# THE IMPACT OF THE EU CLIMATE POLICY ON GREEN JOBS CREATION

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## Abstract

*The term 'green jobs' can be referred to the employment in a narrowly defined set of industries (for example: energy, construction, transport, etc.), which provide environmental services or can be connected with a broader issue of the employment consequences. Most of the literature focuses on the direct employment. The potential impacts of green growth policies on the labour market situation tend to be overlooked. More attention also needs to be paid to how labour markets operate in different types of economy. There are many challenges, especially for the countries, which have built their industrial development strategies around the cheap carbon-based energy. The induced structural green change should be accompanied by active labour market policies. There are many difficulties connected with defining green economy, especially green employment. To determine the impact of green economic policy's tools one requires a precise definition of green jobs. It is very difficult mainly because of many definitions of green jobs in the literature. This impact is not only direct but also indirect. A very important thing is also to determine the main factors, which influence the green employment in the main strategic sectors of the economy at a national and regional level.*

*The main goal of this publication is to show the impact of climate policy on green employment in the EU countries. This will require precise defining of green jobs and to give the information about possible methods of this impact's estimating. Main methods, which are adequate for estimating the impact of climate policy on green jobs' creating were: the OECD ENV-Linkages model which is a recursive dynamic neo-classical general equilibrium model, dynamic approaches based on general equilibrium models (DSGE). There is also possibility to use indicators in the frameworks of taxonomic analysis (for example: Clark's divergence coefficient, Euclidean distance, the measure of an angle and also chosen methods of objects' grouping (for example: Ward's method of grouping). Existing policies included in European Employment Strategy and the OECD Reassessed Jobs Strategy, provide the essential framework for successfully managing the structural labour market changes required to decouple production from harmful environmental effects. Priority ought to be given to:*

- *supporting the mobility of workers and reducing the adjustment costs created by displaced workers.*
- *supporting eco-innovation and their diffusion by strengthening initial education and vocational training,*
- *reforming the tax-benefit system for workers in order to ensure that cost pressures generated by environmental policies do not become a barrier to employment. Taking into account a regional and sector specific of the employment structure, we can formulate many interesting conclusions and advice for climate and economic policy makers.*

***The type of the article:*** *Theoretical article.*

***Keywords:*** *climate policy, green jobs, sustainable development's paradigm, EU.*

***JEL Classification:*** *J21, Q01.*

# 1. Introduction

### Defining green growth

The OECD has noted that "green growth is gaining support as a way to pursue economic growth and development, while preventing environmental degradation, biodiversity loss and unsustainable natural resource use" (OECD/Martinez-Fernandez, Hinojosa, Miranda, 2010). There is a particular concern about the consequences of human-induced climate change. As the World Bank's World Development Report (2010) argues, "Economic growth alone is unlikely to be fast or equitable enough to counter threats from climate change, particularly if it remains carbon intensive and accelerates global warming. So climate policy cannot be framed as a choice between growth and climate change. In fact, "climate-smart policies are those that enhance development, reduce vulnerability, and finance the transition to low-carbon growth paths" (World Bank, 2010). Stern (2007) thinks that "the new industrial revolution and the transition to low-carbon growth constitute a very attractive path. It is likely to bring two or three decades of innovative and creative growth and large and growing markets for the pioneers. Low-carbon growth, when achieved, will be more energy-secure, cleaner, safer and more bio-diverse than its predecessors." The green employment has to be considered as a part of green growth, but this last term is much more difficult to be defined.

### Definitional criteria for green economy

Definitional criteria provide the foundation for the understanding and categorizing the green economic activity as it specifically pertains to the labour market development challenges. The three main definitional criteria include an economic perspective, a technical perspective, and a development process perspective (Defining the green economy, 2010):

- technical perspective - defines the green economy through the application of quantitative, analytical criteria that measure exactly what it is about a product, process or service that is 'green,' and to what extent,
- economic perspective - relates the characteristics of an activity to categorize its economic classification system of sectors, industries, and occupations. The economic criteria might assess whether products or services contribute to the decreased greenhouse gas emissions, or include sustainable resources in manufacturing processes,
- development process - identifies where in the development cycle a green job is situated. The development process includes the phases of development of a product or service, from the research phase to design, delivery, implementation, ongoing use and maintenance.

### Defining green jobs

A green organization is defined as one that produces goods or services designed to minimize environmental impact. Building upon the work completed by other organizations which pursue similar objectives, ECO Canada defines a green job as one that works directly with information, technologies, or materials that minimize environmental impact, and also requires specialized skills, knowledge, training, or experience related to these areas. Through the research process it became evident that the viable approach to build a common and universally consistent language would be to conceptualize and communicate green jobs as the ones which focus on the aspects related to production, and more specifically, the production of goods or services that support ecological integrity and minimize environmental impact (Defining the green economy, 2010).

The United Nations Environmental Programme (UNEP) defines green jobs "… as work in agricultural, manufacturing, research and development (R&D), administrative, and service activities that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help to protect ecosystems and biodiversity; reduce energy, materials, and water consumption through high-efficiency strategies; de-carbonize the economy; and minimize or altogether avoid generation of all forms of waste and pollution" (UNEP, 2008).

´Green jobs´ does not lend itself to a tight definition but certainly includes the direct employment which reduces environmental impact ultimately to levels that are sustainable. This includes jobs that help to reduce the consumption of energy and raw materials, decarbonizes the economy, protect and restore ecosystems and biodiversity and minimize the production of waste and pollution. […] A somewhat wider concept of "green jobs" might embrace any new job in a sector which has a lower than average environmental footprint, contributes to improving overall performance, albeit perhaps only marginally" (ILO, 2008).

The Eurostat methodology for the "Environmental Goods and Services Sector" (EGSS) does not define "green jobs", but measures the employment in the EGSS. The EGSS is a heterogeneous set of producers of technologies, goods and services that prevent or minimise pollution and minimise the use of natural resources. Environmental activities are divided into two broad segments: environmental protection and resource management. Only those technologies, goods and services are considered which have the environmental protection or resources management purpose as their prime production objective (i.e. 'environmental purpose'), hence excluding goods and services that are not provided mainly for environmental purposes (EMCO, 2010). The largest influence of the green economy on employment is in terms of jobs being adapted or reallocated, with existing workers having to learn new skills and/or broaden their pre-existing skill sets. The movement towards greening the economy has resulted in a need for increased economic integration and increased demand for a more holistic economic approach (Defining the green economy, 2010).

**Institutional frameworks for green jobs development in the EU countries**

The Green Jobs Initiative is a joint initiative by the United Nations Environment Programme (UNEP), the International Labour Organization (ILO) and the International Trade Union Confederation (ITUC), which has been launched to assess, analyse and promote the role of the employment in the climate change, i.e. the effect of existing climate change impacts on the employment and the employment consequences of future programmes for climate mitigation (aimed at reducing greenhouse gas emissions and addressing the drivers of climate change) and adaptation programmes (aimed at addressing the impacts of climate change). It supports a concerted effort by governments, employers and trade unions to promote environmentally sustainable jobs and development in a climate-challenged world. Its objectives are:

- to promote awareness and dialogue,
- to identify and respond to knowledge gaps,
- to facilitate a "just transition" that reflects the environmental, economic and social pillars of sustainable development
- to promote policies and measures to achieve green jobs and green workplaces,
- to catalyse employment and poverty alleviation within climate mitigation and adaptation programmes,
- to strengthen collaboration between UNEP/ILO/ITUC, within the UN system and with the international business community (UNEP, 2008).

EU Commission main documents according to the green economy and green employment creation states:

- The European Commission Communication of 3 June 2009 "A Shared Commitment for Employment" (COM(20090, 257), which stresses that Europe must not only tackle the recession but must turn it into an opportunity to create a more productive, more innovative, more inclusive, better skilled low-carbon economy, and that 'green jobs' have the potential to become a key growth segment of future EU labour markets;
- The Council Conclusions of 21 October 2009 "Towards sustainability: Eco-efficient economy in the context of the post-2010 Lisbon Agenda and the EU Sustainable Development Strategy" (14891/09), which invite Member States to use the employment and education policies to reduce current skills gaps for eco-efficiency and to facilitate workers' employability in higher growth sectors such as eco-efficient construction and

housing, sustainable transport, renewable energy and recycling, while encouraging the creation of new green jobs.

The key aim for the transition to a green economy is to enable economic growth and investment while increasing environmental quality and social inclusiveness. Critical points in attaining this objective is the establishment of the conditions for public and private investments to incorporate broader environmental and social criteria (UNEP, 2011).

The problem of green jobs creation in the EU countries is of a crucial significance because it is connected with the development of modern, pro-ecological sectors of the economy which will have a dominant share in the future structure of the economy. Forecasting green jobs development in the EU countries is a very complicated task, mainly for the following reasons:

- the climate policy impact on the employment in green sectors of the economy must be determined in an indirect way which is based on the determination of the impact of this policy on product markets,
- current economic crisis causes the increase in the rate of total unemployment and national debt in the EU countries; its service drains financial means for the development of modern, ecological production techniques,
- the current recession increases also inaccuracy of forecasts, which are essential for the strategies promoting green growth.

Different approaches to support the green jobs creation in the EU are presented in the paper. They are mainly inspired by the sustainable development paradigm and employ different methods of analysis of current and forecasted developments of the green economy, which are based on econometric models. In the article the principal differences between the approaches to the analysed problems, and their main weaknesses were indicated. The proposition of a research methodology going beyond the current analysis was also presented.

The most important climate policy tools used by the EU are:

- subsidies and tax credits have been granted to enhance energy efficiency in a variety of areas, including buildings, transport and households. Renewable feed-in tariffs (FITs) were also introduced in the renewable energy sector. These taxes and credits have raised supplies of clean energy and reduced emission of greenhouse gases (GHGs),
- the EU Emissions Trading System (EU ETS) is the first and largest international scheme that aims to combat climate change and cost-effectively reduce industrial GHG emissions,
- in order to promote the environmentally friendly energy generation and decrease emissions, the governments of the EU Member States launched various climate change programs and funds. Renewable sectors are expanded by investing more in low-carbon energy production such as wind, solar, geothermal, hydro and nuclear power. Major EU Member States announced Public-Private Research Partnerships (PPRP) to fund a wide range of renewable energy investments (Green policies in the EU: a review, 2010). Governments of EU Member States are promoting energy efficiency and the use of renewable energy in the renovation and construction of buildings. Governments have also conducted surveys and feasibility studies while launching educational programs,
- the only evidence of the green labour market policies is from the countries which used tax revenue to finance reductions in distortionary labour taxes. Other quantitative or qualitative green labour market policies are not yet widespread in EU Member States.

Green policies are all measures and instruments implemented by the government or other governmental institutions that have the purpose and the potential to reduce $CO_2$ emissions. Reducing $CO_2$ emissions cannot be limited to a few industries like the energy sector for example. A broad-based approach to encourage behavioural adjustments throughout the entire economy is needed since the consumption of fossil based energy resources can be decreased in many parts of the economy. The primary goal of policy instruments is to reduce the damage to the environment at minimum economic cost. Environmental taxes and charges are the most widely used market-based instruments for the green policies in the EU with governments imposing taxes on transport,

emissions and air pollution, energy and mineral oil.

A variety of policies can encourage the structural change toward a low-carbon economy. The tools of this policy include (Green policies in the EU: A review, 2010):

i. Regulations
ii. Tax Instruments
iii. Emission Trading Systems (Certificates and Licenses)
iv. Research and Development
v. Public Investment

While all of the instruments are relevant to the EU context, the first three options—regulations, tax instruments and trading systems—are identified in the literature as the main approaches to cope with global climate change (Uzawa (2003), Bertram (1992)). Indeed, the EU has relied heavily on tax instruments and trading schemes in addressing climate change, especially because these tools effectively assign a price to carbon – a favoured approach among economists. Some countries have engaged in more comprehensive tax approaches under the Environmental Tax Reforms (ETR) in the 1990s (Green policies in the EU, 2010).

The main climate policy instruments in the EU are presented in Figure 1.

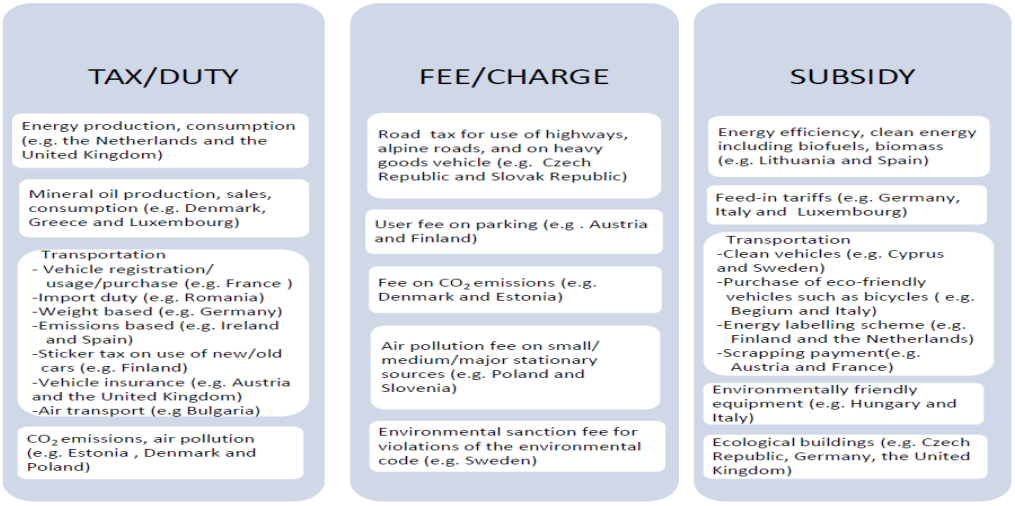


**Figure 1.** Major climate policy instruments in the EU

*Source:* Green policies in the EU, 2010, p. 4

The EU has adopted the "20-20-20" plan (Europe 2020, 2010), which sets climate and energy targets of cutting GHGs by 20 per cent by 2020 compared with 1990 levels, achieving 20 percent of primary energy from renewable resources and improving energy efficiency by 20 percent by 2020. As part of the strategy, many governments in the EU have imposed taxes on the usage of electricity, mineral oils, roads and vehicles, which vary based on weight, purpose and emissions. The European countries have also designed a wide range of taxes including a tax on plastic bags in Ireland, the nutrient surplus charge in the Netherlands and waste disposal and batteries taxes in Denmark (EEA (2005)). The plan also includes conducting surveys and feasibility studies while launching educational programs to provide information concerning renewable energy, energy efficiency and pollution. Understanding the impacts of the climate change on labour markets and the resulting policy implications requires distinguishing the different mechanisms through which this process will take place. The climate change is expected to affect labour markets in several ways, each of them will have different implications on businesses and workforces. The figure 2 presents the three major channels through which the climate change may affect the labour markets: changes in consumer habits, direct impacts on natural and built environments, and impacts from regulations (OECD/Martinez-Fernandez, Hinojosa, Miranda, 2010).

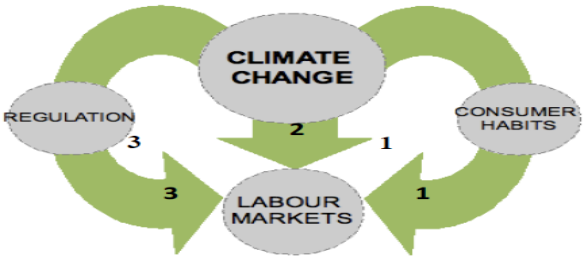


**Figure 2.** Impacts of climate change on labour markets
*Source:* OECD, 2010, p. 7

A consumer-driven demand for cleaner products (goods and services) as a result of an increased social awareness of the dangers of the climate change will be a key driver of changes in the labour markets. Climate change has already begun to modify consumer preferences and habits. The direct impact of this will be a reduced demand for products which are or are perceived to be as damaging to the environment either in their end use or method of production; as well as an increase in demand for energy efficiency and non-polluting products. (OECD/Martinez-Fernandez, Hinojosa, Miranda, 2010).

A survey carried out by Eurobarometer shows that 50 per cent of EU citizens are in favour of taxing products with high environmental footprints, and over 83 per cent of respondents declared taking into account the environmental impact of products before purchasing them (Docquiert, 2009). These market-driven changes are expected to lead to the expansion and to the contraction of certain economic sectors and industries, which is bound to impact labour markets. Activities such as green labelling might need new green analytical skills and more jobs might be created around green labelling but also procurement needs and legal procedures would increase. Another way of influencing the habits of consumers and suppliers in the labour market is through the implementation of green taxes. These taxes act as an incentive for industries and businesses to limit their GHG emissions, and for consumers to buy low-carbon products and services. For instance, France has outlined plans to impose a carbon tax on large industrial installations until 2013 when they start paying for emission permit. On the other hand, France has implemented the malus, which is an additional tax to be paid by consumers when buying a car that emits more than 160g CO2/km (OECD/Martinez-Fernandez, Hinojosa, Miranda, 2010).

In addition to the changes in consumer habits and preferences, the climate change will affect the labour markets through the increase in the climate change-related natural phenomena resulting from global warming such as floods, heat waves, and falls in precipitation levels. These events will eventually lead to resource and species depletion; and to physical impacts on natural and built environments (Reckien *et al*., 2009) and human populations.

Such events will have a significant impact on labour market conditions of the affected regions. On the supply side, climate change related phenomena will affect workforce availability due to potential food shortages (especially in agricultural regions) and a decrease in the health conditions of the population (ILO, 2008). On the demand side, the viability of businesses and economic activities will be strongly undermined leading to decreases in the demand for labour. Several economic sectors have been identified as highly vulnerable to the direct effects of the climate change due to their dependence on regular climate conditions. These include agriculture, tourism, insurance, forestry, fisheries, infrastructure and energy (ETUC, 2006).

Key impacts of the climate policy on the labour market are following:

– the greening of the European economy is already generating significant numbers of new jobs in key sectors, such as renewable energy and energy-efficient construction, and will continue to do so in coming decades. There has also been an acceleration in the development and application of new environmental technologies which is creating new occupational specialties, such as designers and operators of smart electrical grids, and

opening up new export markets,

- while the transition towards a green economy creates new opportunities for workers, it also creates new risks, particularly for workers in the most carbon-intensive industries. A relatively small number of industries account for nearly 90% of CO2 emissions in the EU, but just 14% of employment. Although relatively few workers appear to be at-risk, some of the workers in these industries will likely need targeted assistance, such as retraining to work with cleaner technologies or help finding new jobs in growing green sectors,
- the net impact on overall employment is likely to be small, but it can be increased by well-designed policies. The report uses simulation models to analyse how ambitious climate-change mitigation policies, for example, may affect labour market outcomes. These simulations show that recycling tax revenues from carbon pricing to lower the taxation of labour can sometimes achieve a "double-dividend": both environmental gains and higher overall employment,
- the green transition is changing job skill requirements, but there appear to be few uniquely green skills. As a result, there is no need to "reinvent the wheel". Most of the green skills that new labour market entrants will require can be met through incremental enrichment of established vocational education and training programmes, while a modest amount of top-up training should suffice for most experienced workers. The strong trend increase in environmental patenting, which is documented in the report, underlies the importance of preparing the workforce for a period of the rapid eco-innovation, including the raising of science, technology, engineering and mathematics *(STEM) skills (Main findings from the OECD study…, 2012).*The government regulation includes all the policy interventions designed to make less likely the occurrence of actions that generate negative spillovers or externalities. By its nature, a regulation restricts an individual or firm from doing what it otherwise would have done (OECD/Martinez-Fernandez, Hinojosa, Miranda, 2010) (see Figure 3).

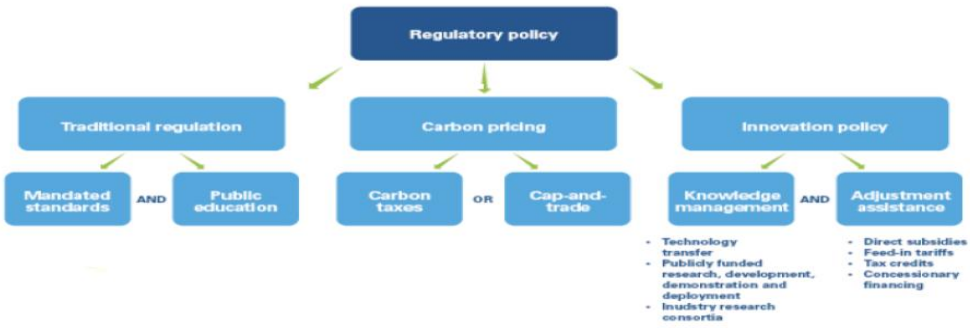


**Figure 3.** A taxonomy of climate change regulation

*Source:* OECD, 2010, p. 10

**Overall impact of the climate policies on the economic growth**

The link between the climate change mitigation policy, growth and jobs is a complex one. The issue is also relatively recent, hence the existing literature on the subject is not wide and there is an "obvious lack of knowledge" on the relation between climate change and employment (ETUC, 2005). Nevertheless, with the rising interest in the climate change and in its implications, a number of studies at national and European level have recently been developed.

The Stern report (Stern, 2007) estimated that the annual cost of cutting total greenhouse gas (GHG) emissions to about three quarters of current levels by 2050 (consistent with a 550ppm $CO_2$e stabilisation level) will range between a benefit of 1.0 to a cost of 3.5% of GDP, with an average estimated cost of approximately 1% (i.e. about €350-400b). The range taken into consideration was wide because of the uncertainties as to future rates of innovation and fossil-fuel extraction costs.

What the exact cost will be will depend on the future cost of low-carbon technologies (which are expected to be cheaper than currently), and also on improvements in energy efficiency.

The Joint Research Centre estimated that, in the EU27, the climate policy repercussions in all sectors will lead to a GDP decrease of 0.19% in 2020 (per year) and of 0.24% in 2030, compared to the baseline scenario. Worldwide, the annual impact of the climate policies on global GDP will be a decrease of 0.14% by 2020, and of 0.19 by 2030. The climate policies were also expected to reduce annual consumers' welfare by 0.20% by 2020 in the EU27 (against 0.10% worldwide), and 0.26% by 2030 (against 0.15% worldwide). World average welfare reductions are smaller than EU values because it was assumed that consumers in developing regions with large reduction potential will benefit from emission trading revenues. The recent impact assessment accompanying the Commission's integrated package of measures on climate change, released in January 2008, calculated that, given a cost-effective emission reductions approach, the European GDP in 2020 would be on average 0.54% lower than it would otherwise be without these measures. Overall, these cost impacts are considered to be limited. If the policies were implemented the GDP is expected to grow by 37.46% over the period 2005-2020, instead of 38% as in the baseline scenario. Private consumption is also projected to decrease by a very limited extent, i.e. by 0.11% (European Commission, 2008a, 2008b).

**Overall impact of climate policies on employment**

Many studies have estimated that the climate policies will create new job opportunities, leading to job reallocation and, potentially, an increase in the employment levels. The Stern Report (2007) highlighted that the expected growth in the markets for renewable energy generation products, stimulated by the climate change policies, will be accompanied by a significant shift in employment patterns. It is expected that by 2050 the number of people working in this sector will grow from the current 1.7 million to more than 25 million worldwide (Stern, 2007). The European Commission (2008a, 2008b) estimates that the impacts of mitigation policies on the employment could lead to a 0.41% reduction in jobs by 2020, though this figure would be affected by different assumptions on international mitigation efforts and the use of the CDM. According to the ETUC, CO2 emission control measures can have a relatively small but positive effect on the overall employment, resulting on an increase in the employment of 1.5% in the EU25 in the coming 10-20 years (ETUC, 2005). GHK, IEEP and Cambridge Econometrics (2007) find that, even if direct effects of policy options on the growth and jobs may be neutral or small, indirect effects can be much larger, generally indicating that the EU economy would gain, especially in employment terms, from the introduction of environmental policies.

It is useful to think of the employment impact of climate policy in three stages. Climate policy will have:

- a short-term effect, when jobs are lost in directly affected sectors and new ones are created in replacement industries. It can be treated as the direct employment effect.
- a medium-term effect, when the impact of climate change policy ripples through the economy. Jobs are created and lost along the value chains of affected industries. These are the higher-order, economy-wide effects of climate policy.
- a long-term effect, when innovation and the development of new technologies generate opportunities for investment and growth. It is dynamic effect of climate policy.

The nature of the jobs created may differ from the nature of jobs lost, and this will have repercussions on labour productivity and pay. For a full assessment, this would have to be taken into account. However, productivity information is scant and little will therefore be said about the relative quality of jobs. (Fankhauser *et al.*, 2008).

In the short term, there will be job creation and loss in directly affected industries. Jobs will be lost in carbon-intensive sectors, which will grow less fast or may even contract (for example, when coal-fired power plants are decommissioned). New jobs will be created in low-carbon sectors. This is the direct employment effect of climate policy. Its sign will depend on the labour intensity of

these industries. There are only a few studies of the employment aspects of concrete climate change policies. Much richer is the literature on the employment effect of renewable energy, compared with fossil-fuel-based energy. (Fankhauser *et al*., 2008). An excellent summary of the employment effect of renewable energy technologies is that of Kammen *et al.* (2006). The comparisons are difficult to make, since each study uses slightly different assumptions, approaches and methodologies. One of the virtues of the Kammen *et al.* (2006) study is the systematic way in which it corrects for such differences. Over the medium term, climate change policy will percolate through the economy as the behaviour changes and value chains adjust. The economy-wide effects of climate policy have to be studied in an input–output framework that traces the effects of a policy through the supply chain. There is an evidence from such models that the indirect effects of the climate change or renewable energy policy are generally positive (Jochem, Madlener, 2003) and could be at least as high as the direct effects.

In the longer term, the climate change policy will unleash a wave of innovation as firms reposition themselves and seek to exploit carbon opportunities. Jobs will be created in R&D of low-carbon technologies. Over time, the results of this research will generate new investment and further job opportunities. What these will be and how this would differ from what would have happened without these policies is hard to predict. What is not in doubt, however, is the powerful effect that innovation and technical change can have on the productivity and economic growth. Growth theory has long identified technical change and innovation as a major source of economic growth. Skill-biased technical change is a major factor in explaining labour market developments over the last few decades in both Europe and the USA – including the changes in the wage income (through productivity growth), job creation (through expansion) but also wage inequality (since some low-productivity jobs remain) (Fankhauser *et al.*, 2008).

## 2. Methods

### Key Statistical indicators (by SWD)

Green jobs cover "all jobs that depend on the environment or are created, substituted or redefined in the transition process towards a greener economy" (SWD (2012), quoted). Such a broad definition accounts for the fact that regulatory and technological changes linked to the shift towards a resource efficient and low-carbon economy have far-reaching implications for a vast range of occupations. To better specify the focus of the green jobs agenda, we can identify two distinct sectors associated with particular challenges:

a) development of green jobs in eco-industries,

b) supporting the 'greening' of traditional industries.

Although skills management represents an outstanding policy challenge in both cases, available evidence suggests treating the two domains differently.

### Objective and approach (by Ecorys)

Two studies in particular are updated namely "Links between the environment, economy and jobs" (GHK, IEEP and Cambridge Econometrics, 2007) and "Study on competitiveness of the EU ecoindustry" (Ecorys, IDEA, 2009). These studies are different in both approach and scope. Whereas GHK et al uses an input – output model and a broader scope for green jobs, the Ecorys and IDEA study uses statistical reporting based on Environmental Protection Expenditure (EPE) and a more narrow scope. The main objective of these elaborations is to (re-)estimate the number of jobs that are directly or indirectly dependent on the environment by different environment related categories and for all EU-27 Member States. To allow for correct estimations, the study follows the methodologies in the previous studies. Since this is only one part in this 'new' study, the methods used in the 'old' studies are only briefly explained. For further explanations and discussions the approaches presented in Ecorys (2012) should be taking into account.

**Approach and definitions (by Ecorys and IDEA)**

Both the Ecorys and IDEA study and the GHK study base their definitions on an OECD – Eurostat definition from 1999 which argues that eco-industries are: "Activities which produce goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and ecosystems. This includes technologies, products and services that reduce environmental risk and minimize pollution and resources". The Ecorys – IDEA study narrows the definition down to limit the scope and exclude adjacent industries: "Eco-industries are those sectors within which the main – or a substantial part of – activities are undertaken with the primary purpose of the development of technologies and the production of goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and ecosystems" The definition excludes jobs such as eco-tourism which are termed 'connected' industries. Furthermore, jobs created as a result of "unnatural" innovation, and jobs that have been "relabelled green" (green washing) have been eliminated from the calculation of environmental and resource efficiency jobs. The GHK study, on the other hand, has generated a typology of jobs related to economic and environmental linkages and thus casts the net much wider that than Ecorys and IDEA. In both studies the use of direct and indirect jobs and industries are used. There are a number of activities falling under the scope of employment dependent on the environment and resource efficiency improvements, and can be broken down into three types of categories:

1. Activities where the environment is a primary natural resource or input into the economic process – Agriculture, forestry, mining, electricity generation and water supply.
2. Activities concerned with protection and management of the environment - Waste recycling, pollution & sewage control and environmental management.
3. Activities dependent on environmental quality – Environment related tourism.

The Ecorys and IDEA study has focused mainly on category 2 activities, that mainly fall within the definition of Eco-industries, whereas the GHK study looks at the broader picture and to a higher extent includes categories 1 and 3: the environment as the primary natural resource as well as activities dependent on environmental quality.

**OECD approach**

The OECD ENV-Linkages model is a recursive dynamic neo-classical general equilibrium model, documented in details in Burniaux et al. (2010). It has been used for OECD publications: the Environmental Outlook to 2030 (OECD, 2008) and The Economics of Climate Change (OECD, 2009). The model represents the world economy in 15 countries/regions, each with 26 economic sectors, allowing structural changes across countries and regions and within each of them to be studied in detail. The economic sectors include five electric generation sectors, five that are linked to agriculture, five energy-intensive industries, three sectors linked to oil and gas extraction, refineries and distribution petroleum products, the remaining sectors being transport, services, construction and four other manufacturing sectors. Technological progress is exogenous, but alternative existing production technologies are modelled in great detail in the energy sector and the mix of technologies used evolves in response to changes in relative prices. A labour market clearing equation equalises the aggregate labour demand to an exogenous employment level, and therefore determines wages. Exogenous employment levels are derived from labour force projections to 2050 and from estimates of national unemployment rates provided by the OECD Economics Department (see Duval, De la Maisonneuve, 2010). The model is built primarily on a database of national economies. The core of the static equilibrium is formed by the set of Social Account Matrices (SAMs) that described how economic sectors are linked; these are based on the GTAP database. Many key parameters are set on the basis of information drawn from various empirical studies and data sources (see Burniaux *et al.*, 2010). The "business as usual" (BAU) projection used as a support for economic policy scenarios is described in detail in OECD (2011) (OECD, 2012).

**Estimating a new growth path for Europe**

A series of climate policy assessments have been produced during the process leading to the EU20/20/20 package (Europe 2020 Strategy, 2010). Some studies consider mainly two effects: the substitution of fossil fuels by renewables and the reduction of energy use by energy efficiency measures. Both effects are assumed to involve social costs in the short run. Their only possible justification can be seen in the avoidance of long-term costs from climate change. A simple linear dynamics is assumed, by which social costs increase for every additional unit of greenhouse gas avoided. In a consequence, the reduction of 30% is seen as more costly than a reduction of 20% of the GHG emissions. The reference study on the 20% target before the financial crisis (Capros *et al.*, 2008) was commissioned by the European Commission and performed using the PRIMES3 equilibrium model of the European energy system. It analyzes the implementation of the EU20/20/20 package under various scenarios of the flexibility mechanisms associated to the emission reductions and renewable energy sources (RES) constraints, as well as the price of fossil fuels. An independent assessment (Boehringer, Rutherford, Tol, 2009) of the EU20/20/20 package has been performed in the framework of the Stanford energy modelling forum, using a series of computable general equilibrium models.

So far in conducted analysis dynamic approaches based on general equilibrium models (DSGE) were mainly used. Because of too short time series and uncertainty according to the shaping of analysed variables during current economic crisis there is a strongly need to broad the 'old' methodology on new approaches based on complex method of structural equations modelling which includes the following stages: specification, identification, estimation, testing (detailed description of these stages – see: Schumacher, Lomax, 2010). There is also possibility to use indicators in the frameworks of taxonomic analysis (for example: Clark's divergence coefficient, Euclidean distance, the measure of an angle and also chosen methods of objects' grouping (for example: Ward's method of grouping). Its implementation would let to increase reliability of conducted analysis and would give opportunity to formulate more precise conclusions.

The research methods are based on structural equation modeling. They primarily use multiple regression, factor analysis, taxonomic methods, and the method of DEA (Data Envelopment Analysis), which will produce an aggregate index takes into account the impact of the implementation of specific tools of EU climate policy for the development of green industries and they generate green jobs (Schumacker, Lomax, 2010). The need to use this method due to the fact that the available statistics are insufficient to create a time series of sufficient length and have a certain, fairly significant gaps. This eliminates the possibility of any analysis of dynamic, based for example on the use of econometric models. DEA method is called *alternative nonparametric method* for measuring the effectiveness of the system (in this case the effectiveness of the green market) without the need for direct connection of input indicators with indicators for output. This method is also limited by the amount of available observations. It is also dependent on the units in which we measure analysed input and output variables. In contrast to the use of econometric approaches is based on determining the efficiency of the system (in this case the effectiveness of green in the markets in selected strategic areas (sectors) of the economy) (Schumacker, Lomax, 2010).

Regarding modeling types, there are several approaches (Rothengatter, Schaffer, 2008; Pfaffenberger, 1995; Kratzat, Lehr, 2007) that use a variety of methods from simple analytical approaches, input-output calculations, econometric models, optimization models to general equilibrium models as well as system dynamic models each aimed at specific research questions and economic theory (Breitschopf, Nathani, Resch, 2011).

There are many challenges that face studies estimating green jobs over extended periods of time. Some of these issues are common across similar studies estimating job creation from investment in any sector of the economy and include static nature of input-output models, uncertainties associated with policies, intricacies of consumer behaviour (hence, difficulty of predicting how consumers may react to certain policies) and external shocks, which are by definition unpredictable (Gülen, 2010).

# 3. Results

## Development of green jobs in eco-industries

There is a lack a systematic collection of data on the development of eco-industries in the EU. Eurostat provides a database on the Environmental Goods and Services Sector (EGSS). Despite continuous improvement efforts, available data are still incomplete, because employment data cover only six countries (DE, FR, NL, AT, RO, SE). To remedy this lack of information, there is necessity to focus on specific sectors (Ecorys, 2012):

- water collection, treatment and supply (NACE E36); sewerage (E37); waste collection, treatment and disposal activities; materials recovery (E38); remediation activities and other waste management services (E39) represent the sectors for which Eurostat provides a more complete and reliable data collection at the present time. In 2011, these four sectors employed around 1.6 million workers in the EU, which made up 0.77% of total employment (15-64). The incidence of these sectors on total employment noticeably differs across EU countries. It ranges from less than 0.5% (in Cyprus, Denmark, Netherlands, Finland and Sweden) to over 1% in Slovenia, Slovakia, Hungary and Bulgaria. Higher employment shares in these sectors should be weighted against labour productivity and energy efficiency of these industries in order to gain a full picture of their state of development in the EU countries.
- water and waste collection, sewerage, and remediation activities – in 2008-2011, employment grew by 45 000 jobs in the EU (+2.7%). However, percentage employment changes between 2008-2011 suggest that the crisis hit green sectors differently in different countries. Data show severe employment losses in Austria, Slovakia, and Portugal during analysed period, other countries noted remarkable employment gains (mainly: Belgium, Bulgaria, Sweden and Slovenia) (see Figure 4).

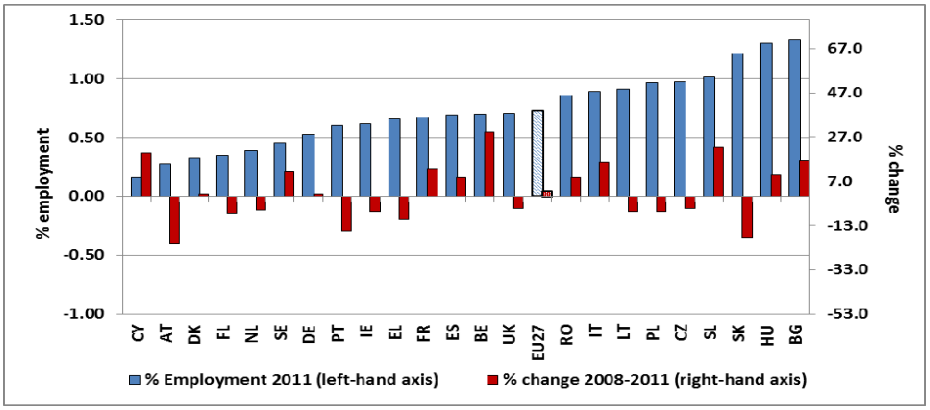


**Figure 4.** Share of employment (in %) in water collection, sewerage, waste collection, and remediation activities (2011), and % change (2008-2011)

*Source:* ec.europa.eu/europe2020/pdf/themes/green_jobs.pdf, p. 3

- the renewable energy sector (RES) is one of the fastest growing sectors in Europe. Between 2005-2009, it contributed to the creation of more than 300,000 jobs. According to the European Observatory of Renewable Energy latest data, in 2010 RES employed about 1.1 million workers in the EU27 (0.5% of total employment). Within the RES, solid biomass, photovoltaic, and wind powers had higher numbers of employees across the EU (over 250,000 each). However, considerable differences were observable among the Member States. Germany, France, Italy, and Spain exhibited the highest number of employees in 2010, even though Finland, Denmark, Sweden recorded the highest shares on total employment (between 1.2 and 2%). Conversely, other countries such as the UK, Malta, Poland, Bulgaria, Romania, and Ireland witnessed the lowest employment incidence of this sector (below 0.2%) (see Figure 5).

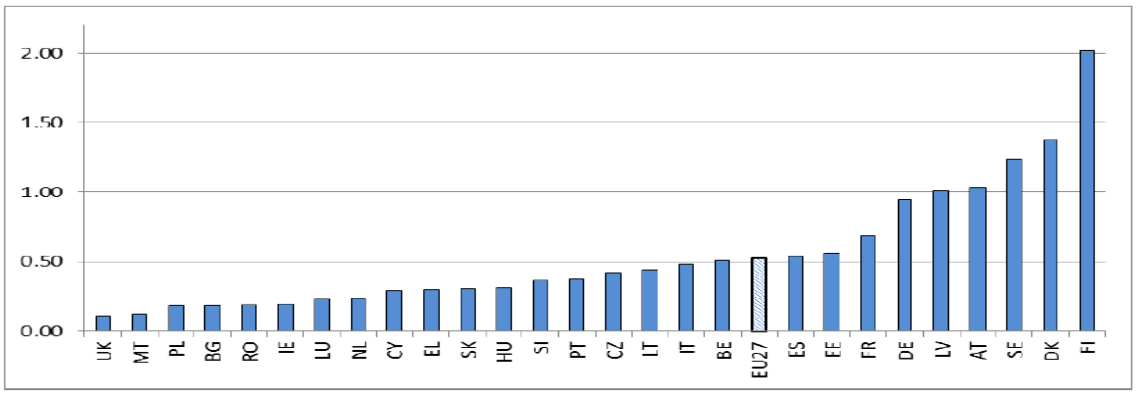


**Figure 5.** Employment in the renewable energy sector as % share of total employment (2010)
*Source:* ec.europa.eu/europe2020/pdf/themes/green_jobs.pdf, p. 4

– environment-dependent activities based on natural resources (non-organic agriculture, organic farming, forestry, fishing, as well as mining, extraction and quarrying, renewable and non-renewable electricity generation ad water extraction and supply) also constitutes important source of direct, indirect and induced employment. In 2007, these sectors employed about 28.4 million individuals (in full-time equivalents) in the EU27, 16.7% of the EU working age population, of which 10.7 million in agriculture only. The employment share of environment-dependent sectors was highest in Romania (60%), Bulgaria (40%) and Poland (about 32%), and in other central, eastern and southern countries like: Lithuania, Slovenia, Austria, Hungary, Portugal and Greece (over 20%) (Ecorys, 2012).

**Greening of traditional industries**

According to the European Environmental Agency, the source of 60% of the total GHG emissions in the EU is attributable to the energy supply (31,8%) and energy use (28.2%) sectors. Transports are responsible for 19.7% of the GHG emissions (Ecorys, 2012).

Green growth policies imply significant challenges for traditional industries with relatively high ratio of GHG emissions to value added (electricity, gas and water supply; water transports; air transports; coke, refined petroleum products and nuclear fuel; inland transports, supporting and auxiliary transport activities; other non-metallic minerals; basic metals; chemicals and chemical products).

Figure 6 shows that, all emission-intensive industries made up 7.45% of total EU employment in 2011, about 15.8 million workers. The Member States present significant differences in the impact of emission-intensive industries on total employment. The lowest share is recorded in Cyprus, Luxembourg, Portugal, the Netherlands, Denmark, and Ireland (below 6%), and the highest share was recorded in Czech Republic, Slovakia, and Poland (over 10%) (Ecorys, 2012) (see Figure 6).

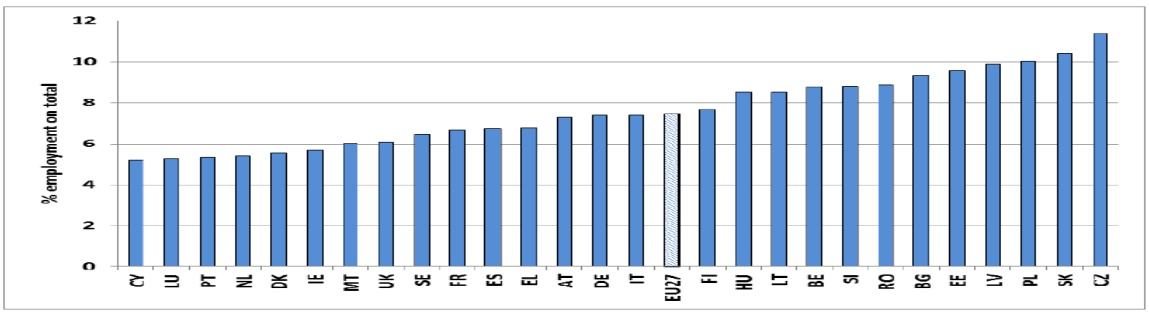


**Figure 6.** Employment share (in %) of traditional industries in the EU27 (2011)
*Source:* ec.europa.eu/europe2020/pdf/themes/green_jobs.pdf, p. 5

Figures 7-8 represent the results of the calculations with the new methodology and adjusted LCF (Trial 2). Compared with the previous results of the 2009 study and methodology, there are some differences in the relative performance of Member States. This is due to a decrease in the absolute and relative figures. Countries with a high share of employment in "Waste Management" are affected more strongly than others, this is particularly the case for Germany, Belgium and Estonia.

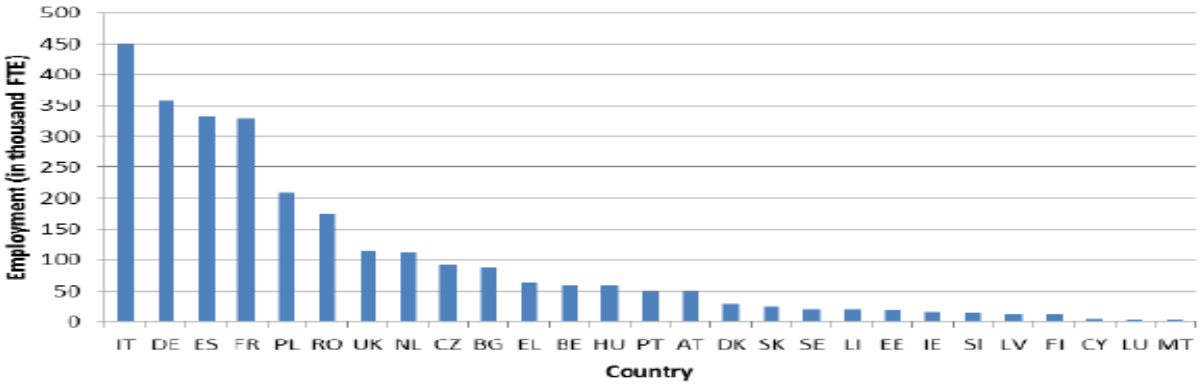


**Figure 7.** Employment in thousands (new methodology & new LCF) in 2008

*Source:* Ecorys, 2012, p. 40

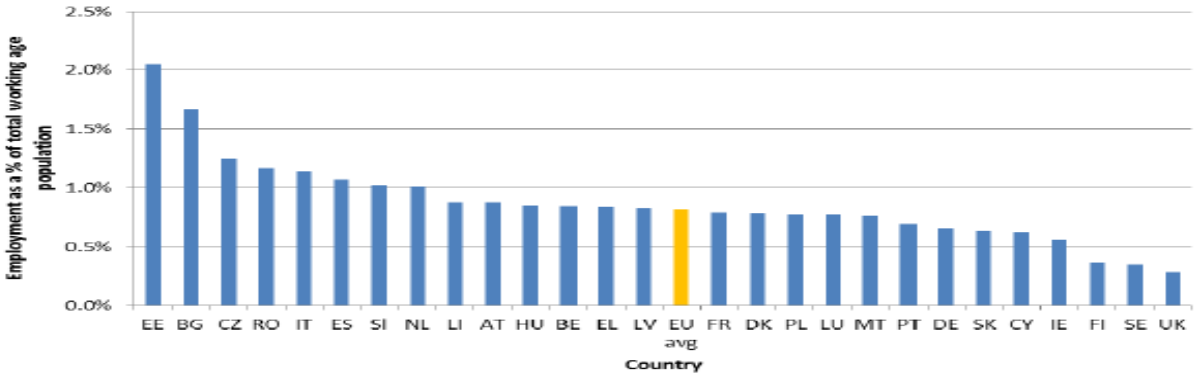


**Figure 8.** Employment as a % of total workforce (new methodology & new LCF) in 2008

*Source:* Ecorys, 2012, p. 40

To facilitate the comparison, the Member States are listed in the same order in the figures. For example, Estonia has the highest employment share of Ecoindustries in its total workforce, but in absolute FTEs a rather low number of employees in Ecoindustries compared to e.g. Italy, Spain and France (Ecorys, 2012).

## 4. Discussion

The purpose of the publication was to present different approaches, which show the impact of the EU climate policy on green economy and green jobs creating. It should deliver to the national authorities recommendations according to the policy instruments possible for implementation, which will support the creation and functioning of the green sectors in the EU economy in the most effective way. The main findings from the conducted analysis, based on different approaches, are following:

1. Green employment should be one of the most important drivers of socio-economic development of the EU-countries in the future.
2. Green employment is strongly connected with green growth and green markets development.
3. The net impact of the green development supporting and development will be

differentiated in short-term and long-term perspectives at regional level and in different branches. In the short-term perspective the net impact can be in most of cases negative (mainly because of high adjustment costs), especially in the UE-12 countries), but in the long-term perspective should be positive.

4. There is a strong necessity to support the development of green markets and green growth development by adequate climate policy leading at supranational (EU), national and regional levels. This policy should take into account mainly the following aspects: the alleviation of the consumers' cost of the transfer to the low emission economy, eco-innovation financing, improving the social awareness, monitoring of the changes, forecasting the costs and the benefits based on the development scenarios
5. The current economic crisis has a strong influence on the situation on green markets. The post-crisis Europe can revitalize its economy by tackling the climate challenge. Raising the European climate target from 20% to 30% emissions reductions can open the way towards higher and faster economic growth which will influence on employment increasing. During the economic and financial crisis the EU growth path will proceed at a lower level than before the crisis. It will be hard to maintain the growth rate of the pre-crisis times. As a result, the unemployment across Europe is likely to stay high. Clear policies associated with a decisive move to a 30% target, can be doubly beneficial for the climate and the EU economy. The climate target must not be pursued in isolation, but be embedded in a comprehensive range of measures, setting expectations for growth of the European economy at a more ambitious level. The EU needs to accept the challenge of increasing economic growth while reducing both unemployment and greenhouse gas emissions. Empirical verification of above mentioned hypothesis should give the opportunity to determine costs and benefits of new green jobs' creating and also the impact of the climate policy tools on its generation (Jaeger *et al*., New Growth, 2011).

Green growth combined with the adequate EU climate policy has the potential to address economic and environmental challenges and open up new sources of economic growth through the following channels:

- Productivity. Incentives for greater efficiency in the use of resources and natural assets: enhancing productivity, reducing waste and energy consumption and making resources available to highest value use.
- Innovation. Opportunities for innovation, spurred by policies and framework conditions that allow for new ways of addressing environmental problems.
- New markets. Creation of new markets by stimulating demand for green technologies, goods, and services; creating potential for new job opportunities.
- Confidence. Boosting investor confidence through greater predictability and stability around how governments are going to deal with major environmental issues.
- Stability. More balanced macroeconomic conditions, reduced resource price volatility and supporting fiscal consolidation through, for instance, reviewing the composition and efficiency of public spending and increasing revenues through the pricing of pollution.

Adequate climate policy can also reduce risks of negative shocks to economic growth resulted from:

- resource bottlenecks which make investment more costly, such as the need for capital-intensive infrastructure when water supplies become scarce or their quality decreases (e.g. desalinisation equipment). In this regard, the loss of natural capital can exceed the gains generated by economic activity, undermining the ability to sustain future growth,
- imbalances in natural systems which raise the risk of more profound, abrupt, highly damaging, and potentially irreversible, effects – as has happened to some fish stocks and as could happen with damage to biodiversity under unabated climate change. Attempts to identify potential thresholds suggest that in some cases – climate change, global nitrogen cycles and biodiversity loss – these have already been exceeded (OECD, 2011).

The greening of the European economy has already generated significant numbers of new jobs in key sectors, such as renewable energy and energy-efficient construction, and will continue to do so in coming decades:

- the transition towards a green economy creates new opportunities for workers, but it also creates new risks, particularly for employment in carbon-intensive industries. Only few workers appear to be at-risk, some of the workers in these industries likely will need targeted assistance,
- the net impact on employment is likely to be small, but it can be increased by well-designed policies. The simulations show that recycling tax revenues from carbon pricing to lower the taxation of labour can sometimes achieve a "double-dividend": environmental gains and higher overall employment[1],
- the green transition is changing job skill requirements, but there appear to be few uniquely green skills. Most of the green skills can be met through incremental enrichment of established vocational education and training programmes. The strong trend increase in environmental patenting, underlies the importance of preparing the workforce for a period of rapid eco-innovation (Main findings from the OECD study, 2012). Labour market and skill policies ought to play an active role in helping workers and employers to make the transition to green growth. Existing policies included in European Employment Strategy (main assumptions, goals and instruments were formulated in April 2012, see: http://ec.europa.eu/social/main.jsp?catId=101&langId=en) and the OECD Reassessed Jobs Strategy (2004), provide the essential framework for successfully managing the structural labour market changes required to decouple production from harmful environmental effects. Priority ought to be given to:
- supporting the mobility of workers and reducing the adjustment costs created by displaced workers,
- supporting eco-innovation and their diffusion by strengthening initial education and vocational training,
- reforming the tax-benefit system for workers in order to ensure that cost pressures generated by environmental policies do not become a barrier to employment. (Main findings from the OECD study, 2012).

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[1] Some commentators such as Pearce (1991) and Oates (1991) have drawn attention to a phenomena of potential „double dividend" from environmental taxes – the possibility that an environmental tax might both improve the environment and provide revenue that can be used to reduce other distorting taxes on labour supply, investment, or consumption. This argument has a number of implications for two important kinds of policy decisions. First, in the tax policy choice about how to raise a given revenue, some have argued for a switch from conventional distorting taxes to environmental taxes. Second, for the environmental policy choice about how to control pollution, some have argued for a switch from non-revenue-raising instruments (quotas or grandfathered permits) to revenue-raising instruments (environmental taxes or auctioned permits) (Fullerton, Leicester, Smith, 2008).

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