705**
Canada								
Cropland	41,651	595	3,576	2,052	237	-	38	48,149
Forest	139	293,867	940	1,603	22,335	-	6,849	325,733
Grassland	1,013	885	19,985	420	14,975	-	170	37,447
Mosaic	1,867	3,319	159	11,706	152	-	117	17,319
Savanna/ Shrub	126	13,508	7,232	390	351,025	-	7,627	379,908
Urban	-	-	-	-	-	859	1	860
Wetland	12	4,635	98	74	5,100	1	26,466	36,386
Totals in 2010	**44,808**	**316,808**	**31,990**	**16,245**	**393,825**	**860**	**41,267**	**845,802**
Indonesia								
Cropland	2,661	257	32	1,196	448	-	66	4,661
Forest	492	131,875	36	3,885	495	-	1,981	138,765
Grassland	31	20	112	49	75	-	6	293
Mosaic	1,365	5,424	49	21,530	1,344	-	171	29,882
Savanna/ Shrub	257	402	87	1,078	3,470	-	86	5,381
Urban	-	-	-	-	-	1,112	6	1,118

Wetland	162	2,578	8	298	119	7	5,289	8,460
Totals in 2010	**4,968**	**140,556**	**324**	**28,035**	**5,952**	**1,119**	**7,605**	**188,559**
Malaysia								
Cropland	105	40	3	108	13	-	9	277
Forest	53	25,940	8	772	20	-	201	26,994
Grassland	3	2	7	7	3	-	0.5	22
Mosaic	111	1,191	6	3,176	21	-	18	4,522
Savanna/ Shrub	12	14	3	27	30	-	3	89
Urban	-	-	-	-	-	285	2	287
Wetland	7	209	1	15	3	1	521	758
Totals in 2010	**292**	**27,395**	**28**	**4,104**	**90**	**286**	**754**	**32,950**
Paraguay								
Cropland	1,940	32	204	219	429	-	1	2,825
Forest	45	10,738	98	78	1,551	-	31	12,540
Grassland	76	26	1,150	33	205	-	27	1,516
Mosaic	464	232	624	2,392	1,767	-	11	5,490
Savanna/ Shrub	458	3,509	1,265	924	10,089	-	198	16,444
Urban	-	-	-	-	-	144	0	144
Wetland	1	60	159	3	75	1	585	884
Totals in 2010	**2,984**	**14,596**	**3,500**	**3,649**	**14,116**	**145**	**853**	**39,843**
Peru								
Cropland	81	13	57	49	58	-	3	261
Forest	11	74,830	155	233	207	-	236	75,671
Grassland	95	103	19,405	270	3,906	-	10	23,790
Mosaic	77	321	131	1,301	195	-	8	2,032
Savanna/ Shrub	96	449	1,888	393	13,074	-	29	15,929
Urban	-	-	-	-	-	408	1	409
Wetland	4	307	3	7	12	1	867	1,200
Totals in 2010	**363**	**76,023**	**21,639**	**2,254**	**17,451**	**409**	**1,155**	**119,293**
Russia								
Cropland	129,388	1,246	5,661	11,531	1,493	-	41	149,360
Forest	1,040	561,016	1,794	5,394	38,312	-	4,895	612,452
Grassland	5,324	2,759	37,644	2,982	10,557	-	386	59,652
Mosaic	9,204	11,428	936	51,519	1,356	-	169	74,611
Savanna/ Shrub	1,139	38,210	10,586	2,888	637,651	-	5,947	696,420
Urban	-	-	-	-	-	2,626	5	2,631
Wetland	41	4,721	71	309	2,567	8	34,889	42,606
Totals in 2010	**146,136**	**619,380**	**56,692**	**74,623**	**691,935**	**2,634**	**46,332**	**1,637,731**
Ukraine								
Cropland	41,556	21	82	1,045	153	-	2	42,860

Forest	14	6,599	3	231	80	-	25	6,953
Grassland	207	11	219	38	51	-	0	526
Mosaic	1,536	579	6	4,424	89	-	11	6,645
Savanna/ Shrub	137	66	29	55	474	-	26	787
Urban	-	-	-	-	-	1,026	0	1,026
Wetland	2	19	0	4	6	0	53	83
Totals in 2010	**43,452**	**7,296**	**340**	**5,796**	**854**	**1,026**	**117**	**58,880**
United States								
Cropland	119,116	344	9,827	8,225	1,999	-	72	139,583
Forest	174	161,032	1,086	4,602	9,125	-	1,070	177,089
Grassland	8,707	1,716	194,609	1,655	21,531	-	337.8	228,555
Mosaic	8,422	7,592	2,009	83,192	6,396	-	163	107,775
Savanna/ Shrub	1,734	10,156	14,802	3,979	193,516	-	1,026	225,212
Urban	-	-	-	-	-	12,062	10.7	12,073
Wetland	20	893	36	55	587	6.8	4,734	6,331
Totals in 2010	**138,173**	**181,733**	**222,368**	**101,707**	**233,154**	**12,069**	**7,415**	**896,618**







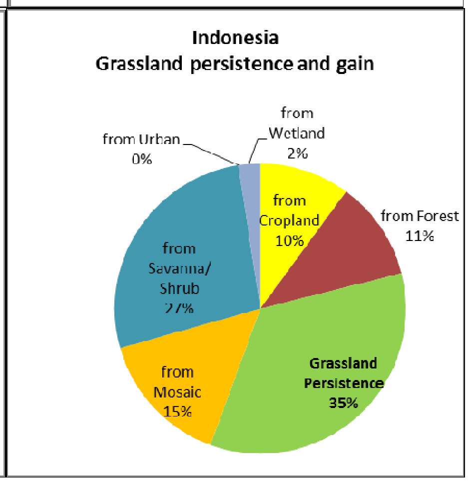
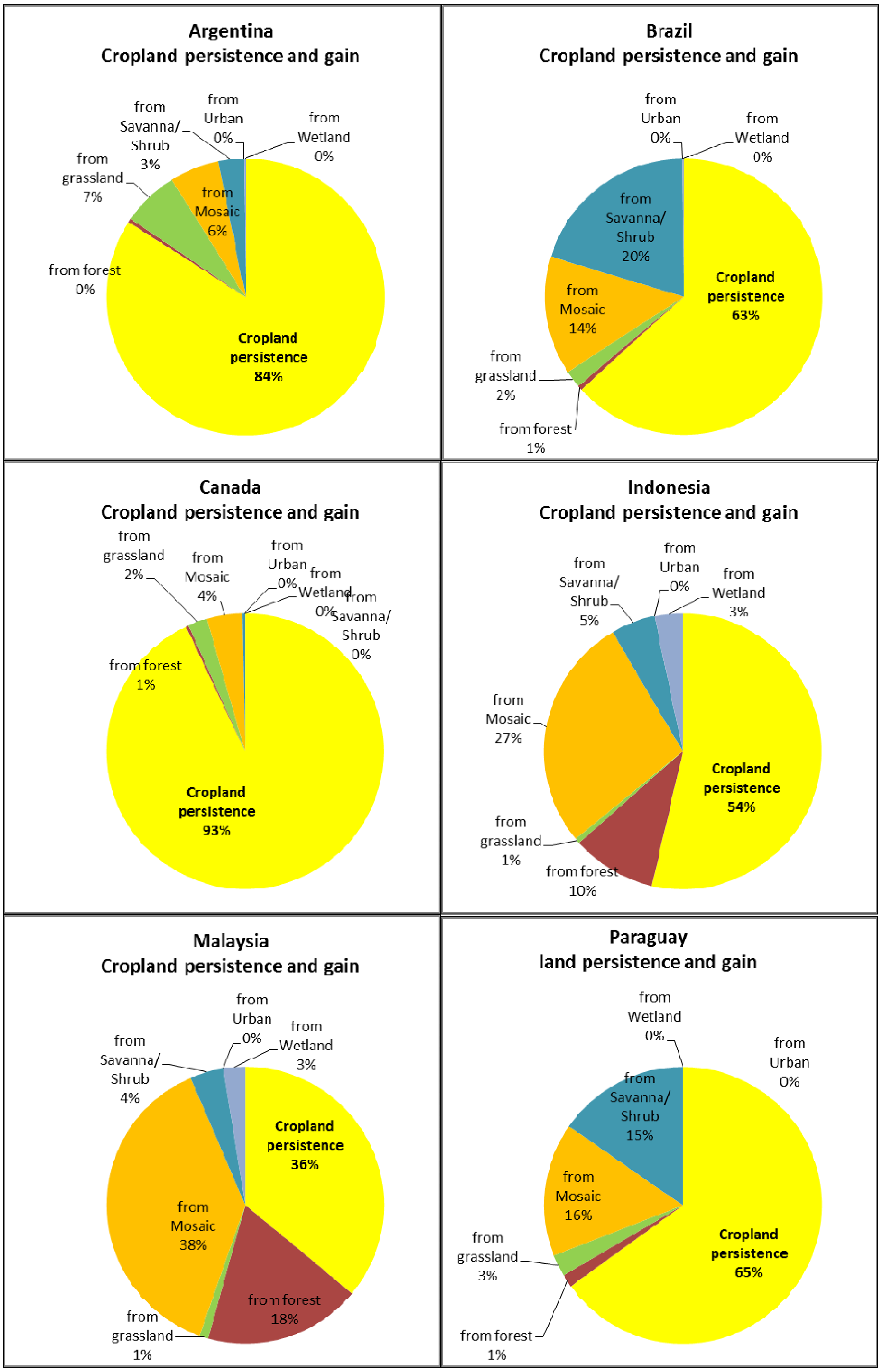


Figure 151. Percent area grassland persistence and gain from other land cover categories between the baseline (2008) and 2010 for the non-EU countries.


Argentina
Cropland persistence and gain
from Savanna/ Shrub 3%
from Urban 0%
from Wetland 0%
from grassland 7%
from Mosaic 6%
from forest 0%
Cropland persistence 84%
Brazil
Cropland persistence and gain
from Urban 0%
from Wetland 0%
from Savanna/ Shrub 20%
Cropland persistence 63%
from Mosaic 14%
from grassland 2%
from forest 1%
Canada
Cropland persistence and gain
from grassland 2%
from Mosaic 4%
from Urban 0%
from Wetland 0%
from Savanna/ Shrub 0%
from forest 1%
Cropland persistence 93%
Indonesia
Cropland persistence and gain
from Savanna/ Shrub 5%
from Urban 0%
from Wetland 3%
from Mosaic 27%
Cropland persistence 54%
from grassland 1%
from forest 10%
Malaysia
Cropland persistence and gain
from Urban 0%
from Wetland 3%
from Savanna/ Shrub 4%
Cropland persistence 36%
from Mosaic 38%
from forest 18%
from grassland 1%
Paraguay
land persistence and gain
from Wetland 0%
from Urban 0%
from Savanna/ Shrub 15%
from Mosaic 16%
from grassland 3%
Cropland persistence 65%
from forest 1%

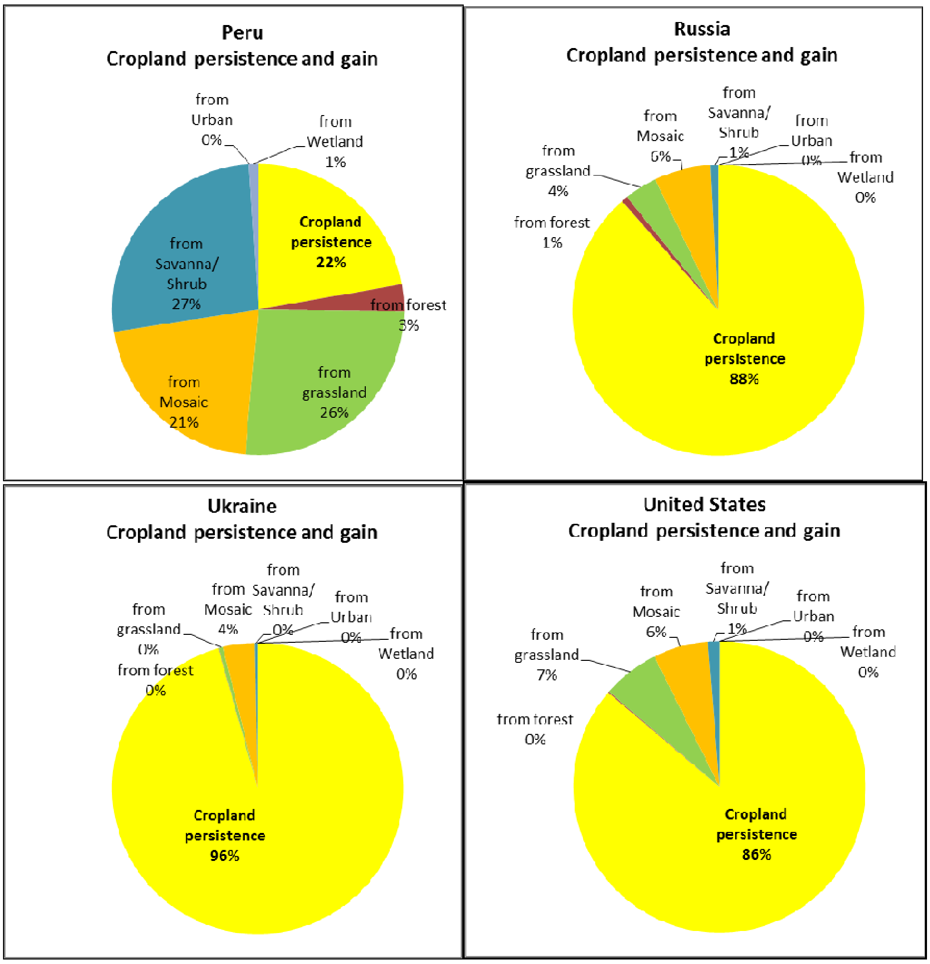
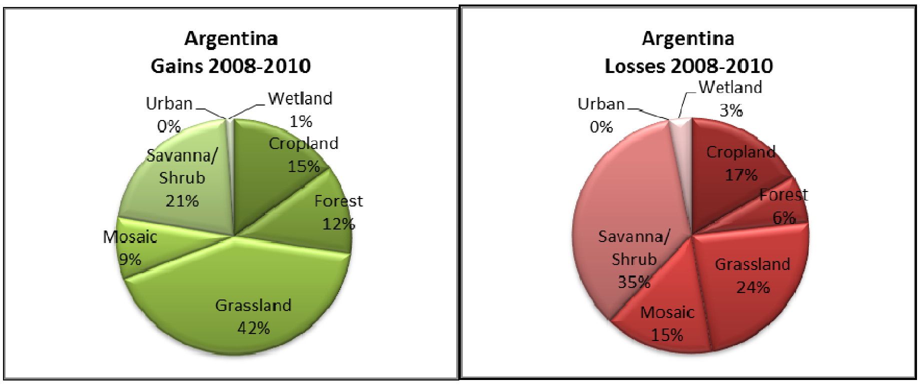
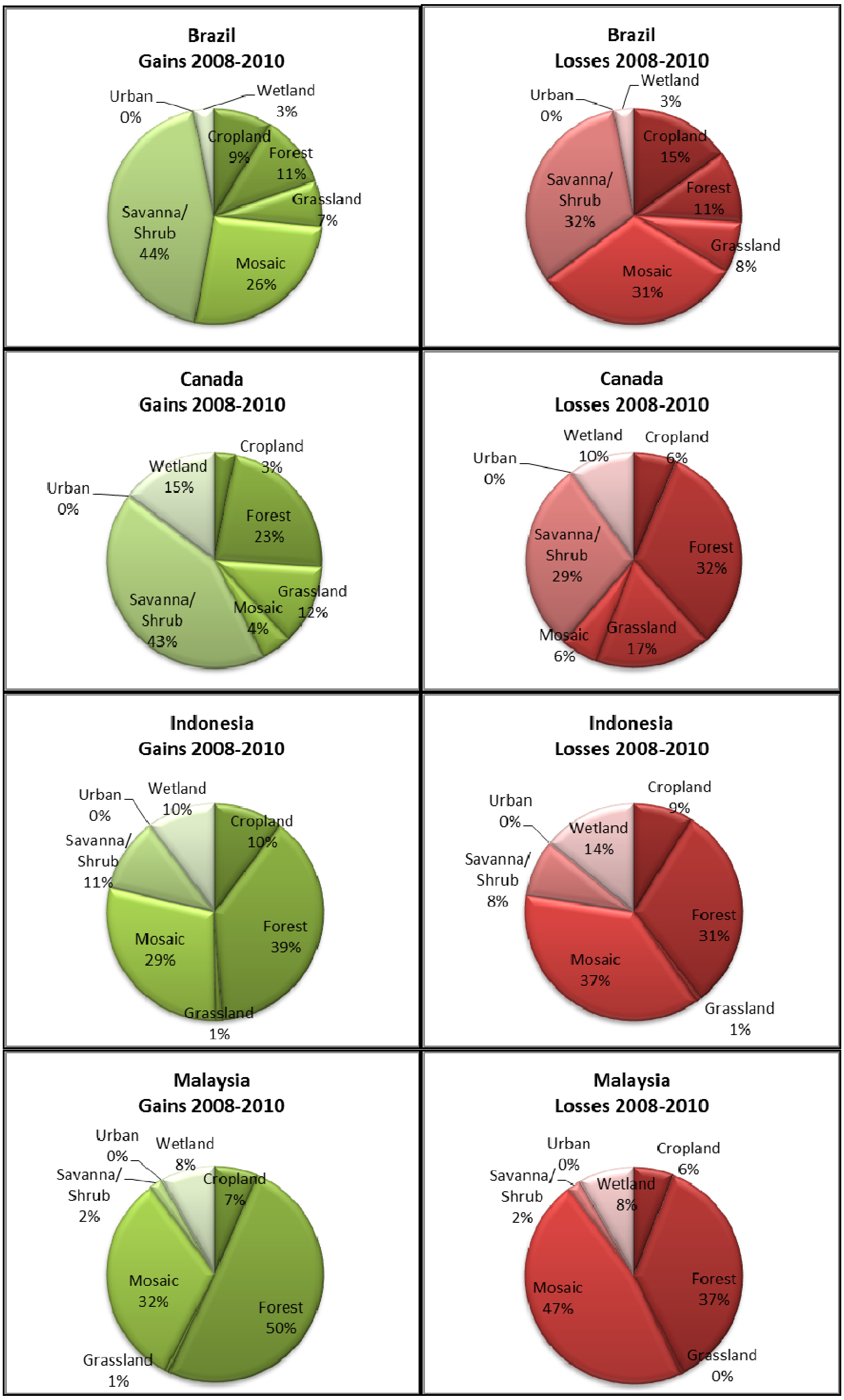
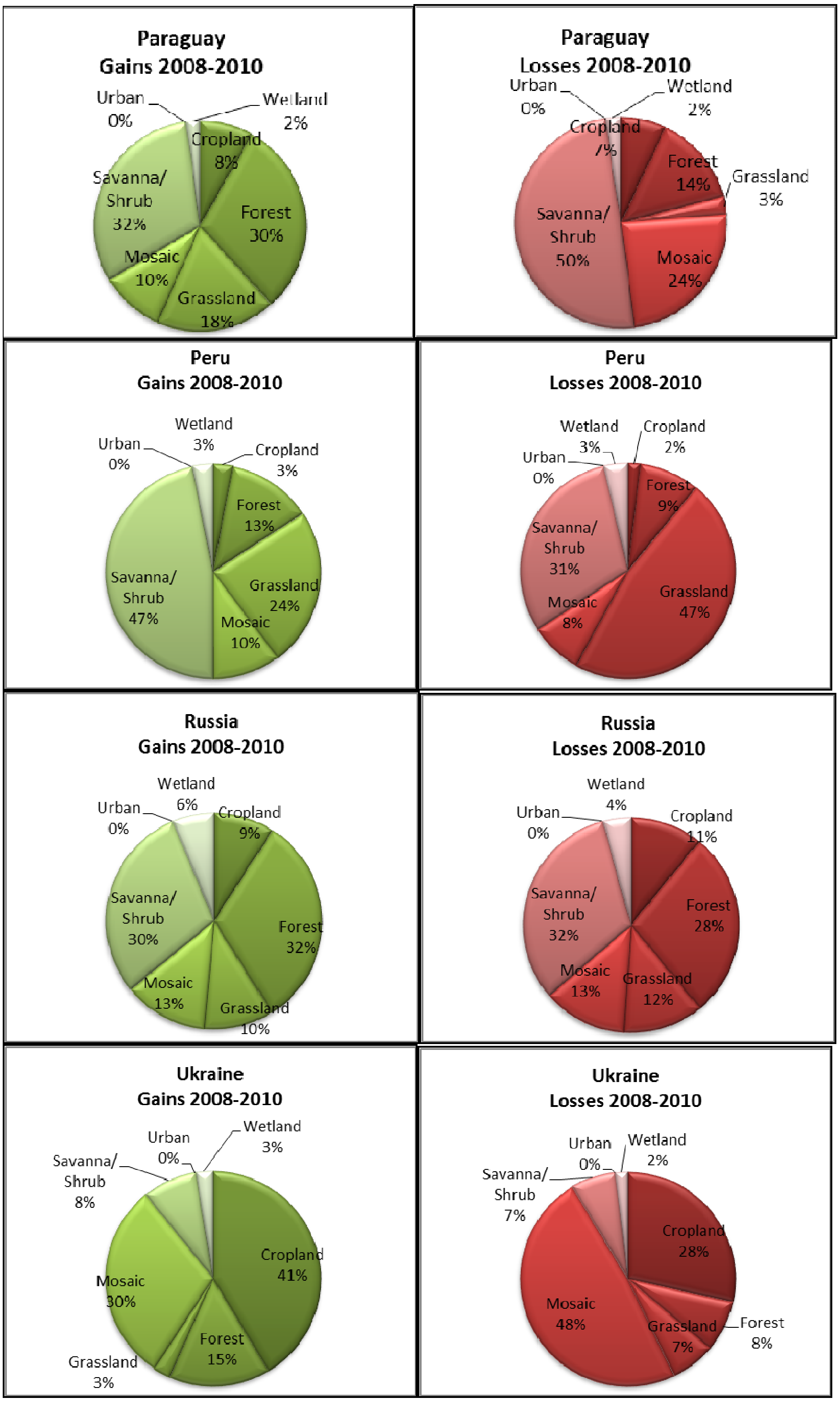


Figure 152. Percent area cropland persistence and gain from other landcover categories between the baseline (2008) and 2010 for the Non-EU countries.




Brazil
Gains 2008-2010
Urban 0%
Wetland 3%
Cropland 9%
Forest 11%
Grassland 7%
Mosaic 26%
Savanna/ Shrub 44%
Brazil
Losses 2008-2010
Urban 0%
Wetland 3%
Cropland 15%
Forest 11%
Grassland 8%
Mosaic 31%
Savanna/ Shrub 32%
Canada
Gains 2008-2010
Urban 0%
Wetland 15%
Cropland 3%
Forest 23%
Grassland 12%
Mosaic 4%
Savanna/ Shrub 43%
Canada
Losses 2008-2010
Urban 0%
Wetland 10%
Cropland 6%
Forest 32%
Grassland 17%
Mosaic 6%
Savanna/ Shrub 29%
Indonesia
Gains 2008-2010
Urban 0%
Wetland 10%
Savanna/ Shrub 11%
Cropland 10%
Forest 39%
Grassland 1%
Mosaic 29%
Indonesia
Losses 2008-2010
Urban 0%
Wetland 14%
Savanna/ Shrub 8%
Cropland 9%
Forest 31%
Grassland 1%
Mosaic 37%
Malaysia
Gains 2008-2010
Urban 0%
Wetland 8%
Savanna/ Shrub 2%
Cropland 7%
Forest 50%
Grassland 1%
Mosaic 32%
Malaysia
Losses 2008-2010
Urban 0%
Savanna/ Shrub 2%
Wetland 8%
Cropland 6%
Forest 37%
Grassland 0%
Mosaic 47%



Paraguay
Gains 2008-2010
Urban 0%
Wetland 2%
Cropland 8%
Forest 30%
Grassland 18%
Mosaic 10%
Savanna/ Shrub 32%
Paraguay
Losses 2008-2010
Urban 0%
Wetland 2%
Cropland 7%
Forest 14%
Grassland 3%
Mosaic 24%
Savanna/ Shrub 50%
Peru
Gains 2008-2010
Wetland 3%
Urban 0%
Cropland 3%
Forest 13%
Grassland 24%
Mosaic 10%
Savanna/ Shrub 47%
Peru
Losses 2008-2010
Wetland 3%
Cropland 2%
Urban 0%
Forest 9%
Savanna/ Shrub 31%
Grassland 47%
Mosaic 8%
Russia
Gains 2008-2010
Wetland 6%
Urban 0%
Cropland 9%
Savanna/ Shrub 30%
Forest 32%
Mosaic 13%
Grassland 10%
Russia
Losses 2008-2010
Wetland 4%
Urban 0%
Cropland 11%
Savanna/ Shrub 32%
Forest 28%
Mosaic 13%
Grassland 12%
Ukraine
Gains 2008-2010
Wetland 3%
Urban 0%
Savanna/ Shrub 8%
Cropland 41%
Mosaic 30%
Forest 15%
Grassland 3%
Ukraine
Losses 2008-2010
Urban 0%
Wetland 2%
Savanna/ Shrub 7%
Cropland 28%
Mosaic 48%
Grassland 7%
Forest 8%

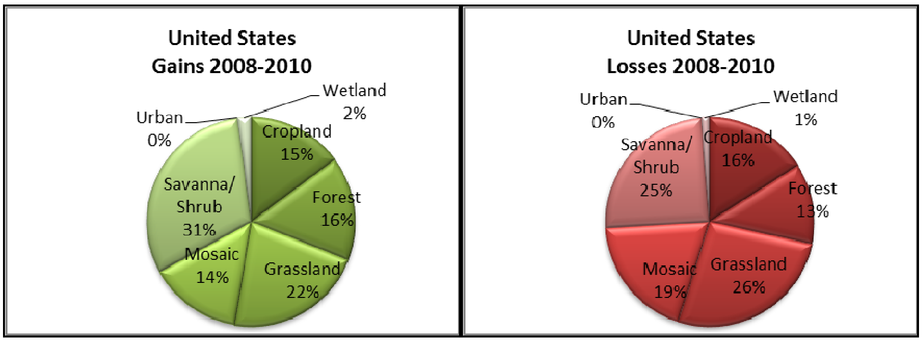


Figure 153. Percent gains and loses per land cover category for the non-EU countries.

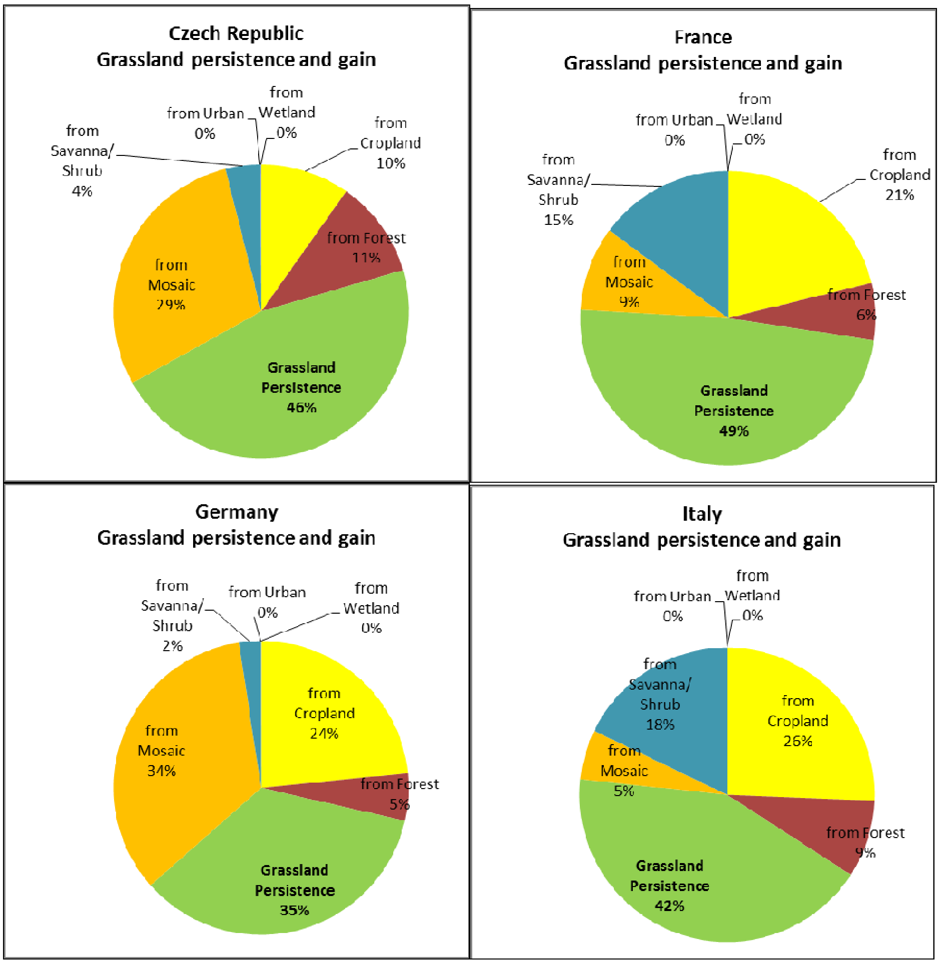
The area of persistence and change (gains and losses) for the EU countries are presented in Figure 154, Figure 156 and Table 80.

Table 80. Land cover change and persistence per land category for each of the EU countries. The persistence is presented in the diagonal outlined cells (bold blue values) and the change is presented in the off-diagonal cells (gains in columns; losses in rows).

2008 land cover category *x 1,000 ha*	2010 land cover category							Totals in 2008
	Cropland	Forest	Grassland	Mosaic	Savanna/ Shrub	Urban	Wetland	
				Czech Republic				
Cropland	**2,754**	7	2	78	5	-	0	**2,847**
Forest	8	**2,465**	2	90	3	-	1	**2,570**
Grassland	25	4	**10**	20	2	-	-	**60**
Mosaic	545	272	7	**1,123**	26	-	0	**1,972**
Savanna/ Shrub	8	8	1	9	**19**	-	0	**44**
Urban	-	-	-	-	-	**340**	0	**340**
Wetland	0	1	0	0	0	-	**0**	**1**
Totals in 2010	**3,340**	**2,757**	**22**	**1,320**	**54**	**340**	**2**	**7,835**
				France				
Cropland	**28,309**	61	107	984	197	-	0	**29,658**
Forest	14	**8,234**	32	429	161	-	10	**8,879**
Grassland	75	45	**245**	46	110	-	0	**521**
Mosaic	1,648	752	47	**7,373**	200	-	0	**10,020**
Savanna/ Shrub	280	497	75	384	**2,987**	-	15	**4,238**
Urban	-	-	-	-	-	**1,216**	0	**1,216**
Wetland	0	5	0	0	2	0	**23**	**30**
Totals in 2010	**30,325**	**9,595**	**504**	**9,216**	**3,657**	**1,216**	**49**	**54,563**
				Germany				
Cropland	**12,387**	75	81	922	54	-	0.2	13,517
Forest	38	**10,062**	18	506	29	-	7	10,660

Grassland	76	22	120	69	8	-	0.2	296
Mosaic	1,847	846	117	5,085	88	-	1	7,983
Savanna/ Shrub	57	162	8	99	233	-	5	564
Urban	-	-	-	-	-	2,449	-	2,449
Wetland	0.2	7	0.1	0.3	1	-	15	23
Totals in 2010	**14,405**	**11,174**	**344**	**6,679**	**413**	**2,449**	**28**	**35,491**
				Italy				
Cropland	10,565	51	158	430	599	-	0	11,804
Forest	17	5,206	53	314	187	-	12	5,788
Grassland	218	59	262	36	196	-	0	770
Mosaic	904	327	34	3,347	503	-	0	5,115
Savanna/ Shrub	483	294	110	277	3,620	-	15	4,798
Urban	-	-	-	-	-	1,354	0	1,354
Wetland	0	6	-	0	7	0	40	53
Totals in 2010	**12,188**	**5,943**	**616**	**4,403**	**5,113**	**1,354**	**67**	**29,683**
				Poland				
Cropland	14,297	121	9	531	75	-	0	15,033
Forest	18	8,209	1	115	14	-	10	8,368
Grassland	20	9	10	23	2	-	0.1	63
Mosaic	1,513	1,036	12	3,682	157	-	4	6,403
Savanna/ Shrub	23	124	1	41	143	-	4	335
Urban	-	-	-	-	-	794	0	794
Wetland	0	12	0	1	0	-	8	21
Totals in 2010	**15,871**	**9,511**	**33**	**4,393**	**392**	**794**	**26**	**31,019**
				Spain				
Cropland	13,528	27	440	349	1,377	-	0	15,722
Forest	6	3,586	3	119	210	-	9	3,932
Grassland	456	9	870	55	1,291	-	0	2,681
Mosaic	468	378	42	2,294	402	-	0	3,584
Savanna/ Shrub	2,211	445	479	517	20,222	-	14	23,887
Urban	-	-	-	-	-	458	0	458
Wetland	0	4	0	0	7	0	33	44
Totals in 2010	**16,669**	**4,449**	**1,833**	**3,334**	**23,509**	**458**	**58**	**50,308**
				United Kingdom				
Cropland	7,608	42	965	237	86	-	0	8,939
Forest	40	3,280	331	151	231	-	21	4,053
Grassland	381	228	5,680	193	328	-	0	6,811
Mosaic	310	132	358	819	60	-	0	1,680
Savanna/ Shrub	75	341	76	92	1,305	-	13	1,902
Urban	-	-	-	-	-	859	0	860

Wetland	0	20	1	1	2	0	45	68
Totals in 2010	**8,415**	**4,043**	**7,410**	**1,492**	**2,013**	**860**	**80**	**24,313**



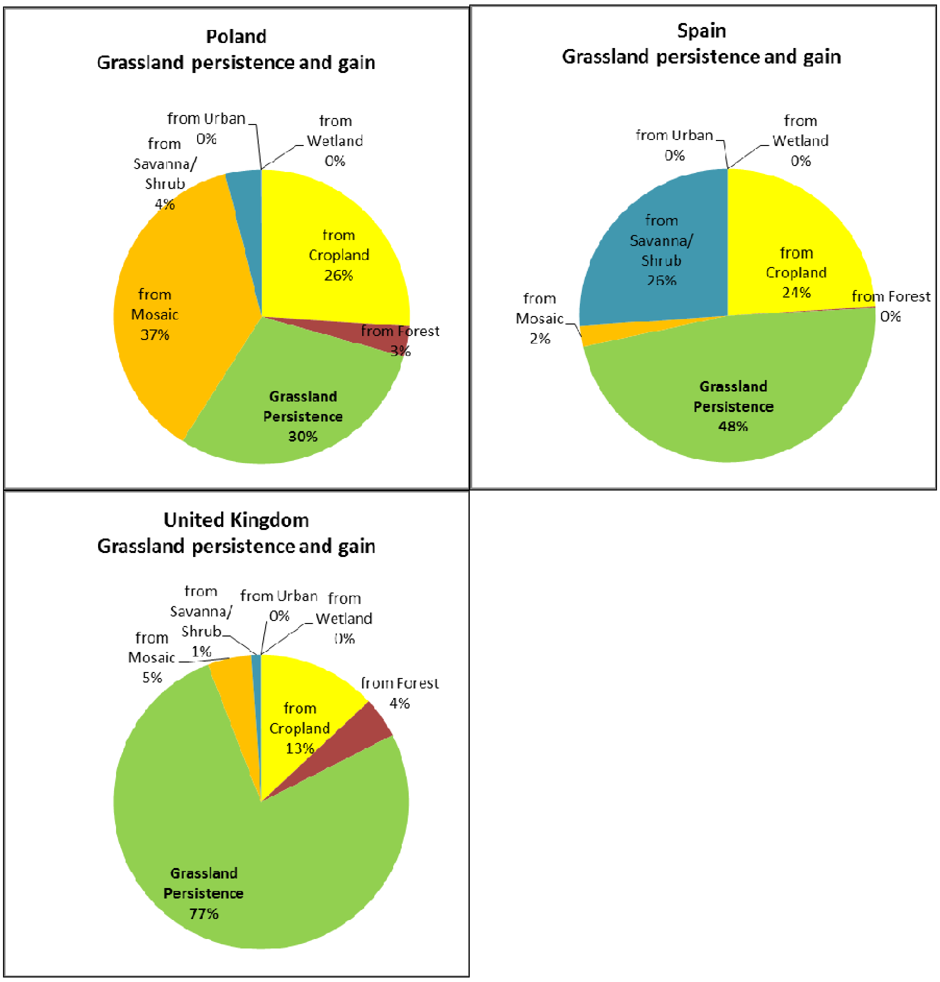
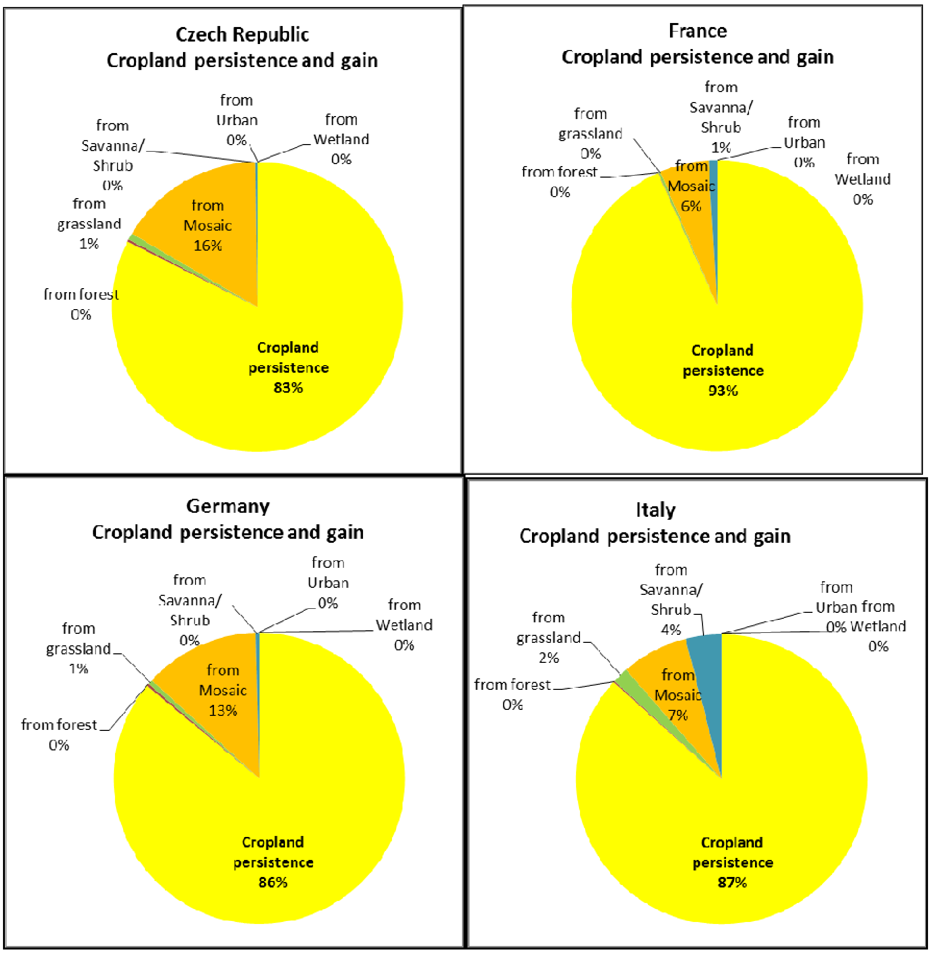


Figure 154. Grassland persistence and grassland gain from other land cover categories between the baseline (2008) and 2010 for the EU 'Main' countries.



Czech Republic
Cropland persistence and gain
from Urban 0%
from Wetland 0%
from Savanna/ Shrub 0%
from grassland 1%
from Mosaic 16%
from forest 0%
Cropland persistence 83%
France
Cropland persistence and gain
from Savanna/ Shrub 1%
from grassland 0%
from Urban 0%
from Wetland 0%
from forest 0%
from Mosaic 6%
Cropland persistence 93%
Germany
Cropland persistence and gain
from Urban 0%
from Savanna/ Shrub 0%
from Wetland 0%
from grassland 1%
from Mosaic 13%
from forest 0%
Cropland persistence 86%
Italy
Cropland persistence and gain
from Savanna/ Shrub 4%
from Urban 0%
from Wetland 0%
from grassland 2%
from forest 0%
from Mosaic 7%
Cropland persistence 87%

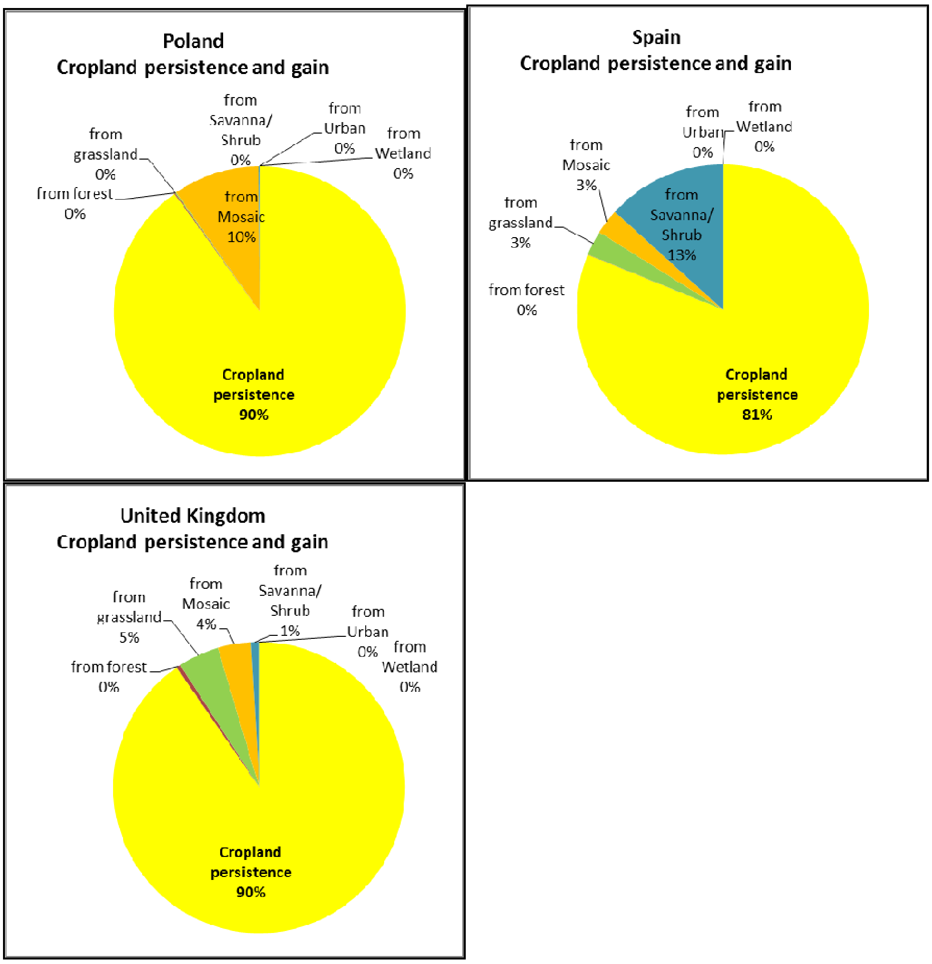
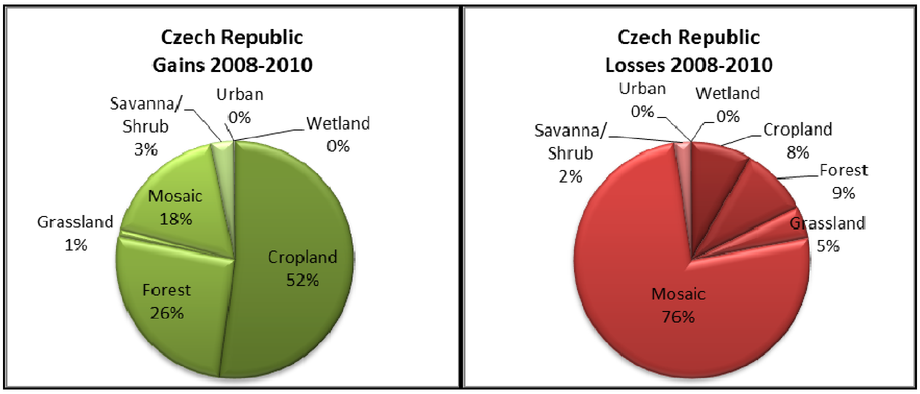
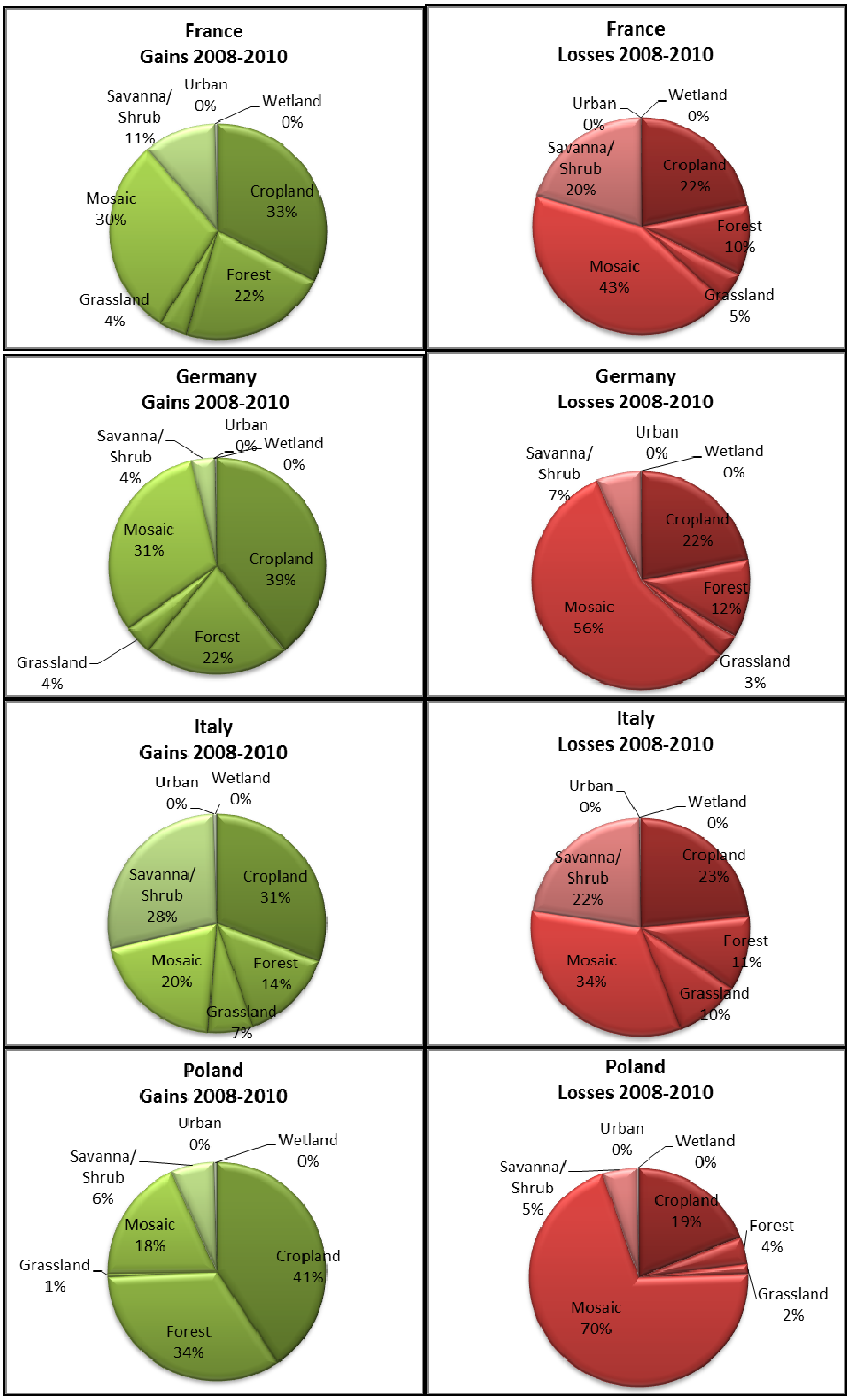


Figure 155. Percent area cropland persistence and gain from other land cover categories between the baseline (2008) and 2010 for the EU 'Main' countries.




France
Gains 2008-2010
Urban 0%
Wetland 0%
Savanna/ Shrub 11%
Mosaic 30%
Cropland 33%
Forest 22%
Grassland 4%
France
Losses 2008-2010
Urban 0%
Wetland 0%
Savanna/ Shrub 20%
Cropland 22%
Forest 10%
Mosaic 43%
Grassland 5%
Germany
Gains 2008-2010
Savanna/ Shrub 4%
Urban 0%
Wetland 0%
Mosaic 31%
Cropland 39%
Forest 22%
Grassland 4%
Germany
Losses 2008-2010
Urban 0%
Savanna/ Shrub 7%
Wetland 0%
Cropland 22%
Forest 12%
Mosaic 56%
Grassland 3%
Italy
Gains 2008-2010
Urban 0%
Wetland 0%
Savanna/ Shrub 28%
Cropland 31%
Mosaic 20%
Forest 14%
Grassland 7%
Italy
Losses 2008-2010
Urban 0%
Wetland 0%
Savanna/ Shrub 22%
Cropland 23%
Forest 11%
Mosaic 34%
Grassland 10%
Poland
Gains 2008-2010
Urban 0%
Wetland 0%
Savanna/ Shrub 6%
Mosaic 18%
Grassland 1%
Cropland 41%
Forest 34%
Poland
Losses 2008-2010
Urban 0%
Wetland 0%
Savanna/ Shrub 5%
Cropland 19%
Forest 4%
Grassland 2%
Mosaic 70%

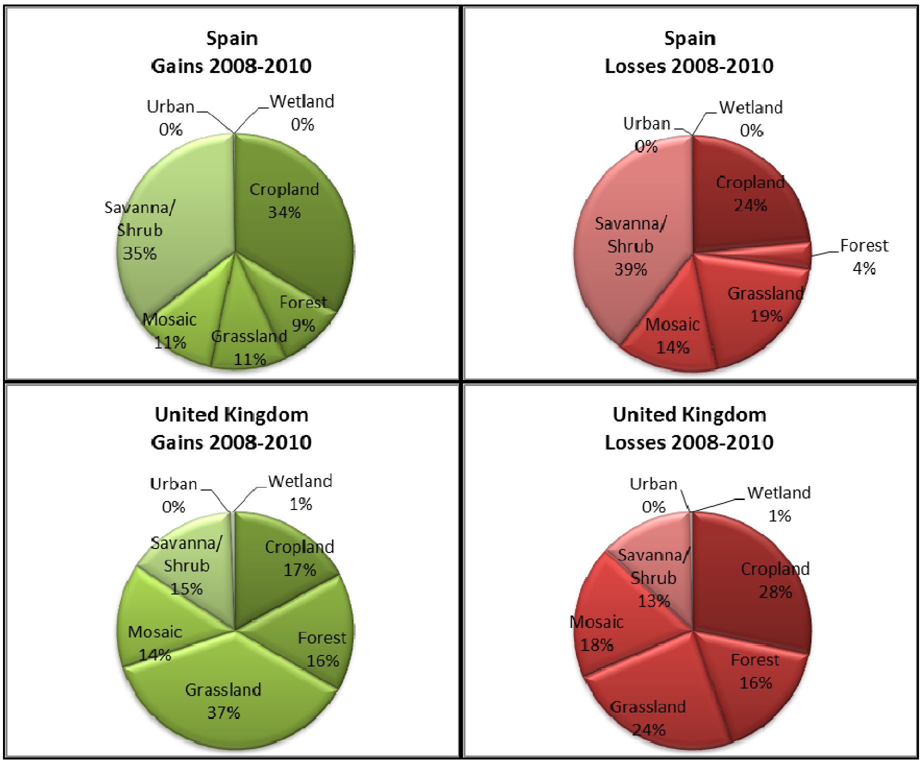


Figure 156. Percent gains and loses per land cover category for the EU countries.

Detailed approach for monitoring biofuel crop expansion

Because specific cropland data at global level are still not available, we illustrate this approach with data presented in Adami et al. 2012[95]. In their work, the authors evaluated the direct land use change (dLUC) of sugarcane expansion from 2005 to 2011 in the South-central region of Brazil using Landsat images. To evaluate the dLUC dynamics, the sugarcane expanded areas per crop season are combined with land cover categories from 2000 land cover map. Based on personal communications with the authors, we present the total sugarcane expansion for the 2008-2010 in Figure 157. The total sugarcane area expansion per state is reported in Table 81. For the period 2008-2010 the total expansion of sugarcane was estimated at 2,300 thousand ha. The largest area of sugarcane expansion was observed for Sao Paulo (1,122 thousand ha) and the least sugarcane expansion was observed for Mato Groso (65 thousand ha). Since at the scale of Figure 157 is difficult to distinguish the expansion areas for 2009 and 2010, Figure 158 has been prepared at a higher scale to show the area expansion per year for the Sao Paulo state.

[95] Adami M., Rudorff B.F.T., Freitas R.M., Aguiar D.A., Sugawara L.M., Mello M.P. Remote Sensing Time Series to Evaluate Direct Land Use Change of Recent Expanded Sugarcane Crop in Brazil. *Sustainability*. 2012; 4(4):574-585.

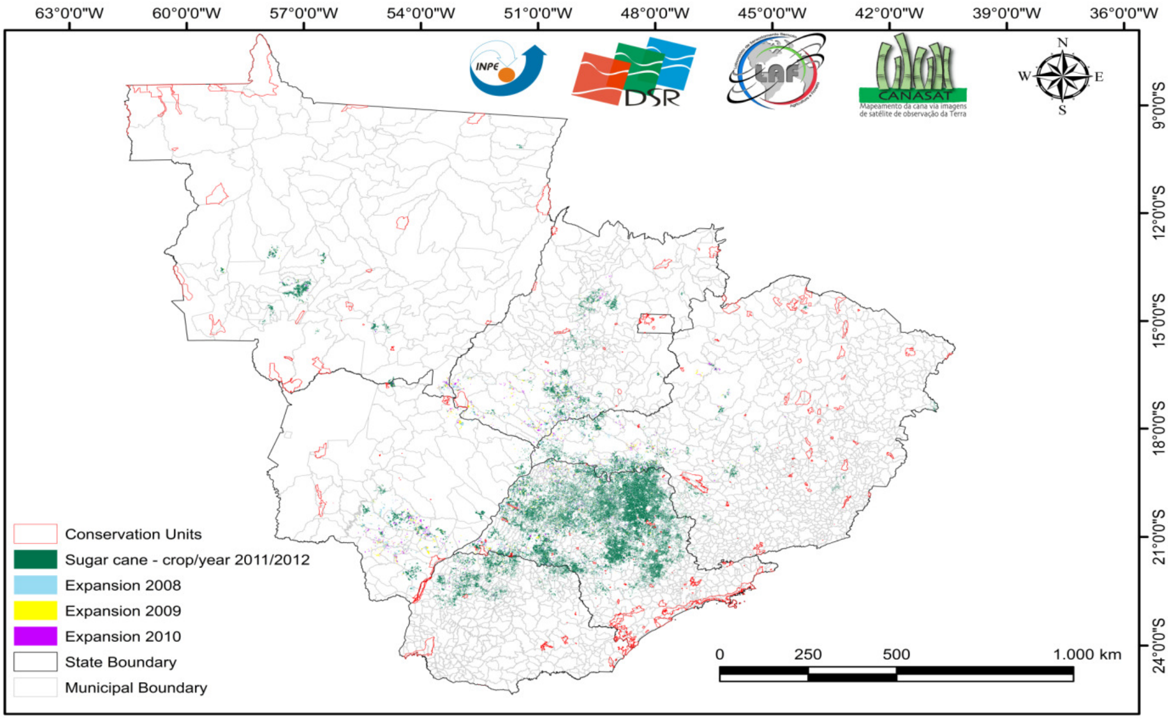


Figure 157. The state of sugarcane crop year 2001/12 and the sugarcane expansion for the South-central region of Brazil between 2008 and 2010.

** Map provided by Adami et al. 2012 team Note: The red areas on the map are the outlines of the conservation area as ,"conservation units*

Table 81. Sugarcane expansion for 2008, 2009 and 2010 per state. Data provided by Adami et al. 2012.

State	Expansion 2008	Expansion 2009	Expansion 2010	Total expansion 2008-2010
	x 1,000 (ha)			
Goias	143	135	80	358
Sao Paulo	662	322	138	1,122
Minas Gerais	141	96	62	299
Mato Grosso do Sul	87	122	83	292
Mato Grosso	34	19	12	65
Paraná	112	38	17	167
Total area	1,177	731	392	2,300

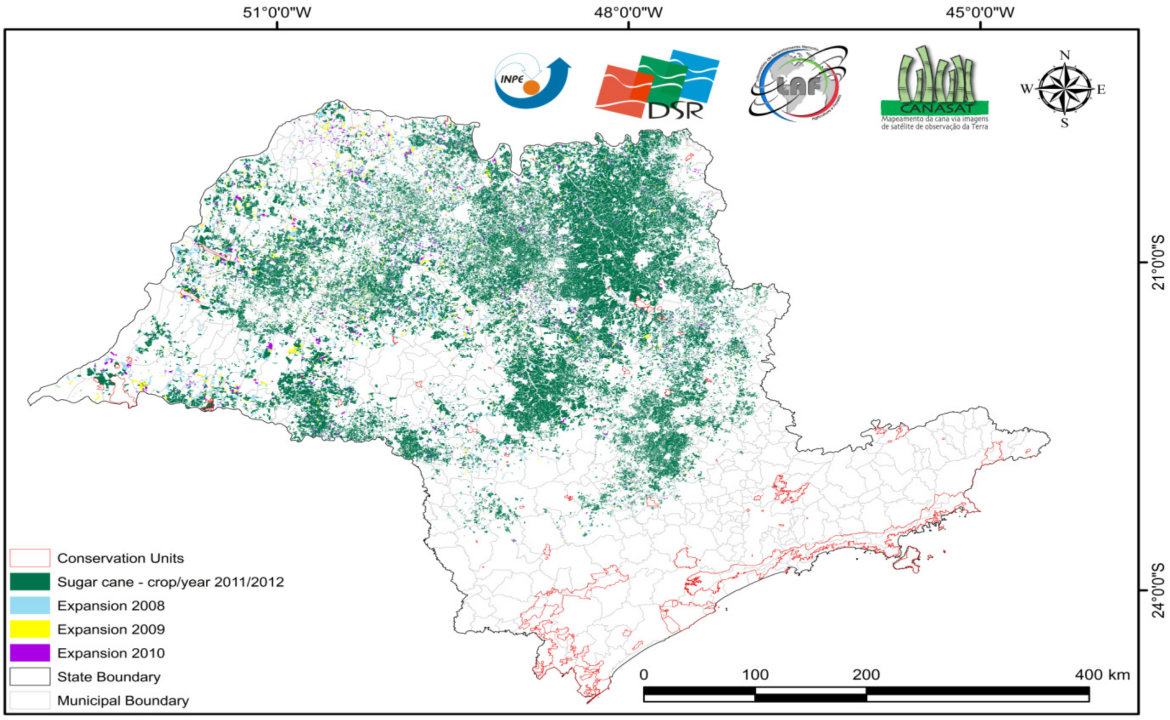


Figure 158. Sugarcane crop year 2011/12 and sugarcane expansion for 2008, 2009 and 2010.

* Map provided of Adami et al. 2012 team

The statistics (presented also in Section 'quantification of land use' in 4.2) show that total sugarcane area in Brazil is 9,081 thousand ha, with 74 thousand ha needed to account for the demand of EU biofuels for 2010. The total cultivated sugarcane area according to the CANASAT website[96] for the 2010/11 crop season is 8,349 thousand ha and consistent with the view that the South-central region is responsible for almost 90% of the Brazilian's sugarcane production (Adami et al. 2012). Overall, the total cultivated sugarcane in South-central region can be linked to less than 1% of the EU demand for biofuel stocks.

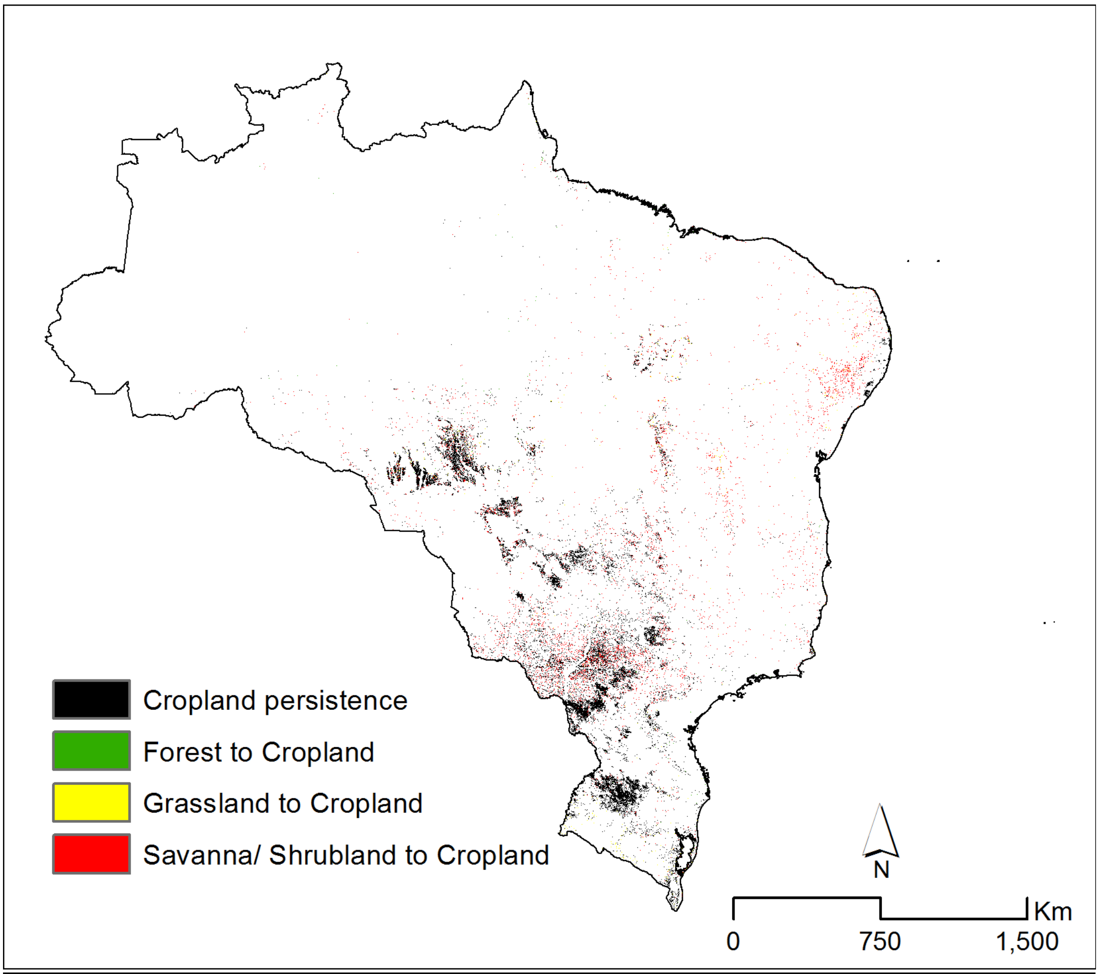
[96] http://www.dsr.inpe.br/laf/canasat/en/tables.html

Appendix VII Biodiversity case studies

More details are given below to explain the logical chain of causality linking conversion of natural ecosystems to demand for various biofuel feedstock crops for a sample of countries. Examples are given for Brazil, Argentina, USA, Indonesia, and Malaysia.

Brazil

Table 79 (Appendix V) showed that, based on MODIS results, approximately 5.5 million hectares of savannah/shrubland, and 0.5 million hectares of grassland were converted to cropland between 2008 and 2010. Over the same period, MODIS results and FAO data indicate that total cropland decreased. The focus of conversion of savannah/shrubland and grassland to cropland during this period is in south-western Brazil, centred on the state of Mato Grosso do Sul, and reaching into the surrounding states of Sao Paulo, Minas Gerais, Goias, and Mato Grosso (Figure 159). This area is naturally the Cerrado ecosystem (Flaskerud, 2003), a tropical grassland savannah. In this area, trees are typically cleared from the savannah and made into charcoal, opening pastures for cattle. As the agricultural frontier expands, the natural grassland pastures are ploughed, and either sugarcane or soy is planted.



Note: Data for this map come from Table 79, Appendix V. Only about 0.1 million hectares of forest, and 58,000 hectares of wetlands were converted in this time period, and so they are not very visible on a map of this scale.

Figure 159. Map of Brazil showing where natural ecosystems have been lost/converted to cropland.

Another area of rapid loss of savannah/shrubland ecosystems between 2008 and 2010 is in northeast Brazil, centred on the state of Pernambuco and reaching into neighbouring Bahia and other states. Here the savannah/shrubland is a seasonally-dry thorn forest and shrubland called Caatinga. The crops being grown in these converted ecosystems were not identified in this study as relevant to EU biofuel consumption.

Argentina

In Argentina, as in south-western Brazil and neighbouring Paraguay, the main current threat to biodiversity from biofuel development is from conversion of grassland and savannah/shrubland ecosystems (e.g., Cerrado, Chaco, Pampas) to biofuel feedstock crops such as soybean and sugarcane. Table 79 (Appendix V) shows that between 2008 and 2010, almost 3 million hectares of grassland, and around 1.3 million hectares of savannah/shrublands were converted to cropland while the total

cropland, based on Modis and FAO data, saw a small decrease. Both of these ecosystems are seriously under-represented in the national PA systems. Over the same time period biofuel consumed in the EU and sourced from Argentina increased, and in 2010 an estimated 868,000 hectares in Argentina produced biofuels for EU consumption (Ecofys, 2012).
"The most significant direct effects of soybean cultivation correspond to the expansion of cultivation on natural ecosystems, such [as] deforestation (of Chaco savannah woodlands) in provinces of northern Argentina. This has caused not only the direct loss of biodiversity, but also soil erosion and salinization, increasing the water table and higher risk of flooding due to higher runoff. These processes affect wetlands in areas near or even distant from the source of the problem." (Herrera, et al., 2012, p. 20)

Although the threat of conversion of savannah/shrubland and grassland ecosystems in Paraguay is currently much lower than in Argentina or Brazil, it may be growing. Paraguay became a soybean supplier for biofuel consumed in the EU in 2010, compared to not supplying any in 2008.

USA

Between 2008 and 2010 almost 9 million hectares of grassland and 1.7 million hectares of savannah/shrubland was converted to cropland in the United States. Over the same period MODIS results and FAO data indicate that total cropland decreased. Grasslands are under-represented in the PA system when judged using the 10% goal of the CBD. Maize-based ethanol prices, created in part by government biofuel policies, are creating an incentive for farmers to take land that has not been cropped (at least recently) – mainly grasslands – out of government-subsidized set-aside programs and plant maize (Campbell and Doswald 2009, pp. 12-13). The ethanol biofuel market is also causing maize to replace soybeans which may be causing the increase of soybean production to other countries, including Argentina, Brazil, Bolivia, and Paraguay, according to some analyses (Union of Concerned Scientists 2011). The US is a supplier of biofuel feedstocks, both soy and maize, to the EU (see Table 59).

Indonesia and Malaysia

In Indonesia and Malaysia the main current threat to biodiversity from biofuel development is conversion of forest to oil palm plantations (Union of Concerned Scientists, 2011, p. 51).Table 79 (Appendix V) showed that 492,000 hectares of forest, and 162,000 hectares of wetlands, were converted to cropland in Indonesia between 2008-2010, an unknown fraction of which could represent conversion to oil palm plantations. This is a relatively modest level of conversion compared to much more dramatic levels in savannah/shrubland and grassland ecosystems elsewhere in the world. "Though palm oil plantations represent a limited proportion of global deforestation in terms of area, they are a disproportionately large source of global warming emissions because they are often established on land converted from swamp forests. When these wetlands are drained, their carbon-rich peaty soils decay, releasing large amounts of both carbon dioxide and methane." (Union of Concerned Scientists, 2011, p. 51).

Appendix VIII The impacts of expanding biofuel production on food prices in 2005-2010

Background

A prime challenge of the agricultural sector today is to provide for future demand of food, feed, fibre and bio-energy crops, while responding to environmental and nature protection concerns to achieve long-term sustainability of land and water resources. To better understand the energy-food security-environment nexus a spatially detailed understanding of alternative land use and rural development options and strategies is essential.

The rapid rise in food prices of 2007 and 2008 coincided with an unprecedented expansion of maize-based ethanol production in the USA and fast biodiesel production expansion in Europe. At the same time various biofuel consumption mandates and targets were established and the industry received substantial subsidies. Agricultural prices substantially decreased in 2009 but reached record high levels again in the beginning of 2011.

There have been many speculations and accusations as to what the main causes of the food price surges in 2007 and 2008 were and what contributed to the observed high volatility of food prices in recent years. Demand-supply gaps in the global food markets due to the rapid expansion of biofuel production was one of the explanations offered. Other contributing factors brought up in the discussion were poor harvests due to weather related factors, strong demand increases in economically fast growing and population rich developing countries, low levels of food stocks, and financial speculations affecting agricultural commodity markets.

While it is impossible to rerun real world history in all its complexity to see what food prices would have been without biofuel expansion and the specific policy measures supporting it, we can simulate history in a simplified way with the help of a computer model to quantify the impacts of demand growth for biofuel feedstocks on prices and conventional demand for food and feed uses of crops. The outcome can be compared to a historical simulation where biofuel expansion is suppressed and the difference in results can be interpreted as an estimate of the market impacts of historical biofuel development and policies. A similar approach can be used to quantify the impact of weather related factors by comparing simulation results for a model calculation with 'smooth' average weather (with and without biofuel expansion) to simulation results where historical production distortions due to specific historical weather events are included.

For the analysis of the global agricultural system a state-of-the-art ecological-economic modelling framework is applied. It includes two major components, the FAO/IIASA Agro-ecological Zone (AEZ) model and the IIASA world food system

(WFS) model. The two model systems, adapted and expanded for resource use and by-product generation of biofuel production, form the basis of scenario evaluation of the impacts of alternative biofuel development pathways on food and agriculture at the national, regional and global levels. The modelling framework also includes a rule-based downscaling methodology to allocate the results of the world food system simulations to the spatial grid of the resource database for the analysis and quantification of environmental implications. A historical baseline assessment serves as point of departure to which alternative biofuel scenarios are compared for their impact. This scenario calculations impose statistically recorded/estimated historical biofuel use throughout 2010. In addition, a scenario variant assumes production shocks derived from an analysis of historical crop production trends of the period 2000 to 2010. The alternative biofuel scenarios then simulate the historical period assuming that either only EU-27 or all countries excluding the EU-27 would follow historical biofuel expansion, or alternatively that biofuel expansion would stop in year 2000. Outcomes are compared also for simulations where historical weather related deviations from regional production trends are ignored, i.e. a smooth growth of crop production without major shocks is assumed. A number of issues were clarified in this analysis, in particular the impact of biofuel expansion on price increases in the critical years 2007 to 2010, and the possible role of production distortions in aggravating price developments in this period.

Scenario approach

The IIASA modelling framework has been applied to study the impacts of historical biofuel production expansion on food and feed markets and on the environment. Table 1 provides a summary of the scenarios simulated for the present analysis.

To assess agricultural development over the last decade, with and without biofuel expansion, several scenario simulation were carried out varying the imposed levels of biofuel production, from (i) levels recorded in the available historical records and estimates, to assuming that (ii) only EU-27 or (iii) only countries except EU-27 would follow the historical path, and to assuming that (iv) no biofuel production expansion would occur after year 2000.

Table 82. List of scenario experiments used in historical biofuel impact analysis

Scenario acronym	Scenario description
1. H0	Simulation for period 2000 to 2010 with country/region specific biofuel production levels and feedstock mix imposed as available from historical data records.
2. H1	Simulation for period 2000 to 2010 with country/region specific biofuel production levels and feedstock mix imposed in all countries except EU-27. For EU-27, biofuel production is kept at the level of year 2000.
3. H2	Simulation for period 2000 to 2010 with country/region specific biofuel production levels and feedstock mix imposed in EU-27 only. For countries other than EU-27, biofuel production is kept at the level of year 2000.
4. H3	Simulation for period 2000 to 2010 with country/region specific biofuel production and feedstock mix fixed at level of year 2000.
5. W0	As in H0 above, simulation for period 2000 to 2010 with country/region specific biofuel production levels and feedstock mix imposed as available from historical data records. In addition to assumptions for scenario H0, the scenario W0 imposes annual production shocks, which were calculated from historical FAOSTAT production data as percent deviations of annual production from the respective 2000-2010 production trend line value.
6. W1	Same as scenario H1 but with production shocks imposed as in scenario W0
7. W2	Same as scenario H2 but with production shocks imposed as in scenario W0
8. W3	Same as scenario H3 but with production shocks imposed as in scenario W0

Another external input to the model system is production fluctuation due to weather factors, which may affect region-specific crop production. For the analysis, historical production trends were calculated for each country/region and every agricultural commodity represented in the simulation model. Deviations from the trend line (in percentage terms) were then interpreted as production shocks and imposed in the historical simulations. Simulation runs for different biofuel expansion scenarios were done with and without weather related production shocks.

Biofuel production

The specification of biofuel scenarios included two steps: first, based on the data collection from different sources carried out in this project, biofuel use was specified for each country and region in the model for the years 2005 to 2010, separately for bioethanol and for biodiesel. Second, biofuel production in 2005 to 2010 is primarily based on conventional agricultural crops (maize and other cereals, sugar cane, cassava, oilseeds, palm oil, etc.). A feedstock mix is imposed for each country/region as derived from the compiled historical data.

Table 83. Use of transport biofuels by region imposed in back-casting simulations.

	Biodiesel transport fuel use Million tons oil equivalent (Mtoe)					Bioethanol transport fuel use Million tons oil equivalent (Mtoe)				
	2006	2007	2008	2009	2010	2006	2007	2008	2009	2010
North America	0.3	0.5	0.7	0.7	0.9	11.1	14.5	19.6	22.1	26.3
Europe & Russia	2.6	4.7	7.4	9.8	10.5	1.1	1.5	2.3	2.9	3.3
Pacific OECD	0.0	0.1	0.1	0.2	0.1	0.0	0.0	0.1	0.1	0.1
Sub-saharan Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Asia, East	0.0	0.0	0.0	0.1	0.1	1.0	1.0	1.2	1.3	1.4
Asia, South & Southeast	0.1	0.1	0.2	0.2	0.3	0.1	0.2	0.3	0.5	0.6
Middle East & N. Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Latin America	0.1	0.2	0.4	0.5	1.4	6.5	8.9	11.7	12.9	13.6
World*	3.2	5.6	8.8	11.5	13.3	19.9	26.2	35.2	39.8	45.4

Source: various data sources, as collected by project members in 2010 - 2012.

Table 83 gives a regional summary of the biofuel use data applied in the backcasting model simulations. For biodiesel, the global production in 2010 is estimated at 13.3 Mtoe of which 9.9 Mtoe (i.e. 74 percent of total use) were consumed in the EU-27. Estimated global production of biodiesel in 2000 was about 0.5 Mtoe.

Bioethanol use in 2010 was dominated by USA and Brazil, which respectively consumed 25.9 Mtoe and 13.3 Mtoe of fuel ethanol, i.e. together 39.3 Mtoe out of a global production total of 45.7 Mtoe fuel ethanol. The EU-27 share in 2010 global fuel ethanol use was only about 6 percent. Estimated global fuel ethanol production in 2000 was 9.4 Mtoe.

According to these data, global biofuel production increased from 10 Mtoe in year 2000 to 45.3 Mtoe in 2008 and 60.1 Mtoe in 2010, a 6-fold increase. For 2005, transport biofuel use is estimated at 18.3 Mtoe, which highlights the very substantial increases achieved during the period of 2005-2010.

Biofuel feedstocks

In the simulations we differentiate between different sources of feedstocks for transport biofuel production, based respectively on biochemical conversion of sugar crops or crops with high starch content for bioethanol or based on vegetable oil for biodiesel production.

The use of feedstocks depends on the type of biofuel (bioethanol or biodiesel) and the country or region. In the project data were collected and compiled to provide inputs into the backcasting model simulations with regard to country/region specific feedstock uses for biofuel production in 2000-2010.

Table 84 provides a summary of biofuel feedstock use in 2007-2010 by scenario as simulated in the backcasting model experiments. Note that the level shown for scenario H3 (no biofuel expansion after year 2000) also represents the biofuel feedstock use in 2000. In our estimates (scenario H0) about 64 million tons of cereals were used for fuel ethanol production in 2007, and about 87 million tons in 2008. For 2009 and 2010 the respective values are 99 million tons and 116 million tons. Of these amounts respectively only 3 and 4 million tons were used in the EU-27 in 2007 and 2008, and some 5 to 6 million tons in 2009 and 2010.

For vegetable oils and fats, our global estimate comes to 6.6 million tons in 2007 and 10.4 million tons in 2008. As indicated in Table 84, in 2009 and 2010 the amount of oils and fats used globally for biodiesel production increased to estimated 13.5 and 15.6 million tons. The EU-27 use of vegetable oils and fats in biodiesel consumption amounted to 5.3 million tons and 8.3 million tons respectively in 2007 and 2008; in 2009 and 2010 the estimated EU-27 use of oils and fats increased further, to respectively 11.2 million tons and 11.9 million tons.

Table 84. Estimated feedstock use for biofuel production in 2007 to 2010.

	Biofuel feedstock use in 2007 (million tons)				Biofuel feedstock use in 2008 (million tons)			
Scenario	***H0***	***H1***	***H2***	***H3***	***H0***	***H1***	***H2***	***H3***
Wheat	5	4	2	0	7	5	3	0
Maize & other cereals	59	58	13	12	80	78	14	12
Sugar crops & other[97]	335	321	185	171	450	428	193	171
Vegetable oils & fats	6.6	2.4	4.8	0.6	10.4	3.5	7.5	0.6

Source: IIASA World Food System backcasting scenario simulations, August 2012.

	Biofuel feedstock use in 2009 (million tons)				Biofuel feedstock use in 2010 (million tons)			
Scenario	***H0***	***H1***	***H2***	***H3***	***H0***	***H1***	***H2***	***H3***
Wheat	8	5	3	0	9	5	4	0
Maize & other cereals	90	88	14	12	108	105	15	12
Sugar crops & other	511	483	199	171	563	529	205	171
Vegetable oils & fats	13.5	4.6	9.5	0.6	15.6	6.5	9.8	0.6

Source: IIASA World Food System backcasting scenario simulations, August 2012.
Note: The technical conversion coefficients used in the backcasting simulations were 5.2 million tons of wheat per 1 Mtoe ethanol, 4.5 million tons maize per 1 Mtoe ethanol, 24.4 million tons sugarcane per 1 Mtoe ethanol, 10.1 million tons cassava per 1 Mtoe ethanol, and 1.2 million tons vegetable oil per 1 Mtoe biodiesel.

Biofuel feedstocks produce not only the ingredients required for biofuel production but often generate by-products. Depending on type of feedstock, conversion technology as well as which parts of the plants are used in biofuel production, substantial amounts of by-products may be produced. By-products include valuable animal feed. They may either substitute imports of feed or compete with conventional domestic feed sources. In such case both trade and domestic feed markets may be strongly affected.

[97] All feedstock use in this category is expressed in sugarcane equivalent. It consists mainly of sugar crops and sugar processing by-products and includes feedstock use from some other sources, e.g. cassava, potatoes.

The animal feed industry has productively utilized the by-products associated with the refining of oilseeds into higher value food material as well as more recently into biodiesel. In fact, in the case of soybean, the soybean meal by-product is usually the main reason for soybean production.

The alcohol-free solids and liquids remaining after fermentation and distillation of starchy crops to ethanol are generally recombined for sale as high-protein animal feed. In its wet form they are known as wet distiller's grains with solubles (WDGS) and can be sold to nearby markets. When they are dried their shelf life is extended and they are sold on domestic markets or exported as dried distiller's grains with solubles (DDGS).

For every ton of ethanol produced from grain crops, about one ton of DDGS is produced. As actual data on the rate of utilization of these by-products were not available, some additional sensitivity analysis and simulations were carried out in this respect. It is assumed in the simulations that a certain fraction of DDGS produced in the bioethanol conversion process has entered commodity markets and was available as animal feed. Utilization rates of DDGS for feeding of 0 to 30 percent were used in the sensitivity analysis.

Production distortions

Adverse weather related distortions of crop production have frequently been stipulated as an important factor contributing to international food price developments in 2007 and 2008.

For considering such distortions in the backcasting simulation experiments, the production deviations in each year from an estimated linear trend line for each crop commodity during 2000-2010 were imposed as exogenous shocks in the simulations of scenarios W0 to W3, i.e. in scenarios with and without biofuel expansion. The results were then compared to the outcomes obtained in scenarios H0 to H3 where no such distortions from the trend were imposed in the simulations.

As an illustration, Figure 160 shows global cereal production for 2001 to 2010. As can be seen, production fell below the trend line in 2002/03 and 2003/04, exceeded trend production in 2004/05, but was short of the trend level especially in 2006/07 and 2007/08, with an implied shortfall of respectively 75 million tons and 11 million tons below the calculated trend line. A global cereal production of some 100 million tons above the trend line was harvested in 2008/09, of which about 80 million tons were used to replenish cereal stock. The calculated shortfall in 2010/11 below the trend line amounted to 65 million tons.

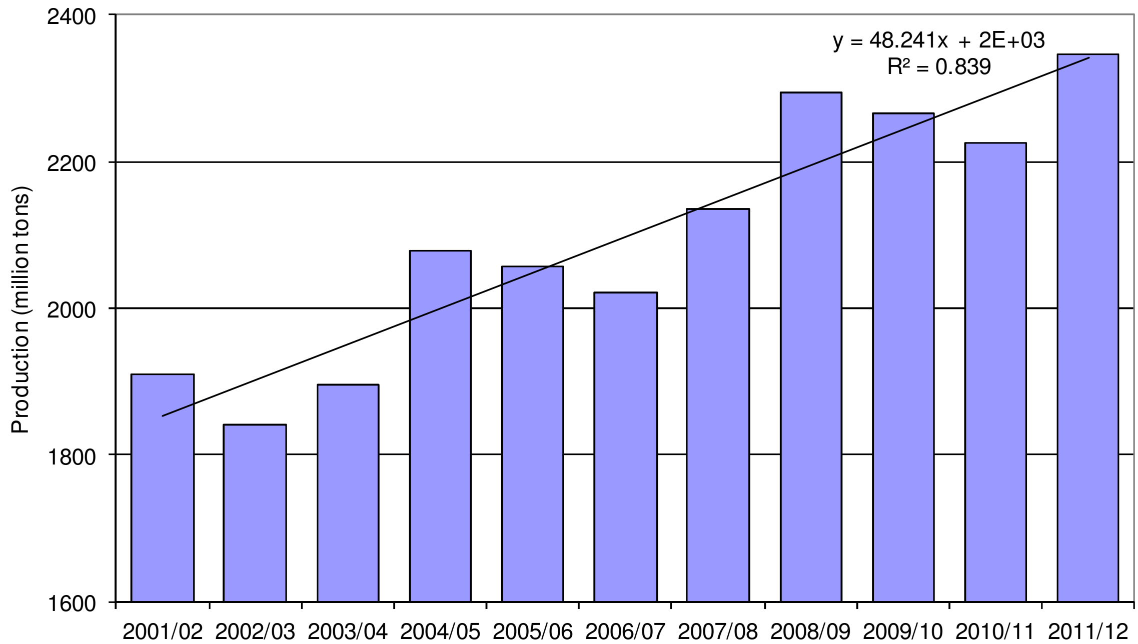


Figure 160. Global cereal production, 2001-2008. Source: FAOSTAT, online at www.fao.org (data download in August 2012).

The production of cereals was well above the trend in 2008/09, which in conjunction with other important demand factors has led to at least a short term recovery of agricultural markets, as was reflected in the decrease of international agricultural prices in 2009. The situation was then again aggravated by production distortions in 2010. As international stock levels of cereal crops where already low when production shortfalls occurred in 2006 and 2007, a consequent price increase in 2007 and 2008 induced by these shortfalls in production is plausible due to creating a temporary demand-supply gap.

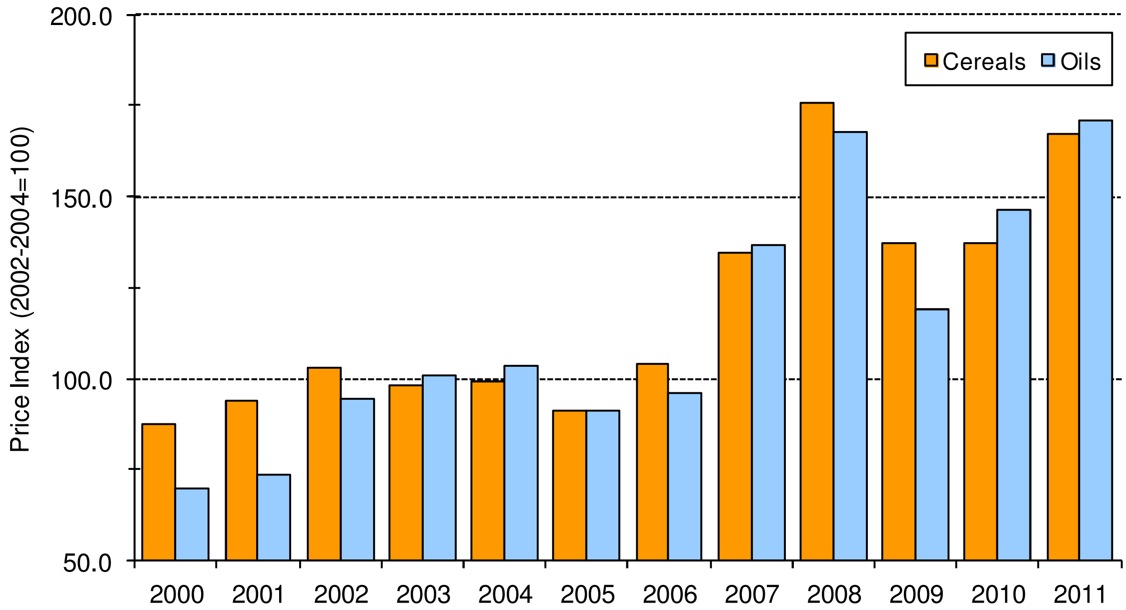
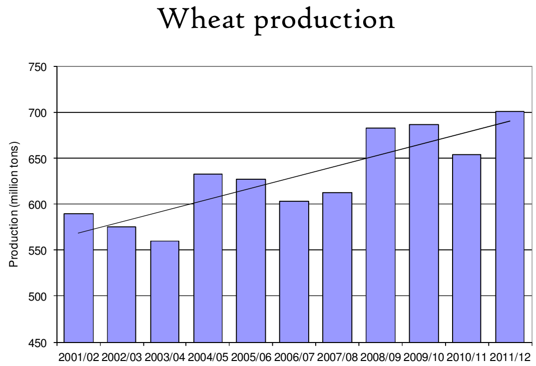


Figure 161. Annual real cereal and oil price index (2002-2004=100), 2000-2011. Source: FAOSTAT, online at www.fao.org (data download August 2012).

As shown in Figure 162, large distortions with production levels below the trend line occurred for both wheat and maize in 2006/07, to a lesser extent in 2007/08, and again in 2010/11.



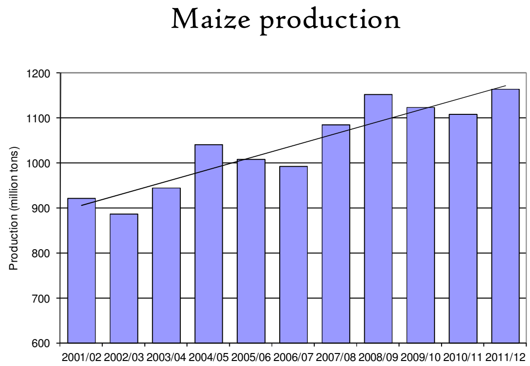


Figure 162. Global production wheat and maize, 2001-2011. Source: FAOSTAT, online at www.fao.org.

Impacts of biofuel expansion on the food system

To indicate the impacts of biofuel production expansion on main agricultural commodity and factor markets, the results are presented relative to a (hypothetical) simulation where no biofuel expansion occurs after 2000 (i.e., scenario H3). The differences between this scenario H3 and alternative biofuel scenarios (H0 = historical biofuel production levels in all countries according to historical data; H1 = historical biofuel production in all countries except in the EU-27; H2 = historical biofuel production only in EU-27; no expansion beyond year 2000 levels in non-EU countries) were computed with regards to impacts on international prices, impacts for food/feed markets, and land use (i.e. use of cultivated land, harvested area).

All policy settings and demand system components were kept the same for all backcasting simulation runs (except, of course, the biofuel production levels and associated feedstock demand) and no specific adjustment measures to counteract altered performance of agriculture have been assumed beyond the farm-level adaptations resulting from economic adjustments of the individual actors in the national models.

Agricultural prices

When simulating scenarios with increased demand for food staples due to the production of first-generation biofuels, the resulting market imbalances push commodity prices upwards (see Table 4). The exception is commodity 'protein feed' where increased biofuel production can result in lower prices (see scenario H2, when only EU-27 is expanding biofuels in the simulation) due to large amounts of co-products generated when crushing oilseeds or converting grains to bioethanol, i.e. livestock feeds from starch-based ethanol production and protein meals and cakes from crushing of oilseeds for biodiesel production). Having access to cheap feed sources also resulted in only very modest increases of livestock product prices.

Table 85. The impacts of biofuel expansion on agricultural prices.

	Change of price index relative to reference scenario H3 (percent change)									
Scenario	*Scenario H0*					*Scenario H2*				
	2006	2007	2008	2009	2010	2006	2007	2008	2009	2010
Crops	5.4	8.5	13.4	15.6	17.4	0.9	1.4	2.4	2.9	2.5
Cereals	9.1	13.9	19.3	22.2	23.4	0.4	0.5	0.8	1.2	1.5
Other crops	3.4	5.8	10.3	12.1	14.1	1.1	1.9	3.2	3.8	3.1
Livestock	0.9	1.3	2.3	4.1	4.6	0.0	0.2	0.2	0.5	0.5
Wheat	7.1	11.5	16.1	19.8	20.7	0.6	0.7	0.9	1.6	2.4
Rice	2.4	3.7	5.6	7.0	8.1	0.3	0.4	0.5	0.5	0.4
Coarse grains	16.1	23.7	32.4	35.5	37.2	0.5	0.6	1.0	1.4	1.6
Protein feed	-2.2	-3.5	-5.7	-8.1	-10.2	-0.2	-0.6	-1.1	-1.7	-2.3
Other food	3.8	6.5	11.5	13.5	16.0	1.2	2.1	3.5	4.3	3.5
Non-food crops	1.1	1.4	2.7	6.1	5.2	0.1	0.1	0.2	1.0	0.5

Source: IIASA World Food System backcasting scenario simulations, August 2012.

Table 85 indicates the magnitude of price differences occurring in the backcasting scenarios when all countries (scenario H0), all countries except EU-27 (scenario H1), and only EU-27 (scenario H2) follow the historical biofuel use path. Results are expressed relative to a scenario where no biofuel expansion is assumed during this historical period (scenario H3).

When all countries follow the historical path, then cereal prices are up in 2008 by 19 percent and by 23 percent in 2010 in scenario H0 relative to prices simulated in scenario H3. Due to the quite low use of bioethanol in EU-27, the price effect on cereals is only 1-2 percent in 2008-2010 for scenario H2. Under the H0 scenario, the simulated impact on coarse grain prices (mostly maize) is 32 percent in 2008 and 37 percent in 2010, about twice the increase simulated for wheat. When only EU-27 historical biofuel use is simulated (scenario H2), then wheat and coarse grain prices increase by about 1-2 percent. This suggests that EU-27 biofuel use played only a very modest role in the dramatic cereal price increases observed in 2008 and 2010. For other food crops, including oil crops, the price increases simulated in 2008 and 2010 due to biofuel production were 12-16 percent when all countries were considered (scenario H0) and 4 percent when only EU-27 biofuel production was included (scenario H2). Thus, the role of EU-27 biodiesel use has been somewhat significant in pushing up other food prices, notably prices of oilseeds and vegetable oils.

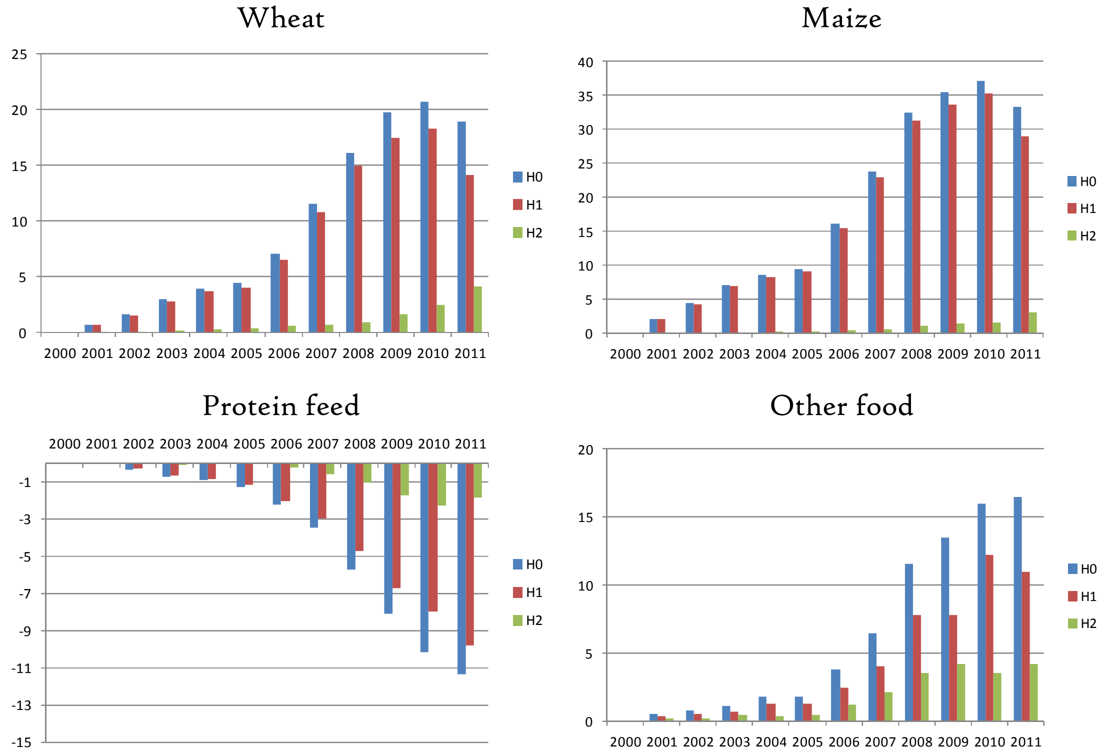


Figure 163. Impact of biofuel production on food prices (% changes relative to scenario H3). Source: IIASA World Food System backcasting scenario simulations, June 2011.

Table 86. Combined impacts of global biofuel expansion and production disturbances on agricultural prices in 2007-2010 (% change in W0 relative to prices in scenario H3).

	Change of simulated price index relative to prices of scenario H3 (percent change)			
Scenario	*2007*	*2008*	*2009*	*2010*
Crops	4.1	28.0	0.4	25.7
Cereals	9.4	38.3	-2.4	18.0
Other crops	1.4	22.5	2.0	29.7
Wheat	21.7	49.8	0.3	4.8
Rice	-3.5	8.9	-8.2	23.6
Coarse grains	11.6	54.4	-0.3	22.9
Protein feed	-13.2	24.7	0.8	-5.3
Other food	1.8	23.2	1.4	31.8
Non-food crops	6.8	6.8	11.8	24.5

Source: IIASA World Food System backcasting scenario simulations, August 2012.

Table 87. Combined impacts of EU-27 biofuel expansion and production disturbances on agricultural prices in 2007-2010 (% change in W2 relative to prices in scenario H3).

	Change of simulated price index relative to prices of scenario H3 (percent change)			
Scenario	*2007*	*2008*	*2009*	*2010*
Crops	-2.2	15.2	-11.5	13.3
Cereals	-2.2	12.1	-20.9	-6.5
Other crops	-2.2	16.8	-6.4	23.9
Wheat	17.6	44.6	-8.2	-8.1
Rice	-6.1	3.8	-21.6	9.3
Coarse grains	-13.1	-3.7	-29.9	-18.7
Protein feed	-11.8	23.2	4.1	0.3
Other food	-2.1	17.1	-7.8	25.1
Non-food crops	5.4	6.2	7.7	21.8

Source: IIASA World Food System backcasting scenario simulations, August 2012.

Table 86 presents the simulated outcomes when both historical biofuel expansion and (commodity specific) production deviations from the respective trend line were imposed. The results are expressed as percentage changes relative to scenario H3, i.e. a model simulation without biofuel production expansion after 2000 and without (weather related) production shocks. The comparison of scenarios W0 and W2 to H3 shows the combined effect of alternative biofuel production levels and historical production shocks for respectively global biofuel use and EU-27 only biofuel use. The simulation suggests that the price impacts in 2008 induced by production shortfalls in 2006/07 and 2007/08 overall would have been in the order of 12 percent, and about 10 percent in 2010. Note that the production shortfall of 2006/07 compares quite well to the amount of cereals used as fuel ethanol feedstock in 2008. Combined with the additional demand for crops as biofuel feedstocks, the simulated price impact in 2008 is 28 percent for all crops and almost 40 percent for cereal crops. Note that the combined impact on simulated coarse grain prices is about 55 percent in 2008 and 23 percent in 2010, but close to zero in 2009 due to substantial above-trend global maize production in 2008/09. Note also that the combined effect of both biofuel feedstock demand and production distortions is larger than the sum of respective impacts in simulations where only one of the two factors was imposed.

Scenario impacts on cereal food consumption

The upward changes in agricultural commodity prices caused by the demand for feedstocks to produce biofuels also affect food consumption. The simulated impacts on cereal food consumption of the biofuel expansion during the period 2000-2010 are shown in Figure 5, presenting the change in direct food consumption of cereals in scenarios H0, H1 and H2 relative to consumption levels simulated in scenario H3 (i.e. keeping biofuel use at the year 2000 level).

For the historical biofuel development path, scenario H0, the simulation results indicate a reduction of cereal food consumption of about 16 million tons (as compared to a total biofuel feedstock use of cereals of 117 million tons; see Table 3), mostly occurring in less developed countries. Due to the predominant reliance of EU-27 biofuel consumption on biodiesel, the simulated impact of EU-27 biofuel expansion on global cereal food consumption in scenario H2 is fairly small, about 1 million tons. Nearly the same impact as in scenario H0 occurs when simulating historical biofuel use in countries except for EU-27 (i.e. scenario H1).

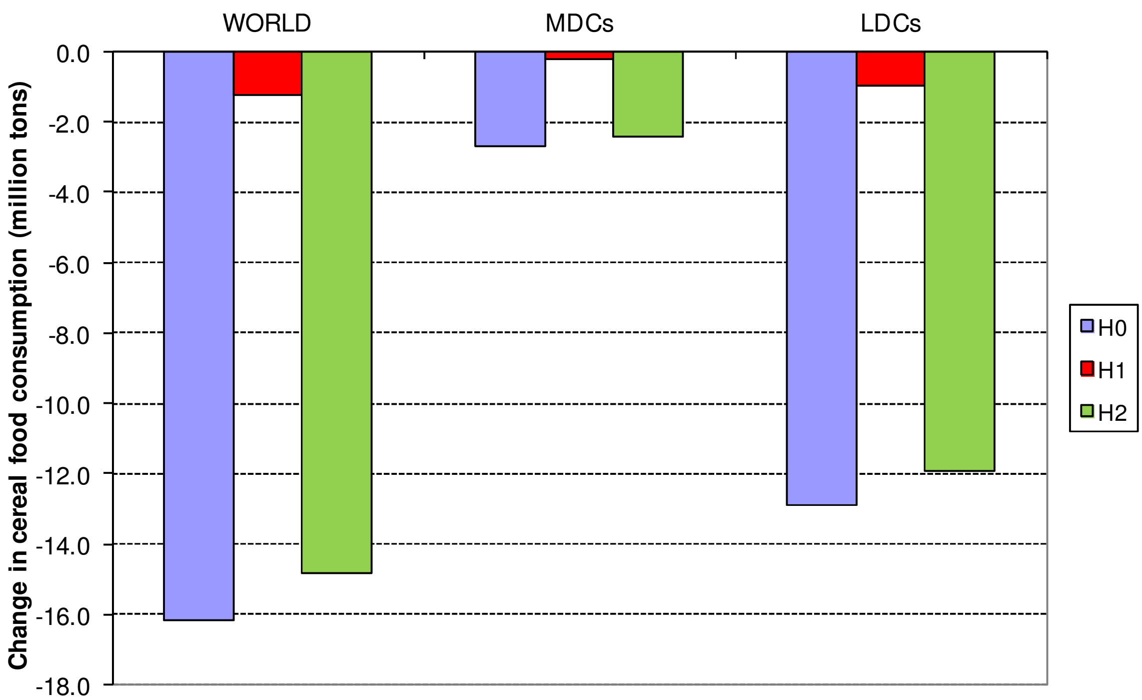


Figure 164. Impact of biofuel expansion on cereal food consumption (% changes in 2010 relative to scenario H3). Source: IIASA World Food System backcasting scenario simulations, August 2012.

Scenario impacts on arable land use

The discussion of the extent and kind of land required for biofuel production and of the impacts on cultivated land caused by expanding biofuel production, distinguishes two elements: first, direct land use changes, i.e. estimating the extent of land that is used for producing biofuel feedstocks; secondly, the estimation of indirect land use effects, which can result from bioenergy production displacing services or commodities (food, fodder, fibre products) on arable land currently in production.

The approach pursued in this study is to apply a general equilibrium framework that can capture both direct and indirect land use changes by modelling responses of consumers and producers to price changes induced by introducing competition with biofuel feedstock production. This approach accounts for land use changes but where relevant also considers production intensification on existing agricultural land as well as consumer responses to changing availability and prices of agricultural commodities.

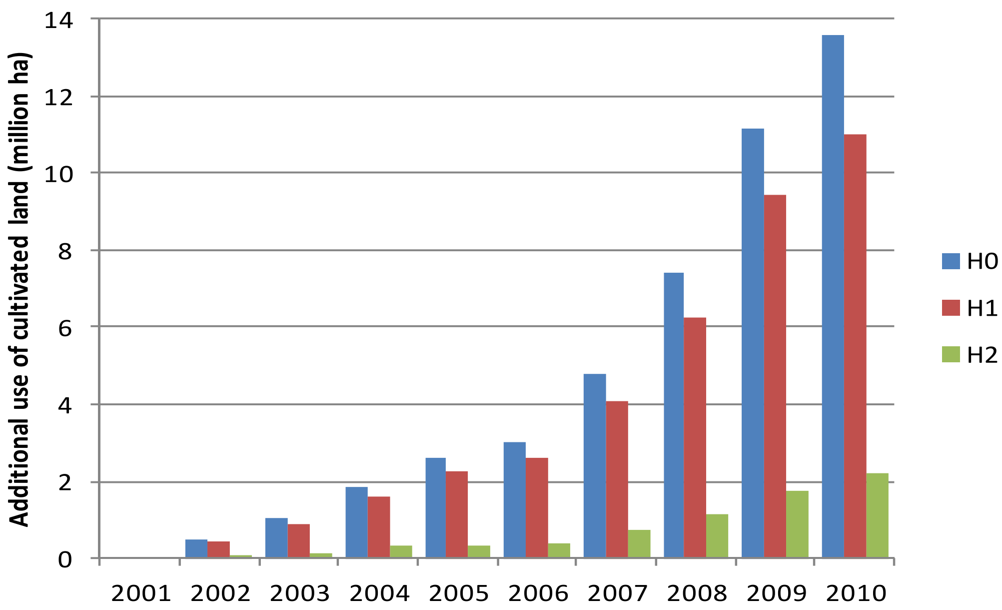


Figure 165. Additional arable land in use due to biofuel expansion relative to *H3.* Source: IIASA World Food System backcasting scenario simulations, August 2012.

Figure 165 shows the simulated additional use of cultivated land in the alternative backcasting biofuel scenarios relative to a simulation run without biofuel production expansion after 2000, i.e. scenario H3. According to these simulations, an additional use of cultivated land in 2008 of about 7.4 million hectares is attributed to biofuel feedstock demand when historical biofuel production figures are used for all countries (scenario H0), about 6.2 million hectares when biofuel production is simulated for countries excluding EU-27, and 1.1 million hectares when simulating for EU-27 alone. In 2010, the simulated changes in use of cultivated land are respectively 13.6, 11.0 and 2.2 million hectares.

Comparing for each scenario the additional use of cultivated land in 2010 to the respective additional production of transport biofuels (increment since 2000) gives an indication of the associated resource use per additional unit of biofuels produced. A summary for 2010 is shown in Table 7. Note that the figures shown are for a relatively short simulation period and a fast expansion of biofuel production especially after 2005 resulting in significant increases of agricultural prices. As use and conversion of cultivated land may be affected with some lag only, the figures shown in Table 7 may underestimate the full resource implications in case of further rapidly expanding biofuel use.

Table 88. Additional use of cultivated land per additional unit of biofuel produced in 2010.

Scenario	Additional transport biofuel production (Mtoe)	Additional use of cultivated land (Mha)	Additional land used per additional unit of biofuel (Mha/Mtoe)
H0	50.1	13.59	0.271
H1	38.0	11.02	0.290
H2	12.1	2.18	0.180

Source: IIASA World Food System backcasting scenario simulations, August 2012.

Conclusions

Backcasting scenario analysis with a world food system model has been used to quantify the impact of demand growth for biofuel feedstocks in recent years on prices and conventional demand for food and feed uses of crops. The outcomes of scenarios with historical biofuel production levels were compared to a simulation for 2000 to 2010 where biofuel expansion was suppressed. The difference in results was interpreted as an estimate of the market impacts of historical biofuel development and policies. This approach was also used to quantify the impact of recent weather related factors by comparing simulation results for a model calculation with 'smooth' average weather (with and without biofuel expansion) to simulation results where historical production distortions due to specific historical weather events were included.

The results indicate that both factors, biofuel production expansion and crop production distortions from the decadal trend in 2006/07 to 2010/11, have contributed to widening the demand-supply gap in 2008 and 2010 and can explain a significant part of the observed historical price increases. The analysis suggests that the combination of the two factors caused a combined impact that was larger than the sum of the two individual impacts, i.e. there was a non-linear and mutually reinforcing interaction of the two stress factors.

The backcasting scenario analysis clearly shows that EU-27 expanding biofuel use has contributed only little to the historical cereal price increases in 2007 to 2010. The impact of EU-27 was more substantial for price increases of non-cereal food commodities, notably through its demand for vegetable oil in the production of biodiesel.

Appendix IX Land-use rights – background table

Table 89. Largest land deals in sensitive regions.

Region	Total deals and area	Agriculture	Top-5 [1)]	Concerns [2)]	
Western Africa [3,4,5,6)]	98 deals 3.8 Mha	84 deals 3.2 Mha	1.4 Mha→ 1.0 Mha	220 kha	16%
Eastern Africa [7,8,9,10,11,12)]	260 deals 8.8 Mha	199 deals 6.9 Mha	1.6 Mha→ 0.9 Mha	470 kha	29%
Central Africa [13,14,15,16,17)]	27 deals 1.1 Mha	23 deals 0.7 Mha	0.5 Mha→ 0.2 Mha	0 kha	0%
North Africa [18,19,20,21,22)]	18 deals 3.1 Mha	15 deals 1.4 Mha	1.3 Mha→ 1.1 Mha	600 kha	46%
Southern Africa [23,24,25)]	5 deals 0.04 Mha	3 deals 0.02 Mha	0.02Mha→0.02Mha	0 kha	0%
South America [28,29,30,31,32)]	132 deals 6.4 Mha	89 deals 4.8 Mha	2.2 Mha→ 0.4 Mha	76 kha	3%
South Asia [33,34,35,36,37)]	114 deals 4.7 Mha	20 deals 3.1 Mha	2.9 Mha→ 0.1 Mha	14 kha	0%
South-East Asia [38,39,40,41,42)]	216 deals 17.3 Mha	196 deals 16.7 Mha	3.9 Mha→ 0.5 Mha	496 kha	13%
Total			13.8 Mha→4.2 Mha	1876 kha	14%

1) The total acreage of the top-5 agricultural investments as found in the database, followed by the acreage corrected for errors, as explained in footnotes per region.

2) Starting from references provided in the Land Matrix database and through brief internet searches. The fraction is based on the corrected acreage of the top-5 of land deals in the Land Matrix per region. Only recent concerns (2009 – present) are taken into account, to establish an understanding of the present situation. The research was limited to examination of reports referenced by the Land Matrix and additional internet searches. As explained in the text, there are no simple guidelines to qualify land grabs. Initiatives, for which significant-major concerns were ventilated in media or research reports, are marked as “concern”.

3) Note that a 350 kha land deal and a 300 kha land deal in Benin as reported in the database seem to overlap (same investor countries, but no further information available for the 300-400 kha deal). De Schutter [2009 Report of the Special Rapporteur on the right to food, Addendum Mission to Benin] and internet postings suggest that these deals were intended, but there is no information about whether they actually materialised. The investor is unknown.

4) Italian company Green Waves acquired 200 kha for the production of Jatropha. No irregularities or discontent were reported.

5) The database notes a deal of 240,000 ha in Liberia by Singapore investor Golden Veroleum, which signed a deal on 220,ooo ha in November 2010. Sustainable Development Institute [2012, Golden Veroleum Liberia: What does the contract say?] analysed the contract and reports minor reasons for concern. The Center for International Conflict Resolution [2012] reports that GoldenVeroleum has made some strong initial attempts to build a good reputation.

6) In 2009, Sime Darby signed a contract with the Liberian government for a 220,000 ha. The Center for International Conflict Resolution [2012, Smell no taste: the social impact of foreign direct investment in Liberia] classifies this project as extremely controversial and reports amongst others the absence of free, prior and informed consent and that community rights have been violated.

7) In 2009 Varun Agriculture from India signed a deal on 170 kha for food production. Note that the Land Matrix incorrectly stated 465 kha which concerns the original plans, of which part was cancelled [GTZ 2009, Foreign Direct Investment (FDI) in Land in Madagascar]. Major concerns on the 170 kha are reported by various media about rushed public consultation and unfulfilled promises.

8) Since 2005, UK GEM Biofuels has secured 495 kha in Madagascar to produce Jatropha for biofuels. So far they started to develop about 200,000 hectares. No irregularities or discontent were reported.

9) Karuturi Global from India secured about 300 kha in Ethiopia over the past decade, for the production of palm oil, rice and sugar cane. ILC [2011: A case study of the Bechera agricultural development project, Ethiopia] signals a lack of consultation with the community with the most recent acreage extension, and records several complaints.

10) The database notes a deal of 220 kha in Tanzania by Agrisol from USA. This deal (which could even stretch to 320 kha according to several media reports) did not (yet) take place, because of public concerns about probable relocation of 162,000 refugees from Burundi. Agrisol currently owns about 14 kha. No major concerns are known about these 14 kha.

11) The database notes a deal of 200 kha in Madagascar by Madabeef from the UK. This deal should have been categorised as livestock. Therefore, we skip this deal and instead analyse the #6 largest initiatives.

12) The database notes a deal of 200 kha in Madagascar in 2009, by not further specified United Arab Emirates companies. The report on which this entry is based [The Oakland Institute, 2010, (Mis)investment in Agriculture, The Role of the International Finance Corporation In Global Land Grabs] only mentions that “June 2009 reports reveal that companies from the US and the UAE are interested in establishing large farms in Zambia to grow sugar and grains”. This report in turn seems syndicate the information from a Reuters posting (Jun 12, 2009) in which the Zambian Minister of Agriculture reveals the interest. However, so far no deal was closed. Additionally, the database notes Jatropha as the most important crop, whereas the underlying information focuses on cane for ethanol production.

13) The database notes a deal of 200 kha in Congo for the production of cereals by AgriSA from South Africa. The database references do not give any information to substantiate this entry. A BBC posting [20 October 2009] confirmed that AgriSA signed a

deal with Congo lease 200 kha to South African farmers (resettling in Congo in reaction to planned South African land reforms) to produce food and fibre for the Congo market.

14) The database notes a deal of 102 kha in Cameroon for the production of banana, palm oil and rubber. The company mentioned is CDC (Cameroon Development Corporation), created in 1947, which operates 79 kha of plantations (when extensions were realised is not publicly recorded). CDC is currently extending its operations with 14 kha. We could not find information confirming the 102 kha deal in the database.

15) The database notes a deal of 70 kha in the Republic of Congo for the production of oil palm, by ENI from Italy. Underlying information and other media reports reveal only that ENI in 2009-2011 had plans to develop 70 kha of oil palm plantations. According to Reuters [Apr 29, 2011], ENI signed a MoU with Congo about developing 70kha of palm oil. According to ENI website [Eni in the Republic of Congo], ENI and the Republic of Congo so far (only) signed a protocol agreement.

16) Since 2005, Magindustries from Canada is involved in 68 kha eucalyptus cropping in the Republic of Congo. This, however, should not be marked as a (recent) land deal, as it concerns the acquisition of all the shares of Eucalyptus Fibre Congo, created by Shell Renewables between 1999 and 2001 [World Rainforest Movement 2007: Congo, Republic: Thousands of hectares of land for eucalyptus, oil palm and mining].

17) The database notes a deal of 58 kha in Cameroon by Group Bolleré from France; the crop is unknown. The references given by the database do not give any information on this initiative. We suppose that the French company Bolloré is meant. Additional research reveals that in 2005, subsidiaries of the Bolloré Group established a pilot biofuels program in Cameroon, of only "100 m3 per year" (this is either a tiny pilot or the correct number is incorrectly cited by media). Bolloré Group controls more than 80 percent of palm-oil production in Cameroon via Socapalm, which involve 78 kha plantations. The plantations already existed for several decades but were privatised and bought by Bolloré in 2000. This entry should not be considered as a land deal (at least not one that changes the land use rights of local people). Socapalm receives critique on social aspects, especially labour conditions. The initial creation of the plantation (by the state) seems to involve (have involved) land grabbing.

18) The largest land deal in Northern Africa noted in the database concerns 600,000 ha for oil palm and Jatropha in Sudan. Additional information from the Oakland institute [2011, Understanding land investment deals in Africa, Nile Trading and Development inc., Land Deal Brief; Understanding Land Investment Deals in Africa, Country Report: South Sudan] reveals that the deal was negotiated in 2008 and involves forestry, agriculture and mining, with an apparent focus on agrofuels. The deal was confirmed by the government of South Sudan. There are much concerns around this deal, the impacted people are not consulted several impacted counties reject the deal. No development has taken place yet.

19) The database notes a 280 kha deal, in agriculture, tourism and conservation in Sudan, by the government of Sudan. According to [Norwegian people's aid, 2011, The new frontier: A baseline survey of large-scale land-based investment in Southern Sudan] this involves the permanent expropriation to establish a reserve area. In return, the government plans to provide the community with certain services. It is impossible to judge the quality of this deal.

20) In 2007, Green Resources from Norway signed a deal on 179 kha development of forestry and conservation projects in the frame of REDD in Sudan. There are no known concerns.

21) The database lists a deal by Eyat Oil Services from North Sudan concerning 162 kha of agriculture. Communities are not compensated [Norwegian people's aid, 2011]. It seems that the project is not yet a deal, as there is only a MoU between the government and the investor.

22) Citadel Capital (Sudanese, Egyptian and Australian company) acquired 105 kha for agriculture. No concerns known.

23) In Southern Africa, the database only listed 3 deals. The largest deal concerns a 13 kha sugar cane project by South African sugar company Illovo in South Africa. Background information is only available from the Illovo website. No concerns are known.

24) Illovo Sugar also acquired 8 kha for sugar cane production in Swaziland. See previous footnote.

25) The database reports that in 2007, New Dawn from South Africa acquired 3 kha for citrus production in South Africa. Background information is provided by [LDPI 2011, Joint ventures in South Africa's land reform programme: strategic partnerships or strategic resource grab?] and reveals that this actually concerns a JV between New Dawn and the community who keeps land ownership. There are no known concerns.

28) The database notes a deal of 800kha of sugarcane in Brazil, and refers to the study by Survival international [2010 - Violations of the Rights of the Guarani of Mato Grosso do Sul, Brazil] which in reality says "[…] in 2008 there were almost 50 new ethanol projects seeking funding, which threaten to occupy 800,000 hectares in the next few years". The report mentions that Conab (a Brazilian government agency) "estimated an increase of 51,000 hectares of sugarcane plantations in Mato Grosso do Sul in the 2007/2008 harvest: a 32% increase from the previous harvest which already covered 160,000 hectares". The report covers diverse concerns of human (indigenous) rights although fails to link these issues to specific acreage.

29) 'Deal #762' (491 kha) is not a deal. The database refers to a study (covered by [MST 2010] which mentions 4.3 Mha distributed over 3.694 municipalities based on data from the Brazilian cadastre (Incra). In São Paulo there are 12 thousand properties occupying 491 kha, mainly for sugarcane. No particular concerns are mentioned in the article.

30) Deal #2177 (300kha, Soy, Brazil) is also not a deal as such. The database refers to a Greenpeace report [2006 – Devorando la Amazonia] which quotes a director of Cargill in Santarém who declared that "there was a potential in the zone to convert 300kha" in 2002. In 2004 there were 14kha in production according to Greenpeace [2006] and 25 kha in 2007 according to ENS Newswire [2007]. Although the area affected is likely much smaller than the 300kha reported by the database, concerns of unlawful land acquisition and environmental impact were serious enough for the Brazilian government to shut (temporarily) down the Cargill processing and shipping operation in 2007 [ENS Newswire 2007].

31) Deal #1054 (330kha, Corn, Soy, Wheat, Argentina) is in reality not a land deal. The Chinese company Heilongjiang Beidahuang State Farms Business Trade announced it will make a 1,500 MUSD investment in Argentinean Patagonia (Rio Negro province) to develop irrigation systems in 330kha, with China buying the product of these lands for a period of 20 years. No land is actually being bought. [America Economia 2011]. Concerns are mostly environmental (use of glyphosphates) [OCRN 2010]

32) Deal #1060 (316,718, Soy, Argentina) relates a concession from the Argentinean government to the Olmedo family of 362kha in 2001, of which 230kha are left today. The concession was about forested land and given to Ecodesarrollo Salta SA (owned by the family) for 64 years (35 with option to other 29). In 2003, Ecodesarrollo turned 132 kha to Cresud under legally disputed conditions [Taringa 2010].

Of the 230 kha left to Ecodesarrollo, 20ka have been exploited and cleared. The forest has been replaced with short rotation trees to sell for wood/fibre.

33) The database notes in deal #641 an area of 2Mha of Jatropha in India. It refers to one study: [Ariza Montobbio et al 2010 - The political ecology of Jatropha plantations for biodiesel in Tamil Nadu, India]. The study does not mention any deal of 2Mha, but only that India had a total of 300kha of Jatropha planted in 2007. Some existing Jatropha plantations mentioned in the study are: (a) 350 ha (NWDPRA project), mostly on farmers' private lands; (b) 12kha in Tamil Nadu in 2007 from D1 Mohan Bio Oils Ltd. (D1 oils is now called NEOS Resources plc); (c) 1200 ha from Shiva Distilleries all around Tamil Nadu in 2007, which leads us to an assessment of total plantations of 13.5kha which were likely planted in the last 10 years, since they concern Jatropha (the Indian National Biodiesel Mission was launched in 2003).

34) In deal #610 the database notes a deal of 400kha of Jatropha in India, but cites the same report as detailed above [Ariza Montobbio et al 2010]. No other references could be found for this deal.

35) Deal #556 notes a deal of 194kha for Jatropha in India and refers to an Italian report by ActionAid [2010 - Biocarburanti - limpatto delle stragegie UE]. This report does not mention any project or deal of this size. From another source [Biofuels Digest 2011], we learn that the investment company (Mission New Energy) has planted 16 kha in 2011 leading to a cumulative planted (Jatropha) area of 94 kha. The concerns over food insecurity and land eviction shown on the map of the ActionAid report cannot be linked to any area or specific project.

36) Deal #640 refers to a 180kha Jatropha deal by the government of India, but refers to the source described in 33) [Ariza Montobbio et al 2010]. No other references to this deal were found.

37) Deal #642 refers to a 150kha Jatropha deal by the government of India, but refers to the source described in 33) [Ariza Montobbio et al 2010]. No other references to this deal were found.

38) 3 of the 5 largest deals in South-East Asia that were labelled 'agricultural' were in fact forestry projects. We therefore selected the top 5 projects that did not involve tree plantations for wood/fibre.

The database reports that deal #184 regards 1.1Mha of corn, oil palm and sugar. This deal concerns a large government project called the Merauke Integrated Food and Energy Estate in West Papua, Indonesia (MIFEE). A report by LDPI [2011 - Resisting Agribusiness Development The Merauke Integrated Food and Energy Estate in West Papua, Indonesia] mentions that "most of the project has yet to materialize" and that "Although planned as a 'food and energy estate,' the largest part of the project is slated for industrial plantations (over 970 kha, later scaled down to less than 500 kha), with oil palm (over 300 kha) and food crops (69 kha) in second and third place". [TempoInteractive 2012] mentions that "228kha of forests seem to have been cleared since the beginning of the project".

39) Deal #319 (1.03 Mha, Eucalyptus, Oil Palm, Trees) is not one deal. Two of the links in the database are not working, but a report from FOE [2008 - Malaysian palm oil - green gold or green wash] gives a lot of information. In Table 2 (p18), it lists 40 forestry licenses, whose total area sums up to 2,827,314 ha, and whose net plantable area is 1,492,992 ha. When looking only at the oil palm plantations, the net plantable area sums up to total 196 kha which represents the existing forestry concessions in 2008, while no dating of the deals is possible. The FOE report further details concerns on environmental sustainability (clearing of natural forests, swamps and burning), and indigenous population land rights.

40) Deal #449 concerns a 1 Mha project in the Philippines for cassava, corn, oil palm and rice. The report from the TransNational Institute [TNI 2011 - Political Dynamics of Land-grabbing in Southeast Asia - Understanding Europe's Role] claims that "In 2009, the Philippine government allocated 1 million ha of so-called 'marginal' and 'uninhabited' lands for a joint venture investment by the Malaysian Kuok Group of Companies and the Filipino San Miguel Corporation (SMC), with a US$1 billion investment exposure". Today it remains unclear how much of the land has been developed. TNI reports the "those who did opt to devote some parts of their land to the scheme […] have become increasingly suspicious and anxious that the new arrangement is a prelude to losing their lands completely."

41) The matrix mentions a deal (#433) of 1Mha. However, all the sources the references from the database don't work or are untraceable (in the form of personal communications). An article by [GRAIN 2007 - Jatropha the agrofuel of the poor?] mentions that "NRG Chemical Engineering Pte (UK) signed a US$1.3 billion deal with state-owned Philippine National Oil Co. in May 2007. NRG Chemical will own a 70% stake in the joint venture which will involve the construction of a biodiesel refinery, two ethanol distilleries and a US$600-million investment in jatropha plantations that will cover over 1 million hectares, mainly on the islands of Palawan and Mindanao." According to the website Duedil [2012] the company NRG Chemical Engineering Ltd was dissolved in 2009, so it is unlikely tha this project was fully realised.

42) The database claims in deal # 191 that 590,791 ha for Oil Palm, Rubber and Sugar was closed in 2007 by IndoAgriFood Resources in Indonesia. The database refers to the company's 2009 annual report, which is no longer available. However, a 2010 presentation (from the company's website) to its shareholders claims that during 2009 the company increased its land bank by 10.2kha (+4.1 kha of outgrower land). As of 31 December 2011, IndoAgri claims it has an aggregate planted acreage of 255,000 hectares, and this includes 217,000 hectares of planted oil palm, 22,000 hectares of planted rubber and 12,000 hectares of planted sugar cane, and 4,000 hectares of other crops, which does not support the high 590kha number in the database.

Appendix X Employment background tables

Below the tables with background information on employment and job creation of the various biofuel feedstock producing countries are presented. Main conclusions can be found in the relevant section in Chapter 4.4.

Table 90. Characteristics of jobs in selected EU countries.

Country	Incentives (Tax, subsidy)	Wages/ jobs	Status Temporality/Contracted/crop	Skill/Point of Value Chain
Poland	Bio components: offering financial Incentives, through a system of tax exemptions and tax relief. (2009 EC Report) Long Term Project 2009 aid for energy crops and European farmers receive subsidies (Pol EC Report 2011) and free parking if using biofuel.	Jobs: 2008 8147 2010 9792	Most labour is contracted ILO reports some issues with discrimination that needs to be addressed.	Production; engineering, plant and processing technologies ranges from the production or /collection of feedstock; processing into fuel; distribution of the fuel; training for drivers of technical, economic and environmental aspects of liquid biofuel used in transport.
Czech Rep.	No subsidies were offered in Czech Republic in 2009 for growing biomass for energy purpose other than transport.	Jobs 2008 - 8147 2010 – 8161	Rapeseed output keeps setting new production records. The 2011 crop recorded both strong yields with good quality. Rising biofuel sector demand is being met through expansion in the country's processing capacity with exportable supplies shrinking rapidly as a result. Soybeans are produced on a very small share of the total area of agricultural crops in the Czech Republic. Domestic soybean production is expected to increase. For adoption of this crop is the increasing practice of devoting more land to production of the most profitable crops (rapeseed, corn, and wheat) but may jeopardize soil.	Engineering, plant and processing technologies ranges from the production or /collection of feedstock; processing into fuel; distribution of the fuel; training for drivers of technical, economic and environmental aspects of liquid bioRuel used in transport.
France	The main incentive is the taxation on polluting activities. Partial exemption from domestic consumption tax helps offset costs of producing biofuels. Grenelle de l'environment scheme launched by the French government, which is aimed at driving clean energy and reducing CO2 emissions. Transportation is also pushing the market forward, In 2008 political concern in France over the perceived link between	Jobs: 2008 21799 2010 25,000 (UNEP)	Contract, permanent and temporary, part time, skilled (estimate)	Diester Industrie, a farmer-owned coop, produces most of the biodiesel in 8 plants . Approximately 70 percent of the total biodiesel production is integrated with crushing plants.; distribution of the fuel;

	biofuels negative impact on food prices is resulting in a reorientation of France's biofuel policy priorities.			
Germany	2006-2010: Germany transfers support from tax incentives to mandates and is gradually increasing the tax on pure biodiesel (B100). Biofuel can be used for motor transport without being taxed. Biodiesel sold in Germany is 100 percent, methyl ester.	Jobs: IRENA cites number of jobs in Germany in 2008 26,100 and in 2010 23,100 biofuels related.	over 200,000 farmers have become energy producers, harvesting energy revenues, green jobs, and local economic development opportunities from renewable energy technologies. Extrapolate similar jobs for biofuels.	Production; engineering, plant and processing technologies ranges from the production or /collection of feedstock; processing into fuel; distribution of the fuel;
Spain	Special tax rate for biofuels.	Number of jobs 2008 18399 2010 18048	Spain is one of the 3 top biodiesel production and capacity though slow in competing with outside imports. Relies on raw material imports for production from Indonesia, Argentina, and Brazil.	Engineering, plant and processing technologies ranges from the production or /collection of feedstock; processing into fuel; distribution of the fuel
Italy	Special tax rate for biofuels	Number of jobs 2008 17,000 2010 17,774 biofuels related jobs	Demand is not expected to change in MY 2010/2011 but increasing land is being dedicated to energy crops.	Technologies ranges from the production or /collection of feedstock; processing into fuel; distribution of the fuel; training for drivers of technical, economic and environmental aspects of liquid biofuel used in transport.
UK	Multiple national programs to encourage use of biofuels such as Alternative Fuels Infrastructure Program. And major research programs	Number of jobs: 2008 10145 2010 9792	**BP**, the official oil and gas partner of London 2012, will test three advanced biofuels in about 100 of the 5,000-odd vehicles that make up BMW Olympic fleet. Two of those fuels — a cellulosic ethanol product and a bio butanol biofuel — could be commercially available by 2014,	Engineering, plant and processing technologies ranges from the production or /collection of feedstock; processing into fuel; distribution of the fuel.

Sources: Bioenergy sites (2010); USDA GAIN (2009, 2011).

Table 91. Characteristics of jobs in selec\ted non EU countries.

Country	Incentives (Tax, subsidy)	Wages/ jobs	Status Temporality/Contracted/crop	Skill/Point of Value Chain
USA	Small Ethanol Producer Tax credit and Value Added Producer Grants. Energy Technology Loans provide Guarantee to projects that support use biofuels both biodiesel and ethanol.	47.000 jobs estimated for biofuels industry (APEC) 2008 (37,000 for ethanol and 9,000 for biodiesel production.. 2008 1 and in 2010 500,000	For transport: feedstock production of energy crops, agricultural jobs: farmers and seasonal labour – are required. Other jobs are involved in collecting Industry residues. Refining ethanol and the transesterification of biodiesel requires workers such as chemists, machine operators and engineers, after which the biofuel can be distributed.	Green jobs should be good jobs and not low-wage or dangerous jobs. Examples of emerging occupations Include biofuels Processing Technicians. Employment in agricultural production in mechanization, farm management, and industrially, in processing, construction, technical assistance, inspections for meeting standards.
Brazil	Government support programs for bioethanol are focused on the poorer regions of the north as a Regional Producer Subsidy. Prices are liberalized and determined by the market. Controls are through mandates for mixtures and tax incentives.	Jobs: By 2009, 150,000 jobs had been created nationwide 2008 688564 2010 1000000 Wages: Salaries are regulated by the Brazilian Government under a minimum wedge policy. In 2010, the minimum salary is R$ 510 per month. The daily rate for seasonal or temporary work is based on this amount. (2008 baseline – UNICA)Brazilian biofuels (including ethanol and biodiesel) generate income for rural areas. The data is not steady and is cited as a range for brazil between 800,000 and I million jobs.	Most of the seasonal issues concern child and maybe migrant forced labour are related to sugarcane harvesting. The harvesting season lasts between 6 to 9 months per year. Mechanization has resolved much child labour and increased production in the southern regions but hazardous child labour is still a problem in the poorer north where mechanization has not taken over. Mechanization may mean job loss or shift but can also mean land expansion or diverse crops	According to IRENA 2011, Brazil had in 2008 688,564 biofuels related jobs and in 2010 800,000. The demand for green occupations is increasing and it is anticipated that this is at all skills levels.

Argentina	Capital subsidy, grant, or rebate Capital subsidies, grants and/or rebates exist. 2011	Number of jobs 2008 5,000 2010 5000 Wages: $492 monthly 2008 average monthly per capita income for rural workers	Farm wages regulated by law and farmers have adequate food purchasing power (2008 BL) Tenant farming is practiced so some debts can accrue to landowner. Small holders in soy bean farming production; 50-60% in land and rent contracts produced.	Direct and indirect manual labour, bio diesel plants supplied by regional companies.
Paraguay	More than half of the soy grown in Paraguay is exported to Argentina, and much of this is turned into diesel either in Argentina or in Europe. Biofuels production is considered in the national interest. The industry continues to expand due to good returns and support from government policy to increase the demand for blends with gasoline – (GAIN 2011)	Number of jobs 2008 1571 2010 1879	Predominately soy bean oil workers on farms,	Unskilled labour, farming and skilled labour for over 26 biodiesel plants - 6 government approved and 20 small holders. Research in feedstock for biofuels is limited (Bioenergy 2010) indicating a need for skills development.
Peru	Small farmers not highly encouraged to grow crop for biofuel as can only sell to private companies. Tend to work as employees on private or commercial farms. (2008 BL) There exist many government programs but little private sector.	Number of jobs 2008 400 2010 4078 (Cardno)	Large plantations $20-25/day Migrant workers $20-25/d Observaciones - $15/d Wages: $20-25 a day work 2008 baseline	The interest of the workers is low, though there exists many government programs. There is no incentive from the private sector, there is no "qualification" (provide basic crop installation and maintenance things) for farmers from the private sector.200 BL
Indonesia	Stimulus Plan S$5.9bn Renewables and rail (Jan. 2009) 1.6 Public funding for research and develop-ment in Indonesia towards	In Indonesia, oil palm represents 13 per cent of national agricultural output and has over 3 million workers directly employed in the oil palm industry (WB 2010b, 8-9).	Average 2008 IIDR/Day = 28,345 for tasks such as digging, planting, land clearing, harvesting, controlling Indonesia Labour Statistic 2008 (BPS, 2009**)** ((2008 baseline) The annual limit on own-use production is 100 liters per hectare of the utilized agricultural area	It is largely the responsibility of the management of individual companies to identify what positions exist and what skills will are and will be required

	clean and green technology appears to be robust and growing.	Jobs related to biofuels are estimated at 121.000 (APEC) 2008 60000 2010 115000	owned by the farmer; paid and unpaid child labour .	for future needs.
Malaysia	Malaysia has encouraged national industries to develop biodiesel production for internal use instead of exporting mostly palm oil due to price increase. (EuropaBio 2008)	Most of the biofuel employment is around 2008 24,000 2010 300,000	Contract farmers; smallholders Seasonal workers; some forced labour and child labour in oil palm sector	Biorefineries; planting, land clearing, pressing and refining.
Ukraine	Alternativa (IOM) Limited and GreenShift Corporation have joined forces on the design and development sustainable integrated feedstock and renewable energy production facilities. The federal government has introduced tax exemptions for the import of equipment used for construction or renovation of biofuel production facilities;	Jobs: 2008 300000 2010 450000	Sugar beet production in Marketing Year 2010/11 (MY 2011) increased by 37% on the year due to an increase in planted area to about 500,000 hectares (ha), up by 56% compared to 322,000 ha planted for the harvest of MY 2010. According to the State Statistics Committee of Ukraine, average yields of sugar beets in MY 2011 were lower, 28 tons /ha compared to 32 tons /ha a year prior. (Bioenergy 2011)	Manufacturing, insulation of buildings, replacement of boilers, upgrading central heating circuits, and biofuels production. The plummeted demand for sugar resulted in the decision to shift sugar beet industry from producing sugar to providing biofuel - agriculture is converting to fuel with the surplus.
Canada	The industry has invested $2.3 billion toward construction of new facilities generating almost 2 billion liters per year.	Jobs: 1,400 2008 APEC 1000 permanent manufacturing jobs and 14,000 for construction of facilities.	Shifting full time jobs to green collar jobs that focus on the environment, natural resource management, carbon credits markets; offsetting greenhouse gas emissions using green technologies.	Ethanol and biodiesel are blended by all major companies across Canada and plants are operated by a well paid workforce.
Russia	Russian Federation Renewable Project in partnership with the GEF and Russian government.	Jobs: 2008 25,564 2010 25,874	Harvesting, production; water Crushing, distribution Soybean and rapeseed export to EU	Russia aims to increase its energy production and share in the global exports, because it is Russia's primary source of revenues. The other areas of

				opportunity are the modernisation of obsolete equipment and infrastructure (pipes, grids and power plants for converting wheat.

Table 92. Relationship of Agriculture to GDP 2008-2010.

GDP 2008	Billions $	% Agri-culture	GDP 2010	Billions $	% Agri-culture
Czech Republic	225	No data	Czech Republic	197	No data
France	2,831	2%	France	2,549	2% *
Germany	3,623	1%	Germany	3,258	1%
Italy	2,307	2%	Italy	2,043	2%
Poland	529	4%	Poland	469	4%
Spain	1,593	3%	Spain	1,383	3%
UK	2,635	1%	UK	2,251	1%
Brazil	1,652	6%	Brazil	2,143	6%
Argentina	326	10%	Argentina	368	10%
Paraguay	17	24%	Paraguay	18	22%
Peru	126	7%	Peru	154	8%
Indonesia	510	14%	Indonesia	708	14%
Malaysia	222	10%	Malaysia	237	11%
Canada	1,502	2%	Canada	1,577	nd
Russia	1,660	4%	Russia	1,487	4%
USA	14,219	1%	USA	14,447	<1%
Ukraine	180	8%	Ukraine	136	8%

Source: World Bank Data and Agriculture and Rural Development *Estimate

Appendix XI Impacts on other biomass using sectors

Table 93. Overview possible advantages & disadvantages between biofuels and other biomass using sectors.

Sector	Type of biomass	Advantage	Disadvantage	Comments / Quantification
Pulp & Paper				
	Bagasse	Increase of bioethanol production from sugarcane means that more bagasse (rest product from sugarcane ethanol) becomes available as feedstock for paper/pulp production.	When large scale commercial production of 2nd generation biofuels becomes a reality this can compete with the paper industry for bagasse as a raw material.	Bagasse is already being used as a feedstock for paper/pulp production. In 2006 the pulp & paper industry absorbed 10% of the world bagasse supply (IRD, 2006). With a growing demand for fibres this could increase.
	Wood residues	The biofuel market provides new opportunities for the paper & pulp industry as biofuel produces from wood residues.		The European pulp and paper sectors aims to develop wood based bio-refinery complexes which among other things produce biofuels. Several projects on second-generation lignocellulosic biofuel have started (CEPI, 2011).
	Starch		The paper industry, ethanol industry and chemical (fermentation) industry each use starch as a raw material in their production processes. This could lead to competition for the same resources and could eventually result in higher starch prices.	No records are available indicating that this interaction has caused any negative impacts so far. However the starch demand in the paper industry is substantial. For example in 2008 3.5 million tonnes starch was used in the EU for industrial use of which 2.2 million tonnes in the paper industry, and 1.3 million tonnes in the chemical and fermentation industry (Raschka & Carus, 2012).
Chemical				
	Sugar		Bio-chemicals and ethanol competing for same resources could result in an increase in prices.	So far no records of negative impact of bio-ethanol production on the feedstock availability or price of sugar for industrial use in 2010 have been found. EU industrial sugar users had access to surplus non-quota supplies, to import at world market prices and sugar beet production contracts with growers. The total EU industrial sugar use in 2010 was approximately 10% of the total sugar consumption of which 1/3 was used in the fermentation industry and 2/3 for ethanol (F.O. Licht, 2011). The prospective growing sugar consumption for the production of (bio)-chemicals will

				compete with the food and increasingly the biofuel industry (KET industrial Biotech, 2011).
	Starch		Bio-chemicals and ethanol competing for same resources could result in an increase in prices.	Although there are no records of such a negative impact, resource competition between the biofuel and biochemical sector could occur in the future. When considering that total global bio-ethanol production for transport would cover about 25% of the total ethylene demand and projections suggest that bio-ethylene could meet between 40% and 125% of the global demand in 2035 this could lead to resource competition (IEA-ETSAP/IRENA, 2012).
	Cellulose	The innovation regarding second generation biofuels from cellulosic feedstocks can equally benefit the chemical industry and vice versa.	When large scale commercial production of 2nd generation biofuels becomes a reality this can compete with the chemical industry for cellulose as a raw material.	As several industrial sectors (biofuels, power generation and chemical industry) compete for biomass feedstock, and starchy and sucrose biomass alone cannot meet the total demand without competing with food production industry the development conversion processes of lignocellulosic biomass could become crucial to increase the basic resources of sustainable biomass (IEA-ETSAP/IRENA, 2012).
Oleo-chemical				
	animal fats		Higher prices and less availability of animal fats due to increased demand biodiesel production.	The use of animal fats for biodiesel production went up from 8% to 15% between 2009 and 2010. In 2010 prices of tallow (and palm oil/stearine) increased. Without this increase in demand from the biodiesel industry prices of rendered animal fats would be lower. (Ecofys, 2011)
	vegetable oils		Higher prices and less availability of vegetable oils due to increased demand biodiesel production.	In 2010 prices of palm oil/stearine (and tallow) increased due to the increased demand from biofuel production. (Ecofys, 2011)
	glycerine		Glycerine market in surplus due to a strong increase in biodiesel production, which	The glycerine output from biodiesel production increase from 284.000 tonnes in 2005 to 902.000 tonnes in 2010. The downstream

			resulted in low prices.	industries did not grow at the same pace which caused a strong decrease in glycerine prices (F.O. Licht, 2011). Glycerin prices dropped from 1.500 Euro/mt to below 500 Euro/mt in 2009 (APAG 2009).
Food processing				
	glycerine	Lower prices for glycerine for use in the food processing industry (as solvent, sweetener, preservative) due to biodiesel related market surplus.		Sectors using glycerine as a raw product could benefit from low prices.

Appendix XII Water impacts of biofuel production

This annex serves as background to the section on water impacts related to EU biofuels consumption 2010 (see section 4.5). The main results are presented in this section, but as background in this annex the following sections are provided:

- Description of methodology;
- General water impacts from biofuels supply chains;
- Detail studies;
- Legislation and enforcement potential.

Methodology

Impacts of crops produced for EU biofuels consumption on water availability and water quality are analyzed for countries within the EU, as well as ten countries outside of the EU from which significant amounts of biofuel feedstocks are sourced. The preliminary step of the evaluation is to compare both the total area and yield of biofuel feedstock production in each country for 2008 and 2010, in order to identify areas making significant relative contributions to EU biofuel production.

These area and yield figures are then used to calculate total "green," "blue," and "grey" water impacts. In this analysis, "green water" refers to natural water availability from rain or soil moisture that is available in situ to cultivation. Green water impacts include the amount of naturally available water used by cultivated crops, which is not available for other purposes. "Blue water" refers to water used through human intervention, including irrigation. Blue water impacts include the amount of irrigated water used by cultivated crops, and not available for other purposes. Finally, "grey water" refers to polluted water resources. Grey water impacts therefore refer to water that is polluted in the process of cultivating crops, and is not available for other purposes. For the purposes of this report, water availability impacts are inferred from green and blue water impacts, and water quality impacts are inferred from grey water impacts. [98]

Within countries with significant green, blue, or grey water impacts (expressed in cubic meters of water), high risk regions for exacerbating water availability or water quality issues by biofuel feedstock production are identified by comparing biofuel crop agricultural regions to a number of factors. These factors include: areas of high environmental water requirements (EWR) [99], high levels of nutrient loading[100], or hypoxic coastal areas.[101] Where relevant, the water quality portion of the analysis is

[98] Mekonnen, M.M. and Hoekstra, A.Y. (2010) The green, blue and grey water footprint of crops and derived crop products, Value of Water Research Report Series No.47, UNESCO-IHE, Delft, the Netherlands
[99] The Environmental Water Requirement (EWR) is the percentage of available water that must be left in-stream for maintenance of ecological integrity and environmental services (per Smakhtin 2008/IWMI)
[100] Nutrient loading statistics from McGill University
[101] Eutrophication/hypoxia from Columbia University

supplemented with information regarding application of fertilizers and pesticides/herbicides. [102]

Finally, potential future trends in areas of high risk are considered by assessing increases or decreases in biofuel feedstocks utilized by the EU in 2008 and 2010. The analysis also considers recent changes in the legal and regulatory framework, as well as voluntary measures implemented between 2008 and 2010.

General water impacts from biofuel supply chains

Cultivation of biofuel crops may exacerbate existing water availability or water quality issues. These impacts may occur at various stages of biofuel supply chains (see Table 94), although feedstock cultivation accounts for 99% of water impacts for most crops (Fingerman et al. 2010). These impacts are not inevitable, and may be mitigated by implementation of good practices.

Table 94. Potential Water Impacts Within Biofuel Supply Chains.

Stage of Supply Chain	Water Availability Impacts	Water Quality Impacts
Land preparation and post harvest	-Land flattening, compaction, and vegetation clearage alters natural waterways and reduces groundwater infiltration. -Peatland or wetland drainage lead to increased flooding due to destruction of natural drainage.	-Clearing vegetation and deforestation lead to increased runoff and soil erosion/water sedimentation. -Burning residues or vegetation lead to increased runoff. -Soil erosion due to land exposure to wind post-harvest for row crops causes sedimentation.
Cultivation	-Irrigation and water withdrawal; feedstock cultivation accounts for the vast majority of biofuel water consumption. May lead to water scarcity downstream, exposure of dry riverbeds, etc.	-Nutrients runoff to surface water and infiltrate groundwater from application of fertilizers. -Leaching of toxins from pesticides and herbicides into surface water and infiltrate groundwater. -Soil erosion due to exposure to wind for row crops causes sedimentation.
Harvest	-Burning (e.g., for sugarcane) leads to increased demand for water.	-Preharvest burning (e.g., for sugarcane) leads to increased runoff containing sediment and nutrients.
Transportation		-Contamination from accidental spillage of intermediate production products, by-products, and fuel.
Processing and refining	-Extraction of water for cooling, cleaning, boilers and processing the feedstock and production of the fuel.	-Processing/industrial effluents contaminate water sources.

[102] Sources include GREET, National Agricultural Statistics Service (NASS), FAOSTAT, and Fertistat. Fractional runoff coefficients were derived from Johnes (1996)

Detail studies

In the three sections below more insights are provided in the cases of Brazil (Sugar cane), United States (maize) and Indonesia/Malaysia (palm oil) since these resulted as country crop combinations with highest risks on water impacts.

The analysis on water impacts showed that Brazilian sugarcane has the highest green, blue, and grey water impacts and has increased significantly between 2008 and 2010. United States maize and soybean cultivation also accounts for billions of cubic meters of water impacts. Finally, palm oil from Indonesia and Malaysia stands out as having notable impacts for both water availability and water quality.

Brazil - Sugar cane

Sugarcane in Brazil is grown in both the southern and eastern parts of the country (Figure 166). Of these two locations, the southern area is of higher risk for water availability impacts, due to the relatively high environmental water requirements of this area (that is, the percentage of available water that must be left in-stream for maintenance of ecological integrity and environmental services.[103] This area is also of highest risk for water quality impacts, as fertilizers applied to agricultural crops in this area have resulted in high levels of nutrients (e.g. nitrogen) in waterways, which eventually make their way to the coast where they contribute to algal blooms and areas of reduced oxygen, which is detrimental to coastal ecosystems.

[103] Smakhtin, V. 2008. Basin closure and environmental flow requirements. Water Resources Development 24(2): 227-233.

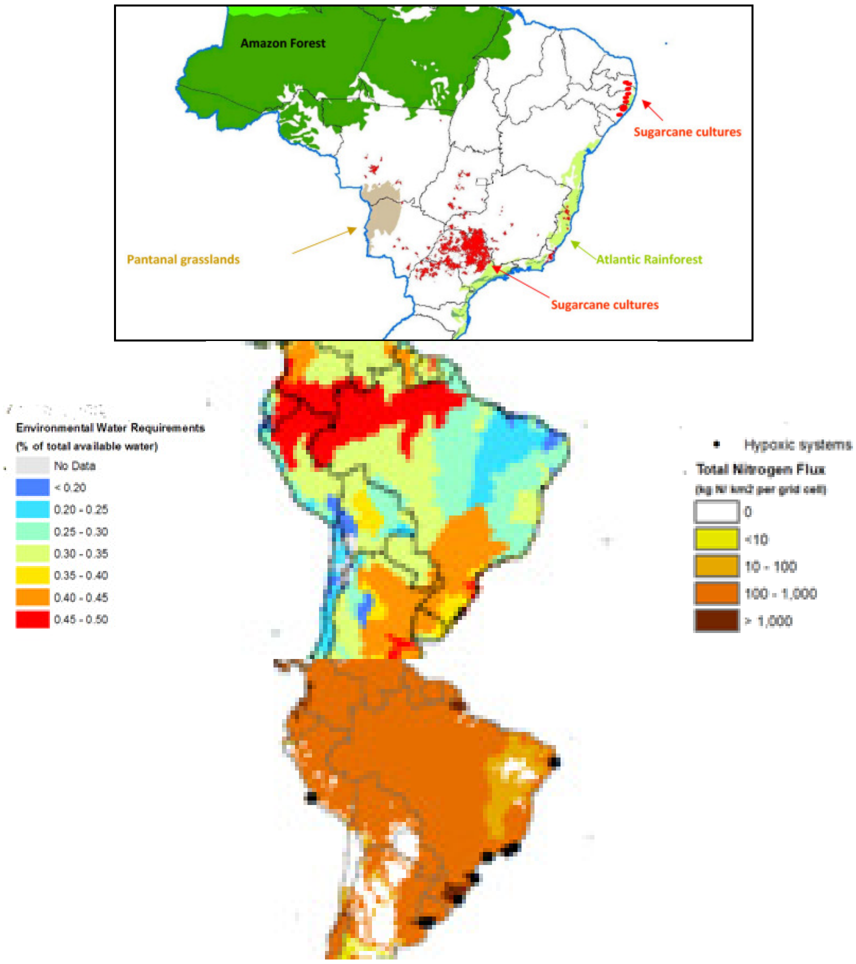


Figure 166. Areas of High Water Availability and Quality Risk for Brazil[104].

USA – Soybeans & maize

Soybeans and maize are most prominently grown in the Midwestern part of the United States, which also tends to be of high risk for both water availability and water quality. Environmental water requirements are very high in this area when compared to other parts of the country. In addition, this area has high amounts of nutrient loading which contribute to the formation of anoxic areas in the Gulf of Mexico as a result of excess nutrients flowing down the Mississippi River.

[104] Water availability and quality maps created be Winrock International. Crop location map from:
http://www.biotechnologyforbiofuels.com/content/1/1/6
http://commons.wikimedia.org/wiki/File:Goldemberg_2008_Brazil_sugarcane_regions_1754-6834-1-6-1_Fig_1.jpg

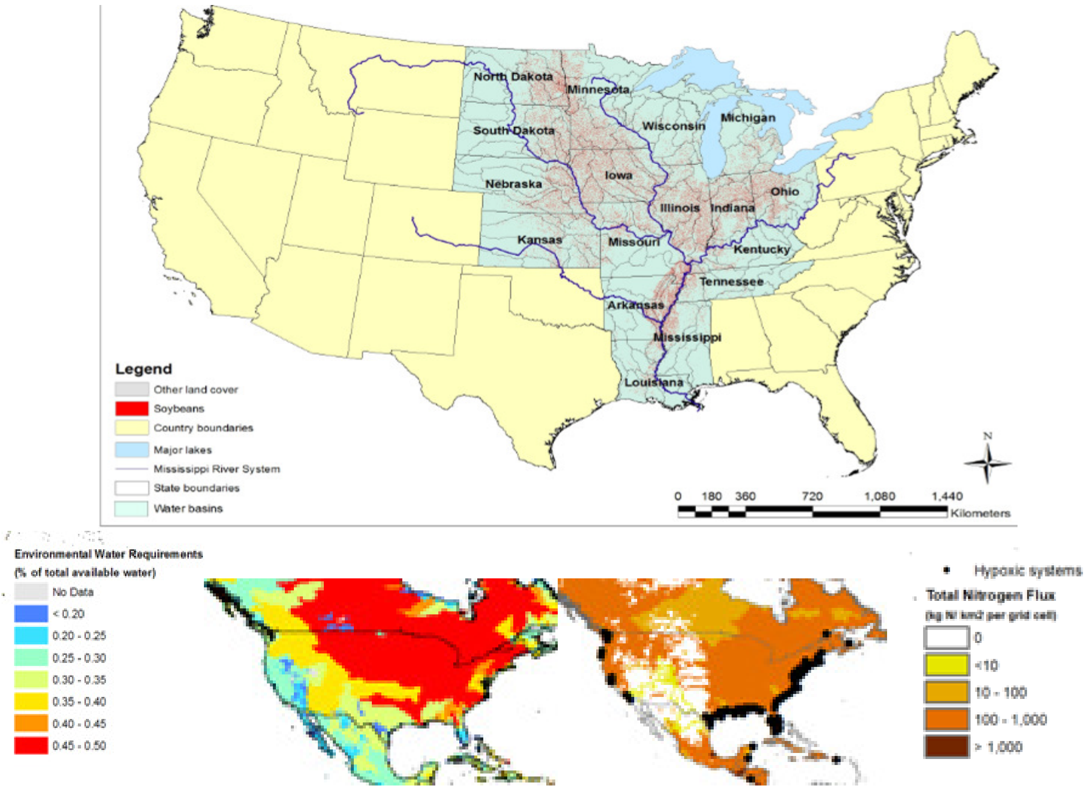
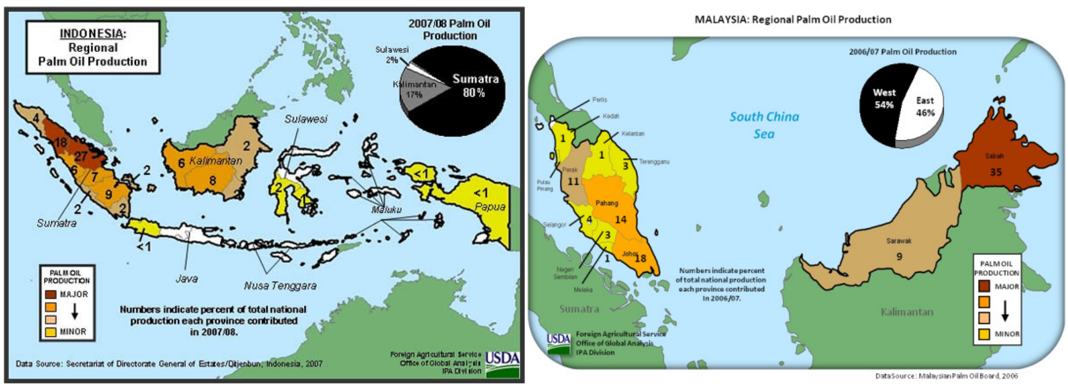


Figure 167. Areas of High Water Availability and Quality Risk for the United States[105].

Indonesia and Malaysia – Palm oil

Oil palm cultivation in both Indonesia and Malaysia is another area of high risk for water availability and quality impacts. Northern Borneo, in particular, has particularly high environmental water requirements. Much of Indonesia and Malaysia is subject to nutrient loading, with Sumatra and portions of Kalimantan on Borneo, both in Indonesia, having the highest risk for water quality issues.



[105] Water availability and quality maps created be Winrock International. Crop location map from: Cheney and Silvia, Winrock International

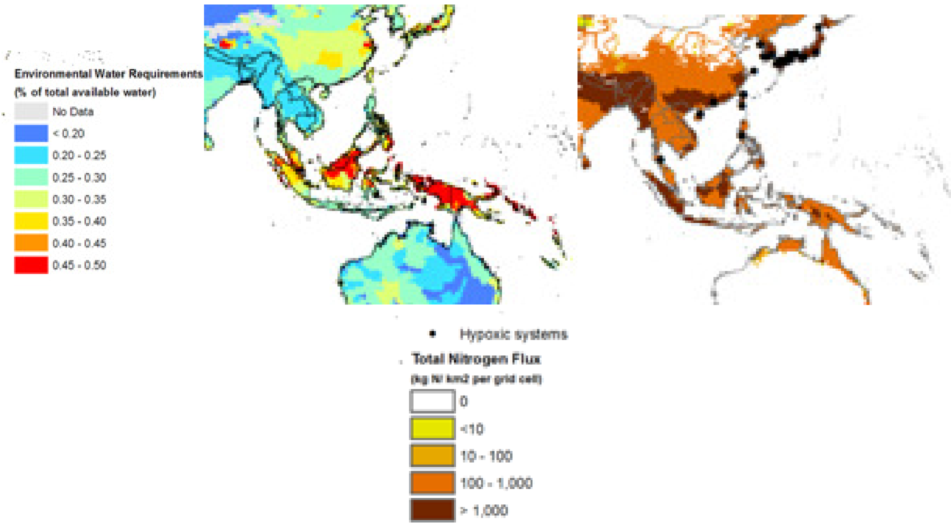


Figure 168. Areas of High Water Availability and Quality Risk for Indonesia & Malaysia[106].

Concluding remarks

High water quality risk in each of these locations is driven in large part by fertilizers and pesticides/herbicides applied to biofuel crops. Brazilian sugarcane and United States soybeans utilize similarly high amounts of nitrogen, phosphorus, and potassium for fertilizer (55, 51,and 110 kg/ha respectively for Brazil, and 30, 60, and 95 kg/ha for the United States). Malaysia and Indonesia, on the other hand, use very different amounts of these chemicals for growing oil palm (0.1, 0.1, and 5 kg/ha for Malaysia and 190, 60, and 150 kg/ha for Indonesia), which contributes to their differing water quality risk. All of these countries use chemical pesticides, with Brazil being the number one importer of agricultural chemicals in the world.[107] Worldwide averages indicate that soybean cultivation generally has higher fertilizer runoff than sugarcane, with palm oil falling somewhat in the middle.[108]

Legislation and enforcement potential

For countries indicated as high risk in this analysis, recent legislation and other key measures may provide addition insights into future trends in countries producing biofuel feedstocks for consumption by the EU. Therefore recent relevant legislation and measures regarding water impacts are presented in Table 95. Improved and new legislation may help reduce risk of impacts to water availability and quality. For example, the passage of a 2008 state law in Sao Paulo, Brazil addresses environmental

[106] Water availability and quality maps created be Winrock International. Crop location map from: http://www.pecad.fas.usda.gov/highlights/2009/03/Indonesia/ and http://www.pecad.fas.usda.gov/highlights/2011/06/Malaysia/

[107] MOE 2010. Fertilizer statistics are from FAO and Fertistat for Brazil (2002), Indonesia (2001), Malaysia (2002), and the United States (1998)

[108] GREET, National Agricultural Statistics Service (NASS) and FAOSTAT. Fractional runoff coefficients were derived from Johnes (1996)

risks of growing sugarcane in the high-risk southern portion of the country. This may indicate mitigation of water availability and quality problems in the future and has relatively an average potential for enforcement, given various indicators of democracy, corruption, and transparency. The United States also has a few measures that may mitigate impacts, with high potential for enforcement. In addition, both Malaysia and Indonesia have recently implemented laws dealing with effluent from palm oil plantations, increased use of environmental impact statements, and appropriate siting of use of plantations. Legal developments in these high risk areas generally indicate improvements in managing biofuel production for protection of water availability and quality, as well as long term sustainability.

Table 95. Key Recent Legislation and Other Measures.

Country (geographic zone)	Key legislative changes between 2008 and 2010	Other key measures	Enforcement Potential [109]
Argentina	Decree 91: Implementation of native forests law (2009) - Implements Native Forests Law and creates National Fund for the Conservation and Enrichment of Native Forests Resolution 554 (2010) - Mandates blending of biodiesel at 5-7%. Resolution from the secretary of energy.	AAPRESID (National Standard) (2008) – Certifies entities meeting the standard. Two were certified in 2008.	Low enforcement potential, but increasing
Brazil	Sao Paulo State Law, SMA-SAA (2008) – Provides for agro-ecological zoning for sugarcane, considering preservation areas and environmental risks. Focuses expansion in Cerrado in South-Central Brazil (note: this is an area of high EWR and nutrient loading)	Renewal of moratorium on Soybean from Amazon deforestation – using satellite monitoring, limits commercialization of soybean production in Amazon biome	Medium enforcement potential with unclear trends for the future
Indonesia	Ministerial Decree No. 32 (2008) – Mandates 1% mixture of biofuel. Requires biofuel producers to ensure feedstock sustainability and prove no harm the environment by way of environmental impact analyses[110] Ministerial Decree on Agriculture (14/Permentan/PL.110 /2/2009)(2009) – Provides guidelines for oil palm cultivation on peatlands	Expanded Roundtable for Sustainable Palm Oil, which has a code of environmental best practices.	Medium enforcement potential and increasing
Malaysia	Environmental Quality (Industrial Effluents) Regulations (2009) – addresses effluent from the oil palm industry	Commitment to maintain 55.6% permanent forests for wildlife habitat and biodiversity conservation (2009)	Medium enforcement potential and decreasing
USA (soybean)	Food Conservation and Energy Act/US Farm Bill (2008) – Allows for retirement of land for environmental protection, as well as water and waste-water facilities.	Expansion of International Sustainability and Carbon Certification program	High enforcement potential, but decreasing

[109] Potential for enforcement at the high, medium, and low level was conducted by reviewing four indices relating to rule of law and corruption, including the Corruption Perception Index, the Global Integrity Index, the Democracy Index, and the Rule of Law/Regulation and Enforcement Index.
[110] (Ariati, pers.comm. 2010).

Appendix XIII Soil impacts from biofuel production

Soils are in their best potential health when they are preserved under natural vegetation - in equilibrium with their environment and not exposed to physical disturbance at the surface. However, once under cultivation soils' equilibrium with the environment is altered and they are subject to degradation. The type and degree of degradation varies from landscape to landscape depending on the landscape form, soil type, climatic conditions, and cultivation practices. A summary of factors that impact soil health/quality, probable impact on soils, and management practices to mitigate those risks is presented in Table 96.

Table 96. Risk factors, their impact on soil resources, and management practices to mitigate the soil risks.

Risk factors	Impact on soil	Management practices to mitigate risks
Deforestation	Erosion, loss of biodiversity, loss of organic matter	Leave natural forests as shelterbelts between deforested swaths.
Tillage	Erosion, loss of biodiversity, loss of organic matter, imbalance of microbial population	Minimum tillage, no-till planting
Machinery	Soil compaction, runoff and erosion, negative impact on soil structure and infiltrability of soil	Minimize use of machinery, (probably will need special design), minimum tillage
Slope	Erosion, landslide	Terracing, contour bunding contour hedgerows, contour planting
Bare soil between cultivation cycles	Water and wind erosion	Cover crop, crop residue as surface mulch
Fertilizers, herbicides, pesticides	Soil and groundwater contamination, acidification, negative impact on microorganisms and their function	Minimize use of chemicals, inter-row cultivation, crop diversity and rotation, disease and pest-resistant varieties, promote IPM
Irrigation	Salinization, acidification	Moisture conservation, drought-resistant varieties
Climate Wet/Dry/warm/cold	Leaching of nutrients in high rainfall areas, higher incidence of pests and diseases requiring higher use of chemicals, loss of soil fertility, soil acidity, salinization in dry climates	Choose planting time to avoid periods of high rainfall amounts and frequency, minimize chemical pesticides, promote IPM, soil amendments, e.g., liming
Removal of vegetative biomass	Mining of nutrients, loss of fertility, acidity	Judicious application of fertilizers, return and incorporate biomass into the soil
Monoculture	Soil-borne diseases, loss of biodiversity	Polyculture, crop rotation

Doran et al. (1999) have proposed a set of key indicators to quantify soil health (Table 97); however, measurements involved and interpretation of results are beyond the producers and farm managers. Taking a pragmatic view, the same authors emphasize the importance of producer-generated observational field experience which translates into descriptive soil quality. These may include: look, feel, resistance to tillage, presence of biota etc. Visual and morphological observations in the field can be used to recognize degraded soil quality caused by loss of organic matter, reduced aggregation, low conductivity, soil crusting, water erosion as indicated by rills, gullies, stones, exposed roots, and uneven topsoil, wind erosion as indicated by dunes, sand against plant stems, sand blasting of plant foliage, and dust in the air, salinization as indicated by salt crusts, acidity indicated by presence of acid-tolerant weeds and stunted plant roots, and poor drainage indicated by standing water and chlorotic appearance of plants.

Table 97. Key soil and environmental indicators[1] as influenced by agricultural management practices (Doran et al., 1999).

Soil or Environmental Indicator	General trend/change	Long-term Agricultural practices affecting the indicator
Soil organic matter	Increase	Continuous cropping with well-managed crop residue, zero or minimum tillage, legume-based and other crop rotations, legume incorporation into the soil (green manure), cover crops, forages.
	Decrease	Excessive tillage, summer fallow, crop residue removed or burned.
Microbial biomass and biological diversity	Increase or decrease	Same as for organic matter
Soil aggregate stability	Increase	Conservation tillage, maintenance of crop residue, forages and legumes in crop rotations
	Decrease	Same as for organic matter
Hydraulic conductivity	Increase	Reduced and zero tillage, maintenance of crop residue, forages and legumes in crop rotations.
	Decrease	Same as for organic matter
Soil depth/rooting volume	Increase	Conservation tillage and forage-based crop rotations should reduce erosion and allow soil forming-factors to maintain and rehabilitate topsoil
	Decrease	Excessive tillage, summer fallow cropping system, and crop residue removal or burning are the main agricultural practices that subject soils to serious wind and water erosion resulting in removal of topsoil
Water quality	Positive or negative	Data are lacking on how soil water quality is affected by different agricultural practices; in general zero or minimum tillage, forage-based cropping systems, and maintenance of crop residue reduce surface runoff and soil loss to water streams; excessive use of herbicides and fertilizers may result in deterioration of water quality.

[1]Additional indicators include soil pH, water-holding capacity, bulk density, and nutrient retention capacity. However, they are affected, to a large extent, by factors listed above.

Soil Conditions and Potential Threats in Selected Countries

Palm oil is a tree crop and it is very different from other field crops. Sugarcane is semi-perennial and usually occupies the land for 5 to 7 years. Most other crops are annual and their cultivation involves similar field practices, i.e., tillage, sowing/seeding, fertilization, weed and pest control, irrigation (where practiced), and harvesting. Except for palm oil, most other crops are produced in European, North American, and South American countries, where farming is on large scale and all are based on mechanization and high use of chemical inputs. Thus, apart from inherent soil vulnerabilities, most crops are likely to impact the soil from the effects that result from use of machinery and chemicals.

Crops that currently serve the EU biofuel feedstock needs include: wheat, maize, rye, rapeseed, sunflower, sugar beet, soybean, sugarcane, and oil palm. Cultivation of these crops spans over variable agro-ecological zones across several EU- and non-EU countries. Accordingly, the risk to soil resources varies with local soil characteristics, landforms, climatic conditions, and management practices.

A brief discussion of soil conditions and potential threats to soils in major exporting countries and the EU is given below.

EU

European soils exhibit a wide range of conditions, including low moisture and nutrient status, low organic matter, calcareous conditions, impeded drainage, and seasonally excess water. These conditions arise partly from natural factors (rainfall, soil types, landscape setting) and partly from management practices. An EU report, "Towards a Thematic Strategy for Soil Protection", has identified eight main threats to European soils: soil sealing, erosion, loss of organic matter, decline in biodiversity, contamination, compaction, hydro-geological risk (floods and landslides), and salinization. These threats apply to practically all soils and it is difficult to attribute any or all to biofuel feedstock.

Table 98 presents potential threats to soils from cultivation of biofuel crops in selected non-EU and EU countries. Based on climatic conditions of the feedstock producing regions, inherent soil vulnerabilities, and known risk factors associated with agriculture practices, the table provides an educated rating of different soil risks as high, medium, or low. Because there are numerous growing regions for a given crop, with variable soil characteristics, landscape settings, and climatic conditions, an objective assessment based on these factors alone is not possible. However, because agriculture in all of the producing regions is mechanized and chemical based, the assessments presented are based on consequences of mechanization and high-input production systems. Where possible, effects of soil and climatic conditions have been taken into consideration.

Brazil

Brazil's main exporting crops are sugarcane and soybean. The main areas of sugarcane production are in the Central East Brazil and a small area in the North. Brazilian soils are characterized primarily by low nutrient holding capacity in the north, seasonal moisture stresses in the middle with patches of seasonally excess moisture and high temperatures. In the south there are areas of low nutrient holding capacity and excessive leaching. The impact of biofuel feedstock crops in Brazil relate to land clearing and agricultural management practices. Although there appears to be a shift from traditional to no-till cultivation, which reduces erosion and improves soil quality, there is a growing trend toward mono-cropping in crops grown for biofuels, especially sugarcane and soybean. This reduces soil fertility, increases crops' vulnerability to pests and diseases, as well as other environmental impacts. Erosion under sugarcane is low due to the semi-perennial nature of this crop. Soybean, on the other hand, may impact soils through the effects of mechanization and use of chemicals.

Malaysia

The major soil stress is due to deforestation and excessive leaching. There are areas of high P, N, and organic retention. There is also impeded drainage along parts of the coastline, high organic retention, and acid sulphate condition. Soil impacts related to palm oil arise primarily from land conversion and replanting. Burning is a common practice for preparing land for replanting. At present there is a trend toward zero-burning, which allows plant material to be recycled. Use of machinery in the oil palm industry is common due to labour shortages. With increased demand for oil palm, it is now being grown on a wider range of soil, including marginal environments.

Indonesia

The major soil stress in oil palm growing areas in Indonesia is excessive leaching due to highly weathered soils and high rainfall. Additional stresses are due to high temperatures, high aluminium, low nutrient holding capacity, and steepness of land. There is increased risk of erosion when forests are cleared to grow oil palm, especially during periods of planting, establishment, and replanting. Drainage of peat-lands results in loss of retention capacity, erosion and emission of greenhouse gases. Acid sulphate conditions exist along many parts of the coastline.

United States

United States contributes corn and soybean as feedstock for biofuel consumed in the EU. The leading corn producing states in the U.S. are Iowa, Illinois, Nebraska, Minnesota, and Indiana. Soybean growing states are in the Midwest, Midsouth, and Southeast. Soil erosion is a major concern related to pre-planting soil preparation. In addition, there are areas of low organic matter, soils of low nutrient holding capacity, acidity in coastal areas, areas of seasonal moisture stresses, and areas of seasonally excess moisture; however, in most cases, these limitations are overcome by management and investment of inputs. No-till planting and conservation tillage are popular, and they have shown considerable improvements in terms of reducing soil erosion and conserving soil moisture. However, there are concerns that demand for biofuel crops will lead to intensification of management practices, including mono-cropping, increased fertilizer use, and intensive tilling. Major soil risks relate to use of machinery and excessive use of chemical inputs.

Argentina

Soybean acreage in Argentina has been increasing steadily. From 1986 to 2011 yearly production of soybean has increased from 7.0 to 48.0 million metric tons/year. The main producing areas are located in the humid Pampa region, where soils and climatic conditions are generally favourable. About two thirds of Argentina is dominated by arid climate, where crop production is constrained by limited supply of soil moisture. Most growers (almost 80%) in the Pampa region have adopted no-till farming, which has shown promising results in terms of reducing soil erosion, conserving soil moisture, and improving soil fertility. The system of no-till planting has been promoted by the Argentinian Association of Farmers (AAPRESID), which has joint research projects with research and technological centers, universities, and agricultural extension. The concerns regarding land degradation are related to intensification of agriculture (e.g., introduction of the double annual cropping wheat-soybean), the change from the rotation cattle-agriculture to continuous agriculture, and untimely tilling sometimes along the slopes.

Table 98. Potential threats to soils from cultivation of biofuel crops in non-EU and EU countries.

Country/region	Biofuel crop	Inherent soil vulnerability	Risk factors linked to management	Risks					
				Erosion	Soil compaction	Contamin-ation	Loss of organic matter	Loss of biodiversity	Salinity/ acidity
USA Midwest	Soybean	Low OM and seasonally excess water	Machinery, High use of chemicals	**Low**	**Medium**	**High**	**Low**	**High**	**Low acidity**
USA Central Atlantic	Soybean	Seasonally excess water, nutrient leaching	Machinery, high use of chemicals	**Medium**	**Medium**	**High**	**Low**	**High**	**Medium acidity**
USA Delta	Soybean	Highly weathered soils, nutrient leaching, seasonally excess water	Machinery, high use of chemicals	**High**	**Medium**	**High**	**High**	**High**	**High acidity**
USA Corn Belt	Maize	Wide range of soils, seasonally excess water	Machinery, high use of chemicals	**Medium**	**Medium**	**High**	**Low**	**High**	**No info**

Canada	Rapeseed	No info	Machinery, high use of chemicals	**Low to medium**	**Medium**	**High**	**Low**	**High**	**No info**
Russia	Rapeseed	No info	Machinery, high use of chemicals	**Low to medium**	**Medium**	**High**	**Low**	**High**	**No info**
Ukraine	Rapeseed	No info	Machinery, high use of chemicals	**Medium to high**	**Medium**	**High**	**Medium**	**High**	**High salinity**
Brazil West-Central	Soybean	Highly weathered soils, leaching, low fertility, acidity and Al-toxicity	Machinery, high use of Chemicals	**Low**	**Medium**	**High**	**Medium**	**High**	**Medium acidity**
Brazil South Central	Sugarcane	Weathered soils, wetter climate, low fertility, leaching, soil acidity	Machinery, high use of Chemicals, burning of leaves	**High**	**High**	**Low**	**High**	**High**	**Medium to high acidity**
Brazil South (similar to West central)	Soybean	Highly weathered soils, leaching, low fertility, acidity and Al-toxicity	Machinery, high use of chemicals	**Low**	**Medium**	**High**	**Medium**	**High**	**Medium acidity**
Brazil Northeast	Soybean,	Ultisols, some Alfisols, seasonal dryness, high temperatures	Machinery, high use of chemicals	**Medium**	**High**	**High**	**High**	**High**	**Medium acidity**
Brazil Northeast	Sugarcane	Ultisols and Alfisols, low fertility, drier climate (drought)	Machinery, high use of chemicals	**Low**	**High**	**High**	**Low**	**High**	**Medium acidity**
Argentina Buenos Aires, La Pampa, Santa Fe, Entre Rios, Cordoba	Soybean	Soils mainly Mollisols and Inceptisols. Salinity-alkalinity, seasonally excess water and dry periods	Machinery, high use of chemicals	**Low**	**Medium**	**High**	**Medium**	**High**	**Medium acidity**
Peru	Sugarcane	Low fertility, seasonally Excess water	Machinery, high use of chemicals	**Low**	**High**	**Medium**	**Medium**	**Medium**	**Medium acidity**
Paraguay	Soybean	No info	Machinery, high use of chemicals	**Low**	**High**	**High**	**Medium**	**Medium**	**Medium acidity**

Indonesia Riau, Sumatra Selatan, Sumatra Utara	Oil Palm	Mostly Oxisols and Ultisols, , leaching, low fertility, acidity, Al-toxicity, pests and diseases	Machinery, high use of chemicals, poor management of slopes	**Low**	**Low**	**High**	**High**	**High**	**High acidity**
Indonesia Kalimantan	Oil Palm	Conditions very similar to those in Sumatra	Conditions very similar to those in Sumatra	**Low**	**Low**	**High**	**High**	**High**	**High acidity**
Indonesia Sulawesi (only 2% of total oil palm)	Oil Palm	Information not available, but oil palm environment and related issues are most probably similar to those in Sumatra and Kalimantan	No info	**No info**	**No info**	**No info**	**No info**	**No info**	**No info**
Malaysia Peninsular (Johor, Pahang)	Oil Palm	Weathered Ultisols, some coastal Histosols. High rainfall, steep slopes, leaching, low fertility, acidity and Al-toxicity, acid Sulphate along the coast.	Machinery, high use of chemicals, poor management of slopes	**High**	**Medium**	**High**	**High**	**High**	**High acidity**
Malaysia Eastern (Sabah, Sarawak)	Oil Palm	Weathered Ultisols, some coastal Histosols. High rainfall, steep slopes, leaching, low fertility, acidity and Al-toxicity, acid Sulphate along the coast.	Machinery, high use of chemicals, poor management of slopes	**High**	**Medium**	**High**	**High**	**High**	**High acidity**
EU countries									
Spain	Sunflower	Sandy to clayey soils responding differently to management inputs	Machinery, high use of fertilizers and other chemicals	**Medium to high**	**High**	**High**	**Medium**	**High**	**Medium salinity**
Spain	Wheat	No info	Machinery, high use of fertilizers and other chemicals	**Low**	**High**	**High**	**Medium**	**High**	**Low salinity**

Spain	Maize	No info	Machinery, high use of fertilizers and other chemicals	**Medium to high**	**High**	**High**	**Medium**	**High**	**Medium salinity**
Spain	Barley	No Info	Machinery, high use of fertilizers and other chemicals	**Low**	**High**	**High**	**Medium**	**High**	**Medium salinity**
Italy	Sugar beet	No info	Machinery, high use of fertilizers and other chemicals	**High**	**High**	**High**	**Medium**	**High**	**Medium salinity**
Italy	Soybean,	No Info on soils, but the crop is perennial	High use of fertilizers and other chemicals	**Medium**	**Low**	**High**	**Low**	**Low**	**Medium salinity**
Germany	Sugar beet	Medium compact, light, and medium-heavy clay	Machinery, high use of fertilizers and other chemicals	**High**	**High**	**High**	**Medium**	**High**	**Medium salinity**
Germany	Rapeseed	No info	Machinery, high use of fertilizers and other chemicals	**Medium**	**Low**	**High**	**Medium**	**High**	**Low salinity**
Poland	Maize	No info	Machinery, high use of fertilizers and other chemicals	**Medium to high**	**High**	**High**	**Medium**	**High**	**Medium salinity**
Poland	Wheat	No info	Machinery, high use of fertilizers and other chemicals	**Low**	**High**	**High**	**Medium**	**High**	**Low salinity**
Poland	Rye	Wide range of soil types low fertility, salinity	Machinery, high use of fertilizers and other chemicals	**Medium**	**Low**	**High**	**Medium**	**High**	**Low salinity**
Poland	Rapeseed	No info	Machinery, high use of fertilizers and other chemicals	**Medium**	**Low**	**High**	**Medium**	**High**	**Low salinity**
Czech Republic	Rapeseed	No info	Machinery, high use of fertilizers and other chemicals	**Medium**	**Low**	**High**	**Medium**	**High**	**Low salinity**

UK	Sugar beet	No info	Machinery, high use of fertilizers and other chemicals	**Medium**	**Low**	**High**	**Medium**	**High**	**Low salinity**
UK	Rapeseed	No info	Machinery, high use of fertilizers and other chemicals	**High**	**Medium**	**High**	**Medium**	**High**	**Low salinity**

Appendix XIV Air quality impacts from biofuel production

The biofuel supply chain can emit air pollutants in every stage from growing feedstocks (e.g., dust from clearing land, smoke from burnings, nitrogen from fertilizers), to transporting feedstocks and refined product (e.g., vehicle emissions and dust generation), to processing (e.g., industrial systems emissions), to use (e.g., combustion)[III]. The types and impacts of the emitted pollutants depend on the local context, including activity causing the emissions, proximity to population centres, sensitivity of ecosystems, concentrations of the pollutant, topography, and meteorology.

This analysis will identify the major pollutants in feedstock production and processing for biofuels in the EU and identify the factors that affect the concentration of those pollutants in the atmosphere and which of those factors are present in the regions supplying significant amounts of EU biofuels. Additionally, existing provisions to mitigate those threats will be identified, and how the magnitude of the threats has changed since the baseline report will be discussed.

Methodology

The analysis is divided in the following steps:

- **Step 1** – Identify potential air quality threats at each production stage, by crop;
- **Step 2** – Subjective technical threat assessment by crop and region, considering the presence and frequency of the potential threats;
- **Step 3 –** Adjusted subjective threat assessment accounting for voluntary and legislative measures to address high and medium threats to air quality by country and region and considering the production level for EU biofuels;
- **Step 4 –** Identification of change between the overall threat from 2008 and 2010.

For the purposes of this assessment, the following factors define what constitutes high, medium, and low threats for a given region:

- Concentrations of air pollutants typically resulting from specified management practices and activities;
- Frequency and likelihood of the practice or activity for a specific crop in a region;
- (for Step 3) Legislative and voluntary provisions that may reduce the risk associated with each threat.

There are other factors that would impact the threats that cannot be accounted for in this analysis, such as proximity to residential areas and baseline concentrations of the air pollutants in each region, due to the level of detail of analysis that would be required to identify those factors.

III Note that biofuel combustion (tailpipe emissions) is considered out of the scope since the current sustainability criteria are focused on cultivation and production.

Based on the above factors, the assessment defines the categories as:

- High threat = Without mitigation measures, the risk for air quality is unacceptable due to impacts that disrupt local ecosystems of significantly threaten human health (e.g., such that there are noticeable impacts on community health indicators and/or people are required to spend less time outdoors due to the air pollution that results;
- Medium threat = Without mitigation measures, the factor may result in long term changes to ecosystems or community health; however, the impacts may go unnoticed if monitoring is not conducted;
- Low threat = The threat posed is unlikely to cause noticeable changes to air quality above what is currently viewed as acceptable and would go unnoticed.

Step 1 – Identification of potential air quality threats at each production stage.

The following table illustrates which pollutants are associated with each stage of the biofuel supply chain[112].

112 GHG emissions are outside the scope of this report as there is existing criteria addressing them under the EU RED.

Table 99. Pollutants associated with the various stages of generic biofuels supply chain.

	SO_2	NOx	CO	NH_3	Primary PM	VOC	Benzene	Heavy Metals
Feedstock cultivation[113]	Biomass burning	Application of manure etc to land as fertilizer and volatilization of nitrogen material	Biomass burning	Fertilizer	Land clearing, Residue burning			
Feedstock /biofuel transport	Fuel burning in vehicles	Vehicle exhaust, especially diesel engines	Vehicle emissions, especially around traffic		Vehicle emissions		Vehicle emissions	
Initial Feedstock processing[114]		Boilers using biomass (see DOE, 2009)	Boilers using biomass		Boiler ash and incinerators (PO)	Methane from biogas from liquid waste (PO)		Coal and other fuel combustion
Biorefining[115]	Natural gas or biomass boilers, dryer, flare, biogas firing.	Power plant emissions (natural gas and biomass boilers, dryer, flare, biogas firing). Syngas engines and diesel generators.	Power plant emissions (natural gas and biomass boilers, dryer, flare, biogas firing). Syngas engines and diesel generators.		Feedstock receiving, conveying, grinding. Natural gas or biomass boilers. Wet cooling tower. Dryer, flare, compost piles, biogas firing. Syngas engine or diesel generator.	Fermentation, distillation and wet cake processes, natural gas and biomass boilers, pumps and compressor seals, storage tanks, dryers, flares, compost, biogas firing. Syngas engines and diesel generators		Coal combustion

The following table presents potential threats to air quality from each production stage for the most common specific biofuel feedstocks used in the EU consumed biofuels.

113 Application and impact of fertilizers is included but their manufacture is not.

114 For example, oil palm fruit processing or soybean crushing

115 http://www.arb.ca.gov/fuels/lcfs/bioguidance/biodocs/finalbiorefineryguidenov2011.pdf

Table 100. Potential air quality threats at each production stage for different types of biofuels in the EU.

Crop (kTOE biofuels in EU 2010)	Land Preparation & Post harvest	Cultivation	Harvest	Transportation	Processing
Rapeseed (4,530kTOE)	-Dust during ploughing of land for crop establishment	-High nutrient requirements therefore enhanced N2O emissions risk from high use of fertilizer. compounds. -Requires significant application of pesticides and herbicides	-Wind erosion of soils following harvest if soil remains uncovered	-Emissions from hauling feedstock to facility (vehicle exhaust and dust from roads)	-Potential emissions of particulates during sorting and processing of seed -Potential emissions of VOCs, SOx, hexane, CO and NOx during processing into biodiesel (generally transesterication -Potential emissions of VOCs during subsequent storage of product
Soybean (2,216kTOE)	-Dust from removal of vegetation/ conversion of land, or land preparation in dry seasons -Particulate matter and toxins from burning residues in post harvest.	-Dust from tillage -Vehicle or machine exhaust from mechanized cultivation -N2O from fertilizer	- Vehicle or machine exhaust from mechanized harvest	-Emissions from hauling feedstock to facility (vehicle exhaust and dust from roads)	-Particulate matter from handling of soybeans and mechanical extraction -VOCs during chemical extraction process and oil pretreatment, including methanol and hexane, and during biodiesel reaction process. -Combustion at flare and boiler produces PM, VOCs, HAPs, CO, NOx, SOx -VOCs and HAPs from storage (See NDEQ, 2007)
Oil Palm (976kTOE)	-Dust from removal of vegetation/ conversion of land, or land preparation in dry seasons -Fire hazard from peatland drainage - Fire for land preparation	- Vehicle or machine exhaust from mechanized cultivation -N2O emissions from fertilizer -Agrochemical applications[116]		-Emissions from hauling feedstock to facility (vehicle exhaust and dust from roads)	-Palm oil processing and transesterfication[117]: -ash from nut/fiber separation -flue boiler emissions: smoke and soot (black smoke if palm shell used), PM, N2O, NO2, CO -Incinerators' white smoke from EFBs

[116] Paraquat (gramoxone) is sprayed on oil palm tree as an herbicide. One hour after spraying the paraquat, about 11 mg per kg body weight may be retained on the laborer's skin. Insecticides are also applied. However, these chemicals are less toxic because of their degradability (Pleanjai et.al., 2007).

[117] The extraction process for crude palm oil is not inherently a significant source of air pollution. However, when solid fuel fired steam boilers utilize the fiber and shell material as the fuel and incinerators burn the empty fruit bunches for recovery of potash, there are significant air emissions. The combustion may emit excessive smoke that may cause localized air pollution problems (DOE 1999).

	(clearing biomass) or of drained peatlands produces particulate matter and toxins				-Emissions from effluent -Electricity generation for operations
Sugarbeet (735kTOE)	-Dust from establishment of crops due to wind erosion of soils especially given sugarbeets preference for light soils	-Herbicide and fungicide application especially at early growth stages -Potentially intensive fertliser demands depending on previous rotation and soil fertility with higher N2O levels of emission	-Emissions from harvest machinery Particulate emissions harvesting a root crop plus soil particulates and potential for wind erosion) and practice of ploughing back in top portions of the crop	Emissions from hauling feedstock to facility (vehicle exhaust and dust from roads)	-Potential emissions of particulates during sorting and processing -Potential emissions of VOCs, SOx, CO and NOx during processing into bioethanol - potential emissions of VOCs during subsequent storage of product
Wheat (623kTOE)	-Dust during ploughing of land for crop establishment	-N2O from fertilizer. Particularly high for winter wheat application of pesticides and herbicides, particularly early in the season	-Wind erosion and production of particulates during harvest esp if ground left uncovered Burning of straw/stubble	-Emissions from hauling feedstock to facility (vehicle exhaust and dust from roads)	-potential emissions of particulates during sorting and processing - potential emissions of VOCs, SOx, CO and NOx during processing into bioethanol - potential emissions of VOCs during subsequent storage of product
Maize (490kTOE)	-Dust during ploughing of land for crop establishment	-Row crop, therefore potential for wind erosion, especially given its preferred habit i.e. relatively high temperatures, hence particulates - N2O from fertilizer -Agro chemical application	-Burning of stubble -Wind erosion leading to particulates if land is left uncovered i.e. stubble removed and no cover crop -Emissions from machinery harvesting the crop	-Emissions from hauling feedstock to facility (vehicle exhaust and dust from roads)	-Potential emissions of particulates during sorting and processing -Potential emissions of VOCs, SOx, CO and NOx during processing into bioethanol - potential emissions of VOCs during subsequent storage of product
Sunflower (438kTOE)	-Dust during ploughing of land for crop establishment – although on-	-Row crop, potential for wind erosion and particulates -Harrowing	-Application of chemicals for artificial desiccation process to allow	-Emissions from hauling feedstock to facility (vehicle exhaust and	-Potential emissions of particulates during sorting and processing of seed -Potential emissions of

	going risk will depend on whether annual or perennial crops are grown	during early establishment can lead to soil disturbance and wind erosion -N2O from fertilizer -Agro-chemical application especially at early stages of production	drying ahead of on phase harvesting -Particulates from wind erosion if soil left uncovered -Emissions from harvest machinery	dust from roads)	VOCs, SOx, hexane, CO and NOx during processing into biodiesel -Potential emissions of VOCs during subsequent storage of product
Sugarcane (336kTOE)	-Dust from removal of vegetation/ conversion of land, or land preparation in dry seasons	-Dust from tillage -Vehicle or machine exhaust from mechanized cultivation -Nitrous oxide (N2O) from fertilizer	-Particulate matter and toxins from pre-harvest cane burning - Vehicle or machine exhaust from mechanized harvest	-Emissions from hauling feedstock to facility (vehicle exhaust and dust from roads)	-Particulate matter and NOx from bagasse boilers (more emissions for more inefficient boilers) (See Goldemberg, 2008)
Rye (81kTOE)	-Dust during ploughing of land for crop establishment	-N2O from fertilizer, Application of agro chemicals	-Emissions associated with harvest machinery -Particulates from exposed soil due to wind erosion	Emissions from hauling feedstock to facility (vehicle exhaust and dust from roads)	-Potential emissions of particulates during sorting and processing -Potential emissions of VOCs, SOx, CO and NOx during processing into bioethanol -Potential emissions of VOCs during subsequent storage of product

Step 2 – Subjective technical threat assessment by crop and region, considering the presence and frequency of the potential threats

Preliminary results in key countries indicate that generally the greatest threats to air quality are associated with burning; there is burning of crop residues, of sugarcane pre-harvest, for clearing vegetation from land, or as a result of clearing lands. Burning creates smoke and haze which are full of particulate matter and other pollutants which may damage respiratory systems and limit visibility. High threats are also associated with some applications of agrochemicals, areas highly vulnerable to wind erosion, and gaseous emissions from processing facilities. Agricultural production in Europe is known to be an important source of PM10 particularly in rural areas and to contribute the vast majority of Ammonia emissions in Europe i.e. 94% in 2009[118]. For the most part, emissions from the transportation stage are unknown as it is dependent on transport distances and methods which are highly variable.

[118] European Environment Agency http://www.eea.europa.eu/publications/air-quality-in-europe-2011

The exact impacts from each country are not known, and therefore only the potential threats based on known practices can be presented. In the cases where specific impacts of an activity within a country or region could not be identified, the typical impact of that activity is assumed. A detailed breakdown with explanations of the factors resulting in the specific threat characterization is included below by country and region and addressing the amount that is used for biofuels in the EU.

Rapeseed (for 4,530kTOE EU biodiesel, primarily from the EU, Ukraine, Canada, and Russia)

Rapeseed production may produce air pollution such as dust from land preparation and erosion of post-harvest, uncovered soils. Rapeseed protection is based on chemical weed, pest and disease control and rapeseed has high nutrient requirements. There are therefore potential risks associated with the volatilization of these compounds depending on the nature of application processes. At the processing facility, air emissions may come from sorting and processing seeds and VOCs from product storage.

Rapeseed is widely grown throughout the EU (in all but three Member States) covering more than 60 per cent of the area covered by oil crops. Rapeseed has relatively high nutrient requirements with winter rapeseed having one of the highest demands for nitrogen fertilizer. As a consequence there is a high potential of nitrogen emissions associated with production, depending upon the effectiveness/efficiency of fertiliser application.

In Ukraine and Russia, due to the state of agriculture, there is less modern and less efficient technology used for farming compared to much of the EU. Industrial infrastructure is aging and energy inefficient[119] and since the 1990s, fertilizer and agrochemical use decreased significantly. In Ukraine, between 2003 and 2008 there was a sharp increase in area used to grow rapeseed (from 54,000ha planted in 2003 to 1.2 million in 2008).[120] However, it is a risky crop to grow in Ukraine and planted area has again decreased.

Canada's rapeseed (Canola) is grown in the Western Prairie regions. Agriculture in Canada has become increasingly more resource efficient, resulting in relatively low fertilizer emissions.

To the extent possible, these risks for each region are categorized as high, medium, and low in the following table.

[119] Ukraine reference
[120] http://ec.europa.eu/agriculture/publi/map/03_09_fullreport.pdf

Table 101. Potential threats from rape cultivation.

	Planted area used for EU biodiesel supply 2010	Key risk factors linked to practices and processes: Land Preparation and Post- harvest	Cultivation	Harvest	Transport.	Processing
EU 27		Risk associated with emissions primarily of particulates during ploughing and establishment – will depend on the nature of the soil and climatic conditions and potential adoption of low till systems	High risk associated with emission of nitrogen compounds and volalilisation of chemicals if not appropriately applied or stored	Potential emissions of particulates depending on approach to harvest and treatment of residues	Difficult to assess as it is not specific to rapeseed impacts. Will depend on emissions from transport and distance to processing plant for which there is no data.	-Handling, storage, and processing emissions
-France	618,732ha 3.2% of cropland 42.2% of rapeseed planted area					
-Germany	595,438 ha 5% of cropland 41% of rapeseed planted area					
-Poland	176,393 ha 1.3% of cropland 23% of rapeseed planted area					
-Czech Republic	175,566ha 5.4% of cropland 47.6% of rapeseed plantings area					
-UK	80,998ha 1.3% of cropland 12.4% of rapeseed planted area					
Ukraine *-Forest Steppe* *-Steppe*	262,779ha 0.8% of cropland 30.5% of rapeseed planted area	Risk associated with emissions primarily of particulates during ploughing and establishment – will depend on the nature of the soil and climatic conditions and potential adoption of low till systems. Likely to replace other crops.	Within the feedstock production, most air pollution associated with fertilizers. Fertilizer and agrochemical use is low. Tillage practices unknown	Machinery used is old and inefficient.	Difficult to assess as it is not specific to rapeseed impacts. Will depend on emissions from transport and distance to processing plant for which there is no data.	Energy inefficient industries that use aging equipment.
Canada *-Saskatchewan (42%)*	207,393ha 0.4% of cropland 3.2% of	Some areas of PM concentrations associated with land preparation.	Low fertilizer emissions in rapeseed growing regions.	Some areas of med-high PM associated with harvest	Difficult to assess as it is not specific to rapeseed impacts. Will	-Handling, storage, and processing emissions

	Planted area used for EU biodiesel supply 2010	Key risk factors linked to practices and processes Land Preparation and Post- harvest	Cultivation	Harvest	Transport.	Processing
-Manitoba (21%) *-Alberta (36%)*	rapeseed planted area		Increasingly using more efficient fertilizer application and production methods. Some areas have med-high PM from wind erosion. High prevalence of no-till and conservation tillage.	practices.	depend on emissions from transport and distance to processing plant for which there is no data.	
Russia *-Orel Region* *-Krasnodar Region* *-Rostov Region (13%)*	128,662ha 0.1% of cropland 21.2% of rapeseed planted area	Unknown	Conventional cultivation equipment used, which is in poor condition. Agrochemical usage unknown	Conventional harvest equipment is used which is in poor condition.[121]	Difficult to assess as it is not specific to rapeseed impacts. Will depend on emissions from transport and distance to processing plant for which there is no data.	-Handling, storage, and processing emissions

Soybean (for 2,216kTOE EU biodiesel, primarily from Argentina, Brazil, United States, Paraguay)

In many countries, soybean residues are burned post-harvest, which is a high level threat for air quality because of the smoke and particulate matter which may lead to respiratory problems and cause haze. There is no burning in Argentina, but there is some in Brazil, the United States, and Paraguay. Dust may also be generated from removal of vegetation to clear lands for initial crop production, from tillage, from vehicle or machine exhaust in cultivation and harvest, from transport on dry roads, and from handling soybeans and mechanical extraction of the oil at the soybean oil processing stage. Other air pollutants come from machine and vehicle exhaust, fertilizer production and application, and soybean storage.

The risk to air quality depends on how many of these practices are employed, especially whether residues are burnt. This may be mitigated through burning alternatives and regulations controlling the timing when burning takes place. Pesticide spraying near communities can also have significant health impacts to those exposed, which is concern in some parts of Argentina (Tomei, 2009).

[121] http://www.fas.usda.gov/pecad2/highlights/2005/03/Russia_Ag/index.htm

Table 102. Potential threats from soybean cultivation.

	Planted area used for EU biodiesel supply 2010	Key risk factors linked to practices and processes				
		Land Preparation and Post harvest	Cultivation	Harvest	Transport.	Processing
Argentina -*Pampas*	867,795ha 2.7% of cropland 4.8% of soybean planted area	No burning.	Highly mechanized. 85% no till. Pesticide spraying. Mineral fertilizer applied to 30% of area.[122]	Highly mechanized	Unknown	-Handling, storage, and processing emissions
Brazil -*South-Central* -*Center-West*	300,353ha 0.4% cropland 1.3% soybean planted area	Burning is practiced, although decreasing.	Mineral fertilizer used.[123] More than half grown under no-till.	Mechanization	Unknown	-Handling, storeage, and processing emissions
USA -*Midwest* -*Central Atlantic* -*Delta*	160,127ha 0.1% of cropland 0.5% of soybean planted area	Some burning.	Use of machinery, but generally reduced tillage. Mineral fertilizer used.[124]	Mechanized harvest.	Unknown	Processing soybean oil.
Paraguay -*Alto Parana (30%)* -*Canindeyu (22%)* -*Itapua (20%)* -*Caaguazu (12%)*	140,376ha 3.5% of cropland 5.3% of soybean planted area	Rapid expansion, some into forest, including through slash and burn of forest (until 2004). Burning unknown	Fumigation of plantations reported health concerns. Mineral fertilizer use 80% produced under no-till.	Practices unknown	High fossil fuel requirements for transportation and for exporting.	Paraguayan soybeans are exported as beans and not processed in country.

Palm oil (for 976kTOE EU biodiesel, primarily from Indonesia and Malaysia)

In 2010, the EU increased its use of biodiesel from palm oil grown in Indonesia and Malaysia. The most significant potential air quality threats associated with this production have to do with burning (to clear lands and unintentional burns resulting from peatland drainage and deforestation), resulting in haze and health hazards. Burns in Indonesia cause severe haze in nearby countries that have partially motivated international response. Other serious air impacts may occur from agrochemical application, especially for workers applying the chemicals, and palm oil processing emissions (ash from nut/fiber separation, smoke and soot and other pollutants from the flue boiler, smoke from burning EFBs, and effluent emissions).

[122] In 2002/3, the average fertilizer application where applied, according to FAO, was 2kg/ha N, 6kg/ha P, and no K.
[123] In 2002, according to the FAO, the average fertilizer application for soybeans in Brazil was 8kg/ha N, 66kg/ha P, and 62kg/ha K.
[124] 70% of area used fertilizer in 1998. Those areas applied 30kg/ha N, 60kg/ha P, and 95kg/ha K. *Reference: Fertistat.*

Processing occurs relatively near to the oil palm trees so the transportation emissions are relatively low.

Table 103. Potential threats from oil palm cultivation.

		Key risk factors linked to practices and processes				
	Planted area used for EU biodiesel supply 2010	**Land Preparation and Post harvest**	**Cultivation**	**Harvest**	**Transport**	**Processing**
Indonesia	56,672ha 0.1% of cropland 1.1% of oil palm planted area	Planned and unintentional burnings. Replanting to replace forest or old rubber or oil palm stands traditionally involves felling and burning.[125] Mechnaization of land clearing. Plantings may replace forest.	Agrochemical application.	Manual	Short distances	Ash, smoke, soot, effluents, etc.
-Sumatra	*80% of total plantings*					
-Kalimantan	*17%*					
Malaysia	11,954ha 0.2% of cropland 0.3% of oil palm planted area	Planned and unintentional burnings. Replanting to replace forest or old rubber or oil palm stands traditionally involves felling and burning. Zero-burning replantiing techniques becoming more prevalent.[126] Some mechanization of land clearing. Plantings may replace forest.	Agrochemical application, although on average, more efficient application compared with Indonesia.	Manual	Short distances	Ash, smoke, soot, effluents, etc.
-Peninsular Malaysia	*56% of total plantings*					
-Sabah	*35%*					
-Sarawak	*9%*					

Sugar beet (for 735kTOE EU bioethanol, primarily from the EU)

Sugar beet is produced in commercial quantities in 19 of the EU-27 Member States. The greatest areas under beet production are found in Germany and France, with the greatest planted area found in Germany. Sugar beet is a root crop, meaning that it requires significant disturbance to extract it from the soil during harvest, hence the potential risks associated with wind erosion. This may also be exacerbated by its tendency to prefer relatively light/medium soils.

In terms of fertilizer requirements, sugar beet is highly demanding depending on soil and preceding crop type. Herbicides and fungicides are used to control weeds and

[125] http://www.croplifeafrica.org/uploads/File/publications/263_PUB-BR_2005_09_01_Conservation_technologies_-_Managing_Natural_Resources_Sustainably.pdf

[126] http://www.croplifeafrica.org/uploads/File/publications/263_PUB-BR_2005_09_01_Conservation_technologies_-_Managing_Natural_Resources_Sustainably.pdf

disease during early stages of development.

Table 104. Potential threats from sugarbeet cultivation.

		Key risk factors linked to practices and processes				
	Planted area used for EU biodiesel supply 2010	Land Preparation and Post harvest	Cultivation	Harvest	Transportation	Processing
EU 27		Dust from establishment of crops due to wind erosion of soils esp given sugarbeets preference for light soils	Herbicide and fungicide application esp at early growth stages Potentially intensive fertliser demands depending on previous rotation and soil fertility, hence risk of nitrogen compound emissions.	Emissions from harvest machinery. Particulate emissions due to the need to harvest a root crop (hence soil particulates and potential for wind erosion) and practice of ploughing back in top portions of the crop	Difficult to assess, not specific to sugarbeet, impact will depend on emissions from transport and distance to processing plant for which there is no data	
-France	59,516ha 0.3% of cropland 15.5% of sugarbeet planted area					
-Germany	20,525ha 0.2% cropland area 5.6% of sugarbeet planted area					
-Italy	7,357ha 0.1% of cropland 11.7% of sugarbeet planted area					
-UK	1,037ha 0.0% of cropland 0.2% of sugarbeet planted area					

Wheat (for 623kTOE EU bioethanol, primarily from the EU)

Wheat[127] is widely grown across the EU in all 27 Member States with the largest areas under cultivation in France, Germany, Poland, Romania and the United Kingdom.

Wheat is highly susceptible to pests and diseases, particularly during the early growing phases. Seed treatment can be an effective means of preventing diseases during early stages but the application of pesticides and herbicides are required throughout the early growing season.

In general terms winter wheat requires more nitrogen fertilizer than summer wheat. Winter wheat grown for good quality grain production has greater nitrogen requirements than winter wheat grown for other purposes.

[127] A large variety of wheat is grown in the EU however the two most important varieties are common wheat (Triticum vulgare) and hard wheat (Triticum durum).

Table 105. Potential threats from wheat cultivation.

		Key risk factors linked to practices and processes				
	Planted area used for EU biodiesel supply 2010	**Land Preparation and Post harvest**	**Cultivation**	**Harvest**	**Transportation**	**Processing**
EU 27		Dust during ploughing of land for crop establishment	Application of fertlisers leading to emission of nitrogen based compounds – particularly high for winter wheat Application of pesticides and herbicides particularly early in the season	Wind erosion and production of particulates during harvest esp if ground left uncovered/ stubble removed Burning of straw/stubble	Difficult to assess, not specific to wheat, impact will depend on emissions from transport and distance to processing plant for which there is no data	
-France	101,748ha 0.5% of cropland 1.9% of wheat planted area					
-Spain	26,812ha 0.2% of cropland 1.4% of wheat planted area					
-Poland	22,618ha 0.2% of cropland 0.9% of wheat planted area					
-Czech Republic	17,164ha 0.5% of cropland 2.1% of wheat planted area					

Maize (for 490kTOE EU bioethanol, primarily from the EU and US)

Being a photophilic (light demanding) crop it is important to ensure that maize plants are grown sufficiently far apart in order to allow light to reach each plant equally. This results in relatively wide row widths, which have implications for exposed soils at risk of erosion.

Weed reduction in maize is carried out by both mechanical and chemical means. Disease control is recommended through the use of rotations and effective crop management but is also dealt with using chemical products. In some locations, the stubble remaining after corn harvest is burned.

Maize is grown in significant quantities in only 18 of the 27 EU Member States with Romania, France and Hungary having the most planted area. Maize is the main source of bioethanol produced in the United States, of which the EU imported significant quantities in 2010. In terms of fertilizer requirements, maize requires half of the total amount of its nitrogen demand in the period from flowering to full maturity. However, the application of fertilisers depends on soil fertility, nutrient content, moisture content, the aim of production and the expected level of yield. For example nitrogen collection depends on the temperature.

Table 106. Potential threats from maize cultivation .

	Planted area used for EU biodiesel supply 2010	Key risk factors linked to practices and processes: Land Preparation and Post harvest	Cultivation	Harvest	Transportation	Processing
EU 27		Dust during ploughing of land for crop establishment. Residue burning.	- Row crop – therefore potential for wind erosion, especially given its preferred habit ie relatively high temperatures, hence particulates - Emissions of nitrogen compounds linked to fertilisation -agro chemical application - potential particulates due to need for ploughing and harrowing during establishment stages leading to bare soils.	- wind erosion leading to particulates if land is left uncovered ie stubble removed and no cover crop - emissions from machinery harvesting the crop	Difficult to assess, not specific to maize, impact will depend on emissions from transport and distance to processing plant for which there is no data	
-France	27,658ha 0.1% of cropland 1.8% of maize planted area					
-Poland	21,881ha 0.2% of cropland 7.3% of maize planted area					
-Spain	8,111ha 0.0% of cropland 2.5% of maize planted area					
United States	33,342ha 0.0% of cropland 0.1% of maize planted area	Dust during ploughing of land for crop establishment and other machinery for land preparation. Some residue burning	Wind erosion of expsed soils between rows. Seeding machines make insecticides airborne and threaten bees. - Emissions of nitrogen compounds linked to fertilisation -agro chemical application - potential particulates due to need for ploughing and harrowing during establishment stages leading to bare soils.	Mechanised harvest. Wind erosion from uncovered lands	Difficult to assess, not specific to maize, impact will depend on emissions from transport and distance to processing plant for which there is no data	Chemicals and particulate matter from the processing facility.
-Midwest (62%)						
-South						
-Northeast						

Sunflower (for 438kTOE EU biodiesel, from the EU)

Fourteen Member States in the EU grow sunflowers in significant quantities with the main areas of production largely confined to southern and Mediterranean Member States. However, there are significant areas of production in the Czech Republic and Romania as well. As a row crop, sunflowers present a greater risk of erosion during establishment and growth, assuming cover crops or other soil management techniques are not applied.

Sunflowers are nutrient demanding, and in comparison to rapeseed require almost twice as much nitrogen and potassium which increases the potential for N_2O release.

Table 107. Potential threats from sunflower cultivation.

		Key risk factors linked to practices and processes				
	Planted area used for EU biodiesel supply 2010	Land Preparation and Post harvest	Cultivation	Harvest	Transportation	Processing
EU 27		Dust during ploughing of land for crop establishment – although ongoing risk will depend on whether annual or perennial crops are grown	- Row crop – therefore potential for wind erosion, hence particulates - Harrowing during early establishment potentially leading to soil disturbance and wind erosion Emissions of nitrogen compounds linked to fertilisation -agro chemical application esp at early stages of production	- application of chemicals for artificial desiccation process to allow drying ahead of on phase harvesting - particulates from wind erosion if soil left uncovered - emissions from harvest machinery	Difficult to assess, not specific to sunflower, impact will depend on emissions from transport and distance to processing plant for which there is no data	
-France	314,219ha 1.6% of cropland 45.2% of sunflower planted area					
-Spain	32,392ha 0.2% of cropland 4.6% of sunflower planted area					

Sugarcane (for 336kTOE EU bioethanol, primarily from Brazil)

Despite significant changes to harvesting green cane, in many sugar cane growing regions burning pre-harvest is the dominant source of air pollution. Other air pollution may come from agricultural activities, such as dust generated from removal of vegetation or tillage, fertilizer emissions, and exhaust from vehicles and machinery. Additionally, sugar mills and ethanol refineries using bagasse boilers emit particulate matter and NOx with the amount dependent on their technology (older plants tend to be worse than newer plants).

Whether pre-harvest burning is practiced is the main factor in determining air quality risk, which may cause health problem due to the particulate matter. Tsao (2012) carried out a lifecycle analysis of sugarcane ethanol air emissions in Brazil, producing calculations of the amount of air emissions from key life cycle activities. The results are shown in the following figure (Figure 169) and indicate burning is the dominate source of most air pollutants.

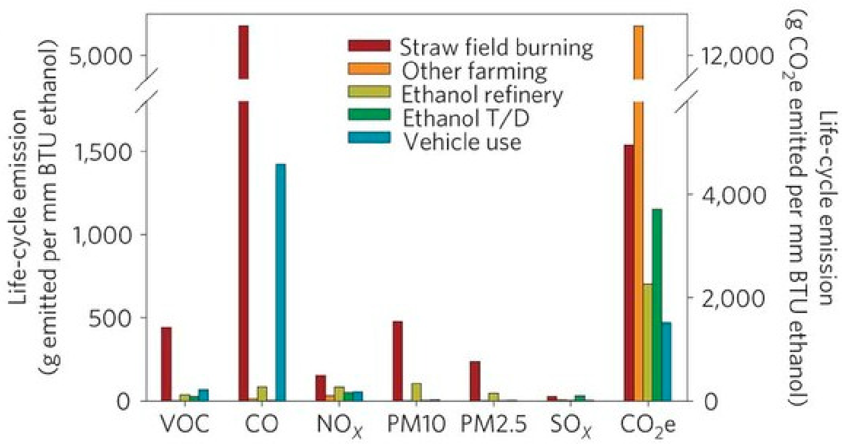


Figure 169. Sugarcane ethanol air emissions in Brazil.

Table 108. Potential threats from sugarcane cultivation.

		Key risk factors linked to practices and processes				
	Planted area used for EU biodiesel supply 2010	Land Preparation and Post harvest	Cultivation	Harvest	Transportation	Processing
Brazil	73,959ha 0.1% of cropland 0.8% of sugarcane planted area	Unknown	Conventional Tillage dominant. Mineral fertilizer applied.128	In 2007, 40% no burn harvest in the State of Sao Paulo. This was forecast to reach 50% in 2010 (Goldemberg, 2008). Some mechanized harvest	Short transportation distances from field to processing.	
-South-Central	90% of sugarcane produced					
-Northeast	10%					
Peru	5,199ha 0.1% of cropland 6.6% of sugarcane planted area	Unkown	Unknown	Preharvest burning	Short transportation distances from field to processing.	
-La Libertad	51% of sugarcane produced					
-Lambayeque	27%					
-Lima	15%					

Rye (for 81kTOE EU bioethanol, primarily from the EU)

Rye for EU biofuels is grown mostly in northern EU Member States, with Germany, Poland and Denmark producing the greatest quantity[129]. However the greatest areas sown to Rye crops are from Germany, Poland and Spain.

Rye can suffer from a large number of diseases during the growing phase and as such requires the application of disease prevention chemicals prior to sowing. Fertiliser requirements for Rye depend on a range of factors such as soil quality, weather conditions, the production technology and the expected or desired yield.

[128] In 2002, according to the FAO, the average fertilizer application for sugarcane in Brazil was 55kg/ha N, 51kg/ha P, and 110kg/ha K.
[129] total output in tonnes of crop per year

Table 109. Potential threats from rye cultivation.

	Planted area used for EU biodiesel supply 2010	Key risk factors linked to practices and processes				
		Land Preparation and Post harvest	Cultivation	Harvest	Transportation	Processing
EU 27		Dust during ploughing of land for crop establishment	Fertiliser application hence nitrogen compounds, however more adaptable than other cereal varieties to different conditions. Application of agro chemicals	Emissions associated with harvest machinery Particulates from exposed soil due to wind erosion	Difficult to assess, not specific to rye, impact will depend on emissions from transport and distance to processing plant for which there is no data	
-Poland						
-Germany						

The results show that soybean, palm oil, maize, and sugarcane have the highest overall potential threats, largely due to the presence of burning as part of their production (land preparation and post harvest). In the cultivation stage, all of the crops have high or medium threats associated with the volatization of nitrogen compounds from fertilizers, and in some countries air pollution from volatization of other agrochemicals raise the threats. While information on the air pollution associated with the processing stage was not obtained for many of the countries, it is assumed from general knowledge that processing facilities have a medium or high threat, depending on the control of gaseous emissions and emissions associated with other waste streams at the facilities.

Step 3, detailed adjusted assessment by crop and region:

Addressing medium and high threats in the EU

In step 2, the threats to air considered to be medium to high in the EU were primarily emissions from nitrogen compounds and facilities for processing oil and biofuels, as well as some potential burning. Within the EU agricultural production is considered to be a significant source of PM10 emissions (accounting for approximately 300Gg/year in 2008[130]) and of Ammonia emissions (according to EEA figures, accounting for 94% of EU emissions in 2009). Additionally, for certain crops there were air threats related to the harvesting of root crops (sugarbeet), early application of pesticides and herbicides (wheat), wind erosion from exposed soils for row crops, residue burning (maize) and chemical application for preharvest drying (sunflower).

Regulation of air emissions from crop production: Within the EU, in order to ensure a minimum level of protection for the environment, the system of cross-compliance requirements was introduced where by farmers receiving the 'Single Farm Payment'

[130] Diagram page 26 EEA report – air quality in Europe 2009 - http://www.eea.europa.eu/publications/air-quality-in-europe-2011

scheme must comply with certain requirements or face a reduction/complete loss of payments. As part of these requirements there are Statutory Management Requirements (SMRs) and a set of standards of Good Agricultural and Environmental Condition (GAEC), which are additional requirements relating to soil erosion, soil structure, soil organic matter and the minimum maintenance of habitats but which are determined at the country level.

In terms of the protection of air quality during cultivation, cross compliance provides the primary regulatory mechanisms for the protection of air. Importantly, cross-compliance requires compliance with the nitrates Directive. Although intended for the protection of watercourses, this actually offers one of the key mechanisms for controlling the application of nitrogen based material to land, hence overall quantities of nitrogen compounds applied. However, it should be noted that controls focus on nitrate vulnerable zones based on the assessment of water risk. The effectiveness of this measure in controlling emissions from manure and fertilisers to air is therefore limited to where this overlaps with water concerns.

More generally GAEC requirements consider soil management including management of crops to minimse exposure of soils and wind erosion and stubble management (including prohibition of burning)[131]. However, GAEC is determined at the national level meaning that there is no one set of principles that govern the management of air emissions from agricultural production. Collectively, these measures reduce the threats from medium and high to low and medium.

Regulation of air emissions from industrial plants: The protection of air quality is highly regulated at the EU level, in particular that from industrial plant given the potential impact upon the internal market of different Member States operating to different standards of environmental protection. Large scale EU biorefineries in the EU would be covered by the requirements of the Industrial Pollution Prevention and Control Directive[132], to be replaced by the Industrial Emissions Directive[133] as of January 2014. Biorefineries are covered under the following category of industrial plant within the relevant Directives ie Annex 1, 1.4 Gasification or liquefaction of: (a) coal; (b) other fuels in installations with a total rated thermal output of 20 MW or more. Under the auspices of the Directives such installations would receive an environmental permit from the relevant Member State controlling their emissions to air (water and land).

For smaller scale plants, the EU does not set direct regulatory requirements. However, air quality limit values established under the Air Quality Framework Directive[134] have to be complied with by Member States. It is up to the Member State how this is delivered; in the UK, for instance, Local Air Pollution Control / Local Air Quality Management (LAQM).

---

131 http://ec.europa.eu/environment/soil/pdf/final_report.pdf
132 Directive 2001/1/EC – codified version - http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:024:0008:0029:EN:PDF
133 Directive 2010/75/EC - http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:334:0017:0119:EN:PDF
134 Directive 2008/50/EC on ambient air quality and cleaner air for Europe, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:152:0001:0044:EN:PDF

For small plant dealing with waste processing additional requirements will applying requiring the management of emissions from processing and storage. At the EU level the overarching principles of permitting and control are set out in the waste framework Directive[135]. However, specific approaches to the application of environmental permits would be left up to the Member States based on an assessment of risk. In the UK, as an example, Waste Management Licensing Regulations (EP Regulations) would be applicable, whereby small-scale plants (<5000 litres of waste cooking oil) are deemed low-risk and hence exempted[136].

Addressing medium and high threats outside of the EU

The highest threats in the non-EU countries in this study are related to burning: burning to clear and prepare land, burning of residues, preharvest burning of sugarcane, and accidental burns resulting from land clearing. Burning is associated with soybeans, palm oil, maize, and sugarcane. Additional high threats are pesticide and agrochemical spraying; wind erosion, especially in row crops; feedstock processing, especially where industry is inefficient, equipment is aging, and environmental controls of the plants may be absent; intensive use of cultivation and harvist machinery, especially where the machinery may be aging and inefficient; nitrogen compounds and other emissions associated with fertilizer; and areas where the crops are produced on land that was converted from forests or high vegetation land cover.

The table below (Table 110) shows each of the non-EU countries' medium and high risks and which legislative measures may address them along with the potential to enforce that. Potential to enforce is based on Transparency International's Corruption Perception Index, the Global Integrity Report's Global Integrity Index, the Economist Intelligence Unit's Democracy Index, and the World Justice Department's Rule of Law Index's Regulation Enforcement score. The ranking of 'low' is given if two or more of the indicators are below 50% the score, 'high' is two or more above 80% of the score, and 'medium' is everything else. See the section on existing provisions for a more in depth explanation of the provisions.

[135] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:312:0003:0030:EN:PDF
[136] See Defra guidance document: http://archive.defra.gov.uk/environment/quality/pollution/ppc/localauth/pubs/guidance/notes/aqnotes/documents/aq06-08-biofuel-production-guide.pdf

Table 110. Overview of threats for air emissions, provisions, enforcement potential and effect on overall threat level.

Region	Threat	Existing provisions addressing threat	Potential to enforce	Effect on overall threat level
-**Argentina** (1,198kTOE)	-Highly mechanized cultivation and harvest of soybeans and aerial spraying of agrochemicals	-General Environmental Law -Rountable on Responsible Soy (voluntary sustainability certification) -SAN/RA (voluntary sustainability certification) -AAPRESID (national voluntary sustainability certification)	Medium	**Remains the same** (for production covered by voluntary certifications, threat is reduced, but this is a small fraction)
	-Soybean oil processing facilities	-General Environmental Law		**Remains the same**
-**Indonesia** (774kTOE)	-Planned and unintentional burnings.	-Minister of Forestry and Plantations Decree No 376/Kpts-II/1998: Decision on criteria relating to forest conversion for oil palm plantations And Decision on restrictions on area of logging concession rights and plantations - Ministry of Forestry and Plantation Revolved Letter No.603/Menhutbun-VIII/2000 joint MoF Letter No. 1712/Menhut-VII/2001 -ISCC, SAN/RA, and RSPO (voluntary sustainability certifications)	Medium	**Remains the same**
	-Agrochemical application	-1992 Law on Cultivation of Plants - 2004 Law 18/2004 on Plantations -Law 32 of 2009 on Environmental Protection and Management -ISCC, SAN/RA, and RSPO (voluntary sustainability certifications)		**Lowers** to the extent enforced (limited enforcement) and depending on coverage of voluntary provisions
	-Processing soot, smoke, ash, etc.	- Law 32 of 2009 on Environmental Protection and Management -ISCC, SAN/RA, and RSPO (voluntary sustainability certifications)		**Potentially will lower** to the extent enforced and depending on coverage of voluntary provisions
-**Brazil** (660kTOE)	-Preharvest sugarcane and soybean residue burning	-Sao Paulo State Law (phase out burning) - Minas Gerais Union of Ethanol Manufacturers protocol to eliminate sugarcane burning -Numerous voluntary sustainability certifications	Medium	**Will lower** once enacted/phase out period occurs
	-Fertilizer and agrochemical emissions and tillage	-Sao Paulo State Environmental Laws -Law No. 7802 on agricultural chemicals and like-substances. -Numerous voluntary sustainability certifications		**Lowers** to the extent enforced
	-Wastes and emissions from soybean oil	-Sao Paulo State Environmental Laws -National Environmental Policy		**Lowers** to the extent enforced

Region	Threat	Existing provisions addressing threat	Potential to enforce	Effect on overall threat level
	processing facilities and ethanol distilleries	-Ordinance No. 323 (Vinasse) -Resolutions No. 0002 (1984) and 0001 (1986) -Numerous voluntary sustainability certifications		
-**United States** (369kTOE)	-Residue burning	-State legislation on burning -ISCC (voluntary sustainability certification)	High	**Lowers**
	-On farm vehicles and machinery and dust from land preparation. Wind erosion from exposed soil of row crops.	-State legislation on machinery and vehicle emissions -1970 Clean Air Act -ISCC (voluntary sustainability certification)		**Lowers**
	-Fertilizer and agrochemical emissions, including airborne pesticides from seeding operations.	-1972 Federal Insecticide, Fungicide, and Rodenticide Act -ISCC -EQIP (voluntary program)		**Lowers**
	-Soybean oil and ethanol processing facilities	-1970 Clean Air Act -National Environmental Policy Act -ISCC (voluntary sustainability certification)		**Lowers**
-Ukraine (280kTOE)	-Fertilizer Use	-1992, 2001 Law on Ambient Air Quality -1995 Law on Pesticides and Agrochemicals -ISCC (voluntary sustainability certification)	Medium	**Remains the same**
	-High polluting industrial equipment	-1992, 2001 Law on Ambient Air Quality -ISCC (voluntary sustainability certification)		**Remains the same**
-Canada (292kTOE)	-PM, VOCs, etc., from soybean handling, storage, and oil procesing	-Environmental Assessment Act -Environmental Protection Act -ISCC (voluntary sustainability certification)	High	**Lowers**
-Malaysia (189kTOE)	-Planned and unintentional burnings.	-Environmental Quality Act (1985, 1996, 1998) -1974 Air Quality Act (original burning ban) -1978 Environmental Quality (Clean Air) Regulation -1998 3rd Amendment to Environmental Quality Act (complete ban on open burning to clear land for oil palm) -2003 Environmental Quality (Declared Activities) (Open Burning) Order PU(A) 460/2003 – additional regulations on open fires. -RSPO and ISCC (voluntary sustainability certifications)	Medium	**Lowers** (high enforcement)
	-Agrochemical application	-Environmental Quality Act (1985, 1996, 1998) -Pesticides Act (1974, 1988, 2004)		**Lowers**

Region	Threat	Existing provisions addressing threat	Potential to enforce	Effect on overall threat level
		-1978 Environmental Quality (Clean Air) Regulation -RSPO and ISCC (voluntary sustainability certifications)		
	-Processing soot, smoke, ash, etc.	-Environmental Quality Act (1985, 1996, 1998) - Environmental Quality Order and Regulations (1977, 1982) regulates effluent discharge from palm oil mills. -1978 Environmental Quality (Clean Air) Regulation -1979 Environmental Quality (Sewage and Industrial Effluents) Regulations -1989 Scheduled Wastes Treatment and Disposal Order -2006 Environmental Quality (Prescribed Premises) (Scheduled Wastes Treatment and Disposal Facilities) Regulations -2009 Environmental Quality (Industrial Effluents) Regulations -RSPO and ISCC (voluntary sustainability certifications)		**Lowers**
-Paraguay (188kTOE)	-Land preparation through slash and burn of forests. -Possible soybean residue burning	-2000 Law 1561 Creating the National Environment System, National Environment Council & Secretary of the Environment (basic environmental oversight) -RTRS (voluntary sustainability certification)	Low-Med (only 2 indicators available)	**Unknown**
	-Fertilizer, agrochemicals, and fumigation used	-2000 Law 1561 Creating the National Environment System, National Environment Council & Secretary of the Environment (basic environmental oversight) -2004 Decree Regulating the Use & Management of Pesticides for Agricultural Use -RTRS (voluntary sustainability certification)		**Unknown**
	-High fossil fuel requirements for transportation	-2000 Law 1561 Creating the National Environment System, National Environment Council & Secretary of the Environment (basic environmental oversight)		**Unknown**
-Russia (124kTOE)	-High polluting cultivation and harvest equipment	-1999 Law on atmospheric air protection" (#96-FZ) -ISCC (Voluntary sustainability certification)	Low	**Unknown**
	-Unknown threat of processing facilities	-1999 Law on atmospheric air protection" (#96-FZ)		**Unknown**
-**Peru** (26kTOE)	-Preharvest sugarcane burning	-2001 National Environmental Standards for Air Quality -2004 National Environmental Management System Law -2005 General Environmental Law	Medium	**Unknown**

Region	Threat	Existing provisions addressing threat	Potential to enforce	Effect on overall threat level
		-ISCC and SAN/RA (voluntary sustainability certification)		
	-Fertilizer and agrochemical emissions	-1998 Environmental Quality Standards and Maximum Permissible Levels -2001 National Environmental Standards for Air Quality -2004 National Environmental Management System Law -2005 General Environmental Law - Over 33 active norms and regulations for agricultural pesticides. -ISCC and SAN/RA (voluntary sustainability certification)		**May lower**
	-Unknown threat of processing facilities	-1998 Environmental Quality Standards and Maximum Permissible Levels -2000 General Law for Solid Wastes -2001 EIA Law -2001 National Environmental Standards for Air Quality -2004 National Environmental Management System Law -2005 General Environmental Law -ISCC and SAN/RA (voluntary sustainability certification)		**Unknown**

Step 4 – Identification of change between the overall threat from 2008 and 2010

Changes in the effects of air impacts associated with EU demand for biofuels depends on changes in agricultural and industrial practices and changes in area of land and volume of feedstock processed/biofuel produced. For the most part, between 2008 and 2010, agricultural and industrial practices will not have changed significantly in any one region. The exception is potentially where new legislation of voluntary programs have been introduced and if there's been a significant change in issues related to enforcement of legislation. Table 111 displays a list of legislation introduced in non-EU countries 2008-2010 which may improve protection of air from the impacts of biofuels production, and an indication of whether enforcement potential of legislation is generally increasing, decreasing, or if there is no trend. The table also shows the percentage and magnitude change in feedstock production for EU biofuels in each country between 2008 and 2010.

Table 111. Changes in legislation and enforcement potential 2008-2010.

Country	Feedstock production for EU change 2008-2010	New legislation 2010 and coverage of voluntary programs 2010-2012	Enforcement potential change (increasing/decreasing/no trend) 2008-2010
-Argentina (1,198kTOE)	Soybeans: +689,795ha +388%	-RTRS certification covers additional 67,500ha and 163,267tonnes soy -ISCC certifies 1 farm, 6 oil mills, 1 refinery, and 4 biodiesel plants (2008 status unknown) -SAN/RA certifies 1 additional supply chain -Additional area certified by AAPRESID unknown, but increasing.	-Global Integrity Index +17/100
-Indonesia (774kTOE)	Palm Oil: -116,328ha -67%	-2009 Law 32 of 2009 on Environmental Protection and Management creates environmental planning procedures and control systems. Places responsibility for pollution, quality standards, strategic environmental assessments, etc. -ISCC certifies additional 17 oil mills, 14 refineries, 4 biodiesel plants. -RSPO certifies 38 additional growers, total coverage comes to 463,786ha and over 2 million MT CSPO.	Only slight changes
-Brazil (660kTOE)	Soybean: +43,353ha +17% Sugarcane: -17,041ha -19%%	-2008 Sao Paulo State Law and 2009 Presidential Decree establishes agro-ecological zoning for sugarcane and ethanol mills, considering environmental risks. -RTRS certification covers additional 78,273ha and 255,946 tonnes soy -Bonsucro certification covers additional 12 sugar mills -SAN/RA certifies 2 additional supply chains -Soja Plus program began in 2010 for environmental and social management -Moratorium on Soybean from Amazon extended past 2008	Only slight changes
-United States (369kTOE)	Soybean: -257,872ha -62% Maize: +33,142ha +16,5751%	-ISCC certified 13 additional ethanol plants and 3 oil mills.	Only slight changes
-Ukraine (280kTOE)	Rapeseed: +48,779ha +23%	-ISCC certified 1 farm and 2 oil mills.	-Global Integrity Index Increased by 6/100 -Democracy Index decreased by 0.6/10
-Canada (292kTOE)	*	-ISCC certified 3 oil mills (2010 status unknown)	Only slight changes
-Malaysia (189kTOE)	Palm Oil: -78,046ha --87%	-2009 Environmental Quality (Industrial Effluents) Regulations adds additional regulation to palm oil industry effluents -ISCC certifies 13 additional oil mills, 2 additional refineries, and 4 additional	-Corruption Perception Index decreases by 0.5/10

		biodiesel plants. -RSPO certifies an additional 62 growers, total covered area comes to 513,730ha and 2.7million MT CSPO. - Agreement on transboundary haze pollution among ASEAN Members which entered into force 2003, was ratified 2010.	
-Paraguay (188kTOE)	*	-RTRS certified 1 producing company, covering 2,765ha and 5,334 tonnes.	Only slight changes
-Russia (124kTOE)	*	-ISCC certified 2 farms (2010 status unknown)	Only slight changes
-Peru (26kTOE)	Sugarcane: +3,119ha +156%		-Global Integrity Index increased 12/100

*Data on 2008 area for EU biofuels is unavailable