JOBS CREATION THROUGH ENERGY RENOVATION OF THE HOUSING STOCK

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NEUJOBS WORKING PAPER D14.2

DECEMBER 2012

Abstract

The European Commission has prioritised the renovation of the existing housing stock as a means of achieving their energy-efficiency targets. Buildings account for 40% of Europe's energy consumption and much of this is used in the residential sector. Insulating the building envelope, improving the efficiency of installations and using renewable energy production technologies can all contribute to improving energy efficiency. The shift from new-build to renovation will have considerable effects on employment in the construction industry and the qualifications, skills and knowledge that are required by the workforce. The EU and its member states have formulated many policies to achieve their energy-efficiency goals through renovation work. These targets are ambitious, and to reach them an increase in the amount and extent of renovation work is needed. The actual rate and extent of renovations are by fare not enough to achieve current targets. Studies show that for every €1 million investment in the existing building stock in the form of energy renovation work, 12 to 17 new jobs could be created. Potentially this could lead to may new jobs. The estimations vary from a couple of hundred thousand to over one million new jobs. However, there are many uncertainties in these calculations. Are these direct or indirect jobs, what sectors would benefit, are these jobs created within the EU or could a part be outsourced outside the EU and what would be the net effect on the labour market? Public and private spending on energy renovation of the housing sector could lead to reduced spending in other sectors. Nonetheless these uncertainties, the positive employment effects within the EU of investments in energy renovations of the housing stock will prevail. Although the current economic crisis is exacerbating matters, a new investment programme in the housing sector could not only improve the energy performance of the sector but create 100.000's of valuable jobs at a time when these are sorely needed.

See the back page for more information about the NEUJOBS project.

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1. Introduction

This working paper is part of the NEUJOBS research financed by the European Commission, under the 7th Framework Programme. The objective of NEUJOBS is to analyse future possible developments of the European labour market(s) under the main assumption that European societies are now facing or preparing to face some main transitions that will have a major impact on employment, in particular for some groups in the labour force or sectors of the economy. The project is organized in 23 Work Packages, in which almost 30 partners are involved. This working paper is one of the deliverables of WP 14 that assesses the potential impact of the socio-ecological transition on employment within the housing sector. The sub field that is being considered here is the relation between large scale energy renovations and employment within the construction sector.

The energy efficiency targets for housing that have been introduced through legislation at the level of both the EU and member states are expected to have a significant impact on the construction market. They will lead to a shift away from newly built dwellings towards more renovation of the existing stock and we can expect to see an increase in the number of renovation projects. This will involve a large increase in the number of people employed by construction companies and up the supply chain. New ways of working will also affect the qualifications, skills and knowledge that are needed to carry out these new activities.

This study explores relevant data relating to energy-efficiency goals in European countries, progress in implementing these goals and the consequences for the European construction sector.

Many reports and studies have already been published on this subject, but the value of a large number of these studies is questionable. There is general agreement that progress towards realising the energy saving targets has hitherto been slower than expected (e.g. EC, 2012). However, there is a lack of unambiguous data about the

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physical characteristics of the European housing stock, the renovation rate, the extent of the measures that are being and have been taken, the investment that has been made, the results of this investment in terms of energy efficiency, and the effect on jobs. Measuring job creation as a result of changes in this policy area is difficult: this study shows that there are various approaches and many uncertainties remain in the calculations.

In this working paper, we will basically try to provide some insight into the number of jobs that could be created in order to carry out the necessary renovations to achieve energy-efficiency goals in the existing housing stock. The timeframe for the study is mainly 2012 to 2020, and sometimes until 2050. Most calculations are based on the relationship between the investment made and the number of jobs created. How the various studies arrived at their figures is not always clear, and many variables could be at play. Investment can be broken down into costs for raw materials, end products and labour costs for design, engineering and on-site construction. This also affects jobs in the building products supply industry. But not all jobs will necessarily be created in the country where the investment is made, and there will also be indirect job creation which is not in the construction sector itself. Another important variable is how the employment effects are calculated: are they gross or net employment effects? This is important because investment in energy renovations may have a positive effect on employment in the construction sector, but at the same time depress investment in other sectors.

The main research method used was desk-top research, analysing EU policy documents, explorative studies for the whole EU and European comparative studies.
In this working paper we do not only confine ourselves to the European level. We selected four countries to exemplify the general picture: the Netherlands, Germany, the United Kingdom (UK) and Ireland. The energy-saving goals, progress and expectations for job creation in these four countries is analysed in order to give a proper perspective to the general picture of developments and progress in the EU. Over recent decades – unlike some other member states – these four selected countries have been setting energy-saving goals and developing and implementing policy instruments. They also have a research tradition, so that progress and results are being monitored. Within the framework of this working paper, experience in these four countries will provide a useful insight into and illustration of the issues involved.

Partners within our network were contacted for brief interviews and asked for sources and background information. Additionally, representatives from relevant organisations within Europe were approached with additional questions. The main organisations that we approached were: the Architects' Council of Europe (ACE), the Executive Agency for Competitiveness & Innovation (EACI), the European Builders Confederation (EBC), the Buildings Performance Institute Europe (BPIE) and the Bremer Energie Institut (BEI).

In section 2, we present relevant background information on the energy-saving goals of the four European countries selected, their progress to date in implementing these goals and the consequences for the construction industry in Europe. The main questions that we will seek to answer (as far as the available data allows) are:

- Which energy-efficiency goals have been set (with a particular focus on the housing stock)?
- Have there been changes in these goals (and why)?
- What progress has been made so far towards realising these goals?
- Have the results been better or worse than expected and why?

Section 2 also indicates the possible effect that developments on the demand side may have on the speed and extent of renovation work in the future.

Section 3 explores the consequences of these developments on the turnover, structure and the possible implications on new jobs and changing working methods in the construction industry. The two central questions answered in section 3 are:

- What do we know so far about the (initial) impact of energy-efficiency goals in housing for the jobs in the construction industry?
- What further effects can we expect on jobs in the construction industry?

In sections 2 and 3 links are made to other relevant Working Packages within the NEUJOBS project. In particular reference is made to WP4 (on skills), WP10 (on labour supply and demand, and the influence of demographic developments) and WP11 (on energy and green jobs).

Section 4 presents the conclusions of this study. We try to give an overall picture of the expectations, the arguments and possible future developments. It is impossible to provide a clear and definitive answer to the question of how many jobs will be created by energy renovations in the years to come, however. There seem to be some unrealistic expectations and – as stated above – there are also many uncertainties in the development of the renovation production.

It is commonly cited that job creation should be viewed as an added benefit to energy-efficiency programmes rather than the main driving force behind them. However, in view of current progress towards realising energy-saving goals and the current economic crisis, one could easily imagine that the opposite argument could lead to greater overall support. Stimulating energy renovation in the housing and building stock could boost the economic and employment situation, as well as providing us with a low-energy building stock in Europe as an important spin-off effect. We will return to this notion later in this paper.

2. Energy renovation of the housing stock

2.1 European energy-efficiency goals and policies for 2020

Following the European Commission's 'Action Plan for Energy Efficiency: Realising the Potential', the European Parliament endorsed an integrated package of energy and climate policy proposed by the European Commission in 2009, including the following legally binding targets for 2020 (known as '20-20-20'):

- Cut greenhouse gas emissions by at least 20 per cent by 2020 compared with 1990 levels (30 per cent if other developed countries commit to comparable cuts).
- Raise the share of renewable energy to 20 per cent of total energy consumption by 2020.
- Reduce energy consumption by 20 per cent of projected 2020 levels by improving energy efficiency.

These percentages vary between individual member states. National targets are set for each EU country which may differ from the 20 per cent targets mentioned above.

The housing sector is very important in attaining these goals. The building stock in the European Union is responsible for 40% of overall energy use and 36% of CO_2 emissions (ACE et al., 2009; Itard et al., 2008). The residential sector accounted for 77% of the CO_2 emissions from all buildings in the European Union in 2002 (Odyssee project, 2008).
Over the last decade, the European Union has issued a number of Directives to reduce greenhouse gas emissions and improve the energy efficiency of the building stock. One of the most well-known Directives is the European Performance of Buildings Directive (EPBD) (2002/91/EC), which has been in force since 2003 and was replaced by Directive 2010/31/EU in February 2012. This Directive includes the mandatory introduction of Energy Performance Certificates (EPCs) for buildings in member states. Member states are obliged[1] to:

- Develop and apply a calculation method (based on a common framework) to assess the energy performance of buildings.
- Ensure that an energy performance certificate is available to the owner or made available to prospective buyers or tenants when buildings are constructed, sold or rented out.
- Define minimum requirements for the energy performance of new buildings as well as existing buildings. Directive 2010/31/EU states that member states should apply 'near-zero' energy standards for new buildings and for buildings after renovation work costing more than 25% of the value of the building. Furthermore, they should take the necessary steps to establish regular inspection of boilers and air-conditioning systems.

The regulations concerning the availability of an energy performance certificate should increase public awareness, which forms the basis for many energy-efficiency policies. However, this does not have a direct effect on the number of energy renovations that occur. The recent requirements to apply 'near-zero' energy standards for new

[1] In the field of energy (policies) the legal competences are shared between the EU and the member states. This "shared competence" means that both the EU and its member states may adopt legally binding acts in the area concerned. However, the member states can do so only where the EU has not exercised its competence or has explicitly ceased to do so.

buildings and existing buildings undergoing major renovation can be expected to have a considerable impact over the coming years.

2.2 *European housing stock and renovation goals*

2.2.1 *Housing stock*

Measured in floor space, the housing stock in the EU accounts for 75% of the total building stock (BPIE, 2011). There are currently around 230 million dwellings across the 27 EU member states (Ministry of the Interior and Kingdom Relations, 2010; Cecodhas, 2011). The majority of these dwellings are in multifamily residential buildings. In the second half of the 20th century, there was enormous growth in the housing stock, which largely determined the housing stock we have today. The energy performance of a dwelling can be closely related to its age (unless it has undergone a major energy performance renovation). In the EU-15 (plus Switzerland) two-thirds of the housing stock is post-WWII (Eurostat, 2010).

However, table 2.1 (which shows the age distribution of the housing stock in the 27 EU member countries) indicates that in most countries around 50% to 60% of the current stock was built before 1970 and as such predates energy-saving regulations in the EU by some considerable time.

The countries with the largest share of older (pre-war) buildings are Luxembourg, Belgium, the UK, Denmark, Sweden and France. It is also evident that all countries experienced a major construction boom after WW-II and with a few exceptions, the housing stock more than doubled in this period. Significant country-by-country variations are also evident. The countries with the most recently constructed buildings (built between 1990 and 2010) appear to be Ireland, Cyprus, Portugal, Austria and Finland.

Compared to the post-war growth, the beginning of the 21st century shows a completely different situation. In most countries, the construction of new housing has fallen below an annual production rate of 1% of the existing housing stock, and often well below this (e.g. Itard and Meijer, 2008; BPIE, 2011). As a consequence, the influence of new construction on the quality and quantity of the existing stock is negligible. According to the Green Jobs Initiative in cooperation with International Institute for Labour Studies (2012), about 75% of the buildings that will make up the housing stock in 2050 already have been built today. For instance, in France half the buildings built before 1975 (when energy regulations for buildings were introduced there) will still be there in 2050. The older part of the housing stock in particular is already facing increasing deficiencies and shortcomings, although the exact extent of these problems is unknown since reliable comparative data on the volume of the qualitative backlog is scarce. Nonetheless, the available data shows an on-going need for reinvestment, in particular when it comes to energy efficiency (Itard and Meijer 2008, Thomsen 2010). The fact that the current housing stock will age considerably means that these problems may escalate significantly. So there can be no doubt of the need for large-scale energy renovations in the housing stock.

Table 2.1 Age distribution of the housing stock[2]

	Year	<1919	1919-1945	1946-1970	1971-1980	1981-1990	1990-2000	>2000
Austria	2009	15.2	8.2	28.0	15.2	11.5	13.6	8.3
Belgium	2009	17.1	24.2	24.2	13.7	20.8	-	-
Bulgaria	-	-	-		-	-	-	--
Cyprus	2001	n/a	7.4	16.9	20.7	27.4	27.1	-
Czech Republic	2005	10.5	14.2	25.4	21.8	15.8	7.9	3.4
Denmark	2009	19.7	16.1	26.4	16.6	9.1	5.4	6.7
Estonia	2009	9.4	14.2	30.0	21.5	19.6	2.0	3.3
Finland	2009	1.5	8.1	27.6	21.5	18.5	11.5	9.8
France	2006	17.0	13.2	17.4	25.2	10.2	8.5	8.4
Germany	2006	14.4	13.6	46.3	13.2	9.2	3.3	
Greece	2001	3.1	7.2	31.8	24.5	19.1	14.4	n/a
Hungary	2005	-	20.8	27.2	23.1	17.8	7.9	3.2
Ireland	2002	9.4	8.0	15.9	14.2	13.2	19.5	19.8
Italy	2001	14.2	9.9	36.8	18.8	12.2	7.9	-
Latvia	2008	13.8	13.1	22.1	19.4	20.2	7.0	4.4
Lithuania	2002	6.2	23.3	33.1	17.6	13.5	6.3	-
Luxembourg	2008	21.8	25.6	29.2	11.6	5.1	4.5	2.2
Malta	2005	12.2	10.0	22.1	16.2	19.1	17.0	3.4
Netherlands	2009	6.9	13.9	27.0	17.0	15.4	12.0	7.9
Poland	2002	10.1	13.1	26.9	18.3	18.7	12.9	-
Portugal	2008	7.4	10.0	21.9	16.1	18.8	17.7	8.1
Romania	2002	3.9	11.5	37.3	23.8	14.8	7.3	1.4
Slovak Republic	2001	3.4	6.6	35.1	25.6	21.0	6.2	0.6
Slovenia	2004	15.1	7.8	27.7	23.2	16.0	6.9	3.4
Spain	2001	8.9	4.2	33.5	24.1	13.6	15.7	-
Sweden	2008	12.1	14.7	37.0	16.8	9.4	5.5	4.6
United Kingdom	2004	17.0	17.0	21.0	21.8	20.0	n/a	n/a

Source: Ministry of the Interior and Kingdom Relations, 2010.

In addition to age, other characteristics of the housing stock can also greatly influence the success of efforts to improve the energy performance of existing dwellings. Building type and tenure are major determining factors in relation to decision-making relating to energy-saving measures and their cost/energy effectiveness.

On the European level (EU-25) it is estimated that the three building types – single-family houses (including two-family houses and terraced houses), multi-family houses, and high-rise buildings – represent 53%, 37% and 10% of the existing EU-25 housing stock respectively (Nemry & Uihlein, 2008). The fact that there are variations in the statistical data on housing characteristics provided by various sources is illustrated by the rather different outcomes of the Eurostat statistics (EC, various years). According to Eurostat in 2009, 34% of the EU-27 population lived in detached houses, 23% in semi-detached houses and 42% in flats.

2 This table gives a rough insight into the age distribution. In many cases, the age categories differ slightly between the countries analysed (see footnotes Housings Statistics report, table 2.4/p. 54).

With respect to the distribution of single-family dwellings and apartments, the various statistical sources agree that there is a great deal of variation. In Ireland, the United Kingdom, Greece and Norway almost 90% of the dwelling stock is made up of single-family houses, for example. At the other end of the spectrum there are countries like Spain, Estonia and Latvia where around 70 per cent of the dwelling stock is located in apartment buildings (BPIE, 2012; EC, various years).

Ownership has a bearing on the willingness and ability to renovate, and thus on the rate and success of renovations and the extent of the energy-savings measures that may be included in renovation projects. BPIE (2011) collected data from 17 countries on the division between owner-occupied properties and those rented from private landlords, public landlords or a mixture of the two. In all countries, at least 50% of residential buildings are owner-occupied. Among those countries with the largest share of private tenants were Greece and the Czech Republic, while countries with a significant share of public rented dwellings (in most cases these are occupied by social tenants) were Austria, the UK, Czech Republic, the Netherlands and France.

2.2.2 *Renovation goals*

Section 2.1 outlined the European energy efficiency goals for 2020. In advance of the case studies that will be presented in the next section and which describe the progress in some selected countries, there generally seems to be perfect agreement that progress in realising energy-efficiency goals is lagging behind expectations. The EC concludes that the reduction in energy consumption is estimated to be only 9% in 2020 (instead of the intended 20% reduction) (EC, 2012). This lack of progress is due to the following reasons:

- Market failures (e.g. poor reflection of environmental and social costs in energy market prices; split incentives or principal-agent problem; information failure; lack of adequate training and knowledge with many actors in the building sector, etc.).
- Financial barriers (e.g. relatively high level of initial investment costs; limited access to credit; biased financial perceptions on the part of private investors about initial costs and payback periods; lack of awareness and knowledge among financiers; relatively high transaction costs due to small size of energy-efficient projects compared to other investments and a lack of a systemic approach to bundling investments; longer-term returns on investment in energy efficiency (and their current illiquidity) in combination with a lack of energy savings-backed securities).
- Regulatory framework (e.g. lack of enforcement; lack of administrative capacity to develop energy-efficiency legislation, frequent changes in the legal framework and financial support programmes; the often decentralised nature of the institutional competences in the building sector, with national, regional and local authorities playing different roles in enforcement, subsidy allocation, tax policy, etc.).
- As well as these arguments, there is a growing awareness that in many cases the relationship between the (theoretical) energy performance of a dwelling and the actual energy use can be quite different to what is expected. Actual energy use is also related to the preferences and lifestyle of the occupants. One study in the Netherlands (Visscher et al, 2012.) appeared to show that energy use in energy-

inefficient houses was much lower than expected, while in very energy-efficient houses it was somewhat higher. This leads us to conclude that the actual energy saved through renovation is much lower than was estimated in many policy documents. After renovation the comfort level of the dwelling increases, reducing the potential savings. Similar conclusions have also been drawn in studies in other European countries. The concern that improving the energy efficiency will lead to lower energy savings and savings on the energy costs can have a serious impact on the feasibility of future renovations.

In order to realise the ambitious energy-saving goals set for the European building and housing stock, member states and the European Union urgently have to find solutions for the barriers described above.

Our knowledge of the actual rate and extent of renovation work is a decisive factor when forecasting what will happen to the energy performance of the existing housing stock and the effects of this on job creation in the construction industry over the coming decades. When it comes to producing current and reliable data on these factors, there is still much that is lacking. However, on the basis of the evidence that can be provided, it seems that the number and magnitude of renovations (the measures that are being taken) are falling short of expectations.

The European Commission states (EC, 2012) that the current general refurbishment cycles are between 30 and 40 years, and those which lead to energy-efficiency improvements are at longer intervals (60-80 years). The EC estimates that approximately 3% of the building stock is being renovated per year. According to this line of reasoning, only half of all energy-efficiency improvements are included (i.e. 1.5% energy-related renovation rate per year). Energy-efficiency improvements are cost-effective in most cases when combined with on-going maintenance and refurbishment work. For this reason, the EC (2012) identifies an upper limit of 3% for the cost-effective rate of energy-efficient renovation. The basis for this assumption is hardly rock solid, however, particularly in view of the current situation, and it would seem to be far too optimistic.

A study by Itard and Meijer (2008) shows that reliable information on renovation activities in European counties is very limited. On the basis of our knowledge of the Dutch situation, however, a renovation rate of 3% is far too optimistic. Moreover the renovation rate alone says nothing about the extent of the measures being taken. Additionally, there is a structural lack of comprehensive information on the costs and savings of building renovations.

Table 2.2 Opportunities for the energy renovation of residential buildings

Opportunities for the energy renovation of residential buildings include: • Improving the thermal performance of the building fabric by insulating walls, floors and roofs, and replacing and tightening of windows and doors. • Improving the energy performance of heating, ventilation, air conditioning (HVAC) and lighting systems. • Installing renewable technologies such as photovoltaic panels, solar thermal collectors, biomass boilers, or heat pumps. • Installing building elements to manage solar heat gains

Source: BPIE, 2011.

The Buildings Performance Institute of Europe (BPIE, 2011) has examined this matter in greater depth and distinguishes the following levels of renovation:

- Minor renovations: the implementation of 1 or 2 measures (e.g. a new boiler) resulting in a reduction in energy consumption of between 0% and 30% (with average costs of €60/m^2).
- Moderate renovations: involving 3-5 improvements (e.g. insulation of relevant parts of the dwelling plus a new boiler) resulting in energy reductions in the range of 30%-60% (with average costs of €140/m^2).
- Extensive renovations: in this approach the renovation is viewed as a package of measures working together leading to an energy reduction of 60% - 90% (with average costs of €330/m^2).
- Almost Zero-Energy Building renovations: the replacement or upgrade of all elements which have a bearing on energy use, as well as the installation of renewable energy technologies in order to reduce energy consumption and carbon emission levels to close to zero (with average costs of €580/m^2).

The BPIE (2011) also concludes that little data is available about the number of renovation projects being undertaken, their extent, costs, effects, or indeed trends in renovation rates. Most estimates of renovation rates (other than those relating to single energy-saving measures) are between 0.5% and 2.5% of the building stock per year (see Itard and Meijer, 2008). These rates typically reflect the activity of the preceding few years, which in some cases are linked to special circumstances during those years. These special circumstances include the existence of a renovation programme or the deployment of a certain policy instrument. All in all, these 'known' renovation rates are almost certainly not standard practice in a country. BPIE (2011) assumes that the current prevailing renovation rate across Europe is around 1%. According to BPIE, 85% of all current renovations could be characterised as 'minor', 10% as 'moderate' and 5% as 'extensive'. The number of renovations leading to nearly zero-energy buildings is considered 'negligible'.

According to the UEA Low Carbon Innovation Centre and Build with CaRe (2012), these figures are slightly higher; it states that currently 1.2% of European buildings are being renovated each year. These percentages seem to be more realistic than the EC's estimate of 3%.

Based on the above assumptions and the total number of dwellings, a rough calculation gives us the following overall picture:

In the EU, 2.3 million dwellings are being renovated annually, of which:
- 1,955,000 are minor renovations;
- 230,000 are moderate renovations;
- 115,000 are extensive renovations.

2.3 Targets and progress in selected EU member states

2.3.1 The Netherlands

The current target, set in 2011, is to increase the proportion of renewable energy used in the Netherlands to 14% by 2020. The aim is to reduce greenhouse gas emissions by 20% by the year 2020 compared to the situation in 1990 (BZK, 2011).

Although current goals are in line with the EU targets set for the Netherlands, they are less ambitious than those set by the Dutch government in the recent past. The initial targets – set in 2007 – aimed at an increase in renewable energy to 20% by 2020, a 30% reduction of CO_2 emissions by 2020 and a yearly 2% reduction in energy consumption. However, the current government continues to take the position that existing dwellings must play an important role in achieving these energy-saving targets. Although some of the instruments have remained unchanged, the emphasis lies on the responsibility of homeowners and the market (the construction and installation industry). The government stresses the benefits of reduced living costs as a result of improvements in energy performance and the role of the market in developing demand for energy efficient dwellings.

The goals for the existing housing (and building) stock are laid down in a covenant entitled "More with Less" (*Meer met Minder*; MmM, 2009), which aims to develop a lasting market for energy efficiency and energy saving of 100PJ by the year 2020. In the existing housing stock, the target for savings is 78PJ, while in industrial buildings an additional saving of 22PJ should be realised (MmM, 2009). Quantified in absolute numbers, this means that in 2.4 million existing dwellings and buildings a structural energy saving of 30% should be realised by 2020. In the period 2008-2011, 500,000 buildings were meant to have been renovated (125,000 annually). In the subsequent period (2012-2020) another 1.9 million dwellings and other buildings should follow (which means 210,000 to 238,000 annually, depending on whether the year 2020 itself is included). June 2012, the covenant was revised. From that point on, 300,000 existing dwellings and other buildings were to be improved every year with at least two energy label (EPC) increments. The new annual number of 300,000 implies that progress so far has fallen short. It is not known what the effect of the change in the target will be ('improvement involving two EPC increments' instead of a 'structural' theoretical energy saving of 30%').

For the social housing sector, a separate covenant (in 2008) was negotiated entitled "Energy-saving in the Housing Association Sector". The goal for the existing social housing stock was to reduce gas consumption by 20% in the period 2008-2018. This covenant was also amended in June 2012 and now also includes goals for the private rental sector. The new target is now that the average dwelling in the social rental sector is to have an energy index of 1.25 (= energy label B). This would – according to the covenant - mean that energy use in the social rented sector would fall by 33% by 2020, compared with 2008. The goal for private rented dwellings is that 80% of the stock should have an energy label C or higher in 2020.

Various instruments have been put in place to achieve these goals. As in most other countries, a distinction can be made between 'regulatory' instruments (e.g. EPCs are required under the EPBD whenever a property is sold or rented), voluntary agreements (covenants) and financial/economic and information instruments. All these types of instruments are being deployed in combination with one another.

An evaluation has shown (Rabobank, 2012; NRC, 2012) that the overall target of 14% renewable energy by 2020 will not be reached: 9% looks far more realistic. The main reason for this (according to Rabobank) is that too much attention is being paid to the production of energy from biomass, while the largest gains by far can be achieved through solar and wind energy. Only a small portion of the €9 billion budget that was reserved for the period 2008-2011 to stimulate renewable energy was actually spent.

With regard to progress in the housing sector, interim evaluations seem to show that there has been some progress. Monitoring reports state that private homeowners have been carrying out more energy-saving measures in recent years, suggesting some possible impact. Between 2008-2010, energy savings of 20% in addition to 'business as usual' were achieved for 314,000 dwellings (MmM, 2011). However, it is not known what measures were taken and how much was invested in the measures. While it appears that on this basis, the goal of achieving additional savings in 500,000 by 2011 will not be met, this is considered a positive result in light of the economic crisis and the general dip in construction activity (Murphy et al, 2012). Progress in the social housing sector so far seems to be satisfactory in terms of energy labelling, but actual energy-saving measures in the social housing sector are lagging behind.

Financial instruments have been put in place at various levels to encourage people to improve the energy efficiency of their homes. Some of these instruments operate at the national level, while others (e.g. subsidy and or low-interest loan schemes) have been developed at the provincial or municipal level. In general, research shows that many (almost half) of the recipients of subsidies were so-called 'free riders' - householders who would have had the work carried out at some stage even without the subsidy (Murphy et al, 2012).

2.3.2 Germany

Successive German governments have long sought to encourage the creation of a market for renewable energies over the long term. The current federal energy policy is laid down in the 'Comprehensive Energy and Climate Plan' (*Integriertes Energie- und Klimaschutzprogramm* – IEKP), a package of 29 measures, adopted by the federal government in 2007, which aims to reduce energy consumption, improve energy efficiency, and promote the production of renewable energy. The IEKP stipulates that Germany must (BMU, 2009):

- Reduce its greenhouse gas emissions by 40% by 2020 compared to 1990.
- Increase its share of renewable energy in total electricity consumption to 30% by 2020 (was 15% in 2008).
- Increase its share of renewable energy in total final energy consumption to 18% by 2020 (was 10% in 2008).
- Increase its share of renewable energy in energy consumption for heating and cooling to 14% by 2020 (was 7.5% in 2008).
- Reduce its primary energy consumption by 20% by 2020 compared to 2008.

In 2010, the German federal government launched the 'Energy Concept' (*Energiekonzept*), in which it committed itself to reducing the primary energy requirement of buildings by 80% in 2050 and increasing the thermal retrofit rate from the current 0.8% to 2% per year. Since Germany has around 40 million homes, this would mean an increase from 320,000 to 800,000 homes per year. Neuhoff et al. (2011) point out that various studies show significant variations in estimating the cost of a thermal retrofit: costs for multi-family homes would be between €80 and €185 per m^2 if the current energy standards are to be attained (single-family homes: €135-205/m^2). If a further reduction to 55% of this standard (resulting in considerably reduced energy use) is to be reached, the average costs will vary between €105 and €230 per m^2 (single family homes: €150-275/m^2). Neuhoff et al. (2011) estimate that the increase in the retrofit rate would require spending an additional €2-4bn per year if the current standards are to be met, while if the 55% standard is to be attained, an additional €4-8bn is necessary.

In 2011, most of the package of 29 IEKP measures was adopted in the Second National Energy Efficiency Action Plan (*2. Nationaler Energieeffizienz-Aktionsplan*), which was drawn up mainly to implement the Energy End-Use Efficiency and Energy Services Directive (2006/32/EC). The measures were related to a range of economic sectors, such as energy production, transport and construction. The package affected two central policy instruments of the German federal energy policy, namely the Energy Savings Ordinance (*Energieeinsparverordnung* – EnEV) and subsidies for the energy renovation of dwellings and municipal buildings operated by the federal development bank *Kreditanstalt für Wiederaufbau* (KfW) (BMWi, 2012).

The KfW provides loans (indirectly via other banks) to citizens who plan to enhance the energy performance of their home, provided that the building permit was issued before 1995. Federal subsidy allows the KfW to charge low interest rates and, under certain conditions, partial amortisations. The maximum loan available for borrowers depends on the energy performance achieved following the work. The standard of energy efficiency is categorised using the building requirements laid down in the EnEV. For example, a home that requires 115% of the primary energy consumed by a comparable new house will be classified as a KfW Efficiency House 115 (*KfW Effizienzhaus 115*) (Scharmanski & Walter, 2012). The employment effects of the KfW loans are looked at in chapter 3.

As for the KfW subsidy programmes, the IEKP stipulates that these should be continued and developed further in the sense that opportunities for local heating systems and other local initiatives were enlarged.

The IEKP announced that energy-efficiency standards for buildings would be made 30% stricter than they were at that time. These new standards came into force in 2009, when the EnEV was revised. In the past, similar revisions of the EnEV took place every two or three years. The next revision is scheduled for 2012, but has still not been finalised at the time of writing. This revision should implement the renewed European Performance of Buildings Directive of 2010 (2010/31/EU; see section 2.1). It is probable that in the coming EnEV the standards for existing buildings will remain unchanged, but that those for new buildings will be made stricter (http://www.enev-online.de, accessed September 2012).

Apart from KfW data on the number of loans made available for energy improvement, this study has not found any monitoring data that indicates the overall progress that has been made towards a more energy-efficient housing stock and to attain a higher energy retrofit rate. Initial monitoring results are expected to appear in 2013.

2.3.3 United Kingdom

The general energy-saving targets of the UK government are (DECC, 2011-b) as follows:

- Cut greenhouse gas emissions to 12.5% below 1990 levels in the period 2008-2012. This is the 'first carbon budget', with the others running from 2013-17, 2018-22 and 2023-2027 (DECC, 2012).
- Reduce greenhouse gas emissions to at least 34% by 2020 compared with 1990.
- Cut greenhouse gas emissions to 80% below 1990 levels by 2050, according to the Climate Change Act 2008 requirement.

The *UK Low Carbon Transition Plan - National strategy for climate and energy* (2009) sets out the Government's ambitions to cut CO_2 emissions from homes by 29% from 2008 levels, by 2020.

The Carbon Emission Reduction Target (CERT) requires all domestic energy suppliers with a base of more than 250,000 customers to make reductions in the amount of CO_2 emitted by householders. Suppliers are meeting this target by promoting the uptake of low-carbon energy solutions to household energy consumers, thereby encouraging them to reduce the carbon footprint of their homes. The main goal of the CERT is to contribute to the UK's legally binding target under the Kyoto protocol and the 2008 Climate Change Act. One of the other goals is to secure jobs in industries related to energy efficiency (DECC, n.d.). The CERT has been extended until December 2012. The

Energy Company Obligation (ECO) will replace the CERT but is similar and has been developed together with the Green Deal as a key part of the overall Green Deal framework. The ECO is supported by a budget of approximately £1.3 billion (about €1.63 billion) per year (DECC, 2012-b).

An important instrument for the UK government is the 'Green Deal', already mentioned above, which will come into full effect in autumn 2012. The basic idea (EEPH /CPA, 2012) is that consumers can improve the energy performance of their homes by using the services of the so-called 'Green Deal Providers'. There are no upfront costs for installing energy-saving measures; rather, those costs are covered by the energy savings on their energy bill (the Pay-As-You-Save principle). The measures can include loft and cavity wall insulation, energy-efficient glazing, innovative hot water systems, condensing boilers and controls, solid wall insulation, as well as micro generation systems. At the heart of the Green Deal Policy is the 'Golden Rule', which determines the amount of money that consumers can borrow. It limits the amount of Green Deal finance that a Provider can attach to the electricity bill, which is related to the estimated energy bill savings that are likely to result from the installation of measures in the Green Deal plan.

In recent years, many of the 26.8 million homes in the UK have been insulated. The most recent numbers from July 2012 (DECC, 2012-a) are:

- Of the 26.8 million homes in the UK, 23.4 million have lofts, 18.9 million have cavity walls with the remaining 7.9 million having solid walls.
- Through government schemes since April 2008 (the start of the CERT), 4.5 million lofts have been insulated, 2.2 million cavity walls and 78,000 solid walls.
- Between April and September 2012, lofts were insulated in another 480,000 properties (with at least 125mm of insulation, which is the threshold for inclusion these figures), 220,000 more had cavity wall insulation (quality differs) and 11,000 more had solid wall insulation[3].
- 15.2 million homes had loft insulation of at least 125mm (65% of homes with lofts).
- 12.9 million homes had cavity wall insulation (68% of homes with cavity walls).
- 144,000 homes had solid wall insulation (2% of homes with solid walls).

According to EEPH/CPA (2012), the current installation rate for solid wall insulation is around 20,000 per year. The targets in the Green Deal will require a tenfold increase in installation rates, so there should be an annual rate of 150,000 to 200,000, by 2015. Looking at the current rate, it seems doubtful whether these number can be achieved.

The report *The Carbon Plan: Delivering our low carbon future* (DECC, 2011-b) presents some statistics on the progress of cutting emissions from buildings: 'In buildings,

[3] Current building regulations require a target U-value of 0.35 $W/m^2.K$ to be reached if this modification to the wall is made. It is likely that installations of solid wall insulation before 2002 (i.e. before the first phase of the Energy Efficiency Commitment) may not achieve this level of thermal performance, so these are recorded separately in the statistics (DECC, 2012a).

emissions have fallen by 18% (1990-2010), despite the growth in population and housing.' It is not clear how this relates to the government's ambitions to cut CO_2 emissions from houses by 29% on 2008 levels by 2020.

Although progress has been made in terms of insulating homes in the UK, the Royal Academy of Engineering (2012) concludes that there is no way that the UK will meet its 2050 target for CO_2 emissions reductions without a fundamental change to the way in which homes are heated. They note that even with the most modern gas boilers and state-of-the-art insulation, it will not be possible to heat the same number of homes using natural gas and achieve an 80% cut in emissions. This means that techniques other than insulation need to be considered. The government is aware that the oil and gas used to drive cars, heat buildings and power industry will, in large part, need to be replaced by electricity, sustainable bioenergy, or hydrogen, and that electricity will in turn need to be decarbonised by using renewable energy, nuclear power and carbon capture and storage (CCS). The electricity grid will need to be larger and more able to balance demand and supply' (DECC, 2011-b).

2.3.4 Ireland

The wider goal of the Irish government is 20% reduction in energy demand across the whole economy by the year 2020.

Housing stock in Ireland is relatively new, with approximately 40% having been constructed since 1990 (see table 2.1). Because of the recent construction boom (which lasted until 2007), the rate of construction has been high over the past decade. According to some estimates, an additional 600,000 new dwellings need to be built before 2015 to meet demand (DEHLG, 2007). In view of the financial and economic crisis that has hit Ireland in recent years, it is questionable whether these figures are going to be attainable in practice.

The Sustainable Energy Authority of Ireland (2010) predicts that around one million homes will undertake energy efficiency improvements between 2010 and 2020, based on the National Retrofit Programme (now called 'Better Energy'). According to DKM Economic Consultants (2012), the residential sector is expected to contribute about 35% of the total targeted savings in 2020.

In 2011, the Irish government introduced the 'Better Energy: the National Upgrade Programme' to improve the energy efficiency of existing homes and other buildings. This programme will replace the various existing programmes and builds on what worked well in the existing grant schemes while adding a role for energy suppliers. The difference is that an upfront discount is given (rather than a retrospective grant) and a national pay-as-you-save scheme will be set up.

According to the Department of Communications, Energy and Natural Resources (2011), the programmes that preceded the *Better Energy* programme were very successful. This is illustrated by the Department with the results of the Home Energy Saving Scheme, which supported 88,000 home upgrades in 2009-2011, bringing a total of a quarter of a billion euro into the economy and supporting up to 5,000 jobs each year. Government grants pay for about one third of the cost of a typical upgrade and are very popular: in 2011, more than 1,000 upgrades were being carried out every single week.

Table 2.3 Results achieved and expected of completed energy-saving schemes and the new Better Energy programme

			Energy savings GWh, PEE*			CO_2 savings (kt CO2)		
Energy-saving measure	End use targeted	Duration	2010 (achieved)	2016	2020	2010 (achieved)	2016	2020
GHS	Heating and hot water in residential sector	March 2006-2011 (complete)	120	-	-	28	-	-
WHS	Heating and hot water in vulnerable homes	2000-2011 (complete)	120	-	-	33	-	-
HES	Existing domestic sector	2008-2011 (complete)	365	-	-	90	-	-
Better Energy	Existing dwellings	2011-ongoing	-	3,000	6,000	0	740	1,476

* The target is expressed in primary energy equivalent (PEE) terms. The conversion from final energy consumption to primary energy equivalent is based on a standardised factor of 2.5 for electricity (Annex I, ESD). It accounts for the conversion losses in electricity generation and makes units of different energy streams more comparable.

Source: Department of Communications, Energy and Natural Resources, 2012.

According to the National Energy Efficiency Action Plan (2011), over €119 million has been paid to homeowners enabling 110,000 homes to undertake 274,000 energy efficiency measures since the start of the Homes Energy Savings (HES) Scheme in 2009, to end of 2011 (this is a relatively low investment per dwelling)
The energy savings achieved by the HESS, WHS and GHS schemes (all completed) and the expected energy savings based on the on-going Better Energy Programme are listed in the table 2.3.

2.4 *Expectations of investments in energy renovations in the EU*

The European housing stock is ageing and the effects of this process will be felt ever more keenly in the near future. Domestic energy use and the contribution of existing dwellings to Green Gas Emissions are considerable. The EU and its member states have of course been well aware of this for decades. Energy-saving goals have been formulated and a wide range of policies and instruments have been put in place to tackle the problem. member states see a great deal of potential for energy savings in the existing housing stock and consider improvement of the energy efficiency of buildings by renovations to be the way to realise wider energy-saving targets. There are high expectations in Europe about progress towards achieving energy-saving targets and the effects of the policies and instruments developed. However, little evidence is available about the number of renovations being undertaken, the sums being invested, the effects on energy use, or indeed the trends in renovation rates. Most estimates of renovation rates (other than those that relate to single energy-saving measures) are between 0.5% and 2.5% of the building stock per year. Some sources suggest a renovation rate of 3%, but based on an analysis of various studies, an average renovation rate of 1% of the existing housing stock seems the most realistic. Most of these renovations can be characterised as 'shallow'. Only a few energy-saving measures have been taken and the effect on overall energy use is minor.

In order to attain the ambitious goals of the EU, the renovation rate would need to be almost triple the current rate of around 1%. In view of the current pace of progress, it seems extremely doubtful whether such an increase can be realised in practice, but it would have a considerable effect on both the energy that will be saved and on job creation forecasts as a result of the renovation work. The next chapter will look at this point in more detail.

There are several reasons why the renovations expected and needed will most likely not materialise, including market failures, financial barriers and inefficient or ineffective regulations. There are also reasons to lower our expectations concerning the effect of renovations on reducing domestic energy use. On the other hand, the housing stock is relatively old. New housing production is limited. If it remains at its current average level of 1%, we will have to rely on our current stock for a very long time. Improvements in the stock will have to be made, if not for the sake of energy efficiency then simply to improve levels of thermal comfort.

The Dutch case shows that the number of dwellings that have been improved is lagging behind expectations. No information is available about the extent of the renovations being carried out, but the evidence would suggest (certainly in the owner-occupied sector) that in most cases only minor measures have been taken.

The German goals and policies for energy renovations seem very ambitious, aiming at a renovation rate of 2% per year. There are currently no data resources available to ascertain whether progress is being made towards this goal or not.

In the UK, a great deal seems to have been achieved with respect to insulation, but it is unclear to what extent this will have the intended effect. The current goals with respect to solid walls seem to be far from realistic. Evidence that current goals will be difficult to achieve – to say the least – are backed up by reputable sources.

Although Irish governmental institutions state that renovation schemes have been a great success, the actual investment made seems very low. This probably means that only minor renovations have in fact been carried out.

2.5 Future developments affecting the demand side

One important factor that should be considered with regard to future renovation activities is the possible influence of developments on the demand side. Technological innovations and demographic changes will have a major effect on (the demand for) future energy renovations in the housing stock. The development of new building renovation technologies is progressing slowly but steadily. No real breakthrough innovations have been achieved to date, however, and - although it is hard to forecast developments in this field – none are expected in the near future.

When it comes to predicting demographic developments in Europe, this is not the case at all. There is general acceptance that low fertility rates, ageing populations and growing immigration are factors that will change Europe in the near future. Some general trends (Berlin Institute for Population and Development, 2008) that are likely to occur between 2007 and 2050 in Europe are that the:

- Population will shrink overall by 8.3%.
- Number of people over 65 years old will grow from 16% to 28%.
- Life expectancy will increase from 76 years to 82 years.

There are various notions about population growth in the EU. A recent EC publication projects that the overall size of the population is going to be slightly larger in 2060 compared with 2010 (EC, 2011-a). The EU population is expected to increase with almost 5% from 2010 up to 2040. Thereafter, a steady decline is foreseen and the population shrinks by nearly 2%. Nonetheless there is wide consensus about the fact that population ageing will be the main demographic trend across Europe. The age structure will dramatically change[4].

Even if the population on EU level will stabilize in the coming decades, more and more regions in the EU will face a declining population and a decrease in economic activity. These developments will affect those regions profoundly. Changes will occur in the size of the population, the household and population structure, the employment and economic situation and the housing market (transactions, vacancies, quality, etc.). The outcomes of these processes will vary between European regions and even within regions. Population decline is expected in the eastern part of the EU, but also in some parts of the Mediterranean region, in the northern periphery and in some declining industrial areas of Western Europe such as Saxony, Rhine-Ruhr, Saarland, Central Scotland, etc. (e.g. Vandermotten, 2010).

[4] In WP10 of NEUJOBS ('Modelling the evolution of the labour supply and labour demand') demographic scenarios are analysed that could influence labour supply and –demand. In general an aging population will decrease the working population and economic growth and could increase public expenditure.

These regions will lose economically active young people, which will further exacerbate the issues of ageing, declining household sizes and a fall in birth rates. Economic vitality and the housing market will also come under pressure (with declining housing prices, maintenance backlogs, vacant properties, and so on[5]). Ageing residents will increasingly stay on in their own dwellings until they reach an advanced age. All in all, these factors could reinforce each other and there is some danger of a downward spiral. This would impact on the quality of housing, the rate and extent of renovation activities and thus also the success of energy-saving renovation policies.

In the research literature, older residents are commonly associated with much reduced willingness to carry out maintenance and repair jobs. Older homeowners are only about half as likely to have repair work done (e.g. Littlewood, A. & M. Munro, 1996). There also appears to be a link with how long one has lived in the dwelling. People become progressively less responsive to the poor condition of their house the longer they live there. Older people are also progressively less likely to be involved in the housing market and so may become less concerned with resale values. Some studies also relate this type of behaviour with household income. Rechovsky and Newman (1991) state that although among older homeowners successive cohorts exhibit lower levels of home maintenance in general, an important underlying factor seems to be their income. Lower income groups cannot afford repairs or use prefer to use their money for other purposes.

These observations may negatively affect the decision to take energy-saving measures. As stated in section 2, one of the most important barriers to achieving a large-scale energy renovation of the existing stock is financing. Even with the recent increase in energy prices, the payback time is still considered too long by many homeowners. Besides that, the cost of improving the energy performance of a dwelling does not (proportionally) increase the value of the dwelling (Tuominen, et al, 2012). All in all, this could hinder the realisation of energy-saving goals of the EU member states.

However, future developments may not necessarily be entirely negative. Some research shows that when homeowners carry out maintenance work on their home, 'consumption-motivated' spending is frequently prioritised over 'investment–motivated' work (Munro and Leather, 2000). Energy-saving measures also tend to enhance the comfort of the living environment, and this 'consumption effect' should be emphasised as part of future energy-saving policies (instead of reductions in energy bills). Elderly homeowners in particular may be receptive to these arguments. Another positive factor could be that elderly homeowners (even though their income generally declines) are not heavily mortgaged and could find the money to enhance the comfort of their dwelling[6].

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[5] This could also have a positive effect. Due to the changes new housing and employment needs will occur. Conversions of vacant existing dwellings and other buildings could offer opportunities to realise high energy performance renovations.

[6] This is especially the case for those who bought their house before the credit crunch. Homeowners who bought their dwelling later may well face depreciation of the value their dwelling.

Predictions at the European level are difficult to make at this moment. What is clear is that these developments have to be taken into account and we need a better understanding of how they are could influence energy renovation in the next decades.

3. Effects on the construction industry

3.1 *General insights into the effect on jobs and skills through energy renovations in EU*

3.1.1 Introduction

Numerous European and nationally based studies have presented results concerning the number of jobs that may be created and the skills that are needed if all the opportunities for improving the energy performance of the European housing and building stocks are used to the full in the future. In § 3.2.1 this section the most important studies are named and cited. The main problem with these results is that in many cases they are widely divergent and that the underlying assumptions and parameters are unknown. This is mainly because the design of research into both the job creation effect and the skills needed for the transition to a lower-carbon economy at the EU level is complex. One has to take account of differences in the availability of data and other information, differences in institutional frameworks between member states, differences in the construction sectors, industries and occupations within and between member states, differences in labour productivity and existing skills, differences in education levels and training practices, and differences in research questions and priorities between countries and research projects (e.g. ILO, 2011-a).

Several methodologies are available to determine job creation and skills analysis (e.g. ILO, 2012-a; Energy Efficiency Industrial Forum, 2012).

- Macroeconomic studies. There are several approaches to macroeconomic analysis. Input-Output models, Social Accounting Matrix (SAM), Dynamic Social Accounting Matrix (DySAM) and computable general equilibrium (CGEM) models, these approaches may all be appropriate depending on the context. According to the Energy Efficiency Industrial forum (2012), Input-Output models are usually applied for top-down forecasting of the employment impact of medium- and large-sized investment, including energy-efficiency investment. However, Input-Output models have been criticised because of the number of implicit assumptions underlying the calculations. Computable general equilibrium models (CGEM) are capable of exploring the relationship between sectors, consumers and the government and of modelling the more complex dynamic effects of climate policies for a range of macroeconomic parameters, including employment.
- Sector-specific studies. A wide variety of approaches to quantitative modelling are used at the sector level. They usually begin with a qualitative analysis to identify the main factors likely to drive employment in a certain direction in the future.
- Analyses of occupations, skills; training and education. Methodologies to research occupations, skills (etc.) involve quantitative modelling or qualitative research. Some questions can be answered purely through quantitative research. However, in

almost all cases, research involving quantitative modelling requires data and contextual information that is not available from standard statistical sources, and so has to be obtained through qualitative research.

3.1.2 *Job creation*

This section begins with a summary of the estimates made by a range of research projects relating to the number of jobs that could be generated if the energy-saving goals for the building and/or housing stock are attained. A distinction is made between data on the absolute number of jobs and the number of jobs that are related to investing in improving the energy performance of the building and housing stocks.

Total new jobs

The EPBD was introduced in the EU in 2003. Members of the European Commission research staff concluded at that time that between 280,000 and 450,000 jobs could be created by 2020. Particularly among energy auditors and certifiers, inspectors of heating and air-conditioning systems, in the construction sector and in industries that produce materials, components and products needed in order to improve the energy performance of buildings (BPIE, 2012).

Comparing this cautious initial forecast with the Commission's latest expectations, we can see that expectations have risen very rapidly. In 2012, the EC published a Consultation Paper which takes the necessary investment as the starting point for its calculations (EC, 2012). The paper states that the total investment needed to reach the maximum energy reduction potential of the building sector is approximately €587 billion over the period 2011-2020, i.e. around €60 billion per year. Nonetheless, according to the EC this amount of €60 million is a minimum level of investment because they adopted a very conservative approach to identifying the potential for savings and the investment needed to achieve it. This approach was attributed to the high degree of uncertainty in the field. The French Ministry for Ecology, Energy, Sustainable Development and Spatial Planning has estimated that for every €1 million of investment in property-related thermal renovation, *14.2 jobs* are created or sustained in the field of energy performance-related work (L'Union Social pour l'Habitat, 2011). If we apply these numbers to the need for investment that was identified, €60 billion per year, this would result in the creation or retention of around *850,000 jobs per year in the EU* (EC, 2012). The European Commission study entitled 'Doing More with Less' (2005) argued - as a rough rule of thumb – that efficiency gains of 1% per year over a ten-year period could lead to over two million person-years of employment. The investment required to save 20% of EU energy consumption in buildings could create up *to 1 million direct and indirect jobs* in Europe according to this study (EC, 2005).

The European Commission (EC, 2011-b) has stated, however, that currently about 1.1 million qualified workers are available, while it is estimated that 2.5 million will be needed by 2015. This means the creation of 1.4 million new jobs between 2011 and 2015.

These numbers are also closer to those of the United Nations Environment Programme (UNEP), which concluded in its 2011 Green Economy Report that "investments in improved energy efficiency in buildings could generate an *additional 2 to 3.5 million jobs in Europe and the United States* alone". It is unknown what assumptions these calculations are based on and what the breakdown is between Europe and the USA.

Investing in new jobs

Most studies relate the possible growth in employment to the investment that is needed to realise energy savings. The UNEP study from 2008 on possible effects on job creation in Europe (UNEP. 2008) links jobs growth not only with investment, but also with the energy savings realised per petajoule. Early German studies have calculated that 100 new jobs were created (in the early 1990s in Germany) per petajoule energy saving. Other studies in the late 1990s in Europe and North America also reported a net increase in jobs, but kept the figure closer to 40–60 new jobs per petajoule of primary energy saved. The explanation for this decrease in jobs per petajoule of energy saved was, according to the report, increased labour productivity.

The 2008 UNEP report attributes job creation mainly to investment. In 2000, a British study looked at 44 energy-efficiency investment programmes in nine EU countries and determined that for every €1 million spent by energy-efficiency programmes in the residential sector, *11.3 to 13.5 full-time equivalent jobs* were created. These jobs were mainly related to the installation and delivery of new efficient materials or equipment, but some were also in management, administration, auditing, and research and development.

We have also already mentioned the results of French research (L'Union Social pour l'Habitat, 2011) that estimated that for every €1 million of investment in (property-related) thermal renovation work, *14.2 jobs* are created or maintained in the field of energy performance-related work.

The Green Jobs Initiative in cooperation with International Institute for Labour Studies (2012) also finds that investing in the energy efficiency of the housing stock can have a significant and immediate impact on employment. According to this study, a number of US and EU projects present a relatively conservative number of twelve direct and indirect jobs for every $US1 million spent. Converted into euros (exchange rate September 2012) shows that for every €1 million spent, *15.7 jobs* can be created. Some other cases in other countries are presented but it is unclear what assumptions lie behind the calculations. What is clear, however, is that the job effects (resulting from an investment of €1 million) can vary greatly between countries. In certain countries in eastern Europe, far more jobs can be created with €1 million than in the west of Europe. This demonstrates the important (and uncertain or difficult to measure) effect of factors such as the average cost of labour and labour productivity.

The Energy Efficiency Industrial Forum (2012) presents the most promising picture. Their research states that on average, investing €1 million energy efficiency for buildings would create *19 new local and non-transferable jobs* in the construction sector. It is not known how 'local and non-transferable jobs' relate to the jobs mentioned in other studies. According to this source, EU policy makers can rely on this 1 to 19 calculation factor when formulating new policies. However, it is also acknowledged that this number can vary when assessing the potential for job creation in individual member states.

A longer-term assessment of the impact of the EPBD was carried out by the Buildings Performance Institute Europe in 2012. This comprehensive review (BPIE, 2011) of the impact of energy-saving building renovation on employment in Europe and North America was undertaken by the Centre for Climate Change and Sustainable Energy Policy at the Central European University in Hungary (Ürge-Vorsatz, D. et al. 2010). On average, the studies show that *17 new jobs* were created for every €1 million of expenditure at today’s prices. This number is based on a local study in Hungary.

A recently published study from Copenhagen Economics (Næss-Schmidt et al, 2012) has calculated that the energy renovation of the European building stock could lead to 760,000 to 1,480,000 new jobs[7]

All the studies above are summarised in tables 3.1 and 3.2.

Table 3.1 Total numbers of jobs created by energy renovations in the housing stock

Total jobs **Source/year**	**new jobs**	**period/year**	**sector**
EC (2003; in BPIE, 2012)	280,000 to 450,000	2020	buildings
EC (2005)	1,000,000 direct and indirect jobs	2005-2015	buildings
EC (2011-a)	1,400,000	2011-2015	buildings
EC (2012)	850,000 (per year)	2011-2020	buildings
Næss-Schmidt et al. 2012)	760,000 to 1,480,000	2012-2020	buildings

Sources: various.

Table 3.2 Numbers of jobs created by energy renovation of the housing stock per €1 million investment

Jobs/€1 million **Source/year**	**new jobs**	**period/year**	**sector**
UNEP (2008)	11.3 to 13.5 full-time equivalent jobs	2000	residential
L'Union Social pour			
l'Habitat (2011)	14.2 jobs in thermal renovation	2011	property
related			
ILO (2012)	15,7 direct and indirect jobs	2012	housing
stock			
EEIF (2012)	19 new local and non-transferable jobs	2012	construction
stock			
BPIE (2011)	17 new net jobs	2010	construction
stock			

Sources: various.

7 According to Copenhagen Economics these jobs will to a very large extent be ‘new jobs’ at a time of economic underperformance. In fact, these jobs are likely to remain in the energy efficiency sector. However, as the economy returns to it structural level, there will be no positive effect on total employment in the economy.

The BPIE has used the average of 17 new jobs (Hungary) to construct scenarios for the possible pathways for building renovation in Europe, the energy savings and the jobs that could be created. It is not clear whether this average of 17 new jobs is representative for the average EU member state, but the construction of the model and the assumptions it makes are robust. Besides that, it is the only realistic model that goes into the possible effects of job creation that may result from implementing energy-saving measures in the building sector.

The positive effect on jobs in the study of Ürge-Vorsatz et al. (2010) has been calculated by taking account of:

- direct effects through the creation of new jobs in the construction industry;
- indirect effects in the supply sectors of the construction industry;
- induced effects: savings caused by the decrease in energy consumption, plus additional consumption because additional are being jobs created, will generate additional benefits to employment

On the other hand, jobs will be lost in the energy sector because of the reduction in energy consumption. Figure 1 shows how the net effect on jobs has been calculated[8]:

Figure 3.1 Calculating the net effect on jobs, Hungarian/BPIE study

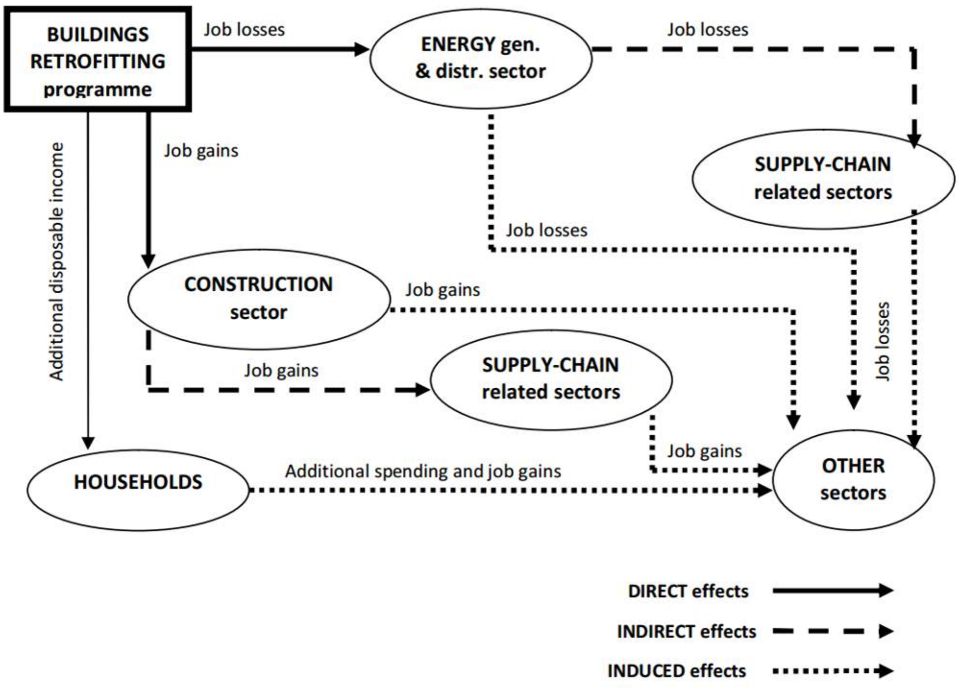

Fig. 1-1: Chain of effects on employment of the proposed intervention

Source: Ürge-Vorsatz et al (2010).

[8] The study applied a 'mixed' approach to calculate the net employment effects.. The estimation of the direct effects in the construction sector is derived from a number of case studies. For indirect and induced effects, the Input-Output method has been used.

In their model, the BPIE recognises the three main variables that influence the future pathways for building renovation: namely the rate, extent and cost of renovation work (see section 2.2). The BPIE's ambition is to see all EU buildings renovated between now and 2050. In order to achieve 100% renovation within these 40 years, an annual average renovation rate of 2.5% needs to be achieved (which – as stated in section 2.2 – is approximately 2.5 times faster than the current rate).

The main variables included in the BPIE model are the rate at which renovation activity may accelerate and the potential peak renovation rate. The BPIE model proposes three main growth patterns: slow, medium and fast[9]. These growth patterns are benchmarked against a baseline which assumes that the current renovation rate remains unchanged over time. In the absence of accurate figures for the extent of renovations currently being undertaken, the BPIE assumes the split that was mentioned in section 2.2 (85% of total renovations are minor, and so on). Based on these assumptions, the following options for the future renovation paths are outlined.

- Shallow renovation path: minor renovations continue to make up the bulk of renovation activity over the next two decades, and will still account for 25% of activity by the middle of the century. Moderate renovations grow steadily over this period, reaching 50% of total activity by 2050. Extensive renovations grow more modestly, achieving only 25% of total activity by 2050. nZEB activity continues to be negligible.
- Intermediate renovation path: minor renovations continue to be most common for the next decade, but fall away so that, by 2030, they are just 5% of the total, continuing at that level thereafter. Extensive renovation grows to 65% of activity by 2050, while nZEB renovation also grows, reaching 5% of all renovation projects by 2050. The remainder are moderate renovation projects.
- Extensive renovation path: by the end of this decade, extensive renovation work has become the dominant activity and remains so until 2050. nZEB renovation projects accelerate from 2020 onwards, such that they account for 30% of the total by 2050, by which time both minor and moderate renovation work will account for just 5% of the total each.
- Two-stage renovation path: in this fourth renovation path, some properties are renovated twice, but according to different standards. Properties that undergo minor or moderate renovation between 2011 and 2030, with new windows and heating systems for example, are then upgraded 20 years later, to extensive or nZEB standard. This scenario is the same as the Medium scenario until the year 2030.

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9 Fast pathway: a rapid increase in the rate of renovation over the next 5 years, to 2016, followed by a constant renovation rate of just under 2.6% for the remainder of the period to 2050, a total of 34 years.

Medium pathway: steady growth over the next decade to reach a constant rate of around 2.7% p.a. by 2022. This renovation rate is then maintained for 28 years, until 2050.

Slowest pathway: renovation activity grows slowly but steadily year on year from 2011, achieving just under 4% p.a. by the year 2050

Subsequently, the BPIE explores six scenarios under which the renovation of the European building stock could evolve over the next 40 years. These scenarios are derived from combinations of the renovation rate and renovation pathways, as well as two decarbonisation rates.
The table 3.3 summarises the results.

Table 3.3 Results of the BPIE scenario analysis'

Scenario Description		**0 Baseline**	**A Slow & Shallow**	**1B Fast & Shallow**	**2 Medium**	**3 Extensive**	**4 Two-stage**
Annual energy Saving in 2050	TWh/a	365	1,373	1,286	1,975	2,795	2,896
2050 saving as % of today	%	9%	34%	32%	48%	68%	71%
Investment costs (present value)	(€ bn)	164	343	451	551	937	584
Savings (present value)	(€ bn)	187	530	611	851	1,318	1,058
Net saving (cost) to consumers	(€ bn)	23	187	160	300	381	474
Net saving (cost) to society – with externality	(€ bn)	1,116	4,512	4,081	6,451	8,939	9,908
Net saving (cost) to society – incl. externality	(€ bn)	1,226	4,884	4,461	7,015	9,767	10,680
Internal Rate of Return	IRR	10.1%	12.4%	11.5%	12.5%	11.8%	13.4%
Fast decarbonisation							
Annual CO_2 Saving in 2050	$MtCO_2/a$	742	821	814	868	932	939
2050 CO2 saved (% of 2010)	%	71.7%	79.3%	78.6%	83.8%	89.9%	90.7%
CO_2 abatement cost	€/tCO_2	-20	-74	-68	-103	-136	-151
Slow decarbonisation							
Annual CO_2 saving In 2050	$MtCO_2/a$	182	410	391	547	732	755
2050 CO_2 saved (% of 2010)	%	18%	40%	38%	53%	71%	73%
CO_2 abatement cost	€/tCO_2	-89	-196	-185	-221	-238	-255
Average annual net jobs generated	Mln	0.2	0.5	0.5	0.7	1.1	0.8

Source: BPIE, 2011.

We can see that if we continue with 'business as usual', the employment effect of investing in the energy efficiency of Europe's building stock would be the creation of fewer than 200,000 people over the next 40 years, while the accelerated renovation scenarios would generate between 500,000 and over one million jobs. The 'employment' figures relate to the annual number of net jobs. These are direct jobs. This means for instance that scenario 3 leads to the creation of 1.1 million direct jobs per year on average for 40 years. This is broadly equivalent to employing 1.1 million people for their full working life.

As stated in the introduction, it is possible to argue that job creation should be the main motivation for investing in the energy efficiency of the European building stock, and that achieving energy-saving goals could be seen as a very important corollary effect. A recent study by Copenhagen Economics is of interest in this regard (Næss-Schmidt et al, 2012). One of the main findings of this study is that the energy savings resulting from the renovation of the existing building stock make this course of action one of the most attractive and low-cost options, and the view of Næss-Schmidt et al. is that the time to act is now. This would not only yield permanent benefits (e.g. energy saving, improving indoor air quality, and reducing greenhouse gas emissions), but would also produce a much-needed economic stimulus in times of recession. Besides that, the current high rate of labour redundancy and record low real interest rates in a number of member states would also help. Additional benefits would be a reduction in spending on government subsidies, improved health of citizens because of the reduction of air pollution and a better indoor climate, both of which mean fewer hospitalisations and improved worker productivity. The study by Copenhagen Economics suggests a monetised permanent annual benefit to society of €104-175 billion[10] in 2020, depending on the level of investment made in the period 2012 to 2020:

- €52-75 billion saved through lower energy bills;
- €9-12 billion saved through the benefits of reduced spending on subsidies and reduced air pollution from energy production;
- an additional €42-88 billion per year if the health benefits from improved indoor climate are included.

If investment is continued after 2020, these annual benefits could double by 2030.

If these actions are undertaken, between 760,000 and 1,480,000 jobs would be created and boost GDP by between €153 billion and €291 billion depending on the level of investment. These benefits would stem from increased economic activity in both the primary affected sectors and through the indirect impact on secondary sectors. These benefits would not be permanent, but rather 'one-off' benefits from stimulating activity in a period of 'economic underperformance'.

Speeding up the recovery over the coming 3-5 years with continued projections of substantial overall unemployment will also have a direct impact on public budgets. In the period 2012 to 2017, we estimate that public revenue could be boosted by between

10 These results include a rebound effect of 20 per cent.

€67 billion and €128 billion depending on the scale of investments. These benefits would come about through increased receipts from income tax, corporation tax, and sales tax, and from reduced spending on unemployment benefits. They would not be permanent, but rather 'one-off' benefits derived from stimulating activity in a period of economic underperformance.

The need to undertake immediate action seems as clear as the potential benefits. The main question however is: will the necessary steps actually be taken? According to Copenhagen Economics, four steps are needed to overcome the existing barriers:

- Rent regulation should be modernised to allow landlords and tenants to split the gains from energy efficient renovation of buildings; this could be done with minimal direct costs to public finances.
- Budget management of publicly owned buildings should be reformed to allow for a longer-term focus on investment and renovating buildings; this will reduce longer-term operating costs for the publicly owned building stock.
- Tax advantages for heating and electricity use in buildings should be removed or reduced to make energy efficient renovation of buildings more attractive, and provide direct net revenue gains to public budgets.
- Risk-sharing programmes should be designed to help governments as well as owners of private buildings to realise cost savings with very limited budget costs.

These actions could certainly help to give a push in the right direction. It is questionable, however, whether all these barriers will be addressed.

3.2 *Skills and qualifications*

WP4 ("Green jobs and green skills") of the NEUJOBS project WP4 is going to produce scenarios of training and education requirements for the upgrading, anticipation and matching of new skills. WP4 also examines what needs to happen for the current training and education systems to adapt. The concept of 'skills' expresses the general educational level of the economically active population. A lot of attention in European Studies is going into the question of an upgrade of skills (especially of younger people) can have positive effects on the employment rate in the EU (this in the view of the rising unemployment figures). Also many studies focus on the question if the supply and demand of skills in the future will still be geared to one another. The educational growth of the working force will continue, but how does this relate with the needs of the demand side?

In this section focus lies on the skills necessary for the transition from new built construction to energy renovation of the housing stock. The International Labour Organization has carried out some studies in this area. First of all, we need to answer the question of which methods can be used to identify which skills are required to achieve low-carbon goals (ILO, 2011-a). Although there is hardly any quantitative data available, the ILO's study can be used to comment on the future effects on the construction industry. Shortages of skills in general are regularly identified as one of the major obstacles to the implementation of energy-saving strategies (ILO, 2011-a). Lack of skills may impede implementation, slowing down the whole process, making it less efficient, driving up costs, and reducing or eliminating the environmental benefits. Although training in green building skills has increased over recent years, employers still face difficulties in finding qualified people to undertake certain jobs. In the case of green building, the main reason for labour shortages is that skill requirements change as green building technologies and practices are introduced or changed, so that previously satisfactory skills sets are no longer adequate. Labour shortages can also come about because there are not enough people interested in working in a particular area, or because of inadequate training that makes it difficult for those who are interested to attain the necessary skills.

The Green Jobs Initiative, in cooperation with International Institute for Labour Studies (2012), points out that although reliable data on the 'green skills gap' is sparse, the data available suggests a huge challenge. To give an indication, in France it is estimated that 20,000 workers need to be found each year; 15,000 for the rise in construction and renovation activities and 5,000 for new requirements relating to renewable energy in construction. Moreover, about 500,000 workers need to be trained before 2013 in order to respond to new requirements in energy-efficiency audits, control of energy performance and compliance to building regulations. In a report from the European Centre for the Development of Vocational Training, (CEDEFOP, 2012) one of the conclusions is that green career opportunities and raising the status of green occupations should be prioritised.

In 2011, the International Labour Organization published a research brief (ILO, 2011-b) in which the study Skills and Occupational Needs in Green Building (carried out with the EU and covering over 30 countries worldwide) is summarised. The research brief concludes – contrary to studies mentioned above – that although green construction involves new construction techniques, most roles can still be filled by skilled workers from existing occupations. Nonetheless, many workers require a skills upgrade (electricians, for example, should be able to install photovoltaic solar panels). The impact on skills needs can also be quantitative (e.g. more retrofitting may well require an increase in the total number of trained carpenters). Besides that, the ILO concludes that 'soft skills such as environmental awareness, innovation and leadership are crucial too'. There will also be need for people who can carry out 'new' jobs. For instance, the new occupation of energy efficiency analyst and or energy auditor is emerging in many countries and is expected to assume an even more prominent role (Strietska-Ilina et al. 2011). It is also expected (e.g. ILO, 2011-b) that a large number of workers will be affected indirectly by the changes in the demand for skills. For instance, a European initiative to train and qualify green construction workers estimated that over 2.5 million workers across the EU-25 will require training between 2006 and 2015 (Williams et al. 2010). But as green construction becomes more mainstream, the ILO (2011-b) argues that the skills of all those working in the area will have to undergo some kind of transition to some extent. It will therefore affect a much greater number of workers: in the EU-25, for instance, about 16.7 million workers in related occupations are estimated to be affected (ILO, 2011-b).

Almost all governments in EU member states are developing and implementing policies and incentivising progress on green construction techniques. However, in many cases these initiatives lack a training component (ILO, 2011-b; Cedefop, 2012). The most appropriate method of developing training and education for green construction depends on the particular occupations being targeted – it makes a difference whether one wishes to train planners and designers or personnel for product manufacturing and installation. The ILO (2011-b) distinguishes six occupational clusters relating to green construction. The distinction is fairly arbitrary but the main message is that in every cluster, attention should be paid to the curriculum, training on the job and how skills and qualifications are going to be checked (e.g. certification schemes)[11].

All in all, the ILO's findings (ILO, 2011-b) lead us to general recommendations such as: include skills when developing green building initiatives, consider skills-led strategies for green building policies, provide general skills for manual occupations, look at skills beyond the construction sector, prioritise green building in the provision of construction-related training and education, provide more and better training in assessment, advice and quality assurance and engage social partners. According to The European Commission (EC, 2011), there is also a lack of appropriate training for architects, engineers, auditors, craftsmen, technicians and installers, notably for those involved in refurbishment. Today, around 1.1 million qualified workers are available, while it is estimated that 2.5 million will be needed by 2015 (see also table 3.1).

To accommodate this lack of qualified workers, the Commission has launched the 'Build up Skills: Sustainable Building Workforce Initiative' to support member states in assessing training needs in the construction sector, developing strategies to meet them, and fostering effective training schemes. This may subsequently lead to recommendations for the certification, qualification or training of craftsmen. The Commission will work with member states to adapt their professional and university training curricula to reflect the new qualification needs (e.g. see section 3.3.1).

Besides the general arguments leading to the formulation of new or changing skills, we can also learn from some research projects that have assessed the performance of buildings. More and more projects are being carried out to assess the actual energy performance of new or renovated dwellings (Guerra Santin, 2012; Visscher et al, 2011). As stated elsewhere in this working paper, it appears that actual energy use in very energy-efficient dwellings is often higher than expected when consumption is calculated theoretically. This can be explained partly by the 'rebound effect' and the behaviour of the user. But another important explanation is that the dwellings and the building services do not perform as well as expected. There is much evidence of inaccurate workmanship, faults and failures in the house construction and renovation chain. Energy-efficient buildings also rely on efficient ventilation systems. It has already been concluded that these requirements are not currently being met in practice,

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[11] The following 6 clusters are identified: 1) conceiving, planning, designing and advising; 2) construction, installation and maintenance; 3) controlling; 4) enabling occupations: 5) manufacturing and distribution; 6) clients

let alone the high-end performances needed for nZEB. If higher quality is higher, the effects of small mistakes can have many effects. This must lead us to conclude that achieving the highest performances will require (far) better-educated and better-trained construction workers (including fitters, electricians, etc.)

All in all, a great deal remains unknown. There is mixed evidence for employment trends in 'green jobs'. The forecasting methods for determining jobs creation and skills require strengthening. In general, the existing studies show that there are some gaps in learning provision. New study schemes (all along the line) and on-the-job training are necessary.

3.3 *Understanding the effect on jobs in selected EU member states*

3.3.1 The Netherlands

In general, there are hardly any studies which help us to understand the effects on jobs and the skills required. Some Dutch studies (e.g. SEV, 2011) note that currently there is both insufficient supply and insufficient demand to make the 'energy leap' that is envisaged. However, if the intended goals are going to be attained, this will involve a considerable increase in employment in the construction sector (with innovative retrofits and new building concepts). This study does not quantify anything, but other studies shed more light on the possible effects.
The Economic Institute for the Construction Industry (EIB, 2009) has explored the effect that incentivisation policies in the field of house construction could have on the construction industry. These incentives aim partly at newly constructed houses and partly at existing dwellings. Two of the instruments studied relate to saving energy and the existing housing stock. The first focuses on a credit guarantee extended by the government to guarantee the risk on loans extended for energy-saving measures. The average investment is calculated at €10,000 and the expectation is that 100,000 owner occupiers will take up these loans. The calculated effects are shown in table 3.4.

Table 3.4 Effects of possible policy incentives in the Netherlands

	2009	2010	2011
Government contribution (€ million)	30	60	10
Investment (€ million)	300	600	100
Building production (€ million)	150	300	50
Employment (persons per years)	900	1,700	300

Source: EIB, 2009.

An investment of €150 million would lead to the creation of 900 jobs (or to be more precise 'years of employment'): an average of €166,667 of investment per year of employment. This means that investing €1 million in the existing housing stock would lead to six new jobs. In comparison with the job creation effects mentioned earlier (in section 3.1), this number is reactively low. When we analyse the effects of the second incentive (an Energy Investment Allowance to improve the energy performance of rental dwellings), we see the same outcome. An annual investment of €250 million will yields 1,500 years of employment (6 jobs per €1 million investment).

To enhance the skills of construction companies, the *Meer met Minder* organisation (whose task it is to persuade building owners to implement energy-saving measures) has developed an online 'one-stop-shop', an educational programme and a system of registration for trades-people (the 'MmM Suppliers'). These suppliers have undergone practical training in the measures that could be taken to improve the energy performance of a building and subsidy schemes that could be important. The fact that these training programmes are necessary seems to indicate that practical skills are not completely up-to-date. As part of the framework of the European 'Build-up Skills Programme' (see section 3.2), a project has been started in the Netherlands to identify and define the knowledge and skills needed by workers in the construction and installation industry in order to realise national energy targets. The results of this project will be used to adapt the qualification structure and the current training and schooling programmes for construction workers, installers, contractors and so on. The project was only started recently, so no results are yet available.

3.3.2 Germany

Most of the German data can be found in evaluations of the subsidy schemes carried out by the KfW banking group (see also section 2.3.2). The employment effects are calculated by using an econometric input-output model. Table 3.5 presents the results of these calculations.

Table 3.5 Job creation from energy renovation according to latest evaluations of KfW subsidy programmes

Source/Report	Names of subsidy regulation	Person-years (direct and indirect) per €1m investment incl. VAT
Clausnitzer *et al.* (2008)	CO_2-Gebäudesanierungsprogramm 2007	16.5 (2005-2006: 18.3)
Clausnitzer *et al.* (2010)	CO_2-Gebäudesanierungsprogramm 2009 (as from April 2009: "Energieeffizient Sanieren")	16
Clausnitzer, Fette & Gabriel (2011)	• KfW-Kommunalkredit – Energetische Gebäudesanierung (2007-January 2009); • Energieeffizient Sanieren – Kommunen (2009 and 2010) • Sozial Investieren – Energetische Gebäudesanierung (2007- 2010)	13.5
Diefenbach *et al.* (2011)	• Energieeffizient Sanieren 2010 • Ökologisch / Energieeffizient Bauen 2006 – 2010	13.5
Diefenbach *et al.* (2012)	• Energieeffizient Sanieren 2011 • Energieeffizient Bauen 2011	13.5 13.7

Sources: various.

The additional employment created includes both direct and indirect jobs. The reports do not give a consistent picture of the share of the indirect employment in the total figure: Diefenbach et al. (2011) and Diefenbach et al. (2012) both mention a share of 27%, while Clausnitzer et al. (2010) 46% and Clausnitzer et al. (2011) put the figure at 28%. Contact with the authors has made it clear that these were gross employment effects. This means that possible job losses (due to the fact that money invested in energy renovation cannot be spent elsewhere) are not factored in.

The total amount invested in the table above includes sales tax. If this were to be excluded, the additional employment would be higher. Table 3.6 presents data for 2005 to 2009.

Table 3.6 Job creation from energy renovation according to evaluations of KfW subsidy programmes over the 2005-2009 period

Year	2005	2006	2007	2008	2009
person-years (direct and indirect) per €1m investment excl. VAT	21.2	20.3	19.6	18.9	19.0

Source: Clausnitzer *et al*., 2010.

Table 3.6 shows a slightly downward trend, which stopped in 2008. According to Clausnitzer et al. (2010), the credit crisis, which has resulted in less (paid) overtime per employee, is an important factor in explaining this change.

The results of the KfW evaluations can be compared with an earlier study carried out by the London-based ACE (2000). ACE investigated the employment effects of 44 energy-efficiency investment programmes. As with the KfW studies, input-output models were used. The overall outcome was that for every million euros spent (both by the government and the private sector) on energy-efficiency programmes, 8 to 14 additional person-years of employment were created. Further, 38 of these 44 programmes generated additional employment (see also Guertler & Smith, 2006). Another remarkable conclusion, however, is that the CO_2-reduction programme evaluated by KfW produced a net loss of employment. Two reasons are given in the report. Firstly, renewable energy is more expensive than energy from fossil-fuel sources, leading to a loss of purchase power. Secondly, KfW loans depend partly on financial support from the government, which means that money cannot then be spent on more labour-intensive activities. It is possible that these aspects were not factored into the German KfW evaluations, which may account for the difference in the results. Nevertheless, this illustrates the weakness rather than the strength of the KfW study. As for the first reason proposed by ACE: their report was published in 2000, the average price of energy from fossil-fuel sources has increased more quickly than the price of energy from renewable sources, and this trend is expected to continue in the future. Also, energy renovation work leads to lower energy demand for heating and cooling, so it involves an absolute reduction in the amount of energy required, rather than simply a switch from fossil to renewable energy. As for the second reason given in the ACE report: the research on the qualitative aspects of job creation through energy renovation (see below) shows specifically that labour-intensive employment is created. The two studies also give a qualitative indication of the employment effects of investing in energy renovation. Most jobs are created in small firms. The KfW evaluation reports found the following data (see Table 3.7a and b).

Table 3.7a Direct and indirect employment effects according to sector

Source/Report	Small and medium-sized enterprises (SMEs)[12]*	Large enterprises
Clausnitzer *et al.* (2010)	77 %	23 %
Clausnitzer, Fette & Gabriel (2011)	82 %	18 %
Diefenbach *et al.* (2011)	82 %	18 %
Diefenbach *et al.* (2012)	83 %	17 %

Sources: various.

Table 3.7b Direct and indirect employment effects according to position in the company

Source/Report	Employees	Self-employed and assisting family members
Clausnitzer *et al.* (2010)	85 %	15 %
Clausnitzer, Fette & Gabriel (2011)	83 %	17 %
Diefenbach *et al.* (2011)	84 %	16 %
Diefenbach *et al.* (2012)	83 %	17 %

Sources: various.

These findings are similar to those of ACE (2000), which gives the following figures for three German energy renovation programmes: 72% manual employment in manufacturing, 85%skilled manual work for small local firms and 87% blue collar skilled work in small local firms.

Not surprisingly, most of the jobs created are in the construction sector. Clausnitzer, Fette & Gabriel (2011) present the following additional employment data per sector for Germany (in person-years):

- 52% building industry ("Bauwirtschaft");
- 26% services related to building industry ("unternehmensbezogene Dienstleistungen");
- 3% commerce/wholesale ("Handelsvermittlung/Großhandel");
- 3% manufacturing of metal products ("Herstellung von Metallerzeugnissen");
- 16% other.

These findings accord with those of Lutz and Meyer (2008). They predict a positive employment effect of 33,500 person-years by 2020, if a subsidy investment of €700

12 SMEs are companies that have less than 500 employees and less than €50m turnover per year (Diefenbach et al., 2011).

million per year were made. According to their calculations, the construction sector and related services would particularly benefit from that investment. Lutz and Meyer state that the investment would result in a loss of employment in some other sectors, but that these negative effects are minimal.

To summarise, we can conclude that in Germany, investing in the energy renovation of buildings would lead to a positive employment effect, but that these effects may vary over the years, with small and medium-sized firms in the building sector benefiting particularly from this kind of investment.

3.3.3 United Kingdom

There are a number of reports that aim to estimate the job-creation effects of improving the energy efficiency of the UK housing stock, and they vary in the number and type of jobs and the time period over which these jobs would be created or sustained.

The Department of Energy and Climate Change (2011-c) estimates that the energy-efficiency industry supports around 75,000 manufacturing jobs in the UK. However, it adds that most of these jobs are in the production of double-glazing materials, and there are only a few thousand UK jobs in the manufacture of insulation materials. This number was predicted to rise to about 10,000 jobs in insulation installation by 2010, up from 5,000 in 2005. Around half of these were loft insulation installers, with cavity wall installers being the next largest category. However, it is not clear whether these are direct, full-time jobs.

Stakeholders in the insulation installation industry agree that the CERT programme (explained in section 2.3.3) has had a positive impact on jobs, especially in the growing insulation market. Jobs include assessors and surveyors as well as installers. Others were created in the manufacturing of double-glazing, minerals and other insulating materials. However, according to some installers interviewed, the insulation market is very competitive, margins are small and wages are relatively low. Stakeholders in the insulation and installation industry say the stop-start nature of the CERT programme gives rise to problems. The demand for energy-efficiency measures fluctuates with the seasons, resulting in the hiring and firing of staff according to this demand. Skills are lost as people are made redundant and new staff needs to be trained again as the market picks up again.

To provide the number of jobs required to meet carbon budgets, the number of workers who install external and internal wall insulation will need to increase over the next ten years, according to EEPH /CPA (2012). The current number of trained operatives is around 2000. This installation rate needs to increase at least ten-fold over time. It is estimated that the Green Deal will require between 8,000 and 10,000 installers. The DECC is working with the National Insulation Association, INCA and others to ensure that an appropriate training infrastructure is in place and that the 1000 Green Deal apprenticeships announced in the Budget 2011 can be fully utilised. Research by various government departments (DBIS, DECC and DEFR) (2011) estimates that the Green Deal alone could see employment in the insulation sector grow from 27,000 (2011) to 100,000 in 2015 and 250,000 by 2025. But, according to a more recent press release (DECC, 2012) the Green Deal and ECO policies will support up to 60,000 jobs in the insulation sector alone by 2015, up from around 26,000 today. This is a much lower number (40,000 less) than estimated in 2011.

As mentioned, the market supports around 75,000 manufacturing jobs, most of which are in the manufacture of glass and double glazed windows and doors. It is more difficult to assess the number of jobs supported in the installation market because many energy-efficiency measures are installed as part of larger renovation or extension projects, making it difficult to attribute a particular proportion of domestic construction jobs to energy efficiency. Because windows and energy-efficient boilers typically have the same installation process as energy-inefficient models, no special skills are necessary (DECC, 2011-b).

To improve the energy efficiency of the UK housing stock, the Energy Savings Trust (2011) proposes measures on three ambition levels:

- Level 1: loft and cavity walls insulation on national and regional level.
- Level 2: Insulation plus boiler replacement.
- Level 3: advanced refurbishment.

In addition to the impact of these measures on carbon emissions, the expected direct and indirect benefits for the economy are listed. The direct benefits include the immediate impact on the economy resulting from households installing micro-generation technology or energy-efficiency measures. Indirect effects include supply-chain spending, spending money that has been saved on fuel bills and employee wages.

Table 3.8 shows the numbers presented.

The term 'jobs supported' relates to the number of jobs (in FTE) that would need to be filled over the course of a year in order to complete the work. A proportion of these jobs – particularly those involving the manufacture and assembly of low-carbon products – would have to be located overseas. According to the report, the larger the scale of British green refurbishment investments, the greater the opportunity for British industry to strengthen its own manufacturing capacity and invest in local supply chains, thus bringing about a positive effect on jobs in the UK.

Table 3.8 Number of jobs supported and gross value added

Number of jobs supported	**Level 1**	**Level 2**	**Level 3 (advanced refurbishment)**
Cavity wall insulation	56,000	56,000	-
Loft insulation	44,800	44,800	-
Boilers	-	39,700	-
Total	100,800	140,500	4.7 million
Gross value added	**Level 1**	**Level 2**	**Level 3**
Cavity wall insulation	£2.2bn	£2.2bn	-
Loft insulation	£2.4bn	£2.4bn	-
Boilers	-	£2.0bn	-
Total	£4.6bn	£6.6bn	£280 billion

Source: Energy Savings Trust, 2011.

Improving the energy efficiency of the building stock will involve both traditional and new building skills. In the report by the DBIS, DECC and DEFR (2011) on the skills needed in building services, engineering and property management, it was concluded that in-depth specialist training for installation is not always required, because traditional building skills can frequently be adapted to energy efficiency renovation very easily. However, the renewables sector would benefit greatly from general up-skilling in the construction sector. Attracting high-calibre young people should be a priority. Specific training is needed for architects and planners concerning the impact of new materials on sustainability. On building products, coatings, extractive and mineral processing, research results suggest that re-skilling was important in carbon-intensive industries to prepare existing employees for new low-carbon, resource-efficient business practices. The whole of the construction sector is being affected by strict new building standards (i.e. BREEAM) and advanced building management systems, new sustainable construction methods, and facilities management and maintenance. New skills are needed in the following areas: environmental legislation targets; ecosystem services design and management; designing and managing multi-functional spaces; land use planning and development planning; developing and using computer-aided design and GIS; life cycle assessment/costing; carbon and water foot printing and so on.

3.3.4 Ireland

It was estimated that the additional €30 million in funding made available in 2011 by the Irish government for the new Better Energy: The National Upgrade Programme (see section 2.4.4), would support an extra 2,000 jobs in 2011 on top of the 3,800 jobs supported by the existing budget allocation of €60 million for energy efficiency in 2011 (DCENR, 2011). This implies that a €1-million investment would create 15 to 16 new jobs.

The Action Plan for Jobs (DJEI, 2012) states that the Irish government will invest €76 million in the Better Homes Scheme during 2012, which will support at least 4,500 jobs in the retrofitting of homes (here a €1-million investment leads to 17 new jobs).

The longer-term effects of the energy retrofitting of dwellings on jobs (up to 2020) depend mostly on how extensive the level of future energy retrofits will be. It is estimated by the SEAI (2010) that extensive retrofitting can increase the number of installation jobs in Ireland to as many as 10,000 per year to 2020. On-going energy-efficiency improvements and a wider roll-out of Low- or Zero-Carbon (LZC) technologies by 2050 could sustain high levels of employment over the period.

A recent analysis by the SEAI (2012) produced data on the jobs currently supported and the potential for the energy-efficiency sector by 2020.

Table 3.9 Jobs currently supported and potential for jobs in the energy-efficiency sector

	Jobs currently supported	Jobs potential in 2020	Basis
Upgrading residential building stock (Better Energy Homes)	4820	6890	Upgrading 100,000 homes per annum
Industry and business EE investments (incl. Better Energy Workplaces)	1020	2110	Investment in energy efficiency improvements via Government programmes and by large industry and SMEs estimated at €30m, growing to €50m by 2020
Smart Grid	30	1000	Smart meter deployment, some technology development occurs in Ireland.
Total	5870	10000	

Source: SAEI, 2012.

DKM Economic Consultants for the Society of Chartered Surveyors Ireland (2012) identifies labour immigration as a major concern for the construction industry. Because of the crisis and the drop in construction activity, many skilled construction workers, professionals and trades people left Ireland to find employment overseas. It is estimated that about 142,000 workers in the two years to April 2011 left the country, almost half of these being Irish nationals. According to the most recent numbers based on the last 12 months (the report was published in April 2012), about 60% of men leaving the country were Irish. This creates a problem in the form of a loss of skills, especially in design and construction. The report considers this to be an essential sector for the delivery of a high-quality infrastructure and a growing competitive economy focused on attracting foreign direct investment and competing on international markets.

The Action Plan for Jobs (DJEI, 2012) mentions some specific steps to be undertaken in 2012 for the construction sector including supporting 4,500 jobs in the green energy economy through retrofit grants programmes and other energy-efficiency initiatives.

It is expected that energy performance and regulations relating to efficiency standards will create employment opportunities for craft workers who have the skills to install renewable energy heating systems, ventilation systems and insulation. The report estimates that it is unlikely to see employment return to the levels recorded in the run-up to the peak before the crisis, creating a big challenge for the state when it comes to retraining and up-skilling those unemployed construction workers for work in the sectors that are expected to expand in the next phase of Ireland's economic recovery.

The government should, in partnership with the construction industry, take the following steps to improve knowledge and skills (DCENR, 2011):

- Use existing skills and increase capacity to enable the widespread deployment of energy-efficiency upgrades.
- Support R&D to bring about a step change in product costs, performance, and installation times.
- Develop training schemes and installation standards for installers, and those who assess energy-efficiency and LZC measures.
- Marketing and education activities relating to the long-term vision to residents by suppliers and new schemes.
- Promote further education and jobs in the energy sector.

3.4 *Summarising expected developments of the effects*

3.4.1 *Job creation*

Numerous studies have looked into the possible effects on job creation if the EU member states manage to achieve their energy-saving goals for the housing/building stock. Some studies (predominantly carried out by the EC) express the expected number of new jobs in total numbers. Varying from:

- 280,000 to 450.000 (2003-2020; EC, 2003; in BPIE, 2012);
- 1,000,000 (2005-2015; EC, 2005));
- 1,400,000 (2011-2015; EC, 2011-a));
- 850,000 (2011-2020; EC, 2012));
- 760,000 to 1,480,000 (2012-2020; Naess-Schmidt et al., 2012)).

The reasoning and assumptions behind these numbers is not always clear and there is clear divergence in their findings, although they presumably relate to the investment needed to realise the formulated energy-saving goals. What is clear without a doubt, though, is that the outcomes are substantially different.

The same applies to the job creation predictions relating to an investment of €1 million. In studies carried out at the European level, outcomes vary between 12 and 19 new jobs through energy renovation goals. In the case studies that have been carried out, the range is between 6 new jobs per €1 million investment (in the Netherlands) to 16/17 new jobs (in Germany and Ireland).

When interpreting these numbers, it is important to remember that many factors are involved. The necessary investment can be split into costs for raw materials, end-ready products and labour costs for design, engineering and on-site construction. This also affects jobs in the building products supply industry.

Not all jobs will be created in the country where the money is invested. If Europe chooses to install solar panels on a massive scale, producers outside the EU could reap a significant benefit from this.

Indirect jobs will also be created outside the construction industry. An important variable is the way employment effects are calculated: are they gross or net employment effects? Investment in energy renovation work may have a positive effect on employment in the construction sector but could at the same time impact negatively on investment in other sectors[13]. Other factors to consider are whether sales tax is included in the calculations and whether the positive effect of government revenues (e.g. tax, unemployment benefits) on new jobs considered?

Differences between EU member states also should be taken into consideration. The national institutional framework, the construction sector, the supply sectors, industries and occupations, labour productivity and existing skills, education levels and training practices all diverge between EU member states.

In a scenario analysis carried out by BPIE, an average of 17 new jobs per €1 million invested was assumed. On this basis, several pathways for the number of jobs created through building renovation between 2012 and 2050 were calculated. These ranged between:

- 200,000 new jobs (hardly any acceleration of the current rate and extent of the renovation work being carried out);
- up to 1,100,000 new jobs (with a very rapid acceleration).

The BPIE analysis appears to be a useful basis to predict the future development of jobs.

Besides these ‘new’ jobs created by energy renovation of the housing stock, the construction industry will also stay in need labour for to built newly built houses. Although the last decade the relative importance of newly built houses is only 1% of the amount of houses that has been already built, new houses will be built in the future. This and the expected growth of the maintenance and renovation sector will

[13] This impact could occur within the construction industry (e.g. a shift within in the heating installation sector from the production of traditional to sustainable heating appliances)), but it can also occur on a more general level. Simply based on the idea that € 1 invested in housing renovation (especially when part of it is government subsidy) cannot be invested anywhere else. This other sectors could lie outside the construction industry.

lead to an overall employment growth in the construction industry[14]. However this growth could be toned down by the current parlous state of the construction sector in many European countries following the economic and financial crises of recent years. Throughout the sector (designers, architects, construction firms, builders, etc.), employment is under threat and many workers have already lost their jobs (see section 3.3.4). At the same time, the housing market has ground to a halt in a number of EU member states. The number of newly built houses has declined dramatically in countries like the Netherlands. If this situation improves over the coming decade, parts of the growth in employment could be aimed at producing new-build houses (to stimulate the housing market again) and probably not directly at improving the energy performance of existing dwellings. But this in itself could stimulate the construction sector, especially the renovation of the existing building stock. Progress towards achieving the ambitious energy targets set for the existing building stock is lagging behind, while the potential for job creation could be huge. Measures taken to stimulate the energy renovation of the building stock to get the economy moving again will also improve the energy efficiency of the building stock as an important by-product.

3.4.2 Skills and qualifications

As the ILO states, reliable data on (the lack of) skills and qualifications is scarce within the EU. Nonetheless, shortages of skills in general are mentioned as an important bottleneck when implementing energy-saving strategies. This could lead to a slower, less efficient, more costly and less effective energy renovation process of the building stock.

The labour shortages have both qualitative as well as quantitative aspects. Studies state that employers still face difficulties in finding qualified people to undertake certain jobs in this field. One reason is that requirements change for existing jobs as new technologies and practices are introduced or changed. As the old skills are no longer adequate, new skills and qualifications are necessary. Another reason is simply that not enough people are interested in working in this field. This could be related with an inadequate training, but it also expresses the apparent lack of attractiveness of this type of work. In order to change this it is necessary to raise the status of green or sustainable occupations. In this respect it is commendable to pay attention to the further development of soft skills as 'environmental awareness' and 'leadership'.

The impact on the skills can also be quantitative (e.g. expansion of retrofitting may well require an increase in the total number of trained carpenters/solar panels installers, etc.). A more general observation is that renovation work (compared with new construction) is relatively labour-intensive and makes special demands on

[14] A factor that could be of influence (and is not analysed in this working paper) is the influence of the ageing population on the working population in the EU. WP10 of NEUJOBS deals with the evolution of the labour supply and labour demand. As stated before in this section population ageing in general will decrease the economic active population. This could also have consequences for the construction industry. Especially considering the fact that construction work draws heavily on the fitness and health of the workers in the construction industry (compared with other economic sectors).

craftsmanship. This means that the skills of construction workers without experience in renovation work need to be upgraded. Besides the up-skilling of existing jobs a range of new jobs and new skills is going to emerge. Highly energy-efficient dwellings also require a high level of workmanship and accuracy in the building process, which impacts on the skills needed. These new roles, such as energy-efficiency analysts and or energy auditors, require new staff with specialised skills.

Although new techniques, new practices and new roles are emerging, most roles can still be filled by skilled workers from existing occupations.

However, it is clear that many workers in the field of energy renovation will require some degree of up-skilling.

Currently there is a lack of appropriate training for architects, engineers, auditors, craftsmen, technicians and installers, notably those involved in refurbishment work. So the necessary up-skilling covers the complete range from low skilled to high skilled employees. If one wants that every occupation is geared to the new situation it is necessary to have a close look into the primary training of workers, the training on the job and the processes that safeguard that skills learned are applied adequately. In many member states and also at the European level, this is recognised and all kind of programmes have been launched to up-skill the workforce and enlarge the number of qualified workers available through training programmes, certification and qualification schemes.

4. Conclusions

4.1 Energy-efficiency goals

There are many good reasons to argue for a reduction in the use of fossil-fuel energy sources by reducing the demand for energy and switching from fossil to renewable sources. Buildings account for 40% of Europe's energy consumption and three-quarters of the floor area of the building stock is residential. Because the building sector is assumed to be the sector in which energy-efficiency measures can be adopted in the most cost-effective way, the EU has formulated policies that oblige member states to implement regulations and measures to improve the energy efficiency of their housing stock significantly. With the Energy Performance of Buildings Directive (EPBD; EC 2010), the EU has a direct influence on the energy-efficiency regulations and policies in the member states. Energy performance certificates must indicate the energy performance of dwellings. The directive also requires that nearly zero-energy requirements must be applied for newly built dwellings and dwellings that will be renovated at a cost of over 25% of their value.

All member states are convinced that the energy renovation of their housing stock will contribute substantially to reducing energy use and greenhouse gas emissions. As the case studies in this report show, many policies and instruments have been and are being developed to reduce the energy use of existing dwellings by renovating the existing housing stock.

4.2 Energy renovations

The construction of new houses is estimated at an average of 1% of the existing stock per year. This means that the housing stock – which is already old - will become still older in relative terms. By 2050, 75% of the housing stock will consist of dwellings that have already been built today. Realising that the energy performance of the current stock already could be greatly improved, this makes the need for swift action even more urgent.

To achieve energy-efficiency targets in this sector, large-scale renovation programmes will have to be carried out. The current average renovation rate in the EU is also estimated at not much higher than 1%. But even within this rate of 1%, the lion's share of the work carried out results in only marginal improvements in the energy performance of the dwellings. It is sometimes calculated at 3%, but this figure is made up mainly of superficial or minor improvements. The renovation rate must be tripled to realise the energy goals that have been set, and not only that: the extent of the renovations (the number and type of measures) should also be increased significantly.

Demand-side developments could influence the rate and extend of renovation work. In the decades to come, changes will occur in the size of the population, the household and population structure, the employment and economic situation and the housing market (transactions, vacancies, quality, etc.).

In this working paper we have argued that the demand-side developments could negatively affect the decision of home-owners to take energy-saving measures. Older owners are generally associated with much reduced willingness to maintain their dwellings. An additional (negative) factor could be the costs of the energy saving measures. This is one of the most important obstacles to realize a breakthrough in energy renovation of the existing stock. Many owners believe that the benefits of the measures do not outweigh the costs. Besides that, the cost of improving the energy performance of a dwelling does not (proportionally) increase the value of the dwelling. We have also pointed out that improving the energy performance of a building does not always result in the expected reduction in actual energy use (and subsequent reduction of CO_2 emissions). Actual energy use also depends largely on the preferences and behaviour of the occupants. On occasion, renovation work may have a lower impact on energy efficiency than expected.

A better insight is required into how these factors and developments may affect future energy renovation work. Within NEUJOBS these subjects are analysed in a range of Working Packages. Especially relevant in this respect will be the results of WP10, which deals with modelling the evolution of the labour supply and labour demand. Within the WP attention is paid to demographic scenarios that could be of influence on the modelling.

4.3 *Jobs related to energy renovation work*

If one takes the goals formulated for energy efficiency in this sector seriously, the consequences for additional investments and jobs could be immense. Calculations have been made that indicate about 1 million new jobs related to energy renovations in Europe in the period 2005-2015. Some have also calculated the number of jobs that can be created to an investment of €1 million. On average this figure is 12 to 17 new jobs per €1 million invested. The assumptions behind these numbers are not always clear and even where they are clear, they appear to diverge significantly.

When interpreting these numbers, one has to bear in mind that many factors have an impact. These are listed in section 3.4 of this working paper. The investment could be broken down into raw materials, ready products and labour costs for design, engineering and on-site construction. This also has an indirect effect on jobs, such as in the supply of products for the construction industry. In these supply sectors employment is expecting to grow. It can also be expected that there will be job losses. When less energy is used this probably will affect the sector that generates and distributes energy to the households. A link can be made here with WP11 ('Energy and Green Jobs') of the NEUJOBS project, which analyses on the one hand which energy sectors will benefit from the transition of European Energy Systems in terms of employment and, on the other hand, which ones will suffer from job destruction. Depending on the definition of 'energy sector', our paper suggests that especially the renewable energy industry will benefit from the transition. Not all these jobs will be created in the country where the investment is made, however. At the moment, energy-efficiency investment is increasingly going into photovoltaic panels. If these are imported from China, then a share of the investment will not create additional jobs in Europe.

We should also question the net effect on the labour market if more is invested this sector. Where will the money come from? Governments could equally decide to spend this money in other sectors, which might have more impact on the labour market. The same goes for individual homeowners. If they invest more in their house, this could lead to reduced spending in other areas[15].

It is more than likely that the trend towards highly energy-efficient dwellings will affect the kind of jobs and the skills required. The realisation of effective and efficient large-scale energy renovation will demand a certain level of education and skills of the construction workers.

Although there is hardly quantitative data available, reports analysed in section 3 state that it is sometimes difficult to find qualified people. The reasons for this can be found in the fact that new technologies and methods asks for new skills, but there also seems

15 We can refer here to WP9 of NEUJOBS which focusses on the combined impacts and mutual interactions of the social and ecological transitions on the European economies, including investment and consumption patterns, behaviour of firms, impact of globalisation and international competition. Scenarios are tested with different investments in different sectors.

to be a lack of interest to work in this sector. Although many jobs could be executed by skilled workers from existing occupations, it is clear that many employees in the field of energy renovation will require some degree of up-skilling. Renovation work in general makes more demands on labour intensiveness and craftsmanship than 'regular' construction work. This alone means that construction workers need to upgrade their skills. Highly energy-efficient dwellings also require a high level of workmanship and accuracy in the building process, which impacts on the skills needed. The impact on the skills needed, can also be quantitative (e.g. expansion of retrofitting may well require an increase in the total number of trained carpenters/solar panels installers, etc.). There will also be demand for staff that can carry out 'new' jobs. New roles, such as energy-efficiency analyst and or energy auditor, are emerging in many countries and more are expected to emerge.

All along the line, there is currently a lack of appropriate training for designers, engineers and construction workers, especially those involved in energy renovations. Member states and also the EC have recognised this and a wide range of programmes have been launched to up-skill the workforce and enlarge the number of qualified workers available through training programmes, certification and qualification schemes.

What one has to bear in mind though is that there is no European labour market. The skills of labour supply and demand and their developments vary widely between the member states. This means that both the upgrading of skills and training needed, will differ per country.

The need to drive down the demand for energy in the housing sector and to make the transition from fossil fuels to renewable energy is clear. Although the direct link between energy-efficiency goals and their impact on the labour market is hard to quantify, there can be no doubt that there will be a significant impact. The housing stock is old and we will have to continue making the best of it for many decades. Investment in quality improvements will be needed. From this perspective and in view of the current economic situation, it would seem wise to invest significantly in the renovation of the building stock in the short term. Investing in renovating the building stock could help drag Europe out of economic recession as well as generating significant, long-term and sustainable corollary benefits (e.g. reducing energy consumption, better indoor air quality and reduction of GHG emissions).

Acknowledgements

We would like to thank Eleni Goni from the Architects' Council of Europe (ACE), Nathalie Cliquot form the Executive Agency for Competitiveness & Innovation (EACI), Alice Franz and Riccardo Viaggi from the European Builders Confederation (EBC), Oliver Rapf and Dan Staniaszek from the Buildings Performance Institute Europe (BPIE) and Günther Gabriel from the Bremer Energie Institut for their time and effort.

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About NEUJOBS

"Creating and adapting jobs in Europe in the context of a socio-ecological transition"

NEUJOBS is a research project financed by the European Commission under the 7th Framework Programme. Its objective is to analyse likely future developments in the European labour market(s), in view of four major transitions that will impact employment - particularly certain sectors of the labour force and the economy - and European societies in general. What are these transitions? The first is the **socio-ecological transition:** a comprehensive change in the patterns of social organisation and culture, production and consumption that will drive humanity beyond the current industrial model towards a more sustainable future. The second is the **societal transition,** produced by a combination of population ageing, low fertility rates, changing family structures, urbanisation and growing female employment. The third transition concerns **new territorial dynamics** and the balance between agglomeration and dispersion forces. The fourth is **a skills (upgrading)** transition and and its likely consequences for employment and (in)equality.

Research Areas

NEUJOBS consists of 23 work packages organised in six groups:

- **Group 1** provides a conceptualisation of the **socio-ecological transition** that constitutes the basis for the other work-packages.
- **Group 2** considers in detail the main drivers for change and the resulting relevant policies. Regarding the drivers we analyse the discourse on **job quality**, **education**al needs, changes in the organisation of production and in the employment structure. Regarding relevant policies, research in this group assesses the impact of changes in **family composition**, the effect of **labour relations** and the issue of financing transition in an era of budget constraints. The regional dimension is taken into account, also in relation to **migration** flows.
- **Group 3** models economic and employment development on the basis of the inputs provided in the previous work packages.
- **Group 4** examines possible employment trends in key sectors of the economy in the light of the transition processes: energy, health care and goods/services for the **ageing** population, **care services**, housing and transport.
- **Group 5** focuses on impact groups, namely those vital for employment growth in the EU: **women**, the **elderly**, immigrants and **Roma**.
- **Group 6** is composed of transversal work packages: implications NEUJOBS findings for EU policy-making, dissemination, management and coordination.

For more information, visit: www.neujobs.eu

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