GOVERNMENT OFFICES OF SWEDEN

Sweden's first progress report on the development of renewable energy pursuant to Article 22 of Directive 2009/28/EC

Foreword

This report comprises Sweden's first progress report pursuant to Article 22 of Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (the Renewables Directive).

Article 22 of the Renewables Directive requires Member States to submit a report to the Commission on progress in the promotion and use of energy from renewable sources by 31 December 2011, and biannually thereafter. The sixth report, to be submitted by 31 December 2021, shall be the last report required.

As the basis for this report, in its Spending authorization for 2011, the Swedish state energy authority (the Swedish Energy Agency) was entrusted with the task of producing a draft national report on how the promotion and use of energy from renewable resources is being developed pursuant to Article 22 of the Renewables Directive. An account of the task was given on 30 October 2011 and subsequently supplemented with, *inter alia*, updated statistics for 2010. The forecasts and statistics included in this report comprise information belonging to the Swedish Energy Agency.

This report follows the template published by the European Commission in May 2011 as a guide for Member States' progress reports pursuant to Article 22.

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1 Draft national progress report under Directive 2009/28/EC

Overall shares and actual consumption of energy from renewable sources in Sweden (point 1 in the template from the Commission)

1. Sectoral and overall shares and actual consumption of energy from renewable sources in the preceding 2 years (2009 and 2010) (*Article 22(1)(a) of Directive 2009/28/EC*).

The data in Tables 1-1d should be viewed as preliminary and may be adjusted. The data are based on the current version of the calculation tool supplied by Eurostat for Member States' reporting of renewable energy. For 2009, the data correspond to the data Sweden reported to Eurostat. The data for 2010 have not yet been submitted to Eurostat.

Because the system for sustainability criteria was being implemented during the period in question, all biofuels used in Sweden today are included in Tables 1 and 1b-d, that is, all are envisaged to comply with the sustainability criteria. Since the information about the origin and type of feedstock (raw material) for imported biofuels is not yet complete, and in addition it is not yet entirely clear which raw materials for biofuels will be entitled to double-counting (under discussion in the work with sustainability criteria[1]), the principle applied is that we only double-count where we currently have a basis for doing so. This means that only biofuels produced in Sweden from waste, residues, non-food cellulosic material and ligno-cellulosic material have been double-counted here, which includes biogas, HVO (hydrogenated vegetable oil) from crude tall oil, and ethanol from residues from sulphite pulp production (see footnotes to Table 1d). In the next progress report, information about the origin of the raw materials will be available from the actual reporting of the sold sustainable quantities of biofuel in accordance with Act on Sustainability criteria for biofuels and bioliquids *[Lag om hållbarhetskriterier för biodrivmedel och flytande biobränslen*] (SFS 2010:598).

***Table 1*: The sectoral (electricity, heating and cooling, and transport) and overall shares of energy from renewable sources[2]**

	2009	2010
RES-H&C[3] (%)	**64.8 %**	**65.3 %**
RES-E[4] (%)	**58.2 %**	**56.0 %**

[1] An informal group of authorities within the EU is also working on harmonising the classification and double-counting of biofuels from residues and waste.

[2] *Facilitates comparison with Table 3 and Table 4a of the NREAPs.* The data correspond to the data Sweden reported to Eurostat for 2009. The data for 2010 have not yet been submitted.

[3] *Share of renewable energy in heating and cooling: gross final consumption of energy from renewable sources for heating and cooling (as defined in Articles 5(1)(b) and 5(4) of Directive 2009/28/EC divided by gross final consumption of energy for heating and cooling. The same methodology as in Table 3 of NREAPs applies.*

[4] *Share of renewable energy in electricity: gross final consumption of electricity from renewable sources for electricity (as defined in Articles 5(1)(a) and 5(3) of Directive 2009/28/EC divided by total gross final consumption of electricity. The same methodology as in Table 3 of NREAPs applies.*

	2009	2010
RES-T[5] (%)	**At least 7.4 %[a] (6.9 %)[b]**	**At least 8.0 %[a] (7.3 %)[b]**
Overall RES share[6] (%)	**47.3 %**	**47.8 %**
Of which from cooperation mechanism[7] (%)		
Surplus for cooperation mechanism[8] (%)	**6.3 %[c]**	**6.4 %[c]**

[a] Including double-counting of biofuels made from wastes, residues, non-food cellulosic material and ligno-cellulosic material. Note however that only biofuels produced in Sweden from the listed raw materials have been double-counted here (which includes biogas, HVO (hydrogenated vegetable oils) from crude tall oil and ethanol from residues from sulphite pulp production – see Table 1d with footnotes). It is therefore possible that this is an underestimation.

[b] Actual value, without multiplication factors.

[c] For the indicative trajectory, there are values in the Directive for the base year (2005) and then only for 2011–2012. In reality there are no values to compare with for 2009 and 2010. The figures for 2005 and 2011 have been interpolated to determine the values in the table (these have been used to calculate the values in Table 7).

The total share of energy from renewable sources (RES) in Sweden amounted to 47.3 % in 2009 and to 47.8 % in 2010. According to the forecast presented in the National Renewable Energy Action Plan (NREAP) for Sweden, Sweden would not achieve this level until 2015/2016.

Note that the forecast for 2020 (that is, the value for 2020) may be more plausible than individual values on the way, since the values for individual years up until 2020 are interpolated. This is an explanation as to why the forecast from Sweden's National Renewable Energy Action Plan (the Action Plan) for the year 2010 differs from the actual value reported for 2010. It is uncertain whether the increase in renewable energy that has occurred since 2005 will continue. Note also that the method for calculating the share of renewable energy is not yet fully developed, for example, in relation to heat pumps.

From 2005 (as reported in the Action Plan) up until 2010, the amount of renewable energy within heating and cooling rose by around 30 %, the amount of renewable electricity rose by approximately 10 %, and the amount of renewable energy in the transport sector rose by approximately 100 % (including renewable electricity for forms of transport and including double-counting of biogas, ethanol and HVO). Within heating and cooling, it has been primarily industry that has increased its use of biomass (30 % rise in 2010 compared with 2005), but district heating and heat pumps have also contributed to the rise. For electricity, the rise is due to more electricity from biomass and wind power. The rise in the use of biomass is due, *inter alia,* to the cold temperature and increased capacity.

Table 1a: **Calculation table for the renewable energy contribution of each sector to final energy consumption (ktoe)[9]**

	2009	2010
a) Gross final consumption of RES for heating and cooling	8,583	9,752
b) Gross final consumption of electricity from RES	7,075	7,248

[5] *Share of renewable energy in transport: final energy from renewable sources consumed in transport (cf. Article 5(1)(c) and 5(5)of Directive 2009/28/EC divided by the consumption in transport of 1) petrol; 2) diesel; 3) biofuels used in road and rail transport and 4) electricity in land transport (as reflected in row 3 of Table 1). The same methodology as in Table 3 of NREAPs applies.*

[6] *Share of renewable energy in gross final energy consumption. The same methodology as in Table 3 of NREAPs applies.*

[7] *In percentage point of overall RES share.*

[8] *In percentage point of overall RES share.*

[9] *Facilitates comparison with Table 4a of the NREAPs.*

c) Gross final consumption of energy from RES in transport	396[a]	429[a]
d) Gross total RES consumption[10]	16,054	17,429
e) Transfer of RES to other Member States	0	0
f) Transfer of RES from other Member States and third countries.	0	0
g) RES consumption adjusted for target (D)-(E)+(F)	16,054	17,429

[a] Note that this is the actual contribution, not double-counting, and that renewable electricity for forms of transport (see Table 1d) is not included here but in b).

Table 1.b: **Total actual contribution (installed capacity, gross electricity generation) from each renewable energy technology in Sweden to meet the binding 2020 targets and the indicative interim trajectory for the shares of energy from renewable resources in electricity.[11]**

	2009		2010	
	MW	**GWh**	**MW**	**GWh**
Hydro[12]:	16,544	68,326[a]	16,624	68,294[a]
non pumped	16,544	65,852[b]	16,624	66,398[b]
<1MW	135	496[b]	143	545[b]
1 MW–10 MW	788	3,114[b]	798	3,253[b]
>10MW	15,621	62,242[b]	15,683	62,600[b]
pumped	108	125[b]	108	103[b]
mixed[13]				
Geothermal				
Solar:	9	7	9	9
solar photovoltaic	9	7	9	9
concentrated solar power				
Tidal, wave, ocean energy				
Wind power:	1,448	2,485[c]	2,018	3,502[c]
onshore	1285	2219	1,855	3,052
offshore	163	266	163	450
Biomass[14,d]:	3,813[e]	11,411	3,854[e]	12,191
solid biomass	3,796[d e]	11,105[d]	3,832[d e]	11,976[d]
biogas	17	34	22	36
bioliquids		272		17
TOTAL	21,814[e]	82,229[f]	22,506[e]	83,996[f]
of which in CHP	3,813[e]	11,411	3,854[e]	12,191

[a] Normalised, excl. pumped storage.
[b] Not normalised.

[10] *According to Art.5(1)of Directive 2009/28/EC gas, electricity and hydrogen from renewable energy sources shall only be considered once. No double counting is allowed.*
[11] *Facilitates comparison with Table 10a of the NREAPs.*
[12] *Normalised in accordance with Directive 2009/28/EC and Eurostat methodology.*
[13] *In accordance with new Eurostat methodology.*
[14] *Takes into account only those complying with applicable sustainability criteria, cf. Article 5(1) of Directive 2009/28/EC last subparagraph.*

[c] Normalised in accordance with Directive 2009/28/EG and Eurostat methodology this corresponds to 2544 GWh for 2009 and 3800 GWh for 2010.
[d] Includes renewable waste.
[e] Note that this includes the total capacity for household refuse (municipal waste), even though only half is assumed to be comprised of renewables, which is the share reported as the contribution to electricity production.
[f] For hydro, the values are normalised and for wind power they are not normalised.

Table 1c: **Total actual contribution (final energy consumption[15]) from each renewable energy technology in Sweden to meet the binding 2020 targets and the indicative interim trajectory for the shares of energy from renewable resources in heating and cooling (ktoe)[16]**

	2009	2010
Geothermal (excluding low temperature geothermal heat in heat pump applications)		
Solar	10	10
Biomass[17]:	7,780	8,949
solid biomass	7,557	8,713
biogas	82	83
bioliquids	142	153
Renewable energy from heat pumps: - of which aerothermal - of which geothermal - of which hydrothermal	793	793 Because this information is lacking, the same value as for 2009 has been used, which is probably a conservative estimate as the trend has been a rising one.
TOTAL	8,583	9,752
Of which DH[18]	2,567	3,261
Of which biomass in households[19]	1,046	1,046

Note that the information regarding imports in Table 1d should be treated with a certain amount of caution, since the focus of the reports used to compile this data was not to map origin. The uncertainty in these figures may therefore be considerable. Note also that no account has been taken of whether or not the raw material for biofuel production may have been imported, even if the actual production occurred in Sweden. Note also that because only a very small quantity of crops was used for the production of biogas, it is assumed that all biogas for transport is produced from waste (see also footnote to Table 1d).

[15] *Direct use and district heat as defined in Article 5.4 of Directive 2009/28/EC.*
[16] *Facilitates comparison with Table 11 of the NREAPs.*
[17] *Takes into account only those complying with applicable sustainability criteria, cf. Article 5(1) of Directive 2009/28/EC last subparagraph.*
[18] *District heating and / or cooling from total renewable heating and cooling consumption (RES- DH).*
[19] *From the total renewable heating and cooling consumption.*

Table 1d: **Total actual contribution from each renewable energy technology in Sweden to meet the binding 2020 targets and the indicative interim trajectory for the shares of energy from renewable resources in the transport sector (ktoe)[20],[21]**

	2009	2010
Bioethanol/ bio-ETBE	198	203
Of which Biofuels[22] Article 21(2)	At least 1[a]	At least 2[a]
Of which imported[23]	Around 70 %[b]	Around 75 %[b]
Biodiesel	162	178
Of which Biofuels[24] Article 21(2)	0	4[c]
Of which imported[25]	Around 45 %[b]	Around 45 %[b]
Hydrogen from renewables	0	0
Renewable electricity	110	140
Of which road transport	0[d]	0[d]
Of which non-road transport	110	140
Others (as biogas, vegetable oils, etc.) – specified	36 (Biogas)	49 (Biogas)
Of which Biofuels[26] Article 21(2)	36[e]	49[e]
TOTAL	506	569

[a] Note that the information refers only to ethanol from sugar-rich liquor sourced from sulphite pulp production. Source: SEKAB, 2011. Ethanol produced from residues from wine production is also used in Sweden, but its total contribution is unknown, as is the origin of the raw materials (SEKAB however reports a figure for 2010 corresponding to 7 ktoe).

[b] Source: Swedish Energy Agency, 2010. Surveillance report on tax exemption for biofuels for 2009, Swedish Energy Agency, 2011. Surveillance report on tax exemption for biofuels for 2010, Swedish Energy Agency, 2011. In addition, the data on which they were based.

[c] Diesel from crude tall oil (termed HVO). Source: PREEM, 2011.

[d] Note that there is a small number of electric vehicles for road transport in Sweden. At the turn of the year 2010/2011 there were barely 200 electric vehicles, a small number of electric buses and approximately 130 electric lorries.

[e] All biogas for transport is assumed to be produced from waste. The biogas used for transport comes from sewage treatment plants and co-digestion plants that use catering waste, food waste, slaughterhouse waste, manure, slurry and to a lesser extent energy crops. For 2009, there is no reliable information on the amount of crops used for biogas production. The estimate that exists is approximately 3000 tonnes wet weight of energy crops, which comprises 0.2 % of the total amount of substrate used in biogas production in sewage treatment plants and co-digestion plants (Swedish Energy Agency 2010, Production and use of biogas in 2009 [*Produktion och användning av biogas år 2009*], ES2010:05). For 2010, the corresponding figures are around 39,000 tonnes wet weight and 0.6 % (Swedish Energy Agency 2010, Production and use of biogas in 2010 [*Produktion och användning av biogas år 2010*], ES2011:07), and the same assumptions were made for that year.

[20] *For biofuels take into account only those compliant with the sustainability criteria, cf. Article 5(1) last subparagraph.*

[21] *Facilitates comparison with Table 12 of the NREAPs.*

[22] *Biofuels that are included in Article 21(2) of Directive 2009/28/EC.*

[23] *From the whole amount of bioethanol / bio-ETBE.*

[24] *Biofuels that are included in Article 21(2) of Directive 2009/28/EC.*

[25] *From the whole amount of biodiesel.*

[26] *Biofuels that are included in Article 21(2) of Directive 2009/28/EC.*

Instruments and measures for energy from renewable sources (points 2-5 in the template)

2. Measures taken <u>in the preceding 2 years</u> and/or planned at national level to promote the growth of energy from renewable sources taking into account the indicative trajectory for achieving the national RES targets as outlined in your National Renewable Energy Action Plan (*Article 22(1) of Directive 2009/28/EC*).

Note that Table 2 includes only changes in the last two years in the measures listed in Table 5 in Sweden's National Renewable Energy Action Plan, and measures added in the last two years. Measures that have been in place for more than two years and which have not been changed in the past two years can be found in Table 5 of the Action Plan.

Table 2: Overview of instruments and measures that have been changed or added in the past two years. For other instruments, refer to Sweden's National Renewable Energy Action Plan.

Name and reference of the measure	Type of measure*	Expected result**	Targeted group and or activity***	Existing or planned****	Start and end dates of the measure
1. Revision and changed levels of energy taxes. Energy Tax Act *[Lag om skatt på energi]* (SFS 1994:1776), Government bill 2009/10:41	Financial	Fiscal and steering tax designed primarily to reduce energy consumption but also to guide the choice of energy carrier	All types of operations	Complements. Existing and planned adjustments of tax levels	2011 Broadening of the bases for the taxes and uniform tax level for heating fuels. 2011, 2013 raised level for diesel
2. Changed levels in CO_2 taxes. Energy Tax Act (SFS 1994:1776), Government bill 2009/10:41	Financial	Environmental tax,	All activities	Complements. Existing and planned adjustments of tax levels	2010 raised level 2011, 2013, 2015 decreased reduction
3. Changed rules for energy and carbon tax exemption for renewable fuels. Energy Tax Act (SFS 1994:1776), Government bill 2010/11:1	Financial	Promotes the use of bioenergy	All activities	Complements. Planned change in tax exemption up to a certain level of blending (see also point 15 for the connection with sustainability criteria)	2011 limit on tax exemption for biofuels
4. Raised level of ambition in the electricity certificate system. Electricity Certificates Act *[Lag om elcertifikat]* (SFS 2003:113). Clarification of rules and expansion of the system. Electricity Certificates Act (SFS 2003:113).	Financial regulatory	25 TWh of new renewable electricity generation by 2020 compared with 2002 (previously 17 TWh by 2016).	Quota-bound electricity suppliers/consumers and producers of renewable electricity.	Complements existing. Adjustment of quota levels (decided 2010) Clarification of rules and expansion of the system (decided 2011)	From 2013, adjusted quota levels to achieve the raised target. from 1 January 2012, clarification of rules and a single Swedish-Norwegian market for electricity certificates
5. EU-ETS. Emissions Trading Act *[Lag om handel med utsläppsrätter]* (SFS 2004:1199)	Financial regulatory	Fuels conversions to renewable energy	Facilities within the ETS.	Complements existing. Planned adjustments	New period from 2013

Name and reference of the measure	Type of measure*	Expected result**	Targeted group and or activity***	Existing or planned****	Start and end dates of the measure
6. Extension of the Programme for Improving Energy Efficiency in Energy Intensive Industries (PFE). Programme for Improving Energy Efficiency Act *[Lag om program för energieffektivisering]* (SFS 2004:1196)	Financial regulatory	Refers primarily to energy management systems for energy efficiency, but has positive spin-off effects in the form of a greater share of renewable energy.	Energy-intensive industry	Complements existing. Existing state aid approved from 2004 also applies for a new period 2009–2014.	From 2005−2009. New period 2009−2014.
7. Investment aid for solar photovoltaic cells connected to the grid. Ordinance on state aid for solar photovoltaic cells *[Förordning om statligt stöd till solceller]* (SFS 2009:689)	Financial	Target is that the number of players will increase in Sweden, that the system costs will be reduced and that electricity from solar photovoltaic cells will increase by 2.5 GWh during the period.	Companies, public and private organisations, as well as private individuals. Refers to solar photovoltaic cell systems connected to the electricity grid (also entitled to electricity certificates).	Complements existing. Supplemented with more funding from 2012.	1 July 2009−31 December 2012. After 2012, this funding will be reviewed.
8. Investment aid for solar heating. Ordinance on aid for investments in solar heating *[Förordning om stöd för investeringar i solvärme]* (SFS 2008:1247)	Financial	Increased installation and use of solar thermal collectors, that is, solar heating for space heating/cooling and water.	Both private individuals and companies can apply for aid for the installation of solar heating system.	Complements existing.	2009−2011 (the aid will be discontinued after 2011)
9. Vehicle tax exemption for green cars. Act with special provisions concerning vehicle tax *[Lag med särskilda bestämmelser om fordonsskatt]* (SFS 2006:228)	Financial	Promotes green cars	Vehicle owners, the automotive industry	Existing. Planned change.	2010, retroactively from 1 July 2009 ─
10. Reduced taxable benefit value for green cars, replaced by continued but reduced benefit value for certain green cars. Income Tax Act *[Inkomstskattelagen]* (SFS 1999:1229) and the Swedish Tax Agency's regulations and general recommendations.	Financial	Promotes green cars (equates the taxable benefit value of a green car with the equivalent alternative, even if the green car is more expensive to purchase)	Company car sector, vehicle owners and the automotive industry	Existing. Decision on change made.	2009−2011 Changed variant introduced from 1 January 2012–31 December 2013
11. Investment aid for biogas and other renewable gases, Ordinance on state aid for measures for the production, distribution and use of biogas and other renewable gases *[Förordning om statligt stöd till åtgärder för produktion, distribution och användning av biogas och andra förnybara gaser]* (SFS 2009:938)	Financial	Aid to projects that contribute to increased production, distribution and use of renewable gases.	Producers, distributors and users of biogas and other renewable gases.	Complements existing. Additional funds allocated for 2012 in 2013	1 November 2009 − 2013

Name and reference of the measure	Type of measure*	Expected result**	Targeted group and or activity***	Existing or planned****	Start and end dates of the measure
12. Investment aid for climate and renewable energy projects, special funds allocated within the Swedish Rural Development Programme *[Landsbygdsprogrammet]*, Ordinance on aid for rural development measures *[Förordning om stöd för landsbygds-utvecklingsåtgärder]* (SFS 2007:481)	Financial	Reduced environmental impact from rural businesses and increased production and use of renewable energy in rural areas.	Business and project aid	Existing (has not been changed since the Action Plan, but is included because it lacks a description there).	2010–2013
13. Aid for energy mapping for SMEs. Ordinance on state aid for energy mapping *[Förordning om statligt stöd till energikartläggning]* (SFS 2009:1577)	Financial	Aid for energy mapping in businesses that have energy consumption in excess of 0.5 GWh (limited to SEK 30,000 per business).	Small and medium-sized enterprises (energy-intensive enterprises are mainly included in the PFE and certain agricultural holdings.	Existing. Final year not specified in the Action Plan (but is included because it lacks a description there).	2010–2014
14. Delegation for Sustainable Cities *[Delegationen för Hållbara Städer]*, Ordinance on state aid for sustainable cities *[Förordningen om statligt stöd för hållbara städer]* (SFS 2008:1407)	Financial	Grant for the development of sustainable cities. During 2009 and 2010, a total of SEK 320 million has been distributed to nine investment projects and 28 planning projects. During 2011 and 2012, a total of SEK 40 million will be distributed primarily in the form of planning aid.	Primarily municipalities, but also economic activities, consultants, universities and other colleges of advanced education and organisations have received aid (for planning measures). Sustainable cities, including contributions to renewable energy such as for example biogas, solar energy, wind power and district heating.	Complements existing.	2009–2010 and extension until December 2012.
15. Implementation of the Renewables Directive's sustainability criteria. Act on Sustainability criteria for biofuels and bioliquids (SFS 2010:598), changes in the Act in accordance with Government bill 2010/11:152, Government bill 2010/11:154 and Energy Tax Act (SFS 1994:1776).	Regulatory[a]	The use of biofuels and bioliquids, which leads to significant reductions in carbon dioxide and which otherwise have low environmental impact.	This Act targets suppliers and users of biofuels and bioliquids.	New. Existing. (Following Riksdag decisions, changes in the law come into force on 1 November 2011 and 1 January 2012, respectively.	Act on Sustainability criteria for biofuels and bioliquids (SFS 2010:598) applies from 1 August 2010. The tax exemption for certain biofuels is conditional on the players holding a sustainability notification from 1 February 2012 (but already in 2011, the Swedish Government's decision on tax exemption for biofuels is conditional on them fulfilling the sustainability criteria).
16. Introduction of the Renewables Directive's rules for guarantees of origin. Act on guarantees of origin for electricity *[Lag om ursprungsgarantier för el]* (SFS 2010:601)	Financial regulatory	The goal is reliable marks of origin for electricity and that the electricity consumer will have clear information about the origin of the electricity.	Covers the generation of electricity and affects both electricity producers and suppliers.	New. Existing.	SFS 2010:601 applies from 1 December 2010.

Name and reference of the measure	Type of measure*	Expected result**	Targeted group and or activity***	Existing or planned****	Start and end dates of the measure
17. New law concerning the environmental requirements when purchasing vehicles and contracting public transport. Act on environmental requirements in the procurement of vehicles and certain public passenger transport services *[Lag om miljökrav vid upphandling av bilar och vissa kollektivtrafiktjänster]* (SFS 2011:846)	Regulatory	The promotion of clean and energy-efficient road transport vehicles	Authorities	New. Existing (decided 16 June 2011)	1 July 2011 –
18. Changed rules of procedure for accounting of alternative fuels, Gov. Bill 2010/11:32	Regulatory	Promotion of renewable fuels	Enterprise	New. Existing.	1 January 2011 -
19. New laws on exhaust emission controls and fuels Exhaust emission controls Act (SFS 2011:318) and Fuels Act (SFS 2011:319)	Regulatory	Reduced emissions of greenhouse gases and the promotion of renewable fuels	Fuel suppliers and car manufacturers	Replaces existing.	1 May 2011 –
20. Super green car premium	Financial	Promotes green cars, renewable fuels and electricity for transport.	Vehicle owners, the automotive industry	Planned	Introduction planned from 1 January 2012–2014

* Indicate if the measure is (predominantly) regulatory, financial or soft (i.e. information campaign).
** Is the expected result behavioural change, installed capacity (MW, t/year), energy generated (ktoe)?
*** Who are the targeted persons: investors, end users, public administration, planners, architects, installers, etc.?
What is the targeted activity / sector: biofuel production, energetic use of animal manure, etc.?
**** Does this measure replace or complement measures contained in Table 5 of the NREAP?
[a] Can also be seen as a condition for financial instruments since no state aid may be given for non-sustainable biofuels.

Description of changes during the past two years
Numbering according to Table 2.

1. ***Changed levels of energy taxes*** and

2. ***Changed levels of carbon taxes***

The changes in energy and carbon taxes are described in general terms in Sweden's National Renewable Energy Action Plan in the chapter "Introduction to Sections 4(3), 4(4) and 4(5)". The current rates of tax are listed on the website of the Swedish Tax Agency. Carbon and energy tax rates are recalculated on the basis of price trends (indexation). The recalculated tax rates come into force on 1 January 2012[27].

3. ***Changed rules for energy and carbon tax exemption for renewable fuels***

Sweden has the approval of the European Commission to exempt biofuels from energy and carbon taxes at the end of 2013. The tax exemption will be effected for ethanol and biofuels other than biogas by means of a government decision on tax exemption. From 1 January 2011, the tax exempted level for a low biofuel blend of ethanol in petrol is a maximum of 6.5 % by volume and for biodiesel in diesel, a maximum of 5 % by volume. All ethanol and biodiesel in low biofuel blends over and above these levels are taxed as petrol and diesel, respectively (Government bill 2010/11:1).
On 1 January 2011, the general tax exemption for biogas also expired.

[27] Govt. bill 2011/12:1. The budget bill for 2012. Draft State budget for 2012, budget proposal and taxation matters, Chapters 1-6 [*Förslag till statens budget för 2012, finansplan och skattefrågor, kapitel 1-6]* and SFS 2011:1134. Available in Swedish only via www.regeringen.se and www.lagrummet.se.

As a consequence of this, operators producing biogas became liable to declare energy and carbon tax (taxable). The exemption from tax liability is compensated for by the possibility of deductions for energy and carbon taxes on biogas that the person liable to pay tax has consumed or sold as motor fuel, or as fuel for heating. See point 15 for the connection to sustainability criteria.

4. Raised level of ambition in the electricity certificate system

The electricity certificate system is a market-based support scheme for the expansion of electricity generation from renewable energy sources and peat in Sweden. Producers of electricity whose electricity generation meets the requirements in Sweden's Electricity Certificates Act (SFS 2003:113) receive one electricity certificate for each megawatt hour (MWh) of electricity they generate. Demand for electricity certificates is created because all electricity suppliers and some electricity consumers are obliged to purchase electricity certificates equivalent to a certain percentage (quota) of their electricity sales/consumption. The quantity of electricity certificates that electricity suppliers are to purchase increases from year to year in pace with the quota gradually rising, which results in a rising demand for electricity certificates. Through their sales of electricity certificates, the producers of renewable electricity thereby get an extra source of income in addition to their income from electricity sales. In this manner, the system stimulates the expansion of renewable electricity generation. The overview of the electricity certificate system conducted in 2009-2010 led among other things to a rise in the level of ambition with the goal of increasing renewable electricity generation by 25 TWh by 2020 compared with the level in 2002. A more detailed description of the electricity certificate system is found in the Action Plan.

On 29 June 2011, Sweden and Norway entered into an agreement to establish a joint market for electricity certificates starting from 1 January 2012. The Riksdag passed the agreement on 30 November 2011. The system is to be technology-neutral and the countries have undertaken similar levels of ambition with respect to increasing the generation of electricity entitled to certificates from the date on which the single electricity certificate market is introduced. The continued expansion of the electricity grid between the two countries is essential for a single electricity certificate system to function.

5. EU ETS: Emissions Trading System

The EU ETS indirectly promotes the development of renewable energy. Directive 2009/29/EC amends the EU ETS directive (Directive 2003/87/EC). The changes will begin to apply in concrete terms in the next trading period (2013), but supplementary legislation already exists to a certain extent. The EU ETS directive is transposed in Swedish law through:

- Emissions Trading Act (SFS 2004:1199)
- Emissions Trading Ordinance *[Förordning om handel med utsläppsrätter]* (SFS 2004:1205); amended by Ordinance amending Emissions Trading Ordinance *[Förordning om ändring i förordning (2004:1205) om handel med utsläppsrätter]* (SFS 2011:844); and Ordinance amending the Ordinance amending Emissions Trading Ordinance *[Förordning om ändring i förordningen (2009:1327) om ändring i förordningen (2004:1205) om handel med utsläppsrätter]* (SFS 2011:845)
- Swedish Environmental Protection Agency Regulation and general advice on CO_2 emissions allowances *[Naturvårdsverkets föreskrifter och allmänna råd om utsläppsrätter för koldioxid]* (NFS 2007:5)
- Commission Regulation (EC) No 2216/2004 for a standardised and secured system of registries with its amendments and Regulation governing the emissions allowances register *[Föreskrifter om register för utsläppsrätter]* (STEMFS 2004:8)
- Swedish Environmental Protection Agency Regulation governing applications for free allocations of emissions allowances to facilities within the ETS 2013–2020 *[Naturvårdsverkets föreskrifter angående ansökan om fri tilldelning av utsläppsrätter till anläggningar inom handelssystemet 2013–2020]* (NFS 2011:3)

Sweden proposes that waste-incineration plants be included in the system (for more information see under the last heading in the progress report "Other matters"). There is also a provision in the EU ETS stating that the profits from the sale of 300 million emission allowances held in the New Entrants Reserve (NER) of the EU Emissions Trading System (ETS) (the NER 300) are to be given to those who invest in new technology for renewable energy or carbon capture. On 9 May 2011, through the Swedish Energy Agency, Sweden submitted nine applications, which were received in the NER 300 call, to the European Investment Bank. The applications contain Swedish demonstration projects in the areas of bioenergy, wind power and smart grids. All projects are deemed to have great significance for the development of renewable energy within the EU.

6. Extension of the Programme for Improving Energy Efficiency in Energy Intensive Industries (PFE).

The primary purpose of the PFE is to improve energy efficiency in industry but it can also have the positive spin-off effect of increasing the use of renewable energy. A new programme period for the PFE started on 1 July 2009. The current state aid approval from 2004 also applies for a new period 2009-2014.

7. Investment aid for solar photovoltaic cells connected to the grid

The possibility of applying for investment aid for solar photovoltaic cells connected to the grid was introduced on 1 July 2009 and this possibility will continue until 31 December 2012. The aid applies to all types of solar photovoltaic cell systems connected to the grid. The subsidy was originally 60 % (55 % for large companies) but the subsidy level has now been dropped to 45 % of eligible expenses. The subsidy covers the entire solar photovoltaic cell system installation (materials, parts and labour). The total amounts allocated for this funding were SEK 100 million in 2009 and SEK 50 million and SEK 60 million for 2010 and 2011, respectively. For 2012, SEK 60 million has been allocated. After 2012, this funding will be reviewed. Information about this funding is available on the websites of the Swedish Energy Agency and the Solar Energy Association of Sweden (SEAS), and from the county administrative boards.

8. Investment aid for solar heating

This investment aid, which has been available since the year 2000, will be discontinued after 2011. A description of this aid is found in the Action Plan (Section 4.4, Aid for investment in solar heating). Compared with that which is stated in the Action Plan, this investment aid was extended for 2011.

9. Vehicle tax exemption for green cars

Passenger cars that fulfil the requirements for green cars, and which enter into service for the first time in Sweden, are exempt from vehicle tax for five years from the vehicle's entry into service. The vehicle owner thus does not need to pay vehicle tax for those years. The purpose of this measure is to encourage the purchase of fuel-efficient cars and cars that can run on biofuels or electricity. The definition of a green car contains the following requirements:

- For conventional passenger cars, including electric hybrids, average CO_2 emissions may not exceed 120 g CO_2/km (for diesel cars, there is an additional requirement that particle emissions do not exceed 5 mg/km).

- For passenger cars that run on alternative fuels (other than petrol, diesel and LPG), fuel consumption may not exceed 0.92 litres of petrol/10 km or 0.97 m³ of gas/10 km.

- For electric cars, electric energy consumption per 100 km may not exceed 37 kWh.

The definition of a green car in this respect differs from that which applies for a reduction in preferential taxation (see below). The Swedish Government has announced a revision of the definition of green cars for the purpose of possibly making energy-efficiency requirements even stricter.

10. Reduced taxable benefit value for green cars/Reduced taxable benefit value for certain green cars

In December 2011, the Riksdag decided to extend the time-limited reduction of the taxable benefit value of green cars that run on electricity or a gas other than LPG (that is, electric cars, plug-in hybrids and gas fuelled cars). The level of the reduction corresponds to 60 % of the taxable benefit value of the nearest comparable conventional car. According to the budget, the reduction in the taxable benefit value for ethanol cars (80 % of the taxable benefit value of comparable conventional cars), and for electric-hybrid cars that are charged only with electricity generated by the vehicle, will not be extended and will therefore expire after the 2011 fiscal year. It is proposed that the new provisions will come into force on 1 January 2012 and apply until 31 December 2013. For the background to the proposal concerning the changes, see the latest Budget Bill[28].

11. Investment aid for biogas and other renewable gases

The purpose of this aid is to promote energy technology that is climate-friendly but not yet commercially competitive. It is intended to promote more efficient and expanded production, distribution and use of biogas and other renewable gases. Evaluations are made on the basis of the criteria set out in the Ordinance on state aid for measures for the production, distribution and use of biogas and other renewable gases *(*SFS 2009:938).

This investment aid has been distributed in two phases: the first in 2010 comprising around SEK 100 million and the second phase up until July 2011 comprising around SEK 41 million. Funding for this investment aid has been allocated up until 2013. See also point 4.

12. Investment aid for climate and renewable energy projects, special funds allocated within the Swedish Rural Development Programme

This project aid within the Swedish Rural Development Programme is primarily related to knowledge and skills development in preliminary studies in climate and renewable energy in rural areas and maybe given to biogas projects, for example. The projects are intended to reduce the environmental impact of rural enterprises, and to support development and cooperation within renewable energy in rural areas through, for example, the development of new products, processes or technologies. The project aid is distributed within the framework of the budget for the Swedish Rural Development Programme. This aid has not been changed since the Action Plan, but is included because it lacks a description there.

13. Aid for energy mapping for SMEs

As with the PFE, aid for energy mapping for SMEs is primarily intended for increasing energy efficiency in industry but it can also have the positive spin-off effect of increasing the use of renewable energy. This aid is also called an “energy mapping check” and can be applied for up to and including 2014. It covers 50 % of the cost of the energy mapping, up to a maximum of SEK 30 000. This aid applies to companies that use more than 500 MWh of energy per year. Agricultural enterprises can also receive this aid even if their energy use is less than 500 MWh per year provided that they have at least 100 livestock units.

14. The Delegation for Sustainable Cities – Contributions to the development of sustainable cities

The task of the delegation for sustainable cities has been extended to include 2012 and during 2011, the delegation is able to decide on aid up to a total of SEK 19 million. This aid is intended to stimulate the development of sustainable cities and city districts that is primarily intended to contribute to reduced emissions of greenhouse gases. It does not primarily target renewable energy, but it can have the positive spin-off effect of increasing the use of renewable energy.

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[28] Govt. bill 2011/12:1. The 2012 Budget Bill for Sweden. Draft State budget for 2012, budget proposal and taxation matters, Chapters 1-6 and Draft State budget for 2012, budget proposal and taxation matters, Chapters 7-12 and Annexes 1-10 *[Förslag till statens budget för 2012, finansplan och skattefrågor, kapitel 7-12 och bilagor 1-10]*. Available in Swedish via www.regeringen.se.

15. Implementation of the Renewables Directive's sustainability criteria

Sweden's Act on sustainability criteria for biofuels and bioliquids (SFS 2010:598) came into force on 1 August 2010 to implement the Directive's provisions concerning sustainability criteria. On 1 November 2011, a change in the Act came into force which means that the reporting obligation is linked to the tax liability for biofuels and bioliquids, and also gives companies that have a reporting obligation the opportunity to apply for what is termed a sustainability notification from the Swedish Energy Agency. This means that the company's control system can be deemed to ensure that the sustainability criteria are met for the biofuels and bioliquids that are handled and reported by the company as sustainable. From 1 February 2012, the tax exemption for biofuels and bioliquids will be conditional upon the presentation of a valid sustainability statement. Note however that already during 2011, decisions issued by the Swedish Government concerning tax exemptions for biofuels are conditional upon the fuel meeting the sustainability criteria in the Renewables Directive. The Directive's provisions concerning sustainability criteria also mean certain changes in the Electricity Certificates Act (SFS 2003:113). The Act, Ordinance and Regulation have been adopted and are published in Swedish on the website of the Swedish Energy Agency (www.energimyndigheten/hbk).

16. Introduction of the rules for guarantees of origin

The implementation of the rules for guarantees of origin are described in more detail in the section with the heading Describe the functioning of the system of guarantees of origin for electricity and heating and cooling from RES, and the measures taken to ensure reliability and protection against fraud of the system (point 5 in the Commission's template for this progress report).

17. New environmental requirements when purchasing vehicles

The environmental requirements when purchasing vehicles and contracting public transport are adapted to an EU directive. Public authorities who purchase cars or lease them for at least one year are to take into account the car's energy and environmental impact throughout their entire period of use in the procurement process. The energy and environmental impact can be specified in monetary terms and is to be included in the evaluation of tenders. The new legislation applies from 1 July 2011.

18. Changed rules of procedure for accounting of alternative fuels

On 1 January 2011, the rules for accounting of alternative fuels were changed in the excise duty declaration. In exceptional cases, the Government may grant full or partial exemption from energy tax and carbon tax on fuel produced from biomass, or on fuel consumed as part of pilot project for the technological development of more environment-friendly products. The possibility of full or partial exemption from energy tax and carbon tax applies even if the fuel is an ingredient in another fuel. From 1 January 2011, the tax exemption for fuel that is covered by the Government's decision is effected by means of a deduction in the excise duty declarations instead of as previously by means of net accounting.

19. New laws on exhaust emission controls and fuels

In order to implement in Swedish law the changes in the Fuel Quality Directive, two new Acts – the Exhaust Emission Controls Act (SFS 2011:318) and the Fuels Act (SFS 2011:319) – replaced the Motor Vehicle Exhaust Emission Controls and Motor Fuels Act *[lagen om motorfordons avgasrening och motorbränslen]* (SFS 2001:1080). The new Exhaust Emission Controls Act corresponds to the applicable law with some clarifications, which are needed primarily as a consequence of the EU regulations in the area of exhaust emissions; while the new Fuels Act is to contain the changes from the Fuel Quality Directive transposed into Swedish law. These changes mean, *inter alia*, the transposition of the Directive's provisions governing accounting for greenhouse gas emissions from fuels, and requirements for fuel suppliers to reduce their emissions of greenhouse gases. The new Acts came into force on 1 May 2011.

20. The super-green car premium

The purpose of the premium is to stimulate the market introduction of the most environment-friendly cars in a technology-neutral way. A super-green car means a passenger car that complies with the EU's latest exhaust emissions limits and which emits no more than 50 g of carbon dioxide per kilometre. The

Government has laid down the criteria governing which vehicles the premium is to cover in the *Förordningen om supermiljöbilspremie* (SFS 2011:1590 - the Super-Green Car Premium Ordinance). This support scheme will cover both natural and legal persons. Since companies are also able to receive this aid, this measure is covered by the EU's government aid rules[29]. It is proposed that the target group for the assistance cover private individuals, car pools, the public sector and businesses, including taxi companies and car hire companies. This means that privately owned cars, company cars and cars provided as fringe benefits can be covered by the super-green car premium. The size of the premium per super-green car is proposed to be SEK 40 000 for natural persons and 35 % of the additional cost of the super green car up to a maximum of SEK 40 000 for legal persons, which is deemed to be in line with the EU's government aid rules. The financial framework for the premium for the years 2012-2014 is SEK 200 million. It is planned that the super-green car premium will be introduced from 1 January 2012 and it is described in the Swedish Government's 2012 Budget Bill[30].

Soft instruments

In addition to the instruments described above (and in Table 5 in the Action Plan), there are in Sweden a number of soft instruments in the form of information campaigns, plans and programmes. These are also an important part of Sweden's energy policy. For example, the county administrative boards have been tasked on behalf of the government with developing regional strategies for energy and climate issues in their respective counties. These strategies are an important part of Sweden's national energy and climate policy in being able to achieve the targets at the local and regional levels. Among other things, the purpose of these strategies is to increase the share of renewable energy. These strategies are to be formulated in cooperation with other regions and local actors and are to ensure that all are pulling in the same direction in the county. This work is supported by the Swedish Energy Agency.

There are also additional instruments for increasing energy efficiency which are of significance in this context. The EU directive on the energy performance of buildings, which has been implemented in Sweden, includes requirements to take renewable energy into account[31].

Instruments/measures that have ceased to apply since the Action Plan

Table 2a: Overview of instruments/measures that have ceased to apply since the Action Plan

Name and reference of the measure	Type of measure*	Expected result**	Targeted group and or activity***	Existing or planned****	Start and end dates of the measure
1. Planning aid for wind power, Ordinance on aid for planning initiatives for wind power *[Förordning om stöd till planeringsinsatser för vindkraft]* (SFS 2007:160)	Financial contribution	To support the planning process	Municipalities, county administrative boards, municipal and regional joint action bodies	Has ended	2007−2010

[29] This aid is intended to be applied in accordance with Commission Regulation (EC) No 800/2008 of 6 August 2008 declaring certain categories of aid compatible with the joint market in application of Articles 87 and 88 of the Treaty (General block exemption Regulation).
[30] Govt. bill 2011/12:1. The 2012 Budget Bill for Sweden. Draft State budget for 2012, budget proposal and taxation matters, Chapters 1-6 and Draft State budget for 2012, budget proposal and taxation matters, Chapters 7-12 and Annexes 1-10. Available in Swedish via www.regeringen.se.
[31] See for example "Boverket" Swedish National Board of Housing, Building and Planning, 2010. The EU directive on the energy performance of buildings – consequences and the need for change in the Swedish regulatory framework and the Swedish Energy Agency, 2010 *[EU-direktivet om byggnaders energiprestanda - konsekvenser och behov av förändringar i det svenska regelverket och Energimyndigheten],* National strategy for low-energy buildings *[Nationell strategi för lågenergibyggnader]* ER 2010:39.

2. Investment aid for conversion from direct-acting electro heat in dwelling houses. Ordinance on aid for conversion from direct-acting electro heat in dwelling houses *[Förordning om stöd för konvertering från direktverkande elvärme i bostadshus]* (SFS 2005:1255)	Financial	Conversion from direct-acting electro heating to district heating, bioenergy, heat pumps.	Owners of dwellings or dwellings attached to premises.	Has ended	Investment aid may only be used for measures begun at the earliest on 1 January 2006 and completed by 31 December 2010 at the latest.
3. Grants to fuel retail outlets for investments in pumps for fuels other than ethanol, Ordinance on government aid for measures to promote the distribution of renewable fuels *[Förordning om statligt stöd till åtgärder för främjande av distribution av förnybara drivmedel]* (SFS 2006:1591)	Financial	In 2009, 114 retail outlets had been awarded grants for the installation of biogas pumps (on average around SEK 1 million per application).	Retail outlets for fuel	Has ended	2007-2009, grants may still be applied for, for works begun before the end of 2009 and concluded before the end of 2010.

1. Planning aid for wind power

Since 2007, municipalities, county administrative boards and regional self-governing bodies and municipal joint action bodies have been able to apply for aid for planning initiatives for wind power. The purpose of this aid is to inject resources for spatial planning so as to create the conditions for a greater expansion of wind power. The possibility of applying to this aid ceased on 31 December 2010. Those who applied for and received aid are now working on the implementation of their planning efforts. The Swedish National Board of Housing, Building and Planning is monitoring this work. Up until the beginning of December 2010, 212 municipalities and 13 county administrative boards had been awarded grants. In total 48 municipalities or joint action groups of municipalities had submitted their final accounts, and 4 county administrative boards.

2. Investment aid for conversion from direct-acting electro heat in dwelling houses

This aid was provided for the replacement of direct-acting electro-heating systems to district heating, geothermal from a downhole heat exchanger, ocean thermal heat pumps or shallow geothermal, or biofuel and the installation of waterborne heating systems. This aid applied for measures implemented during the period 1 January 2006-31 December 2010. This aid has ended.

3. Grants to fuel retail outlets for investments in pumps for fuels other than ethanol

The Swedish Environmental Protection Agency has been the responsible authority for this aid, which ceased at the turn of the year 2010/2011. In total SEK 114 million was distributed in investment aid.

Proposed measures and instruments not yet decided

New definition of a green car

Already in its 2011 Budget Bill, the Swedish Government expressed a desire to tighten the definition of a green car and replace it with a new definition based on Regulation (EC) No 443/2009 of the European Parliament and of the Council setting emission performance standards for new passenger cars. The consequence of the new definition ought to be a tightening of the requirements for exemption from vehicle tax. In 2010, 40 % of passenger cars were registered as green cars, which can be compared with approximately 15 % green cars at the time of the introduction of the green car premium in 2007. The definition of a green car should therefore gradually be tightened so that roughly a constant proportion of new cars are covered by the definition. The new definition ought to be introduced from 1 January 2013.

The use of cooperation mechanisms

In its Spending authorization for 2011, the Swedish Energy Agency was given the task of analysing the various alternatives cooperation mechanisms in the Renewables Directive. For a brief summary of the report, see point 11.1. This question is currently under consideration by the Government Offices of Sweden.

Responsibility for information about existing support schemes

Responsibility for providing information about existing support schemes lies in the first instance with the authority that manages the aid. The Swedish Energy Agency supplies a large amount of information material which is distributed through various channels. Besides the Swedish Energy Agency's website, the municipal energy and climate advisers and the Swedish Regional Energy Agencies are important distribution channels. In addition to these, there are regional information centres in some regions. The principal target groups for the energy and climate advisers are the general public and SMEs.

The Swedish Energy Agency is of the opinion that currently no further measures are needed to ensure that information about support schemes and measures is available to interested operators.

Research efforts

From 2009, the Swedish Energy Agency has had at its disposal fully SEK 1 billion per year for energy research. In addition, in the field of energy, annual appropriations to universities and other tertiary education institutions were and will be increased by SEK 50 million in 2010, by an additional SEK 50 million in 2011, and by an additional SEK 60 million in 2012. This funding is focused on the following areas: Large-scale renewable electricity generation and its integration in the grid, electrical drive systems and hybrid vehicles, energy complexes, biofuels and renewable materials; as well as basic energy research in the areas of new nuclear technology, and carbon capture and storage, among others.

In addition to the investment in energy research made by the Swedish Government in its Research and Innovation Bill, the decision by the Riksdag means an increase compared with the 2008 level in the Swedish Energy Agency's appropriation for energy research by a further SEK 145 million in 2009, SEK 380 million in 2010, and SEK 350 million in 2011. For 2012, the Swedish Energy Agency's appropriation for energy research will be SEK 1314 million. This funding is provided to facilitate the demonstration and commercialisation of new technologies for renewable energy.

These investments refer in the first instance to second-generation biofuels, and in the second instance to the demonstration and commercialisation of other energy technologies of great national importance, and with substantial export potential.

2.a Please describe the progress made in evaluating and improving administrative procedures to remove regulatory and non-regulatory barriers to the development of renewable energy *(Article 22(1)(e) of Directive 2009/28/EC).*

Wind power is deemed to provide the greatest contribution to new renewable energy in the form of electricity in Sweden to the year 2020. Many of the changes described in this section also concern wind power.

Measures to accelerate the procedures for grid connection and other grid measures

Sweden has implemented Article 16(5) of the Renewables Directive by introducing a regulation which means that from one December 2010, a grid company that receives an application for the connection of an electricity generation facility must specify a timetable for the processing of the application, and the timetable for the connection of the facility (see Chapter 4 Section 12 of the Electricity Act SFS 1997:857). This regulation means that the electricity producer receives clear information regarding when a connection can occur, and the electricity producer will therefore be able to plan the construction of the facility and its connection to the grid more reliably and rapidly.

The Government is currently investigating the possibilities of the introduction of early sharing of the grid reinforcement costs associated with large-scale generation facilities for renewable electricity. The introduction of such a system is also expected to lead to more rapid processes at the time of connecting these facilities to the grid. This investigation is not yet complete. A potential proposal could be presented at the earliest during the spring of 2012.

The Government has assigned the task of looking into hourly metering and smart grids to the Energy Markets Inspectorate. The Energy Markets Inspectorate has reported on this task in a report entitled Adapting Electricity Networks to a Sustainable Energy System – Smart metering and smart grids EI R2011:03 (Swedish original report reference number EI R2010:18) concerning smart grids; and another report available only in Swedish entitled Empowering the customer in the electricity market – Hourly metering for electricity consumers with subscriptions of maximum 63 amperes *[Ökat inflytande för kunderna på elmarknaden – Timmätning för elkunder med abonnemang om högst 63 ampere]* EI R2010:22, concerning hourly metering. These reports contain concrete proposals on how Sweden should proceed with the development of smart grids and the introduction of hourly metering on a large scale. These reports are currently under consideration in the Government Offices of Sweden.

On 23 June 2011, a bill entitled Strengthening the role of the consumer for a developed electricity market and sustainable energy system *[Stärkt konsumentroll för utvecklad elmarknad och uthålligt energisystem]* (Govt. bill 2010/11:1539) was submitted. The Government bill contains a number of measures that directly or in the long run are intended to assist electricity consumers to take control over their electricity bills. This includes measures intended to make it easier for electricity consumers to adapt their electricity usage when prices are very high, to make their energy use more efficient, to generate their own renewable electricity, and to charge an electric vehicle.

Sweden has transposed Article 16(3) of the Renewables Directive in a new provision which means that from 1 December 2010, all grid companies shall be required to make public their standard rules relating to the bearing and sharing of costs of technical adaptations when integrating new connections to the grid (see Chapter 4 Section 13 of the Electricity Act).

Concerning the coordination of permits for electricity grids and for generation facilities, as a general rule, the approval of grid infrastructure and other administrative and planning procedures constitute two procedures that run in parallel with each other. It is not necessary for any of the decisions to have come into force for the procedure to be able to be concluded in the other case. Matters relating to the construction or use of an electric power line where a case concerning the permit has been brought before the court under the Environmental Code does not need to be tried again in a permit case under

the Electricity Act. (This rule does not apply to hydro generation plants. There, first a network concession for the power line is required in order to be able to submit an application for an environmental judgement of the hydro plant.)

Measures to promote wind power and other types of renewable electricity generation

The Riksdag approved the Government Bill A new Electricity Certificates Act – simplified rules and a single electricity certificate market *[En ny lag om elcertifikat – enklare regler och en gemensam elcertifikatsmarknad]* (Govt. bill 2010/11:155, Report 2011/12:NU 6, Riksdag Comm. 2011/12:46) on 30 November 2011. This means that the Riksdag has decided on a new Electricity Certificates Act at the same time as the current targets and functioning of the electricity certificate system are kept unchanged; and that an agreement between Sweden and Norway has been struck concerning a joint market for electricity certificates. The main new features of the decision are that rules have been introduced the meeting a single electricity certificate market with other countries, the requirements for hydroelectricity production to be awarded electricity certificates have been tightened, smaller producers of renewable electricity that use electricity they produce themselves may be exempted from the renewable energy obligation, all registered electricity intensive industries will get the same opportunity to exempt other electricity from their renewable energy obligation, the supervisory authority is decide on the cancellation of electricity certificates instead of the account keeping authority, and it is to be possible for the supervisory authority to make decisions regarding depositions of electricity certificates. The new Electricity Certificates Act should lead to the simplification of rules and improved administrative routines The new Acts came into force on 1 January 2012. It is considered that a joint market between Sweden and Norway for electricity certificates will lead to a better functioning market, and make it possible to meet targets more cost effectively. The planned start date for the joint market electricity certificates is 1 January 2012.

In its Spending authorization for 2011, the Swedish Energy Agency has been entrusted with the task of monitoring the licensing processes for facilities that produce renewable electricity in consultation with the authorities involved each year. In this monitoring, the authority is to identify any shortcomings and propose measures for making processes more efficient. An initial report[32] is to be submitted to the Government Offices (Ministry of Enterprise, Energy and Communications) on 31 August 2011. A number of measures have been identified that could be taken in order to simplify the procedure for establishing generation facilities for renewable energy and make it more efficient. The report only outlines these measures and further measures require the development of arguments and in some cases further investigation. There is a need to complement measures to make the establishment of electricity generation facilities simpler and more efficient with ensuring that the backbone grid and other transmission grids have sufficient capacity.

Work with and the development of planning aid for wind power is reported annually by the Swedish National Board of Housing, Building and Planning. With the help of basic data from the county administrative boards and in accordance with the Spending authorization for 2010, the Swedish National Board of Housing, Building and Planning reported to the Ministry of the Environment on 31 March 2011 significant initiatives and projects implemented within the framework of the planning aid for wind power, and also noted changes in the municipalities' master plans[33]. The Swedish National Board of Housing, Building and Planning concludes that, according to the final reports on the planning aid received from the municipalities up until the

[32] Swedish Energy Agency, 2011. The Swedish Energy Agency's monitoring of permit processes for facilities that produce renewable electricity [*Energimyndighetens uppföljning av tillståndsprocesser för anläggningar som producerar förnybar el]*. Ref. no. 00-10-6567.
[33] The Swedish National Board of Housing, Building and Planning supervision report, planning and building in 2010 [*Boverkets uppsiktsrapport, planering och byggande under 2010]*. Report 2011:4.

writing of its report in March 2011, their planning includes the basis for the equivalent of 44 TWh of electricity per year.

The Swedish Environmental Protection Agency is tasked with annually reporting on what measures the Agency has taken to increase the knowledge of the county administrative boards, the municipalities, wind power industry players and the general public about the combined effects of wind power on the natural environment. The Swedish Environmental Protection Agency has reported in its annual report[34] at seminars have been held for the county administrative boards and municipalities and about the Agency's participation in work on the Vindlov website, where the Swedish Environmental Protection Agency is responsible for the information concerning environmental issues. The Swedish Environmental Protection Agency is also required to report on how many wind power cases they have received for consideration from the examination authorities, how great a proportion of these have been replied to, on what grounds the selection has been made in the matter of which cases the Agency has replied to, when in the drafting process the Agency has expressed its opinion, and a rough account of the substance of these statements of opinion[35].

According to its Spending authorization for 2011, in consultation with a number of other authorities, the Swedish Energy Agency is to manage and develop the Internet platform for all permit issues(www.vindlov.se) that may arise in conjunction with the expansion of wind power. The purpose of the website is to provide a general grasp of the permit process for wind power plants and to make all of the gathered information readily available.

In its Spending authorization for 2011, the Swedish Environmental Protection Agency has been tasked with producing a guidance document clarifying the possibilities of establishing wind power in the Natura 2000 area in consultation with the Swedish Energy Agency, the Swedish National Board of Housing, Building and Planning and, from 1 July 2011, the Swedish Agency for Marine and Water Management. This task is to be reported on by 31 December 2011 at the latest.

Other measures

Together with the Swedish National Board of Housing, Building and Planning and Swedac, the Swedish Energy Agency is to develop proposals for a national coordinated certification scheme or equivalent qualification schemes in accordance with Article 14(3) of the Renewables Directive for installers of small-scale biomass boilers and stoves, solar photovoltaic and solar thermal systems and heat pumps.

The task includes developing proposals on how information about this can be made available to the public. This task is to be reported on by 31 December 2011 at the latest.

In April 2011, the Swedish Energy Agency accounted for what additional measures need to be taken according to the authority in order to ensure that the information requirement as set out in Article 14(1),(2),(5) and (6) of the Renewables Directive is fulfilled[36]. The Swedish Energy Agency proposes, *inter alia*, that information to the public is improved through the expansion of the municipal energy and climate advisory service. In the 2012 Budget Bill, the Swedish Government proposed that the municipal energy and climate advisory service should be developed to also cover the dissemination of locally and regionally adapted information about the use of renewable energy. It is anticipated that a change in Ordinance on contributions to municipal energy and climate advisory services *[Förordningen om bidrag till kommunal energi- och klimatrådgivning]* (SFS 1997:1322) will be decided in January 2012.

[34] See the Swedish Environmental Protection Agency's Annual Report 2010 [*Naturvårdsverkets årsredovisning för 2010]*, page 46.
[35] For the most recent account, see the Swedish Environmental Protection Agency's Annual Report 2010, page 41.
[36] ER 2011:05 Information about renewables *[Förnybar information]*. Task 18 Part 2.

2.b Please describe the measures in ensuring the transmission and distribution of electricity produced from renewable energy sources and in improving the framework or rules for bearing and sharing of costs related to grid connections and grid reinforcements *(Article 22(1)(f) of Directive 2009/28/EC).*

In Sweden, the state-owned *Affärsverket svenska kraftnät* or *Svensk Kraftnät* (the Swedish national grid) has the task of managing, operating and developing a cost-effective, reliable and environment-friendly power transmission system, selling excess capacity, and in other ways operating activities that are linked to the power transmission system. According to its instruction for its sphere of activities, Svenska Kraftnät is to ensure that the possibilities of expanding renewable electricity generation are facilitated[37].

To facilitate the connection of renewable electricity production to the backbone grid, Svenska Kraftnät has produced a document providing guidance for project planners of large wind power generation facilities in matters related to grid connection[38]. The guidance document has been formulated for the management of connecting new production to the backbone grid. This guidance document has been produced for wind power, but is also relevant for the connection of other types of electricity production (including non-renewable). Svenska Kraftnät has also decided on certain measures. After having identified a need from wind power companies to be able to reserve spare capacity in advance, this option has been introduced. To facilitate the connection of new electricity production such as wind power to the backbone grid, Svenska Kraftnät has also decided to permit a certain amount of overbooking of capacity on radial lines and cross-border connections. With a rise in the connection of wind power, this should be an economically advantageous solution for the wind power company, since it results in an increased utilisation of the line before gain becomes necessary. However these measures cover all types of electricity production, not just from renewable sources. For a more detailed description of the measures, see the guidance document[39] mentioned above.

Chapter 3 Sections 6 and 7 of the Electricity Act (SFS 1997:857) contain provisions which mean that a grid company is obliged to connect electricity generation facilities on reasonable terms. The grid authority (the Energy Markets Inspectorate) may appraise the merits of these terms. It follows from Chapter 3 Section 9 of SFS 1997:857 that the grid company is under an obligation to transmit electricity on behalf of another on reasonable terms.

Chapter 4 section 1 of SFS 1997:857 states that grid tariffs are to be objective and non-discriminatory. In Chapter 5 there are provisions governing how big the revenue from its grid operations a grid company may receive. The grid authority appraises the grid tariffs in relation to revenue framework set for each grid company.

In 2009, as tasked by the Swedish Government, Svenska Kraftnät submitted a proposal concerning changes to the content of the regulatory framework with regard to responsibility for grid reinforcements of national significance, and with regard to the grid connection of large electricity generation facilities, with a view to reducing barriers in the form of threshold effects on the expansion of renewable electricity generation.[40] The threshold effect refers to the power producer

[37] See Section 3, point 12 in Ordinance with instruction for Affärsverket svenska kraftnät [*Förordning med instruktion för Affärsverket svenska kraftnät]* (SFS 2007:1119.)
[38] Svenska Kraftnät 2011, Guidance for connecting wind power to the backbone grid *[Vägledning för anslutning av vindkraft till stamnäte]*, Ref. no. 2009/393, 2011-05-06, available in Swedish from: www.svk.se/global/06_energimarknaden/pdf/vindkraft/110506-vagledning-forvindkraftsanslutning.pdf
[39] Svenska Kraftnät 2011, Guidance for connecting wind power to the backbone grid *[Vägledning för anslutning av vindkraft till stamnäte]*, Ref. no. 2009/393, 2011-05-06, available in Swedish from: www.svk.se/global/06_energimarknaden/pdf/vindkraft/110506-vagledning-forvindkraftsanslutning.pdf
[40] See Svenska kraftnät 2009, Threshold effects and renewable energy *[Tröskeleffekter och förnybar energy]*, Ref. no. 1495/2008/AN46. Available in Swedish from: www.svk.se/Global/02_Press_Info/Pdf/090420-Troskeleffekter-bilaga.pdf

connecting to a grid that lacks spare capacity being forced to pay the entire grid reinforcement cost, including for added capacity that the producer itself cannot utilise. Producers that subsequently connect to the grid can then utilise this spare capacity without any particular cost. For this reason, no producer wants to be the first to connect to such a grid.

Svenska Kraftnät's proposal covers what is termed early sharing of the grid reinforcement costs, and also that the state through Svenska Kraftnät should take over the financial risk involved in making grid reinforcements with higher capacity than there is initially connected generation to cover. It is proposed that early sharing be done through sharing the cost of grid reinforcement across the capacity that the grid reinforcement provides. Thus, when producers connect to the grid, they pay their share of the total cost of the grid reinforcement in relation to their nominal installed capacity. In the same way, the grid company pays its share for the regional grid reinforcements that the grid company will be able to utilise at a later date. This eliminates the risk taking through Svenska Kraftnät providing subsidies that finance firstly the part of the grid reinforcement that the grid company does not immediately have any use for, and secondly the part that future producers have not taken up. This question is currently under consideration by the Government Offices of Sweden.

In an investigation (Greater proportion of biogas in a developed gas market *[Ökad andel biogas på en utvecklad gasmarknad],* EI R2009:12), the Energy Markets Inspectorate has proposed that the upgrading of biogas ought to comprise a part of grid operations, that is, something that the grid owner is responsible for, which means that the upgrade costs are distributed among the gas grid customers. According to current practice, it is the biogas producer who is responsible for upgrading the biogas to natural gas quality, with the cost of the upgrading comprising a significant portion of the total cost of the biogas. This investigation has been circulated for comment and is currently under consideration by the Government Offices of Sweden.

3. Describe the support schemes and other measures currently in place that are applied to promote energy from renewable sources and report on any developments in the measures used with respect to those set out in your National Renewable Energy Action Plan *(Article 22(1)(b) of Directive 2009/28/EC).*

Note that an account of the changes with regard to support schemes and other measures being applied compared with the measures specified in the national Action Plan is given first and foremost under point 2. Under this point, only more detailed information about the support schemes for renewable energy requested in Table 3 is provided.

Note also that the support schemes listed in Table 3 in many instances overlap each other, and for this reason it may be difficult to obtain a true picture of the total subsidies involved. This factor, together with the fact that it has not been possible to quantify all aid for renewable energy (and because it has not been possible to separately record energy tax exemptions), is the reason why the total calculated aid, per sector and in total, have not been specified.

Generally speaking for Table 3, the specified age levels are the estimated values. It should therefore not be interpreted as the aid level, whether a capital grant or a loan, amounting to precisely the level specified in this table. For example, the table should not be interpreted as the subsidy for solar photovoltaic cells amounting to SEK 1.1/kWh of electricity for all beneficiaries. The table should not be taken out of its context and makes no claim to be complete.

Table 3: **Support schemes for renewable energy Note comments about the table and footnotes.**

RES support schemes, year specified per scheme		**Aid per unit[a]**	**Total, millions SEK***	**Total, MEUR*[a]**
Renewable electricity 2010				
Electricity Certificate System[b]	Obligation/quota (%) = 17.9 % of quota-bound			
	electricity use. Penalty/Buy out option/ Buy out price	420 SEK/MWh	0.8 MSEK	
	Average (euro/unit) electricity certificate price	295 SEK/MWh	5092 MSEK (to renewables excl. peat), 792 MSEK (to peat)	
Solar photovoltaic cells 2009-2012				
Investment aid for solar photovoltaic cells	Investment subsidies (capital grants or loans) (euro/unit)	1.1 SEK/kWh[c]	Granted amount (2009-2011) approx. 195 MSEK. Granted amount (to 30-09-11) approx. 83.2 MSEK.	
Wind power 2009				
Aid for placing wind power on the market	Investment subsidies (capital grants or loans) (euro/unit)	Information not available	181 MSEK (2009). As per Government bill 2010/11:1	
Renewable heating 2006–2010				
Investment aid for conversion from direct-acting electro heat in dwelling houses[d]	Investment subsidies (capital grants or loans) (euro/unit)	0.11 or 0.39 SEK/kWh electricity savings[d]	722 MSEK (1 Jan 2006 to 13 July 2011)	
Solar heating (solar thermal collectors for the production of hot water)				

RES support schemes, year specified per scheme		Aid per unit[a]	Total, millions SEK*	Total, MEUR*[a]
Investment aid for solar heating [e]	Investment subsidies (capital grants or loans) (euro/unit)	0.15 SEK/kWh[e]	160 MSEK (1 Jan 2000–4 Oct 2011)[e]	
Renewable fuels 2009 and 2010				
Energy and carbon tax exemption for biofuels[f]	Tax exemption/refund	Information not available	2040 MSEK[g] (2009) 2330 MSEK[g] (2010) In the government communication Annual account of tax expenditure 2011 [*Redovisning av skatteutgifter 2011]* the tax loss from the energy tax exemption for biofuels is estimated to be 1840 MSEK for 2011 and 2170 MSEK for 2012.	
Energy and carbon tax exemption for biofuels (not for transport)[f]	Tax exemption/refund	Information not available	180 MSEK[g] (2009 and 2010, respectively). Note that this only applies to energy and CO_2 tax exemptions for certain heating fuels (vegetable oils and fats, etc., and biogas). In the government communication Annual account of tax expenditure 2011, the tax loss from the energy tax exemption for biofuels, peat, etc., for heating is estimated to be 4840 MSEK for 2011 and 5000 MSEK for 2012.	
Vehicles				
Vehicle tax exemption for green cars	Tax exemption/refund		40 MSEK (tax loss 2009) 140 MSEK (tax loss 2010)	
Reduced taxable benefit value for green cars	Tax exemption/refund		440 MSEKg (tax loss 2009) 450 MSEK (tax loss 2010). In the government communication Annual account of tax expenditure 2011, the tax loss from the reduced taxable benefit value for green cars is estimated to be 410 MSEK for 2011 and 110 MSEK for 2012.	
Biogas and other renewable gases 2010 and 2011				
Investment aid for biogas and other renewable gases	Investment subsidies (capital grants or loans) (euro/unit)	-[h]	142 MSEK[h] of which 41 MSEK 2011	
Biogas 2009 and 2010				

RES support schemes, year specified per scheme		Aid per unit[a]	Total, millions SEK*	Total, MEUR*[a]
Investment aid for the production or refinement of biogas within the Swedish Rural Development Programme.	Investment subsidies (capital grants or loans) (euro/unit)	-[i]	40.1 MSEK[i]	
Total annual estimated aid in the electricity sector				
Total annual estimated support in the heating sector				
Total annual estimated aid in the transport sector				

***** The quantity of energy receiving aid per unit gives an indication of the effectiveness of the aid for each type of technology.

[a] The official rates of exchange have been used for the conversion of MSEK to euro.

[b] The average electricity certificate price specifies the average price based on all transfers executed in the account keeping system during the year in question and differs from the market price. In 2010, electricity certificates for 17.2 TWh of renewable electricity generation were allocated. Source: The Swedish Energy Agency 2011, The Electricity Certificate System 2011, ET2011:32. For comparison, for 2009 the following applies: Quota 17 %, Penalty 470 SEK/MWh in total 0.7 MSEK. Average electricity certificate price 293 SEK/MWh in total 4307 MSEK (for renewables excl. peat). However this system should not be deemed government aid in accordance with Article 107 TFEU subsequent to a decision by the Commission in 2003 in government aid case N 789/2002.

[c] Estimated as the total aid granted divided by the sum of the figures for estimated generation of electricity (on an annual basis) specified per actor in the applications, divided by an assumed life of 25 years. Because not all solar photovoltaic cells granted aid have yet come into production, there is currently no figure on the actual electricity generation.

[d] Reference: Swedish National Board of Housing, Building and Planning, 2011. SEK 0.11/kWh refers to the loss when the entire electricity savings are assumed to be due to the aid; and SEK 0.39/kWh refers to the loss when 28 % of the total electricity savings are assumed to be due to the aid (72 % of property owners report to the Swedish National Board of Housing, Building and Planning that they would have made the conversion even without the aid).

[e] Reference: Swedish National Board of Housing, Building and Planning, 2011. Because the Swedish National Board of Housing, Building and Planning is currently carrying out its final evaluation of the solar heating support scheme, this data should be seen as a very preliminary and may well be adjusted. 0.15 SEK/kWh represents the effectiveness of the subsidy calculated as annual aid (that is, the total aid converted into annual instalments for the 20 year life of the measure) divided by the solar thermal collectors' estimated annual production of heating (kWh/year) and is based on the assumption that all heat production that has been added from solar heating systems is due to the aid.

[f] Note that the carbon tax exemption for biofuels should not be seen as a form of aid for biofuels (because they ought to be tax-exempt from the emissions of fossil fuels they do not lead to from a life-cycle perspective); it is instead an instrument. In the government communication Annual account of tax expenditure, what the aid would correspond to in the form of tax exemption is calculated.

[g] Source: Ministry of Finance, 2011 which provided the information for the tax exemption that required state aid approval. Note also that the Swedish National Audit Office has examined the tax exemption for biofuels. This examination is reported in: Swedish National Audit Office 2010, Biofuels for a better climate – How is the tax exemption used? *[Biodrivmedel för bättre klimat – Hur används skattebefrielsen?]* RiR 2011:10.

[h] Since the aid goes to the production, purification, distribution and the use of biogas, good information regarding aid per unit is lacking. The total amount of new biogas produced thanks to the aid in 2010 amounted to 36.7 MNm3/year, of which almost 80 % was used in the transport sector. Aid was granted to a total of approximately 18 projects during 2010 and 2011.

[i] A national evaluation of biogas production from the facilities that have received aid is lacking. On 31 December 2010, a total of SEK 39 052 million had been granted to 23 biogas facilities and a total of SEK 1049 million had been granted to 6 digestion residue tanks. Source: Information from the Swedish Board of Agriculture, 2011.

Each authority that investigates the content and levels of support schemes for renewable energy is also required to carry out impact assessments of the analysed support schemes. These include, for example, assessing the socio-economic benefit and the impact on the environment. A political assessment is then made of the content and level before a final proposal is tabled. In recent times, the Swedish Government has attached great importance to these socio-economic impact assessments.

For example, for information about the methods used to determine the level within the electricity certificate system, see Swedish Energy Agency, 2009, The Task of proposing new quotas in the electricity certificate system *[Uppdrag att föreslå nya kvoter i elcertifikatsystemet]* ER2009:29. For an analysis of the instruments that impact Sweden's climate strategy (for example, energy taxes), see for example Swedish Energy Agency and Swedish Environmental Protection Agency 2007, Development in Sweden's climate strategy *[Den svenska klimatstrategins utveckling]* ET2007:29.

3.1. Provide the information on how supported electricity is allocated to final customers for purposes of Article 3(6) of Directive 2003/54/EC *(Article 22(1)(b) of Directive 2009/28/EC).*

Support for producers of renewable electricity through the electricity certificate system is paid for by those who have a renewable energy obligation. Those with a renewable energy obligation are (i) electricity suppliers the supply electricity to consumers; (ii) electricity consumers who use electricity that they themselves have produced, imported or purchased on the Nordic electricity exchange; and (iii) electricity intensive industries. Electricity intensive industries however have the right to deductions for electricity used in the manufacturing process when calculating their renewable energy obligation.

Under Chapter 8 Section 12 of the Electricity Act (SFS 1997:857), electricity suppliers are required to provide information about:

1 each individual energy source's share of the average composition of energy sources used to generate the electrical power that the electricity supplier sold during the immediately preceding calendar year, and
2 the impact on the environment in the form of carbon dioxide emissions and the quantity of nuclear waste resulting from the generation of the electricity sold.

This information is to be provided on or in conjunction with invoices for the sale of electrical power and in advertising directed at electricity consumers. The electricity supplier may also choose to direct the customer to where they can find this information, for example, on the company's website. Electricity from renewable energy sources that has been allocated certificates within the electricity certificate system is not accounted for separately, but the energy sources that are entitled to electricity certificates are described within the framework of the system.

A large proportion of the electricity in the Nordic countries is sold via the Nordic electricity exchange Nord Pool. The customers in this market purchase their electricity from electricity suppliers who in turn primarily purchase in electricity via Nord Pool. Under the rules in the Electricity Act (see above), a customer who has signed a contract with an electricity supplier is to receive information about the electricity supplier's electricity mix during the previous year. Some electricity suppliers also offer their customers the option of signing an electricity agreement that specifies the origin of the electricity, or example electricity from only wind power or only hydro power. The electricity supplier who purchases electricity via Nord Pool can purchase guarantees of origin in order to guarantee the specific origin of the electricity (the Swedish system for guarantees of origin for electricity is described under point 5). Requirements relating to the origin of the electricity may also be found in bilateral agreements. In this way, an electricity supplier can guarantee that an equivalent amount of electricity of a certain origin has been purchased. There are even some types of eco-labelling, such as Good Environmental Choice *(Bra Miljöval)*, where demands are made in relation to how the origin of the electricity can be traced. This is monitored during audits. Many electricity suppliers account for the origin of their electricity for their various contracts on their websites.

The Energy Markets Inspectorate has supervisory authority with respect to the Electricity Act. The Inspectorate is also currently working on developing regulations for marks of origin for electricity, which the Energy Markets Inspectorate it is also the supervisory authority for. The Swedish Energy Agency intends to publish a fact sheet about choosing production-specified electricity. This fact sheet will include information about how consumers can act in order to get electricity of a certain origin. The Swedish Consumer Agency is responsible for electricity suppliers complying with the rules that exist governing marketing, etc.

4. Provide information on how, where applicable, the support schemes have been structured to take into account RES applications that give additional benefits, but may also have higher costs, including biofuels made from wastes, residues, non-food cellulosic material, and ligno-cellulosic material *(Article 22(1)(c) of Directive 2009/28/EC)*.

Firstly, it should be mentioned that all via fuels produced from wastes, residues, non-food cellulosic material, and ligno-cellulosic material are entitled to a share in the relevant general instruments described under point 2 and in the Swedish National Renewable Energy Action Plan.

Biogas

Investment aid for the production or refinement of biogas within the Swedish Rural Development Programme (SFS 2007:481, see the description in the Action Plan). The overall goal of this aid is to achieve reduced emissions of greenhouse gases from the management of livestock manure in combination with the production of renewable energy carriers in rural areas. When distributing this aid, the following priorities are applied:

Livestock manure: High priority is to be given in the first instance to companies that, through investments in biogas, intend to:

1. digestive large quantities of livestock manure;
2. co-digest livestock manure and other substrates; or
3. in some other way, contribute to a significant reduction in greenhouse gas emissions in combination with the production of renewable energy carriers.

In the case of co-digestion (point 2 above), at least 50 % of the included substrate (wet weight) is to the comprised of livestock manure. When assessing whether a company meets this criterion, information is to be gathered about the company's access to livestock manure, either from the farm's own livestock farming or through contracts (for at least five years) with other livestock farming companies. For example point 3 above can concern (i) the digestion of cultivated crops (e.g. pasture) from cultivation systems where the crop in question serves a major environmental function in the crop cycle; (ii) the digestion of perennial crops cultivated in nutrient rich soil for the purpose of minimising tillage and us also greenhouse gas emissions; or (iii) the digestion of waste from the food industry.

Storage of digestion residue: High priority shall be given to facilities where discharges from the digestion residue are minimised through secondary digestion in sealed tanks with gas collection. High priority may also be given to facilities where other solutions are applied to the same end, and which can be deemed to be an equivalent alternative to gas-tight storage in tanks. Equivalent alternatives might be, for example, regulating the temperature of the digestion residue in combination with some form of stable floating crust. Systems that involve a very high degree of digestion of the substrate through, for example, long dwell times, may also function as equivalent alternatives.

Investment aid for measures to promote biogas and other renewable gases (SFS 2009:938 – see description under point 2). The purpose of this aid is to promote energy technology that is climate-friendly but not yet commercially competitive. Each project can be granted a maximum of SEK 25 million in the funding may comprise a maximum of 45 % of the additional expenditure in the project. When distributing this aid, priority is given according to the following criteria:

- Energy and resource efficiency (emphasis on digestion residue handling);
- Greatest possible climate benefit (emphasis on reducing methane leakage);
- Technological potential in the project;
- Feasibility.

The technological potential is weighted higher than the other parameters because it is gives rise to the eligible additional expenditure. The aid is not directly designed to prioritise specific raw materials but instead emphasises a reduction in methane emissions. However in practice this means to a large extent that it is projects that make use of wet organic waste and livestock manure that are supported. During 2009, the Government allocated SEK 150 million for this aid. To date, the Swedish Energy Agency has distributed fully SEK 100 million.

Other biofuels made from wastes, residues, non-food cellulosic material and ligno-cellulosic material

Other biofuels from the priority raw materials qualify for tax relief[41] and other instruments to do with renewable fuels (and vehicles that can run on these) but as things currently stand they are not especially promoted in the existing system instruments. On the other hand, they are supported via research funding. One objective with these efforts is to develop production technology for biofuels with high efficacy and low net CO_2 emissions. The Swedish Energy Agency finances most of the big projects where the entire chain – from growing the raw material for biofuel to using the new fuel – is in focus. Among other things, this is done through research into fuel production methods, for example, in the ethanol research programmes (see description below which is to be viewed as an example of the research being done in Sweden). The Swedish Energy Agency finances many pilot and demonstration facilities in Sweden in order to drive the development of alternative fuels (see point 8).

The Ethanol programme aimed to develop technology that could support a cost-effective introduction of cellulose-based ethanol into the Swedish fuel market. The programme ran between 2007 and 2011 with a financial framework of SEK 144 million. The overall goal of the programme was to generate research results of sufficient quality that project planning of a demonstration facility based on enzymatic hydrolysis could be started after the end of the programme. The work was focused on identifying a limited number of alternative ethanol processes and on developing essential knowledge such that one or more of these processes could meet the overall goal of the programme. The activity covered laboratory studies from the basic level to pilot studies, and also permitted other types of efforts such as process modelling, synthesis and system-oriented studies. A new, subsequent programme for ethanol research entitled *Ethanol processes* with funding amounting to SEK 130 million will run from 9 June 2011 to 30 June 2015. The goal is for Sweden to continue to let lie at the forefront of research in the area and to attract industrial players.

Renewable electricity for transport

electricity certificates are allocated to electricity generation reduced from certain biofuels[42], but the electricity certificate system gives no extra advantage to this form of energy compared with other renewable energy that is entitled to electricity certificates that is, wind, solar, wave and geothermal power, some hydropower installations, and peat in cogeneration plants (see the description of the electricity certificate system under point 2 in the Action Plan). Renewable electricity from technologies that are deemed to need extra financial support has the opportunity to receive investment aid. Currently there is investment aid available for solar photovoltaic cells connected to the grid (see

[41] In principle, biofuels are exempted from both energy and carbon tax (see Table 2, points 3 and 15). Sweden has an approval from the Commission for the tax exemption (which is counted as State aid) until the end of 2013. The tax exemption is conditional on it not resulting in any over-compensation of biofuels. From 1 February 2012, the tax exemption for biofuels and bioliquids will be conditional upon the presentation of a valid sustainability statement. But already during 2011, decisions by the Swedish government on tax exemptions for biofuels will be conditional upon the fuel meeting the sustainability criteria in the Renewables Directive.

[42] This applies to biofuels (even in refined form) that consist of (1) trees, parts of trees, residues from tree felling and other waste and by-products from forestry; (2) bark, recovery liquors, sludge, tall oil, wood chips, shavings and other waste materials and by-products from the forestry industry's processes; (3) energy wood, energy crops, cereals, olive pits, nut shells, straw and reeds; (4) wood waste sorted at source and wood waste sorted from mixed waste; or (5) biogas formed when organic material such as manure, sludge from municipal and industrial treatment works, household refuse as well as waste from food production, restaurants and shops is broken down by methane-producing bacteria under anaerobic conditions.

under point 2). However there is no follow-up of which sector uses this form of renewable electricity. In Sweden, 58 % of electricity generation is comprised of renewable energy (2009) and the target in the electricity certificate system is around 25 TWh more of renewable electricity including peat by 2020 compared with 2002.

The development and use of electric and electric-hybrid vehicles is supported separately by instruments for 'green' cars (for example, reduced taxable benefit value and exemption from vehicle tax for five years – see point 2), and by research projects. An example of the latter is FFI (Strategic Vehicle Research and Innovation), Energy-Efficient Road Vehicles *[Energieffektiva Vägfordon]* and the demonstration program for electric vehicles[43]. The Swedish Energy Agency also supports the procurement of electric vehicles. However the use of renewable electricity is not specifically supported in these programmes. But the motivation for the aid is that electrification can result in increased energy efficiency and facilitate the use of renewable electricity.

[43] For more information see this page in Swedish
www.energimyndigheten.se/sv/Forskning/Transportforskning1/

5. Provide information on the functioning of the system of guarantees of origin for electricity and heating and cooling from RES, and the measures taken to ensure reliability and protection against fraud of the system *(Article 22(1)(d) of Directive 2009/28/EC).*

The Swedish system of guarantees of origin for electricity is described below. However, currently Sweden does not have any system of guarantees of origin for heating and cooling from renewable energy sources.

The purpose of guarantees of origin is to make it possible to rely on marks of origin electricity. The end consumer of electricity should be able to get clear information about the origin of the electricity. Under the Guarantees of Origin for Electricity Act (SFS 2010:601), electricity producers in Sweden have the right to get guarantees of origin issued that show the origin of the electricity produced. A guarantee of origin is given for each megawatt hour of electricity generated. Guarantees of origin can be issued for all types of electricity generation, which is more comprehensive than the Directive's minimum requirements. An application for the right to the allocation of guarantees of origin is made on a separate form[44] to the Swedish Energy Agency, which assesses the applications. The Swedish Energy Agency is also the supervisory authority under the Act and the agency has also issued regulations (STEMFS 2010:3). The allocation of guarantees of origin is managed in purely practical terms by *Affärsverket Svenska Kraftnät* (SvK). Guarantees of origin exist only electronically as a record in an account in SvK's account keeping system CESAR. There is thus an electronic register of guarantees of origin. The Swedish Energy Agency informs SvK of decisions concerning the right to the allocation of guarantees of origin and transfers the details that are necessary for the issuing of guarantees of origin to SvK. A guarantee of origin from another Member State of the EU is also recognised in Sweden unless there is reason to doubt its authenticity.

To warrant the reliability of the guarantees, there are requirements related among other things to measuring and reporting the transmitted electricity, unique identification numbers for each guarantee of origin and that the guarantees are to be cancelled after they have been used[45]. The party noted as the holder in the register of guarantees of origin is to ensure that the account keeping authority (SvK) cancels a guarantee of origin after it has been used. A guarantee of origin is also to be cancelled if it has not been used within 12 months of the time that the energy unit to which the guarantee of origin refers was generated. In this way, the cancellation becomes a guarantee that the producer and supplier do not sell more electricity of a certain origin than what has been generated. A guarantee of origin cancelled because of the 12 month rule cannot be used to label product-specific electricity but goes up into the residual mix.

The Swedish Energy Agency is the supervisory authority for the system of guarantees of origin and has the right to obtain on request information and to view the documentation required to carry out the supervision. The Agency also has the right on request to gain access to generation facilities as well as premises and sites associated with the generation facilities in question to the extent necessary to carry out the supervision. The Swedish Energy Agency can also revoke a decision concerning the allocation of guarantees of origin.

[44] The form is available from: www.energimyndigheten.se/Global/F %c3 %b6retag/Ursprungsgarantier/Formul %c3 %a4r/UG %20utf %c3 %b6rlig %20ans %c3 %b6kan.pdf

[45] For more detailed background about the system, see Government bill 2009/10:128 Implementation of the Renewable Energy Directive *[Genomförande av direktiv om förnybar energy]*.

The development of biomass for energy purposes (points 6-9 in the template)

6. Describe the developments in <u>the preceding 2 years</u> in the availability and use of biomass resources for energy purposes *(Article 22(1)(g) of Directive 2009/28/EC).*

Note that domestic and imported biofuel and biofuel raw materials are specified uniformly in thousands of tonnes of total solids (1000 tonnes TS) in Table 4. The reason for the choice of reporting unit is that tonnes TS is a better unit of measurement in comparisons of different sources of raw material. Note also that the figures in Table 4 for 2010 are preliminary. This is because the final versions of the underlying publications and other data on which these figures are based are not yet available. Note that the information regarding imports of biomass for transport should be treated with a certain amount of caution, since the focus of the reports used to compile this data was not to map origin. The uncertainty in these figures may therefore be significant. Exports of biofuels, if any, have not either been taken into account.

***Table 4*: The use of biomass for energy**

	Amount of domestic raw material (1000 tonnes TS)*		**Primary energy in domestic raw material (ktoe)**		**Amount of imported raw material from EU (1000 tonnes TS)***		**Primary energy in the amount of imported raw material from EU (ktoe)**		**Amount of imported raw material from non-EU (1000 tonnes TS)***		**Primary energy in the amount of imported raw material from non-EU (ktoe)**	
	Year 2009	**Year 2010**	**Year 2009**	**Year 2010**	**Year 2009**	**Year 2010**	**Year 2009**	**Year 2010**	**Year 2009**	**Year 2010**	**Year 2009**	**Year 2010**
Biomass for heating and electricity:												
Direct use of wood biomass from forests and other wooded land energy purposes (fellings etc.)**	6500	9000	2790	3780	330	320	130	130	215	240	85	95
Indirect use of wood biomass (residues and co-products from wood industry, etc.)**	17800	18300	6030	6230	470	530	130	150	480	560	115	130
Energy crops (grasses, etc.) and short rotation trees (Salix)	55	60	20	20								
Agricultural by-products / processed residues and fishery by-products **	270	290	130	140	95	95	70	70				
Biomass from waste (municipal, industrial etc.) **	2670	3250	820	1000								
Other - Biogas	210	210	70	60								
Biomass to transport:												
Traditional agricultural crops for biofuels (sugar cane, cereals, maize)	400	410	140	140	790	1260	390	530	2060	1080	230	120

Energy crops (grasses, etc.) and short rotation trees for biofuels (Not used)												
Other – Biomass-based waste for biogas	130	180	40	50								
Residues/by-products from the pulp and paper industry (sulphite liquor and tall oil)	20	50	1	6								

* Amount of raw material, if possible in m3 for biomass from forestry, and in tonnes for biomass from agriculture and fishery, and biomass from waste. Note that domestic and imported biofuel and biofuel raw materials are specified uniformly in thousands of tonnes of total solids (1000 tonnes TS). In Tables 7 and 7a in Sweden's Action Plan, tonnes of TS (or dry matter) and ktoe are also used as units of measurement.
** The definition of this biomass category should be understood in line with Table 7 of part 4.6.1 of Commission Decision C (2009) 5174 final establishing a template for National Renewable Energy Action Plans under Directive 2009/28/EC.

Comments on the category 'forest fuels'

The following forest fuels are included in the reporting:

- Round timber and fuel wood
- Residues from tree felling such as branches, tops and (stumps)
- The forestry industry's solid residues such as shavings and bark, etc.
- The forestry industry's liquid residues such as black liquors, crude tall oil, and tall oil pitch
- Recovered (recycled) wood such as packing material, old furniture and demolition timber
- Processed fuel wood such as pellets, briquettes and wood powder.

Imports

A variety of forest biofuel raw materials are sometimes imported (including pellets[46], wood waste[47] and shavings/sawdust[48]). In such cases, the quantities are reported separately. Indirect imports also occur, that is, that the forest industry imports round timber for forestry purposes. When processing round timber, whether this is done mechanically in a sawmill or processed into pulp, residues are generated that can be used for energy purposes. Reliable statistics that this are lacking.

The following sources of information have been used concerning fuel from forestry:

- The Swedish Forest Agency[49]
- The Swedish Energy Agency[50]
- Statistics Sweden (SCB)[51]
- Swedish Fuel Wood Association *[Svenska trädbränsleföreningen]*[52]
- Swedish Pellet Association *[Pelletsindustrins Riksförbund]*[53].

[46] The Swedish Pellet Association, Statistics. http://www.pelletsindustrin.org.
[47] The Swedish Forest Agency. Swedish Statistical Yearbook of Forestry 2010. Tables 15.2 and 15.7 www.svo.se.
[48] The Swedish Forest Agency. Swedish Statistical Yearbook of Forestry 2010. Tables 15.2 and 15.7 www.svo.se.
[49] The Swedish Forest Agency. Swedish Statistical Yearbook of Forestry www.svo.se.
[50] The Swedish Energy Agency. Energy in Sweden 2010 www.energimyndigheten.se.
[51] Statistics Sweden (SCB). Statistics publications, EN11, EN31, EN23, ES2011:1, ES2011:2, ES2011:3. www.scb.se.
[52] The Swedish Fuel Wood Association. Annual reporting to the Swedish Energy Agency (2009/2010). www.tradbransle.se.
[53] The Swedish Pellet Association. Statistics. www.pelletsindustrin.org.

The following sources of information have been used for the conversion rates and ratios:

- The conversion between the units of measurement m^3 and tonnes TS has been done on the basis of established conversion rates/ratios in forestry in accordance with the Practical forestry manual *[Praktisk skogshandbok]* (1992)[54].
- The conversion between the physical units of measurement (m^3 and tonnes TS) and energy units is done on the basis of established conversion rates according to Lehtikangas (1998)[55].
- Conversion rates for waste liquors were derived from Alakangas (2000)[56].

The following conversion rates are used for fuel wood:

- Residues from tree felling, round timber, etc. 4.65 MWh/tonne TS
- Sawdust and bark, etc. 4.5 MWh/tonne TS
- Black liquors, etc. 3.6 MWh/tonne TS
- Black liquors, etc. 4.8 MWh/tonne TS
- Recovered wood 4.8 MWh/tonne TS

Comments on the category biomass from agriculture
The biofuels and biofuel raw materials included are:

- Cereals
- Straw
- Short rotation trees (Salix)
- Bio-oils (animal and/or vegetable oils and fats)
- Olive pits, sunflower pellets, bean pods/husks, etc.

The information about fuel from agriculture comes from the following sources:

- SCB[57]
- Swedish University of Agricultural Sciences[58]
- The Bioenergy Portal *[Bioenergiportalen]*[59]
- Swedish Board of Agriculture[60]
- Swedish Fuel Wood Association *[Trädbränsleföreningen]*.[61]

The conversion between physical units of measurement (m^3, tonne, tonne TS) and energy units (MWh or similar) is done on the basis of established conversion rates/ratios in agriculture, derived in part from Data book for operational planning in agriculture *[Databok för driftsplanering i jordbruket]* (1992)[62], and in part from the Bioenergy portal[63] as well as Fredriksson et al (2004)[64].

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[54] The Swedish Forestry Association. 1992. Practical forestry manual (1992).
[55] Lehtikangas, P. 1998. Storage Handbook *[Lagringshandboken]*. Swedish University of Agricultural Sciences.
[56] Alakangas, E. 2000. *Suomessa käytettävien polttoaineiden ominaisuuksia. Tiedotteita. 2045*. VTT. Finland.
[57] SCB. 2009 and 2010. The Provision of Electricity Gas and District Heating *[El-, gas- och fjärrvärmeförsörjningen]*, EN11SM.
[58] Swedish University of Agricultural Sciences. 1992. Data book for operational planning in agriculture.
[59] www.bioenergiportalen.se
[60] Swedish Board of Agriculture, 2011. Annual agricultural statistics www.jordbruksverket.se and separate report to the Swedish Energy Agency for Article 22 progress reports.
[61] The Swedish Fuel Wood Association. Annual reporting to the Swedish Energy Agency (2009). www.tradbransle.se.
[62] Swedish University of Agricultural Sciences. 1992. Data book for operational planning in agriculture.
[63] www.bioenergiportalen.se
[64] Fredriksson, C., Padban, N. and Zinti, F. 2004. Broadening the fuel base for pellets and powder burners *[Breddning av bränslebasen för pellets och pulverbrännare]*. Swedish District Heating Association.

The following conversion rates used for biomass from agriculture:

- Cereals 4.0 MWh/tonne TS
- Straw 4.0 MWh/tonne TS
- Short rotation trees (Salix) 4.6 MWh/tonne TS
- Bio-oils (animal and/or vegetable oils and fats) 9.3 MWh/tonne
- Olive pits, sunflower pellets, bean pods/husks, etc. 5.0 MWh/tonne TS.

Comments on the category solid waste

The information about refuse derived fuel (RDF) and biogas comes from the following sources:

- Swedish Energy Agency[65]
- Avfall Sverige AB.[66]

The renewable fraction of the waste has been consistently assumed to be 50 % (for reference and reasoning, see point 12 according to the template). This proportion may be corrected once the basic data has been analysed more thoroughly and statistics in the area have been improved. The renewable fraction of solid municipal waste, including bio-waste and the biodegradable fraction of industrial waste is specified in tonnes of total solids.

Comments on the category biomass for transport

The quantities specified in Table 4 are an estimate of the amounts of raw material used for the production of various biofuels. The following raw materials are included in the reporting:

- Cereals
- Maize
- Sugar cane
- Oil plants
- Catering waste sorted at source
- Waste from foodstuffs
- Slaughterhouse waste
- Sewage sludge
- Industrial waste
- Tall oil
- Sulphite liquor.

Since neither energy crops nor short rotation trees are used for the production of biofuel in Sweden, there is no data about these in Table 4.

The information about biomass for transport comes from the following sources:

- Swedish Energy Agency[67]
- Contacts with Swedish producers of biofuels.[68]

[65] The Swedish Energy Agency. Energy in Sweden 2010.
[66] www.avfallsverige.se.
[67] Swedish Energy Agency, 2011. Surveillance report on tax exemption for biofuels for 2010, Ref. no. 00-11-428, Swedish Energy Agency, 2010. Surveillance report on tax exemption for biofuels for 2009, Ref. no. 00-10-848, Swedish Energy Agency, 2011. The Markets for Ethanol and Biodiesel *[Marknaderna för etanol och biodiesel],* ER2011:13, Swedish Energy Agency, 2011. The Transport Sector's Energy Use 2010 *[Transportsektorns energianvändning 2010]*, ES2011:05, Swedish Energy Agency, 2011. The Transport Sector's Energy Use 2009, ES2010:04, Swedish Energy Agency, 2010. Production and Use of Biogas in 2010 *[Produktion och användning av biogas år 2010]*, ES2011:07, Swedish Energy Agency, 2011. Production and use of biogas in 2009, ES2010:05.
[68] Lantmännen Agroetanol AB, SEKAB AB, Perstorp Bioproducts, PREEM AB.

Information about the origin of imported quantities of biofuel has been obtained to some extent from the annual report produced by the Swedish Energy Agency in its work of monitoring the companies that hold an exemption from energy and carbon taxes on biofuels. This investigation covers virtually all oil companies, importers and producers of biofuels in Sweden and is based on information from the companies themselves. The focus of the investigation is not to map origin, which means that the figures should be treated with a certain amount of caution. On the other hand, the figures provide an approximate picture of the relationships between different origins of ethanol. The raw materials used in many instances are not specified in the statistics, and for this reason some assumptions about the raw materials used to produce the ethanol have been made, for example, sugar cane for Brazilian ethanol, etc. Concerning biodiesel, RME is the only form used in Sweden (on a commercial scale) and for this reason all imported by a diesel is assumed to have been produced from rape seed oil. The data about Swedish production is based on information from Swedish RME producers in terms of both the use of Swedish raw materials and import of raw materials. The same applies for ethanol. For biogas, statistics are kept for production and use as well as which substrate has been used, and for this reason this information has been used.

The conversion from physical units of measurement for raw materials to energy terms has been done with the help of various conversion factors is taken from:

- Alakangas (2000)[69]
- The Phyllis database[70]
- Swedish Board of Agriculture[71]
- *Bioenergiportalen*[72]
- USDA[73]
- Hadders (2004).[74]

Biogas is reported in the substrates used for refined biogas (the proportion used as a vehicle gas). the conversion from physical units of measurement for the substrate to energy content has been done with the help of various conversion factors taken from Substrate handbook for biogas production *[Substrathandbok för biogasproduktion]*[75] (2009), Basic data about biogas *[Basdata om biogas]* (2011)[76] and Alakangas (2000)[77].

The main residue used from forestry is tall oil, which is refined into HVO. The energy value for tall oil has been taken from Alakangas (2000) and for sulphite liquor (for ethanol production) from Paper products – Basic module *[Papperprodukter – en basmodul]* (2010)[78].

The Swedish Energy Agency as being in contact with the Commission[79] and describe the difficulties of filling in Table 4 in its entirety. Firstly, it is difficult to fill in the total biomass usage in biomass terms. This is due to the industry's production pathway and because it is not possible to determine exactly what specific quantities (domestic or imported) have actually been consumed in the process. Imported round timber is used primarily for industrial purposes but various waste and by-products are generated at different stages in the process and may be used for energy purposes. Secondly, we find it difficult to enter in full the amount of biomass for energy purposes that is imported. This is because the current import statistics do not specify the purpose for which the raw material is being imported.

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[69] Alakangas, E. 2000. *Suomessa käytettävien polttoaineiden ominaisuuksia. VTT tiedotteita 2045*. Finland.
[70] ECN, "Phyllis database for biomass and waste", available from: www.ecn.nl/phyllis/single.html
[71] Tolke et al, 2011. Renewable fuels from agriculture – ethanol, biodiesel, biogas *[Förnybara drivmedel från jordbruket – etanol, biodiesel, biogas]* Report 2011:14.
[72] Available in Swedish from: www.bioenergiportalen.se
[73] USDA, 2002. The Energy Balance of Corn Ethanol: An Update.
[74] Hadders, G. 2004. Cereals as fuel *[Spannmål som bränsle]*.
[75] Carlsson, M., Uldal, M. 2009. Substrate handbook for biogas production *[Substrathandbok för biogasproduktion]*, Svensk Gasteknisk Centrum AB. Report SGC 200.
[76] Svenskt Gastekniskt Centrum AB, 2011. Biogas – Basic data about biogas 2011 *[Biogas – Basdata om biogas 2011]*.
[77] Alakangas, E. 2000. *Suomessa käytettävien polttoaineiden ominaisuuksia. VTT tiedotteita 2045.* Finland.
[78] Svanen, 2010. Paper products – A basic module *[Pappersprodukter – en basmodul]*.
[79] Via e-mail correspondence with policy officer Kristine Kozlova and her colleagues. Sweden has also described the causes of this for the Commission in its reply to letter ENER C1/FPL/pd D (2011) 102 445 from the Commission with questions regarding the Swedish NREAP.

Compared with the Action Plan, its progress report has better information about importation of some ranges of unprocessed fuel wood products via the Swedish Forest Agency's import statistics (does not apply to 2010 since those data are not yet available). This progress report also contains better information about the importation of raw materials for biofuels and that information about biogas is now accounted for in two categories: (i) biogas for heating and electricity; and (ii) biogas for transport. In addition, information for sulphite liquor and tall oil, which are used for fuel production, is accounted for this time.

Table 4a. Current domestic agricultural land use for production of crops dedicated to energy production (ha).

Land use	Surface (ha)	
	2009[1]	**2010**[1]
1. Land used for traditional arable crops (wheat, sugar beet etc.) and oilseeds (rapeseed, sunflower etc.) (Please specify main types)	At least around 77 000 (of which 72 000 is wheat, triticale, barley and rye, and at least 5 000 is rape seed)	At least around 85 000 (of which 83 000 is wheat, triticale, barley and rye, and at least 2 000 is rape seed)
2. Land used for short rotation trees (willows, poplars). (Please specify main types)	Around 13 000 (of which Salix 12 000, Poplars 400, Hybrid aspen 200)	Around 12 000 (of which Salix11 500, Poplars 500, Hybrid aspen 200)
3. Land used for other energy crops such as grasses (reed canary grass, switch grass, Miscanthus), sorghum. (Please specify main types)	Around 800 (Reed canary grass)	Around 800 (Reed canary grass)

[1] The information for traditional agricultural crops is based primarily on information from the biggest biofuel producers (Lantmännen Agroetanol AB, Perstorps Bioproducts AB and Energigårdarna Eslöv/Ecobränsle) but for rape seed 2009 from the Swedish Board of Agriculture. The information for short rotation trees and other energy crops comes from the Swedish Board of Agriculture and is clarified in the text below.

The Swedish Board of Agriculture's statistics on agricultural land use contain information about which crops are grown and on which acreages. However there is no information about what the crops are used for. Today's biofuel is produced primarily from cereals that may also be used for the production of food and feed. There are no official statistics for precisely how great a proportion of domestically produced cereals go to biofuel production.

For the years 2005-2009, there is data for this through the special aid that existed during that time for energy crops. For these years, there is a statistical foundation that covers the areas of energy crops cultivated on arable land for which aid was sought. We can only get information about the size of the areas of arable land on which energy crops were cultivated where no application for energy crop aid was made for dedicated energy crops that do not have any alternative use (for example, energy wood and energy grass). For 2009, a comparison of the areas receiving energy crop aid and areas receiving farm payments shows that energy crop aid was not applied for, for fully 20 % of the total areas used for dedicated energy crops (that is, energy wood and energy grass) receiving farm payments. The figures in Table 4a correspond to the total area for energy wood and energy grass receiving farm payments, which is assessed as being in principle comprehensive.

Because the energy crop aid could only be applied for until 2009, from 2010 the Swedish Board of Agriculture only has information about dedicated energy crops such as short rotation coppice (Salix, hybrid aspen, poplars) for energy wood on arable land and energy grass (reed canary grass). These figures based on areas receiving farm payments are reported in the table above.

In 2009, for traditional agricultural crops energy crop aid was sought 5400 ha of oil crops (rape seed and turnip rape) and for cereals 2530 ha for wheat and triticale and 540 ha for oats. For cereals however the energy crop aid unfortunately does not provide any good foundation for statistics. The figure for wheat however does not tally with the production of ethanol from domestically produced wheat that occurs in Sweden today. The reason for the difference is most likely that the farmers do not wish to bind themselves to contracts, which was a requirement in order to receive energy crop aid. The farmers want to be free to dispose of their harvest to the application that pays best. The figures for areas used for traditional agricultural crops intended for energy generation in the table above are therefore based primarily on information received from the biggest biofuel producers in Sweden. But since the figures for areas of rape seed from the producers asked to provide the information were lower than from the energy crop aid, the latter has been used for 2009.

7. Provide information on any changes in commodity prices and land use within your Member State in the preceding 2 years associated with increased use of biomass and other forms of energy from renewable sources. Please provide where available references to relevant documentation on these impacts in your country *(Article 22(1)(h) of Directive 2009/28/EC).*

Changes in commodity prices

No empirical studies have been done that show what impact the increased domestic use of biomass has had during the period on either domestic raw material prices or domestic land use. Neither are there any observed major changes in either land use or raw material prices during the period in question that can directly be explained by the increased use of biomass. It is assessed that the changes that have anyway occurred could be explained by many factors, among which an increased demand for biomass is one.

One reason for the link being weak is assessed to be due to the fact that the majority of biomass usage is primarily based on waste and residues with limited alternative areas of use. In a future where competition for these waste and residue products could arise, or when forests or agricultural land is used to a greater extent than currently directly for the production of biomass for energy purposes, more tangible effects may arise.

The trend in prices for solid biofuels is shown in Figure 2.

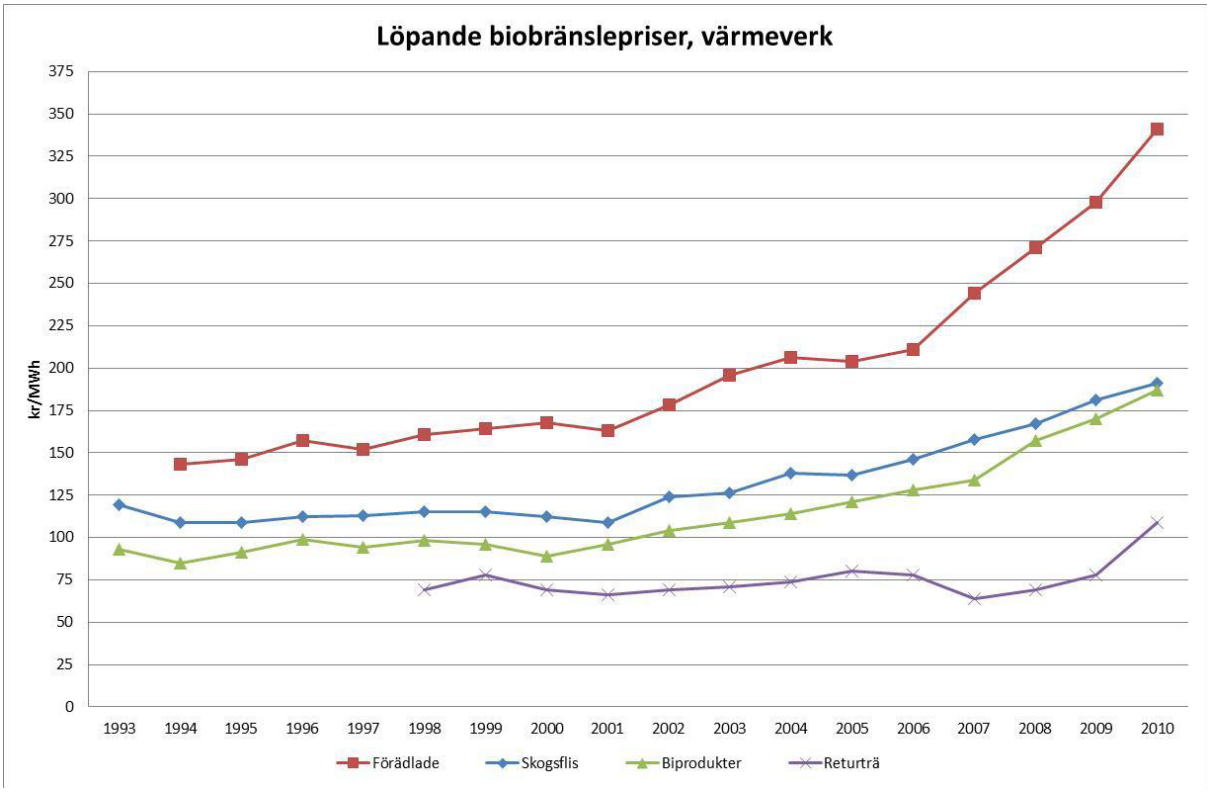


Figure 2: **The trend in prices for fuel wood and peat used by heating plants. Processed biofuel includes pellets, briquettes and wood powder. (Source: Swedish Energy Agency price list).**

(Translation of figure above:

Biofuel prices, heating plants
Y-axis = yr/MWh

Red = Processed Blue = Forestry chips Green = Byproducts Purple = Recycled wood)

During the spring of 2011, the Swedish Energy Agency was tasked with analysing the market for ethanol and biodiesel[80]. In this report, it was found that the costs of raw materials have become an increasing large proportion of the production costs for biofuels. This is due in part to the fact that production costs have decreased and in part to the costs of raw materials having increased. The conclusion has thus been drawn that the link between the agricultural markets and the energy markets is becoming stronger and stronger, and the probability is that oil prices will increasingly modulate the prices of biofuels in the future.

Changes in land use due to increased use of bioenergy

Because the predominant use of biofuel in Sweden today comprises by-products and residues generated by forestry, the wood and timber industry, and the pulp and paper industry (see Table 4), its use is currently not leading to changes in land use. It is assessed that the cultivation of energy wood in the form of short rotation coppice is not either influencing land use to any appreciable extent. The current use of domestic crops for the production of biofuels and bioliquids is still limited, and is assessed as not either leading to any change in land use in Sweden. Because the total cultivated area for cereals and rape seed/turnip rape has reduced compared with 2008 (applies to both 2009 and 2010)[81], it is only reasonable to assume that the majority of cereal and rape seed cultivation for biofuel production is occurring on what was previously open areas of arable land.

Changes in land use due to the expansion of wind power

In Sweden in 2009, 198 wind power plants (188 on land and 10 offshore with a total capacity of 363 MW of which 30 MW is offshore) were built, and in 2010, 389 wind power plants (all land-based with a total capacity of 574 MW)[82] were built. The mean power generated by new wind power plants was 1.8 MW in 2009 and 1.9 MW in 2010.

The land occupied varies depending on conditions at the site as well as the requisite distance from other land use. There is a safety distance to residents that is associated with the sound levels (40 dBA), that is, not any strict distance. This generally means a distance of at least 500 m, often more. A general figure used to estimate the land required for a wind power installation is around 0.3 km^2 for a normal 2-3 MW power plant. However wind power plants generally only change land use to a certain extent, since the land around them can still be used for certain purposes. Industrial activities are compatible with wind power installations, but are naturally dependent on other parameters as well. Agriculture or forestry are very common in wind power areas and here, the establishment of a wind power plant does not mean in practice any demands in terms of distance to the plant. Roads, etc., to wind power plants of course take some land and can alter the current land use. However there is no estimate of this area available. During the construction phase, access to the land around wind power installations is limited for security reasons, but not to operating installations. For the former, the same rules apply as to other construction sites. With regard to the safety distance for ice throw, there are control programs that can indicate that access roads may be closed if there is a risk of ice throw, but this is in special cases.

This means that it is deemed to be not possible to estimate quantitatively the change in land use resulting from wind power.

The change in land use due to the expansion of wind power in 2009 and 2010 is assessed to be minimal.

[80] Swedish Energy Agency 2011. Analysis of the markets for ethanol and biodiesel *[Analys av marknaderna för etanol och biodiesel]*, ER 2011:13.
[81] Based on information from the Swedish Board of Agriculture, 2011.
[82] Swedish Energy Agency, 2011. Wind power statistics *[Vindkraftsstatistik]* 2010, ES 2011:06.

8. Describe the development and share of biofuels made from wastes, residues, non-food cellulosic material, and lingo cellulosic material *(Article 22(1)(i) of Directive 2009/28/EC)*.

Note that because complete information about the origins of imported biofuels is lacking, and because final information about which raw materials for biofuels are to be double-counted is still lacking, no more complete information concerning the use of biofuels than that which is in Table 5 can be provided at the present time. Under the headings "Total usage of Art.21(2) biofuels" and "% share of 21(2) fuels from total RES-T", only the known quantities have been counted, which means that they may be underestimates. More complete information will need to be provided in the next progress report.

Table 5: Production and consumption of Art.21(2) biofuels (ktoe).

Article 21(2) biofuels[83]	2009	2010
Production –		
Biogas	36	49
Ethanol	1[a]	2[a]
HVO (hydrogenated vegetable oils)	0	4[b]
Usage – Biogas Ethanol HVO	36 At least 1[c] 0	49 At least 2[c] 4
Total production of Art.21(2) biofuels	37	55
Total usage of Art.21(2) biofuels	At least 37	At least 55
Share of 21(2) fuels from total RES-T (%)	At least 7 %	At least 10 %

[a] Ethanol from sugar-rich liquor sourced from sulphite pulp production. Source: SEKAB, 2011.
[b] HVO based on crude tall oil. Source: PREEM, 2011.
[c] The information refers to ethanol from sugar-rich liquor sourced from sulphite pulp production. Source: SEKAB, 2011. Ethanol produced from residues from wine production is also used in Sweden, but complete information about the origins of imported biofuels is lacking and its total contribution is unknown (SEKAB however reports a figure for 2010 corresponding to 7 ktoe). In the next progress report, there will be information about the quantities of fuel produced from residues, etc., via the system for sustainability criteria.

The use of biogas in the transport sector has increased significantly in recent years. For more information about HVO, see point 9. There are several projects running in Sweden concerning the development of more biofuels from waste, residues, non-food cellulosic material, and ligno-cellulosic material.

SEKAB E-technology is operating a demonstration production facility for cellulose-based ethanol. The annual capacity of the facility if it is run continuously is 100-150 m^3. However, because the facility is being run in campaigns in order to test various process parameters, different raw materials, etc., its actual production is only a few tens of m^3 per year, all of which is used internally and only in part as fuel. The Swedish Energy Agency is contributing financially.

Chemrec has a demonstration facility of pilot scale for producing DME from biomass in Piteå, which was opened in September 2010 and which will probably begin producing soon. The Swedish Energy Agency is supporting this facility financially and is also supporting the development of trucks from Volvo that can run on DME.

GoBiGas is a project for the conversion (via gasification) of forestry raw materials into bio-methane (biogas), and as part of this project, a demonstration facility is being built in Gothenburg. The Swedish Energy Agency is providing financial support (aid granted: maximum SEK 222 million to Göteborgs Energi). The plan is to initially build a 20 MW facility. The facility will then be dimensioned for around 100 MW gas (with an estimated production of around 800 GWh/year).

In addition there is a project running with the purpose of extracting biofuel from black liquor via gasification at a facility in Domsjö, Örnsköldsvik (using Chemrec AB's technologies). This project will entail the pulp mill developing its bio-refinery with pulpwood and other biomass as the raw materials and paper pulp and fuel as the products. The aid granted by the Swedish Energy Agency for this project is a maximum of SEK 500 million.

[83] *Biofuels made from wastes, residues, non-food cellulosic material, and ligno-cellulosic material.*

9. Provide information on the estimated impacts of the production of biofuels and bioliquids on biodiversity, water resources, water quality and soil quality within your country in the preceding 2 years *(Article 22(1)(j) of Directive 2009/28/EC).*

The biofuels produced in Sweden from crops comprise primarily ethanol and biodiesel. Biogas is produced from residues from the community.

Production of biofuels

Ethanol

In Sweden in 2009, the use of ethanol for biofuels amounted to 391 000 m^3 (which is the equivalent of around 2.30 TWh or 199 ktoe) and in 2010 it amounted to 400 000 m^3 (2.36 TWh or 203 ktoe)[84]. In 2010, around one third of the ethanol used in Sweden was domestically produced[85]. At the same time, Sweden exported a certain amount of ethanol (73 000 m^3 in 2010)[86]. Around 90 % of the raw material for the total Swedish ethanol production was domestically produced in 2009. The corresponding figure for 2010 was around 70 %[87].

Today there are two factories in Sweden that produce ethanol on a commercial basis. The biggest ethanol production facility is located in Norrköping and operated by Lantmännen Agroetanol AB. Its production capacity is 210 000 m^3 per year (which is the equivalent of around 1240 GWh or 107 ktoe). Lantmännen produce ethanol through fermentation of cereals and the raw material comes primarily from Swedish farmers' crops[88]. However, if the Swedish harvest is of high quality and in demand as food, cereals of lower quality may be imported for ethanol production. The facility is located near the harbour and thus is well placed to import the raw material when demand and prices change.

The other Swedish factory is located in Örnsköldsvik where ethanol is produced from sugar-rich liquor sourced from Domsjö Fabrikers' sulphite pulp production (the ethanol is purchased by SEKAB). Its production capacity amounts to around 11 000 m^3 that is, around 9000 tonnes per year (around 65 GWh or 5.6 ktoe) but not all of it is used as fuel for transport. In 2009 and 2010, around 1330 tonnes and 3080 tonnes, respectively, of ethanol from SEKAB's facility was used as fuel, which corresponds to around 10 and 23 GWh, and 0.85 and 2.0 ktoe, respectively, per year[89]. The raw materials of this ethanol production will most likely be counted as industrial residue under the Renewables Directive's provisions concerning sustainability criteria. This means that this ethanol will not need to fulfil the sustainability criteria related to the land. For this reason, its impact on soil and water quality has not been analysed.

In addition to this, there is a demonstration facility for the production of ethanol from cellulose (formerly the ethanol pilot "*Etanolpiloten*") which is operated by SEKAB-E technology in Örnsköldsvik. Since this is a research and development project that only produces a small amount of ethanol (a few tens of cubic metres per year, of which only around 1-3 m^3 equivalent to 0.001 ktoe has been used as motor fuel and with a maximum capacity of 100-150 m^3)[90], this ethanol will not be included in the analysis in this part of the report.

[84] Swedish Energy Agency, 2011. Surveillance report on tax exemption for biofuels for 2010, Ref. no. 00-11-428.
[85] Swedish Energy Agency, 2011. Surveillance report on tax exemption for biofuels for 2010, Ref. no. 00-11-428.
[86] SCB statistikdatabasen. www.scb.se. (See also Swedish Energy Agency 2011. Analysis of the markets for ethanol and biodiesel *[Analys av marknaderna för etanol och biodiesel]*, ER 2011:13).
[87] Personal communication, Lantmännen Agroetanol AB, 25 May 2011.
[88] Swedish Energy Agency, 2011. Analysis of the markets for ethanol and biodiesel, ER 2011:13.
[89] Personal communication, SEKAB, 20 May 2011.
[90] Personal communication, SEKAB, 20 May 2011.

Biodiesel

In Sweden in 2009, the use of biodiesel amounted to 205 000 m^3 (1.89 TWh, 162 ktoe) and in 2010 to 225 000 m^3 (2.06 TWh, 178 ktoe).[91] Fully 60 % of the biodiesel (imported and domestic production) was produced in Sweden. There are a number of actors involved in the domestic production of biodiesel, of which most produce relatively small amounts. In 2010, at least five companies (Perstorps Bioproducts AB, Energigårdarna Eslöv/Ecobränsle, Karaby bioenergi HB, Norups gård AB, SoilOil i Häckeberga AB) have produced biodiesel.

Larger scale domestic production occurs in two facilities. Perstorp's facility in Stenungssund as a production capacity of around 180 000 m^3 per year (1.7 TWh or 142 ktoe). Energigårdarna's facility in Karlshamn as a production capacity of around 50 000 m^3 per year (0.5 TWh or 40 ktoe). The sum of this production capacity corresponds quite well to the use of biodiesel in Sweden in 2010, but in reality a significant proportion is in fact imported. The majority of the raw materials for Sweden's bio diesel production are currently imported (this applies for example to Perstorp's production). The rape seed oil used for this production is imported primarily from Denmark[92]. For the production in Karlshamn, around 60 % of the rape seed comes from Swedish crops[93].

In recent times, a new diesel product in the form of HVO (hydrogenated vegetable oils) has been launched on the market in Sweden. Preem has invested in a bio-refinery facility where common diesel can be produced from diesel raw material from crude tall oil but also from other crude bio-materials. Crude tall oil is transformed into diesel through hydrogenation, thus becoming identical with petrodiesel at the molecular level. The diesel from tall oil is then processed with fossil raw materials and the result is diesel with a renewable component. Currently, the raw material used is crude tall oil, which is a residue from the forestry industry where wood in the sulphate pulp process is converted into cellulose, ligno-cellulosic material and hemicellulose. Access to tall oil is limited, so that currently the maximum Swedish production capacity for diesel raw material from crude tall oil is 100 000 m^3. In 2009, no renewable diesel was produced in this manner in Sweden. In 2010 when production started up, the production of diesel tall oil amounted to 5000 m^3 (which is roughly the equivalent of 50 GWh or 4.3 ktoe)[94]. In 2011, production is much higher. Because crude tall oil is most likely to be counted as an industrial residue in the Swedish registry framework governing sustainability criteria, it will not need to fulfil the land criteria, and for this reason together, with the fact that production in 2010 was relatively limited, we have not analysed its impact on soil and water quality, etc.

Biogas

In Sweden in 2009, the use of biogas for transport amounted to around 43 Mm^3 (the equivalent of 0.42 TWh or 36 ktoe) and in 2010 to 59 Mm^3 (0.57 TWh, 50 ktoe).[95] Currently, all biogas used as fuel is upgraded and produced almost solely from domestic waste[96]. Most of the upgraded biogas (85 %) is used as fuel for gas-fuelled vehicles. The upgraded biogas comes from sewage-treatment plants and co-digestion plants that use, for example, catering waste, food waste, slaughterhouse waste, manure, slurry and to a lesser extent energy crops (the latter applies only to co-digestion plants). For 2009, there is no reliable information on the amount of crops used for biogas production. The estimate that exists is approximately 3000 tonnes wet weight of energy crops[97], which comprises 0.2 % of the total amount of substrate used in biogas production in sewage treatment plants and co-digestion plants. For 2010 the corresponding figures are around 39 000 tonnes wet weight and 0.6 %[98]. Because this

[91] Swedish Energy Agency, 2011. Surveillance report on tax exemption for biofuels for 2010, Ref. no. 00-11-428.
[92] Personal communication, Perstorp, 20 April 2011.
[93] Personal communication, Energigårdarna Eslöv/Ecobränsle, 110513, share of domestic varies around 55-65 %.
[94] Personal communication. PREEM, 13 May 2011.
[95] Swedish Energy Agency, 2011. Surveillance report on tax exemption for biofuels for 2010, Ref. no. 00-11-428.
[96] Swedish Energy Agency, 2010. Production and use of biogas in 2009 *[Produktion och användning av biogas år 2009]*, ES2010:05. Biogas.
[97] Swedish Energy Agency 2010. Production and use of biogas in 2009 *[Produktion och användning av biogas år 2009]*, ES2010:05.
[98] Swedish Energy Agency 2011. Production and use of biogas in 2010, ES2011:07.

quantity is so marginal, for the present we have chosen to disregard it in this analysis, and we consequently make the assumption that all biogas transport is produced from waste.

Other bioliquids

In 2010, the use of vegetable and animal oils and fats for heat production in Swedish cogeneration plants amounted to around 2.3 TWh. Since the majority of the vegetable oils and fats used are comprised of various forms of residues, which means that they will not need to fulfil the sustainability criteria related to the land, their impact on soil and water quality has not been analysed.

Impacts on biodiversity, water resources, water quality and soil quality

The use of agricultural land for growing crops for Swedish biofuel production

The current use of domestic crops for the production of biofuels and bioliquids is still limited, and is assessed as not leading to any change in land use in Sweden. Because the total area of land growing cereals and rape seed/turnip rape in Sweden has decreased compared with 2008 (applies to both 2009 and 2010)[99], it can be argued that cereals and rape seed/turnip rape for biofuel production has not led to any further impact (compared with if the crops were being grown for other purposes, which is a reasonable scenario). As long as new agricultural land take with these crops or other crops start being cultivated in order to be used as raw material, the effects of growing these crops are the same, whether the harvest is used to produce food or biofuel. However, in this section we attempt as far as possible to quantify the actual impact that the cultivation of crops for biofuels has. But it should also be noted that it is possible that the effects described below would arise even if Sweden did not have any production of biofuel from domestic raw materials. This would be the case if the same amount of wheat and rape seed was grown for purposes other than energy.

The Swedish Energy Agency receives to some extent information about annual production of ethanol and bio diesel, and to some degree the origin from the various producers in conjunction with the preparation of its Surveillance report on tax exemption for biofuels. However, these figures are not published because they are deemed to be sensitive. The producers are few, the information is confidential and cannot be used without the consent of the producers. In addition the proportion of domestic/imported raw materials varies from year to year depending on the harvest, the quality of the harvest and because the raw materials market is international.

For these reasons, we have elected to first estimate the maximum impact that the Swedish production of biofuels could have (with the exception of biogas, where we have actual production and know the origin of the raw materials). This means that the total production capacity for the production facilities for ethanol and biodiesel in Sweden has been used, while also assuming that all the raw materials in the calculations are domestically produced. The calculations below thus show an upper limit for the impact in Sweden for the years 2009 and 2010 (since the production capacity is the same for these two years). Furthermore, the approximate share of the crop produced in Sweden is also specified, along with what impact this has, taking into account this information. After contact with the producers of biofuel, we also give an account of how the actual production differs from the total production capacity, which means that we also comment to some extent on the possible impact from actual production. Note that the by-products produced as part of the biofuel production have not been taken into account, which accordingly ought to stand for a certain share of the effect that we report here for the biofuel (which consequently ought to comprise an overestimation of this impact). That the by-products' environmental impact has not been taken into account at all is of course a considerable simplification.

An estimate of the number of hectares of agricultural land used for the production of crops for Swedish biofuel production is reported in Table 4a. Based on the assumption that all raw materials are domestically produced, approximately 100 000 ha of agricultural land is needed to grow the

[99] Based on information from the Swedish Board of Agriculture, 2011.

cereals that correspond to the total production capacity for cereal-based ethanol (Agroetanol's facility of 210 000 m^3 per year). This corresponds to around 10 % of the total production of cereals in Sweden. Similarly, around 50 000 ha are needed to fully utilise the existing production capacity for biodiesel with domestic raw material.[100] This corresponds to around 45 % of the cultivation of oil crops in Sweden today.

Biodiversity

The land take for biofuel production in Sweden is marginal. Sweden's total utilized agricultural area is 2.6 Mha and comprises 6 % of Sweden's land area. Barely 0.1 Mha of agricultural area is utilized for crops for biofuels, which is the equivalent of around 0.2 % of Sweden's total land area. The total cultivated area is currently not controlled to any great extent by demand for raw materials for biofuels.

The loss of biodiversity in agriculture is well documented and is due to a high degree to rationalisation and new agricultural methods. Because it is so marginal, being able to quantify the effects on biodiversity of Sweden production of biofuels from wheat and rape seed is hardly possible. It is difficult to determine changes at all over such a short period of time as the two years that the Commission has asked for. In addition, questions arise concerning the choice of methodology and the zero alternative for comparison[101]. The production of various agricultural crops is dependent on demand and the general EU assistance to agriculture. Energy crops are grown in a similar way to conventional agricultural crops. The absence of a focus on biofuel would not necessarily mean reduced production of the crops. Work is currently being done in Sweden in an attempt to preserve biodiversity in agriculture. This work is done irrespective of what the products of agriculture are used for. The main initiatives are environmental compensation of various types in order to preserve biodiversity, as well as information and advice.

For the reasons mentioned above, it is hardly possible to quantify how the cultivation of raw materials for biofuels is impacting biodiversity. It is true that one could, in very rough terms, model what a marginal *indirect* impact might look like in the long term and with assumptions regarding, *inter alia,* how price signals in the markets might affect how landowners choose to use their land. However such analyses are extremely difficult and probably not very meaningful to do for an individual Member State.

Water resources

The interpretation of "water resources" is that it here refers to activities that impact water quality, that is, irrigation, etc. In Sweden, access to water is not a problem other than in particular years when parts of the country can be hit by drought. However, cereals and other crops used to produce biofuels are not irrigated, not even during years with drought.

The use of water in facilities that produce biodiesel amounts to less than one litre of water per tonne of rape seed oil[102]. The use of water in facilities that produce ethanol amounts to around two litres of water per tonne of ethanol[103]. Cereals are first ground down into a flour and then mixed with water before being fermented to produce ethanol. Besides ethanol, other products form at the same time – products which are used for animal feeding stuffs. Thus, a certain proportion of these two litres of water goes to other things than ethanol. In the production of digestion gas (biogas before upgrading) from sewage sludge, no water is generally added[104]. This production is instead part of the water

[100] Börjesson, P., Tufvesson, L., Mikael, L., 2010. Life-cycle analysis of Swedish biofuels *[Livscykelanalys av svenska biodrivmedel]*. Report 70, Lund University.
[101] Does this refer to land entirely unaffected by humans, that is, native forest, or is it when biodiversity in agriculture was at its greatest before the mechanisation of agriculture, or should one compare with a particular year before which the crop was used for something other than biofuel?
[102] Personal communication. Energigårdarna Eslöv/Ecobränsle, 16 May 2011.
[103] Personal communication. Agroetanol, 17 May 2011.
[104] Personal communications. Svenskt vatten, 17 May 2011, 9 June 2011. Information has also been obtained from others via DH (SGC on consumption during upgrading, Henriksdals reningsverk (municipal treatment works) on consumption when water is used to wash out carbon dioxide).

treatment process, and thus increases access to clean water. The upgrading/purification of digestion gas involves technologies that use water. The water consumed has been assessed as being around 0.05-0.1 litres/Nm^3 raw gas. (Some of the technologies used for upgrading, in particular water scrubbers, are based on using water to scrub carbon dioxide in particular from the digestion gas. For these, the water consumption goes up to 3.3 litres of water/Nm^3).

Soil and water quality

Since it is assessed that no new agricultural land is taken for the current production of crops for biofuels, the assumption is that these do not contribute to any direct changes in stored carbon in the soil that need to be taken into account in this context.

The production capacity for ethanol from cereals in Sweden amounts to 210 000 m^3. If all raw materials were domestic, the cultivation of wheat for ethanol would be adding around 650 tonnes of eutrophying substances ($PO4^3$ equivalents) and around 300 tonnes of acidifying substances[105] (SO2eq). See Table A below. If we assume that 70 % of the raw material is domestic, the cultivation of Swedish wheat for ethanol production would be adding around 460 tonnes of eutrophying substances ($PO4^3$ equivalents) and around 120 tonnes of acidifying substances (SO2eq). In 2010, around 90 % of the production capacity for cereal-based ethanol was used (in 2009 around 80 %), which means that the actual impact from the production was somewhat lower.

The production capacity for biodiesel is around 230 000 m^3. If all raw materials for the biodiesel that could be produced were domestic, the cultivation of rape seed for ethanol would be adding around 1850 tonnes of eutrophying substances ($PO4^3$ equivalents) and around 600 tonnes of acidifying substances (SO2eq)[106]. See Table A below. If we assume that barely 15 % of the raw material is domestic (based on information received from the producers concerning the share imported), the cultivation of rape seed for biodiesel production would be adding around 240 tonnes of eutrophying substances ($PO4^3$ equivalents) and around 80 tonnes of acidifying substances (SO2eq). According to information from the producers, because the actual production is far from the total production capacity, it appears that in reality only around 1.5 % of the total production capacity is used for production using domestic raw material, which means that the actual environmental impact from the biodiesel in such cases is lower by a factor of 10.

In 2009 the production of biogas for biofuel amounted to around 43 Mm^3 (the equivalent of 0.42 TWh or 36 ktoe), adding around 12 tonnes of eutrophying substances ($PO4^3$ equivalents) and around 70 tonnes of acidifying substances (SO2eq) if the value for the biogas substrate from householder refuse is used to the entire production. In 2010 the production of biogas for biofuel amounted to around 59 Mm^3 (the equivalent of 0.57 TWh or 50 ktoe), adding around 17 tonnes of eutrophying substances ($PO4^3$ equivalents) and around 100 tonnes of acidifying substances (SO2eq) with the same assumptions as the 2009.

The report Life-cycle analysis of Swedish biofuels *[Livscykelanalys av svenska biodrivmedel]* from Lund University, Faculty of Engineering[107] has been used for the estimates above. The information about the emissions of eutrophying substances and acidifying substances for Swedish biofuels based on current conditions and with the energy allocation method have been used (see Table B below which, along with information reported in the text comprises the foundation for Table A).

[105] Today the proportion of domestic crops used for the ethanol produced in Sweden is around 70 %.
[106] Today the proportion of domestic crops used for biodiesel produced in Sweden is around 13 %.
[107] Börjesson, P., Tufvesson, L., Mikael, L., 2010. Life-cycle analysis of Swedish biofuels *[Livscykelanalys av svenska biodrivmedel]*. Report 70, Lund University.

Table A: Estimated emissions of eutrophying substances (mg $PO4^3$eq) and acidifying substances (mg SO2eq) from the total Swedish production capacity for biofuels if only domestic raw materials were used (Maximum impact); and taking into account the approximate share of raw materials domestically produced (Estimated impact taking into account domestic raw materials) for 2009 and 2010.[108] Note that the actual impact for ethanol and biodiesel appears to be even lower, and that the fact that the by-products bear a portion of the environmental impact has not been taken to account.

Biofuel	Production capacity (m^3)	Maximum impact (tonnes $PO4^3$eq)	Maximum impact (tonnes SO_2eq)	Estimated impact take into account domestic raw materials (tonnes $PO4^3$eq)	Estimated impact take into account domestic raw materials (tonnes SO_2eq)
Ethanol	210 000	650	300	460	210
Biodiesel	230 000	1850	600	240	80
Biogas 2009 2010	 42 905 000 59 147 000			 12 17	 70 100

Table B: Summary assessment of biofuel emissions of eutrophying substances (mgPO_4^3eq/MJ fuel) and acidifying substances (mgSO2eq/MJ fuel) based on today's conditions. Source: Börjesson et al., 2010.

Crop or substrate	Biofuel	mgPO_4^3eq/MJ fuel	mgSO_2eq/MJ fuel
Wheat	Ethanol	147	66
Rape seed	Biodiesel	243	78
Household wastes	Biogas	8	47
Industrial waste	Biogas	6	32
Manure	Biogas	9	49

Besides water and organic material, the digestion residue formed in the production of biogas also contains microorganisms and various nutrients. The digestion residue can be used as fertiliser. Depending on its origin, the digestion residue is given different names: biofertiliser (co-digestion plants) and digested sludge (sewage treatment plants). For biofertiliser, there is a certification system (SPCR 120) through which the biogas facility can quality assure its biofertiliser and show the entire chain from raw material to end product. Concentrations of metals and pathogenic bacteria for example are checked regularly. Through a regulatory framework and lack of acceptance, the heavy-metal content of digested sludge can limit its use in agriculture. To develop and systematise the upstream work of sewage treatment plants Sweden has a certification system called ReVAQ.

[108] The following energy content has been used in the estimation: 21.2 MJ/litre ethanol, 33 MJ/litre biodiesel and 35.3 MJ/Nm3 biogas.

Estimated net greenhouse gas emission savings due to the use of energy from renewable sources (point 10 in the template)

10. Estimate the net greenhouse gas emission savings due to the use of energy from renewable sources *(Article 22(1)(k) of Directive 2009/28/EC)*.

According to Article 22(1)(k) in the Renewables Directive, Member States are to estimate the net greenhouse gas emission savings due to the **total** use of energy from renewable sources in the Member State. For the Swedish context, such an estimate with the method proposed above is not particularly interesting (see below). For Sweden, the significance of the increase in renewable energy that has occurred in recent years would be of more interest. Because of this, the net greenhouse gas emission savings have been estimated for both the total use of energy from renewable sources in 2009 and 2010, respectively; and for the change in energy from renewable sources between the selected base year 2005 and 2009, and 2010, respectively.

In order to be able to estimate the greenhouse gas emission savings due to the use of energy from renewable sources, assumptions must be made concerning which fossil fuels the renewable energy sources replace. The net greenhouse gas emission savings have been estimated as the difference between the emissions from the fossil comparators of the renewable energy sources, and the net emissions from the renewable energy sources. Because the assumptions made as to the fossil comparators are crucial for the result, two different methods have been used (these apply to both the total amount of energy from renewable sources and the change compared with a base year).

In other words, besides the fact that both the total amount of energy from renewable sources and the change compared with a base year are included, the greenhouse gas emissions savings have been estimated in two different ways:

1. Potential theoretical savings of greenhouse gas emissions have been estimated by calculating the difference between emissions from the renewable energy sources and their fossil comparators, where emission factors for the fossil comparators are based on the Commission's recommendations, which correspond to the fossil marginal production of electricity and heating.
2. Emissions from the fossil comparators of the renewable energy sources are represented by the emission factors for Swedish electricity and district heating production mixes for 2009 instead of emission factors for marginal production, as in 1.

For biofuels, the Commission's recommendations had been used in both cases, that is, the emissions savings specified in Annex V of the Renewables Directive.[109] For the first case, it should be pointed out that only values for the fossil comparators have been obtained from the to which the Commission refers. The emission factors for net emissions of greenhouse gases from renewable fuels have been obtained from elsewhere[110]. These emission factors have been compiled from a life-cycle perspective and include all material emissions – from raw materials recovery and production of the fuel to use and distribution. However, emissions from the use of the biofuel have been set to zero. For all cases, the actual values (not normalised) for hydro and wind power have been used in the estimates.

For the second case, it ought to be pointed out that the emission factor for the district heating mix has been used as the fossil comparator for all heat production (that is, even for heat pumps and solar heating, etc.), which is a very simplified assumption. In addition, note that the emission factors used

[109] For those biofuels whose production pathways are not specified in Annex V, assumptions have been made concerning which value in Annex V best represents this pathway. Ethanol produced from residues from pulp production and wine production has been assumed to have the same value as ethanol from sugar cane. For ethanol from wheat, the highest typical value for ethanol from wheat has been used.

[110] Gode, J et al., *Miljöfaktaboken 2011* - Estimated emission factors for fuels, electricity, heat and transport in Sweden, Värmeforsk (Swedish Thermal Engineering Research Association).

in this case represent the total greenhouse gas emissions (that is, the life-cycle perspective).[111] For fuel for co-generation in district heating networks, the energy allocation method has been used for allocating the fuel energy to the end products of electricity and heating. Thus the allocation has been done in proportion to the generated amount of energy in terms of electricity and heating. Finally, it should also be pointed out for this case that 2009 was a year with high CO_2 intensity in Swedish electricity production compared with other years. Because the statistics for determining the emission factors for 2010 are not available, the statistics for 2009 have been used anyway, although they are not the best for estimating potential reduction from Swedish prospective. A more detailed description of the approach used for these two cases is found in Annex 1.

With the use of the Commission's fossil comparators (Case 1) the use of energy from renewable sources in 2009 provides a theoretical possibility of reducing emissions by around 84 MtonneCO_2eq (see Table 6 for figures per sector). With the use of the emission factors for the Swedish electricity and district heating production mixes (Case 2) the use of energy from renewable sources in 2009 provides instead a theoretical possibility of reducing emissions by around 13 MtonneCO_2eq (see Table 6 for figures per sector). For 2010, the corresponding figures are around 89 MtonneCO_2eq for Case 1 and around 14 MtonneCO_2eq for Case 2.

Note also that the absolute values for the estimated reduction in greenhouse gas emissions reported in Table 6 did not comprise a description of the actual reduction in emissions due to the use of energy from renewable sources, but should only be seen as a theoretical estimate of the potential reduction in greenhouse gas emissions due to the use of energy from renewable sources, based on the methods used. Both calculation methods imply a highly simplified description of the fossil emissions that it is assumed have been replaced, but did demonstrate how important the choice of method used is for the result. The case that the Commission recommends means that we assume that all energy from renewable sources would have been used fossil fuels if the energy from renewable sources had not existed (and thus generally entailing high carbon emissions). This information should therefore not be taken out of its context nor used in other contexts. However the absolute values may be of interest for the purposes of comparing with the corresponding estimates for Sweden in future progress reports for the development of energy from renewable sources. This is because they can be used to say something about what further reductions have occurred between the years studied. The reason that the Swedish Energy Agency has chosen the approach described above is that this is the one that the Commission has asked for.

Alternative method of calculation. Estimation of the net greenhouse gas emissions savings due to the change in the use of energy from renewable sources compared with a base year

In order to make an estimation of the actual net greenhouse gas emissions savings due to the change in the use of energy from renewable sources that is closer to reality, a more thorough description is needed of what would have been used instead for each unit of energy from renewable sources used in Sweden. For Sweden, this would be possible to do through studying only the energy from renewable sources that has been added since a specific base year, for example 2005 (obviously based on many assumptions). Attempting to predict what Sweden's energy system might have looked like without, for example, all its wind power (which started being used on a large scale already at the beginning of the 1900s) is marred by many uncertainties and doing so cannot be motivated in this context. Without the possibility of the expansion of hydro power, most likely the structure of industry in Sweden would also have looked quite different. Estimating the effects for Sweden in accordance with the Commission's suggestion is not even of academic interest.

The Swedish Energy Agency has been in contact with the Commission[112] to clarify that it will be the total greenhouse gas emissions savings or emissions savings due to the use of energy from renewable

[111] Amounts to around 25 g CO_2eq/kWh for electricity and around 120 g CO_2eq/kWh for heating. These emission factors come from: Martinsson, F. and Gode, J., 2011. Emission factors for Swedish electricity mix and Swedish district heating mix 2009 *[Emissionsfaktorer för svensk elmix och svensk fjärrvärmemix år 2009]*. IVL Swedish Environmental Research Institute. Report produced for Article 22 progress reporting. Available from the Swedish Energy Agency.

[112] Via e-mail correspondence with policy officer Kristine Kozlova and her colleagues.

sources compared with a base year that will be reported under this point (for example, 2005 is used as the base year in the National Renewable Energy Action Plan). In this context, the Swedish Energy Agency described the difficulties of estimating the total greenhouse gas emissions savings due to the use of energy from renewable sources under the conditions that prevail in Sweden. Sweden has had a relatively large share of energy from renewable sources in the form of hydro power for example since the early 1900s, which lies behind part of the social progress that has occurred in Sweden (for example, the growth of industries). This means that the assumption that all of this would have been the consequence of the use of fossil fuels feels unreasonable from the Swedish perspective. The Swedish Energy Agency is of the opinion that it would be preferable to estimate the greenhouse gas emissions savings due to the use of energy from renewable sources compared with a base year, because it allows for a more detailed estimation and shows more clearly what progress has been made. It will not either be as misleading for a country such as Sweden, which has had a large amount of energy from renewable sources for a relatively long period of time (which, with the proposed method, would get unrealistically large potential savings).

In view of the above, the Swedish Energy Agency has chosen to make a simplified estimation of the potential greenhouse gas emissions savings that could be due to the change in the use of energy from renewable resources in 2009 compared with 2005, and in 2010 compared with 2005, respectively[113]. The savings in greenhouse gas emissions have been estimated in accordance with both the approaches described above. That is, by using the fossil comparators that the Commission recommends, and by using the emissions factors for Swedish electricity and district heating production mixes; but instead of counting in the total amount of energy from renewable sources, taking into account the change in energy from renewable sources (for each type of energy) that has occurred between 2005 and 2009, and between 2005 and 2010, respectively.

Using the Commission's fossil comparators, this change in energy from renewable sources since 2005 gives a theoretical possibility of having reduced emissions by around 0.5 MtonneCO_2eqalents, for 2009, and around 7 MtonneCO_2eq, for 2010. With the use of the emission factors for the Swedish electricity and district heating production mixes (Case 2), the use of energy from renewable sources in 2009 provides instead a theoretical possibility of having reduced emissions by around 1 MtonneCO_2eq for 2009, and 2.5 MtonneCO_2eq for 2010, compared with 2005. Note that industrial use of biofuel in 2009 decreased as compared with 2005, and the production of hydropower also decreased.

It is important to finally point out that it is not possible to compare the estimated net greenhouse gas emissions savings due to the use of energy from renewable sources of different Member States unless the Member States have used the same method and made the same assumptions.

***Table 6: Estimated* potential theoretical *greenhouse gas emissions savings due to the use of energy from renewable sources (MtonneCOeq)* by comparing emissions from renewables with the Commission's recommended fossil comparators, and with fossil comparators represented by the emission factors for the Swedish electricity and district heating mix (the latter is shown in parenthesis).**

Environmental aspects	2009	2010
***Total estimated* theoretical *net reduction in GHG savings from the use of energy from renewable sources*[114]**	*84 (13)*	89 (14)
- Estimated net GHG saving from the use of renewable electricity	54 (1.5)	57 (1.3)
- Estimated net GHG saving from the use of renewable energy for heating and cooling	29 (11)	31 (12)
- Estimated net GHG saving from the use of renewable energy for transport[a]	0.8 (0.8)	0.9 (0.9)

[a] Note that renewable electricity for transport is not included in this item but is instead included in the estimation of the net greenhouse gas emissions savings from the use of renewable electricity.

[113] A more detailed estimation could possibly be done for the next progress report if this is deemed to be of interest.
[114] *The contribution of gas, electricity and hydrogen from renewable energy sources should be reported depending on the final use (electricity, heating and cooling or transport) and only be counted once towards the total estimated net GHG savings.*

The potential for and information about cooperation mechanisms (point 11 in the template)

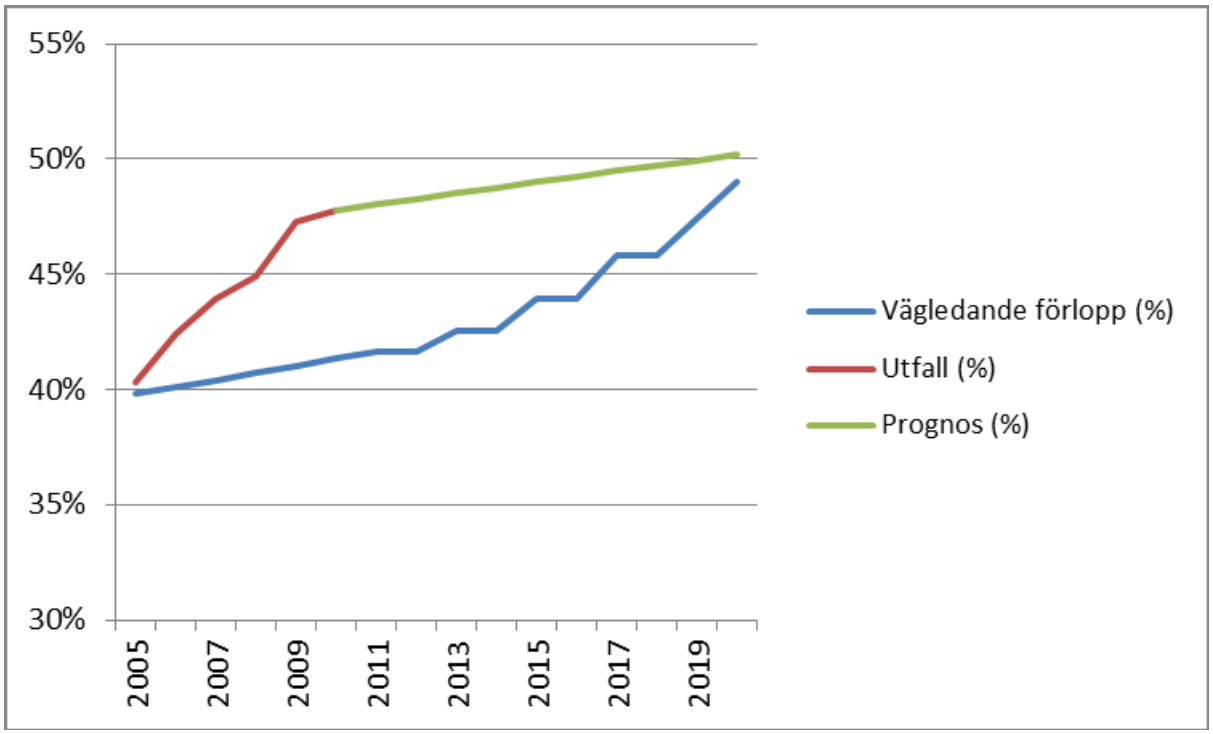
11. Report on (<u>for the preceding 2 years</u>) and estimate (<u>for the following years up to 2020</u>) the excess/deficit production of energy from renewable sources compared to the indicative trajectory which could be transferred to/imported from other Member States and/or third countries, as well as estimated potential for joint projects until 2020 ***(Article 22(1)(l–m) of Directive 2009/28/EC).***

According to the forecast that is the basis for estimating the potential excess production and/or deficit production all energy from renewable sources compared with the indicative trajectory in this progress report (Table 7), Sweden lies over the indicative trajectory throughout the entire forecast period (see Figure 1 below). Note that the value reported for 2020 lies within the forecast's uncertainty range. For a description of the underlying forecast, see Annex 2.

Table 7 shows the actual (for 2009 and 2010) and the estimated (for the other years) excess production of energy from renewable sources compared with the indicative trajectory. The reason that these data differ significantly from those reported in the Action Plan is that those in the Action Plan are based in part on an older forecast and were estimated using a more simplified method of calculation. The data in this progress report are calculated by comparing the actual values and the forecast values for each year, respectively, with the indicative trajectory for that year.

In an investigation (ER 2001:16 - see more under Section 11.1), the Swedish Energy Agency has proposed that if joint projects are to be realised, then they should be for offshore wind energy. Here there is currently a potential among operations that have been granted authorisations of around 7 TWh per year if all projects were to be expanded. Obviously this potential could change leading up to 2020.

Figure 1: **The indicative trajectory and the existing forecast growth in the share of energy from renewable sources in Sweden up to 2020 (for a description see Annex 2).**



(Translation of figure above:

Blue = Indicative trajectory (%) Red = Outcome (5) Green = Forecast (%))

Table 7: **Actual and estimated excess and/or deficit (-) production of energy from renewable sources compared to the indicative trajectory which could be transferred to/from other Member States and/or third countries in Sweden (ktoe).[115],[116]**

	Year 2009	Year 2010	Year 2011	Year 2012	Year 2013	Year 2014	Year 2015	Year 2016	Year 2017	Year 2018	Year 2019	Year 2020
Actual/estimated excess or deficit production[117].	2130	2450	2430	2530	2280	2380	1940	2040	1430	1530	1000	470

11.1. Please provide details of statistical transfers, joint projects and joint support scheme decision rules.

The work involved in establishing a joint market for electricity certificates for renewable electricity production with Norway is complete and the joint market for electricity certificates will begin from 1 January 2012. Such a joint market for electricity certificates constitutes a joint support scheme for the promotion of renewable electricity production under Article 11 of the Renewables Directive. Sweden and Norway have come to an agreement regarding a joint support scheme for renewable electricity production by means of a joint market for electricity certificates[118]. The Riksdag approved the agreement on 30 November 2011. The Stortinget approved the agreement on 12 December 2011. On 20 December 2011, the EU's Renewables Directive was given force in law in the EEA Agreement, which means that Norway has adopted the Renewables Directive. A joint market for electricity certificates means that renewable electricity production can be located in both Norway and Sweden. The market determines where it most cost-effective to build for a certain type of electricity production. The producers of renewable electricity can then sell their electricity certificates in this joint market. A larger electricity certificate market with more actors is likely to mean better competition and more stable prices for electricity certificates while at the same time achieving the target more cost effectively.

The Swedish Government is fundamentally positively disposed to the use of cooperation mechanisms in accordance with the Renewables Directive.

In 2011, the Swedish Energy Agency was tasked with analysing the various alternative cooperation mechanisms[119]. The analysis includes an impact assessment for Sweden of using the mechanisms to various extents. This report may comprise the foundation for the Swedish Government's decision on its line of action for working with cooperation mechanisms.

The Swedish Energy Agency's analysis shows that Sweden ought to be able to compete as a seller. The Swedish Energy Agency is of the opinion that, in the first instance, the Swedish Government should work to implement the cooperation mechanisms via the electricity certificate system. This could be done by broadening electricity certificate system to include additional Member States. It could also be done through a partial coordination of the support scheme. The Agency has analysed a model where a Member State purchases and cancels electricity certificates in the market in order to

[115] *Please use actual figures to report on the excess production in the two years preceding submission of the report, and estimates for the following years up 2020. In each report, the Member State may correct the data of the previous reports.*

[116] *When filling in the table, for deficit production please mark the shortage of production using negative numbers (e.g. –x ktoe).*

[117] The Commission has asked for this information to be "distinguished per type of renewable energy and per origin/destination of import/export", which we have disregarded in this report because the data on which this report is based does not present the excess production per type of renewable energy.

[118] Press release from the Ministry of Enterprise, Energy and Communications, 29 June 2011 www.regeringen.se/sb/d/14953/a/171933

[119] Swedish Energy Agency (2011). Cooperation mechanisms under the Renewables Directive – an in-depth analysis *[Samarbetsmekanismer enligt förnybartdirektivet – en fördjupad analys]*, ER2011:16.

generate further expansion within the electricity certificate system. The purchase of electricity certificates corresponds to the amount of electricity that the Member States have contracted to purchase. Subsequently statistics on the equivalent amount of electricity is transferred to the purchasing Member State. Furthermore, the Swedish Energy Agency is of the opinion that a joint projects should be limited to offshore wind energy, in order to minimise the impact on the electricity certificate system. Currently there are six offshore wind power projects that had been granted authorisation but have not yet been built. The Swedish Energy Agency does not either see any obstacle to transferring the statistics for the years when Sweden has excess production. Note that the Swedish Government has not yet taken a position on whether and to what extent Sweden will utilise cooperation mechanisms or how this might occur.

Through the Swedish Energy Agency, Sweden is participating in the concerted action under the Renewables Directive. Work to do with the cooperation mechanisms is being carried on within this framework.

Other information (point 12 in the template and Article 22(3))

12. Please provide information on how the share for biodegradable waste in waste used for producing energy has been estimated, and what steps have been taken to improve and verify such estimates *(Article 22(1)(n) of Directive 2009/28/EC).*

Current method of estimating the share of biodegradable waste

In the Action Plan, the Swedish Energy Agency made the assumption that 50 % of the waste is comprised of renewable materials. This assumption is based on two studies carried out in 2008 by energy consultant Profu and commissioned by the Swedish Energy Agency.

The first study was based on figures for the amounts of waste sent to incineration in the facilities included in Avfall Sverige AB's (Swedish Waste Management) annual statistics. These statistics include all facilities that incinerate household refuse, as well is to facilities that incinerate sorted refuse derived fuel, wood waste and plastic. In order to calculate the respective proportions of renewable and fossil energy content in the waste incinerated, initially information was gathered about the amount and composition of each category of waste. The majority of the fractions that were identified in this matter were comprised of either 100 % fossil, renewable or inert material. The contributions from the different fractions were weighted together to give the chemical composition of the waste category and then subsequently the category's heating value was calculated using the Miles and Chan equations[120]. The fossil materials' and the renewable materials' contributions to the heating value are being calculated The result from the calculations of each category could then be added together by each category's contribution being totalled in proportion to the amount of waste of each category incinerated. In this manner, the proportions of renewable and fossil-derived energy in the waste for incineration could be calculated[121]. However it became apparent in the study that the figures from Avfall Sverige AB concerning waste incineration differ from SCB's statistics, which meant that the result, which showed a renewable fraction of barely 60 %, could not be directly used.

The second study was carried out by Profu in cooperation with SCB with the purpose of clarifying the differences between SCB's total estimation of the waste and the estimation from Avfall Sverige AB's study. Profu's studies showed that the renewable share in the Swedish Energy Agency's statistics (which were based on SCB's estimation) most likely lie around 50–60 %. For the forecast in the Action Plan, the Swedish Energy Agency chose to use the lower level as a precaution.

The inclusion of co-incineration plants in the EU ETS

A co-incineration plant is a plant whose primary function is the generation of electricity or material, where waste is used as the normal fuel or additional fuel, or where waste is heat-treated for the purpose of disposing of it[122].

In accordance with the Guidance on Interpretation of the scope of the EU ETS Directive, Sweden has decided to include co-incineration plants in the EU ETS, starting with the trading period 2013-2020.

This change can be viewed, *inter alia*, as a step to improve and verify the estimates of the proportion of biodegradable waste for energy production at these plants. The number of plants that will be included in the EU ETS for the first time is around 10. Some 20 plants are already covered by the EU ETS today due to the dedicated oil or bioboilers in the plants, and for these the scope has now been broadened to also include co-incineration boilers.

[120] ECN (2006) http://www.ecn.nl/phyllis/
[121] For more information, see the study. Analysis of the renewable portion of waste for incineration in Sweden with reference to energy content *[Analys av den förnybara andelen av avfall till förbränning i Sverige med hänsyn till energiinnehåll]*, Profu (2008).
[122] Waste Incineration Ordinance *[Förordning om avfallsförbränning]* (SFS 2002:1060).

Once these plants are included in the EU ETS, when reporting the fraction of biomass in the fuel, they will use the rules found in the revised decision on monitoring and reporting under the EU ETS Directive (the decision is likely to be made at the beginning of next year), and in other documents associated with this decision.

Amended methods of calculation – the "*14C projektet*"

In 2010-2011, Avfall Sverige AB carried out a project with SP as the project manager. The Swedish Energy Agency participated in the project as a co-financier. The purpose of the project was to generate a knowledge base that would provide the industry with an opportunity to be involved and influence the instruments and legislation within the area of waste incineration.

The project has three objectives:

1. To determine the proportion of fossil carbon from household and commercial waste, respectively, from Swedish waste incineration plants.
2. Compare two different methods for determining the waste's content of fossil and biogenic carbon which are 1) analyses of solid waste, and 2) analyses of the flue gases formed during incineration.
3. Evaluate the analysis results in relation to established standards which are based on selective analyses of the analysed waste.

Seven plants were included in the study: Sysav Malmö, Renova Göteborg, Borås Energi och Miljö, Händelöverket Norrköping, Tekniska verken Linköping, Högdalen Stockholm and Umeå Energi. The compiled results are not yet available.

In the first progress report, according to Article 22(3)(a)-(c) of Directive 2009/28/EC the Member State is to answer the following.

Does Sweden intend to establish a single administrative body responsible for processing authorisation, certification and licensing applications for renewable energy installations and providing assistance to applicants? *(Article 22(3)(a) of Directive 2009/28/EC).*

In Sweden's environmental legislation (the Environmental Code) it is laid down that either a license from an authority or notification to the municipality is needed for the building or operation of facilities that could impact the environment or public health. Such facilities include, among others, heating plants, hydropower installations and wind power plants. The size/scope of the operation and its impact on the environment determine what level of administration is responsible for licensing or approving the installation[123]. Currently, Sweden has no plans to establish a single administrative body responsible for processing authorisation, certification and licensing applications for renewable energy installations. There is no certification or licensing process for this type of installation[124].

Does Sweden intend to provide for automatic approval of planning and permit applications for renewable energy installations where the authorising body has not responded within the set time limits? *(Article 22(3)(b) of Directive 2009/28/EC).*

The municipalities being able to control their own land use is fundamental to decision-making procedure in Sweden. The licensing process for renewable energy plants however is an issue that has attracted a lot of attention. This applies in particular to wind power installations, since the licensing process for this is deemed to be more wide-reaching and time-consuming than for other energy installations The area is being continuously monitored and changes are being implemented. For example, in its Spending authorization for 2011, the Swedish Energy Agency has been entrusted with the task of monitoring the licensing processes for facilities that produce renewable electricity in consultation with the authorities involved each year. In this monitoring, the authority is to identify

[123] For more information see Section 4.2.1 f) of Sweden's National Renewable Energy Action Plan.
[124] For more information see Section 4.2.1 a) of Sweden's National Renewable Energy Action Plan.

any shortcomings and propose measures for making processes more efficient. Sweden has no plans for changing the current system.

Does Sweden intend to indicate geographical locations suitable for exploitation of energy from renewable sources in land-use planning and for the establishment of district heating and cooling? *(Article 22(3)(c) of Directive 2009/28/EC).*

Yes, in part: such locations may be identified for wind power and in municipal planning (see below).

Wind survey

A nationwide wind survey[125] was carried out in 2007 by Uppsala University on assignment from the Swedish Energy Agency. A wind survey means a modelled estimate of the wind speed and mapping of wind conditions per square kilometre. This has been done in order to increase the reliability of in estimations of Sweden's wind energy potential. The survey was updated in 2009-2010 in order to correct shortcomings in the previous calculations for southern and western Sweden. The results of the wind survey form the foundation for determining which areas may be of national interest for energy production (see below) and are to be used as basic data into wind power planning within county administrative boards and municipalities. The survey is also intended to provide project planners and power companies with a good basis for where to locate wind power plants.

The areas of national interest for energy production (use of wind power)

Since 2004, there are land and marine areas that have been deemed by the Swedish Energy Agency to be of national interest for the use of wind power[126]. An inspection of these areas was carried out in 2008 and today there are 423 areas that are deemed to be of national interest for the use of wind power. These are distributed among 20 counties. The total area is barely 10,000 km^2 and comprises 2.2 % of Sweden's land area. In order to improve planning tools and to assist municipalities and county administrative boards in their task of planning the utilisation of their local land and water, the Swedish Energy Agency will revise the areas deemed to be of national interest for the use of wind power in 2011-2012. The scope of revision will include processes, methods and criteria.

When the Swedish Energy Agency has deemed that an area constitutes an area of national interest for the use of wind power, this means that the area is deemed to be particularly suitable for the generation of electricity from wind power. This evaluation takes into account, among other things, the average wind speed in the area. Provisions governing the management of land and water areas, including provisions covering such areas as are of national interest for various purposes, are found in Chapters 3 and 4 of the Environmental Code. Chapter 3 Section 8 of the Environmental Code states, *inter alia*, that areas that are of national interest as sites for facilities for energy production shall be protected against measures that may be prejudicial to the establishment or use of such sites.

Municipal outline planning

In Sweden, the spatial planning of the municipalities is controlled by their outline and local plans. The regulatory framework for outline plans and local plans is found in the Planning and Building Act (PBA). A new Planning and Building Act came into force on 2 May 2011. A major change was that the rules governing requirements on construction works in the Act on Technical Requirements for Construction works, etc. (SFS 1994:847) were incorporated into the new Act.

Under the PBA, each municipality is obliged to have a current outline plan covering the entire municipality. The outline plan specifies the general direction for long-term development of the physical environment, but it is not binding. In the outline plan, the municipality is to describe how the national interest is being managed. This can include among other things how it is intended that

[125] For more information about the wind survey, see Swedish page: www.energimyndigheten.se/sv/Om-oss/Varverksamhet/Framjande-av-vindkraft1/Vindkartering1/

[126] See www.energimyndigheten.se/sv/Om-oss/Var-verksamhet/Framjande-av-vindkraft1/Riksintressevindbruk-/

land and water areas that are particularly suitable for energy production and energy distribution might be used.

In addition, the use of land and water areas within the municipality may be regulated in local plans under the PBA. The local plan is binding but it is not mandatory to have local plans for all areas in the municipality. In a local plan, the municipality may decide on land reserves or traffic and road construction works, energy installations, facilities for electronic communications networks and cables and conduits needed for public purposes. For the establishment of wind power plants, a local plan is not generally required with the exception of the case that there is high demand for construction in this particular area and if the location of the wind power plant cannot be appraised in conjunction with the application for planning permission, tentative approval or the notification.

In 2010, the Swedish National Board of Housing, Building and Planning was tasked by the Swedish Government with submitting proposals for, *inter alia*, the implementation of Article 13(3) of the Renewables Directive. According to the Article, Member States shall recommend to all actors, in particular local and regional administrative bodies to ensure that systems are installed for the use of electricity, heating and cooling from renewable energy sources and for district heating and cooling when planning, designing, building and renovating industrial or residential areas. Member States shall also, in particular, encourage local and regional bodies to include heating and cooling from renewable energy sources in the planning of city infrastructure, where appropriate.

In Sweden today, the municipalities already have the basic tools for including renewable energy in spatial planning through, among other things, the municipal outline plan. In addition to this, the Swedish National Board of Housing, Building and Planning's enquiry proposed that all municipalities should be able to share in the collective knowledge from the project Sustainable municipalities and support to sustainable cities *[Uthållig kommun och stödet till Hållbara städer]* and the experiences from wind power aid.

Planning aid for wind power

From 2007 until 31 December 2010, municipalities, county administrative boards and regional self-governing bodies and municipal joint action bodies had the opportunity to apply for aid for planning initiatives for wind power. The purpose of the planning aid was to create opportunities for the increased expansion of wind power through spatial planning. Aid has been given among other things to in-depth amendments or additions to outline plans but also to the development of a new outline plan for that part of the work that the planning for wind power has given rise to. An in-depth amendment to the outline plan means that more detailed planning is done for a selected geographical area; while automatic addition goes into more depth on one or more issues, for example the use of wind power with respect to the entire municipality. The county administrative boards, invisible joint action bodies and regional self-governing bodies have been able to receive grants for planning data that facilitates outline planning for wind power, for example detailed wind surveys or landscape analyses.

During the years 2000 to 2010, around SEK 84 million in planning aid was granted to 212 municipalities and 13 county administrative boards.

2 Annex 1 supplementary description of the estimation of net greenhouse gas emission savings due to energy from renewable sources

About the approach

This Annex provides supplementary information concerning the methods and results used to obtain the estimates of savings in greenhouse gas emissions due to the use of energy from renewable sources presented in the Swedish Energy Agency's draft progress report on the development of renewable energy.

The savings in greenhouse gas emissions that the commission has asked for have been estimated in two different ways:

1. Potential theoretical savings of greenhouse gas emissions have been estimated by calculating the difference between emissions from the renewable energy sources and their fossil comparators, where emission factors for these are based on the Commission's recommendations, which correspond to the fossil marginal production of electricity and heating.
2. Emissions from the fossil comparators of the renewable energy sources are represented by the emission factors for Swedish electricity generation and district heating production mixes for 2009[127] instead of emission factors for the marginal production, as in Case 1.

The Commission's recommendation for greenhouse gas emissions savings from the use of biofuels has been used in both cases. For biofuels, the Commission refers to Article 22(2) of the Renewables Directive, where it is stated that the typical values for net greenhouse gas emissions savings given in Annex V to the Renewables Directive may be used, and these are the values that have been used. For those biofuels whose production pathways are not specified in Annex V, assumptions have been made concerning which value in Annex V best represents the production pathway in question.

For the first case, it should be pointed out that only the values for the fossil comparators have been taken from the report[128] to which the Commission refers. The emission factors for net emissions of greenhouse gases from renewable fuels have been obtained from elsewhere[129].

For the second case, it ought to be pointed out that the emission factor for the district heating mix has been used as the fossil comparator for all heat production (that is, even for heat pumps and solar heating, etc.), which is a very simplified assumption. In addition, note that the emission factors used in this case represent the total greenhouse gas emissions (that is, the life-cycle perspective). For fuel supplied to co-generation in district heating networks, the energy allocation method has been used for allocating the fuel energy to the end products of electricity and heating, that is, the allocation has been done in proportion to the generated amount of energy in terms of electricity and heating. Finally, it should also be pointed out for this case that 2009 was a year with high CO_2 intensity in Swedish electricity production compared with other years. Since the statistics for determining the

[127] The emission factors used come from: Martinsson, F. and Gode, J., 2011, Emission factors for Swedish electricity mix and Swedish district heating mix 2009. IVL Swedish Environmental Research Institute. Report produced for Article 22 progress reporting. Available from the Swedish Energy Agency.
[128] Report from the Commission to the Council and the European Parliament on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling. The report is available from: http://ec.europa.eu/energy/renewables/transparency_platform/doc/2010_report/com_2010_0011_3_report.pdf
[129] Gode, J et al., *Miljöfaktaboken 2011* - Estimated emission factors for fuels, electricity, heat and transport in Sweden, Värmeforsk (Swedish Thermal Engineering Research Association).

emission factors for 2010 are not available, we have in any case chosen to use this year (2009), even though this does not present Sweden in the most favourable light.

General method of calculation

In order to be able to estimate the greenhouse gas emission savings that the use of energy from renewable sources has led to, assumptions must be made concerning which fossil fuels the renewable energy sources replace. The greenhouse gas emissions savings have been calculated as follows:

$$Saving = EC_F - EC$$

where EC_F if the emissions from the fossil comparators of the renewable energy sources, and EC refers to the net greenhouse gas emissions from the renewable sources.[130]

EC_F differs between the two calculation cases

It is the calculation of EC_F (that is, the emissions from the fossil comparators of the renewable energy sources) that differs between the two calculation cases. The Commission's report on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling recommends that emission factors in accordance with Table 1 used as the fossil comparators. This means that all electricity and heating produced from biofuel is assumed to have replaced fossil-fuel based marginal production. Because there are no emission factors that can be used as fossil comparators for non-fuel-based electricity generation, for electricity from hydro and wind power, the same fossil comparators as for solid and gaseous biomass sources have been used in Case 1.

Table 1: Fossil comparators. (European Commission, 2009[131])

Area of application	Fossil comparators EC_F
Biofuel	83.8 gCO_2eq/MJ
Bioliquids for electricity generation	91 gCO_2eq/MJ
Bioliquids for heat production	83.8 gCO_2eq/MJ
Bioliquids for cogeneration	85 gCO_2eq/MJ
Solid and gaseous biomass for electricity generation	198 $gCO_2eq/MJ_{electricity}$
Solid and gaseous biomass for heat production	87 gCO_2eq/MJ_{heat}
Solid and gaseous biomass for cooling production	57 $gCO_2eq/MJ_{cooling}$

In the alternative calculation case 2, instead the emissions from renewable energy compared with the emissions from the Swedish electricity and district heating production mixes, instead of the fossil comparators recommended by the Commission. The Swedish Energy Agency asked the IVL Swedish Environmental Research Institute to work out emission factors for the Swedish electricity and district heating production mixes for 2009. The fossil comparators are then lower, which results in lower levels of savings. In calculating the emission factors for electricity and district heating mix, the allocation of emissions between electricity and heating in the case of cogeneration have been made using both the energy allocation method and the alternative production method. However in this progress report, only the data derived from the energy allocation method has been used.

[130] These have been estimated with the help of emission factors from Gode, J et al., *Miljöfaktaboken 2011* - Estimated emission factors for fuels, electricity, heat and transport in Sweden, Värmeforsk (Swedish Thermal Engineering Research Association).

[131] Report from the Commission to the Council and the European Parliament on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling. The report is available from: http://ec.europa.eu/energy/renewables/transparency_platform/doc/2010_report/com_2010_0011_3_report.pdf.

Miljöfaktaboken 2011 - Estimated emission factors for fuels, electricity, heat and transport in Sweden gives the emission factors from the LCA perspective

The emission factors used to calculate the net greenhouse gas emissions for the renewable energy sources (besides biofuels) are based on the report *Miljöfaktaboken 2011*[132]. This report contains emission factors for the fuels and types of energy used in Swedish electricity generation and heat production, and vehicle operation. The emission factors have been compiled from a life-cycle perspective and include all material emissions – from raw materials recovery and production of the fuel to use and distribution. However, emissions from the use of the biofuel have been set to zero in the estimates in this report. The changes in stored carbon in the soil are included for wood chips from GROT (Swedish acronym for branches and tops) but not for forestry chips, pellets or briquettes.

The emission factors presented in the Miljöfaktaboken are not based on new measurements but rather have been determined based on compilations of data and results from other reports. A number of life-cycle analyses for a variety of fuels were analysed, after which the most relevant were selected and formed the basis for the data collection. A consequence of this is that there may be some differences in the assumptions made between different studies for example. For some fuels, there are no available studies of emission factors over their entire life cycle. In such cases, assumptions have been made or approximations have made with respect to other fuels.

The origins of the biofuels

For biofuels, the typical values for greenhouse gas emissions savings specified in the Renewables Directive were used. To be able to apply these, you need information about the origin of the biofuel in the form of its raw materials and production process. Since this is confidential information from suppliers and producers, estimates have been made based on the surveillance reports on tax exemptions for biofuels that the Swedish Energy Agency submits annually to the Government Offices of Sweden[133].

For those biofuels whose production pathways are not specified in Annex V, assumptions have been made concerning which value in Annex V best represents this pathway. Ethanol produced from residues from pulp production and wine production have been assumed to have the same value as ethanol from sugar cane (because residues are not deemed to have upstream emissions and thus have the potential to lead to relatively large savings in emissions). For ethanol from wheat, the highest typical value for ethanol from wheat in Annex V of the Renewables Directive has been used.

Statistics used

To the greatest extent possible the Swedish Energy Agency's own statistics have been used. Because this progress report is a recurrent task, it is important that statistics are kept continuously and can be compared between years. For 2010, some of the statistics used have been preliminary only. Some statistics are not yet available and therefore a simplified calculation has been done for that year.

Statistics on the fuel used in electricity generation and district heating production have been sourced from the publication the Provision of electricity gas and district heating in 2009 *[El-, gas- och fjärrvärmeförsörjningen 2009]*[134] which is in Swedish with some English summaries. Statistics on industry's energy use come from the publication Industry's annual energy use 2009 [*Industrins årliga energianvändning 2009]*[135], which is also in Swedish with some English summaries, and statistics on

[132] Gode, J et al., *Miljöfaktaboken 2011* - Estimated emission factors for fuels, electricity, heat and transport in Sweden, Värmeforsk (Swedish Thermal Engineering Research Association).
[133] Swedish Energy Agency, 2011. Surveillance report on tax exemption for biofuels for 2010, Ref. no. 00-11-428, Swedish Energy Agency, 2010. Surveillance report on tax exemption for biofuels for 2009, Ref. no. 00-10-848.
[134] The Provision of electricity gas and district heating in 2009 *[El-, gas- och fjärrvärmeförsörjningen,* EN11SM. Final statistics. Corrected version 25 March 2011. EN11SM1101.
[135] Industry's annual energy use 2009, final figures *[Industrins årliga energianvändning 2009, slutliga uppgifter]*. EN23SM1101.

energy use in buildings come from the Swedish Energy Agency's publications on energy statistics for single family dwellings, multi-dwelling buildings and commercial premises[136].

For 2010, preliminary statistics have been used for electricity generation and district heating production[137]. Energy use by industry and buildings has been estimated with the help of energy balances for 2010[138] and figures for previous years.

Heat from heat pumps and solar thermal collectors is taken from the statistics that the Swedish Energy Agency report annually to Eurostat. The statistics for energy use in the transport sector have been sourced from the publication *Transportsektorns energianvändning*[139].

Emission factors for Swedish electricity mix and Swedish district heating mix for 2009

Carbon emissions and greenhouse gas emissions for Swedish electricity and district heating production mixes have been calculated. These calculations have been done both with and without a life-cycle perspective (that is to say, with and without upstream emissions). In addition to this, two different allocation methods have been applied for cogeneration: the energy method and the alternative production method. The results are presented below:

	Swedish electricity generation mix		**Swedish district heating production mix**	
	The energy method	**The alternative production method**	**The energy method**	**The alternative production method**
CO_2 emissions g/kWh (total, LCA perspective)	24.5	31.1	116.3	101.3
Greenhouse gas emissions (g/kWh), total, LCA perspective	25.3	32.1	121.1	105.6
Of which: Greenhouse gas emissions (g/kWh), upstream	*6.2*	*6.9*	*14.0*	*12.5*
Of which: Greenhouse gas emissions (g/kWh), direct emissions	*19.1*	*25.3*	*107.1*	*93.1*

The greenhouse gases and global warming potential (GWP) factors used in the calculations are those found in the Renewables Directive, that is, 1 for carbon dioxide, 23 for methane and 296 for nitrous oxide. The emission factors related to upstream emissions are primarily sourced from the *Miljöfaktaboken 2011*[140] and those related to incineration emissions come in part from the *Miljöfaktaboken 2011*, in part from the Swedish Environmental Protection Agency's national emission factors and in part from the IVL report Update of climate related emission factors *[Uppdatering av klimatrelaterade emissionsfaktorer]*. It should be pointed out that the emission factors in the *Miljöfaktaboken 2011* are general and apply generally to Swedish conditions. The system limits for each LCA are described in *Miljöfaktaboken*. The data for the fuel mix for electricity generation and heat production come from SCB's national statistics which are supplied to the Swedish Energy Agency.

[136] Swedish Energy Agency, 2011. Energy statistics for single family dwellings, multi-dwelling buildings and commercial premises 2009 *[Energistatistik för småhus, flerbostadshus och lokaler 2009]*. ES2011:04
[137] The Provision of electricity gas and district heating in 2010. Preliminary figures. EN11SM1102
[138] Quarterly energy balances fourth quarter and the years 2009 and 2010 *[Kvartalsvisa energibalanser fjärde kvartalet samt åren 2009 och 2010]*. EN20SM1102.
[139] The Swedish Energy Agency, 2010 and 2011. The Transport sector's energy use 2010 *[Transportsektorns energianvändning 2010]*, ES2011:05 and the Transport sector's energy use 2009, ES2010:04.
[140] Gode, J et al., *Miljöfaktaboken 2011* - Estimated emission factors for fuels, electricity, heat and transport in Sweden, Värmeforsk (Swedish Thermal Engineering Research Association).

Greenhouse gas emissions are calculated for net electricity supplied to the distribution grid (net production). Therefore, the distribution of electricity to consumers, and the export and import of electricity, are not included. Greenhouse gas emissions are calculated for heat supplied to the distribution network (net production). The distribution losses are not included.

For a more detailed description, see the underlying reports[141].

Results

Estimation in accordance with the Commission's recommendation

The estimated greenhouse gas emission savings due to the use of energy from renewable sources for calculation case 1 (that is, in accordance with the Commission's recommendation) are summarised in Table 2 below.

Table 2: Estimated potential greenhouse gas emissions savings due to the use of energy from renewable sources in 2009 and 2010 (MtonneCO_2eq) using the Commission's fossil comparators.

Environmental aspects	2009	2010
estimated net GHG saving from the use of renewable energy		
- Estimated net GHG saving from the use of renewable electricity	54	57
- Estimated net GHG saving from the use of renewable energy for the production of heating and cooling	29	31
- Estimated net GHG saving from the use of renewable energy for transport	0.8	0.9

Electricity generation

Table 3 shows the emissions from the fossil comparators and upstream emissions (that is, emissions from the production and distribution of the renewable energy sources).

Table 3: Emissions from fossil comparators and upstream emissions for the renewable energy sources for the years 2009 and 2010.

	2009	2010
Emissions from the fossil comparators to the renewable energy sources* MtonneCO_2eq	55	58
net emissions from the renewable sources** MtonneCO_2eq	0.5	0.7

*The emission factors for the fossil comparators are in accordance with the Commission's recommendations and reproduced in Table.
**Emission factors for fuels are sourced (for each fuel) from the *Miljöfaktaboken*.

[141] Martinsson, F. and Gode, J., 2011. Emission factors for Swedish electricity mix and Swedish district heating mix 2009. IVL Swedish Environmental Research Institute. Report produced for Article 22 progress reporting. Available from the Swedish Energy Agency.

Production of heat and cooling

In order to estimate the savings in greenhouse gas emissions from the production of heat and cooling, the sector has been divided into district heating, industry, buildings,[142] and heat pumps and solar heating. Table 4 shows the compilation of the emissions from the fossil comparators and emissions from the production and distribution of the renewable energy sources. District cooling is produced in Sweden from free cooling or with district heating as the driver and is thus not attended by any more greenhouse gas emissions than those of the district heating sub-sector.

Table 4: Emissions from fossil comparators and upstream emissions from renewable energy sources for the sub-sectors for the production of heating and cooling.

	2009	2010
District heating		
Emissions of greenhouse gases from the fossil comparators of the renewable energy sources MtonneCO_2eq	9	9
Net emissions of greenhouse gases from renewable energy sources MtonneCO_2eq	0.3	1
Industry		
Emissions of greenhouse gases from the fossil comparators of the renewable energy sources MtonneCO_2eq	15	17
Net emissions of greenhouse gases from renewable energy sources MtonneCO_2eq	0.1	0.1
Dwellings		
Emissions of greenhouse gases from the fossil comparators of the renewable energy sources MtonneCO_2eq	3	4
Net emissions of greenhouse gases from renewable energy sources MtonneCO_2eq	0.1	0.2
Other		
The fossil comparators of heat extracted from heat pumps and solar thermal collectors MtonneCO_2eq	3	3
Net emissions from heat pumps and solar thermal collectors MtonneCO_2eq	0.4	0.4

[142] Single family dwellings, multi-dwelling buildings and commercial premises.

Alternative estimation

Table 5 shows the results from the Swedish Energy Agency's alternative method of calculation (Case 2). The savings for transport are the same in both cases (and follow the Commission's recommendation), but are affected indirectly because emissions from the use of electricity in the transport sector is included in the savings from electricity generation. The fuel mix for electricity generation and district heating production, and the use of energy in transport, are based on the same statistics in all calculations.

Table 5: Estimated potential greenhouse gas emissions savings due to the use of energy from renewable sources in 2009 and 2010 (MtonneCO_2eq) with the fossil comparators represented by the emission factors for Swedish electricity and district heating production mixes.

Environmental aspects	2009	2010
estimated net GHG saving from the use of renewable energy		
- Estimated net GHG saving from the use of renewable electricity	1.5	1.3
- Estimated net GHG saving from the use of renewable energy for the production of heating and cooling	11	12
- Estimated net GHG saving from the use of renewable energy for transport	0.8	0.9

3 Annex 2: Description of the underlying forecast

Background, pre-requisites, limitations and assumptions made for the calculations

Background

The forecast that forms the basis for Figure 1 and the estimated excess production of renewable energy compared with the indicative trajectory as presented in Table 7 is the Swedish Energy Agency's Long-term forecast 2010 *[Långsiktsprognos 2010]*[143]. The forecast that formed the basis of the corresponding figures in Sweden's National Renewable Energy Action Plan was an updated version of the previous forecast, the Long-term forecast 2008.

The long-term forecast for 2010 was made in order to, in accordance with the Climate Reporting Ordinance *[förordning om klimatrapportering]* (SFS 2005:626) implement the forecasts for the energy sector pursuant to Decision 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions. For more detailed information about the forecasting method and determinations, the reader is referred to the report Long-term forecast 2010 (see Footnote 143).

The pre-requisites of the underlying forecast

The long-term forecast for 2010 is based on some important pre-requisites and assumptions:

- The oil price is USD 98 per barrel in 2020 and USD 113 per barrel in 2030.[144]
- Emission allowance price is EUR 16/tonne.[145]
- Economic growth: 2.4 % per year between 2010-2020.
- The operating life of nuclear power reactors since their start year: 60 years, that is, current reactors are in operation throughout the entire forecast period and planned power increases are carried out.

Updated prerequisites for this forecast

Compared with the forecast that was the basis for the Action Plan, the long-term forecast for 2010 has been updated with the following pre-requisites:

- The production costs for wind power have been updated which results in a somewhat altered allocation of production types within the electricity certificate system.
- The changes in instruments taken up in the Government bills[146] on climate and energy and introduced in 2011, 2013 and 2015 are included.
- The Swedish Energy Agency has assumed a lower blend than the 10 % low biofuel blend of ethanol in petrol and the 7 % FAME in diesel specified in the fuel quality directive (Directive 2009/30/EG). the levels in the forecast are 6.5 % ethanol and 5 % FAME since these are the levels that are tax-exempt in Sweden and other deemed to constitute the ceiling for the percentages of the blends.
- The forecasts for energy use in the functional sectors[147] housing and service, transport, and industry have been adjusted on the basis of the points mentioned above.

[143] The Swedish Energy Agency report Long-term forecast 2010, ER 2011:03 can be downloaded in Swedish from the website of the Swedish Energy Agency.
[144] Source: World Energy Outlook 2009, IEA.
[145] Source: Analysis of options to move beyond 20 % greenhouse gas emission reductions and assessing the risk of carbon leakage (SEC(2010)650).
[146] Government bills, A Coherent Climate and Energy Policy – Climate *[En sammanhållen klimat- och energipolitik –Klimat]* (2008/09:162) and – Energy (2008/09:163).

Specific assumptions required to calculate the share of renewables under the Directive

It should be pointed out that the Directive sets up a number of limitations on what renewable energy may be counted towards target compliance. These limitation rules must be dealt with, too, even in the forecast context, despite the fact that the Commission still has to come back with clarifications and decisions, and that Eurostat needs to develop and further develop methods for the statistical basis.

Heat pumps

Specific limitation rules apply for extracted ambient heat for heat pumps – rules that will finally be laid down by the Commission in 2013 according to Annex VII to the Renewables Directive. Prior to this, Eurostat, in consultation with the Member States is to develop methods for being able to account for heat pumps at all in the European energy statistics. Sweden has basic statistics on heat pumps, but just like all the other Member States, Sweden lacks seasonal performance factors (SPF) four heat pumps in various applications, of various ages and in various locations. A number of assumptions need to be made.

The Swedish Energy Agency assumes that for 2020 extracted heat from the following sources can be counted towards the target:

- 100 % from geothermal[148] and hydrothermal heat pumps;
- 50 % from aerothermal heat pumps; and
- 40 % from heat pumps in district heating plants.

With regard to geothermal and hydrothermal heat pumps, this assumption is most likely not controversial. With regard to heat pumps in district heating plants, we have assumed the same apportionment with respect to these heat sources (40 % fresh/salt water versus 60 % non-approved heat source such as urban waste water) as today. Finally, when it comes to their advantage heat pumps, the assumption is less reliable, particularly given that it is more difficult for aerothermal heat pumps to achieve a sufficiently high SPF, and that the proportion of exhaust heat pumps (which may not be counted) in the aerothermal stock is difficult to estimate.

Biofuels and bioliquids

For biofuels (and bioliquids) there are sustainability criteria[149] that must be fulfilled in order for their use to be counted towards the target.

The Swedish Energy Agency assumes that:

- All biofuels and bioliquids used to 2020 fulfilled the sustainability criteria and may be counted towards the target.

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[147] The Renewables Directive uses other sector groupings where in particular the heating and cooling sector is a sector that also includes energy used for processes in industry, in addition to energy for space heating and cooling purposes, excluding electricity.

[148] Here, the Directive's designations are used. Geothermal heat pumps include downhole heat exchangers and shallow geothermal heat pumps. Hydrothermal heat pumps include fresh water and salt water heat pumps. Aerothermal heat pumps extract heat from the air. The Directive does not permit exhaust air, urban waste water or other waste heat to be counted as renewable energy.

[149] According to the Renewables Directive, the sustainability criteria must be met in order for a biofuel or bioliquid to be counted towards the target and to receive financial aid. The sustainability criteria set requirements with regard to minimum levels of reduction in greenhouse gas emissions among other things as well is a requirement that the biofuel must not be produced from raw materials from land of high biodiversity value or with large carbon stocks.

The Swedish Energy Agency bases this on the assumption that the design of the instruments will result in the use of non-sustainable biofuels and bioliquids being non-existent, or negligible. On the other hand, the Agency has not made any assessment of the consequences for access, price formation and currents of trade for the first-generation biofuels that the Directive and the sustainability criteria might have. This is because currently it is difficult to do this[150].

Other biofuels – the biggest contribution to Sweden's share of renewable energy

Today there are no requirements for Member States to introduce a sustainability scheme for other biomass for energy purposes similar to that which exists for biofuels and bioliquids. There is a voluntary possibility of introducing such a system. However the Commission will get back on this issue at a later date.

Such a sustainability scheme could encompass the other – very large – use of bioenergy in Sweden.

The Swedish Energy Agency has assumed that:

- All use of "other biomass" in Sweden will be sustainable, even under any additional requirements to come.

The basis for this assumption is that the majority of the use is based on domestically produced raw material. The Swedish Energy Agency makes the assumption that any additional sustainability criteria to come will not do any appreciable extent prevent or limit the current possibilities of using biomass from Swedish forestry for energy purposes. The legislation dealing with Swedish forestry in combination with instruments that promote the use of biofuels that fulfil the criteria thus mean that the use of non-sustainable biofuel is will be negligible. The outcome of the Directive ought not to be to prevent renewable energy from being produced from Swedish forestry.

Waste

The Swedish Energy Agency has assumed that:

- 50 % of waste comprises renewables

This assumption is based on a study commissioned by the Swedish Energy Agency in 2008 and the authority has thus assumed that the renewable portion will remain unchanged until 2020. For more information about the portion of waste that comprises renewables, see point 12 in the progress report.

[150] In a separate report, the Swedish Energy Agency has analysed the current and future situation for the markets for ethanol and biodiesel with a primary focus on how price setting occurs. See Analysis of the markets for ethanol and biodiesel ER 2011:13, which can be downloaded in Swedish from the Swedish Energy Agency's website.