Assessing the Employment and Social Impact of Energy Efficiency

Final report
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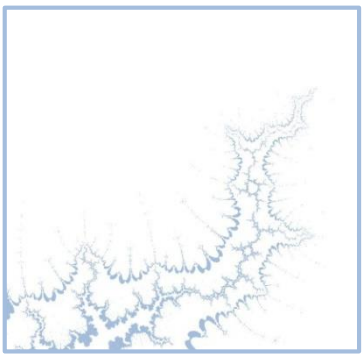

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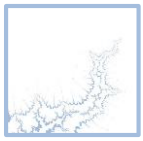

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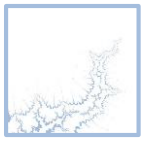

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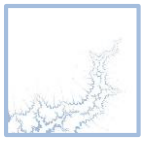


Appendix A Description of the E3ME model

A.1 Overview

This section describes the macroeconomic E3ME model and summarises how it will be applied in the study. The model will be the principle tool used to assess indirect and macroeconomic costs and benefits, including employment impacts.

A.2 Introduction to E3ME

While it is clearly necessary to apply a modelling approach to assess the policies in this study, E3ME is particularly well suited because:

- it covers each of the European Member States at national level
- it has a detailed sectoral specification
- it has been applied extensively at European level before, for a variety of clients
- its econometric specification provides a strong empirical grounding
- it has a detailed treatment of labour market effects
- it incorporates physical flows of energy in its structure

Further information, including the full model manual, is available online at www.e3me.com.

Economic pedigree and recent applications

E3ME is a computer-based model of Europe's economies, linked to their energy systems and the environment. The model was originally developed through the European Commission's research framework programmes in the 1990s and is now widely used in collaboration with a range of European institutions for policy assessment, for forecasting and for research purposes.

Economic structure

The economic structure of E3ME is based on the system of national accounts, as defined by ESA95 (European Commission, 1996). provides a summarised graphical representation of the main economic flows for a single European country. Short-term multiplier effects occur through the various interdependencies and feedback loops that are present in the model structure. The labour market is also covered in detail, with estimated sets of equations for labour demand, supply, wages and working hours. In total there are 33 sets of econometrically estimated equations, also including the components of GDP (consumption, investment, international trade), prices, energy demand and materials demand. Each equation set is disaggregated by country and by sector.

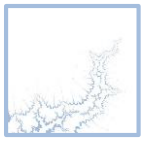
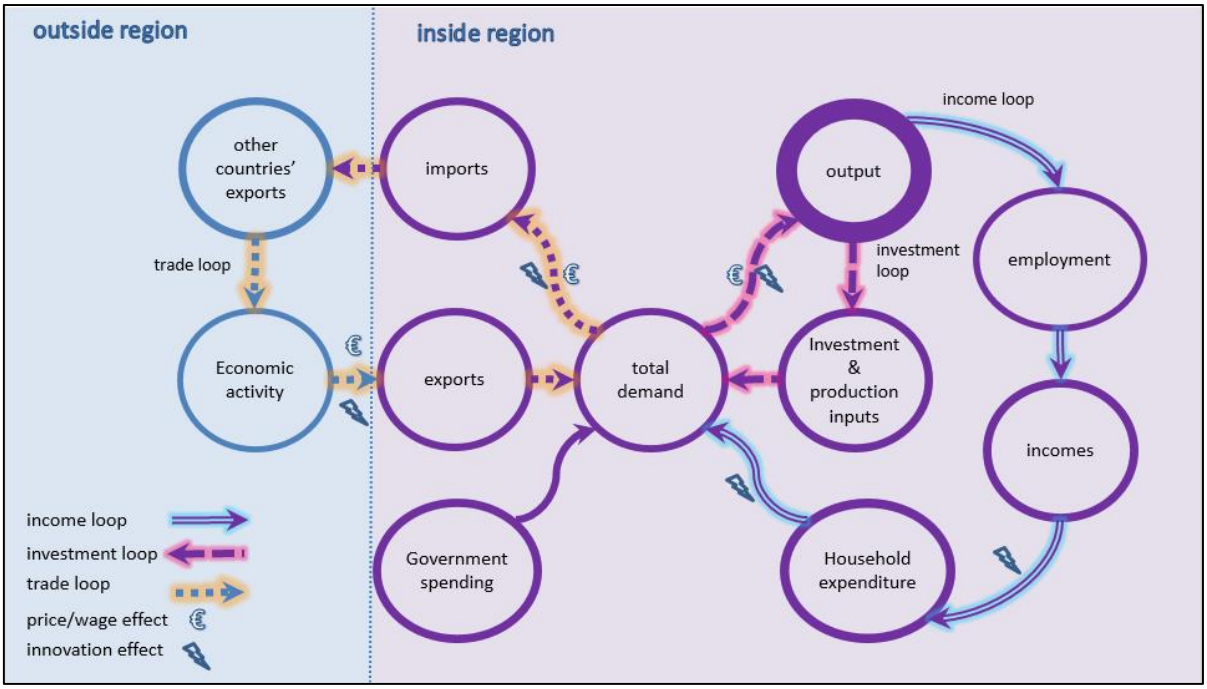


Figure A.1: E3ME's basic economic structure



Source: E3ME, Cambridge Econometrics

The E3 interactions

Error! Reference source not found. shows the main modules in E3ME. The economy and energy demand are closely linked; economic activity creates the demand for energy, but energy consumption also affects the economy through output in the energy production and distribution sectors (e.g. electricity sector, oil and gas sector). Most environmental emissions are caused by fuel combustion (modelled as a fixed coefficient) but there are also direct economy-emission linkages through process emissions.

Technology, which is endogenous in E3ME, can affect many of these relationships. For example, the use of energy-efficient vehicles allows an increase in economic production without an increase in energy consumption and emissions. Some particular technologies like CCS or renewables allow energy consumption to increase without increasing emissions.

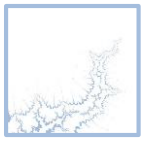
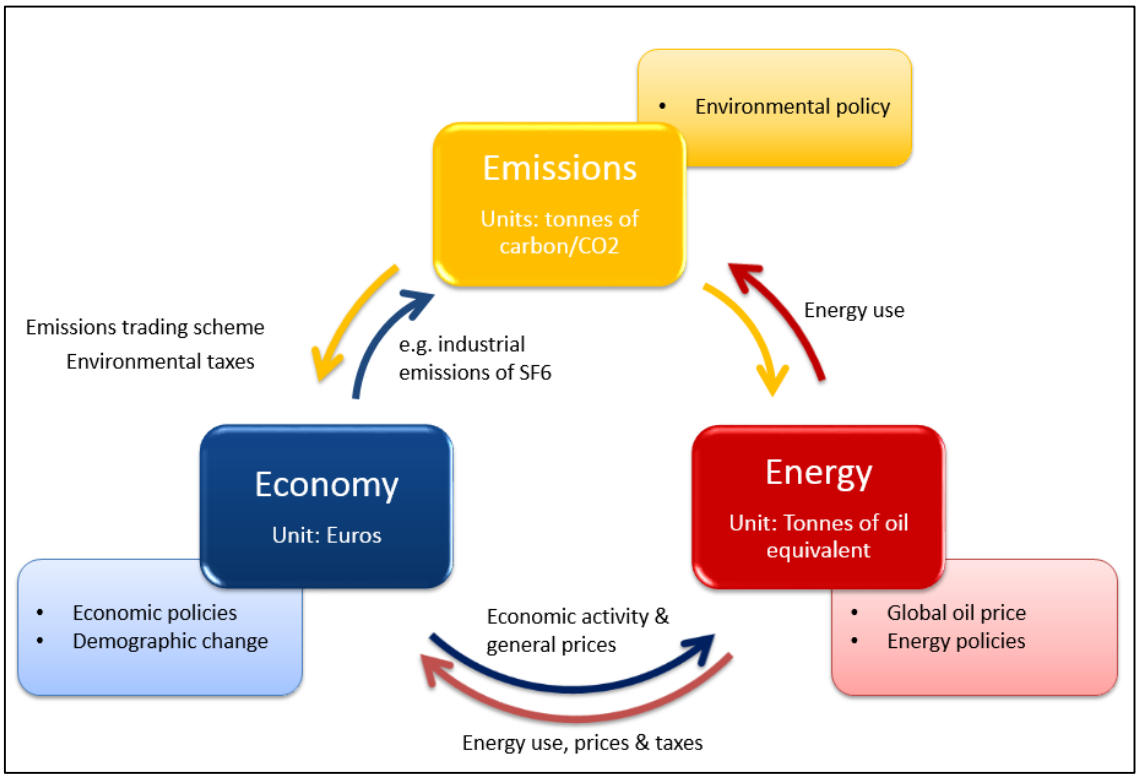


Figure A.2: E3ME modules



Source: E3ME, Cambridge Econometrics

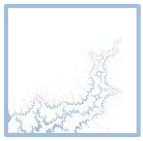
The main dimensions of the model are:

- 33 countries (limited in scope to the EU28 Member States for this study)
- 69 economic sectors, defined at the NACE (rev2) 2-digit level, linked by input-output relationships;
- 43 categories of household expenditure;
- 13 types of household, including income quintiles and socio-economic groups such as the unemployed, inactive and retired, plus an urban/rural split;
- 22 different users of 12 different fuel types;
- the 6 Kyoto GHGs; other emissions where available.

A.3 How the model was applied: Reference and policy scenarios

Policies are simulated in E3ME using a scenario-based approach. For this study the scenarios were *ex ante*, covering the period up to 2030. This means that a reference case forecast is required, which was matched to the PRIMES Reference Scenario.

The scenario inputs are taken from the PRIMES policy scenario results. The results from the decarbonisation scenarios are compared to the reference case with the difference between the two being the policy impacts.



A.4 Model calibration

Overview

The term calibration is used differently for E3ME as for a CGE model. Calibration allows the model to match a published forecast. It does not determine the model parameters, which are econometrically estimated. The E3ME model software includes a built-in function for model calibration. The procedure has two main stages.

In the first stage, the Reference Scenario projections from the PRIMES model are stored on one of the E3ME databanks as annual time series. The E3ME model is solved with all the econometric equation sets forced to match the figures that are stored. The differences ('scaling factors') between what the model would have predicted on its own and the figures on the databank are calculated and saved. These are then written on to another databank.

In the second stage, E3ME is solved to produce its own forecast within each equation set (this means that the model results are the outcome of the defined equitation sets and estimated parameters). However, the scaling factors are applied to these results, with the result that they reproduce the published PRIMES figures. It is now possible to change the model inputs and use the equations to obtain different model outcomes, while maintaining consistency with the reference scenario.

Impact on outcomes

Calibration has only a minor impact on model outcomes when reported as percentage difference from base. The process allows the absolute levels to match those of the published forecast, thereby providing a degree of consistency with other modelling approaches.

Because a consistent reference scenario is crucial for ensuring that results are not biased in any way, the model calibration is an important part of the overall assessment. Further information is provided in the model manual.

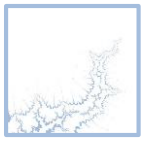
The reference scenario

E3ME takes the following indicators from the projections directly:

- GDP and sectoral economic output
- energy and ETS prices
- projections of energy demand by sector and by fuel
- CO_2 emissions by sector
- population

These indicators combined allow us to construct an economic scenario based on the energy system results from PRIMES. In addition, changes in investment (i.e. relative to the reference scenario) are added in the policy scenarios (see below).

E3ME's Energy Technology sub-model of electricity capacity and generation also makes use of some of the more detailed PRIMES outputs. In the present exercise, however, the focus was on final energy demands and not the composition of electricity generation.



E3ME is frequently calibrated to match published PRIMES projections and the software routines to do the matching are now well established[1]. The following paragraphs describe the main steps in the calibration.

Economic indicators

The E3ME reference scenario was updated to be consistent with the economic indicators that were fed into the PRIMES model. These include projections of GDP, sectoral GVA[2] and consumer expenditure. The calibration was made in terms of growth rates and not actual levels, as the two models have slightly different vintages of historical data (e.g. E3ME solves on an annual basis rather than every five years). The differences between the two models' historical datasets are small; the use of growth rates to calibrate the forecast ensures that there is a smooth path for the projected economic indicators and eliminates any jumps in the data, however small.

The calibration is made at Member State level; Table A.1 summarises the main indicators for the EU as a whole.

Table A.1 PRIMES reference scenario macroeconomic inputs, EU28

	2010	2020	2030
Population, m	504	517	525
GDP, €2010bn	12,302	14,246	16,668
Consumer expenditure, €2010bn	7,145	8,155	9,534
GVA, €2010bn	1,637	1,889	2,128

Source: PRIMES assumptions.

Further processing

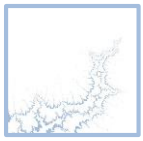
Whereas the PRIMES datasets provide figures for sectoral GVA and household incomes on a constant price basis, the classifications used are at a higher level of aggregation than those in the E3ME model and further processing is, therefore, required to calibrate the more detailed E3ME outputs.

PRIMES sectoral GVA growth rates were mapped to the E3ME sectors, while all the categories of household expenditure were set to grow using historical trends and then constrained to the published total. Aggregate disposable income was set to grow at the same rate as household expenditure, in accord with the standard economic assumption that, in the long run, over one's lifetime all income is spent.

Gross economic output in each sector was set to grow at the same rate as sectoral GVA (and, hence, at the same rate as the PRIMES assumptions),

[1] 'Studies on Sustainability Issues – Green Jobs; Trade and Labour', Final Report for the European Commission, DG Employment, available at: ec.europa.eu/social/BlobServlet?docId=7436&langId=en
'Employment effects of selected scenarios from the energy roadmap 2050', Final Report for the European Commission, DG Energy, available at: http://ec.europa.eu/energy/en/content/employment-effects-selected-scenarios-energy-roadmap-2050-0
'A policy framework for climate and energy in the period from 2020 up to 2030. Impact Assessment', available at: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52014SC0015

[2] Gross Value Added.



whereas the other components (apart from household expenditure) of final demand at sectoral level (*e.g.* investment and trade) were set to grow at rates based on historical rolling averages and then constrained to be consistent with the total output projections.

Prices for industries other than the energy-related ones reported in the PRIMES figures were projected using historical trends.

Energy demand

The PRIMES projections include a comprehensive set of projections of energy demands and their resulting emissions. E3ME's reference scenario projections of energy demand were set to match the growth rates from PRIMES. The high level of detail of the PRIMES outputs makes it possible to map them straightforwardly to the E3ME classification.

Energy and CO_2 prices

E3ME's (exogenous) fuel prices were set to match the PRIMES reference scenario fossil fuel price assumptions shown in Table A.2. Prices of economic outputs of the energy-related industries in E3ME were also made consistent with these assumptions.

Table A.2: PRIMES reference scenario energy prices, US$ /boe

	2010	2020	2030
Oil	60.0	88.5	93.1
Gas	37.9	61.5	64.5
Coal	16.0	22.6	24.0

Sources: PRIMES model outputs.

Reference scenario CO_2 prices in E3ME were also updated to be consistent with the prices in the PRIMES projections (see Table A.3). The revenues from the ETS allowances that are auctioned to the Power generation sector are held by government. We do not make an explicit judgment about how ETS auction revenues are used by each Member State. However, one option would be to fund improvements in energy efficiency.

As we describe in the next section, the policy scenarios that we assess are revenue neutral, meaning that there is no net change in the public balance. Changes in revenues from ETS auctions are included in this calculation.

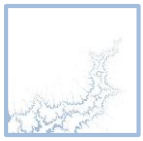
In both E3ME and the PRIMES reference scenario there is no carbon price for the non-ETS sectors.

Table A.3: PRIMES reference scenario CO_2 price, 2010 prices euro/tCO_2

	2010	2020	2030
EU-ETS sectors	11.2	10.0	35.0
Non-ETS sectors	0.0	0.0	0.0

Sources: PRIMES model outputs.

A key driver in the scenarios is electricity prices. Electricity prices could be calculated within E3ME but, because it is an energy systems model, the PRIMES model conducts this calculation at a much higher level of detail.



Electricity prices from 2010-30 in the E3ME reference scenario (and also in the policy scenarios) were therefore set to match the projections from PRIMES.

CO_2 emissions

The PRIMES projections provide only a total for energy-related CO_2 emissions and not the underlying detail by fuel user. The E3ME projections for CO_2 were updated to match the PRIMES total, by updating projections for individual fuel users to be consistent with the energy demand projections and constraining them to the total.

Annual time series

All the PRIMES projections are converted to annual time series using linear interpolation across the five-year time periods that are solved and published for PRIMES.

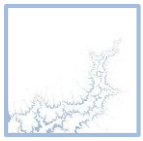
A.5 Model outputs

E3ME is capable of producing a broad range of economic and environmental indicators. The following list provides a summary of the most common outputs:

- GDP and the aggregate components of GDP (household expenditure, investment, government expenditure and international trade);
- sectoral output and GVA, wages, prices, investment, trade and competitiveness effects
- consumer prices and expenditures, and implied household distributional effects (from which welfare can be estimated);
- sectoral employment, unemployment, sectoral wage rates and labour supply;
- energy demand, by sector and by fuel, energy prices;
- CO2 emissions by sector, GHG emissions; and material demands.

Each of these is produced at the Member State level annually up to 2030, although usually specific years of interest are chosen for presentational purposes.

Further information about E3ME, including the full manual, is available at www.e3me.com.



Appendix B Description of the GEM-E3 model

Introduction to GEM-E3

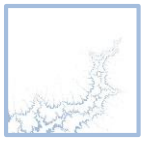
The GEM-E3 model is a multi-regional, multi-sectoral, recursive dynamic computable general equilibrium (CGE) model which provides details on the macro-economy and its interaction with the environment and the energy system. It is an empirical, large scale model, written entirely in structural form. GEM-E3 allows for a consistent comparative analysis of policy scenarios since it ensures that in all scenarios, the economic system remains in general equilibrium. In addition it incorporates micro-economic mechanisms and institutional features within a consistent macro-economic framework and avoids the representation of behaviour in reduced form. The model is built on rigorous microeconomic foundations and is able to provide is a transparent way insights on the distributional aspects of long-term structural adjustments. The GEM-E3 model is extensively used as a tool of policy analysis and impact assessment.

The model is modularly built allowing the user to select among a number of alternative closure options and market institutional regimes depending on the issue under study. The GEM-E3 model includes projections of full Input-Output tables by country/region, national accounts, employment by economic activity, unemployment rate, balance of payments, public finance and revenues, household consumption, energy use and supply, GHG emissions and atmospheric pollutants.

The version of the GEM-E3 model used for this study simultaneously represents 38 regions and 29 sectors linked through endogenous bilateral trade flows. The model features perfect competition market regimes, discrete representation of power producing technologies, semi-endogenous learning by doing effects, equilibrium unemployment, different labour skills, option to introduce energy efficiency standards, formulates emission permits for GHG and atmospheric pollutants. The environmental module includes flexibility instruments allowing for a variety of options when simulating emission abatement policies, including: different allocation schemes (grandfathering, auctioning, etc.), user-defined bubbles for traders, various systems of exemptions, various systems for revenue recycling, etc.

Its scope is general in two terms: it includes all simultaneously interrelated markets and represents the system at the appropriate level with respect to geography, the sub-system (energy, environment, economy) and the dynamic mechanisms of agent's behaviour.

It formulates separately the supply or demand behaviour of the economic agents which are considered to optimise individually their objective while market derived prices guarantee global equilibrium, allowing the consistent evaluation of distributional effects of policies. It also considers explicitly the market clearing mechanism and the related price formation in the energy, environment and economy markets: prices are computed by the model as a result of supply and demand interactions in the markets and different market clearing mechanisms, in addition to perfect competition, are allowed.



The model formulates production technologies in an endogenous manner allowing for price-driven derivation of all intermediate consumption and the services from capital and labour. In the electricity sector a bottom up approach is adopted for the representation of the different power producing technologies. For the demand-side the model formulates consumer behaviour and distinguishes between durable (equipment) and consumable goods and services.

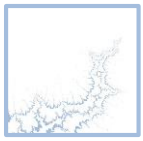
The model is dynamic, recursive over time, driven by accumulation of capital and equipment. Technology progress is explicitly represented in the production function, either exogenous or endogenous, depending on R&D expenditure by private and public sector and taking into account spillovers effects. Moreover it is based on the myopic expectations of the participant agents.

The GEM-E3 model includes an explicit accounting framework (investment matrix) that decomposes total sectoral investment to specific demand for investment goods. The structure of the investment matrix is based on a reconciliation of data from various sources including the European Wind Energy Association (EWEA, 2009) on PV, biomass and wind investments and the National Renewable Energy Laboratory (NREL) of the US Department of Energy Jobs and Economic Development programme (JEDI) for coal and conventional power generation technologies.

The GEM-E3 model represents public and freight transportation split in three sectors which refer to the transportation mode: land, air and water. Each public/freight transport sub-sector sells services to other production sectors and to households. Transportation using private cars and motorcycles is part of final consumption by households and more specifically it is provided by the durable goods (cars and motorcycles) which are purchased by households.

Households can choose the mix between public transportation and the use of private cars and motorcycles depending on utility, income and relative unit costs. Using private cars entails a cost to the consumer which includes annualised expenditure for acquiring the vehicle and annual expenditures for operation, maintenance and fuelling. Three types of vehicles are represented in the model: conventional, electrical and plug-in hybrid. Each vehicle type has different structures in terms of acquisition and operation costs. Cars are purchased from the transport equipment sector.

- The design of GEM-E3 model has been developed following four main guidelines:
- Model design around a basic general equilibrium core in a modular way so that different modelling options, market regimes and closure rules are supported by the same model specification.
- Fully flexible (endogenous) coefficients in production and in consumer's demand.
- Calibration to a base year data set, incorporating detailed Social Accounting Matrices as statistically observed.
- Dynamic mechanisms, through the accumulation of capital stock.



The GEM-E3 model starts from the same basic structure as the standard World Bank models. Following the tradition of these models, GEM-E3 is built

on the basis of a Social Accounting Matrix (SAM). Technical coefficients in production and demand are flexible in the sense that producers can alternate the mix of production not only regarding the primary production factors but also the intermediate goods. Production is modelled through KLEM (capital, labour, energy and materials) production functions involving many factors (all intermediate products and three primary factors –capital, natural resources and labour). At the same time consumers can also endogenously decide the structure of their demand for goods and services. Their consumption mix is decided through a flexible expenditure system involving durable and non-durable goods.

The GEM-E3 model is built in a modular way around its central CGE core. It supports defining several alternative regimes and closure rules without having to re-specify or re-calibrate the model. The most important of these options are presented below:

- Capital mobility across sectors and/or countries
- Flexible or fixed current account (with respect to the foreign sector)
- Flexible or fixed labour supply
- Market for pollution permits national/international, environmental constraints
- Fixed or flexible public deficit
- Perfect competition or Nash-Cournot competition assumptions for market competition regimes

The model is not limited to comparative static evaluation of policies. The model is dynamic in the sense that projections change over time. Its properties are mainly manifested through stock/flow relationships, technical progress, capital accumulation and agents' (myopic) expectations.

The model is calibrated to a base year data set that comprises a full Social Accounting Matrices for each country/region represented in the model. Bilateral trade flows are also calibrated for each sector represented in the model, taking into account trade margins and transport costs. Consumption and investment is built around transition matrices linking consumption by purpose to demand for goods and investment by origin to investment by destination. The initial starting point of the model therefore, includes a very detailed treatment of taxation and trade.

Total demand (final and intermediate) in each country is optimally allocated between domestic and imported goods, under the hypothesis that these are considered as imperfect substitutes (the "Armington" assumption). Institutional regimes, that affect agent behaviour and market clearing, are explicitly represented, including public finance, taxation and social policy. The model represents goods that are external to the economy as for example damages to the environment. Figure B.1 illustrates the overall structure of the GEM-E3 model.

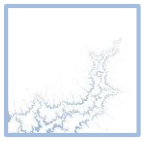
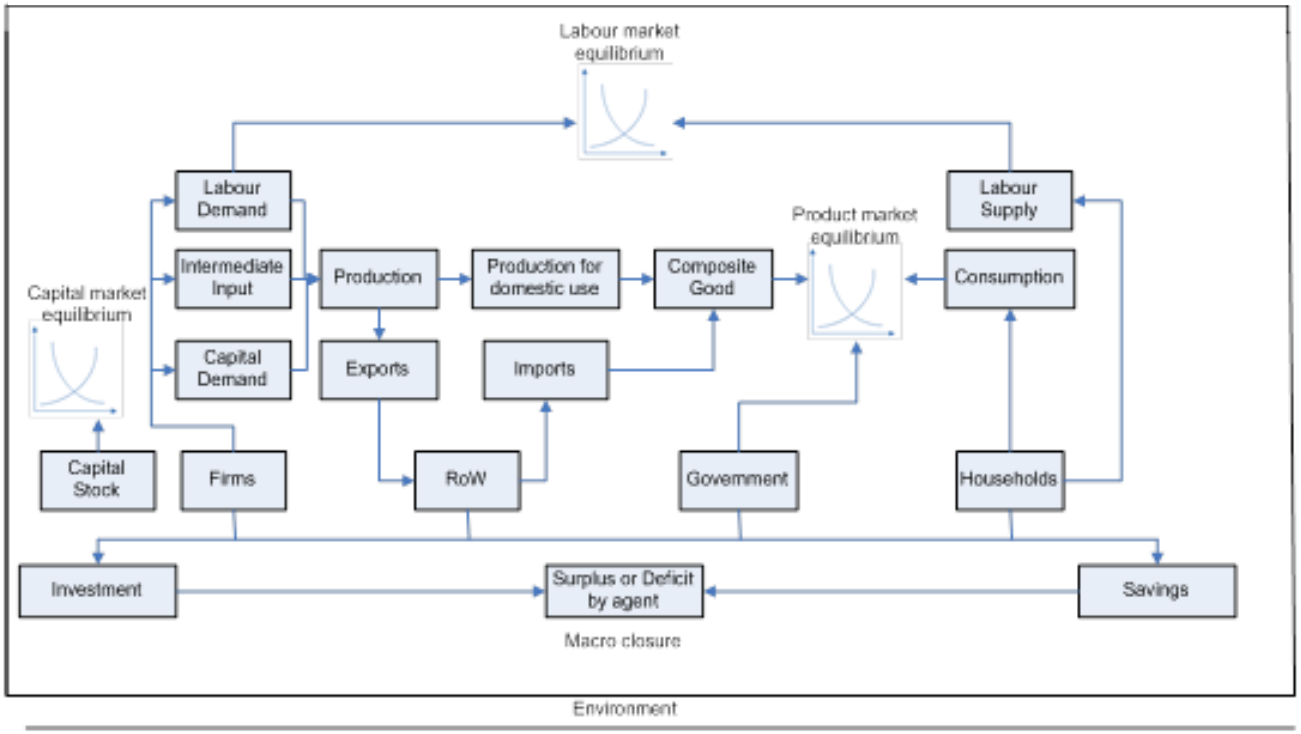


Figure B.1: Economic circuit in GEM-E3



The internalisation of environmental externalities is achieved either through taxation or global system constraints, the shadow costs of which affect the decision of the economic agents. In the GEM-E3 model global/regional/sectoral constraints are linked to environmental emissions, changes in consumption or production patterns, external costs/benefits, taxation, pollution abatement investments and pollution permits. The model evaluates the impact of policy changes on the environment by calculating the change in emissions and damages and determines costs and benefits through an equivalent variation measurement of global welfare (inclusive environmental impact).

Once the model is calibrated, the next step is to define a reference case scenario. The reference case scenario includes all already decided policies. The key drivers of economic growth in the model are labour force, total factor productivity and the expectations on sectoral growth. The “counterfactual” equilibria can be computed by running the model under assumptions that diverge from those of the reference scenario. This corresponds to scenario building. In this case, a scenario is defined as a set of changes of exogenous variables, for example a change in the tax rates. Changes of institutional regimes, that are expected to occur in the future, may be reflected by changing values of the appropriate elasticities and other model parameters that allow structural shifts (e.g. market regime). These changes are imposed on top of the assumptions of the reference scenario thereby modifying it. To perform a counterfactual simulation it is not necessary to re-calibrate the model. The different steps for performing a counterfactual simulation in GEM-E3 are depicted in Figure B.2.

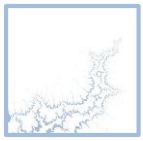
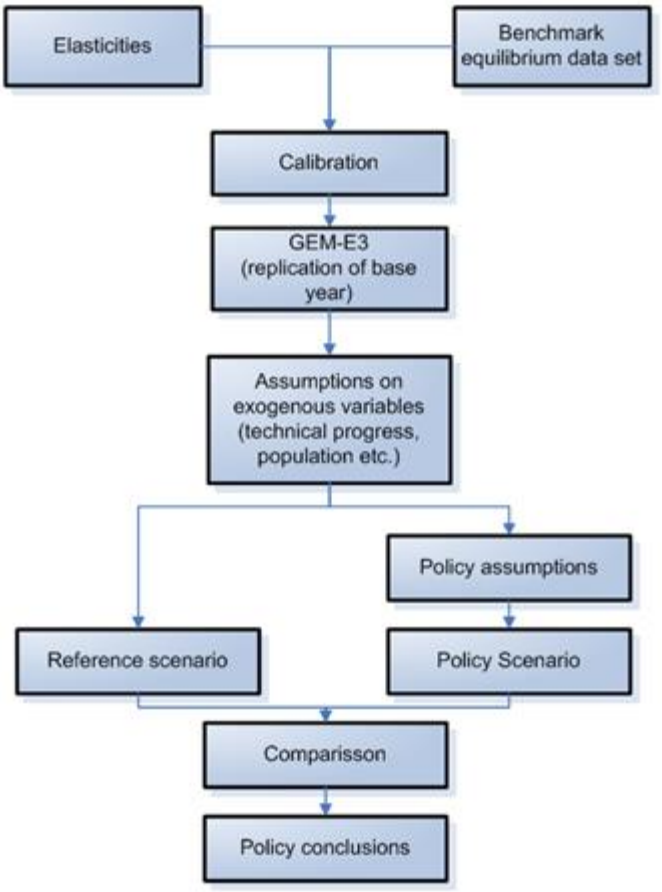
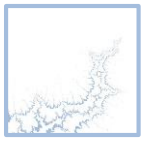


Figure B.2: GEM-E3 Reference case and policy scenarios set-up



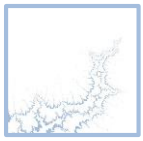
A counterfactual simulation is characterised by its impact on consumer's welfare or through the equivalent variation of his welfare function. The equivalent variation can be, under reasonable assumptions, directly mapped to some of the endogenous variables of the model such as consumption, employment and price levels. The sign of the change of the equivalent variation gives then a measure of the policy's impact and burden sharing implications. The most important results, provided by GEM-E3, are as follows:

- Dynamic annual projections in volume, value and deflators of national accounts by country.
- Full Input-Output tables for each country/region identified in the model.
- Distribution of income and transfers in the form of a social accounting matrix by country.
- Employment by economic activity and skill and unemployment rate by country.
- Capital and investment by country and sector.
- Greenhouse gasses, atmospheric emissions, pollution abatement capital, purchase of pollution permits and damages.
- Consumption matrix by product and investment matrix by ownership branch.
- Public finance, tax incidence and revenues by country.
- Full bilateral trade matrices.



The model also puts emphasis on:

- The analysis of market instruments for energy-related environmental policy, such as taxes, subsidies, regulations, emission permits etc., at a degree of detail that is sufficient for national, sectoral and World-wide policy evaluation.
- The assessment of distributional consequences of programmes and policies, including social equity, employment and cohesion for less developed regions.



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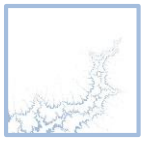

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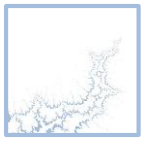

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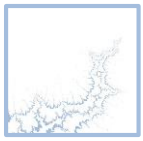

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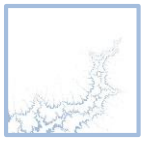

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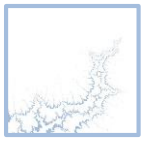

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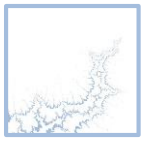

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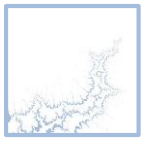

Appendix D Literature Review

Table D.1: Economic and employment impacts of energy efficiency policies, international studies

Study	Scope	Employment impact	Economic impact (output/GDP)
Green growth from labour to resource productivity. (OECD, 2012)	EU	Aggressive mitigation policy will alter the sectoral composition of employment cf. baseline scenario.	The study found that, policies that significantly reduce GHG emissions depress real GDP, real wages and aggregate living standards (evaluated in terms of the consumption of marketed goods and services) below their growth paths under the BAU scenario. The percentage fall in wages is larger than the fall in GDP, indicating a risk that workers will bear a disproportionate share of the costs of the transition in the absence of compensating policies.
Power Perspectives 2030: On the road to a decarbonised power sector. (European Climate Foundation, 2011)	EU	n/a	To support the deployment of low-carbon technologies, more upfront investment (capex) in generation capacity is required. In the 'On Track' case specified in the study, €1,153 billion capital expenditure (of which €1,028 billion for generation, €57 billion for back-up and €68 billion for transmission expansion) is needed in the period from 2020 to 2030.
Studies on Sustainability Issues – Green Jobs; Trade and Labour. (Cambridge Econometrics et al, 2011)	EU	The policies had very little impact on total employment levels. The investment required to meet the renewables target and the energy-efficiency objective is likely to result in an increase in employment, while the effects of higher energy prices is likely to depress economic activity and employment.	The policies had only a marginal impact on GDP. The use of revenues from market-based instruments (MBIs) to offset other taxes or to finance investment in energy-saving equipment could have positive economic, social and/or labour market benefits.
National and Local Employment Impacts of Energy Efficiency Investment Programmes. (Association for the Conservation of Energy, 2000)	EU	The study suggests that, in the majority of cases, energy efficiency investment programmes increased employment. One of the cases studies found that with lower energy prices than expected, investment causes a net reduction in household consumption expenditure, resulting in job losses in labour intensive sectors.	According to the GEM-E3 model used in the study all EE policies impacts on GDP and productive investment are positive in all cases in the short and long terms.
Study on the competitiveness of EU Eco-industry. (ECORYS et al, 2009)	Eco-industry on the whole (EU)	The direct-employment of the total EU eco-industry in EU27 is estimated at about 2.8 million and 3.4 million in respectively 2004 and 2008 (6.7% growth in real terms). The ratio between the growth rates of the Environmental Protection Expenditures (EPE) and employment differ among the eco-industry sub-sectors due to specific sector- and/or country-related wages...etc. for example the sub-sector 'air pollution' there is growth in EPE, but a negative growth of the employment possibly indicating	New Member States show relatively high Environmental Protection Expenditures turnover in relation to GDP, indicating the importance for their new market economies. Exceptionally high are the percentages in Slovenia and Bulgaria In terms of micro-economic productivity the study found, that on average for the period 2004-2006 the productivity of the EU eco-industry was higher compared to manufacturing and that the growth rates were higher.

		a significant wage increase or a relatively high increase of air pollution EPE in high-wage countries.	
'The macroeconomic rebound effect and the UK economy' (Allan et al. 2006)	Economy-wide (UK)	The energy efficiency improvements increase employment by 0.21%.	The energy efficiency improvements increase long-run GDP by 0.17%. They have a proportionally greater impact on the competitiveness of energy intensive sectors which is passed through in lower product prices despite a 0.3% increase in real wages. Output is increased in all sectors, with the iron and steel and pulp and paper sectors benefiting the most with long-run increases of 0.67% and 0.46% respectively.
Spreading the net: the multiple benefits of energy efficiency improvements (IEA, 2012)	Energy efficiency (IEA member countries)	n/a	Increased spending due to reduced energy bills; the increased investment in energy efficiency products and services; and reduced energy prices and costs for industry leading to increased production and exports (Barker and Foxton, 20083) There are several examples of analyses of energy efficiency programmes using CGE models. The few studies examining the macroeconomic effects of improved energy efficiency (where energy demand is reduced by 8 to 15%) suggest significant potential impacts including increases in GDP ranging from 0.8% to 1.26%.
Economic and Environmental Analysis of Energy Efficiency Measures in Agriculture: Case studies and trade-offs. (AGREE , 2012)	Agriculture (6 EU MS: DE, FI, GR, NL, PL, PT)	n/a	The analyses showed a limited economic effect of the technologies such as Precision Farming - ultimately this is a major constraint for the adoption of EE technologies.
The impact of Information Communication Technology on Energy Efficiency. (Bio Intelligence Service et al. 2008)	ICT sector (EU)	Using the Eco-scenario specified in the study, it is estimated that there will 11,000 more e-workers compared to the baseline scenario by 2020.	n/a

[3] Barker, T. and Foxton, T. (2008) "The Macroeconomic Rebound Effect and the UK Economy", Research Report, REF UKERC/WP/ESM/2008/001

Table D.2: Economic and employment impacts of energy efficiency policies, Member State studies

Study	Scope	Employment impact	Economic impact (output/GDP)
Modelling environmental, economic and employment effects of resource savings in Austria (Stocker et al, 2007)	Material cost savings (Austria)	Implementing a reduction in material costs of 20% between 2005 and 2020 will increase employment by 2.4% above Baseline scenario in 2020.	Measures projected to lead to €76.5bn value added above Baseline in 2020.
Energy technology market assessment and job estimates, (Danish Energy Association, 2013)	Energy efficiency technologies (Denmark)	The energy efficiency market (technology, equipment and advice) has the potential to create 9,000 jobs in Denmark by 2020. Increases in the export of energy efficiency equipment are estimated to support 5,000-6,000 jobs. While between 1,000- 2,000 jobs in production and installation of EE equipment and 1,000 new jobs in the advisory service market are foreseen. The development of smart grids will support 8,000 jobs.	Overall, the growth potential in the energy efficiency field is estimated at more than 27 billion DKK in terms of revenues.
Economic effects of energy efficiency improvements in the Finnish building stock (Tuominen et al. 2013)	Buildings sector (Finland)	In the short term a slight decrease in the level of employment is expected as a result of a modest increase in annual construction and renovation investments. In the medium to long term, however, the effects on both would be positive.	In the short term a slight decrease in the level of GDP is expected as a result of a modest increase in annual construction and renovation investments. In the medium to long term, however, the effects on both would be positive.
Environmental Innovation and Employment Dynamics in different Technology Fields (Horbach and Rennings, 2012)	Eco-innovations (Germany)	Innovative firms are characterised by significant dynamic employment development compared to non-innovative firms. In-depth analysis of different eco-innovations shows that employment effects of the introduction of cleaner technologies and environmental processes are more advantageous within a firm compared to end-of-pipe oriented technologies.	n/a
The Economic and Environmental Impact of Promoting Energy Efficiency in Housing (KfW Bankengruppe Workshop, 29 April 2009)	Energy efficient construction and retrofit (Germany)	Jobs amounting to 35,000 man-years overall (gross) could be generated by a 'CO2 Buildings Rehabilitation Program' initiative – 20,500 direct and 14,500 indirect man-years. 16.5 man-years would be created per €1m of additional investment. A yearly average of about 203,000 jobs could be created or protected	n/a
Employment Impacts of a Large-Scale Deep Building Energy Retrofit Programme in Hungary. (Uerge-Vorsatz et al, 2012)	Buildings sector (Hungary)	Jobs could be created in 2020 by the deep renovation scenarios, ranging from 52,000 jobs in the S-DEEP3 scenario to the 131,000 jobs created by the more intensive S-DEEP1 scenario. It is also demonstrated that deep renovations are one of the most employment intensive interventions for climate change mitigation or other economic recovery attempts.	Forecasts in the study show that the costs of renovation will decrease and the productivity of workers grow as a consequence of economies of scale and the learning factor. In balance, it is suggested that a staggered renovation programme reduce the potential negative impact on the supply of labour in terms of skills scarcity.
Employment Impacts of a Large-Scale Deep Building Energy Retrofit Programme in Poland. (Uerge-Vorsatz et al, 2012)	Buildings sector (Poland)	There are net employment benefits in virtually all sectors of the economy, but in particular in the construction sector. These results indicates that hundreds of thousands of net additional jobs can be created in 2020 by deep renovation scenarios, ranging from the 86,000 additional FTE per year of S-DEEP3 scenario to the 254,000 additional jobs created by the more intensive S-DEEP1 scenario.	

A National Perspective on Spain's Building Sector. (Cuchi, A., Sweatman, P. 2012)	Housing / Building Deep-renovation (Spain)	10 million Spanish primary homes built before 2001 can be transformed into low-energy, low emissions, modern housing delivering benefits to owners and occupants, and creating 110,000-130,000 stable, long-term direct jobs in the new housing sector from 2012 to 2050.	Member states can productively invest 0.5 to 0.8 %4 of GDP into the refreshment of buildings to meet the 2020 EE targets. With Spain's GDP of over €1 trillion, this suggests that the total size of the refurbishment sector in Spain ought to be in the order of €5-8 billion per annum.
Estimated impacts of energy and climate change policies on energy prices and bills. (DECC, 2013)	Households, Manufacturing & Enterprises' energy bills (UK)	n/a	Energy prices for UK medium-sized business users is estimated to increase on average around 26 (non-CRC) to 22% (CRC participant) in 2020 and 40 and 39% in 2030 in assuming no new policies are adopted.
The macro-economic rebound effect and the UK economy"(Barker and Foxon, 2008)	Energy efficiency sector (UK)	UK EE policy from 2000-2007 resulted in roughly 270,000 additional jobs in 2010 owing to the cumulative impact of higher growth.	Estimates that the UK EE policy increased the annual rate of economic growth by around 0.1 percentage points from 2000 to 2007.

[4] Climate Strategy and Eurima (2011), Financing Mechanisms for Europe's Buildings Renovation: An Assessment and Structuring Recommendations for Funding European 2020 Retrofits Targets.

Table D.3: Projected employment impacts of EE policies and associated effects on occupational profiles in the EU

Sector overview	Key policies or industry drivers	Projected change in job numbers	Associated impact on occupational profiles
Energy generation and electricity (Manufacturing/ Services)	Renewable Energy Directive Cogeneration directive EU ETS Fiscal stimulus measures and subsidies Revised Labelling Directive 2010/30/EC	OECD (2012): Fossil fuel industries experiencing the steepest employment declines and renewable energy industries the sharpest increases.	ETUC (2007): More stringent energy-efficiency norms should engender more jobs in energy consultancy, engineering and energy service provision (mainly power suppliers, operating service providers and installers (e.g. of grids or co-generation units). OECD (2012): The additional reallocation of employment across industries up until 2030 is likely to be modest by comparison with the rates of reallocation observed in OECD countries in recent years and have little impact on the overall level of job skill demand.
Construction / Buildings (Services/ Manufacturing)	Energy Performance of Buildings Directive (EPBD) 2010/31/EU Directive on the final use of energies (2006/32/EC) EU ETS, especially for construction and insulation materials Efficiency Requirements for New Hot Water Boilers Directive 92/42/EEC Minimum standards for televisions Energy Service Directive 2006/32/EC	ETUC (2007): Alternative 'Eurima' (European Insulation Manufacturers Association) scenario: 70,000-200,000 gross jobs created annually across the EU 25 by 2017 (i.e. 700,000-2m gross jobs over 10 years, or 4-12% of 2010 sector employment), owing to extended reach of regulation; MOSUS (2005): 1.6% more employment in EU 15 construction sector in 2020 under a 'strong sustainability' scenario compared to the baseline); CE et al. (2011a): Predicts the net impact of climate change policies on employment levels to vary from baseline levels by between - 291,000 (-1.93%) and 413,000 (2.74%), depending on the scenario considered.	Green job creation primarily in installation and delivery of material and equipment, but also in management, administration, auditing and R&D (UNEP, 2008); Job generation potential positively linked to energy savings potential (Syndex et al., 2009).
Communications / IT sector	Eco-design directive R&D investment	BIO-IS (2011): Using the Eco-scenario specified in the study, it is estimated that there will 11,000 more e-workers compared to the baseline scenario by 2020	

Industry (Manufacturing – Basic industry)	EU ETS (allocation of permits) Energy-efficiency policy Minimum standards for electric motors Energy Service Directive 2006/32/EC R&D investment SME-centred policies (given importance of SMEs in this industry)	**Cement** (ETUC, 2007): 8,000-20,000 gross job losses expected by 2030 (between 15% and 40% of total EU sectoral employment) as labour productivity improves, given current industry trends; import restrictions and curbs on relocation could reduce these figures MOSUS (2005): EU 15 industrial employment in 2020 to be 1% lower in a 'high' ('strong sustainability') scenario (reduced material and energy use of 30-40%) than in a baseline scenario (no additional policy measures implemented for sustainable resource management). **Iron and steel** ETUC (2007): Reduction in production by 2030 likely to lead to loss of 80,000-120,000 (gross) jobs. R&D investment and low-carbon production estimated to be able to offset 50,000 of these; thus 30,000-70,000 net job losses expected (i.e. circa. 8-18% of a total of 370,000 employed in integrated sites) In addition, ETUC (2009) estimates that reckoning in jobs in cold processing and tubes would raise overall sectoral employment figure to almost 550,000. This produces revised estimate of net jobs lost by 2020 as 24,000-45,000 (i.e. less than 10% of overall employment in the sector). MOSUS (2005): Industrial employment in EU 15 1% lower in 2020 under a 'strong sustainability' scenario cf. baseline. **Machinery and electrical equipment** ETUC (2009): Energy efficiency and production (core of industry) could see gross increase of about 670,000 jobs; an additional 250,000 jobs possible via advanced supplier investment. Thus, potential for gross job creation of up to 920,000 (nearly 25% of 3.7m total employment in sector as of 2006).	**Cement** UNEP (2008): Shift towards energy-efficient plants, both newly constructed and retrofitted, will probably generate some jobs in short run, but might lead to reduced employment over a longer period as 'greener' plants tend to be more automated and require less labour. Surviving jobs could require higher skill levels and retraining ('green' jobs), but such green jobs would not be a major source of employment. **Iron and steel** Making steel mills greener and more competitive – essential for job retention, although such mills are not necessarily labour intensive (UNEP, 2008). Business-as-usual scenario involves ongoing employment retrenchment, but a proactive policy favouring jobs in green, high-quality space could encourage job retention (e.g. the EU's 'Ultra-low CO2 Steelmaking' (ULCOS) initiative). ETUC (2009): Potential for specialist qualifications to replace jobs currently held by general technicians; energy-efficiency culture is important for production and maintenance operators. Productivity gains will necessitate greater emphasis on computer-centred processes, worker security (vis-à-vis rigorous operating standards) and training. Likelihood that one-third of jobs at risk will be replaced by positions subject to poorer working conditions and increased health risks, owing to need for greater contractual flexibility and outsourcing (ETUC, 2007). **Machinery and electrical equipment** Findings are subject to assumptions about relocation potential, role of imports and labour productivity in the EU. Market-share trends will hinge on industry-academia proximity and supply of highly skilled labour. As SMEs constitute 50% of market, their integration into support programmes and regional competence networks will prove crucial (ETUC, 2009).

Transportation (Services/ Manufacturing)	EC transport-related directives and measures, e.g. Road transport: Emissions new cars (130 g CO2/km 2015), Regulations 443/2009 and 715/2007, Directive 2009/33/EC Tyre labelling Regulation Directive 1222/2009/EC Air transport: Regulation 82/2010, Decisions 2009/339/EC and 2009/450/EC Maritime transport: Directive 2005/33/EC	ETUC (2009): Replacement of conventional engines by greener alternatives (e.g. electric engines) by 2030 could lead to net job gains in range of 62,000-125,000 (i.e. 2.7%-5.4% of the 2.3m people directly employed in vehicle production in 2007, although only 0.5%-1% of 13.4m overall EU employment in transport, storage and communication in 2007). ETUC (2007): 'Extended Policy' scenario envisages shift in favour of public and rail transport (vis-à-vis BAU case). By 2020 this shift would lead to employment increases of over 24% in public passenger road transport, of 20% in rail passenger transport. Employment in private transport, predictably, rises less rapidly than in BAU case as focus shifts to public transport (more environmentally-friendly and labour-intensive). Overall, over 2000-30 such policies could lead to 2% average annual employment growth in passenger transport and 1.25% in freight transport. Railways: over last few decades, trend of decreased development noticed in several countries, accompanied by corresponding employment declines. EU: railway employment down to about 900,000 jobs; number of workers in manufacturing rail and tram locomotives and rolling stock down to 140,000. Policies focusing on sustainability and strategic investment are needed to counter these trends. CE et al. (2011a): Compared to the baseline scenario, the net impact of climate change policies on employment ranges from a reduction of 50,600 (-0.55%) to an increase of 38,000 (+0.41%).	UNEP (2008): More sustainable systems will have to be based on shorter distances. Balancing shift in modes of transportation would give greater weight to public transit systems, walking and biking. This could lead to considerable net employment gains, reduced emissions and better air quality. More jobs in vehicle maintenance and servicing than in manufacturing – e.g. in fuel refining, wholesaling and retailing; freight services; rental and repair activities etc. Extent to which jobs may be classified as 'green' depends on vehicles and fuel type, content of biofuels and sustainability. ETUC (2009): Restructuring of value chain would necessitate mobilisation of resources to finance professional mobility and skill upgrading. ETUC (2007) emphasises that legislation on social conditions is important in influencing distribution of transport across modes (particularly road and rail transport). Skills shortages are emerging in rail transport as apprenticeships and vocational training are declining, despite the great importance of rail transport as greener and more labour-intensive than the car industry.

Market research data

The development of the spreadsheet tool to estimate employment by market segment involved an initial identification and review of market data from which to consider the possibilities for the estimation of related employment. The lack of consistent EU scale data prevents an approach based on this type of data. However, in case there is interest in revisiting this approach, or some interest in available market estimates in the literature we summarise below the sources and initial point estimates identified.

Table D.4: Preliminary scan of EU market research data to identify the size and share of EE industries

EE market segment	EE market size (€bn)	Data notes	Total market size (€bn) / share (%)	Employment (000s)	Data sources
Electric vehicles	50,090 (stock)	2008, EU28	0.023%	:	Odyssee database
Public mass transit	:	2008, EU27	17.79%	:	link
Electric and hybrid passenger cars[5]	:	2010, EU27	0.07%	:	ICCT (2011) link
EE Buildings[6]	€140.0	EuroACE[7]	:	:	EEEIF
EE Lighting	:	ELCFED[8]	€5.0	50	(2009) link
Domestic appliances ('white goods')	:	CECED[9]	:	200[10]	
Energy management services	€30.0		:	130	
Rigid polyurethane / building insulation	€4.0	2010, PU Europe[11]	:	38[12]	
Domestic insulation	£0.8	2010, UK	:	:	OFT (2012) link
Building technologies[13]	£15.4	2012, UK	:	:	BIS (2013)
Energy management[14]	£2.9	2012, UK	:	:	link
Alternative fuel vehicles	£14.0	2012, UK	:	:	

[5] Electric / fuel cell (0.1%) and hybrid cars (0.6%) account for 0.7% of total registrations (13,305,479).

[6] Glazing, building controls, boilers, coolers, lighting/shading, insulation, on-site installations & regenerative drive elevators.

[7] The European Alliance of Companies for Energy Efficiency (EuroACE) represents 20 of Europe's leading companies involved with manufacture, distribution and instillation of energy saving goods and services in buildings.

[8] European Lamp Companies Federation (ELCFED) represents the leading lamp manufacturers in Europe;, covering 95% of total European lamp production.

[9] European Committee of Domestic Equipment Manufacturers (CECED) covers large appliances (gas and electric), small appliances, heating, ventilation, air conditioning and heat pump appliances.

[10] An additional 300,000 workers are estimated to be employed in the upstream and downstream sectors.

[11] Polyurethane (PU) Europe, formerly BING, represents foam producers, raw materials suppliers and component manufacturers from 11 Member States.

[12] PU Europe represents 18,000 employees, while European Insulation Manufacturers Association (EURIMA) represent a further 20,000 employees.

[13] Windows (£5.65bn), installation and heat retention materials (£4.63bn), doors (£3.47bn) and monitoring control systems (£1.69bn) make up the building technologies market in the UK.

[14] Energy Management includes Lighting, Heating & Ventilation and Engineering.

Energy efficient glass[15]	:	Glass for Europe	€4.6	16.5	EEEIF (2009) link
Electric motors and generators[16]	:	2010, EU27	€10.4	:	ISR and Atkins (2012) link
Transformation, buildings and appliances	€200.0			600	EEEIF (2009) link

[15] Innovative products: Solar Control Glass, Low-emissivity (low-e) Glass, Solar Energy Glass.

[16] Motors are categorised as: IE1 = Standard Efficiency; IE2 = High efficiency; or IE3 = premium efficiency. In the industry and tertiary sectors in 2010, IE2 motors represented approximately 6% and 10% of the installed base.

Appendix E EU Energy Efficiency Policy

EU measures, on the one hand, already amount to nearly one-third of all measures in the residential sector (as a consequence, in particular, of the appliance labelling directives) and nearly one-third of the general cross-cutting measures (as a consequence of such measures as the CHP Directive, renewables policies that affect decentralised renewables, and the eco-design Directive). On the other hand, EU policy is still less stringent in industry, tertiary and transport sectors.

Cross-sectoral EE measures

First, the **Energy Efficiency Directive (EED) (2012/27/EU)** is the legislative result of the new Energy Efficiency Plan (EEP) that was published in March 2011. While the Climate and Energy Package[17] (ECEP) had set the target of achieving 20% of energy savings by 2020, an assessment showed that the EU would fall short of that target. In order to put the EU back on track, the EC therefore adopted the **Energy Efficiency Plan 2011 (COM/2011/0109)** which contains more concrete measures. These are intended to help generate financial savings of up to €1,000 per household and to have the potential to create up to 2 million jobs[18]. The EED covers all sectors except transport and includes, for the first time, measures for supply side efficiency.

The energy savings targets are not binding[19], but by 30 April 2014 and every three years thereafter Member States will have to submit their **National Energy Efficiency Action Plans (NEEAPs)** to the Commission. With regard to public procurement, Article 6 of the EED states that central governments should purchase only products, services and buildings with high energy-efficiency performance provided that to do so is consistent with cost-effectiveness, economic feasibility, technical suitability, etc.

Second, the **Directive 2009/125/EC on Eco-design**[20], adopted on 21st October 2009, aims to reduce the environmental impact of products, including their energy consumption, throughout the entire life cycle. In principle, the framework directive applies to all energy-using products that are placed on the EU market and to imported products. Means of transport (vehicles) for people or goods are excluded. The directive also covers parts that are intended to be incorporated into products that are placed on the market as individual parts for end-users. All energy sources are covered, in particular electricity and solid, liquid and gaseous fuels.

[17] http://ec.europa.eu/clima/policies/package/index_en.htm

[18] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0109:FIN:EN:HTML

[19] EC Executive Summary of the impact assessment for a policy framework for climate and energy in the period from 2020 up to 2030 of January 2014: http://ec.europa.eu/clima/policies/2030/docs/swd_2014_xx2_en.pdf

[20] Directive 2009/125/EC of 21 October 2009 establishing a framework for the setting of eco-design requirements for energy-related products: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009L0125:EN:NOT

Third, the **Directive 2010/30/EU on energy labels**[21], adopted on 19th. May 2010, provides incentives for industry to develop and invest in energy-efficient product design. The EC is currently reviewing its effectiveness and is due to present a report to the European Parliament and Council by the end of 2014.

Launched in 2009, the **Covenant of Mayors** (CoM)[22] is an EU-wide initiative that aims to foster and support activities of local and regional authorities to contribute towards EU emissions reduction targets. The novel approach to emissions reduction targets taken by the CoM involves commitments by municipal authorities to adopt concrete policy measures for energy efficiency and/or renewable energy. In parallel, regional stakeholders (e.g. provinces, regions) are encouraged to participate by supporting or coordinating the activities of the municipalities. Signatories are required to officially adopt a Sustainable Energy Action Plan ("SEAP") along with a detailed Baseline Emission Inventory ("BEI"). The latter is an integral part of the SEAP since it involves the measurement and monitoring of CO2 emissions reductions. The plan must contain a set of priority targets, including targets for buildings (public and non-public) and for public procurement schemes, in order to encourage the development of markets for energy efficiency solutions.

Cross-sectoral price-based measures

Although not directly aimed at improving energy efficiency, there are two EU policies that could reduce energy consumption through price increases.

The **European Emissions Trading Scheme (EU ETS)** was launched in January 2005 and covers around 11,000 large greenhouse gas emitting installations in the energy and industry sectors[23]. Although low allowance prices have reduced its effectiveness, it remains the instrument with the broadest sectoral coverage.

The **Directive for the taxation of energy products and electricity** (Directive 2003/96/EC) sets minimum rates of taxation, including those for industry. Energy products and electricity are only taxed when they are used as motor or heating fuel, and not when they are used as raw materials or for the purposes of chemical reduction or in electrolytic and metallurgical processes. Although the fit is not perfect, the Directive generally covers sectors not covered by the EU ETS.

Sector-specific policy measures

In addition to the cross-cutting energy efficiency measures, a number of measures apply to specific end-users of energy as well as the upstream sectors for energy supply.

[21] Directive 2010/30/EU on energy labels: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32010L0030:EN:NOT

[22] Covenant of Mayors website : http://www.eumayors.eu/about/signatories_en.html

[23] The EU ETS covers combustion installations with a rated thermal input capacity of at least 20 MW, as well as refineries, coke ovens, steel plants, and installations producing cement clinker, lime, bricks, glass, pulp and paper, provided that they exceed certain threshold production levels.

Residential

The building sector is responsible for around 40% of energy consumption and 36% of CO_2 emissions.[24] Improved energy efficiency in buildings was a key goal of the ECEP. The Energy Performance of Buildings Directive (EPBD)[25], recast in 2010[26], is the main instrument for promoting energy efficiency in the building sector.

The revised EPBD (2010) aims that all new buildings should be nearly-zero energy by 2020 (2018 in the case of public buildings) and that a cost-optimal methodology should be used to set minimum requirements for both the building envelope and technical systems. The new Directive also requires Member States to apply stringent control mechanisms and to impose penalties for non-compliance (Art. 27).

With regard to the built environment, the EED prescribes that Member States establish a long-term strategy beyond 2020 for mobilising investment in the renovation of residential and commercial buildings with a view to improving the energy performance of the building stock. That strategy must address cost-effective deep renovations, in order to significantly reduce both the delivered and the final energy consumption of a building.

Tertiary

The EED aims to stimulate the development of the energy services market. It strengthens the necessary prerequisite of an energy service, namely energy audits, and emphases the importance of energy management systems (art. 8).[27]

On 5th. April 2006, the EU adopted the Directive 2006/32/EC on energy end-use efficiency and energy services[28]. It includes an indicative energy savings target for the Member States, obligations on national public authorities in relation to energy savings and energy efficient procurement, and measures to promote energy efficiency and energy services.

With the aim of promoting the production of energy-efficient office equipment, the European Energy Star Programme[29] is a voluntary energy labelling programme for office equipment. The Energy Star logo helps consumers identify office equipment products that save energy and money. Manufacturers, assemblers, exporters, importers and retailers willing to place the Energy Star label on products meeting or exceeding energy

[24] DG TREN, Unit D4 Presentation: "EU Energy Policy for Buildings after the recast": http://ec.europa.eu/energy/efficiency/doc/buildings/presentation_general_short.pdf

[25] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings: http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF

[26] Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:001:0065:0071:EN:PDF

[27] http://www.esd-ca.eu/themes/energy-services

[28] Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:114:0064:0085:EN:PDF

[29] EU Energy Star programme: http://www.eu-energystar.org/en/index.html.

efficiency guidelines are invited to register with the European Commission (EC). The programme was jointly adopted with the United States on 18th December 2006.

Transport

Transport's share of final energy consumption is 31.7%, making it the single largest end-use sector[30]. Most of the fuel used in the sector comes from fossil fuels.

There are several major directives and regulations related to energy efficiency in transport:

- Directive 98/69/EC of the European Parliament and of the Council of 13th. October 1998 relating to measures to be taken against air pollution by emissions from motor vehicles
- Directive 1999/94/EC concerning the availability of consumer information about fuel economy and CO2 emissions in relation to the marketing of new passenger cars
- In 2009, Regulation (EC) No 443/2009 of the European Parliament and of the Council of 23rd. April 2009 setting emissions performance standards for new passenger cars
- Regulation (EC) No 1222/2009 on the labelling of tyres with respect to fuel efficiency and other essential parameters[31] came into force on 1st November 2012. It aims to harmonise information about the energy performance of tyres, as well as about wet braking and external rolling noise. It should promote tyres which are both energy-efficient and capable of braking on wet roads, and which also increase the energy efficiency and safety of road transport.

Energy generation and electricity

The EED obliges Member States to carry out a comprehensive assessment of the potential for the application of high-efficiency cogeneration and efficient district heating based on a cost benefit analysis. Moreover, the EED includes provisions on energy transformation, transmission and distribution. The EED also introduces specific energy savings targets from an energy efficiency obligation. In the words of Article 7: "That target shall be at least equivalent to achieving new savings each year from 1 January 2014 to 31 December 2020 of 1.5% of the annual energy sales to final customers of all energy distributors or all retail energy sales companies by volume, averaged over the most recent three-year period prior to 1 January 2013.

Energy savings potential

An overview of the energy savings potential (ESP) from end use energy consumption and sectoral contributions is presented in Table E.1. Data by Member State are provided in Table E.2. Several observations can be made across the sectors. Where figures are given, these are taken from ESP projected for 2030.

[30] Emissions from buildings are larger, but this is split between households and tertiary/services.

[31] Regulation (EC) No 1222/2009 of 25 November 2009 on the labelling of tyres with respect to fuel efficiency and other essential parameters: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009R1222:EN:NOT

Industry

- Paper and printing shows by far the highest saving potential across industry sectors. Potentials differ strongly among countries: they vary by a factor of 2 from a minimum of 1 ktoe (Luxembourg) to 8529 ktoe (Austria). Slovenia and Czech Republic have the highest ESP ranging around 40%. Austria, Cyprus, Finland and Sweden follow with ESP over 20%. Given the fact, that Sweden and Finland already have the most efficient pulp and paper industry in Europe, increasing efficiency by 20% is substantial. As Odyssey notes, part of the energy intensive component, pulp, may be imported instead of being produced in the country which will reduce the unit energy consumption, all things being equal (EEA 2012[32]).
- ESP from heat generation, motors and lightning and process technologies for the EU27 are small, ranging at 3.3, 5.1 and 2.0% respectively. In heat generation, the Czech Republic and Slovenia lead the pack with ESP above 15% while all other MS stay below or in the case of Austria, Denmark and Bulgaria around the 5% mark. Malta exceeds all other MS by a factor of 3 in motor and lightning (ESP 19.3%). All MS range around the same low mark in process technology improvements.

Residential

- Across all end-use sectors, heating shows the highest potential for energy savings, both in the residential and tertiary sector. Energy consumption in the residential sector could almost be halved by 2030 with ESP estimated at 46.3% for the EU27. New dwellings take the biggest share among this with ESP of 55.2%. While Belgium, Cyprus and Malta are leaders ranging in the high 60%, all member states are estimated to reach around 50% ESP from new dwellings.
- The existing housing stock (this includes refurbishment of existing housing), is projected to achieve ESP of 43.7% across the EU. Belgium leads the rank again with 57.5% followed by Germany with 50.8%. Again, savings across all MS are high around similar ESPs with no outliers. Water heating and electrical appliances also have significant potential bringing about 31.8% and 27.8% respectively in the EU.

Tertiary

- Similar observations to the residential sector can be made: Compared to electricity use, heating has almost twice as much potential for energy savings. The EU can increase its energy savings in heating by 38.9%.
- ESP from heating in existing stock (including refurbishment) accounts for 40.8% with all MS having very high potential between 70-90%; Finland and Sweden being the exception with around 33% (Latvia is comparatively low with 38% as well).
- ESP in heating from new stock takes 32.4%. The MS with highest potentials here is Southern Europe with Greece, Portugal, Spain, Cyprus and Malta.

Transport

- Both technical interventions and behavioural change such as modal shift are included in the potentials for transport. Total ESP for transport are

[32] Available here: http://www.eea.europa.eu/data-and-maps/indicators/energy-efficiency-and-energy-consumption-6/assessment, accessed 17 January 2014

distributed fairly evenly across MS around 25% with the Netherland leading at 28.7% and Estonia at the bottom with 14%.

- For passenger transport, with around 20% for all MS ESP from technical measures far exceed ESP predicted due to behavioural change (EU27 average of 2.3%).
- Freight transport ESP average around 20% across all MS with Estonia (9.7), Latvia (10.3) and Sweden (13.4) at the bottom and Belgium at the top (26.3).

Table E.1: Energy saving potentials in end-use sectors in EU28 from 2010-2030

Broad sector	Sub-sectors	2010	2012	2020	2030	2010	2012	2020	2030
		Final energy consumption (ktoe)				Rates of energy saving (%)+			
Total	All end-use sectors	81,356	100,645	183,655	308,316	5.8	7.0	12.1	19.1
Industry*	Industry total	10,711	14,968	31,797	48,467	2.9	3.9	7.6	10.4
Industry by technology	Heat generation	3,259	4,387	9,014	15,450	0.9	1.2	2.2	3.3
	Motors and lighting	5,403	7,711	16,506	23,572	1.5	2.0	4.0	5.1
	Process technologies	2,049	2,870	6,277	9,446	0.6	0.8	1.5	2.0
Industry by sector	Iron and steel	1,516	1,915	3,382	4,753	2.4	3.1	5.7	8.6
	Non-ferrous metal	296	416	878	1,261	2.4	3.3	6.6	9.2
	Chemicals	1,867	2,584	5,465	8,770	2.7	3.5	6.4	8.6
	Non-metallic mineral products	782	1,063	2,177	2,992	1.7	2.3	4.5	5.8
	Paper and printing	1,948	2,854	6,445	9,339	5.0	7.1	15.1	20.6
	Food, drink, tobacco	1,154	1,666	3,744	6,152	3.0	4.1	7.8	10.9
	Engineering and other metal	1,109	1,623	3,731	5,988	3.1	4.2	8.3	11.1
	Other	2,039	2,847	5,975	9,212	:	:	:	:
Residential	Total residential	15,930	22,082	51,521	105,497	5.2	7.4	18.6	42.3
	Heating	14,625	20,018	45,201	89,103	5.8	8.2	20.6	46.3
	Of which: existing stock	6,683	10,971	31,131	65,300	2.9	5.2	17.0	43.7
	Water heating	872	1,170	2,609	5,336	4.1	5.6	13.3	31.8
	Electrical appliances**	434	893	3,710	11,057	1.4	2.6	9.9	27.8
Tertiary	Total tertiary	5,951	9,805	25,480	46,599	4.2	6.8	16.7	28.7
	Heating	5,168	7,116	14,431	27,206	7.2	9.9	20.0	38.9
	Of which: existing stock	5,168	6,874	13,658	21,994	7.7	10.6	22.6	40.8
	Electricity-by-end-use***	836	2,769	11,240	19,744	1.2	3.6	13.3	20.4

Transport	Total transport	48,711	53,710	74,666	107,402	14.2	15.3	19.2	24.3
	Of which: Passenger transport	24,746	29,495	48,856	78,035	10.7	12.4	18.4	25.9

Source: Data Base on Energy Saving Potentials, available at www.eepotential.eu, accessed on 16/01/14

[+] For rates of energy saving, the percentage for Croatia is omitted and numbers show EU27 only.

* Total: Includes saving potentials from both fuel and electricity.

** Includes: Refrigerators, freezers, washing machines, dishwashers, dryers, lighting for households, TVs, set-top boxes, desktops, laptops, modem routers, and IT screens.

*** Includes: Street lighting, lighting for buildings, computers and monitors, copying and printing, servers, commercial refrigeration and freezing, ventilation, air conditioning, and other electric motors.

Table E.2: Energy Saving Potential (ESP) (toe) per €m of GDP, 2012

	Industry	Buildings	Appliances	Transport	Total
EU27	1.2	2.1	0.4	4.1	7.8
EU15	1.1	1.9	0.4	4.0	7.4
EU12	2.3	4.1	0.5	5.5	12.5
Austria	1.3	2.6	0.3	2.5	6.6
Belgium	1.2	3.0	0.3	3.6	8.1
Bulgaria	4.0	4.8	0.8	6.5	16.0
Croatia	0.7	4.6	0.5	6.0	11.8
Cyprus	0.5	2.6	0.6	3.2	6.9
Czech Republic	3.4	3.2	0.5	5.8	13.0
Denmark	0.6	1.9	0.3	2.7	5.5
Estonia	1.5	2.1	0.7	6.6	10.8
Finland	3.1	1.8	0.5	3.8	9.2
France	0.7	2.1	0.3	4.0	7.2
Germany	1.0	2.5	0.3	3.8	7.6
Greece	0.7	3.8	0.8	5.2	10.6
Hungary	1.3	4.3	0.8	4.8	11.1
Ireland	0.6	2.7	0.3	2.4	6.0
Italy	1.0	1.3	0.4	3.7	6.5
Latvia	1.8	4.2	0.6	7.3	13.9
Lithuania	2.6	2.4	0.5	8.0	13.5
Luxembourg	1.0	1.4	0.2	1.6	4.2
Malta	0.7	1.6	0.6	1.6	4.5
Netherlands	1.2	1.1	0.3	2.6	5.1
Poland	2.2	4.7	0.5	5.2	12.6
Portugal	1.7	2.7	0.6	4.7	9.6
Romania	2.4	5.1	0.3	5.3	13.1
Slovak Republic	0.8	3.0	0.5	7.1	11.4
Slovenia	4.4	2.5	0.4	3.9	11.3
Spain	1.4	1.9	0.5	7.9	11.8
Sweden	2.4	0.8	0.4	3.5	7.1
United Kingdom	0.7	1.2	0.3	3.6	5.9

Appendix F Case studies for the social impacts of energy efficiency

Case studies serve to identify and showcase good practice examples of effective policy design that maximise the positive social impacts of investment in energy efficiency. The results complement and illustrate the modelling results and the data provided by the literature. The objective is on identifying what worked, and the transferable lessons for other types of activity, EU regions and sectors.

The selection sought to identify examples where some qualitative research and assessment of energy efficiency policies, measures and programs had been undertaken and from which lessons might be drawn. Besides the energy saving impact, special consideration was primarily given to the need for and supply of training to build on existing capacity or develop new skills, and to improve distributional outcomes, for example by targeting the energy poor.

The initial identification of possible cases was based on consultation with experts in the field. It was followed by a preliminary screening of potential case studies, and a first selection of case studies was identified. Finally six case studies were shortlisted in agreement with Commission Services, based on a multi-criteria analysis addressing the availability of existing information, the feasibility of the study, the relevance for jobs, skills and training and the relevance for incomes and poverty alleviation. Geographical balance was also considered. The table below provides a summary of the selected cases.

Table F.1: Selected case studies

Country	Title	Purpose
EU	Overview of Electric Vehicles	EU wide overview of the sector with specific examples from Germany and the UK
Spain	Build up Skills Spain	To produce curriculums and educational materials for EE and RE training that standardized the quality of teaching and learning processes, and identified priority actions and recommendations for their implementation, and to deliver the training
Austria	The Green Building Cluster of Lower Austria - ECO-plus	To connect construction and building professionals with researchers to foster their competencies in the areas of sustainable building and living.
Germany	Make your home fit	The provide energy saving information advice to local communities in order to reduce the energy consumption of buildings.
UK	Embedding Resource Efficiency in Key Sectors	To create a regional programme to cover the full spectrum of environmental impacts generated by a business – from the products it makes, through to the processes it uses and the waste it generates.
Romania	Improving energy efficiency in low-income households and communities	To remove barriers to the implementation of improvements in the energy performance of buildings, especially with respect to households which may be classified as being in fuel poverty

The selected case studies cover a wide variety of programs and diverse European regions. They feature the energy improvements of low-income households, the networks and R&D capabilities of professional business in the industry, or the provision of the skills required for manual workers and professionals in the building sector. The selection also targets homeowners, business-providers and workers, as well as low-income and all other households. It was agreed that cases would be primarily (though not exclusively) focussed on energy efficiency programmes targeted at residential buildings, where the greatest potential for social impacts. Additionally, a case study focusing on resource efficiency in key industrial sectors is also featured. It showcases energy savings delivered in the form of cost and resource savings, as well as a review of activities and initiatives on electric vehicles at a pan-European level. All the programmes delivered significant energy savings, including reductions in energy consumption derived from the retrofit of old buildings (insulation and ventilation and heating) or the construction of new EE buildings.

However, as part of their design and delivery, all these programmes also resulted in positive social impacts in the areas of employment, skills and training, or the improvement of the living conditions of low income households or the energy poor. Selected social impacts of these energy efficiency programs are highlighted in the table below:

Table F.2: Selected social impacts of the energy efficiency studies

- The direct generation of new employment;
- The improved capacity at the local level to reduce fuel consumption in low-income communities;
- The expansion of policies to support energy efficiency in low-income communities;
- The delivery of training of sector professionals, or the unemployed;
- The support and provision of R&D opportunities;
- The provision of networking opportunities for relevant industries;
- The design of a national qualification roadmap anticipating the EE and RE skills required in the future, and the provision of the relevant training to address those shortcomings;
- The increase of data and information availability for decision-makers in the design of programmes to address fuel poverty; or
- The training of highly skilled energy advisers to provide special and targeted training.

Also, as per above, these case studies serve to identify and showcase good practice examples of effective policy design that maximise the positive social impacts of investment in energy efficiency. Some of the conclusions on this regard are listed below.

Table F.3: Good practice lessons from the energy efficiency case studies

They are explicitly aimed programmes

- Programmes carefully planned where the EE policy responses would have a greater social impact, tailoring the programmes to the specific needs of the region and target groups.

They work with long-term vision and planning

- These programs envisaged a long term plan, either to correct market failures or to prepare and frame responses for foreseeable challenges. Programmes designed skills required to meet future objectives in the future, and accordingly plan a roadmap towards their achievement.

They deliver focussed and precisely targeted activities

- Programme activities were tightly linked to defining particular skills needs and training responses. The training programmes were particularly addressed to the populations that would require it the most, and that would be using it to a greater impact in the future. The poverty alleviation campaigns were addressed to low-income households that would benefit most significantly from the retrofitting of their buildings. As a result, impacts of the actions were maximized to their full potential.

They count on a collaborative (often multidisciplinary) and comprehensive approach

- All the case studies benefitted from the involvement and collaboration of different stakeholders and sectors in society. The activities had input from multidisciplinary teams, for instance in the cases that delivered training both sector experts but also teachers and educators were involved, in the electic vehicles case, a wide range of stakeholders were engaged. Information campaigns also benefited from a wide-ranging use of tools and methods

They are effective programmes

- All the programmes had recognised the value of monitoring and evaluation. This provides an evidence base which suggests the case studies present effective programmes that achieved multiple objectives. As well as providing energy savings and energy efficiency results, they all delivered positive social impacts in terms of cost savings, job creation, poverty alleviation and training provision with improvements in the scale and level of skills available. Most have some attempt to monitor and evaluate activity, although this is not always comprehensive or up to date.

Case study 1: Policies and initiatives on electric vehicles in the EU

The context

The use of electric vehicles (EVs) features in European policy due to the role that these technologies can play in achieving various targets around sustainability, climate change and CO_2 emissions. The EC's Transport White Paper (2011) set a goal of achieving a 60% reduction in CO_2 emissions by 2050 and, given that transport accounts for a significant share of overall emissions, policies to improve the development and adoption of lower emission and sustainable technologies are unsurprisingly important features of policy across Europe. "Electric cars could contribute to savings of 5 Mt CO_2/year if the national and regional objectives of putting 5m electric vehicles on the market by 2020 is met" (Report of the European Expert Group on Future Transport Fuels, 2011).

Various legislative acts are concerned with areas which encompass or apply to EVs. These acts include:

- Clean road transport vehicle – the Directive on the promotion of energy efficient road transport vehicles (2009/33/EC); CO2/cars Regulation ((EC) No 443/2009); setting standard for CO2 emissions from cars; and EU legislation on type approval of vehicles.
- European strategy on clean and energy efficient vehicles – the Commission Communication COM (2009)186 which sets out an action plan for green vehicles.
- The expected outcomes vary across the numerous projects and initiatives currently underway in Member States. The overall intention of the increased development and use of EVs in Europe is focused on reducing CO2 emissions and meeting the 2020 and 2050 targets. Other benefits associated with EVs which have been noted in various policy and project documents include: reduce traffic congestion; sustainability and reduced reliance on fossil fuels; and, reduced noise and vibration compared with road transport using internal combustion engines.33 Support for developments of EVs within Europe is also seen as an important measure in ensuring that the automotive industry in Member States can compete with others and worldwide the industry moves towards improving green technologies and their adoption.

The programme: selected programme examples

Policies and initiatives on EVs, and electromobility more broadly, tend to focus on development and improvement of technologies and development of markets for EVs. Amongst the priority areas are issues regarding: battery life and reliability; building up the charging infrastructure; and, ensuring compatibility across Europe to allow for ease of movement.

In 2010, the European Commission presented a strategy for clean and energy efficient vehicles ('green vehicles'). Vehicles using alternative fuels, battery EVs and hydrogen fuel cell vehicles are included in this strategy and the strategy set out a number of flagship initiatives. The strategy also emphasises the need for research on electric cars and others to ensure their manufacture eventually becomes economically feasible and sustainable. The Commission

[33] There is also the potential for renewable energies to be used to meet any peak demand when electric vehicles are plugged into the grid – e.g. before morning and evening rush hours.

has thus proposed a long-term research strategy in the Strategic Transport Technology Plan and in the Communication on Clean Transport Systems. The Commission has also presented guidelines on financial incentives to consumers to buy 'green vehicles', including EVs. Amongst the specific actions set out in relation to EVs, are: development of technical rules relating to EV safety; and mandating the development of a standardised charging interface.

The Commission's European Green Cars Initiative (EGCI) (a Public Private Partnership (PPP) of the European Economic Recovery Plan announced in 2008) aims to provide financial support to research into green technologies and, on the demand side, supplements through promoting regulatory actions by Member States and the EU (e.g. taxation of vehicles according to CO_2 emissions). The overall budget for EGCI is around €5bn which is being made available through the European Investment Bank, 7th Framework Research Programme (FP7) grants and demand-side measures and public procurement. The FP7 (from 2007 to 2013) funding in relation to EGCI focused initially on electric road transport.

The European Green Vehicles Initiative (EGVI) has been established as continuation of the EGCI (2009-2013) and is, again, dedicated to developing and delivering green vehicles and mobility system solutions aligned with major societal, environmental and economic challenges. The main differences to its predecessor are that EGVI focuses on the energy efficiency of vehicles and alternative powertrains and covers additional vehicle types to those covered in EGCI but the working methods and approach are similar. EGVI aims to accelerate research, development and demonstration of technologies allowing the efficient use of clean energies in road transport and has a budget of €3bn over the seven year period, 2014-2020.

At international level, there is the Clean Energy Ministerial Electric Vehicles Initiative (EVI) and the International Energy Agency (IEA). EVI is a multi-government (currently 15 members, including nine European members) policy forum dedicated to accelerating the introduction and adoption of EVs across the world. According to EVI, national governments focus most of their spending on RD&D and consumer incentives whilst local governments (cities) and the private sector tend to support the deployment of supporting infrastructure (e.g. charging facilities, priority lanes, and car-sharing schemes).

The EVI has a group ambition to have 20m passenger car EVs on the roads by 2020 – this is equivalent to about 6m sales per year by 2020. The key activities of EVI include: publication of EV City Casebook which highlights the most innovative ideas being followed through in different cities across the countries that are members of EVI; collection, analysis and dissemination of data from EVI member government and cities; pursuit of public-private dialogue; and publication of Global EV Outlook which presents a collection of national level data on EV deployment. The EVI supports various pilot projects (and highlights these in various publications) with expected outcomes ranging from: improving access to battery charging points within cities; ensuring compatible systems for EVs across regions.

Structure and key features

The European Commission launched a European Electro-mobility Observatory (EEO) in 2012 with the intention of ensuring collection and dissemination of key statistical data on electromobility. EEO has published an overview of pilot programmes and projects across Europe (EEO, 2013). There are numerous projects in the EU that are concerned with the development of electromobility with regards to development of vehicles, subsystems, charging infrastructure, etc. fall under the European Green Cars Initiative of the EU's FP7 Research Programme. The EEO focus on projects and programmes that are concerned with the implementation of electromobility in practice. Amongst these projects are a number of demonstrations and a great deal of partnerships across Member States. Examples include:

- eBridge: €1.7m (€1.3m EC funding), April 2013 to March 2016. eBridge is concerned with transforming / converting existing car fleets to electric, improving the services provided and thereby encouraging the use of these fleets and making the recharging network readily available. The activities within the project include car-sharing within various municipalities in Germany, Austria, Spain, Italy, Portugal and UK. The outputs include: solutions to facilitate the use of electric car sharing offers, awareness raising and marketing, up-scaled impacts, and dissemination materials.
- Green eMotion: €42m (€24m EC funding), 2011 to 2014. This is a large scale demonstration project with the primary goal to define Europe-wide standards. It includes practical research in demonstration regions across Europe34 with the aim to demonstrate a commonly accepted and user-friendly framework within a sustainable business platform. Partners include EV manufacturers, utilities, systems providers, municipalities and RTD institutions which are located all over Europe (including countries where there no demonstration projects). It is led by Siemens.

Example in Member States: Electric vehicles and mobility in Germany

In Germany, the Federal Government has shown considerable interest in developing electric vehicles. This interest commenced with the Nationaler Entwicklungsplan Elektromobilität (NEPE- National Development Plan for Electric Mobility) in 2009 which represented a ten-year framework for the development of electric vehicles[35]. It represented the German government's long-term commitment to developing electric transport with an expectation that business and industry would show a similar commitment[36]. Further investment was agreed in 2011 which effectively doubled existing levels of expenditure on R&D to €1bn.

That Germany should have invested so heavily in electric vehicles relates to the dominance of its car industry in the EU. Just under 40% of the EU's 2.2m automotive sector workers are located in Germany[37]. The country has sought

[34] Countries in which demo projects have taken and place or are ongoing are; Greece, Germany, Denmark, Ireland, Spain, Italy, Hungary and Sweden.

[35] Bundesregierung (2009) *Nationaler Entwicklungsplan Elektromobilität der Bundesregierung*. Berlin: Bundesregierung.

[36] Bär, H. (2013) Lead Markets for electric vehicles – *China's and Germany's strategies compared*. Working Paper No. 12, Lead Markets Funded under BMBF Programme WIN 2. Berlin: Freie Universität Berlin

[37] EU Skills Panorama (2014) *Automotive sector and clean vehicles: Analytical Highlight*

to ensure that it is the leading producer of electric cars. The National Electric Mobility Platform (NPE) has brought together various stakeholders to promote the development of electric vehicles. In part this stems from a desire to develop a degree of standardisation across products so that the vehicles produced by different manufacturers can all use the same charging points.

The scale of the EV sector in Germany provides that country with a degree of competitive advantage as the consumption of EVs across the EU increases. Whether production of EVs will continue to be so concentrated in Germany in the future is a moot point, but clearly it is strategically well placed to meet demand. Of course, as the take-up of EVs increases the benefits of energy saving impacts will be experienced by the EU as a whole and not just limited to the countries producing them. So Germany may be dominant in the production of EVs, but the potential energy saving impacts will be experienced EU-wide.

Both the first and second reports from the NPE have drawn attention to develop the skills base. The second report of the Platform outlined the need to develop a roadmap in relation to supply of the academic and vocational skills that the electric vehicle industry will need to develop. By 2015, €360m will have been invested via the NPE in the development of the skills base: €155m in academic studies (allied to R&D) and €205m in professional / vocational education[38]. Accordingly, substantial investments are being made in human capital at all stages of the production process: from R&D (development of batteries, lightweight design, rapid charging, etc.) through to the vocational skills required in order to manufacture and service electric vehicles. The NEPE estimates that, by 2020, an additional 30,000 jobs could be created in Germany if electric mobility is further developed.

Initial evidence suggests that there is a lack of qualified staff in battery technologies – both research staff and technicians who need to work with batteries in the manufacture and repair of electric vehicles[39]. So the emphasis has been to ensure that skill shortages do not act as a drag on the development of the sector. The electric mobility roadmap[40] published by the NPE in 2013 makes reference to the need to develop a training and qualifications roadmap. This is because the skills needed to develop electric vehicles require previously separate disciplines to be brought together. These disciplines may include sociology, economics, social sciences and humanities and integrating them in the roadmap would aim to help "address the subjects of marketing, business management aspects, future business models and advanced services, as well as, in particular, the rooting of electric mobility in society."[41] The competence roadmap – for both academic and vocational skills

[38] Nationale Plattform Elektromobilität (2011) *Zweiter Bericht der Nationalen Plattform Elektromobilität* Berlin: Nationale Plattform Elektromobilität.

[39] Stock, L. and Vogler-Ludwig, K. (2010) *Skills for Green Jobs: Germany*. Economix / GHK.

[40] Nationale Plattform Elektromobilität (2013) *Vision and Roadmap of the National Electric Mobility Platform.* Berlin: NPE. http://www.bmwi.de/English/Redaktion/Pdf/vision-and-roadmap-of-the-national-electric-mobility-platform,property=pdf,bereich=bmwi2012,sprache=en,rwb=true.pdf

[41] See p. 31, Nationale Plattform Elektromobilität (2010) *Interim Report of the National Platform for Electric Mobility.* Berlin: NPE. http://www.bmwi.de/English/Redaktion/Pdf/electro-mobility-report,property=pdf,bereich=bmwi2012,sprache=en,rwb=true.pdf

– sets out a framework of how qualifications and training can be developed so that individuals are skilled in working with battery technology, high voltage systems, and charging systems[42].

Its recommendations relate to:

- Academic qualifications
- Developing expertise in universities relating to electrochemistry / battery research, lightweight vehicle development, etc.
- Vocational qualifications
- Developing postgraduate training centres
- Ensuring skilled workers in the manufacturing sector are aware of the development of electric vehicles and are able to develop their skills accordingly
- Ensuring that vocational training centres are suitably equipped
- Developing training modules and learning platforms
- Ensuring that training the trainer takes place to ensure that there is a pool of expertise

Joint actions required to achieve the goals set out in the roadmap have been outlined by NPE and include: annual meetings on implementation of the National Education Conference for Electric Mobility recommendations (eMob in progress); marketing to ensure a steady flow of new recruits to the industry and professional development of specialised personnel; development of handouts and practical aids regarding vocational training and further education qualifications as well as similar materials regarding in-service retraining. Cooperation between universities, higher education institutions, industry, education experts, professional associations, local and regional authorities are considered to be important in conducting activities and ensuring success.

In its latest progress report[43] (December 2014), the NPE highlights that Germany looks on track to achieve its goal of becoming a leading player in the international electric mobility market. NPE has completed the market preparation phase (which ran from 2010 to 2014) and the report sets out proposals for the next stage – the market start-up phase (2015 to 2017). There are views that the NPE has not achieved its original targets – whilst it set out to have 100,000 EVs on the road in Germany by 2014, the progress report states that there are 24,000.[44]

Perhaps most interesting about the development of electric vehicles (e-mobility) in Germany is the medium- to long-term planning horizons, especially at national level with the National Development Plan for Electric Mobility, which have been put in place and the centrality of skills development in ensuring that the goals of the e-mobility / electric vehicle industrial strategy are realised.

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[42] Müller, K.and Goericke, D. (2014) *Kompetenz-Roadmap Nationale Plattform Elektromobilität (NPE) AG 6 – Ausbildung und Qualifizierung*. Berlin: Nationale Plattform Elektromobilität.

[43] See http://www.bmub.bund.de/en/press/press-releases/detailansicht-en/artikel/nationale-plattform-elektromobilitaet-uebergibt-der-bundesregierung-fortschrittsbericht-2014/?tx_ttnews%5BbackPid%5D=698&cHash=b97eb801887b1dce329c73fa4532bd07

[44] http://www.dw.de/the-future-is-electric-or-is-it/a-18108847

Example in Member State: Switchev in north east of England

The SwitchEV programme, which was in operation from 2010 to 2013, was a demonstration project. It was one of eight national trials of electric and hybrid vehicles funded by the Technology Strategy Board's €33.6m Ultra Low Carbon Vehicle Demonstrator Programme. The project had a value of around €14.5m. Contributions were made by the consortium partners and others including One North East and Newcastle University. SwitchEV took place alongside the Plugged in Places initiative that has involved the installation of 1,300 charging points (by One North East).

In order to overcome misconceptions for consumers and businesses about usability of EVs and to capture data on various outcomes including range, costs, and emissions associated with use of EVs. There is a lack of knowledge regarding the practical implication of introducing and adopting EVs on a large scale. The project aimed to monitor a range of EVs to allow for evaluation of the technical, economic and social aspects of regular and mainstream use of EVs. The Plugged in Places initiative, which coincided with SwitchEV intended to install widespread charging infrastructure in order to support the growth of EVs in the region. The project was meant to 'act as a trailblazer prior to wider scale adoption of electric vehicles across the UK'[45].

Switch EV was a North East regional project, with project partners from the area. The project intended to take advantage of the work that local authorities had already completed on recharging infrastructure provision (through the Plugged in Places initiative). At the time (and currently) the charging infrastructure in the North East is highly developed and has far greater capacity than other regions of the UK.

Recharging infrastructure is developing across the North East, updating as new technology becomes available with rapid charge points (to address practical concerns from drivers) being implemented as well. According to the Switch EV project's website: "Organisations are benefiting from the associated supply chain requirements, and are contributing to the project, including electric vehicle dealerships, education courses for technicians, specialist insurance providers and dedicated breakdown service providers."

Members of the general public[46] were invited to use the electric vehicles for six months in the same manner as they would normally use their conventional petrol or diesel powered cars. The trial was unique nationally in that it was operating in conjunction with the 'Plugged in Places' infrastructure project allowing the vehicles to operate in the presence of comprehensive availability of public charging. Newcastle University has analysed a comprehensive set of data that was collected directly from cars and drivers during the project.

Alongside the Switch EV and Plugged in Places projects, at a national level in the UK, there are various grants and subsidies available to individuals and

[45] http://vehicletrial.switchev.co.uk/the-project.aspx

[46] The trial included 'single users' (members of the general public) who would drive and be responsible for the EV whilst taking part in the trial and 'pool users' where the cars would be driven by individuals but the cars would be managed by (and the responsibility of) the general fleet operator of an organisation or company. Single users would typically have used the cars for a period of 6 months each whilst organisations (which managed cars for pool users) would have cars for up to one year in the trial.

companies for the purchase / lease of EVs and other low carbon vehicles. The North East region also houses a number of major manufacturers of EVs (e.g. Nissan) and the region (employers, universities, etc.) places great emphasis on the low carbon sector and the development of EV and other technologies with the aim of promoting economic growth, whilst also reducing carbon emissions and other environmental impacts.

The SwitchEV project was delivered and managed by Future Transport Systems (a consultancy) and involved a consortium led by Nissan. The project involved a number of partner organisations (including partners from academia, multinational vehicle manufacturers and regional SME expertise) as well as organisations (e.g. companies that took part in the trial itself[47]. Members of the consortium included: Simon Bales Peugeot; AVID vehicles; Smiths Electric Vehicles; Liberty Electric Cars; Newcastle University; One North East; and the Technology Strategy Board. Trial organisations were selected from across the region. This is an important development for the North East of England where Nissan – and its supply chain – is a major employer providing relatively highly skilled employment. The investment in EV production on the North East signals that the automotive sector there is potentially well placed to be involved in the future production of EVs. In this way, the importance of vehicle manufacture in the local area's economic development is safeguarded.[48]

The outcomes of the Switch EV project included:

- use of 44 vehicles within the project
- more than least 145 trial periods with 'real world' drivers[49]
- vehicles to be used as pool cars and car club vehicles, giving many the opportunity to drive
- More than 400,000 miles driven during the trial
- raised awareness of EVs in the region
- increased understanding of EV charging

The project also involved:

- data collection from trial vehicles
- collection of subjective data from drivers (through before and after surveys)
- knowledge transfer within the consortium and the wider business community
- skill development to support the regions industry and SMEs
- job creation, directly and indirectly

Outputs and results/impacts

The project included a total of 44 electric vehicles which together travelled over 400,000 miles across the North East of England, between March 2010 and May 2013. The project entailed more than 90,000 journeys and 19,000 charging events (associated 120 MWh energy transferred) were recorded. The project has provided an extensive and unique dataset on the charging

[47] Organisations (e.g. companies) which had cars under the trial for 'pool users'.

[48] It needs to be borne in mind that the North East of England is a region that has historically experienced relatively high levels of unemployment. Inward investment from companies such as Nissan is important to securing a relatively high skill, high wage future for the local economy.

[49] Including both single users and pool users.

behaviour of EV users. This data has been used to help identify barriers to the introduction of EVs to the market and to inform future policies on electric transport. The charging infrastructure in the region represents the largest network in the UK and thus the results from the trial are both nationally and internationally leading.

The project collected and analysed data on CO_2 emissions. The average carbon content of EV travel in Switch EV was 91gCO_2/km in winter and 84gCO_2/km in summer. Even the maximum values (96gCO_2/km in winter and 91gCO_2/km in summer) provide considerable reductions compared to the average vehicle in the UK (208gCO_2/km) and to new car sales (140gCO_2/km). The final project report notes that 'the carbon emissions for EVs could be lowered to 80gCO_2/km in winter and 65gCO_2/km in summer if EVs were recharged overnight'. The advantage of EVs is apparent even after accounting for emissions from electricity generation. The report also pointed out that electric vehicles were important for improving air quality and that widespread usage of EVs instead of vehicles with internal combustion engines could improve mortality due to particulate matter (PM10) in the air but figures are an approximation (see p. 30).

There has also been an impact on more general use of EVs outside of the trial. Since the wider programme to install EV infrastructure began in 2010, public charge points have been used more than 26,000 times, delivering 178,000kwh of electricity and resulting in a reduction of £88,819 in EV drivers' fuel costs. This equates to a saving of over 144m grams of CO_2.[50]

There are additional financial benefits for individuals who buy EVs. In the UK there are government grants (c. £5,000) available to help towards the cost of an EV; drivers do not pay vehicle excise duty; there are reduced parking charges for EVs in some areas, including the North East where the SwitchEV trial took place; EVs have lower maintenance costs; and lower fuel costs (compared to internal combustion engines).[51] Switching to an EV then can mean that an individual has more to spend on other things in the economy which contributes to economic growth in the area, too. It is estimated that: "...as swell as being eligible for a £5000 Government grant to help towards the cost of an EV, financial benefits to motorists include no vehicle excise duty, cheaper parking and charging at locations around the North East, lower maintenance costs and dramatic reductions in CO2 emissions and fuels costs - as an example, 20,000 miles would cost around £800 a year in an EV while petrol or diesel would cost around £2,400 - a saving of £1600."[52]

By the end of the SwitchEV trial there had been nearly 200 trial periods undertaken in 44 vehicles with 'real world' drivers (including single and pool users) in the region.[53] By mid-2012, around a quarter of those drivers who had

[50] http://www.bodyshopmag.com/News-north-east-pioneers-ev-infrastructure-.aspx

[51] http://www.simonbailes.co.uk/news/teesside-switch-ev-leader-reveals-major-boost/4385/newsdetail.aspx#.VO4KlSzSQa5

[52] See footnote 19

[53] See *SwitchEV Final Report:* http://www.futuretransportsystems.co.uk/_diskcache/296-final-report-for-seminar.pdf

participated in the trial had bought or entered a longer term lease on an EV.[54] Users were asked about their willingness to buy an electric vehicle after they had completed their trial driving period. 16% indicated that they would consider purchasing an electric vehicle as their main car and nearly half (46%) said they would consider buying one as their second car. The remainder (38%) however considered EVs to be too expensive and they had concerns about battery life.[55]

There have been direct jobs created by the Switch EV project and, more widely, skills requirements for installing and maintaining charging points and maintenance of EVs themselves. The impact of the project on the uptake of EVs by consumers also has implications for other jobs (including manufacturing, maintenance, design, etc.) and skills requirements. However, the project's final report does not provide information about these outcomes/impacts.

Results

In developing electric vehicles, the OECD has drawn attention to the wide variety of actors who will be involved if there is to be substantial take-up of EVs in the future[56]. The actors include, for example, electricity generators, vehicle manufacturers, producers and installers of rapid chargers, etc. To date, the role of public policy has been in large measure to stimulate R&D activities in relation to electric power chains and charging technologies[57]. These tend to bring together R&D institutions (e.g. universities) and business. In France, for example, The Vehicles of the Future programme has a €950m funding package aimed at supporting the development of innovative transport technologies. Clearly this generates a substantial demand for high level skills linked to, amongst other things, R&D specialists.

If the trend is a move away from the internal combustion engine to increasingly electrified power-trains, coupled with the move to the use of lighter materials this also creates a substantial demand for skills used in the production of electric vehicles / hybrid vehicles. An understanding of the specific skills needs resulting from moves to using increasingly electrified power-trains is increasingly becoming apparent. Higher level skills courses are emerging in the tertiary sector aimed specifically at electric vehicle technologies – for example, the Master's degree offered by the Paris Engineering Schools in Electric Vehicle Engineering[58]. The emphasis at the moment, however, is very much on policies aimed at the development of a mass market in electric vehicles and changes that need to take place in order for that to happen. To some extent, the emerging skill needs, especially at the level of the craft and related trades worker is, perhaps, less apparent at the moment. But as the German example demonstrates, there is perhaps a need

[54] See http://www.futuretransportsystems.co.uk/news/2012/07/trial-urges-drivers-to-switch-to-ev.aspx

[55] http://www.futuretransportsystems.co.uk/_diskcache/296-final-report-for-seminar.pdf

[56] Stevens, B. and Schieb, P.A. (2013) *Developing Infrastructure for Alternative Transport Fuels and Power-trains to 2020/2030/2050: A Synthesis Report*. Paris: OECD International Futures Programme.

[57] Ministry of Ecology, Sustainable Development and Energy (2014) *The Energy Transition for Green Growth*. Paris: Ministère de l'Écologie, du Développement durable et de l'Énergie.

[58] http://www.enpc.fr/en/node/8470

to concentrate on emerging skill needs at all levels if skills are not to act as a drag on the potential employment opportunities presented by electric vehicles.

Comments and conclusions

Strengths in approach identified by the case study are reflected in two features which are particularly useful in increasing the use of EVs, thereby increasing the potential market, and for ensuring that the country/area is prepared to take advantage of growth in this market. These are:

The use of demonstration projects to provide information to consumers and to address those concerns they have about the practicalities of using EVs, as illustrated in the SwitchEV project in the North East of England. This project takes the up-front risk away from individuals/companies of purchasing a first EV without being sure of the benefits. The large scale data collection which took place alongside the trial (on CO2 emissions from the EVs) as well as surveys of users are also strong features of the trial as this has allowed for a breadth of analysis about the impacts of EV use and indications of the implications that widespread uptake could have.

The design and implementation of a relatively long-term strategy for development of the EV sector and market as set out in the example of Germany and its NEPE and NPE. Such a longer term horizon allows for skills development to take place so that required skills are ready to take advantage of and to support growth in the market. It also allows for other factors which may or may not already be in place to be put into place or improved, again to ensure that the strategy is being followed.

The automotive sector has proved to be an important source of output and skilled employment in the EU. It is likely that the consumption of EVs will increase in the future. It is important, therefore, that the technologies are developed in the EU. In this way the potential employment and skill gains that result from technical change are maximised in the EU. In this way, the potential benefits that stem from the EU's knowledge base can be realised. This is important in the context of EU policy initiatives such as New Skills for New Jobs.

There are, however, significant risks attached to development of EVs for private firms, including those that relate to ensuring that the technologies are capable of being brought to market, and if they are brought to market that the skills are available that will allow the products to be produced in the EU. The pilot projects are important in this regard insofar as they simultaneously address the development of the technologies and, at the same time, ensure that the skills necessary for that development and the production of EVs are in either in place and / or provide a roadmap to effectively developing those skills.

- In Germany, the NPE brought together various stakeholders not just to develop the technologies but to develop the skills base – or at least provide a roadmap for its development and certification – that will be essential if the production of EVs is to significantly increase. Skills was clearly recognised as a potential constraint on being able to fully capitalise upon the development of EVs and ensure that production takes place without being hampered by a lack of skilled personnel;

- In the North-East of England the emphasis, in part, was learning about to persuade drivers of the merits of eventually moving over to using EVs. Clearly, there is a learning curve to be climbed if drivers are willing to move over to using EVs (there is no point in scaling up production if potential consumers are potentially unwilling to move over to EVs). Developing and maintaining the infrastructure to allow EVs to be used is clearly a vitally important economic activity.

It is likely the future production of EVs will be geographically concentrated. It is also likely that the production will be concentrated in areas that are already heavily involved in vehicle manufacture. Whilst programmes such as NPE are vitally important in ensuring that EVs are developed and manufactured in the EU and that the skills base is in place to support that development and production, it is likely that the scope for developing similar pilot projects will be limited. This is not for one moment to suggest that such pilots are not important. To the contrary, they are vitally important in ensuring that the production of EVs is not constrained by skill shortages. There is potential merit in looking at how the approach in Germany could be replicated in other areas that are dependent upon vehicle manufacture.

The example from the North East is also important in looking at how an EV infrastructure can be developed and drivers persuaded to move over to EVs. This will be vitally important if the various economic and health benefits that potentially accrue from the diffusion of EVs is to be realised. The particular strength of the North East approach is that it could be rolled out almost anywhere in the EU. There is, therefore, considerable potential for policy makers to look at how more of these type of projects could be initiated across the EU. It also emphasises the importance of a wide range of stakeholders working in concert to ensure that EVs are used – car retailers, those providing the charging infrastructure, electricity providers, etc.

Case study 2: BUILD UP Skills Spain

Context

The Spanish economy has been severely impacted by the financial crisis, particularly in employment and the construction industry. The building sector made a 13% contribution to its GDP in 2006, but has since suffered a 90% decrease in the number of new projects[59]. Similarly, the number of people employed in construction has fallen sharply. At its 2006 peak the sector employed almost 3.5m people. Figures for 2011 reveal a total loss of over 1.1m workers in the sector. As a consequence the number of companies working on the extraction and production of building materials has significantly decreased, and so have production volumes. At the same time, decreased public spending has reduced investment and the supply of credit granted to companies and families.

Despite the challenging context, the regulatory environment (and especially the 2011 Plan de Energias Renovables[60] [61]) has stimulated investment in EE and RE, with a particular interest shown by the hospitality and food businesses sectors. More precisely, the *Ley 38/1999, de 5 de noviembre, de Ordenación de la Edificación (LOE)*[62],and its Codigo Tecnico de la Edificacion[6364] required existing building professionals to learn new, specialised skills to guarantee the compliance of energy efficiency demands stimulated by the energy plan.

The 2011 Spanish law on Sustainable Economy[65] and the Spanish sustainable development strategy[66] sets the strategic framework for the development of a 'green economy' which is expected to generate up to 2.7m green jobs by 2020, of which 265,000 will be related to EE and 160,000 on average in RE[67]. The most significant contributions to these figures come from the sectors presented in Table 1.3 below.

[59] http://spain.buildupskills.eu/sites/default/files/BUILD%20UP%20Skills_status_quo_report_EN.pdf

[60] http://www.idae.es/uploads/documentos/documentos_11227_PER_2011-2020_def_93c624ab.pdf

[61] http://www.minetur.gob.es/energia/es-ES/Novedades/Documents/PER_2011-2020_VOL_I.pdf

[62] http://www.boe.es/buscar/pdf/1999/BOE-A-1999-21567-consolidado.pdf

[63] http://www.fomento.gob.es/NR/rdonlyres/7BD6D398-EE9B-40F5-86A9-D28C4A684444/95701/1.pdf

[64] http://www.fomento.gob.es/NR/rdonlyres/B83B66E3-0BA0-4270-BEF5-84A07A4C77F8/95714/14.pdf

[65] http://www.boe.es/boe/dias/2011/03/05/pdfs/BOE-A-2011-4117.pdf

[66] http://www.magrama.gob.es/es/ministerio/planes-estrategias/estrategia-espanola-desarrollo-sostenible/09047122800cfd5b_tcm7-14860.pdf

[67] *Empleo verde en una economía sostenible. Fundación Biodiversidad and Observatorio de la Sostenibilidad en España (OSE).*
http://www.ccoo.es/comunes/recursos/1/doc19288_Informe_sobre_empleos_verdes_del_Observatorio_de_la_Sostenibilidad_de_Espana.pdf

Table F.4: Predicted green jobs generation for key sectors[68]

Sector	Predicted job generation 2006-2020
Sustainable construction	a. 265.000 jobs
Eco-industry	b. 260,000 jobs
Eco-agriculture	c. 212.000 jobs
Sustainable transport	210,000 jobs
Renewable energies	140.000-180.000 jobs
Sustainable tourism	24.000 jobs

Source: Informe Económico del Presidente del Gobierno (2009)

It is anticipated[69] that an additional 166,000 to 648,000 construction workers are needed to meet the European 2020 energy targets, 25%-35% of which will be directly related to EE and RE and in need of training or re-training. Therefore, there is a need to train between 227000 and 487000 professionals[70]. The table below depicts the number of workers to be trained in EE and RES.

Table F.5: Number of workers that need to be trained in EE and RES[71]

Number of workers need to be trained in EE and RES			
Total number low scenario: 909.420		**Total number high scenario:** 1.391.048	
227.355 (25%)	347.762 (35%)	347.762 (25%)	486.867 (35%)
Workers to be trained per year (2013 to 2020)			
28.419	43.470	43.470	60.858

Source: National Roadmap for Construction: 2020

Programme

To respond to the requirements introduced by the 2010/31/EU Directive on the energy performance of buildings[72], together with Spanish regulations, and the necessary improvements in the skills and training of professionals in the construction sector for the delivery of projects providing RE and EE, Spain has

[68] Informe Económico del Presidente del Gobierno (2009) accesible here: http://www.elpais.com/elpaismedia/ultimahora/media/201101/11/espana/20110111elpepunac_2_Pes_PDF.pdf

[69] http://www.fundacionlaboral.org/uploads/documento/applications/ARCH537c5d95c69f1.pdf

[70] Further calculations on the basis of these figures agree that an average of 90h of training will be needed per employee, at an average cost of €11/hour, adding to a total budget of €28m and €60m (€169m-€421m total).

[71] Source: National Roadmap "Construye 2020" http://www.fundacionlaboral.org/uploads/documento/applications/ARCH537c5d95c69f1.pdf

[72] European Energy Performance in Buildings Directive http://eur-lex.europa.eu/legal-content/EN/ALL/;ELX_SESSIONID=FZMjThLLzfxmmMCQGp2Y1s2d3TjwtD8QS3pqdkhXZbwqGwlgY9KN!2064651424?uri=CELEX:32010L0031

several instruments available, such as the Training System for Employment, which regulates vocational training for the employed and unemployed, and the National System of Professional Qualifications, which is developing the National Catalogue of Qualifications.

However, current vocational training in the country does not fully address all relevant EE and RE requirements. Also, formal training in energy efficiency is targeted at highly qualified experts, but there is not sufficient training activity or training materials for workers.

The purpose of the BUILD UP Skills project was to establish a roadmap setting out a clear plan of action to ensure that qualification and training systems respond to the training needs arising in the field of improvements in the energy performance of buildings.

BUILD UP Skills is structured in two phases:

- The first phase (BUILD UP Skills I) started in November 2011 and finished in March 2013. It involved the initial management and planning of the programme, the analysis of the national status quo, as well as the elaboration of a national platform for qualifications and a roadmap to deliver the skills and training necessary for the labour force of construction workers required to achieve Europe 2020 energy targets.
- The second phase started in October 2013 and is expected to end in September 2016. It follows the roadmap and aims to introduce new qualifications and training, and to improve existing training.

Objectives

BUILD UP Skills Spain's main objective is to provide building workers in Spain with the competences and skills required in the fields of EE and RE in order to contribute to the achievement of 2020 energy objectives. It aims to do so by promoting education, skills and training to professionals and workers in the construction sector in areas relevant to energy efficiency including the use of renewable energy technologies such as solar thermal. The objective is to increase the number of qualified workers trained to deliver energy efficient buildings or quasi-zero energy consumption buildings. The programme addresses all skills related to EE and RE, for all types of buildings, and all types of projects both refurbishment and new build.

Specifically, BUILD UP Skills Phase I aimed to:

- Determine the current characteristics of the building sector;
- Analyse the policies and national strategies available to help reach the EU 2020 energy targets;
- Compile data on the energy and building sectors, covering the stock and typology of buildings, the workforce in the sector, and statistics relating to energy consumption and RE in buildings;
- Examine the current Training and Professional Qualifications National System as applied to the sector;
- Define skills and training gaps between the current situation and those necessary to meet the EU 2020 energy targets; and
- Identify existing barriers to reaching a suitable level of qualified building workers which could jeopardise the achievement of the EU 2020 energy targets.

Structure To meet these objectives, the project was structured in five stages:

1 Gaining first-hand knowledge of the status quo of the building sector within Spain with the aim of answering the energy efficiency and renewable energy training needs of qualified staff;
2 Developing a national e-community platform to enable debate on the need and nature of qualifications, and training required by projects providing energy efficiency and renewable energy
3 Establishing a roadmap on professional qualifications in this field which will anticipate demand produced with the aim of meeting sustainability objectives;
4 Promoting strong institutional support to contribute to the effective implementation of this roadmap; and
5 Sharing knowledge and experience through exchange activities with other EU countries with the final aim of establishing a common European strategy in this respect

BUILD UP Skills II, is currently ongoing, implementing priority actions identified in the roadmap. These are summarised below:

TableF.6: Priority actions identified on the "National Roadmap Construction 2020" BUILD UP Skills Spain

Action 1. Training action on profitable economic parameters in EE
Action 2. Training action on the impact on the consumption and energy billing
Action 3. Training itinerary "Placement of indoor and outdoor insulation and sealing of joints according to CTE for construction operators"
Action 4. Training action "Assemblers in EE hollow façade enclosures with aluminium and PVC metalwork."
Action 5. Training action "Installation and maintenance of heating and highly efficient hot and cold water systems"
Action 6. Training action "Energy efficiency in buildings"
Action 7. Training action "Installation of lighting systems according to CTE"
Action 8. Training action "The renewable energy systems in buildings"
Action 9. Training itinerary "Installation and maintenance of heat generation systems through geothermal energy"
Action 10. Training itinerary "Installation and maintenance of heat generation systems through biomass"
Action 11. Training itinerary "Installation and maintenance of aero thermal and thermodynamic solar installations for building"
Action 12. Training itinerary "Energy management of building facilities"
Action 13. Training action "Installation and maintenance of high performance heat pumps"
Action 14. Monitoring and development network of professional skills in the national and EU level.
Action 15. Integrated platform of information and guidance in the SNCFP field
Action 16. Quality assessment of the SNCFP
Action 17. Review of existing qualifications in the EE and RES areas
Action 18. Skills development and certifiable associated training: geothermal
Action 19. Observatory for prospecting employment and skills in the EE and RE areas
Action 20. Thematic networks of experts through the use of ICT

Action 21. Training itinerary of trainers' technical requalification in EE and RES
Action 22. Global training plan "Construye 2020".
Action 23. Design and development of professional certificates in e-learning
Action 24. Training resource multimedia for the installation of heat systems through the combustion of biomass
Action 25. Training resource multimedia for the installation of geothermal energy heat systems
Action 26. Training resource multimedia for the installation of RES as the aero thermal and solar thermodynamic
Action 27. Outreach campaigns aimed at informing about the different solutions available on EE and RES
Action 28. Build up green mobile. Outreach campaigns aimed at changing attitudes and awareness
Action 29. Energy calculation and energy rehabilitation simulator

The Roadmap included 11 recommendations, specified in the box below:

Table F.7: Proposed recommendations identified on the "National Roadmap Construye 2020" BUILD UP Skills Spain

Recommendation 1. Assigning an economic value to the reduction of CO2 emissions
Recommendation 2. Allocation of financial resources to promote the adoption of cost-effective EE measures Recommendation 3. Tax benefits for companies and individuals who undertake IF energy rehabilitation
Recommendation 4. Basis of a new system of grants based on energy efficiency targets
Recommendation 5. Legislation of the energy certification of existing buildings
Recommendation 6. Regulation of the internal consumption of energy coming from renewable energy in the homes
Recommendation 7. Increased calls for recognition procedures and accreditation of skills in UCs related to EE and RES
Recommendation 8. Establish training in EE and RES as priorities in the call for tender plans
Recommendation 9. Proposed regulatory changes in the system of training for employment
Recommendation 10. Basis of a new system of grants based on the implementation of RES
Recommendation 11. Instituting policy changes that encourage demand.

Target groups

The target groups were workers and companies in the construction industry, as well as training providers related to building activities. In particular, the occupations and trades that were identified as being in a greater need to re-train or acquire new skills were:

- Foremen
- Builders
- Plumbers
- Electricians
- Gas installers
- Isolation installers
- Heating and air conditioning installers
- Quality control and environment technicians

Other target groups included dwellings' owners, non-residential buildings owners, industrial facilities, and leisure areas, in an attempt to stimulate demand (Actions 27-29).

Institutions involved

BUILD UP Skills (Spain) was managed by the Executive Agency for Competitiveness and Innovation (EACI) and funded by the European Commission. It is part of the Intelligent Energy Europe (IEE) program. Total budget for BUILD UP Skills I was €423.808, of which 10% (€42.380) was co-financed by the *Plan Nacional de Formacion para el Empleo*, from the Spanish Public Employment Service. The budget for BUILD UP Skills II is €826.770, of which 75% (€620.076) is co-financed too.

The *Fundacion Laboral para la Construccion (FLC)* acted as the Project Coordinator. The FLC works to provide businesses and workers with the necessary resources to promote a more professional qualified and educated construction sector. The FLC is financed through member fees. It also receives public funding for training and courses both to workers and unemployed people from the construction sector.

Other organisations and institutions involved in the implementation are the Ministerio de fomento, Departamento de estado de vivienda y urbanismo, the Instituto tecnológico de la construcción (AIDICO), and the Instituto nacional de las cualificaciones (INCUAL).

Planned energy savings

For the 2011-2020 period, the Savings Action Plan and Energy Efficiency 2011-2020 forecasts several measures that will reduce both the energy demand for heating and cooling. For new buildings, the strategy will focus on promoting high energy ratings of buildings and developing a specific plan for buildings with almost zero energy consumption. As per the domestic or commercial equipment it will focus on improving the energy efficiency of the appliances and the commercial refrigeration facilities.

BUILD UP Skills Spain is fundamental for the achievement of EU 2020 energy objectives in Spain. In particular, a better trained and more energy efficient construction sector is expected to contribute through EE and RE projects to achieving a specific energy consumption reduction of 11.5% (and considering the equipment savings too, a reduction of 15.6% is pursued[73]).

- Explicit achievements are expected in relation to the building sector amount to a total reduction of 12,119 ktCO2 by 202074. A further breakdown is presented below: Improvements in the insulation of existing buildings (saving 2,943 ktCO2 by 2020);
- Improvement in the energy efficiency of the heating systems in the existing buildings (saving 3,449 ktCO2 by 2020);
- Improvement in the energy efficiency of interior lighting installations in existing building (saving 4,251 ktCO2 by 2020);

[73] Savings Action Plan and Energy Efficiency 2011-2020

http://www.idae.es/uploads/documentos/documentos_11905_PAEE_2011_2020._Executive_Summary_AP._A2011_2a1f1f92.pdf

[74] National Roadmap Construye 2020

http://www.fundacionlaboral.org/uploads/documento/applications/ARCH537c60d8174e4.pdf

- Construction of new buildings to replace, and rehabilitation of buildings, with high energy rating (saving 1,002 ktCO2 by 2020);
- Construction or rehabilitation of buildings with energy consumption almost zero (saving 3.2 ktCO2 by 2020);
- Improvement of the energy efficiency of commercial cooling installations (saving 8.1 ktCO2 by 2020); and
- Improvement of the energy efficiency of appliances (saving 463 ktCO2 by 2020).

More precisely, some initial estimates have been calculated for the energy efficiency savings associated to the delivery of the BUILD UP Skills II programme, and a better trained workforce. These include the following:

Table F.8: Energy efficiency savings associated to the delivery of the BUILD UP Skills II programme

Performance Indicators [75]	Target within the action duration:	Target by 2020:
Renewable Energy production triggered	455 Toe	45.530 Toe
Primary energy savings compared to projections	11.876 toe of primary energy per year (1 % of total Target by 2020)	1.111Mtoe 1.111.000 toe
Reduction of greenhouse gas emissions	26,3 t of CO2 per year	2.460 kt CO2 2.460.000 tons CO2

Results to date

As total of 29 priority actions and eleven recommendations emerged from the Status Quo Report and the Roadmap. Implementation of all these priority actions is currently underway.

These actions have been designed to improve the Vocational Education and Training (VET) system and the qualifications framework, as well as to develop training tools and schemes that will allow workers to be trained and qualified in EE and RE, considered as key resources in order to reach 20-20-20 target

Phase I produced the following outputs in addition to the status quo report and roadmap:

- Endorsement activities: The roadmap was sent to 70 key players and a technical seminar (titled “The new and future energy efficiency requirements of buildings: a challenge for technicians in the sector” was organized). On dissemination day (April 2013) 75 market players validated the roadmap. In total, 29 institutions expressed publicly their commitment to the action plan including the employers’ and trade unions’ main associations for the construction sector, as well as several public bodies. A steering committee was set up to monitor the implementation of the roadmap.

[75] This data was in draft form at the moment of writing the report, and indicators were due to be updated after four months

- Communication: The communication strategy was considered to have been successful. Besides the events organised featuring the project, the project benefited from good media coverage, appearing in more than 50 media following press releases as well as twice on live radio shows. The project's website is up to date.
- Peer review activities: The project was peer reviewed with Cyprus and Portugal. Two specific meetings were organised, one alongside the EU exchange meeting in Brussels in November 2012.

Social impact results of BUILD UP Skills

The Programme has:

- Identified the number of professionals that will require training to meet the Europe 2020 energy targets. Between 25% and 35% of the workforce (28,000 to 61,000 workers) needs retraining
- Estimated the budget required, €28m to €60m. These calculations were made on the assumptions that 90 hours of training will be required per worker from 2013 to 2020, at a cost of 11 € per hour, totaling 990 on average per trained worker. At a ratio of 20 students per class, between 1,421 a 3,043 trainers are needed.
- Designed a national qualification roadmap for the building and construction sector and related training courses (see below)
- Provided educational materials and curriculums for EE and RE, standardising the quality of teaching and learning process76.
- Integrated EE and RE competencies into professional occupational families of Civil and Building Works, Energy and Water and Installations and Maintenance.
- Led to the National Institute for Qualifications reviewing existing qualifications in terms of EE and RE and exploring the possibility of developing a new qualification for geothermal systems (or integrating them in existing qualifications).
- Ensured materials produced have received the endorsement of relevant public and private institutions.
- Created a community for work, discussion, reflection and dissemination, key to the success and endorsement of the roadmap, securing ownership from relevant players in the field of training and EE and direct contribution to its design.
- Established a monitoring tool to observe the building labour market in order to anticipate its changes and allow training and qualifications institutions to react more quickly to these situations.
- Raised awareness about the necessity of undertaking building refurbishment to improve EE, as well as informing workers about training and qualifications.

The development of nine training courses had a twofold approach. First, a competence map was designed for each of the occupations that required training or retraining; carried out as per the European Qualifications

[76] WP2. Desarrollo de acciones formativas y Medios didácticos

http://www.fundacionlaboral.org/documento/coleccion-acciones-formativas-proyecto-build-up

Framework (EQF)'s methodology. On this basis, the Qualifications at European level are defined according to three concepts: knowledge, skills and competencies, which result in acquired capacity. One of these maps was prepared for each of the nine roles that would receive training[77].

Then, a didactic programme was structured to provide training on those competences. Each of these programmes had four pillars: the general details of the formative action; objectives; contents; practical training and evaluation. One plan was fully developed for each of the nine occupations identified[78].

BUILD UP Skills II will be implementing 20 priority actions and the 9 training courses starting from 2015. Courses are fully subsidized and targeted to both in-work and unemployed professionals.

Table F.9: Priority actions of BUILD UP Skills I that will be executed under BUILD UP Skills II in 2015

Action 1. Training action on profitable economic parameters in EE
Action 3. Training itinerary "Placement of indoor and outdoor insulation and sealing of joints according to CTE for construction operators"
Action 4. Training action "Assemblers in EE hollow façade enclosures with aluminium and PVC metalwork."
Action 5. Training action "Installation and maintenance of heating and highly efficient hot and cold water systems"
Action 6. Training action "Energy efficiency in buildings"
Action 8. Training action "Installation of lighting systems according to CTE"
Action 9. Training action "The renewable energy systems in buildings"
Action 10. Training itinerary "Installation and maintenance of heat generation systems through geothermal energy"
Action 14. Monitoring and development network of professional skills in the national and EU level.
Action 15. Integrated platform of information and guidance in the SNCFP field
Action 16. Quality assessment of the SNCFP
Action 17. Review of existing qualifications in the EE and RES areas
Action 18. Skills development and certifiable associated training: geothermal
Action 19. Observatory for prospecting employment and skills in the EE and RE areas
Action 21. Training itinerary of trainers' technical requalification in EE and RES
Action 23. Design and development of professional certificates in e-learning
Action 24. Training resource multimedia for the installation of heat systems through the combustion of biomass
Action 25. Training resource multimedia for the installation of geothermal energy heat systems
Action 27. Outreach campaigns aimed at informing about the different solutions available on EE and RES
Action 28. Build up green mobile. Outreach campaigns aimed at changing attitudes and awareness

Table F.10: Training courses currently being implemented

1. Installation and maintenance of geothermal installations
2. Installation of aluminium and PVC
3. Installation of insulation
4. Energy efficiency in buildings
5. Renewable energy systems in building
6. Economic parameters that determine the profitability of actions in energy efficiency in buildings

[77] http://www.fundacionlaboral.org/documento/coleccion-acciones-formativas-proyecto-build-up

[78] http://www.fundacionlaboral.org/documento/coleccion-acciones-formativas-proyecto-build-up

7. Installation of biomass systems
8. Heating and air conditioning
9. Improvement of trainers in Energy Efficiency and Renewable Energy

Comments and conclusions

BUILD UP Skills I has identified skills shortcomings and developed plans for the improvement of the skills of building workers. The output of BUILD UP Skills I was a Status Quo report of the sector and needs in the country, and the definition of a roadmap setting out a clear plan of action to ensure a response to the skills and training needs to achieve an energy performance of buildings aligned to the EU2020 targets.

The roadmap proposes 29 actions and 11 recommendations with training measures and accompanying measures. For each action, a clear timeline, an estimation of costs and an identification of key actors is proposed. The roadmap was validated and endorsed by 75 market players, and 29 institutions expressed publicly their commitment to the action plan including the Employers and Trade Unions main associations for the construction sector.

Training actions include the development of training courses, training itineraries for the priority professions as well as e-learning platforms and multimedia educational resources. Accompanying measures and actions include a mechanism for monitoring skills needs and ensuring the quality assessment of training, the revision of professional qualifications profiles, retraining for trainers, as well as campaigns for the general public to foster demand for a high energy performance in buildings.

The roadmap also develops recommendations to be further explored to set up a framework to encourage energy renovations and the training of workers such as further regulation, allocation of subsidies and tax benefits for individuals and companies renovating their assets, identification of EE and RES as priority issues to benefit from training grants.

The BUILD UP Skills I results have been used for defining the "Sectorial reference plan". This document is the basis, for instance, to set up the "plan for training for employment" for the building sector, which is an annual and nationwide training scheme that has a funding over than 6 million euro. This plan is mainly aimed at nonqualified building workers.

In sum, Skills I was successful in building ownership around the project that enabled it provide credible analyses of future skills and training required by the sector in the country, and designing a comprehensive plan that would address those skills required to deliver Europe 2020 targets, and which are aligned with the European Qualifications Network.

Particular strengths of this project include:

- The training courses and supporting competence mapping, although targeted at the needs in Spain, provide a well-developed platform from which Member States facing similar challenges could build on.
- The project benefited from a comprehensive approach that involved professionals in the field, technical experts and academics to develop a complete and well-rounded package.

- The project covered all aspects from the design and definition of goals and objectives to the detailing of the minor components, including hours per training etc.
- The project aligned local, national and international priorities, as well as the country's most pressing needs with the long term vision of an energy efficient sector. It was also in line with other strategic policy areas, such as the European Qualifications Network

Weaknesses include:

- The real impact will be materialized with the successful development of the second phase of the project, which will rely heavily on the availability of the expected funds.

Case study 3: The Green Building Cluster of Lower Austria - ECOPLUS

Context

The province of Lower Austria started to implement cluster initiatives in 2001, in the key strategic development sectors of the region. Among them was also the development of the Timber cluster and later "Ökobau" cluster which in 2007 merged into the Green Building Cluster. The cluster aims to strengthen the regional competence in the area of sustainable building and living. It is part of the Regional Specialization Strategy which is linked to the Austrian economic strategy 2001 – 2015.

The launch of the cluster initiative was based on an in-depth mapping study which analyzed the importance and relevance of the sector for the regional economy and identified main regional actors, existing collaborations and public support needs for the future. The construction sector has been traditionally one of the economic strengths of the Lower Austria.

The aim of establishing clusters was to increase productivity, competitiveness and innovation of the Lower Austrian companies. This was to be achieved through scale effects such as improved division of labor, shared utilities and distribution channels, joint promotional activities and organized specialized trainings. In addition, spillover effects were expected such as know-how, new technologies and innovation.

Through the Green Building Cluster focus on strengthening the sustainable building sector in Lower Austria, the Cluster initiative expected to have an impact not only on the innovation capacity of Lower Austrian companies but also on energy savings in buildings and on the generation of new green jobs in the region in the construction sector and all related professions (e.g. heating-cooling-ventilation, renewable energy, energy management, etc.).

The Cluster also focuses on refurbishment of detached and semidetached homes. Around 94% of homes in Lower Austria are older and in need of refurbishment. The buildings were built in the period of 1945 and 1980 when the recent energy performance standards have not been in place. The cluster focus on thermal refurbishment is in line with the Austrian climate strategy which has as an objective an annual thermal refurbishment rate of 3% of buildings (2008 – 2011). In addition, The Energy Efficiency Directive from 2012 foresees that public bodies need to refurbish 3% of their buildings each year. The actual rate in Austria is 1.5%.

In addition to the refurbishment of old buildings the cluster members are also active in the construction of nearly zero energy houses according to the EU Building Directive, mainly detached and semi-detached houses as Lower Austria has a limited construction of multi-story buildings. The standard results in ultra-low energy buildings which require little energy for space heating or cooling. In 2009, passive homes presented only 5% of new buildings built in Lower Austria. Currently the development of passive houses has reached between 20% to 25% market share in new built houses in Lower Austria. Average share of passive homes in all Austria is 24%. Low-energy homes have also became a standard in subsidized new residential buildings of Lower Austria.

The Lower Austrian Cluster Programme is part of the Regional Innovation Strategy, co-financed by the EU. The cluster Programme continuous to be an integral part of the new Economic Strategy 2020.

Programme

The Green Building Cluster of Lower Austria is one of the five Lower Austrian clusters. As of September 2014, the Cluster has 239 member companies and 35,092 employees with a total combined turnover of € 8 billion. The cluster is a network of the Lower Austrian companies active in areas of energy efficiency and sustainable building construction and refurbishment, energy management and energy technologies.

The cluster members focus on innovative building technologies, modernization of old buildings to improve energy efficiency, healthy interiors and comfortable living. However, to keep its member companies up to date on issues related to energy-efficient refurbishment, the Green Building Cluster initiates and coordinates trainings programs.

Objectives

The main objectives of the Green Building Cluster of Lower Austria are to

- Establish a robust network encouraging cooperation and innovation among companies, skilled craftsmen, and R&D institutions; and
- Connect and strengthening existing Lower Austrian competencies in the area of sustainable building, refurbishment and living.

Structure

The Green Building Cluster management provides pre-competitive support for mainly small and medium- sized companies in order to strengthen their innovation capacity and foster expertise in the area of sustainable building and living. It acts as a neutral platform, enabling trust building between cluster members, mediating between businesses and public administration to help shape business and innovation friendly framework conditions, while building a bridge between SMEs and R&D institutions.

It provides the following services and benefits for the cluster members:

- Innovation through Cooperation: the cluster supports cooperation among companies as well as with R&D and qualification facilities, enables access to national and international programs, the cluster assumes organizational tasks on behalf of the companies which enables SMEs to engage in application oriented R&D projects;
- Qualification: the cluster offers sector specific trainings, organizes professional events with focus on sector-specific themes, study trips and trade fair visits. The broad qualification initiative was launched in 2009 together with its partners from the province, federation and the Economic Chamber. Around 450 companies participated in this initiative. Their professionals are now certified “climate:active” and passive home planning experts;
- Information: the cluster supports Cluster partners by way of professional recommendations and collects detailed information about Cluster partners and projects;
- Public Relations: the cluster in in charge of the dissemination of sector information and presentation at national and international trade fairs; and

- Internationalization: Cluster in particular supports international cooperation in projects in R&D.

Target groups

The direct target group are the cluster members. Currently the majority of the cluster members are companies, followed by R&D and educational institutions (10%), organisations (9%), and administrative bodies (4%). 87% of the cluster companies are SMEs.

In addition the target groups of cluster training programs are: heating specialists trained in the installation of ventilation systems with heat recovery for passive houses; master builders and architects on new renovation methods using passive house technologies.

Institutions involved

The business agency of Lower Austria, Ecoplus, is the main institution in charge of The Green Building Cluster of Lower Austria. Ecoplus is responsible for cluster management. The role of the cluster management is to initiate cluster projects, identify and connect potential cluster partners, to inform the cluster partners about the funding opportunities and supervise cluster projects.

The Cluster has been funded through EU ERDF fund from 2007 until 2013. In total €937,370 was funded from ERDF.

Results

Social impact results

- Green skills: More than 500 professionals (representing cluster members as well as non-cluster members) were trained on new technologies to reduce energy consumption of buildings including master builders, carpenters, architects, planners, site managers, heating and plumbing professionals and energy and building consultants. Those present around 0.2% of total construction workforce of the region;
- New employment: In 2011 estimated employment effect of the cluster was 396 FTE[79]. In other words, project volumes implemented by the cluster have led to the equivalent of 396 people being employed for one full year (regardless of whether these were employed full or part-time)80. This amounts for cca. 0.07% of the total employment in the region. The Green Building Cluster had the highest employment impact among the Lower Austrian clusters[81];
- Added value: In 2011 the Green Building Cluster cooperative projects were responsible for around 81% of the total added value generated by the Lower Austrian Clusters (€ 11.81 million). The branch with the largest contribution within the cluster was the energy efficiency construction (34% of the added value), followed by business-to-business service providers and education and training facilities; and
- Network opportunities and links with R&D: Cluster members noted they benefited from networking opportunities provided by cluster membership. An important service provided by the Lower Austrian Cluster is giving the opportunities for small and medium-sized businesses to participate in R&D

[79] Full Time Equivalent

[80] This is based on the referenced study – the study did not distinguish the employment effect based on the type of professions

[81] The Economic Impact of the Lower Austrian Clusters – Research Report

projects. An example is the project combining 24 entrepreneurs from four regional states of Austria (windows manufacturer, assembly organization, preparation and supply industry, and building material manufacturers) to jointly structurally optimize installation solutions for windows according to passive house standards. The project also developed an online training for professionals where they can learn how to optimally install windows.

- The main difficulties within this project are the ability to find the right R&D and know-how for cooperation, associated costs and access to finance. The cluster management helps small companies to cope with these problems by facilitating access to R&D institutions, informing about public funding possibilities, matchmaking of potential partners (sharing of risks and costs) and disseminating results to the sector.

Energy saving results

- Energy saving from 75% to 90% are expected to be achieved by using modern technologies to improve insulation, ventilation and heating systems and by incorporating elements of passive house technology in finishing details[82].

Comments and conclusions

9.7% of green jobs in Austria are in the construction sector. It was estimated that by 2020 up to 10% of workforce in Austria would work in green industries. The Green Building Cluster of Lower Austria connects construction and building professionals with researchers to foster their competencies in the areas of sustainable building and living. In 2010 more than 47,000 jobs existed in the Lower Austrian construction sector with an annual turnover of some €6bn.

Particular strengths of this project include:

- By connecting companies with R&D and facilitating energy efficiency trainings the cluster has an impact on developing green skills in the construction sector of the region.
- Improved green skills of the construction companies translate into energy efficiency impacts, as the cluster members apply new skills to sustainable building construction and refurbishment in the region.
- A strength of the Green Building Cluster is that it is part of the Regional Specialization Strategy and is linked to the Austrian economic strategy. As a result the development of the cluster initiative was based on an in-depth mapping study to ensure its relevance and to define the main cluster objectives.
- The cluster has been successful in fostering jobs and competencies in the areas of sustainable building and leaving.
- The cluster initiative provides lessons on how to foster capacity building and development of competencies by providing training within the cluster and enabling an environment for collaboration between companies, R&D institutions and funding.

Weaknesses of this project include:

[82] The cluster does not have more precise data on this. They do not have any studies on their energy saving impact.

- The main difficulties within this project are the ability to find the right R&D and know-how for cooperation, associated costs and access to finance. The cluster management helps small companies to cope with these problems by facilitating access to R&D institutions, informing about public funding possibilities, matchmaking of potential partners (sharing of risks and costs) and disseminating results to the sector.

Case study 4: Make your home fit!

Context

The largest energy consumer in Germany is buildings, which offers the greatest potential for conserving energy. More than 80% of energy used in buildings is used to heat rooms and water; the remaining 18% powers electrical appliances and lighting. In this context the potential of energy savings is particularly high in the buildings constructed before 1979, before any energy efficiency regulations were introduced. So far, only approximately 9m of the pre-1979 homes have been rehabilitated to high energy-efficiency standards, leaving 20m still requiring rehabilitation. In addition, there are 1.5m non-residential buildings, including 40,000 school buildings and many other public buildings with significant energy saving potential.

In this context, Germany has implemented the most ambitious energy saving programme in Europe, aiming for 30% reduction in energy usage by 2020 and a 30 percent renewable energy share[83]. In order to achieve this target the German federal government has developed a strategy to develop renewable energy and energy efficient construction and refurbishment of all types of buildings. The strategy is based on three main pillars:

- Reducing energy demand through regulation and legislation;
- Creating financial incentives for energy saving and 'green' investment;
- Providing energy saving information and advice.

The official government body created to promote energy saving and renewable technologies (i.e. implementing the third pillar of the strategy) is the Deutsche Energie Agentur (DENA). It provides advocacy and technical advice to drive energy efficiency at national level. It works with independent regional agencies to deliver specific projects. The DENA sets out standards, and regional agencies implement them and pass on the expertise to regional building organisations and professionals. Hence, the main purpose of the DENA is to link government subsidy programmes to promote energy efficiency and market-oriented activities to spread the take-up of energy efficiency and renewable technologies.

One of the most relevant project implemented was the campaign "Make your home fit!" which aimed at reduce energy consumption of buildings in the district of Hamelin-Pyrmont.

Programme

The campaign 'Make your home fit!' offers free of charge energy advice to homeowners in the district of Hamelin-Pyrmont. In this area approximately 80% of buildings were built before the first heat protection regulation, as a result they have an inadequate thermal protection. In addition, the proportion of old oil heating systems (older than 25 years) is high, reaching approximately 40%, whereas heating systems based on renewable energy sources are rare.

The information campaign started in October 2011 and was offered to all cities and municipalities of the district of Hamelin-Pyrmont. The local energy agency (Klimaschutzagentur Weserbergland) together with cities and municipalities identified one or more neighbourhoods with a high number of one and two-

[83] Power and Zulauf, 2011

family homes built before 1960. In each neighbourhood about 500 owners were selected and informed of the opportunity to a free consultation. At the same time the local energy agency carried out tailored advertisement activities in local media and newspapers.

Consultations were than carried out between households and a team of energy advisers. The energy advisers provided initial information through door-to-door advisory activities to the homeowners. During these ten minute consultations they informed the homeowner of the opportunity to reduce the energy consumption in the house, provided information materials and offered a more-in-depth consultation. The homeowners interested could book a one-hour long and free of charge consultation with energy advisers through the local energy agency. During this consultation, energy advisers provided individual energy saving advice, based on an analysis of the energy costs, possible energy saving measures adopted and subsequent levels of consumption.

After the consultation homeowners were allowed to contact the local energy agency for further information and advice concerning modernization of their house and the access to funding opportunities. The aim was to assist the homeowner through the entire process of modernization. Although planning tasks were not directly performed, the local energy agency was able to provide a network of planners, architects, craftsmen and financial institutions implementing energy efficiency advice according to high quality standards.

In order to effectively conduct the consultation with households the local energy agency has hired and trained ten qualified energy advisers. The candidates were selected from the expert list provided by the DENA. They must have some relevant building experience, such as engineers, architects or craftsmen, but they also received special training provided by the local energy agency in advising households on energy savings opportunities. In order to ensure a high quality service, homeowners are required to provide feedback on the level of service received.

Objectives

The main objective of the campaign is to promote energy savings in the housing sector. The campaign aims to do so by increasing energy awareness in specific areas through information and advice campaigns.

The specific objective is to increase the energy saving potential of one and two family houses, mainly through the introduction of energy efficient heating systems and the installation of new windows.

In addition, the campaign aims to raise awareness on energy efficiency among the residents by promoting and supporting positive behaviours.

Structure

The campaign was structured in different stages:

- Initially an intense information campaign was carried out to inform residents. Local events were organized, using local media and parishes. In addition the local energy agency, together with cities and municipalities, identified specific neighbourhoods with an old stock of one and two family houses (i.e. with a high potential of energy saving);

- At first a short individual advice session was carried out by the energy advisers, previously trained for the purpose of the work. During this short consultation householders are usually provided energy efficiency material;
- After the first consultation, the homeowners could ask for to have a second consultation. This second consultation included a more in-depth analysis of the energy efficiency potential and possible steps to achieve it; and
- Eventually, homeowners were supported during the whole restructuring process by the local energy agency.

Target groups

The target group of the campaign was one and two family households whose buildings were not in line with the current standards on energy efficiency. The total target group accounted for 34,342 one and two family houses, of whom 10,300 households were reached through the information campaign carried out in the local media. Approximately 3,500 households have been directly reached through the information and advice campaign. Of these about 1,400 have been informed individually through door-to-door advice.

Institutions involved

The campaign is implemented by the local energy agency Klimaschutzagentur Weserbergland and supported by the DENA.

Results

The main results from the programme are summarised below.

- Approximately one third of the target group was reached through the information and advice campaign. In addition, the 40% of households selected by the local energy agency together with cities and municipalities have been informed through a first door-to-door energy efficiency advice.
- Approximately 400 one hour in-depth consultations have been carried out during the campaign.
- During the first year of the campaign, 70% of households reached through the campaign reported to have carried out energy efficient renovation activities or were in the process of doing so, while 16% of households were planning to carry out the work within the next two years. Only 14% of households did not take any action.
- In terms job creation, the campaign allowed to hire ten energy advisors. In terms of indirect impact on employment, relevant effects were observed in supply chains and in the building work itself: the campaign triggered an annual investment of €6.55m, with an average investment per household of €21,000.
- Also, the homeowners were required to provide feedback on the level of advisory activities provided by the energy advisers. This feedback mechanism allowed the programme to provide high-level advice and to fine-tune the training provided by the energy advisers.

Energy saving results

Most of the renovation activities carried out during this campaign are related to new windows and modernisation of heating systems. The measures implemented in the areas resulted in savings of approximately 2,347,000 kWh of heating energy in the following years, which corresponds to an annual saving of 570,000 kg or nearly 15,000 tons over the average lifetime of the modernisation measures.

Social impact results

- Effectiveness. With the campaign "Make your home fit!" the Klimaschutzagentur Weserbergland has developed a tool that, coupled with other services of the agency and the provider of network energy professionals Weserbergland, represents an effective lever to the actual implementation of energy modernisation measures.
- Expert energy advisers: The campaign has been successful in identifying highly skilled energy advisers and to provide special training. The advisors also received special training in advising low-income households on energy savings.
- Transferability: The independently conducted evaluation of the campaign certified its high relevance and effective operation. The concept of 'Make your home fit!' is therefore perceived as being easily transferable to other regions and thrives on the activities of the relevant local actors[84].

Comments and conclusions

Make your home fit! has been a successful project in terms of raising awareness and promote the potential of energy efficiency measures in the housing sector. The initiative connects owners of old buildings with energy advisers to increase the energy efficiency potential of their houses.

Particular strengths of this project include:

- A particularly interesting aspect of the initiative was the approach used to disseminate information on energy efficiency potential among the population. The information campaign was developed through the collaboration of a wide number of stakeholders. Local authorities allowed to identify specific areas with old stocks of buildings and to effectively organise local events, and use several type of tools to effectively disseminate the initiative (media, parishes etc.). At the same time energy agencies provided technical knowledge both in terms of training energy advisers and supporting the restructuring process of the houses. The success was highlighted by the high number of households reached through the information campaign.
- Another important element of the initiative was the ability design and implement a comprehensive approach that supported homeowners through the whole restructuring process. Initially, homeowners were provided with useful information through two consultations: the first consultation provided general information by disseminating material to raise awareness on energy efficiency. Interested homeowners were than allowed to ask for a second and more in-depth consultation with a professional energy adviser which provided tailored and practical information to increase the energy efficiency potential of their building. Eventually, homeowners were supported through the whole restructuring process by the local energy agency.

Weaknesses include:

- The success of this project is partly dependent on the tailoring of the messages of the communications campaign to the very specific and carefully selected population of 500 residents. Transferability would have

[84] No specific information is available on the costs related to this campaign.

to consider adaptation of messages, tools and techniques to different socioeconomic and demographic characteristics.

Case Study 5: The ENWORKS 'Embedding Resource Efficiency in Key Sectors (EREIKS) project

Context The project was established in the UK to improve resource efficiency in key industrial sectors, and so reducing costs and improving economic performance.

Programme The ENWORKS[85] Embedding Resource Efficiency in Key Sectors Project (hereafter referred to as 'the project') provided business support to companies in the North West of England between October 2009 and March 2013. The project aimed to increase the market penetration, quality, consistency, rate of adoption and impact of resource efficiency support to businesses in the region. The key objective of the project was to create a regional programme to cover the full spectrum of environmental impacts generated by a business – from the products it makes, through to the processes it uses and the waste it generates – the full 'lifecycle' of impacts. The project budget was approximately €10 million over the project period 2009 - 2013.

Objectives More specifically the Project was designed to conform to the objectives of the Regional Operational Programme (ERDF) for the North West of England and to build on the lessons from similar programmes operated previously. The project objectives were to:

- Improve the competitiveness and productivity of companies in the North West region of the UK, focusing on priority sectors, (identified by the programme managers from previous programmes), high growth and high environmental impact companies, by reducing their exposure to environmental risk and improving their resource efficiency.
- Reduce the CO2 emissions, energy, water and material usage of these companies and divert commercial and Industrial waste from landfill.
- Create a single, regional, resource efficiency and environmental risk business support offer that is accessible by all companies in the region and is fully compliant with the government's overall aim of simplifying its approach to business support (the Business Support Simplification Programme).

Structure All potential beneficiary businesses were subject to a multi-stage 'triage' process to determine whether a business was categorised as Tier 1, Tier 2 or Tier 3, in order to match the support available to their needs and the project offer in the most cost effective way. The triage process enabled the project to tailor a package of support designed to meet individual business needs and deliver return on investment for the project, by identifying how an individual business would be supported, dependent on its sector and scope of improvements. The triage model is designed to allocate resources and the level of support based on initial referrals from business advisors. The model is outlined in the box below.

Tier 1 and 2 businesses received up to 4 days of technical advice paid for by the programme, examining the products and processes of identified

[85] More details about the ENWORKS organisation are available here: http://www.enworks.com/about

businesses. This included audits of various resource uses, and identification of key actions / investment cost that could result in resource savings. Payback periods were indicated where costings had been provided. Businesses that wished to implement identified savings measures, were advised on possible suppliers but were required to finance the costs themselves.

Target groups

Table F.11: Target groups and support[86]

	Tier 1	Tier 2	Tier 3
	Businesses within high impact priority sectors identified as Food & Drink, Automotive, Chemicals and Textiles (Advanced Flexible Materials)	Businesses from other sectors with the potential for significant environmental improvements and/or growth.	Businesses which do not fall into either of the other two categories
Intensity of support	Medium – High	Medium – High	Low – Medium
	A comprehensive support package was offered to enable companies to improve their competitiveness through reducing their environmental impact at all stages in a product lifecycle, including support on product design (using existing technologies), manufacturing processes and residual wastes and measuring the lifecycle carbon footprint of specific products where appropriate.	This activity was to focus on companies in other key sectors with either high growth potential or those businesses which could generate significant saving opportunities; targeting improvements in the efficiency of energy, water and materials usage and the management and avoidance of environmental risk.	Companies that are not in the priority sectors and/or those that did not have the potential to realise savings were offered limited support through, for example, electronic information updates (ENWORKS "Green Intelligence") and signposting services (e.g. to Business Link Environment Connect) to access other Regional and National business support provision.

Institutions involved

The project was funded by the European Regional Development Fund (ERDF) and the UK Government's Single Programme fund (with total grant funding of €10m[87]). At the time of project design and implementation these funds were managed by the Northwest Regional Development Agency (NWDA) and the Department for Business, Innovation and Skills (BIS). The project commenced delivery in October 2009, and ended in March 2013. The programme is

[86] Source: ICFI Analysis of EREiKS Project documents

[87] Values in UK pounds converted to Euro at a rate of £1 = €1.25

expected to continue in the period 2014-2020 subject to available funding. The project has also been used to provide evidence for wider replication[88].

Activities undertaken

Examples of the types of support provided include:

- A range of audits/reviews – starting with opportunity identification and leading to more specialist audits to target specific opportunity areas as determined by the initial findings, e.g. material usage, waste generation, energy management, water utilisation, compressed air optimisation, thermal efficiency;
- Support with the implementation of the audit findings – e.g. on-site assistance with root cause analysis, option analysis & prioritisation, monitoring & measurement, change management; off-site research into best practice or alternative material / technology options;
- Skills transfer – includes both on-site staff training and open training events (both general awareness raising and subject targeted) to embed both knowledge and 'know how' into business, as well as providing individuals with transferable skills that are increasingly valuable in the marketplace and support wider dissemination if/when staff change companies;
- Information provision – e.g. targeted electronic information; newsletters; and, best practice.

Key features of the activity are:

- that the initial contact is made with selected advisors operating at local (County) level and therefore have a good understanding of both the business base, and the resource efficiency issues faced by businesses. They are also in a position to propose and assess technical advisors selected and paid for by the programme; and
- The operation of a resource efficiency toolkit that can provide benchmarks and monitoring of proposed and achieved resource savings.

Results

The impact assessment of project was based on a review of the outputs captured by the project[89] alongside a review of the project monitoring data, as collected in the ENWORKS Resource Efficiency Toolkit[90], verified by the beneficiaries, and information from a beneficiary survey that was conducted as part of an independent evaluation conducted by ICF. Resource savings resulted from a variety of improvements to the operation of industrial processes in light of the advice and auditing carried out.

[88] Research to Assess the Barriers and Drivers to Energy Efficiency in Small and Medium Sized Enterprises, ENWORKS, published by DECC, November 2014

[89] Data presented for Project impacts is correct to January 2013 so does not include the full impact of the project as results continue to be captured through to April 2013.

[90] The ENWORKS Resource Efficiency Toolkit is an online software platform which enables companies to record and prioritise the improvement actions identified through working with ENWORKS. (See: http://www.enworks.com/our-support/toolkit)

Energy saving results

The project generated CO2e savings of 320,000 tonnes. The average CO2e saving per assisted business was estimated at €375[91], representing an economic benefit of €0.4m. These benefits are outlined below.

Table F.12: Environmental benefits

Project Output[92]	Achieved
Material Savings (tonnes)	81,167
CO_2 Savings (tonnes)	320,871
Water Savings (m^3)	2,510,689
Waste Diverted from Landfill (tonnes)	290,243

Social impact results

- Economic impact of cost savings in beneficiary firms: This illustrates that the project has assisted firms to implement an average of €22,500 in cost savings, and a gross additional impact for the region of €20m when adjusted for deadweight (established using the beneficiary survey returns). Cost Savings increase profits but do not necessarily result in increased sales and purchases, In these cases it is not appropriate to apply displacement and leakage adjustment factors. In some cases businesses also reported increased sales as a result of improvements made. The net economic impact for the region form cost savings is estimated to be approximately €20m.
- Impacts for beneficiary firms – jobs and sales: The economic impact of new sales and sales safeguarded in beneficiary firms used project monitoring data to establish the gross impact generated from sales at £48m. Deadweight, leakage, substitution and an economic multiplier are all applicable to increased sales. The net economic impact of sales is, therefore, estimated at €39m.
- The economic impact of new jobs and jobs safeguarded in beneficiary firms: As a result of additional sales generated through assistance from the project a total of 232 jobs were created and 512 jobs safeguarded in beneficiary firms. These jobs were associated with expansion of existing industrial businesses and were generated at all levels but largely related to production workers. The net impact on wages from additional jobs is estimated at €19m. This analysis also presents additional income to the UK Government as a result of employer-paid National Insurance contributions, made as a result of additional salaries (an additional €2m)[93].
- Supply-side impacts. The purpose of the project was to provide support to firms in the region to assist them to identify resource efficiency measures and to develop implementation plans. Improving the supply side was not a primary aim of the project, as such it has not been subject to any

[91] Based on a CO_2 price per tonne of £5.76 (source: http://www.decc.gov.uk/assets/decc/11/cutting-emissions/carbon-valuation/6667-update-short-term-traded-carbon-values-for-uk-publ.pdf)

[92] Sources: ENWORKS output data.

[93] This analysis uses the HMRC National Insurance payment calculator for employers (this analysis assumes that all jobs created and safeguarded are permanent, full-time and located in the region)

substantive evaluation. However, a number of impacts on the supply side can be identified, these are explained below:

- Of the €10m project approximately 80% (€8m) was spent on business advisors
- Business assistance leveraged an additional €20m of capital spend on implementation. This activity realised 23% of identified resource efficiency improvement opportunities. If further identified opportunities were implemented this could result in a further €65m of capital expenditure on implementation of resource opportunities. This would provide opportunities for suppliers in the region.
- The project also provided an opportunity for firms providing assistance to deepen their knowledge and skills in developing resource efficiency measures to meet industry challenges. The support received was well received by firms. A survey of beneficiary companies indicated that the level of satisfaction with ongoing support amongst businesses was high: 56% of respondents were 'highly satisfied' with the ongoing support received with a further 40% 'satisfied', 87% of businesses would recommend the ongoing support that they had received to implement resource efficiency savings.
- Delivery of the project has also improved the capacity of delivery organisations: the project effectively promoted intelligence and raised awareness of the benefits of resource efficiency to firms in the North West of England. This was undertaken through a network of business support providers that operated at the sub-regional level on behalf of ENWORKS. This was an effective model of delivering support based on local knowledge of the requirements of firms across the region. It also built up skills or individual advisors and organisational capacity to deliver similar support in the future (for public or private sector providers).

Comments and conclusions

The programme has operated in the region since 2001, supported by EU regional development funds and related matched funding. The programme has been subject to regular evaluations by different evaluators, and has demonstrated a high level of cost-effectiveness.

Strengths of the programme include:

- The use of the triage system and toolkit, developed during the course of the previous programmes and which provide the basis for effective use of funds and programme monitoring.
- Establishing the range of resource saving potentials, through targeted technical audit and advice.
- Avoidance of direct grant finance for investment measures; although a high share of resource savings remain unrealised (due in part because of long-payback periods). Comparison with other UK regional programmes suggests it has one of the highest levels of value for money.
- The collection of data over the various programmes, which has provided the basis of advice to national government on the costs and benefits of resource efficiency programmes.

Weaknesses of the programme:

- Due to the experience from previous programmes and continuity in programme design and management, there were few weaknesses. A result of the project was a view that the selection of businesses for support on the basis of sector was not cost-effective; and that the case for business support should be made on a case by case basis.

Recommendations:

- Replication requires the use of local business advisors well versed with the industrial base and related resource efficiency issues, capable of identifying the opportunities for resource efficiency improvements. Given the cost if the four day technical audit and review, some prior assessment of the scope for the identification of opportunities should be made based on industrial experience.
- The quality of the technical advice is key – and sufficient time needs to be allocated to the recruitment of a panel of experienced technical advisors that can undertake the in-depth technical audits
- As information failures extend across different industrial sectors, a particular focus on key sectors does not necessarily identify those businesses with the greatest opportunities for improvement
- Since there are many improvement opportunities that have short payback periods the use of direct grant support is not necessary, with resources better allocated to expanding the numbers of technical audits carried out.

Source Evaluation of the ENWORKS Project: “Environmental Resource Efficiency in Key Sectors” 2009-2013; Final Report; April 2013, ICF International

Case study 6: Improving energy efficiency in low-income households and communities

Context

In Romania, buildings account for more than one-third (36%) of final energy consumption and 56.1m tonnes of national CO_2eq emissions (of a total of 152.3m tonnes in 2007). Residential buildings comprise 95.4% of all buildings in Romania and existing residential buildings are generally old (the majority being built pre-1970) with poor thermal properties[94].

Newly constructed buildings will be required to meet higher efficiency standards under the European Energy Performance in Buildings Directive (EPBD)[95]. The construction of new buildings, especially residential ones, has fallen since 1990 due to dramatic economic changes following a shift from communism to a capitalist system. A large proportion of the population will likely continue to live in 50-80 year old buildings. The vast majority of residential units are in serious disrepair despite being owner-occupied, which is a problem especially evident for low-income households. Further complications arise as new construction in rural areas (and especially in poorer households) tend use energy inefficient materials within "Do-It-Yourself" (DIY) projects and there is concern that such projects are unlikely to meet EPBD requirements.

According to the project document, the existing energy inefficiencies in the District Heating systems and more generally in the building sector alongside the slow pace of building turnover result in high energy consumption and wastage and a need for large quantities of expensive fuel (especially natural gas and oil) to be imported. These inefficiencies result in many Romanians not being able to afford to adequately heat their homes in winter and in fuel poverty being a significant issue for many households.

In 2008 (based on household survey data), on average, 14.6% of families in Romania struggled to pay heating bills[96]. This was higher in particular regions, including: South-East (30.3%); North-East (26.9%); South-West-Oltenia (24.6%); and South-Muntenia (18.2%).

Programme

The Improving Energy Efficiency in Low-Income Households and Communities programme was introduced in 2011 and is due to end in 2015. The initiative focuses on low-income households and communities and comprises pilot projects intended to improve energy efficiency (EE) and reduce fuel poverty[97] at the national level. It is intended to influence and direct policies and produce guides to good practice for dissemination through Romania and internationally. At the individual level, the initiatives target those families and communities where there is greater risk of being in fuel poverty.

[94] Figures taken from UNDP/GEF (2011) United Nations Development Programme – Country: Romania, Project Document. http://www.undp.ro/libraries/projects/Improving_Energy_Efficiency_in_Low-Income_Households_and_Communities_in_Romania_-_Project_Document.pdf

[95] European Energy Performance in Buildings Directive http://eur-lex.europa.eu/legal-content/EN/ALL/;ELX_SESSIONID=FZMjThLLzfxmmMCQGp2Y1s2d3TjwtD8QS3pqdkhXZbwqGwlgY9KN!2064651424?uri=CELEX:32010L0031

[96] A household is considered to be in fuel poverty if it cannot afford to maintain an adequate level of warmth.

[97] A household is said to be in fuel poverty when its members cannot afford to keep adequately warm at reasonable cost, given their income. The term is mainly used in the UK, Ireland and New Zealand, although discussions on fuel poverty are increasing across Europe,[1] and the concept also applies everywhere in the world where poverty may be present.(EU Fuel Poverty Network http://www.fuelpoverty.eu)

Two important pieces of legislation directly related to the aims and activities of the project are the Electricity and Gas Law in Romania and the EU Directive on Energy Efficiency. These concern the provision of energy services and also offer opportunities to develop new approaches to tackling fuel poverty, a priority for Romania. The EU Directive on EE sets out EE targets and requirements for long-term strategies on building renovation as well as provisions for obligation schemes to be set up by Member States in order to achieve social aims (e.g. to reduce fuel poverty).

Romanian legislation sets out a number of relevant changes including gradual liberalisation of electricity and gas markets, social protection measures for vulnerable customers (i.e. those at risk of or already in fuel poverty). Supply-side subsidies for heating/energy are being phased out and replaced by demand-side subsidies for poorer households. The project complements existing national legal frameworks and activities by addressing additional buildings and attempting to stimulate the market for EE services and products in the residential buildings sector from both the supply and demand sides. The project is considered to be aligned with current national priorities including (RNDP)[98]. In fact, this project is directly related to three of the six priorities set out in the RNDP, namely: protecting and improving the quality of the environment; developing human resources, promoting employment, social inclusion and strengthening administrative capacity; and reducing development disparities between regions. The project is also consistent with the National Energy Strategy 2007-2011[99] and the National Action Plan on Climate Change[100] (namely, the action on promoting EE among energy end-users).

The project's overall budget is $3m (USD) provided through a GEF-UNDP grant. The allocation of this budget is detailed in Table 1 below. Two-thirds of the UNDP-GEF budget is allocated to Outcome 3 (buildings and retrofits) and 15% to capacity building and training (Outcome 2). A total of nearly $2.5m of the UNDP-GEF grant is allocated to these two outcomes which directly relate to EE. The remaining 18% of the UNDP-GEF budget is allocated to outcomes 1, 4 and 5 and project management. Additional co-financing/contributions total US$119m. Other organisations providing cash and/or in-kind contributions to the project include: Ministry of Regional Development and Public Administration (MDRT), Ministry of Environment and Forests, Association of *Energy* Auditors for Buildings (AAEC) and *Romania* Green Building Council (RoGBC). According to further GEF documentation relating to the project[101]', the second component of the project has been allocated around $149k worth of co-financing/in-kind contributions. The third component (Outcome 3: EE building and retrofitting) has the most co-financing/in-kind contributions, around $118m.

[98] Romania's National Development Plan http://www.fonduri-ue.ro/posdru/images/downdocs/ndp0713.pdf

[99] The draft 2011-2035 National Energy Strategy is now available, see: http://www.econet-romania.com/files/documents/27April12/Vortrag%20ANRE.pdf (key points) and http://media.hotnews.ro/media_server1/document-2014-12-5-18755546-0-strategia-energetica-analiza-stadiului-actual.pdf (Romanian)

[100] National Action Plan on Climate Change http://mmediu.ro/file/PNASC_en.pdf

[101] See 'Request for CEO Endorsement/Approval' (2011) http://tinyurl.com/nkybezv

Table F.113: UNDP/GEF budget allocation across project outcomes

	Description	UNDP/GEF budget allocation ($US)	Share of UNDP / GEF budget
Outcome 1:	Romanian energy policy integrates fuel poverty issues and addresses EE needs in low-income communities	$144,420	5%
Outcome 2:	Supply of trained architects, building engineers, builders and auditors with EE experience expanded; municipalities in low-income regions have a better understanding of EE issues and are able to support auditing and weatherization projects - including disseminating information for DIY projects	$451,960	15%
Outcome 3:	Energy efficient buildings reconstructed (and potentially new buildings constructed) with reduced fuel costs or using improved sustainable energy technologies in low-income communities	$2,027,100	67%
Outcome 4:	Data and information available for decision-makers for designing programmes to address fuel poverty	$170,570	6%
Outcome 5:	Monitoring, learning, adaptive feedback and evaluation	$97,000	3%
Project management		$133,790	4%
Total GEF and UNDP funding		$3,024,840	100%
Additional funding (in-kind and cash; not through UNDP account)		$119,152,000	
Total (UNDP/GEF Grant + Additional Funding)		$122,176,840	

Objectives The project aims to:

- Improve capacity at the local level in order to address fuel poverty;
- Dismantle barriers to the implementation of EE measures among poorer households and communities;
- Address EE needs;
- Develop appropriate policy measures;
- Build capacity for implementation of EE measures in poorer regions; and
- Stimulate the market for locally-produced, EE building materials.

Structure There are four main components of the project:

- Developing improved policies to support EE in low-income communities;
- Improving capacity at the local level to reduce fuel consumption in low-income communities;
- Reduction of energy consumption directly through community-based retrofits and market development; and
- Making data and information available for decision-makers to use in designing programmes to address fuel poverty.

The project involves activities at both national and local levels, including:

- Establishment of the Inter-Organisational Working Group.
- Development and adoption of policy recommendations and an action plan for integrating EE issues and fuel poverty issues into the practice of public administration at the national level.

- Integrating EE policy-making and fuel poverty into the existing development plans or into a new energy plan of selected pilot counties (Dolj and Hunedoara). Local initiatives in relation to this include:
  - raising general awareness of fuel poverty
  - promotion of cross-institutional partnership to maximise resources and opportunities for reducing fuel poverty
  - promotion of community involvement and co-ownership of the strategy
  - facilitating the dissemination of information on sources of funding for EE measures
  - setting measurable targets and timetables and monitoring of progress during the project[102]
  - developing training and employment opportunities for policy-makers, information providers, general public, and service suppliers (e.g. architects, builders).
- Capacity building and training with regards to EE legislation and EE building materials and processes; this includes continuing education and training for professionals in related sectors and within municipal and regional organisations as well as training of trainers to build capacity.
- Building and retro-fitting, involving first the identification of buildings requiring thermal improvement; replacement of inefficient heating systems; provision of grant and training for DIY improvements (for poorer households). With the aim of improving EE performance of 40 social buildings, 500 apartment blocks and 150 houses. Prior to any works being carried out, properties would need to have an energy audit carried out and other technical assessments (e.g. regarding design) as well as building permits in place.
- Development of locally produced materials for thermal insulation of dwellings: this involves workshops and training for construction companies and building materials companies
- The project document[103] outlines the key indicators being monitored over the project. These are; changes in tonnes of CO2eq per year (and over the lifetime) of the EE measures; heat energy savings per year (MWh); volume of investment in EE buildings leveraged; and the number of people living in EE buildings. The project document[104] also highlights the difficulty of using an indicator of fuel poverty itself to measure the project's outcomes and effectiveness. One of the outcomes of the project however is focused on defining (and thereby measuring) fuel poverty.

  The overall expected outcomes of the project include:

- Increased supply of trained architects, building engineers, builders and auditors with EE experience (target of 200 such professionals by end of project);

[102] Though comprehensive documentation on progress (e.g. progress, evaluation and audit reports) could not be accessed in compiling this case study.

[103] http://www.undp.ro/libraries/projects/Improving_Energy_Efficiency_in_Low-Income_Households_and_Communities_in_Romania_-_Project_Document.pdf

[104] http://www.undp.ro/libraries/projects/Improving_Energy_Efficiency_in_Low-Income_Households_and_Communities_in_Romania_-_Project_Document.pdf

- Training and certification of 300 building professionals by the end of second year ;
- Better understanding by municipalities in low-income regions of the EE issues and support to auditing and weatherisation projects;
- Retrofitted buildings (and potentially new buildings constructed) with reduced fuel consumption or using improved sustainable energy technologies in low-income communities;
- Improvement in lives of over 110,000 people (target of 110,616 to be living in EE buildings (i.e. buildings that have been constructed or retrofitted with EE materials and / or technologies) by the end of the project) ;
- Reduction of greenhouse gas (GHG) emissions by over 660,000 tonnes of CO2eq; and
- Savings of 43,000 MWh in heat energy per year as direct result of the project

Target groups The main focus of this project, as specified in the title, is on low-income households and communities. This project comprises action at two levels – national level and local level within two counties. The specific counties, Dolj and Hunedoara, were chosen on the basis of evaluations carried out during Project Preparation Grant[105] (PPG) exercises. The initiative focuses on low-income households and communities. With respect to project activities including retrofitting and refurbishing of buildings, the focus is on social buildings (including social dwellings and schools). With regards to building capacity, the project aims to increase the supply of trained architects, building engineers, builders and auditors with EE efficiency experience.

Institutions involved This UNDP-GEF project is being implemented through the MDRT (lead organisation), with support from: Ministry of Environment and Climate Change; Association of Energy Auditors for Buildings (AAEC); and the following municipalities: Craiova, Calafat (Dolj), Vulcan, Petrosani, Petrila and Calan (Hunedoara). There is also an inter-organisational working group which was set up to bring together representatives of central and local government, private sector and the public, coordinate the project's activities, and expand activities at national level. The Inter-organisational working group meets twice a year and has published a number of background and findings reports about fuel poverty, energy efficiency and other relevant topics.

Results Limited information is available at present on outcomes to date[106]. The Mid-Term Evaluation (MTE) for this project is not currently available (though it was scheduled to be produced in 2013) however the Management Response[107]

[105] Project Preparation Grant http://www.thegef.org/gef/sites/thegef.org/files/gef_prj_docs/GEFProjectDocuments/Climate%20Change/Romania%20-%20%284115%29%20-%20Improving%20Energy%20Efficiency%20in%20Low-Income%20Househol/10-29-09%20ID4289%20PPG%20revised.pdf

[106] One of the main (and only) sources of information on progress on targets and outcomes thus far that was available for developing this case study is a presentation on the project's website (see: http://www.undp.ro/libraries/projects/EE/UNDP-GEF%20Project%20Presentation.pdf)

[107] Management Response http://erc.undp.org/evaluationadmin/manageresponse/view.html?evaluationid=7172

(MR) to the MTE is available. Some of the recommendations covered in the MR are:

- Recommendation that UNDP take full formal responsibility and direct control over the project implementation – MR indicates that it has initiated and secured this.
- Recommendation that the project assign one full-time project manager for all project activities – MR indicates that a project coordinator and an additional monitoring and implementation specialist have been recruited (June 2014)
- Recommendation that the project develop information on cheap materials for insulation and EE, and DIY methods for the most vulnerable low-income households – the MR indicates that they have identified the specific materials/methods to be promoted and have initiated the development of information on these and the organisation of events targeted at these groups
- Recommendation to strengthen the link between the UNDP project and national programmes and initiatives to maximise impact – MR indicates that they will focus in this respect on the National Rehabilitation Programme and the Regional Operational Programme.
- Recommendation for the project to work with associations of apartment owners to disseminate experience of implementing and financing EE – MR indicates that has proven difficulty but they will look for cooperative and willing groups.

For 2013, UNDP-GEF rated[108] the project's implementation progress as 'satisfactory' (this refers to the Project Implementation Progress (IP) Rating which is defined as annual implementation progress) and the project's progress on end-of-project targets as 'moderately satisfactory' (this refers to the Project Development Objective (DO) Rating which is defined as cumulative progress to end-of-project targets).The only data available on energy savings, budget outcomes, etc. are relayed in the following sections however, it is important to note that there without any interim evaluation nor associated data on project outcomes to date, the information available is limited. Due to lack of information about targets/achievements it is impossible to objectively evaluate the effectiveness of the project. The management response to the MTE (which is not available) indicates that there are a number of weaknesses with this project but many of these seem to be in relation to the handling of the project rather than content.

Energy saving results

The main direct energy saving results are connected to the outcomes of activities within Component 3 of the project (direct reduction of energy consumption through community-based retrofits and market development)[109]:

- Thermal rehabilitation of seven social buildings in two counties (Dolj and Hunedoara): has achieved cumulative energy savings of 645.12 Mwh per year and CO2 emissions were reduced by 199 tonnes per year. Around 1,000 people have benefited from this activity in the two pilot regions;

[108] http://web.undp.org/gef/document/APR_2013_UNDP_GEF_13MAY2014.pdf

[109] Figures from: http://www.eusew.eu/awards-competition/awards-archive/23-awards-nominees-2014/living/131-improving-energy-efficiency-in-low-income-households-and-communities-in-romania

- Subsidies have been provided for 11 further buildings to install biomass fuelled central boilers (which are considered to be sustainable heating systems which should bring longer term benefits) and further buildings are scheduled to have the same systems installed; and
- National programmes in conjunction with the UNDP activities have resulted in almost 160,000 people in Romania now living in energy efficient apartment blocks with lower heating bills.

No further figures are available.[110]

Social impacts results

Amongst the social benefits of the UNDP project are poverty alleviation, creation of employment opportunities, improved quality of life and alleviation of the impacts of removing energy subsidies. Some of the outcomes from the project's activities to date which are related to social impacts are provided below.

Within Component 1 of the project (Improved policies to support energy efficiency in low-income communities) a Fuel Poverty Assessment[111] report has been published on the UNDP project website. The report recommends that:

- A definition of FP based on principle of 'low income, high energy costs' should be used;
- The threshold for low-income should be 60% of median household income;
- Two indicators of high energy costs should be used to measure the magnitude of the issue: 1) non-availability of reasonably priced energy sources; 2) being in a dwelling with poor thermal performance;
- The energy price threshold should be at a level such that an household's energy costs would be equal to 10% of its income (assuming the household is in a thermally efficient dwelling);
- The thermal performance threshold (to be used in looking at the energy costs of households) should be set to level of the best-performing (unrehabilitated) pre-1990 buildings (i.e. 140 kWh/m2); and
- Other recommendations in the report are concerned with the use of energy efficiency obligation and white certificate scheme (e.g. initially obligation should take the form of a target level of energy savings); binomial tariffs (e.g. all energy retailers should be obliged to offer at least one binomial tariff with a fixed component); and grants and soft loan schemes (e.g. redesign of thermal rehabilitation schemes so that the household contribution required is dependent on household income; more precise targeting at households with the lowest incomes).

Within Component 2 (Improved capacity at the local level to reduce fuel consumption in low-income communities) a number of activities have taken place to date which should have impact on the overall objectives of the project.

[110] The UNDP data dashboard was contacted however no data have been provided.

[111] Fuel Poverty Assessment

http://www.undp.ro/libraries/projects/EE/Assesment%20Report%20on%20Fuel%20Poverty%20-%20DRAFT(1).pdfhttp:/www.undp.ro/libraries/projects/EE/Assesment%20Report%20on%20Fuel%20Poverty%20-%20DRAFT(1).pdf

These activities have focused on providing information about energy efficiency, including sustainable materials, to a variety of groups and thereby increasing the capacity of individuals and organisations to implement EE measures and whilst doing so increase employment opportunities, reduce costs to households and improve living standards (e.g. through warmer homes). Amongst the activities which have taken place are:

- Training sessions on EE measures (42 participants in two training sessions of the Local Public Authorities);
- Training for trainers on EE measures (involving 96 trainers with 480 specialists being trained by these trainers);
- Analysis of, and report on, existing sustainable building materials produced locally; and
- Information provided to 50 local municipalities for setting up EE information point.
- In total (to mid-2014), around 637 professionals (architects, engineers, energy auditors, etc.) have undertaken training courses, including local authority technical staff, thereby strengthening capacity to identify and implement EE measures.[112]

As noted in the section on energy savings results, within Component 3 and in conjunction with other national programmes, nearly 160 000 people are now living in EE apartment blocks and are paying lower heating bills. Reduction in costs of individuals and households has implications for fuel poverty amongst households and for well-being.

Under the activities associated with Component 4 of the project (Data and information available for decision-makers for designing programmes to address fuel poverty), working group meetings have taken place and there have been bilateral discussions between the project team and national level stakeholders in order to define specific IT platform requirements for each stakeholder necessary for setting up data collection and maintenance. Future activities planned under this aspect of the project are include creating and maintaining a registry or database of social buildings, apartment blocks and publicly owned housing; training for local municipalities to allow them to collect and add data to the registry; and, sharing of the registry with potential donors and investors.

Comments and conclusions

Without further information on outcomes and progress on key indicators to date, which one would expect to have in the project's Mid-Term Evaluation, it is difficult to assess how effective the project is and to conclude anything about value for money.

Particular strengths of this project include:

- National level programme, with substantial funding and cross government support;
- Inter-organisational cooperation;
- Capacity building, with an emphasis on increasing local skills and dissemination of information which should enable further energy savings and reductions in emissions in the future as well as employment opportunities with the expansion of the market for EE materials and

[112] Figures from http://www.undp.ro/libraries/projects/EE/UNDP-GEF%20Project%20Presentation.pdf

buildings (GEF has indicated that this project will help to ensure there is capacity in the public sector and communities to take advantage of financing for EE that is generally available);
- Targeting of groups who are at highest risk of being in fuel poverty.

Weaknesses include:

- Overall, the unavailability of documentation regarding measureable outcomes and progress on the project is a shortcoming of the project;
- There appears to be some delay in production of evaluation reports or at least in the publication of these – this may suggest that the overall timetable of the project has incurred delays;
- The overall outcome of fuel poverty is not being directly measured though it is useful that the project has involved an assessment and recommendations of how to best measure fuel poverty – it would be helpful to have the before and after figures for fuel poverty indicated on the basis of the recommendations of the assessment report.

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Appendix G Direct jobs per unit of contract value for different kinds of energy efficiency activity

G.1 Overview

This section presents estimates of the number of direct jobs created per unit of contract value for selected energy efficiency activities.

The figures shown provide an estimate of the number of jobs supported per million euro of contract value in one year. For example, approximately 7 jobs would be supported for each €1m of expenditure on cavity wall insulation, assuming that typical proportions of materials are imported. This impact would increase to 7.6 jobs per €1m of expenditure if all the materials were produced in the EU. The jobs estimates are direct only and 'gross' (that is, they take no account of subsequent impacts in the economy, including any job losses in the energy supply sector that would arise from a reduction in energy use).

The figures are derived by making estimates of the proportion of the contract value going to different sectors and then applying the employment per unit of gross output ratios in these sectors. Data for employment ratios are taken from the E3ME model for the year 2013. It is assumed that the employment intensity of the energy efficiency measures is the same as the average for the (E3ME) sector in which the activity lies.

In almost all cases, the jobs that are created are temporary: they exist for as long as the investment activity that installs the energy efficiency technology goes on. For example, if a house is insulated, the jobs are created for the duration of the installation work, whereas the impact of the insulation on the temperature of the house and on energy use within the house continues for the lifetime of the materials and the house.

Table G.1: Direct jobs per unit of contract value in selected energy efficiency activities

Energy efficiency activity	Details	Underpinning Policy	Regulation comments	Broad sector in which jobs are created	Detailed sectors and share of expenditure	Direct jobs per €1m of contract value	Direct jobs per €1m of domestic contract value
Energy saving building materials							
Cavity Wall Insulation (incl. hard-to-treat)	Single components generally injected: polystyrene bead, polyurethane foam, mineral fibre	EED	**EED Art. 7** requires MS to establish **Energy Efficiency Obligation Schemes** (as in DK, Fr, UK, It and Flanders) for energy retailers/distributors to achieve a cumulative end use energy savings targets by providing free/subsidised EE measures to householders. This will cascade into government programmes such as the ECO in the UK.	Manufacturing; Construction; Repairs	24% non-metallic minerals 1% rubber and plastic products 75% installation	7.0	7.4
Solid Wall Insulation	Multiple components for External Wall Insulation - wet rendered with metal fixings and insulation board. Requires scaffolding. EWI has some noise reduction and aesthetics qualities which could help justify the high price hence 5% of costs attributed to these aspects. Internal Wall Insulation (IWI) = board fixed with adhesive and/or screws. Large extra costs from EWI represent a minimum of 34% of the costs of External wall insulation. Overall labour (assuming 60% labour on main materials/fittings) suggest ~73% of overall installation - higher than US research. This increases slightly to 74% for IWI. Extra costs will be lower on large scale retrofit such as blocks of flats.	EED	**EED Art. 7** requires MS to establish **Energy Efficiency Obligation Schemes** at MS level for energy retailers/distributors to achieve a cumulative end use energy savings targets by providing free/subsidised EE measures to householders. This will cascade into government programmes such as the ECO in the UK.	Manufacturing; Construction; Repairs	75% installation 23% non-metallic minerals 2% metal products (i.e. fixings)	7.1	7.4

Energy efficiency activity	Details	Underpinning Policy	Regulation comments	Broad sector in which jobs are created	Detailed sectors and share of expenditure	Direct jobs per €1m of contract value	Direct jobs per €1m of domestic contract value
Loft Insulation	Single components in rolls of insulation: mineral wool; glass wool. Alternative rolled insulation for loft: sheep's wool, recycled plastic bottles; recycled materials (e.g. jeans). Also waste paper (cellulose fibre can be blown in www.excelfibre.com/pr).	EED	**EED Art. 7** requires MS to establish **Energy Efficiency Obligation Schemes** (as in DK, Fr, UK, It and Flanders) for energy retailers/distributors to achieve a cumulative end use energy savings targets by providing free/subsidised EE measures to householders. This will cascade into government programmes such as the ECO in the UK.	Manufacturing; Construction; Repairs	50% repairs 45% non-metallic minerals (i.e. insulation board and rolls) 4% metal products (i.e. aluminium backing on board) 1% rubber and plastic products	6.4	7.2
Draught-proofing (reduced infilitration through windows and doors) and pipework insulation	Draught proofing = foam seals for windows or brush strips; metal with brushes for doors - not widely deployed as forgotten about. Pipe insulation = urethane foam (e.g. www.kingspantarec.com) or silica aerogels (Aspen Aerogels: www.aerogel.com/products/pdf/Pyrogel_XT-E_DS.pdf). Pipe insulation will be minimal in buildings unless there is district heating involved (and far more significant for high temperature pipes in industry where greater efficiency gains)	EED	**EED Art. 7** requires MS to establish **Energy Efficiency Obligation Schemes** (as in DK, Fr, UK, It and Flanders) for energy retailers/distributors to achieve a cumulative end use energy savings targets by providing free/subsidised EE measures to householders. This will cascade into government programmes such as the ECO in the UK.	Manufacturing; Construction; Repairs	25% non-metallic minerals 12.5% metal products (i.e. metal strips) 12.5% rubber and plastic products 50% repairs	6.4	7.2

Energy efficiency activity	Details	Underpinning Policy	Regulation comments	Broad sector in which jobs are created	Detailed sectors and share of expenditure	Direct jobs per €1m of contract value	Direct jobs per €1m of domestic contract value
Heating, ventilating, and air conditioning and building controls							
High efficiency burner / chiller		EED		Manufacturing	90% metal products / machinery (producing of burner product itself) 10% repair & installation / construction / engineer	4.9	6.6
Boiler waste heat recovery		EED, Ecodesign		Manufacturing	70% metal products (heat exchangers) 30% repair & installation / construction / engineer	6.2	7.8
CHP installation		EED		Manufacturing	70% electrical / machinery manufacturing 10% electronics 10% basic metals 25 / 30 (10%) - repair & installation / construction	3.1	5.3
Variable Speed Drives (VSD)	VSDs are typically utilized to regulate speed of the driver mainly for better control functions. The EE advantage comes as an added benefit.	EED, Ecodesign		Manufacturing	50% electronics 50% repair & installation / construction / engineer	5.1	6.7

Energy efficiency activity	Details	Underpinning Policy	Regulation comments	Broad sector in which jobs are created	Detailed sectors and share of expenditure	Direct jobs per €1m of contract value	Direct jobs per €1m of domestic contract value
Premium efficiency motors/fans/pumps / compressors		EED, Ecodesign		Manufacturing	90% electrical equipment 10% repair & installation / construction / engineer	3.2	5.7
Advanced process controller (boiler, chiller, process)		EED		Manufacturing	90% electronic manufacturing (controllers and electronic control components) 10% repair & installation / construction / engineer	3.2	5.7
Industrial metering and Energy Management Information System (EMIS)	Submetering itself does not improve EE but forms part of the monitoring process attributing to eventual EE improvement. Sub metering is particularly crucial in verifying energy efficiency improvements accurately to ensure appropriate accounting of any EE opportunities invested. Most plants implement EMIS based on existing plant Information System related to the core business process, hence the 25% share of EE. But if EMIS is installed solely for energy monitoring, then this would represent 100%.	EED		Manufacturing	60% electronic / electrical manufacturing 40% repair & installation / construction / engineer	4.7	6.5

Energy efficiency activity	Details	Underpinning Policy	Regulation comments	Broad sector in which jobs are created	Detailed sectors and share of expenditure	Direct jobs per €1m of contract value	Direct jobs per €1m of domestic contract value
Enhancing building management systems & energy services (including heating/cooling buildings during core occupancy times / in line with guidance)	Automation and intelligent dynamic systems can enhance savings from heating, lighting and HVAC. Building Energy Management systems are increasingly used to ensure correct temperature of HVAC systems (as well as hot water settings) linked to external temperatures. Lighting and signage is also controllable. Sophistication varies but they are now increasingly integrating occupational considerations (including heat gain from computers) to provide more balanced temperatures which avoid over-heating or cooling needs. BEMS also control daylight shading systems on the outside of buildings and automatic blinds inside. Initially high capex with lower install costs as linked to key devices; fast ROI	EED; Recast EPBD	From June 2014 (transposition deadline of the EED), the EED will repeal the Directive on Energy Services and Directive on Co-generation - increasing markets for facilities managers and outsourced energy services as organisations find it more challenging to reduce their energy usage and improve efficiencies. BEMS (see right) are a vital tool in delivering optimal services to consumers. **EPBD** sets out inspection regimes for air conditioning plant in buildings; EPBD (Art 8) requires MS to set appropriate technical building system requirements.	Manufacturing; Professional services (consultancy); Installation (management systems)	20% manufacture of control systems (ICT) 70% repair/ installation 10% other professional services (consultancy)	6.7	7.7
Pumps, water heaters (incl. boiler upgrade), circulators, reduced flow fittings, etc., condensing boilers		EED & Recast EPBD, ErP	**EED Art. 7** requires MS to establish **Energy Efficiency Obligation Schemes** (as in DK, Fr, UK, It and Flanders) for energy retailers/distributors to achieve a cumulative end use energy savings targets by providing free/subsidised EE measures to householders. This will cascade into government programmes such as the ECO in the UK.	Manufacture; repairs	30% manufacture of electrical equipment 30% machinery and equipment 40% repair and installation	4.8	6.2

Energy efficiency activity	Details	Underpinning Policy	Regulation comments	Broad sector in which jobs are created	Detailed sectors and share of expenditure	Direct jobs per €1m of contract value	Direct jobs per €1m of domestic contract value
Vents and fans (incl. AC units)	The ErP measure for ENTR Lot 6 tertiary air conditioning includes regulations around ventilation units in domestic and non-domestic capacity. This regulation will require heat exchangers to be installed, resulting in very significant gas savings (gas assumed to be the primary heating fuel)	ErP (regulation eco-design: installation of heat exchangers)	Specific ErP measures include Lot 11 industrial Fans, plus ventilation units in ENTR Lot 6 Tertiary Air Conditioning (domestic and commercial sector)	Manufacturing, installation	95% electical equipment 5% installation (heat exchangers will need to be installed/maintained as part of a more energy efficient ventilation system)	2.8	5.5
Green architecture and construction services							
New builds		Recast EPBD	**EPBD** sets requirements for new buildings to be nearly zero energy: new public buildings are to be nearly zero by 2019; all new buildings nearly zero by 2021. Directive also requires MSs to set minimum energy performance requirements for new buildings	Construction	50% construction 45% non-metallic minerals (i.e. insulation board and rolls) 5% metal products (i.e. aluminium backing on board)	7.1	7.9

Energy efficiency activity	Details	Underpinning Policy	Regulation comments	Broad sector in which jobs are created	Detailed sectors and share of expenditure	Direct jobs per €1m of contract value	Direct jobs per €1m of domestic contract value
Deep renovation	EED states that cost-effective deep renovations lead to a refurbishment that reduces both the delivered and final energy consumption of a building by a significant percentage compared with the pre-renovation levels leading to a very high energy performance. Commission has indicated (see SWD(2013) 143 final) that efficiency improvements resulting from deep renovation are typically of more than 60% . Deep renovation will take a building close to being a low energy building . Two ways to approach target setting – either focusing on a level of energy savings to be achieved (typically 40-60%) or focus on a particular energy performance level after refurbishment. Both approaches have to be economically feasible. Most buildings undergo major renovation only every 20 or 30 years so building age is crucial in determining which constructions are good candidates for deep renovation.	EED and Recast EPBD	**EPBD Recast (Art 2)** states that major renovation means renovation when the total cost of the renovation relating to the building envelope or the technical building systems is higher than 25 % of the value of the building, excluding land value	Manufacture and construction/repairs	25% construction 25% installation 45% non-metallic minerals (i.e. insulation board and rolls; glass) 2% metal products (i.e. aluminium backing on board) 3% rubber and plastic products	6.7	7.5
Professional energy services							
Energy and Management System Audits	Both energy audit and EnMS itself are mainly labour cost. The effort required strongly depends on the state of the plant and its energy complexity ,and so the cost provided here is illustrative	EED		Manufacturing	10% electronics 90% engineer	7.7	8.4

Energy efficiency activity	Details	Underpinning Policy	Regulation comments	Broad sector in which jobs are created	Detailed sectors and share of expenditure	Direct jobs per €1m of contract value	Direct jobs per €1m of domestic contract value
Energy saving consumer products (inc smart meters)							
Smart metering	Refers only to the smart meters themselves (relate to meter information and billing improvements) rather than a smart grid, which goes much further into load balancing and other benefits	EED; Directive 2009/72/EC (common rules for the internal market in electricity); Directive 2009/73/EC (Gas Directive)	80 percent of EU households have a smart meters installed by 2020 based on DIRECTIVE 2009/72/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC; http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:211:0055:0093:EN:PDF	manufacturing, installation, professional services	80% electrical equipment 20% repair and installation	3.6	5.9
Smart grid							
Smart meter deployment	Significant cost associated with enhancing transmission system and substation performance to the level of a Smart Grid, such as transmission line sensors, storage for bulk transmission wholesale services, short circuit current limiters, communications infrastructure to support transmission lines and substations, core substation infrastructure for IT, etc. Load growth will require new substations.	EED; Directive 2009/72/EC (common rules for the internal market in electricity); Directive 2009/73/EC (Gas Directive)	EED (e.g., Art 15(1); 15(4)) strengthens earlier regulations, such as Directive 2009/72/EC and Directive 2009/73/EC, which strongly encourages Member States to introduce intelligent metering systems or smart grids. Directive 2009/72/EC requires 80% of electricity meters with smart meters by 2020	Electricity	100% electricity transmission and distribution	1.6	1.6

Energy efficiency activity	Details	Underpinning Policy	Regulation comments	Broad sector in which jobs are created	Detailed sectors and share of expenditure	Direct jobs per €1m of contract value	Direct jobs per €1m of domestic contract value
Electric vehicle technologies (include energy saving in conventional vehicles)							
Technical measures	More fuel-efficient conventionally fuelled road vehicles (i.e. excluding electric vehicles). Includes drivetrain, aerodynamics, auxiliary equipment and tyre rolling resistance, engine improvements, driveline friction, gearbox ratios, transmission, start-stop technologies, secondary heat recovery cycle, thermal management.	1. Regulation (EC) 443/2009 setting emission performance standards for new passenger cars. 2. The law setting 2021 targets for passenger cars is awaiting formal publication, but is agreed. 3. Regulation 510/2011 setting emission performance standards for new light commercial vehicles. 4. The law setting 2021 targets for passenger cars is awaiting formal publication, but is agreed. 5. for HGVs - none in force - in progress 6. Green Cars Initiative 7. Regulation (EC) No 1222/2009 on the labelling of tyres (amended by Regulation 228/2011 and Regulation 1235/2011)	This is difficult to identify / quantify due to private nature of the industry. What is visible is the reductions in CO2 levels of the fleets. Complication: the investments made by manufacturers are in order to deliver efficiency gains *as measured under the vehicle test cycles*. These don't necessary agree with real world efficiency gains however. Note that Fraunhofer report uses technical measures from TNO IEEP and LAT (2006)	Transportation and storage; manufacturing (Vehicle purchase)	100%-manufacture of motor vehicles	1.7	3.3

Energy efficiency activity	Details	Underpinning Policy	Regulation comments	Broad sector in which jobs are created	Detailed sectors and share of expenditure	Direct jobs per €1m of contract value	Direct jobs per €1m of domestic contract value
Encouraging uptake of electric vehicles through provision of charging infrastructure		1. Clean Power for Transport: European alternative fuels strategy (COM(2013) 17) 2. European Green Cars Initiative (EGCI)	Based on current average European energy mix, the battery electric vehicle represents a smaller [not negligible] life cycle CO2e (assume energy to be correlated) footprint than a conventionally fuelled vehicle (*Hawkins et al 2012and others*). However, the results are very sensitive to the electricity mix used. Note that marginal impact of electric vehicles over the vehicles they replace has 2 variables: the vehicle replaced, and the carbon intensity of supplied electricity.	Transportation and storage (electric charge points)	100% electrical equipment (electric charging points)	2.6	5.4