G H K

Thematic Expert Work on Green Jobs for DG EMPL/D1

August 2009

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European Commission, DG Employment

A report submitted by GHK

Date: 04/08/2009

526 Fulham Road, London SW6 5NR

Tel: 020 7471 8000; Fax: 020 7736 0784

www.ghkint.com

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1 INTRODUCTION

1.1 Purpose of the Paper

As part of efforts to address the looming threat of climate change, Europe's leaders have pledged to cut carbon dioxide emissions by 20% by 2020 and source 20% more "clean" energy from renewables. Beyond the targets, most Member States are proposing ambitious long term plans to place Europe's economies and labour markets firmly on a low-carbon development path.

The transition to a low carbon economy will require a dramatic transformation of EU (and global) industry, especially in the transport, construction and electricity sectors, creating new goods and services, spawning new businesses, and providing millions of new jobs. At the same time, other industries will face rising costs and a risk of declining international competitiveness.

The adjustment to a low carbon economy is the subject of extensive and continuing research and discussion. The adjustment process will inevitably create costs for the economy as well as new market opportunities. This will mean that even if the overall positive and negative impacts balance out at the EU level, there may be specific gains and losses at the level of individual industries and regions.

The adjustment to a low carbon economy is itself only part of a wider concern with the sustainability of economic development and the need to recognise resource constraints and the environmental impacts of production and consumption. Of course there is a long history of environmental policy and regulation designed to internalise some of these adverse impacts, which although generating costs, has given rise to the initial 'eco-industries' providing employment ('Green' jobs), exports and output in relation to pollution control, waste management and environmental consultancy. It is now possible to add to these original eco-industries, those industries more specifically focused on providing specific goods and services for a low carbon society, such as renewable energy, 'clean' transport (e.g. electric vehicles) and low energy buildings, which also generate 'Green' jobs.

This paper concerns itself with the implications of environmental policy, including low carbon policies, for the international competitiveness of EU industries and the implications for the levels and distribution of employment within the EU. The paper takes a short to medium term perspective, focused on impacts over the next 10 years.

1.2 Moving beyond 'Green Jobs' to the Wider Employment Impacts of Environmental Polices

As noted above, Green jobs were previously narrowly defined[1] as employment in pollution control and waste management. In recognition of the wider changes in the economy and society to secure sustainable development and the associated broadening of related policies, UNEP/ILO[2] have defined Green jobs as work in agriculture, industry, and services that contributes to preserving or restoring the quality of the environment while also meeting the requirements of decent work – adequate wages, safe conditions, workers' rights, social dialogue and social protection, which

[1] OECD/Eurostat (1998) Eco-industries definition.

[2] Green Jobs Report, (UNEP, ILO, IOE, ITUC 2008).

relate to activities specifically capable of contributing positive environmental and social outcomes.

Although somewhat broader than the traditional focus on pollution control and waste management, it arguably still misses the point that environmental policies, including those required to secure a low carbon economy, will influence the number and types of jobs in all sectors of the economy. In other words, there will be Green and less Green jobs in every sector as environmental policies lead directly, and through changes in other policy domains such as transport, enterprise, innovation and energy, to changes in the competitiveness and employment in the EU economy. The economic and employment impact of these policies is not confined to 'green jobs' but rather affects the whole economy – employment in all sectors is now clearly influenced by such policies; albeit the impacts vary in scale and direction of change between sectors.

As a result, it is difficult to demarcate Green jobs (even using the UNEP/ILO definition) within economic sectors. Many so-called "green jobs" flow from activities which are not classified as generating "green jobs". For example, solar technology, heat insulation and bio- energy would not be possible without products from the chemicals industry. Even the previously defined pollution control sector is now difficult to distinguish, with the move from end-of pipe solutions to integrated systems. Cross-cutting environmental, enterprise and transport policy is creating change not just for a small number of environment related industries but across the economy as a whole.

1.2.1 Problems with Quantifying Employment Impacts

Environmental policy measures have different effects on prices, international trade, and the economies of the Member States, and therefore on employment. These effects have been the subject of a number of studies that have sought to quantify employment effects at the level of the EU, Member States and also in the US. Any review of the results of these studies has to carefully categorize the different indicators used and the underlying assumptions of the different approaches. In particular, it is important to distinguish:

Gross employment – Increase in investment in, say renewables, leads to higher turnover creating ***direct*** jobs. This leads to an increase in ***indirect*** jobs due to increased demand for inputs from intermediate sectors, such as metal industries and mechanical engineering. The sum of direct and indirect employment is called ***gross employment*** in the literature.

Net employment – Any increase in employment has to be balanced with jobs being displaced elsewhere or jobs being substituted. When the investment has to be paid for from private or public budgets, it causes negative effects from foregone demand and consumption in other sectors. However, new markets and technologies can also attract international capital and yield positive impacts. Furthermore, changes in the price of the green good or service (e.g. electricity from renewable sources) also affects the entire price structure of the economy, influencing intermediate and final demand, production and imports. Increased production can lead to more value added, but also to more imports and more use of intermediate inputs. Developments in prices, wages, and productivity play an important role in this distribution and the question of whether or not additional output also leads to more employment. The resulting balance of all these positive and negative effects on the job market is referred to as ***net employment***, the calculation of which generally requires more complex modelling work.

The estimate of employment impacts as a result of environmental policy differs according to the particular policy interest. The most common terms are:

- Green Jobs
- Jobs in the Environment Goods and Service sector (EGS) or eco-industries
- Jobs in the low carbon economy
- Jobs attributed to climate change package
- Jobs attributed to renewable energy targets or renewable energy sources (RES)
- Jobs attributed to energy efficiency measures
- Jobs attributed to green fiscal stimulus

There is no consistent definition for the above in the literature. Given the inherent difficulties in assessing what could constitute climate change policy related jobs or green jobs, it is unsurprising that a variety of figures have been used to show the impact of environmental or climate change policy on the economy and employment[3]. For example, estimates of jobs related to renewable energy published in the literature have considerable differences depending on *definition*. This can range from the number of employees in the companies that produce windmills or photovoltaic systems to indicators measuring jobs in the production of the systems and operation and maintenance per mega-watt installed capacity, to estimates of gross employment of the whole value chain to net employment taking into account the displacement of employment in conventional energy sectors and (if subsidised from tax revenues) the employment lost as a result of higher taxes.

To summarise, the focus on 'green' jobs has a number of pros and cons for formulating policy targets (Table 1.1 below).

Table 1.1: Pros and Cons of Using Green Jobs for Formulating Policy Targets

Pros	Cons
Attractive, easy to capture the imagination and trendy.	No consistent definition, green-job profile is diverse and ever changing.
Preferred by politicians due its simplicity and attractiveness	Some green jobs may be 'greener' than others (e.g. pollution prevention vs. pollution control).
Provides a distinction to polluting (or 'brown') jobs	Integrated production structure and complexity of environmental protection makes demarcation increasingly difficult.
Has been used in the title for high profile reports e.g. UNEP et al (2008), ILO (2007), Centre of American Progress (2008), US Conference of Mayors (2008)	Policy should provide opportunity not just for a small number of environment related industry but across the economy as a whole

[3] Please see Annex for examples of estimates of the numbers of jobs (current or potential) in relation to a low carbon economy.

'Green' jobs tend to focus on gross rather than net impacts	Quantifying net 'green' jobs is complex

This paper therefore considers the impacts of environmental, including low carbon, policies on employment, not just in terms of Green jobs, but also on the wider economy and employment. This enables the consideration of both positive and negative impacts on growth and employment across all sectors.

1.3 International Competition and Employment: The Influence of Green Stimulus Packages

Environmental policy is constantly evolving. Most recently, in addition to the existing range of environmental regulations and incentives that shape international competition, countries have, as part of economic stimulus packages, invested over €300 billion worldwide in meeting environmental and climate policy objectives. Investment in the EU accounts for €42 billion of this, or about 13% of the global total (Table 1.2). A recent OECD report (2009) presents the challenges and opportunities for green growth in overcoming the current economic crisis. The report also has a detailed breakdown of direct investments in 'green' infrastructure or R&D in OECD and some non-OECD countries' economic stimulus packages.

Table 1.2: Value and Share of Green Fiscal Stimulus in Selected Countries and Globally

	Total	Green Funds		RE	CCS	Bldg	Veh	Rail	Grid	W/W
	€ Bil	€ Bil	%	€ Bil						
EU	30.0	17.6	58.7	0.5	9.7	2.2	1.5	--	3.8	--
Germany	81.0	10.7	13.2	--	--	8.0	0.5	2.2	--	--
France	26.0	5.5	21.2	0.7	--	0.6	--	1.0	3.2	--
UK	23.5	1.6	6.9	--	--	0.2	1.1	0.3	--	0.02
Italy	80.0	1.0	1.3	--	--	--	--	1.0	--	--
Spain	11.0	0.6	5.8	--	--	--	--	--	--	0.6
Other EU MSs	238.5	4.8	2.0	1.5	--	0.3	3.0	--	--	--
Total EU	**490.1**	**41.9**	**8.5**	**2.7**	**9.7**	**11.4**	**6.1**	**4.5**	**7.0**	**0.7**
ROW	1,670.5	295.1	16.2	26.7	5.9	40.3	6.2	89.6	63.9	62.4
World	2,160.6	336.9	15.6	29.4	15.5	51.6	12.3	94.1	70.9	63.1

Sums may not add up due to rounding.
RE - Renewable Energy
CCS - Carbon Capture and Storage, and other low-carbon technologies
Bldg - Building Energy Efficiency
Veh - Low-Carbon Vehicles
W/W - Water and Waste Management
Source: HSBC Global Research "A Climate for Recovery".

This investment financed out of future revenues will provide a significant driver for the growth of 'Green jobs'. However, the stimulus is largely financed out of increased public sector borrowing, which will need to repaid either by higher taxes or reduced public spending in future years, and which may have negative employment impacts as a result.

The European Commission's Economic Recovery Plan includes, among other provisions, initiatives on green cars (€5 billion), energy-efficient buildings (€1 billion for

R&D), and "factories of the future" (€1.2 billion for R&D). A substantial portion of the Commission's funds—close to 60 percent—are "green"[4].

The European Commission has also announced some €105 billion in cohesion funds to be spent in 2007-2013 to create "green jobs and growth"—a substantial portion of which will go to Eastern Europe (Bulgaria and Romania are the countries with the largest share of national cohesion funds earmarked for environmental projects—45% and 42%, respectively). While these are not new funds but rather concern the dispersal of previously committed sums, they are triple the amount allocated for similar purposes during 2000-2006. Specifically, some €48 billion is aimed at climate objectives (€23 billion for railways, €6 billion for public transport, €4.8 billion for renewable energy, and €4.2 billion for energy efficiency)[5].

The completion of 30 priority transport projects under the Trans-European transport network (TEN-T)[6] will lead to an investment of €600 billion to enhance and modernise Europe's transport network in the enlarged EU. These investments favour rail and water based transport modes largely on environmental grounds. These investments will have substantial local and regional employment and GDP benefits.

Overall, these types of major investments are expected to generate a number of temporary (infrastructure, construction and design related) and permanent jobs in the EU.

1.4 Supporting Policies and Measures

The influence of environmental policy on international competition and employment is also affected by non-environmental policies and programmes, both to limit the negative consequences and to enhance the positive benefits.

1.4.1 Counteracting Negative Impact of Environmental Policy on Competition and Jobs

Where the EU imposes stronger environmental measures than elsewhere, associated increases in relative costs could lead to a loss of competitiveness of EU industries with associated loss of output and jobs. It could also be counter-productive if less polluting and resource efficient activity is replaced by more polluting or less energy efficient production in non-EU countries. The EU carbon emission trading scheme (ETS) is cited as an example of a measure that increases the costs of EU energy intensive industries (EII), leading to a loss of output and 'carbon leakage' (i.e where emissions savings in the EU are offset by increases in emissions elsewhere).

Table 1.3 summarises a number of policy proposals to aid EU industries where there is a risk that more stringent EU policies are likely to reduce their international competitiveness.

Table 1.3: Specific EU Policy Proposals to Support International Competitiveness Affected by Environmental Policy

[4] "European Economic Recovery Plan 2010-2013. Public Private Partnerships in Research Activities," European Commission, Brussels, 30 March 2009, at http://ec.europa.eu/research/index.cfm?pg=newsalert&lg=en&year=2009&na=ppp-310309

[5] Leigh Phillips, "'Green Jobs' Focus for €105bn in Funds to EU Regions," euobserver.com, 9 March 2009, http ://euobserver.com/9/27741

[6] European Communities (2005): Trans-European Transport Network. TEN-T Priority Axes and Projects 2005. Luxembourg: Office for Official Publications of the European Communities.

Policy proposals	Objectives
International sectoral agreements (ISA)	▪ Level playing field for international trade ▪ Promote best available technology
Trade policy (Border Tax Adjustments (BTA) or facilitating trade of environmental technologies and products)	
Revision of the Environmental Guidelines for State Aid	▪ Assist with environmental/energy policy compliance burden
Functioning of the internal electricity market	▪ Prevent windfall profits for electricity generators ▪ Prevent high electricity prices ▪ Competitive electricity market ▪ Provide incentive for low carbon technologies ▪ Level playing field
EU ETS review and international ETS	

1.4.2 Policies to Further Enhance Competitive Advantage and thus Jobs

A low carbon development path has the potential to create jobs and incomes across a range of sectors. However, this can only be achieved with coordinated and ambitious policies. For example, in the EU, renewable energy is not developing as fast as hoped. Although progress has been made, current projections indicate that the EU looks unlikely to reach a contribution from renewable energy sources exceeding 10% by 2010, compared to a target of 12% (SEC (2006) 1719). Evidence from the US also suggests that although alternative energy can provide employment across many sectors of the economy, policies to spark alternative energy can take years to develop[7].

Policy can also be justified on the grounds of **government intervention failure**, where existing policies are failing to deliver an optimal solution and would benefit from reform. A good example would be the reform of environmentally damaging subsidies, where subsidy reform may deliver environmental and economic gains while reducing distortion of the market mechanism.

In addition, policy support is required on the grounds of **equity**. Even where markets deliver solutions that are economically efficient, markets may lead to variable rates of economic development, with some regions performing better than others and some groups in society benefiting more from economic activity than others. This provides a further rationale for regional development policies and programmes designed to benefit those sectors or groups losing out in the transition to a low carbon economy.

The case for government intervention with regard to environmental policy can be made as follows:

[7] U.S. governors report to a Senate committee. http://www.reuters.com/article/environmentNews/idUSTRE56K5YY20090721?feedType=RSS&feedName=environmentNews

- Energy Efficiency Programmes – Investment in energy efficiency is often cost effective for firms and households but may not take place as a result of information failures or general inertia. There are also benefits in reducing externality effects, since energy efficiency helps to reduce the social costs of climate change, and, in the case of domestic households, helps to reduce problems of fuel poverty.
- Environmental Infrastructure Investments – Investments in water supply, wastewater treatment and waste management facilities have strong public good characteristics, benefiting society as a whole, and therefore often justify public sector investment.
- Renewable Energy Investments – Support for renewable energy may be justified on the grounds of reducing externalities – investing in renewables plays a key role in reducing the future costs of climate change and therefore provide wider benefits to society. Renewables is a rapidly developing sector and there is also a case for intervention to promote innovation, enhancing the EU's collective knowledge base and enhancing our competitive position internationally. There may also be a case for intervention in order to enhance competition and address disparities in market power between large energy utilities and smaller producers. Some suggested policy support measures are:
    - Fine-tuning of national support schemes involving feed-in tariff and quota systems to be based on a technology-specification of RES support.
    - Intensified cooperation between member states, including an intensively coordinated RES support all over Europe and an enhanced sharing of corresponding costs and benefits.
    - Implementation of renewable rights trading, amongst all the Member States, (most likely through an EU-wide tradable green certificate scheme).
- Cohesion Policy – The overall rationale of cohesion policy is based on a combination of equity and economic efficiency arguments, i.e. the need to achieve a more even distribution of income across the EU, while addressing a variety of market failures that lead to certain regions performing below their true potential. Environmental activities funded by cohesion policy span the breadth of different spending programmes, including investments in infrastructure (e.g. buildings, renewable energy, energy efficiency, transport, water, waste management and the natural environment), eco-innovation, business support and skills development programmes.
- Innovation Programmes – Government support for innovation can be justified on the basis of the positive externalities associated with "technology spillover" effects. In other words, innovation benefits not just the direct target of intervention but also other firms and society as a whole over time, justifying public sector support. The Commission already has mechanisms for monitoring and evaluating FP7 (the EU's main instrument for co-financing of environment and energy related RTD[8] and demonstration projects in Europe); CIP (covering the resolution of non-technical barriers to technology adoption, skills and training programmes, financing and institutional capacity building); and, LIFE+ (covering environmental demonstrators). However, further measures are needed to accelerate the market adoption of environmental technologies and eco-innovation through improved education,

[8] Research and technological development (RTD)

awareness raising and coordination. Each EU funding instrument is generally targeted at a different stage of the innovation 'pathway'. In principle, this helps to provide a coordinated and coherent support framework for enabling new technologies, services and innovative business models to be adopted by the market. In practice, however, there are often disconnects between one programme and another. There is also potentially a lack of awareness amongst stakeholders as to how these different mechanisms work together. By examining how the initiatives target different stages of the innovation chain, it may be possible to achieve greater coherence and faster adoption of innovative technologies.

- Skills and Training – There are positive externality effects associated with skills development, which yields greater benefits to society at large than to individual employers, especially in areas and sectors where labour is mobile. Labour market interventions are often justified on equity grounds, in order to enhance the skills and earning potential of disadvantaged groups in society.
- Business Advice – Information failures may mean that businesses are not fully aware of environmental market opportunities – business advice and support schemes may help to address these.
- Environmental Labelling – Labelling schemes help to overcome asymmetries in information between producers and consumers, helping the latter to make informed choices and potentially to save money by adopting more energy and resource efficient products.
- Environmental Taxes – The case for environmental taxes is based on the external costs of environmental damage, which are not included in market prices. Environmental taxes are designed to "internalise" these externalities, leading to a more efficient working of markets. If tax revenues are used to reduce taxes on labour, they can also reduce distortions in labour markets.
- Reform of Subsidies – Subsidies in energy and agriculture can be environmentally damaging, as well as distorting trade and the allocation of resources. Subsidy reform can help to address these intervention failures and lead to a more efficient functioning of markets, as well as benefiting the environment.

1.5 Structure of the Paper

The paper continues in the next Section (2.0) with a review of the potential impacts of environmental and climate change policies on international competitiveness and employment. In Section 3.0, the paper considers some of the distributional implications of the potential employment changes driven by environmental policies and the implications for skills and training. It also presents some of the implications of the impacts on employment for active labour market policies, and hence the role that such policies can play in facilitating the adjustment to a more sustainable, low carbon economy. Some brief conclusions are provided in Section 4.0.

2 THE IMPACT OF EU ENVIRONMENTAL POLICY ON INTERNATIONAL COMPETITION AND EMPLOYMENT

2.1 Introduction

Community environmental policy addresses all sources of environmental pollution, such as emissions to air and water, solid and liquid wastes, and noise; seeks to ensure levels of nature protection and biodiversity; and to manage industrial risks and civic protection from technological hazards.

Some EU businesses have argued that the more stringent environmental policies, regulations, and economic instruments have imposed additional costs relative to non-EU countries, affecting the competiveness of EU firms in international trade, partly because of the restricted time to adjust to new standards and economic measures. For example, the EU car industry lobbied strongly against the introduction of high carbon emission standards on the basis of the related costs and the impact on competition of adjusting to high emission standards[9].

On the other hand, there is a growing consensus that investment in eco-innovations, low-carbon technologies and resource efficiency will boost EU competitiveness[10]. There is increasing evidence that environmental policy and eco-innovations can promote economic growth, as well as maintain and create jobs, contributing both to competitiveness and employment.

At the same time, environmental constraints to rapid economic growth are increasingly being recognised by non-EU countries, which have a growing awareness of the need for stronger environmental policies to secure sustainable development. A number of non-EU countries have allocated significant funds to low carbon activities as part of their fiscal stimulus packages (HSBC, 2009).

In sum, the implementation of environmental policy generates significant implications for competition among producers located in different countries and in particular industries, depending on the relative character of environmental policy between the EU and other parts of the world.

The impact on competition can lead to three main impacts on EU jobs:

1. ***Loss of jobs (or relocation of jobs)*** – for example in energy intensive sectors (eg. steel, cement, paper) where EU climate change policy leads to higher costs or where non-EU countries with relatively lower environmental standards allow for lower producer costs;
2. ***Transformation of jobs (inc. substitution)*** – for example jobs being transformed or upskilled, such as car workers trained on hybrid/electric engines and related technology and gas-fitters installing gas CHP instead of traditional systems;
3. ***New jobs*** – for example, additional insulation fitters for retrofitting homes or jobs resulting from the production of new types of biomass for transport fuels.

[9] ENDS Report 407, December 2008, pp 57-58. Business Green 'MEP's defy car lobby to stand by tough emission caps'. http://www.businessgreen.com/business-green/news/2226963/mep-vote-car-emission-caps-snub

[10] DG TREN (2009), E&Y (2008), UNEP/ILO et. Al (2008), EC Recovery Plan (http://europa.eu/rapid/pressReleasesAction.do?reference=IP/08/1771),

2.2 Overall Economic Impact of Climate Change Policies

At the level of the economy, the impact of climate change policies in the EU has been the subject of a range of studies. To date, there appear to be only a few estimates of what the macroeconomic impact might be of meeting carbon reduction targets in terms of the net effect on GDP levels (global, European or national level) and the potential level of investment required to attain these levels of reductions. These suggest that in aggregate, the overall level of impact is modest and that costs will also be associated with the opportunity to take competitive advantage from the structural changes triggered by climate change policies (see Box 2.1).

Box 2.1: Estimates of Overall Economic Impact from Climate Change Policies

Key points from the literature:

- Globally, market growth in the environmental sectors is driven primarily by legislation, whether at the international or national level, particularly in the more mature markets of the US, EU and Japan (Ernst and Young, 2008)
- In one of the more detailed assessments, the economic impact of implementing climate change policies was estimated at 1% of annual global GDP to 2050 to stabilise emissions at 550ppm CO2-e (Stern, 2006)
- The Framework Programme 5 Mosus project indicated that measures to achieve 2020 targets will have a small impact on total employment but with positive impacts on GDP (FP-5 Mosus, 2005[11])
- Costs will increase if the most efficient carbon reduction technologies are not used. Delays in implementing climate change polices will increase costs to achieve given reductions or fail to achieve target reductions (Stern Review, 2006; McKinsey, 2009)
- Overall climate change policy will have a modest aggregate economic impact on job growth in the US (CERES, 2008) and in the EU (ETUC, 2008). Climate change policies are more likely to lead to a redistribution of jobs within and across sectors than to changes in absolute employment levels (ETUC, 2008), (IEEP, 2008), (CERES, 2008).
- Markets for low-carbon energy products are likely to be worth at least $500bn per year by 2050, and perhaps much more (Stern, 2006)
- US and EU support for the renewable energy industry will benefit sectors of the economy and states that currently suffer from high unemployment (Apollo Alliance, 2008), (CERES, 2008), (ETUC, 2008), (Fankhauser, 2008), (Kammen, Kapadia, & Fripp, 2004), (WWF, 2001)
- All models estimate that overall, the renewable energy industry generates more jobs per MWa than the fossil fuel based industries (mining, refining and utilities)" (CES, 2007), (Deutsche Bank , 2008), (ETUC, 2008), (Kammen, . Kapadia, & Fripp, 2004), (Kammen D. M., 2007), (US Conference of Mayors, 2008), (UNEP, 2008) (WWF, 2001)

Climate change policies will affect all sectors. Each sector and business will face its own set of challenges and opportunities. A study by the OECD/IEA (2008) concludes

[11] http://www.mosus.net/documents-reports.html

that the required expenditure to meet carbon reduction targets reflects a re-direction of economic activity and employment and not necessarily a reduction of GDP.

The degree to which net employment is expanded as a result of climate change policy will be in part affected by the size of the pool of unemployed labour and the natural rate of unemployment in the economy. This natural rate can be reduced through improving the skills of the workforce (which reduces occupational immobility). However, some workers may still be 'hurt' by restructuring due to climate change policy, and there may be differences in impact between MSs in the EU.

In summary, the conclusion is not dissimilar to that for environmental policies as a whole, namely that '…environmental policy just contributes to a process of structural change'. The main (macro) economic impacts of climate change policy are:

- Comparative advantage for some industries - marginal reallocation of resources from those sectors financing a policy (paying its costs) to sectors that benefit from the intervention. More bluntly, its main impact is to shift resources from polluting sectors to more environmentally-friendly sectors;
- Increase in value added - a transfer of demand to higher-value 'green' industries - this could finance an expansion in net employment;
- Increase in investment - this could come from the Government or from the private sector (e.g. 'clean tech' venture capital); and
- First mover or fast follower advantage - A firm or sector may gain a first mover advantage under certain market conditions – for example, where significant barriers to entry exist, such as strong intellectual property rights or large economies of scale. In other situations, it may be more efficient to be a fast-follower, taking advantage of the work done by the first mover. This may be the case where there are much lower R&D costs for followers, and where there are high initial marketing costs for the first mover in order to educate the public.

2.3 Loss of Jobs due to the Impact of Environmental Policy on Competition

At the level of individual sectors, environmental and climate change policies are likely to have an especially strong impact on sectors sensitive to international competition. A number of EU industries are losing their market share over time due to the growth in global competition. The costs of stringent product and quality standards resulting from environmental regulation and/or from the EU ETS increase the burden of competing in international markets. As a result job losses (and job shifts) will occur, especially in energy extraction and refining, the power sector, and in energy-intensive industries like chemicals, steel, aluminium, paper, and cement.

It should be noted that extractive industry jobs have been on the decline for many years in the EU-15 and EU-27 (See Figure 2.1). This job loss is largely due to growing automation, rising labour productivity, and trade dynamics (exchange rate fluctuations, growth in non-EU markets and trade policies), rather than an outcome of environmental policies alone. One major argument for the relocation of production to other parts of the world, mostly emerging economies, is low labour cost (KPMG, 2004) or – more general - lower production costs. This is where countries like India, China and Brazil have a competitive advantage though energy costs are slowly rising but labour costs still remain relatively low. Transportation costs have also fallen over time,

especially shipping costs. It is now cheaper to transport 35,000 tonnes of cargo (cement) across the Atlantic Ocean than to truck it 300 km[12].

Studies find that it is difficult to isolate the effect of environmental regulation on trade, particularly because other variables, such as the cost of capital and exchange rate fluctuations, overshadow the effects of increased environmental regulation costs[13]. Given that pollution abatement and control costs as a share of total production costs is very small for all but the high pollution-intensive activities, in general they do not significantly affect the overall price competitiveness of the industrial sector compared to other factors[14]. Jaffe et al. (Jaffe et al. 1995) reviewed 16 empirical studies on the effect of environmental regulation on competitiveness, with a particular focus on the U.S, and concluded that there was relatively little evidence that environmental regulations have had a large adverse effect on competitiveness. Even for energy intensive industries in Europe, given the current level of EU ETS free allocations, the overall average impact on industry margins in the short and medium term is limited (DG Environment, McKinsey & Ecofys study (2006)). The exceptions are primary aluminium production and integrated pulp & paper production based on mechanical or thermo-mechanical pulp. It is important to stress that for some industries such as cement, lime and aluminium, the share of environmental compliance costs depends significantly on the level of free allocation.

Figure 2.1: European Union Employment Index, Extractive Industries

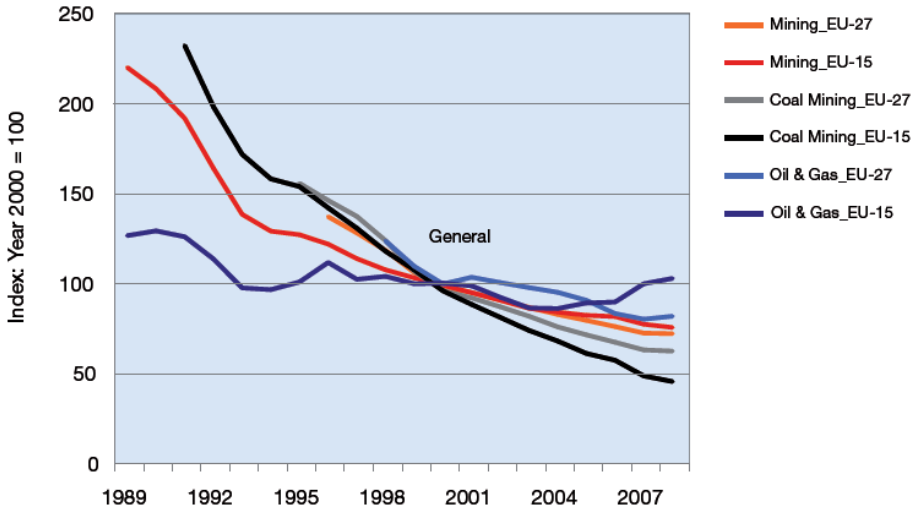
[12] Cembureau Key Facts. http://www.cembureau.be/default.asp?p=Key_03.asp

[13] Industrial Competitiveness and Environmental Regulation: Final Report, April 1999, Michalis Vassilopoulos, IPTS. ftp://ftp.jrc.es/pub/EURdoc/AppendixS2.pdf

Dynamics of Institutions and Markets in Europe (DIME) workshop on Empirical Analyses of Environmental Innovations, Jan Peuckert (TU Berlin) paper http://www.dime-eu.org/files/active/0/ISIWorkshopPeukert.pdf

US Office of Technology Assessment. 1992. Trade and the environment: Conflicts and opportunities. Report no. OTA-BP-ITE-94. Washington, D.C http://www.ciesin.org/docs/008-067/appendixe.html#fn12

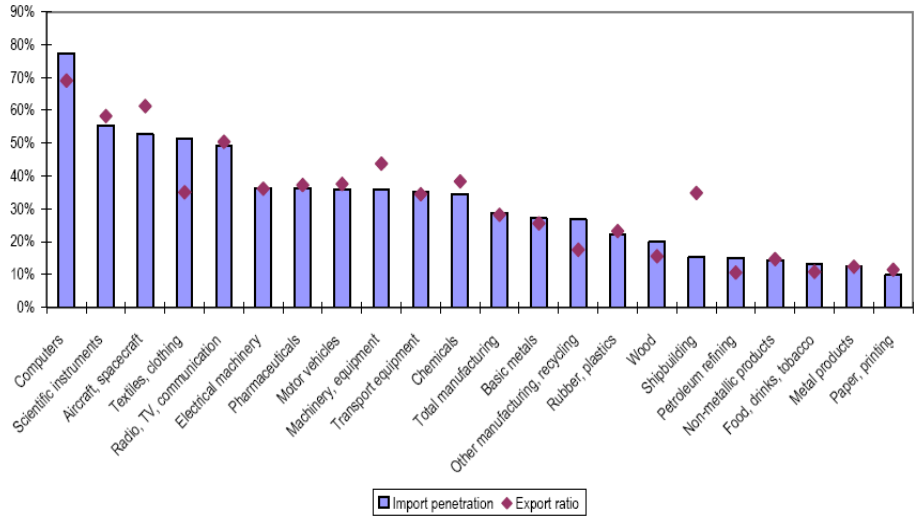
[14] United Nations Economic Commission for Europe, discussion paper No. 2007.6, November 2007



Source: Eurostat, "Industry, Trade and Services": accessed 27 February 2009.

Over time, import penetration in most of the EU manufacturing industries, especially energy intensive industries, has increased (Figure 2.2). For example, in 1992, the EU was the world's largest chemicals-producing region, with 32% of world output, but this is projected to fall to between 16 – 23% by 2015.

Figure 2.2: Import Propensity and Export Ratio1[15] in Selected OECD Countries[16], 2003



Source: OECD Economic Globalisation Indicators, 2005

These energy intensive industries also face relatively high compliance costs from climate change policies aimed at increasing the price of energy and incentivising

[15] The export ratio indicates the share of output Y which is exported, i.e. X/Y, and the import penetration rate shows to what degree domestic demand D is satisfied by imports M, i.e. M/D = M/(Y – X + M).

[16] OECD includes Austria, Canada, Denmark, Finland, France, Germany, Italy, Japan, Korea, Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom, and the United States.

energy efficiency. This generates competitive pressures for these industries. The production of cement and lime, steel, aluminium, primary container glass and some basic chemicals were expected be among the activities most significantly affected by climate change policies (IEEP, 2008). These sectors are exposed to a high degree of international competition and are responsible for a significant share of EU Gross Value Added (23%) and jobs (18%), as illustrated in Table 2.1. High regulatory burden and energy prices are major factors responsible for reducing the market share of these industries.

Table 2.1: Economic Significance of the EU Energy Intensive Industries

	EIIs	Value added, 2003 (EUR million)	Share of industrial value added, 2003 (%)	Number of persons employed, 2003 (thousands)	Share of industrial employment, 2003 (%)	Production mil tonnes (2005)	
1	Manufacture of pulp, paper and paperboard (NACE 21.1)	20,448	1.2	243	0.7	Primary pulp	41.5
						Recovered fibre	41.4
						Total paper & board	99
2	Chemicals and chemical products(1)	241,000	14	3,560	10	436[a]	
3	Glass and glass products	16,000	0.9	375	1.1	35	
4	Ceramic goods and clay products	14,200	0.8	360	1.0	27[a]	
5	Cement and concrete	28,876	1.7	501	1.4	239[b]	
6	Manufacture of first processing of ferrous metals (2)	31,085	1.8	550	1.6	EAF Steel	73
						BOF Steel	114
7	Manufacture of basic precious and non-ferrous metals (3)	13,000	0.8	215	0.6	Primary Aluminium	3[c]
						Recycled Aluminium	5[c]
	Total	**364,609**	**23**	**5,804**	**18**		

Note: the industrial economy comprises of NACE Sections C to E. Source: Eurostat (SBS), Rounded estimates based on non-confidential data. Value added and related share, rounded estimates based on non-confidential data. Production figures: P&P -CEPI, Chemicals-CEFIC, Glass-CPIV, Ceramics-Ceramunie, Steel-World steel report, 2006, Aluminium- International Aluminium Institute. (1) Includes basic chemicals, pharmaceuticals, rubber and plastics. (2) Covers manufacture of basic iron and steel and ferro-alloys, manufacture of ferro alloys and other associated activities (3) Covers manufacture of metals such as aluminium and nickel, including precious metals (e.g. Gold, silver) and common metals (e.g. Zinc, copper). [a] *in Billions of €,* [b] *Cement only,* [c] *estimates for 2004*

2.4 Impact of Environmental Policy on Competitiveness and Composition of Jobs and Output by Sector

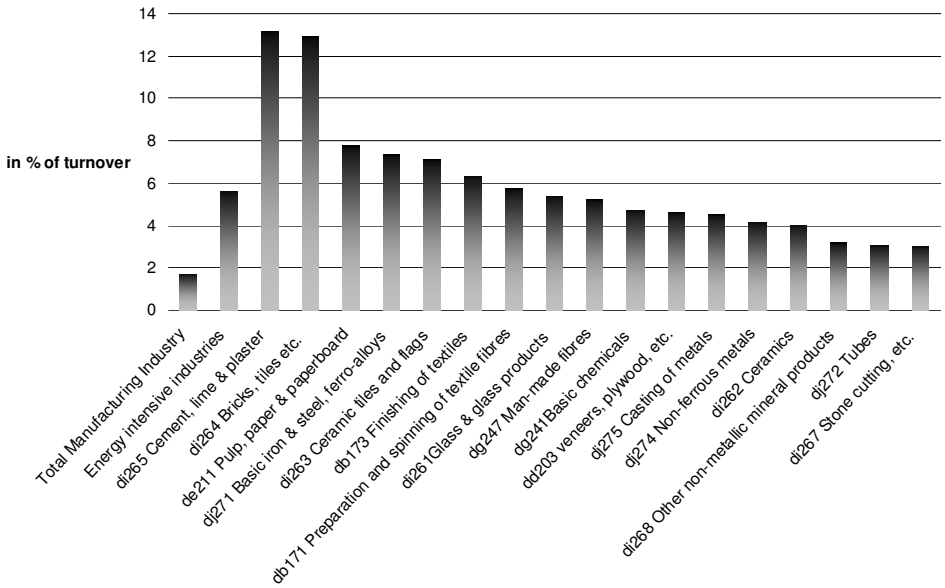
The impact of environmental policy on EU competitiveness and the composition of jobs and output across all sectors will depend on a number of factors, such as:

- the cost incurred relative to competitors outside the EU;
- the pattern of changes in total and intermediate demand;
- the ability to pass on these costs in prices of products and services;
- the share of that market taken by domestic producers as against imports;
- the prevailing budget constraints of households;
- the share of output sold to households compared to businesses;
- the extent to which compensating measures are taken; and
- the assumptions regarding non-EU country environmental policies.

The overall macroeconomic results can be calculated as the sum of its sectoral outcomes. Sectoral impacts will however vary because of the relative importance of these factors.

In the case of climate change policies, the main sectors expected to be negatively impacted are the ones most affected by higher electricity and energy prices (Figure 2.3).

Figure 2.3: Energy Costs of Energy-Intensive Industries in EU, 2004



Source: Eurostat: Structural business statistics

The sectors positively impacted from climate change polices are mainly the eco-industries (inc. renewables) and certain activities in transport (e.g. rail, hybrid cars), and business and financial services. Eco-industries are expected to grow at 5% per annum by 2020,[17] creating new jobs in the process. Investment in rail infrastructure and higher emission standards for vehicles will lead to more green jobs in the transport sector.

Two European projects - petrE[18] and MOSUS[19] - are examining the impact of environmental policies and sustainable growth within a macroeconomic, multi-sectoral framework. Both projects model the following policy themes:

- Links between resource productivity, resource (especially energy) prices, environmental quality, economic growth and competitiveness
- Resource and labour impacts of EU environmental policies

[17] Roland Berger Strategy Consultants. In presentation by Gert-Jan Koopman, DG Enterprise http://www.ceps.be/Article.php?article_id=585

[18] http://www.petre.org.uk/

[19] http://www.mosus.net/index.html

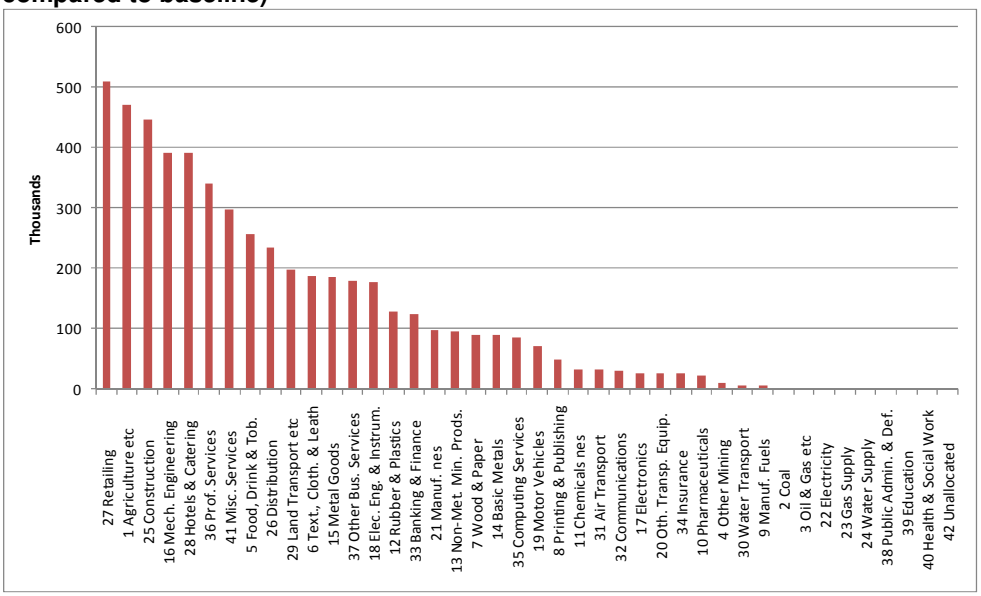
- Single-country, European and global economic and environmental effects of different sustainable and environmental policies including environmental tax regimes (ETR)

Key Findings from the Modelling Studies of the Impacts of Environmental Polices on EU Sectors

The petrE project has estimated the net impact on jobs (Figure 2.4) by sector in 2020 of meeting the EU 20% GHG emissions target[20]. Jobs in sectors (eg. coal, oil & gas, gas supply) most likely to be affected by environmental policies are assumed to remain unchanged due to modelling assumptions[21] although some reports have quoted a negative impact on jobs in fossil fuel based sectors (e.g. ETUC (2007)). Employment in the refining sector is expected to drop because of the partial replacement of petrol with organic fuels in the transport sector and the tightening of carbon constraints in national allocation plans. The ETUC (2007) study has estimated this impact at between 15,000 and 48,000 jobs by 2020.

The high cost of energy makes labour relatively cheaper, leading to the creation of more jobs under the 20% GHG scenario. The sectors with the highest job losses or smallest gains are those affected mainly by high energy prices and high import intensity (Figure 2.2).

Figure 2.4: Net Impact on Jobs by Sector (to meet EU 20% GHG emissions target compared to baseline)



Source: petrE results, E3ME model www.e3me.com

The modelling in the Mosus project clearly shows that output will shift from industry to service based sectors (Figure 2.5), with extraction and fossil fuel based industries suffering the most. This was also the finding of the UK's Committee of Climate Change in their modelling of measures for meeting the UK's carbon budgets to 2020[22]. The

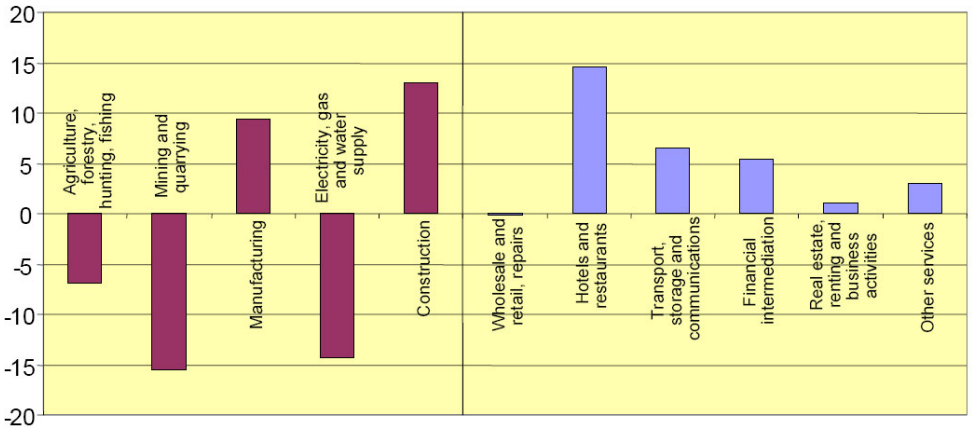
[20] EU's overall environmental target of a 20 % reduction in greenhouse gases compared to 1990 levels.

[21] Based on policy uncertainty and option to reduce energy imports.

[22] CCC (2008), Projections of UK CO2 emissions and assessment of the economic impacts of carbon budgets, Cambridge Econometrics.

study found that the largest reduction in value added was in gas supply (about 11% lower in 2020), electricity supply (5½% lower in 2020), and in manufactured fuels[23] (found to 2½% lower in 2020).

Figure 2.5: Percentage changes in GVA between the baseline and high scenarios for the EU-15 in 2020 (excluding Finland, Ireland, Italy, Luxembourg and Portugal due to lack of I-O data).



Source: Mosus project
http://www.mosus.net/documents/Results_and_evaluation_IIASA.pdf

Even though GVA in the manufacturing sector as a whole will be positively affected in the higher sustainability scenario, a breakdown of the manufacturing sector shows that some sub-sectors such as cement, fossil fuel based activity, pulp and paper and iron and steel will be negatively affected in terms of higher energy prices and international competition (Figure 2.6). As previously noted, the Mosus project indicates that the net impacts on total employment are likely to be small, with positive impacts on GDP. Structural changes were found to be more rapid and intense in the high sustainability scenarios. The study also found that labour productivity in sustainability scenarios increases above the annual rate in the baseline scenario.

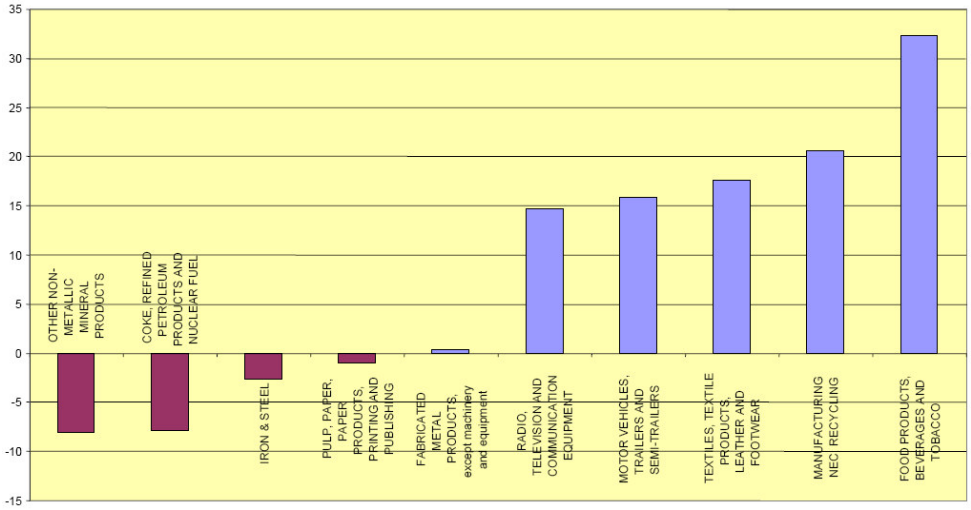
The Mosus study[24] found no substantial difference between the baseline and sustainable scenarios in terms of public financial performance in the EU-15, measured by net government borrowing/lending as a percentage of GDP. By 2020, all countries, except Denmark, will have experienced an improvement in their public financial performance. In several countries, this improvement is expected to be very significant.

Figure 2.6: Percentage changes in the structure of manufacturing output (GVA) between the baseline and high sustainability scenarios for the EU-15 in 2020. (excluding Finland, Ireland, Italy, Luxembourg and Portugal due to lack of I-O data).

http://www.theccc.org.uk/pdf/Projections%20of%20UK%20CO2%20emissions%20and%20assessment%20of%20the%20economic%20impacts%20of%20carbon%20budgets%20%28Cambridge%20Econometrics%29.pdf

[23] Including oil refining.

[24] http://www.mosus.net/documents/MOSUS%20Economic%20evaluation.pdf

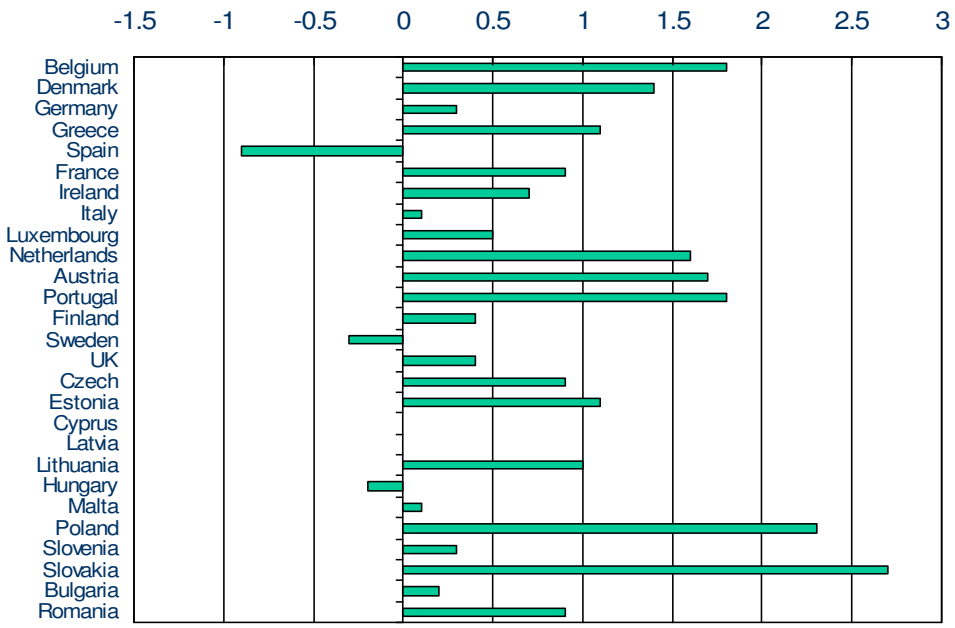


Source: Mosus project
http://www.mosus.net/documents/Results_and_evaluation_IIASA.pdf

The economic impact on GDP by Member State is shown in Figure 2.7. The impact on GDP depends on a number of factors:

- fuel mix and ease of switching
- sectoral composition of the economy
- how much of the energy/material price increases are passed on
- whether lower employers' taxes creates jobs
- trade ratios

Figure 2.7: GDP Impacts by Member State (to meet EU 20% GHG emissions target compared to baseline)



Source: petrE results, E3ME model www.e3me.com

The GDP effects are a combination of positive and negative impacts:

- ***Negative impacts*** – higher energy prices leads to higher industry and consumption prices and loss of real income. Also higher export prices leads to loss of competitiveness.
- ***Positive impacts*** - Income taxes are reduced which leads to higher real income and household spending, leading to higher employment so higher real income and household spending.

The reason Spain experiences a negative impact on GDP is because Spain's industries are relatively more energy intensive and so would lose competitiveness, especially if export industries are price sensitive. Furthermore, its large construction industry will be hit disproportionately by environmental taxes such as taxes on aggregate materials. Sweden, on the other hand, has a very tight labour market[25] and so fewer jobs were created from the modelling exercise.

2.5 Environmental Policy, Competitiveness and Carbon Leakage

The case for carbon leakage arises when climate change and environmental policies lead to higher carbon and energy prices within the EU and result in increasing prices for energy intensive products and therefore to more imports of these products from countries where the production is less efficient than in the original country.

According to the EU Climate Change and RES policy package impact assessment SEC 85 (2008) meeting, the 20% GHG and RES target will result in carbon leakage estimated to be approximately 2.5% of EU emissions (Table 2.2). The highest impacts are projected in the energy intensive part of the sub-sector of ferrous metals. Access to

[25] A "tight" labour market has more jobs than workers.

JI/CDM up to 25% of the GHG reduction effort (column 4 in Table 2.2) reduces the potential carbon leakage (from 2.5 to less than 1%). The JI/CDM scenario also reduces the pressure on CO2 and electricity prices, has a positive economy-wide effect in terms of welfare losses (-0.5% instead of -0.7%) and significantly improves the output performance of energy intensive industries. Global Sectoral Agreements (GSA), free allocation on the basis of benchmarks for energy intensive industries, free allocation for indirect emissions and inclusion of importers in the EU ETS are further policy options to reduce carbon leakage.

Table 2.2: Impact of Transfers of Renewable Targets and JI/CDM on Sector Output in 2020 (% Change Compared To BAU)

	Reference scenario	Reference scenario + No RES Transfers through GO trade	Reference scenario + Access to CDM up to 25% of reduction effort
	(1)	(2)	(3)
Share renewables (%)	20	22.6	20
Change CO2 emission EU cf to 1990 (%)	-16.8	-16.8	-11.0
Carbon leakage (% of EU's 1990 emissions)	2.5	2.9	0.8
Change global CO2 emission (% of 1990)	+47.0	+47.1	+46.5
CO2 price (€/t CO2)	34.2	34.2	21.0
Electricity price (% change vs BAU 2020)	22.0	30.7	13.9
Welfare loss (% cf to BAU in 2020	-0.69	-0.92	-0.51
Ferrous metals (%)	-8.0	-8.5	-5.4
Paper products (%)	-1.1	-1.3	-0.7
Mineral products (%)	-2.8	-3.0	-1.8
Non-ferrous metals (%)	-6.5	-7.4	-4.2
Chemicals output (%)	-4.3	-4.6	-2.7

Source: PACE Model

2.6 Generation of Jobs Due to the Impact of Environmental Policy on Competition

Environmental and climate change policies provide businesses with new market opportunities. Regulatory driven markets for waste recovery and management, pollution control and resource management have led to the creation of new jobs and services. EU eco-innovation policies and programmes such as the Seventh Framework Programme for Research and Technological Development (FP-7), Environmental Technologies Action Plan (ETAP) and Lead Market Initiative (LMI) for Europe are already having a positive impact on the competitiveness and growth of EU businesses.

EU businesses have already developed a comparative advantage in a number of technologies (See Box 2.2). Many of these technologies have led to reductions in costs and reinforced the competitive strength of EU industry. European employment in these businesses will be influenced not only by EU policy, but also by the extent to which other countries adopt strong environment and climate policies and subsidise businesses to adjust to and to exploit related market opportunities. As already shown in Table 1.2, a number of EU and non-EU countries have recently announced green stimulus packages to move to a low carbon trajectory that will influence competition and employment within the EU.

Box 2.2

'First mover' advantage – Danish wind power

The Danish wind power industry is often cited as an example of first mover advantage in environmental markets. It is now Denmark's third largest exporter with 38.5% of the global market for wind turbines; and has generated €4 billion of economic activity; and created 20,000 jobs. The development of wind power in Denmark has been characterized by a close collaboration between publicly financed research and industry in key areas such as research and development, certification, testing, and the preparation of standards. A very consistent energy policy and the introduction of greenhouse gas abatement policies including carbon taxation are also key factors for the success of the Danish wind industry. Denmark also provided support schemes for wind energy, such as subsidised tariffs and green certificates. Furthermore, tax discounts for cooperative and community investments have been replicated in Germany and the Netherlands.

However, some argue that, whenever a market arises because of government intervention, distortions and inefficiencies inevitably result. They point out that, after taking account of the subsidies and tax incentives provided by Danish taxpayers, cost-benefit analysis has shown a net economic loss of €400 million (although this takes no account of environmental gains). It is very difficult to prove net benefit and whether or not the Danish economy as a whole is better off from its wind power industry. What is clear, though, is that, through investment in R&D and market deployment support, technological advances have produced profitable technology, and the future export potential of wind turbines could help offset the Danish Government's initial investment.

[Source: CEMEP (2007), BERR and DEFRA. Sharman, Hugh (May 2005). "Why Wind Power Works in Denmark]

'Ecological Industrial Policy' in Germany

The German Federal Environment Ministry believes that Germany is well placed to play a pioneering role in the 'third industrial revolution', as the world's energy-efficiency and environmental engineer. It has proposed an innovation-based environmental policy that represents a 'New Deal' for economy, environment and employment and will achieve a 'double dividend' for the environment and German trade and industry.

Germany had at least 1.8 million environment-related jobs in 2006. This represented 4.5 percent of all gainful employment in 2006, up from 3.8 percent in 2004. In the renewable energy sector, the German workforce increased by almost 50% between 2004 and 2006, from 160,000 to 235,000 employees, and is predicted to rise to 400,000 by 2020. The government believes that reaching its climate protection goals will require annual investments of about €30 billion, which could lead to the creation of 800,000 additional jobs by 2030. Shifting subsidies for coal into building retrofits would offer a net gain of 30,000 jobs. It predicts that growth in environmental technology markets will vastly outstrip traditional economic sectors, with a 4% annual growth rate taking turnover in Germany to €1,000 billion by 2030.

[Sources: Ecological Industrial Policy. Memorandum for a "New Deal" for the economy, environment and employment, Federal Environment Ministry (2006); Renewable energy: employment effects, Federal Environment Ministry (2006); Renewable energies create work for 235,000 people, Federal Environment Ministry press release 245/07 (2007); Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU) and Umweltbundesamt (UBA), Umweltwirtschaftbericht 2009 (Berlin and Dessau-Roßlau, January 2009), pp. 32-36.]

2.7 Main EU Environment Related Sectors/Activities with Competitive Advantage and a Positive Impact on Jobs

2.7.1 Environmental (or Eco) Industry

The environmental or eco-industry is a dynamic and growing sector in the EU. The impact on jobs, output and trade strongly depends on the boundaries of eco-industries' definition. A study by GHK et al (2007)[26] describes and quantifies all the links between the economy and the environment and therefore covers a much broader range of environment related economic activities than just eco-industries. The types of economic activities covered include:

- Eco – industries: Activities relating to the protection and management of the environment – e.g. waste recycling, pollution & sewage control and environmental management
- Activities reliant on environmental quality – e.g. environment-related tourism
- Activities where the environment is used as a primary natural resource or input – e.g. agriculture, forestry, mining, electricity generation and water supply

Estimates of employment based on the different definitions are presented in Table 2.3. Based on the broad definition (which includes all activities), about 21 million people are directly employed in environment related jobs in the EU. When the multiplier effects are included, this total increases to 36 million (or 17% of total EU employment), meaning one in six jobs in the EU are in some way linked to the environment.

Table 2.3: Employment and Total Turnover in Eco-industries in the EU27 – narrow to broad definitions

	Direct Employment	Total Employment	Share of Total EU Employment
Eco-industries (mainly pollution control or treatment)	2.4 million	4.6 million	2%
Eco-industries plus activities closely dependent on a good quality environment (environment-related tourism, organic agriculture, renewable energy etc) - CORE	4.4 million	8.7 million	4%
CORE definition plus all activities dependent on the environment (all agriculture, energy, mineral extraction, etc)	21 million	36 million	17%

Source: GHK et al. (2007). Links between the environment, economy and jobs

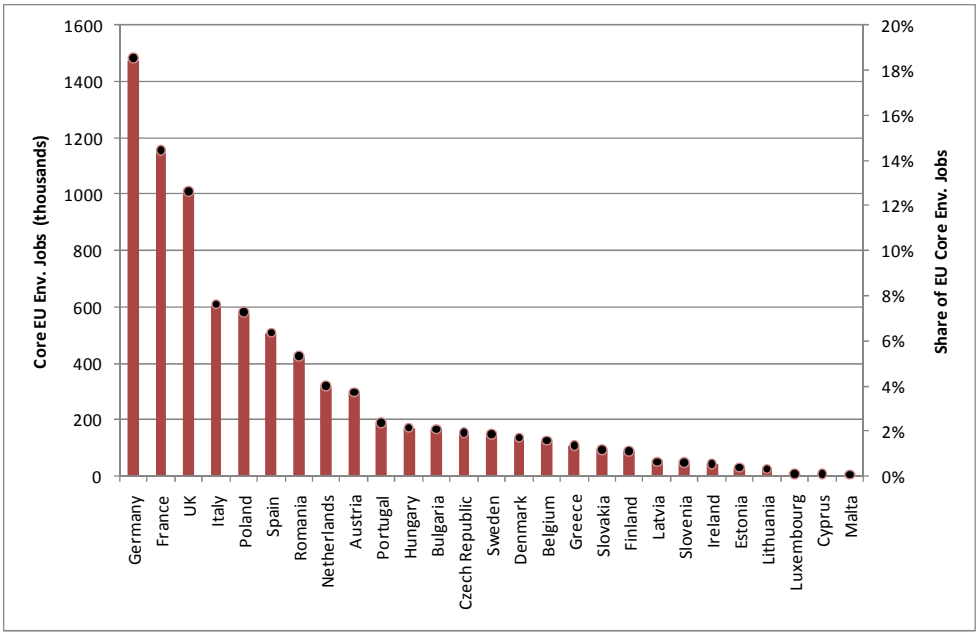
The positive employment effects of environmental and climate change policies are best approximated by the 'Core' definition of environment industries comprising pollution control and management plus natural resource based activities (organic farming and sustainable forestry), environment related tourism, renewable energy and water supply.

The estimated number of jobs in the eco-industry (using the core definition) by EU Member States is shown in Figure 2.8. Germany and France are the two largest producers of environmental technologies in the EU and account for 19% and 14% respectively of the total (including direct and indirect jobs) of EU core environmental

[26] GHK et al. (2007). Links between the environment, economy and jobs. http://ec.europa.eu/environment/enveco/industry_employment/pdf/ghk_study_wider_links_report.pdf

jobs. Denmark and the Netherlands have over 50% of jobs in pollution management activities and UK, Cyprus, Spain, Ireland, Greece and Malta have more than 50% of environment related jobs in environment related tourism.

Figure 2.8: Core Environmental Jobs by Member States



Source: GHK et al. (2007)

One way to quantify the dynamics in the eco-industry markets in New Member States is to use estimates of investments needed to close the "compliance gap", which is defined as the total expenditures needed to comply with EU environmental legislation. The investment (based on 2004 trends) and time needed to fill the compliance gap is shown in Table 2.4 below. For some countries, the investment period could be extremely long if there is no change in the current rate of investment.

Table 2.4: Years Needed to Fill the Compliance Gap at 2004 Trend

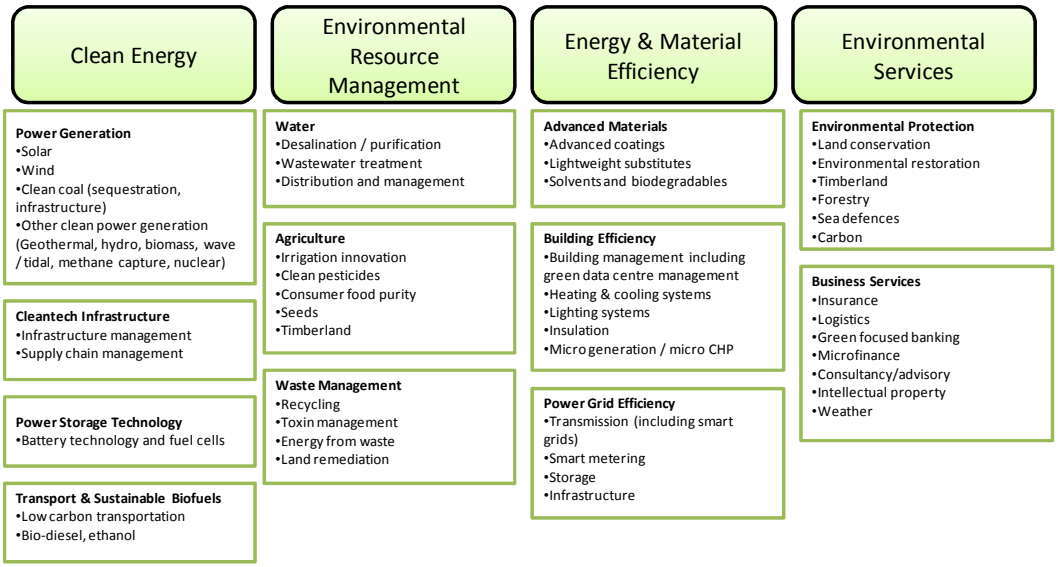
	CAPEX (2004 expenditure)	CAPEX (financing needs)	years needed to match financing need
	MEURO	MEURO	
Czech Republic	399	8000	20
Slovakia	128	4809	37
Slovenia	283	2430	9
Poland	1 222	32500	27
Hungary	662	7050	11
Latvia	34	1920	56
Lithuania	50	1600	32
Estonia	58	4406	76
Cyprus	17		
Malta			

Source: E&Y (2006), Study on Eco-industry, its size, employment, perspectives and barriers to growth in an enlarged EU

2.7.2 Employment Impacts from Pursuing a Low Carbon Economy

In terms of future employment changes, these are likely to be largely influenced by policies to encourage adjustment to a low-carbon economy. This will have a particular impact on four broad sectors: (i) Clean energy, (ii) Environmental resources management including agriculture and water, (iii) Energy and material efficiency and, (iv) Environmental services. Combined, these sectors represent a fast-growing marketplace, with potentially positive employment impacts (Figure 2.9).

Figure 2.9: Main Sectors Driving the Low-Carbon Economy



Source: Deutsch Bank Report (2009)

As previously noted, the employment impact at the level of the EU economy is unlikely to be significant because the positive and negative effects are likely to balance out. Studies have sometimes taken a partial view of selected policies and sectors to examine employment impacts. However, some of these studies only focus on the direct impacts in sectors receiving financial support (such as renewables) and have tended to ignore the displacement effects on those sectors that lose market share as a

result of the policy (as discussed in section 1.2.1). (See Annex 1 for different estimates of the numbers of jobs (gross/net and current or potential) in relation to a low carbon economy).

One study that takes into account some displacement effects is that by the WWF in France (Box 2.3). A recent DG TREN (2009) report was the first report to calculate the net effect of achieving the target of 20% RES in final energy consumption in 2020. The calculations covered jobs in the RES sector as well as its impact on other sectors of the economy. The study estimated a net effect of about 410,000 additional jobs and 0.24% additional gross domestic product (GDP). The ETUC (2007) report also found that there will be a limited positive impact on employment from climate change, provided appropriate economic policies are put in place. Compared to the trend scenario, the overall net gain in employment for the sectors covered in the ETUC (2007) study was around 1.5%.

Box 2.3: Job Gains and Losses in France from Reducing Carbon Emissions

WWF France's study of the impacts of cutting CO2 by 30 percent by 2020 suggests that the job gains outnumber the job losses. It concludes that some 316,000 renewables jobs and 564,000 energy efficiency jobs will be created in France, while 138,000 jobs in the conventional energy sector and 107,000 in the auto industry could be lost. Redirected spending from energy savings could induce an additional 48,000 jobs if oil prices are at $100 per barrel (but 467,000 jobs at $150 per barrel), for a net gain of 684,000 jobs (or 2.5% of total employment).

However, to the extent that the policy requires public funding, there will also be a related negative employment effect not included in this estimate.

Source: WWF, Low Carbon Jobs for Europe (2009)

An assessment by the German government[27] suggests that EU countries currently control a substantial portion of global sales of many critical resource efficiency technologies necessary to achieve a low-carbon economy: industrial processes (71%), water-use efficiency (66%), eco-design for materials efficiency (64%), electrical appliances (55%), building technologies (53%), propulsion technologies and emission controls (51%), and vehicle technology and design (42%). This suggests that a low carbon development path would yield positive economic benefits to the EU.

We briefly summarise the employment associated with some of the key low carbon industries that might be expected to grow as a result of EU policies and stronger international competitiveness.

Renewable Energy Sources (RES) – realities. The European Union is already the global leader in renewable technologies, which account for a turnover of €20 billion and employ 300,000 people[28]. According to the European Commission's Impact Assessment (SEC (2006), 1719) the cumulative investment needed to increase the share of RES in total energy generation from 6.5% in 2005 to 20% in 2020 is in the range of €600–670 billion (2005). This would result in an increase in GDP by 0.5% compared to business-as-usual conditions and would increase that employment by around 0.3%, which amounts to about 650,000 additional jobs. The jobs are likely to be

[27] Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU) and Umweltbundesamt (UBA), Umweltwirtschaftbericht 2009 (Berlin and Dessau-Roßlau, January 2009), pp. 32-36.

[28] European Renewable Energy Council "New renewable energy target for 2020 – a Renewable Energy Roadmap for the EU".

created across the entire supply chain of the renewable industry including environmental monitoring, development design, commissioning and procurement, manufacturing, installation, project management, transport and delivery and operations and maintenance. Some other RES related job estimates and ratios are given below:

- The European Wind Energy Association (2008) has determined that on average, 15.1 jobs are created in the EU per new megawatt (MW) (manufacturing) and 0.4 jobs per cumulative MW (operations and maintenance), declining gradually (with rising labour productivity) to 11 and 0.29 jobs, respectively, by 2030.
- Kammen et. al (2004) reviewed 13 EU and US studies and found that the renewable energy sector generates more jobs per megawatt of power installed, per unit of energy produced, and per dollar of investment, than the fossil fuel-based energy sector. According to research conducted by the University of California between 1970 and 2005, solar and wind provided stronger marginal returns to labour investments than fossil fuel technologies. They also found that renewable technologies' patents show greater returns to R&D investment relative to fossil fuels.
- The University of California Berkeley's Renewable and Appropriate Energy Laboratory also finds that renewable energy technologies create more jobs per average megawatt of power generated and per dollar invested than coal or natural gas.
- A Centre for American Progress (2008) report states that a $100 billion investment in clean energy and efficiency would result in 2 million new jobs, whereas similar investment in old energy would only create around 540,000 jobs.

Germany and Spain are leading forces in Europe for RES deployment. In Germany, the number of renewables jobs jumped from 56,600 in 1998 to almost 250,000 in 2007 and 278,000 in 2008[29]. Roland Berger business consultants projected that Germany may have 400,000 to 500,000 people employed in renewables by 2020 and 710,000 by 2030[30]. In 2007, a trade union study found that Spain's renewables industry employed 89,000 workers directly and another estimated 99,000 indirectly, for a total of 188,000. Renewables firms are spread evenly throughout different regions of Spain, though with some concentration in already industrialized regions, including Madrid, Catalonia, Valencia, Basque country, and Andalusia[31].

A recent DG TREN report (2009)[32] looked at the current and potential RES job profile by Member States. In most countries, biomass use has a high relevance for

[29] Marlene Kratzat et al., Erneuerbare Energien : Bruttobeschäftigung 2006 (Stuttgart, Berlin, and Osnabrück : Zentrum für Sonnenenergie und Wasserstoff-Forschung Baden-Württemberg, Deutsches Institut für Wirtschaftsforschung, Deutsches Zentrum für Luft- und Raumfahrt, and Gesellschaft für wirtschaftliche Strukturforschung, September 2007); Umweltwirtschaftsbericht 2009, op. cit. note 16, p. 93; Marlene O'Sullivan, Dietmar Edler, Marion Ottmüller, and Ulrike Lehr, "Bruttobeschäftigung durch Erneuerbare Energien in Deutschland im Jahr 2008. Eine erste Abschätzung," 6 March 2009, prepared for Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU).

[30] Theo Bühler, Herbert Klemisch, and Krischan Ostenrath, Ausbildung und Arbeit für Erneuerbare Energien. Statusbericht 2007 (Bonn : Wissenschaftsladen Bonn, 2007), p. 4.

[31] Joaquín Nieto Sáinz, "Employment Estimates for the Renewable Energy Industry (2007)" (Madrid : ISTAS and Comisiones Obreras, 4 February 2008).

[32] DG Transport and Energy (2009), The impact of renewable energy policy on economic growth and employment in the European Union.

employment. Again, wind technology is an important contributor to employment in Germany, Denmark and Spain and photovoltaics is relevant in Germany. Eastern European countries have generally been slow to embrace RES technologies, especially wind energy, but this is changing now. Wind power increased 150% in 2008 in the Czech Republic[33]. Poland's wind capacity grew 71% in 2008. Bulgaria has a goal of 220 MW wind capacity by 2012, up from 16.5 MW today. Spain's Iberdrola Renewables is building projects in Poland, Romania, Hungary, and Estonia[34].

Wind energy development has helped revitalize regions that had suffered from economic decline, such as northwestern Denmark, Schleswig-Holstein in northern Germany, or Navarra in Spain. Denmark has experienced a shift from shipbuilding to wind energy[35]. Wind development can provide similar benefits in other European countries for areas that suffer from deindustrialization or outsourcing.

Future RES Potential by Member States

The future RES potential differs significantly across Member States due to a number of reasons. The possible use of RES depends in particular on the available resources and the associated costs. In this context, the term "available resources" or RES potential depends on theoretical, technical and realisable potential.

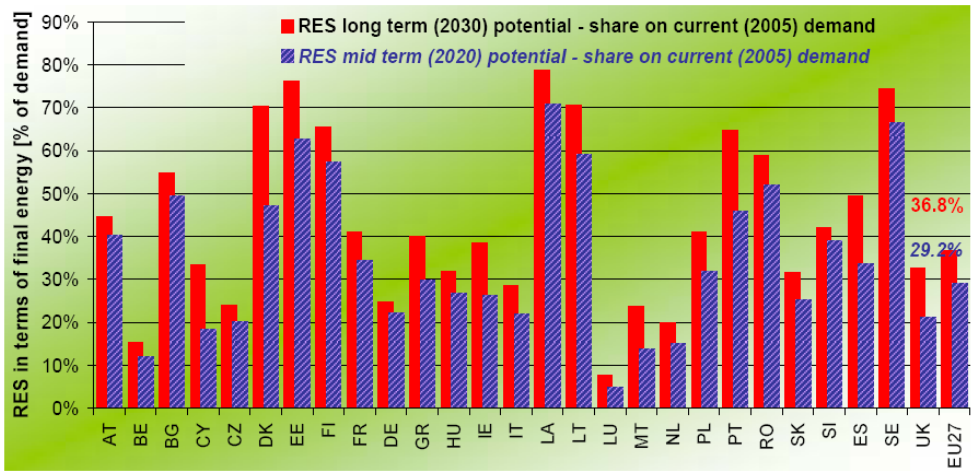
Figure 2.10 provides a comparison of the RES potentials at country level. Mid-term (2020) and long-term (2030) potentials are depicted in relative terms, expressed as a share of current (2005) gross final energy demand. This shows the importance of RES for energy supply, independent of the country size. A number of Member States possess significant RES potentials – e.g. in countries like Denmark, Estonia, Finland, Latvia, Lithuania, Portugal or Sweden, the long-term potential is above 60% of current energy needs.

Figure 2.10: Comparison of mid-term (2020) and long-term (2030) realisable potential for RES in terms of gross final energy for all EU-27 Member States

[33] Adam Cardais, "Seeing the Green Light," Transitions Online, 7 April 2008.

[34] Joel Makower, Ron Pernick, and Clint Wilder, Clean Energy Trends 2009 (San Francisco and Portland : Clean Edge, March 2009), p. 12.

[35] EWEA (2008), Wind at Work. Wind energy and job creation in the EU.



Source: DG TREN (2009)

As shown in Figure 2.9, the overall long-term RES potential up to 2030 at EU-27 level is 16% higher than the realisable mid-term potential in the 2020 timeframe, whereby differences are observable among the countries. At country level, the strongest increase of the realisable RES potential in the period 2020 to 2030 occurs for Cyprus (87%), followed by Malta (71%), Luxembourg (57%), UK (54%), Denmark (49%), Ireland and Spain (both 47%). These are countries where novel RES options such as wind offshore, tidal stream, wave power or solar power – all technologies which are currently in an early phase of market deployment – hold a high share in the overall long-term RES potential.

Recycling - the ambitious recycling and recovery targets from waste directives are a key driver for the European recycling industry. If the European recycling industry can maintain its competitive position through innovation and the introduction of more effective processes and improved technologies, waste and recycling industries are expected to grow from a turnover of €24 billion in 2006 to €36 billion in 2020 (a growth rate of almost 3% per year), providing 535,000 jobs in 2020.[36,37,38]

Sustainable construction – the promotion of sustainable construction solutions across residential and non-residential buildings and infrastructure constructions could increase the uptake of new products and services in construction by 5% in new construction and 3% in renovation. This would create a market by 2020 worth €87 billion, generating around 870,000 jobs. Regarding job substitution issues, it is believed that sustainable construction (especially renovation) will lead to most sustainable construction projects generating additional turnover and employment[39,40,41]. The

[36] European Commission, 2007, A Lead Market Initiative for Europe. COM(2007) 860.

[37] Ecological Industrial Policy – Memorandum for a "new deal" for the economy, environment and employment, German Federal Ministry for Environment, Nature Conservation and Nuclear Safety (BMU), 2006

38 EurActiv.com – Waste Prevention and Recycling, http://www.euractiv.com/en/sustainability/waste-prevention-recycling/article-128551 (accessed 16/6/2009)

39 European Parliament, 2009. Eco-innovation – putting the EU on the path to a resource and energy efficient economy. Study and briefing notes, Policy Department Economic and Scientific Policy, IP/A/ITRE/ST/2008-06&14

40 European Commission, 1997. The Competitiveness of the Construction Industry, COM(97)539

41 European Commission, 2007. A lead market Initiative for Europe. COM(2007) 860 final

construction sector, which is set to benefit from stimulus packages and climate policies, currently provides employment for 13 million people in Europe[42].

Bio-based products - McKinsey have estimated[43] that the volume of global markets for bio-based products might more than triple to €250 billion by 2020. In 2005, bio-based products accounted for 7% of global sales of the chemical industry; by 2020 this could increase to 20%. Based on these projections and on the assumption that the EU maintains its current market position in bio-based products (30%), the European Commission estimates an increase of the volume of bio-based production in the EU from €19 billion in 2006 to €57 billion in 2020; increasing employment from 120,000 to 380,000 jobs. JRC[44] argues that modern biotechnology leads to "better jobs", reflecting the higher knowledge-intensity of these jobs, and helps to safeguard jobs by supporting competitiveness.

Energy Efficiency - According to the European Commission[45], energy end-use efficiency investments create three to four times the number of jobs created by comparable energy supply investments, i.e., coal-fired and nuclear power plants. The EC (2005) study estimated 12–16 job-years of direct employment created for every $1 million invested in energy efficiency, compared with just 4.1 job-years for investing in coal-fired power plants or 4.5 job-years in nuclear power plants. The study also states that the EU could save at least 20% of its present energy consumption (and related to CO_2 emissions) in a cost-effective manner, equivalent to €60 billion per year, or the present combined energy consumption of Germany and Finland. Overall, a recent WWF report[46] estimates total jobs in insulation materials and installation, building energy efficiency goods and services and combined heat and power currently to be around 900,000 in Europe.

The EU is considering making its existing Energy Performance of Buildings Directive (EPBD) more stringent. Commission staff have examined a range of proposals and options and assessed the likely job implications. Between 280,000 and 450,000 new jobs might be created by 2020, chiefly 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 to improve the performance of buildings[47]. Eurima, the insulation industry umbrella group, provides more optimistic projections, projecting additional employment figures ranging from 274,000 to 856,000 jobs by 2030 (ETUC, 2007).

Green Transport – jobs are expected to be created in manufacturers of rail equipment, suburban trains, undergrounds and tramways (engineering, rails, electrification, telecommunication safety and signalling equipment, rolling stock); the development of new automotive technologies to adapt vehicles to all clean energies: natural gas for vehicles (NGV), liquid petroleum gas (LPG), bio-fuels and diesel/electric

[42] Eurostat (2009), 'Persons Employed by Sector'.
[43] Riese, J. and Bachmann, R. (2004). Industrial Biotechnology: Turning the Potential into Profits. Chemical Market Reporter, http://www.mckinsey.com/clientservice/chemicals/potentialprofit.asp.
44 JRC (2007). Consequences, Opportunities and Challenges of Modern Biotechnology for Europe. Joint Research Centre, Institute for Prospective Technological Studies, European Commission, Luxembourg: Office for Official Publication of the European Communities.
[45] Doing More with Less: Green Paper on Energy Efficiency (2005).
[46] WWF (2009), Low carbon Jobs for Europe, Current Opportunities and Future Prospects
[47] Commission of the European Communities, "Communication Staff Working Document. Accompanying document to the Proposal for a Recast of the Energy Performance of Buildings Directive (2002/91/EC). Impact Assessment (Brussels, 2008), pp. 2, 13.

hybrid vehicle. In Europe, close to 2 million people are currently working in urban transport, railway operations, and manufacturing of locomotives and rolling stock. Including indirect jobs would at least double these numbers[48].

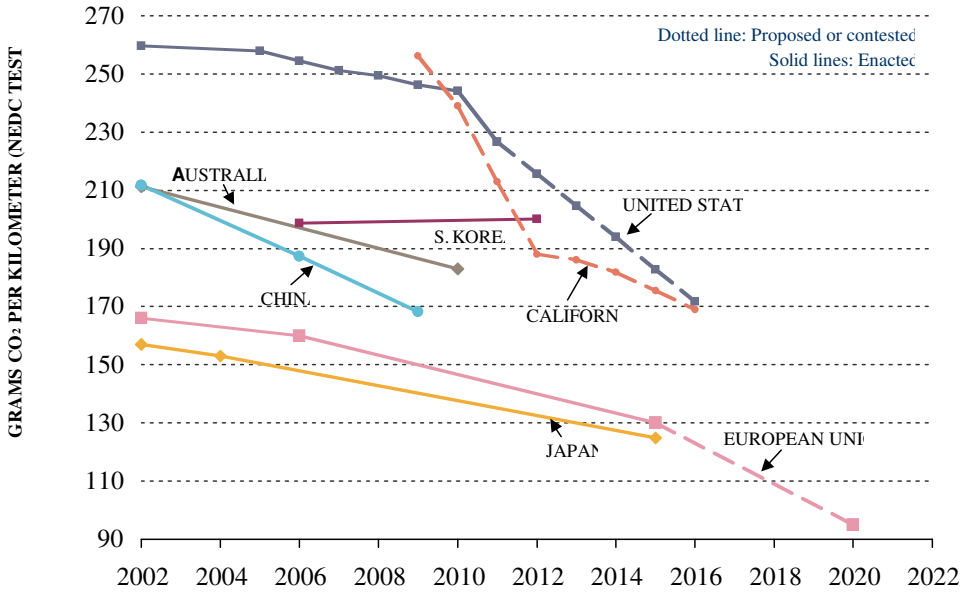
An Öko- Institut study[49] estimated in 2003 that even in the short-run, an expansion of local public transport could yield a net gain of 200,000 jobs by 2010 in Germany. Achieving a 14% share of biofuel by 2020, if primarily through domestic production, was estimated to lead to employment in the EU being up to 144,000 jobs higher than it would otherwise have been – assuming that oil behaves like other commodities, so that changes in demand affect its price (SEC(2006) 1719). The GHK et. al (2007) study projected that replacing a 10% share of fuel consumption with biofuels could yield a net gain of over 100,000 direct jobs and 30,000 indirect jobs in the agriculture sector.

Europe's auto-manufacturing jobs can be considered a 'shade of green' by virtue of high fuel-efficiency. Japan and Europe continue to lead the world with the most stringent passenger vehicle greenhouse gas and fuel economy standards, although recent regulatory actions have moved these two important governments in opposite directions. In 2006, Japan increased the stringency of its fuel economy standards, while Europe is in the process of weakening its CO_2 standards. As a result, Japan's standards are expected to lead to the lowest fleet average greenhouse gas emissions for new passenger vehicles in the world (125 g CO_2/km) in 2015 (Figure 2.11 below).

Figure 2.11: Actual and Projected GHG Emissions for New Passenger Vehicles by Country, 2002-2018

[48] WWF (2009), Low carbon Jobs for Europe, Current Opportunities and Future Prospects

[49] http://www.oeko.de/oekodoc/204/2003-011-en.pdf?PHPSESSID=q



Source: *Passenger Vehicle Greenhouse Gas and Fuel Economy Standards: A Global Update*,ICCT. May 2009 update.

Among members of the European Automobile Manufacturers Association (ACEA), about 26% of passenger vehicles sold in 2004 satisfied a limit of 140 grams per kilometre of driving. But only 7.5 percent of vehicles sold met a stricter standard of 120 g CO_2/km (Table 2.5). Assuming that the portion of sales that is represented by efficient cars can be applied to the industry's workforce, some 150,000 auto industry jobs could be considered a 'shade of green' under the stricter standard and 526,000 jobs under the more lenient one[50].

Table 2.5: Estimated Jobs Producing Fuel-Efficient Vehicles, European Manufacturers, 2004

	Vehicle Production / Employment	
	Number of vehicles	
Vehicles sold in Europe by ACEA members	11,484,785	
Of which vehicles emitting less than :	120 g CO_2/km: 879,401	140 g CO_2/km: 3,085,165
Share of total sales	7.5%	26.3%
	Number of Employees	
Passenger car manufacturing workforce	2,000,000	
Percentage share of "clean" vehicles, pro-rated vis-à-vis workforce total	150,000	526,000

Source: European Federation for Transport and Environment (T&E), Reducing CO2 Emissions from New Cars: A Study of Major Car Manufacturers' Progress in 2007 (Brussels, August 2008)

However, there are great variations among European countries and companies. According to the European Federation for Transport and Environment (T&E), French and Italian firms fared best in terms of offering vehicles with low carbon emissions,

[50] European Commission, "The Automotive Sector," op. cit. note 78.

whereas German-produced vehicles have relatively high emissions values[51]. This means, in rough terms, that a larger share of the 500,000 jobs in the French and Italian auto industry can be considered somewhat green, and a smaller share of the 733,000 German jobs[52]. Given the fact that car manufacturers source materials and inputs from an array of locations, a far more fine-grained analysis of factories would be needed.

2.8 Summary of Current and Future EU Environment Related Jobs

Table 2.6 summarises some of the key EU environment related jobs referred in this report.

Table 2.6: Overview of Selected Estimates of the Positive Employment Impacts from Environmental Polices in the EU

	Current jobs in the EU	Future jobs in the EU
Core Environmental Activities (includes renewables)	4.4m (direct jobs) plus a further 4.3m indirect and induced jobs	5% per annum growth till 2020
Renewables	Around 1.4 million gross jobs in 2005, and 0.3m to 0.4m net jobs	2020 RES target would generate ~ 0.4m net additional jobs and 2.8 million jobs in total
Energy Efficiency Goods and Services	0.9m (direct jobs)	n.a
Efficient Automobiles	0.2m(direct jobs)	n.a
Transport Infrastructure (Rail manufacture, urban transport, etc.)	2.0m (direct jobs)	n.a

[51] European Federation for Transport and Environment (T&E), Reducing CO2 Emissions from New Cars : A Study of Major Car Manufacturers' Progress in 2007 (Brussels, August 2008), p. 9.

[52] Job figures from International Organisation of Motor Vehicle Manufacturers, "Employment," http ://oica.net/category/ economic-contributions/auto-jobs/, viewed 8 March 2009

3 IMPACT OF ENVIRONMENTAL POLICIES ON SKILLS AND JOB QUALITY

3.1 The Changing Skills Profile

Environmental policies, including low carbon policies, will impact on sectoral employment, leading to new jobs, but also the loss of some jobs. The implications of these changes in demand for sectoral output will also affect the demand for skills in each sector as well as the number of jobs.

In summary, these changes can be characterised as follows:

- Some skills will become **obsolete** due to structural changes in the labour market and employment shifts both within and across sectors due to demands for a greener economy (e.g. as utility meter reading services are rendered obsolete by the introduction of 'smart' household meters that automatically relay data to utility companies);
- Demand for some **new skills** will be created as new 'green-collar' occupations emerge to support adaptation to and mitigation of climate change (e.g. support and servicing of solar, wind and other renewable energy technologies);
- The skills required for existing jobs will have a **stronger green element** as existing occupational profiles change (e.g. bottle manufacturers learning new technical skills to reduce carbon emissions from production). Upskilling and retraining of the current workforce will therefore be very important.

Table 3.1 illustrates what the change in skills profile is likely to be for sectors affected positively and negatively in the transition to a low carbon economy, as highlighted in Section 2.3.1:

Table 3.1: The Nature of Skills Required in Certain Environment-Related Sectors

Sector	Change in skills profile	Type of skills required
Recycling / waste treatment and recovery	New skills created	Rapid technological changes in this area are likely to create a growing need for 'new skills'
Construction	Stronger green element of existing jobs	Same generic skills of those already in the building sector required but jobs will require an 'add-on' in terms of e.g. renewable energy knowledge; installation; diagnostic techniques. Industry may experience increased demand in higher-skilled employees e.g. researchers and engineers but some jobs created as result of Energy Performance of Buildings Directive are likely to be low-

		skilled.
Bio-based products	New skills / stronger green element of existing jobs	Modern biotechnology likely to require highly-skilled employees with intensive knowledge although still unclear as to whether the skills they need are 'new' or add-on to existing skills
Energy Efficiency	New skills / stronger green element of existing jobs	Legislation such as the European Building Performance Energy Directive will create a strong demand for energy assessors (creation of new skills).
Green Transport	Stronger green element of existing jobs	Legislation on fuel economy standards will create demand for natural gas vehicles (NGV), liquid petroleum gas (LPG), bio-fuels and diesel/electric hybrid vehicle.

What is regarded as a 'green skill' is ultimately unclear and subject to debate. The OECD sees environmental job qualifications and skills as traditional qualifications and skills applied to environmental related sectors. In other words, there are no environmental qualifications per se but there are, for example, chemists working in the water and waste sectors. Renewable energy companies require 'regular' engineers and science graduates and their skills are **topped up** with in-house training programmes. On the other hand, the recent DG Environment report 'Environment and labour force skills' (2008) states that *specific* skills are needed for the 'green economy', examples being knowledge of sustainable materials, "carbon foot-printing" skills and environmental impact assessment skills.

3.2 Skills Needs Arising from Environmental Policies

Environmental policies are likely to lead to a rising demand for increasingly qualified and educated workers both in terms of technological advances and innovation. Examples include research into new composites materials for wind energy and new 'low-carbon IT', such as the design and management of control systems for building. In some sectors (such as logistics, inter-modal transport, building, electrical engineering) however, the additional jobs are perceived as less 'secure' in terms of pay and working conditions, and will need to 'evolve' to be able to attract well-qualified workers.

The number of studies undertaken in recent years to identify which skills, both specific and generic, associated with a move to a lower carbon development path, remains relatively limited. However, some Member States have made progress in identifying such skills. One example is the report commissioned in the UK in 2008, 'Skills for a Low Carbon & Resource Efficient Economy'[53]. In agreement with other literature[54], the report claims that many of the 'priority skills' required are in fact not new skills, but

[53] Defra (2008), 'Skills for a Low Carbon & Resource Efficient Economy': A Review of Evidence

[54] See, for example, Cedefop (2008) 'Identification of future skill needs for the green economy'

skills which '...already exist, whose availability needs to be increased or which need to be applied in new situations.'

3.2.1 Generic skills

A wide range of generic (cross-sector) skills will continue to be essential in a low carbon economy such as leadership, management, communication and financial skills, as well as the more traditionally identified skills such as those in energy, water and waste.

- More specifically, leadership and management skills are required to communicate the low carbon economy 'message' within organisations, strategic business planning, life cycle analysis, managing change, and financial investment modelling and management with the low carbon economy in mind. Effective organisations (both public and private) should already possess many of these, but should apply these day-to-day 'within a low carbon and resource efficient economy ethos'. Such skills are required in almost all sectors.
- Other generic skills required are: sustainable procurement skills, monitoring and measuring skills, carbon accounting, performance reporting, Environmental Management Systems, risk management, whole life costing, cost benefit and analysis and innovation and commercialisation skills.

3.2.2 Specific skills

Specific skills are likely to be of particular importance to the green economy. As the Cedefop report states, this is because "...the green economy creates a new skills paradigm that, in general, is more holistic in approach than the traditional skills paradigm, and.....places greater emphasis on design and working in multidisciplinary teams with high degree of autonomy and responsibility[55]."

However, instead of being entirely new skills, specific skills will relate mainly to either 'add-on' skills or an 'amalgam of existing skills'. For example, some knowledge of plumbing is still required to install sustainable heating systems and similarly solar tube and panel technologies require fitting or electrical skills.

Good diagnostic skills will also be in demand in the emerging green economy and the ability to measure the carbon footprint will be an important competence. Other examples of specific skills include:

- Renewables – planning, design and installation skills were highlighted as important e.g. competences required for the installation of sustainable biomass heating technologies (wood pellets or wood chip boilers) and technologies such as solar tubes and panels, photo-voltaic tiles or geothermal heating systems
- Energy sector skills across the board, including skills for renewables, clean fossil fuel technologies and new distribution network skills.
- Planning skills, skills in building services engineering and financial skills.

Demand for skills relating to a low carbon economy remains latent, and in Member States where the skills delivery system is demand-led, is likely to be driven forward only by organisations pushing for more 'green skills'. At the moment, those organisations which take action are driven mainly by a clear business case to do so, such as cost savings, or by legislation. In the UK, the growth of green technology within certain sectors is driving forward 'green' skills development responses (Box 3.1).

[55] Page 3, Cedefop (2008) 'Identification of future skill needs for the green economy'

Box 3.1: Nissan driving forward growth of low carbon technologies in the North East of England:

In July 2009, the carmaker Nissan pledged to invest over £200 million (EUR 230 million) in a new rechargeable lithium-ion battery factory in Sunderland, adding further impetus to the north-east region's drive to become a leading centre for green technology and economic area specialising in 'ultra-low carbon vehicles'. The region is in need of significant economic regeneration as a result of the decline in its traditional shipbuilding, steam engine and coalmining industries.

The investment in the new battery plant will potentially create up to 350 direct jobs and create and safeguard hundreds more in the associated supply chain. Furthermore, the region's designation as a low carbon economic area will lead to the establishment of a training centre to teach the manufacture and repair of green cars, the creation of a research and development hub collating work from five universities on using low carbon cars, and the opening of a test track to try out new vehicles. The region's offer of training will be crucial in meeting the rise in the demand for mechanics able to fix a new breed of electric vehicles, and the training is likely to range widely from basic training to masters and PhD levels.

Source: The Guardian, 21st July 2009

More recently, GHK Consulting was commissioned by DG Employment to conduct a number of company case studies for the Restructuring Forum[56] (held on 22 and 23 June 2009 in Brussels) on the impact of climate change on EU employment in the medium term (to 2020). All companies saw skills as a major area for impact from climate change drivers and much more significant than impacts on the numbers of jobs[57]. All companies, except the energy companies, had environmental training programmes to raise general skills and awareness of environmental and climate change issues, energy efficiency opportunities etc. Beyond this general training different companies had tailored training to address their specific needs. For example:

- Kiln operators in Holcim are trained on a fuel mix optimiser combined with financial software which evaluates savings from different fuel mixes for producing cement;
- Coca Cola trained its packaging designers to develop lighter packaging;
- Virgin Atlantic has trained its pilots in more fuel efficient procedures for take-off and landing;
- ANCC-COOP has a training centre (the "COOP School"). Training on sustainability and climate change is part of a mainstream training programme for heads of sale points. Specific training modules are also organised on specific topics (for example on packaging and recycling) and when new technology or management procedures are introduced (i.e. waste reduction, recycling, energy saving and management);
- Menzies has trained its drivers extensively, with refresher courses, in more fuel efficient driving.

[56] http://ec.europa.eu/social/main.jsp?catId=103&langId=en&eventsId=172&furtherEvents=yes

[57] The Impacts of Climate Change on European Employment and Skills in the Short to Medium-Term: Company Case Studies (Vol 1)

3.3 Job Quality – Green but not Necessarily 'Decent'

There tends to be an assumption in much of the literature that green jobs are 'well-paid' and have good working conditions in the EU, although there are mixed views on the impacts of an increased number of 'green' jobs on job quality. The AK Wien study (2000)[58] concluded that "overall, integrated environmental protection results in clear positive effects regarding employment quality. Apart from a significant increase in skills levels, there is an improvement in physical working conditions."

However, the ILO/UNEP report (2008)[59] highlights the fact that 'green; jobs are often characterised by:

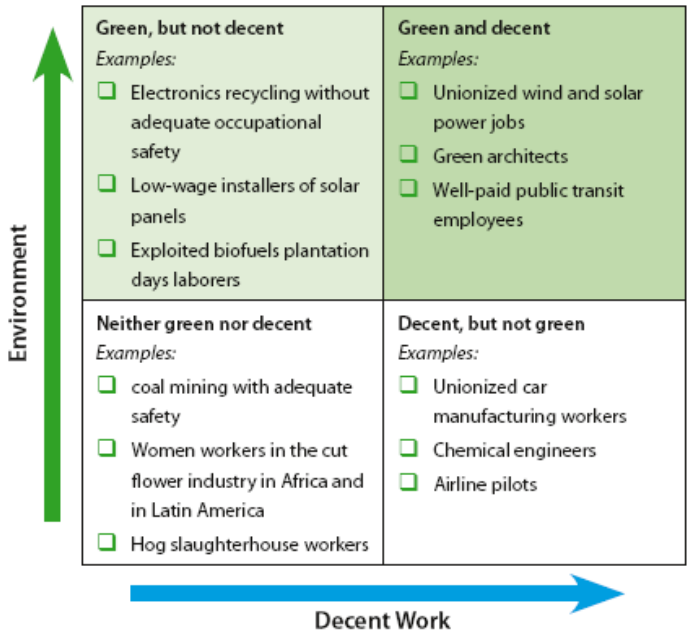
- poor practices, such as exposure to hazardous substances that threaten health and quality of life
- low pay
- forced and/or child labour.

Failure to meet any one of these criteria is considered to make the job '**indecent**', according to the UNEP/ILO (2008) report. UNEP and ILO have developed a quadrant-like schematic overview to illustrate the varying levels of 'green' and 'decent' jobs that exist (Figure 3.1).

Figure 3.1: Schematic Overview Green Decent and Indecent Jobs

[58] Institut für Wirtschaft und Umwelt der Arbeiterkammer Wien (AK Wien) (2000), Environment and Employment: sustainability strategies and their impact on employment". Quoted in DG Environment report 'Environment and labour force skills' (2008).

[59] UNEP, ILO (2008) Green Jobs: Towards decent work in a sustainable, low-carbon world



Source: UNEP/ILO (2008)

Examples of 'green but not decent jobs' cited by UNEP/ILO include electronics recycling without adequate occupational safety and low-wage solar panel installers.

A recent study by 'Good Jobs First'[60], a US national policy resource centre, found a wide variation in employment conditions in some existing workplaces in a number of 'environment-friendly' sectors of the economy - including manufacturing of components for wind and solar energy, green construction and recycling. The study indicated that:

- Low pay was not uncommon in the workplaces profiled, and wage rates at many wind and solar manufacturing facilities are below the national average for workers employed in the manufacture of durable goods. In some locations in the US, average pay rates fall short of income levels needed to support a single adult with one child.
- Some US wind and solar manufacturers had already begun to offshore the production of components destined for US markets to low-wage havens such as China and Mexico. Examples of offshoring included the manufacture of blades for wind turbines, 'defying the common assumption that such blades are too large to ship overseas'.
- Very few workers at wind and solar manufacturing workplaces identified in the course of the research were covered by collective bargaining agreements.
- Publicly available data on overall construction wages for non-union construction workers employed in 'green' building suggested that they were far lower than those of the union members profiled in the report.

It remains uncertain how applicable these observations are to green jobs in the EU; there appears to be almost no literature with an equivalent level of detail on working conditions within environment-related sectors in Europe.

[60]Good Jobs First (2009), 'High Road or Low Road? Job Quality in the New Green Economy' http://www.goodjobsfirst.org/pdf/gjfgreenjobsrpt.pdf

3.4 Social Impacts of Transformation to a Low-Carbon Economy

There are conflicting arguments as to whether the impact of environmental policies on employment will reinforce social opportunities and equity. On the one hand, it could be argued that the creation of more green jobs will open up employment opportunities for those who were previously excluded from the labour market, acting as a 'platform' for integrating those who had been on the 'fringes' of the labour market. On the other hand, there is a fear that the increase in green jobs may exacerbate the gap between skilled and unskilled jobs.

The social impacts modelled in the Mosus project found that structural changes due to sustainability scenarios may enhance risks of social exclusion. This is because to exploit the advantages of enhanced effectiveness and opportunities from moving to a low carbon economy, a certain degree of flexibility is required, particularly in the labour market. People must be able to change and adapt to new jobs, and they may have to move to other places. The sustainability scenarios in the Mosus modelling found that the high and low sustainability scenarios lead to a notable increase in the rates of structural change in most countries in the EU-15. There were also differences in structural change between EU-15 and new Member States. Economic growth is conditioned upon these structural changes, which is why high economic growth in itself may lead to unemployment among those who adapt slowly. Normally, such changes contribute to enhanced risk of social exclusion, particularly for those who move to urban areas[61].

However, new technologies and developments in work organisation associated with 'green' jobs may result in an important increase in demand at the 'high level' end of the job spectrum. At the same time, medium-skilled routine tasks and repetitive work may be replaced by automation and computerization[62], or indeed outsourced to countries outside the EU, leaving a large number of people out of work and with 'obsolete' skills. This 'polarisation' effect has been envisaged in several Member States, although at this stage, it is not 'clear-cut' and may be offset by a high replacement demand for middle-skilled workers.

Some of the key social process issues related to skills expected to arise when moving to a low carbon economy, and the actions to overcome them are summarised in Table 3.2 below.

Table 3.2: Issues Emerging from Changes to Environmental Policy and the Potential Social Process Responses

Issue	Action
Jobs losses in certain industries as a	Creation of a **compensation fund** at the

[61] CICERO (2005): Evaluation of social exclusion: Work Package 5.3, CICERO: Centre for International Climate and Environmental Research, Oslo.
http://www.mosus.net/documents/MOSUS_Evaluation_Social_Exclusion.pdf

[62] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - New Skills for New Jobs - Anticipating and matching labour market and skills needs {SEC(2008) 3058} http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52008DC0868:EN:NOT

result of 'going green' e.g. damage caused to the freight industry as a result of encouraging a move away from private road transport	EU level to elicit the support of industries who may suffer as a result of environmental policy. Re-training of those workers whose skills have become obsolete, in sectors requiring skills that are similar to those used in their previous roles.
Insufficient 'green agenda' within those companies not particularly impacted on by environmental policies	Selective incentives for the adoption of sustainable practices and training programmes, designed to equip participants with a more holistic perspective on their skills and business practices
Too slow a development of green skills requirements within education and training systems to meet the needs to industry and increased demand	Improved social dialogue between those developing education systems and training standards and both employers and trade unions Promotion of multidisciplinary learning environments and a broader view of how competences are defined and acquired
Inadequate training being provided by those sectors experiencing the greatest employment impacts as a result of environmental policy (whether obsolete or new jobs)	A closer working relationship between the needs of industry and the formal education and training system Continuous professional development through the provision of greening or mitigation technology modules
A lack of recognition of the importance of certain 'new' green jobs in meeting demand	Potential role for the EU to create an EU wide certification for green skills such as, for example, energy assessors

In 2008, the TUC set out its views on a just transition to a low carbon economy[63]. In doing so, it described a set of 'Just Transition principles':

- ***A meaningful environmental transition and sustainable development*** – all sections of society should work together to prevent further damage to the planet's ecosystems;
- ***Representation and employee involvement*** – all sections of society should have the opportunity to have their perspectives voiced and considered;
- ***Stable employment and long-term planning*** - long-term planning to preserve job equity and ensuring work conditions do not suffer in the transition;

[63] TUC (2008) A Green and Fair Future For a Transition to a Low Carbon Economy, www.tuc.org.uk/touchstone/Justtransition/greenfuture.pdf

- ***Social justice and a fair distribution of costs*** – ensuring the costs and benefits of change fall proportionately on different sections of society;
- ***Government backing and a united purpose*** – a high level of commitment from all relevant stakeholders, including the Government, trade unions and business federations.

As part of this, the TUC report suggested the establishment of a national framework or mechanism to ensure long-term planning and representative decision making on environmental transition.

3.5 Role of Labour Market Policies for Enabling Transition to a Low Carbon Economy

The small net impact on jobs due to climate change and environment policies conceals considerable changes in jobs within sectors and the flow between sectors. It is important to understand the transition flow of jobs within sectors as well as between sectors. The transition will have important implications for the labour market. This raises the question of whether labour market policies are geared to cope with the transition. In particular:

- Are training mechanisms in place for forward planning of jobs and skills?
- Can labour market policies guarantee decent jobs to replace lost jobs?
- Are labour and social contracts keeping in pace with the transition?
- What are the bottlenecks? Some EU countries have found that funding or infrastructural issues are not the main problem but the provision of basic and ongoing education of people in the winning and losing sectors.
- Are mechanisms in place for increasing cooperation and coordination amongst businesses and policy makers? For example, the transition to electric vehicles and bio-fuels requires automobile companies to work extensively with electronic and electrical companies, requiring a significant transformation and cultural shift.

The emphasis on creating 'more and better' green jobs as part of the European economic recovery, in the context of the Lisbon Agenda, may mean that green jobs emerge as more 'secure' jobs and consequently may attract an influx of migrants both from within and outside the EU.

In particular, active labour market policies[64] including flexicurity and labour mobility policies in Europe can ease the transition. They can help in smoothing the reallocation of workers towards less polluting activities and in making workers more receptive to experimental innovations. Table 3.3 discusses how the key components of flexicurity can contribute towards meeting the challenges of moving to a low carbon economy.

Finally, where there are negative consequences for employment, it might be possible to create a compensation fund at EU level, similar in concept to the example of the 'globalisation fund', specifically designed to assist those who have suffered unemployment as a result of global competition.[65]

[64] http://ec.europa.eu/employment_social/news/2006/nov/employment_europe_en.pdf

[65] Cedefop (2008) 'Identification of future skill needs for the green economy' http://www.cedefop.europa.eu/etv/Upload/Projects_Networks/Skillsnet/Flashes/GreenEco-conclusions.pdf

Table 3.3: Flexicurity Response to the new Challenges created by the Transition to a 'Low Carbon/green economy'

	Component of flexicurity	Challenge	How each flexicurity component can respond to the new challenges created by the transition to a 'low carbon/green economy'	Source
1	Flexible and secure contractual arrangements and work organisations	The employment security conditions particularly for lower qualified new jobs (e.g. low wage installers of solar panels), modified tasks (e.g. labourer in recycling management chain) created as a result of new climate policies will enjoy less secure conditions of employment than in established branches*.	The situation could be responded by an appropriate modern labour laws, collective agreements according to both employers' and employees' needs. In other words, the policy component is designed: ▪ to help 'outsiders', who are employed on short-term or irregular contracts or unemployed to find work and to move to stable contractual arrangements; ▪ to help 'insiders' who are permanent employees prepare themselves for job changes in advance due to economic transition**.	*ETUC (2007), 'Climate Change and Employment', p. 50 **Obadic (2009), 'The Danish Flexicurity Labour Market Policy Concept', p. 6
2	Effective Active Labour Market Policies (ALMPs)	Climate policies will create new opportunities for businesses (e.g. in clean tech, pollution control) and the public sector (e.g. regulation and monitoring); enlarge the scope of certain practices (such as business, management and engineering departments); close down certain 'brown activities'(e.g. production of certain packaging materials); increase demand for higher skilled, more educated and more specialised employees, and reduce the number of jobs available for the least skilled workers***. As a result of this, the transition will lead to new jobs, job losses and job shifts/transformations.	ALMPs help both employers and employees cope with the (rapid) transition to new low carbon/green jobs. They can reduce the effect of certain contingencies such as unemployment. By implementing ALMPs such as an efficient job search support and good work incentives, jobseekers can be encouraged to find new employment. Well designed ALMPs are intend to: ▪ identify both employed and unemployed workers' needs; ▪ assist and train the victims of the transition; ▪ identify recruiters which look for certain skills and knowledge; and ▪ identify job seekers who actually posses these skills and knowledge. The ALMPs aim at creating a link between labour market needs and the education/skills institutions as certain key environment-related employment such as eco-consulting and biofuels processing will require high skills and educational background+.	***ETUC (2007), 'Climate Change and Employment', p. 50 +ECORYS (2008), 'Environment and Labour Force Skills', pp. 30-33
3	Reliable and responsive lifelong learning (LLL) systems	Need for investment in human capital both (re)training existing employees and creating new skills/expertise. Requires ambitious and creative solutions. This is crucial for a sustainable 'green economy' and moving to a low-carbon path.	LLL systems ensure the continuous adaptability and employability of all workers, and enable firms to keep up the productivity level. The main objective is to invest in human capital in order to respond to rapid change and innovation by giving employees necessary practical skills and knowledge (for example, Virgin Atlantic has trained its pilots in more fuel efficient procedures for take-off and landing; similarly, Coca Cola trained its packaging designers to develop lighter packaging++).	++GHK (2009), 'The Impacts of Climate Change on European Employment and Skills in the Short to Medium-Term: Company Case Studies', volume: 1,

	Component of flexicurity	Challenge	How each flexicurity component can respond to the new challenges created by the transition to a 'low carbon/green economy'	Source
			Furthermore, in sectors which are more likely to be affected by the transition process (for positively and negatively affected sectors), the scope of expertise and skills for the positions (e.g. managers, business and finance professionals, engineers and ITC professionals) are expected to undergo transformation and expansion (or contraction)+++. This component of the strategy intends to increase the competitiveness of the market players and contribute to the long-term employability of workers.	p. 10 +++EC (2009), 'Investing in the Future of Jobs and Skills: Sector report; Electricity, Gas, Water, and Waste'
4	Modern social security systems	Possible skill gaps and mismatches arise in the labour market increasing the burden of the transition, such as unemployment, very low salaries (e.g. waste management labourers) ±, higher commodity prices, falls particularly on vulnerable groups (e.g. women, young people).	The component provides people in need with adequate income support and facilitates market mobility. This includes broad coverage of social protection provisions.	±UNEP (2008), 'Green Jobs: Towards decent work in a sustainable, low carbon world', p. 40
5	Need for social partnership and social dialogue	Need for supportive and social dialogue, and highly developed industrial relations. Increased cooperation and coordination amongst businesses, policy makers and civil society.	Employer organisations and other stakeholders have a role in facilitating the transition process by encouraging their affiliates and partners to engage in social dialogue and to take practical action within the workplace on the issues. Effective interaction among the actors increases awareness and builds a broader political and social consensus about the need for climate measures and how to implement them±± (such as the creation of tripartite climate change plan between Spanish government, unions and business in 2006). The interaction and dialogue is also a key element particularly in developed EU countries where the level of deindustrialisation has become so advanced that the policy-makers will need to be made to ensure that the green manufacturing sector is capable of functioning without crippling bottlenecks and skills gaps in the workforce±±±.	±±ITUC (2009), 'Just transition: A trade union proposal' ±±±UNEP (2008), 'Green Jobs: Towards decent work in a sustainable, low carbon world', p. 289

4 CONCLUDING OBSERVATIONS

As with previous structural changes to the economy, a shift to a low carbon economy will affect each business, worker and family differently. This will depend on the sector a person works in, the type of job they are doing and where they are geographically located. Previous economic structural shifts have had huge social impacts, with some workers and communities becoming socially excluded as industries close. It is thus important that the low carbon agenda should be considered from social, environmental and economic viewpoints. The positive message is that the low carbon agenda is now set in motion and recognised in the new green stimulus packages across the world, as capable of generating economic as well as environmental benefits.

Essentially, the number and nature of jobs will change as the relative importance of sectors changes, with some expanding, others contracting, and others remaining stable but with changes in processes and products. Labour market and social impacts will depend on the mix of these sectors within national, regional and local economies.

Key concluding observations from this note are:

- Environmental policies can be linked or integrated with a broader range of polices (enterprise, trade, research and innovation, employment) both domestic and abroad, to secure positive employment impacts in Europe from pursuing environmental objectives
- In particular, active labour market policies, together with broader trade and sectoral polices, can be used to maximise the employment and social benefits from the move to a low carbon / greener economy
- Europe's leadership in environmental policies has yielded a growing number of (green) jobs, which will expand still further as a result of the green stimulus packages. Economic modelling suggests the net employment impacts of future and planned environmental policies are likely to be small at the level of the EU, but that there will be significant sectoral employment changes, with the potential for significant social impacts in some locations
- Renewable energy appears to provide the largest potential for new jobs (even after taking account of reduced conventional energy activity), followed by green transport infrastructure and technology and investment in the energy efficiency of goods and services
- These sectoral changes are reasonably predictable, allowing forward planning, retraining and aid for adjustment and transition
- The extent to which the change in employment between sectors leads to more decent jobs is unknown and represents a risk to social cohesion and to a smooth transition

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