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## Greening of Industries in the EU: Anticipating and Managing the Effects on Quantity and Quality of Jobs

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## Greening of Industries in the EU: Anticipating and Managing the Effects on Quantity and Quality of Jobs

### Abstract

[Excerpt] All jobs will be affected as the EU moves to a green economy: new jobs will be created and some will be eliminated, but most existing jobs will be transformed. To ensure a socially responsible transition towards high-quality green jobs, concerted efforts by governments, employees, employers and other stakeholders are crucial in anticipating and managing this process.

The research carried out in this study examined green business practices and greening processes aimed at mitigating climate change – if radical mitigation measures are not taken in time, adaptation could eventually prove impossible. The study had two main objectives:

- to provide an overview at both sectoral and cross-sectoral level in the EU of the effects of greening on the quantity and quality of jobs in 10 sectors (automotive, chemicals, construction, distribution and trade, energy, furniture, non-metallic materials, shipbuilding, textiles and transport);
- to analyse good practice examples of the anticipation and management of green change at company level in these sectors.

### Keywords

European Union, EU, green economy, labor market, climate change

### Comments

#### Suggested Citation

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Eurofound

# Greening of industries in the EU: Anticipating and managing the effects on quantity and quality of jobs

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**Research project:** Growth and employment: Anticipating and managing the effects of greening of industries in the EU

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The individual company case studies and the following annexes are available on the Eurofound website at <http://www.eurofound.europa.eu/emcc/labourmarket/greening.htm>:

Annex 1: Definitions used in the report

Annex 2: Overview of the target sectors

Annex 3: Evidence for the impact of climate change on the quantity of jobs

Annex 4: List of interviewed stakeholders



# Executive summary

## Introduction

All jobs will be affected as the EU moves to a green economy: new jobs will be created and some will be eliminated, but most existing jobs will be transformed. To ensure a socially responsible transition towards high-quality green jobs, concerted efforts by governments, employees, employers and other stakeholders are crucial in anticipating and managing this process.

The research carried out in this study examined green business practices and greening processes aimed at mitigating climate change – if radical mitigation measures are not taken in time, adaptation could eventually prove impossible. The study had two main objectives:

- to provide an overview at both sectoral and cross-sectoral level in the EU of the effects of greening on the quantity and quality of jobs in 10 sectors (automotive, chemicals, construction, distribution and trade, energy, furniture, non-metallic materials, shipbuilding, textiles and transport);
- to analyse good practice examples of the anticipation and management of green change at company level in these sectors.

To achieve these objectives, the following six tasks were carried out:

- identifying the major challenges to the targeted sectors arising from climate change;
- mapping the main motivations of companies for greening;
- providing examples of green business practices implemented by companies;
- assessing the impact of climate change on the quantity and quality of jobs;
- identifying the approaches used for the anticipation and management of socially responsible green change;
- making policy recommendations on the anticipation and management of green change at company level.

The study used a variety of data collection and analysis methods, including a literature review; an online survey; interviews with representatives of stakeholders, companies and workers; case studies of companies; and an expert workshop.

The analysis looked at good practice that aimed to increase the quantity and quality of productive and sustainable jobs. Particular attention was paid to collaborative approaches involving social partners, public authorities, education and training providers, non-government organisations and other actors. The focus was on the direct impact on jobs in the EU of green business practices and the greening process.

## Policy context

To address the challenges arising from climate change, the European economy is witnessing an unprecedented need for greening. In addition to the climate and energy targets ('20-20-20' targets) to be met by 2020 (as agreed in 2007), the European Commission's roadmap for moving to a competitive low-carbon economy proposed an 80%–95% reduction in greenhouse gas emissions by 2050 from a 1990 baseline. This challenging target will require even more coordinated action from all actors in creating and implementing the instruments and investments necessary to promote the transition to a low-carbon economy.

## **Key findings**

The main challenge arising from climate change is the so-called ‘employment challenge’ – how to mitigate climate change, maintain or even increase employment levels and secure existing or even improve job-quality standards.

Implementation of green business practices may have a twofold impact on jobs. It may affect the quantity of jobs by creating new jobs, eliminating inefficient existing jobs or substituting them with greener ones, and may transform jobs by introducing new types of environment-related responsibilities. Green business practices may also affect the quality of jobs, defined in four dimensions: career and employment security, skills development, health and well-being of workers, and reconciliation of working and non-working life.

Greening seems to have redistributed jobs between sectors (especially smaller ones) and has not altered absolute employment levels. The main effect of the economic and financial crisis has been to slow down (mainly through cuts in public support) the overall pace of greening across industry in the EU.

No straightforward conclusions can be made on the overall impact of climate change on job quality. Available evidence suggests that the impact is moderate. Skills development is the job-quality dimension most notably affected; the impact on the other dimensions is less clear.

The results indicate that companies tend to manage rather than anticipate green change. Most companies are likely to use conventional approaches and not make use of eco-innovations. The evidence gathered during the study suggests that employees are not sufficiently engaged by employers in green change processes; they are not fully convinced why greening is necessary, and greening of their workplaces is often not clearly associated with higher job quality.

Since the transition to a low-carbon economy is policy driven, the anticipation of green change could be more straightforward and explicit, while management measures can even be planned and launched right at the outset. Public authorities play a crucial role in helping the market to eco-innovate and to achieve the desired level of low-carbon economy across industry.

## **Policy pointers**

The greening of industry provides many opportunities for businesses.

One of the key prerequisites for successful socially responsible green change is a general awareness and acceptance of change among employees. Thus, promotion of organisational and behavioural innovations aimed at clear communication and employee involvement could significantly facilitate the greening of industry in the EU.

Public authorities are often regarded as the key facilitators of green change anticipation and management processes in the economy. To ease the greening of industry, public authorities could apply well-balanced regulatory and financial measures accompanied by non-financial measures, such as those that address the question of ‘why’, support networking by small and medium-sized enterprises, and coordinate new training programmes.

Innovative capacities and barriers to the greening of industries concentrate at the local level. Central government should coordinate its actions with local governments and involve local institutions.



A number of tentative trends at cross-sectoral and sectoral level identified by the study need to be supported by further, more detailed research at (sub-)sector level.

The company case studies demonstrate that the implementation of green business practices can result in a ‘triple win’ situation:

- greater competitiveness and profitability for companies;
- more and higher-quality jobs for employees;
- a stronger economy and a healthier environment.

It is vital to brand the greening process so that the positive aspects of greening are communicated clearly to all stakeholders and to urge industry forward in the non-stop loop of eco-innovation.



## Context

To address the challenges arising from climate change, the European economy is witnessing an unprecedented need for green change (greening). In addition to the climate and energy targets ('20-20-20' targets) to be met by 2020 agreed by the European Union in March 2007 (Council of the European Union, 2007), on 8 March 2011 the European Commission adopted 'A roadmap for moving to a competitive low carbon economy in 2050', in which it proposed a 80%–95% reduction in greenhouse gas (GHG) emissions by 2050 from a 1990 baseline (European Commission, 2011a). This challenging target will require even more coordinated action from all actors in creating and implementing the instruments and investments necessary to promote the transition to a low-carbon economy.

It is acknowledged that all jobs will be affected by the transition to a green economy: new jobs will be created and some eliminated, but most (existing) jobs will be transformed. To ensure a socially responsible transition towards high-quality green jobs, concerted efforts by governments, employees, employers and other stakeholders are crucial in anticipating and managing this process. The ministerial conference organised by the Belgian presidency in September 2010 concluded:

*All jobs have to become greener. The workplace, the labour conditions, the use of new materials that need energy efficiency standards, the work planning and commutes must be thoroughly revised. In order to achieve this, the social dialogue, the employees and employers will all have to play a crucial role.*

Belgian Presidency of the European Union (2010)

The Council conclusions of 6 December 2010 on employment policies for a competitive, low-carbon, resource-efficient and green economy (Council of the European Union, 2010) also emphasised that:

*In the pursuit of a competitive, low-carbon, resource-efficient and green economy, special attention should be paid to the need to sustain and increase productivity and to encourage quality in employment.*

The Council invited Member States and the European Commission to 'endeavour to ensure that the jobs created or transformed by the greening of the economy are of good quality'. It stressed that:

*To make a positive impact on job transformation and job creation, all relevant actors should take the appropriate measures in order to anticipate and manage change on labour markets.*

Much research on the impact of climate change on employment has been carried out by various European and international organisations. However, research in this area largely focuses on the impact on the quantity of jobs while effects on job quality are considerably less often addressed. For example, *Employment in Europe 2009* concluded that:

*There appears to be almost no literature with an equivalent level of detail on working conditions within environment-related sectors in Europe.*

(European Commission, 2009a)

Recent research on job quality (for example, EMCO, 2010; Cambridge Econometrics et al, 2011) has mainly examined the development of indicators and quantitative estimates in this area.

This study seeks to:

- provide a qualitative estimation of the impact of climate change on job quality;
- present examples of good practice in collaborative approaches to anticipate and manage this impact.

## **Objectives**

The study had two main objectives:

1. To provide an overview at both sectoral and cross-sectoral level of greening effects on the quantity and especially the quality of jobs in the following 10 economic sectors in the EU:
  - automotive;
  - chemicals;
  - construction;
  - distribution and trade;
  - energy;
  - furniture;
  - non-metallic materials;
  - shipbuilding;
  - textiles;
  - transport.
2. To analyse good practice examples of the anticipation and management of green change at company level in these sectors.

The targeted sectors were selected on the basis of the findings of two projects commissioned by the European Commission:

- comprehensive sectoral analysis of emerging competences and economic activities in the European Union;<sup>1</sup>
- transversal analysis on the evolution of skills needs in 19 economic sectors (Oxford Research, 2010).

## **Scope**

The analysis in this study focuses on:

- good practice in strengthening clean and sustainable competitiveness;
- efforts to increase both the quantity and quality of productive and sustainable jobs.

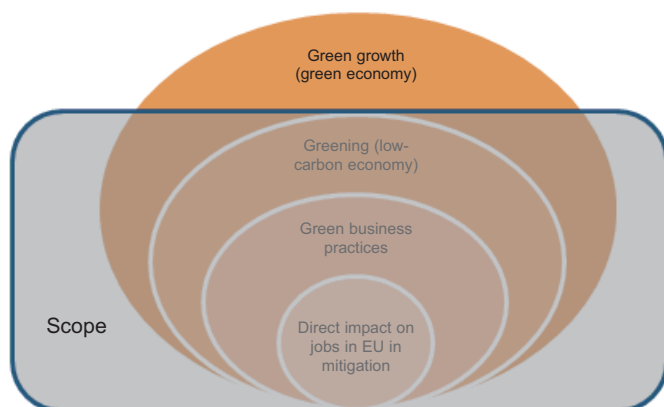
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<sup>1</sup> <http://ec.europa.eu/social/main.jsp?catId=784&langId=en>

The special interest is in collaborative approaches involving the social partners, public authorities, education and training providers, non-governmental organisations (NGOs) and other actors. The research described in this report paid particular attention to green business practices and overall greening processes aimed at mitigating climate change (see definitions in Annex 1), because if radical mitigation measures are not taken in time, adaptation could eventually prove impossible (European Commission 2009a).

The emphasis is on direct impact (that is, impact on the main economic sectors) of green business practices and greening process on jobs in EU aimed at mitigating climate change. Analysis of indirect employment effects (that is, effects on jobs in the value and supply chains) as well as analysis of the employment implications of the wider green growth process which, for example, includes protection of biodiversity and ecosystems, is beyond the scope of this study. The scope of the study is visualised in Figure 1.

Figure 1: *Scope of this study*



Note: See Annex 1 for definitions.

### Defining the impact on jobs

The implementation of green business practices may have a twofold impact on jobs. First, green business practices may affect the quantity of jobs (UNEP, 2008) by:

- creating additional (new) jobs (for example, solar technician);
- eliminating inefficient current jobs (for example, when more sustainable packaging of materials is introduced);
- substituting them with greener ones (for example, jobs shift from fossil fuel to renewables);
- transforming current jobs by introducing new types of environment-related responsibilities within existing jobs (for example, up-skilling employees in the financial sector for carbon trading).

Second, green business practices may also affect the quality of jobs and the following four dimensions of job quality:

- skills development, including requirements for qualifications, demand for training, patterns of organisation of learning activities and career development issues;

- career and employment security, which includes such issues as employment status (for example, full time or part time, self-employment), wages, workers' rights (including equal opportunities, information, consultation and involvement in organisational change) and social protection (for example, the correspondence between working hours and pay);
- health and well-being of workers, which encompass psychosocial and physical health problems, risk exposure, work organisation (for example, work intensity, share of monotonous tasks, job satisfaction, length and organisation of working hours in relation to health) and ageing-related issues;
- reconciliation of working and non-working life (for example, length/flexibility/predictability of working time, ability to carry out non-working tasks and availability of social infrastructure such as day care centres).

Both types of the greening impact on jobs (quantitative and qualitative) are analysed in this study.

### Research methodology

The study involved the following six tasks, concentrating on the 10 target sectors:

- Identify the major challenges arising from climate change.
- Map the main motivations of companies for greening.
- Provide examples of green business practices implemented by companies.
- Assess the impact of climate change on the quantity and (especially) quality of jobs.
- Identify various approaches (especially collaborative) used for the anticipation and management of socially responsible green change.
- Draw conclusions and make policy recommendations on the anticipation and management of green change at company level.

The study used a variety of methods of data collection and analysis.

A literature review was conducted of the most important and most recent available analytical reports, policy documents and statistics, including both qualitative and quantitative estimates of the impact of climate change on employment.

An online survey was carried out between 14 October and 28 November 2011, with a total of 145 responses from companies (12% of all respondents), employer associations (21%), trade unions (41%), national, regional and local public authorities (5%), European and international organisations (5.5%), other EU and national-level stakeholders (10%) and others (7%), to collect opinions on the anticipation and management of socially responsible green change and its effects on European workplaces in the target sectors. The questionnaire used in the online survey was piloted before its official launch. The results of the online survey are not representative, as it was based on qualitative (that is, fewer but higher-quality responses) and not quantitative targeting.

Interviews were carried out with (a) 27 representatives of EU or national-level social partners, policymakers, experts and other stakeholders (a complete list is provided in Annex 4); and (b) two or three company and workers' representatives and related stakeholders for each company case study.

Forty-eight company case studies of good practice examples of the anticipation and management of the green change at company level in the 10 target sectors were conducted: 22 case studies were prepared by the contractor and 26 by Eurofound's network of correspondents and Eurofound staff.

An expert workshop was held in Brussels on 14 December 2011 to discuss the study's preliminary findings.

### Criteria for case study selection

The company case studies were selected on the basis of company availability and the following criteria:

- green business practices are related to the targeted sector;
- preference given to small and medium-sized enterprises (SMEs) (that is, companies with up to 250 employees);
- preference given to major industries;
- selected green business practices should have an implementation history (that is, be based on facts rather than speculation);
- case study should demonstrate a significant impact of green business practices on job quality;
- case study should include collaborative approaches in anticipating and managing greening effects on employment;
- green business practices should be transferable to other companies in the same or related sectors.

### Key message of the study

The study's authors argue that the implementation of greening, through energy saving, through manufacturing green products or the provision of green services, or through other green business practices, can result in a 'triple win' situation:

- benefits for companies in terms of, for example, higher competitiveness or profitability;
- benefits for employees in terms of, for example, number of jobs or higher job-quality standards;
- stronger economies with a healthier environment.

It is crucial to brand the greening process so that the positive aspects of greening are communicated clearly to all stakeholders and urge industry forward in the non-stop loop of eco-innovation. Public authorities, with their regulatory, financial and non-financial measures, play a key role in this process by supporting employers, securing the involvement of employees and linking all other stakeholders in the anticipation and management of greening across industry.

### Structure of the report

The report presents the results of work carried out between July 2011 and May 2012. Five chapters provide a cross-sectoral picture of the impact of climate change on employment.

The first chapter summarises major challenges arising from climate change. The second chapter provides an overview of the major motivations of businesses to mitigate climate change. The third chapter presents the most popular groups of green business practices. The fourth chapter analyses the impact of climate change on employment in two ways, that is, the effects of greening on job quantity and job quality.

The fifth chapter is devoted to the analysis of approaches that companies have adopted to anticipate and manage green change. It also outlines key issues in the anticipation and management of green change and the role of public authorities in these processes. Conclusions and recommendations follow in the sixth chapter.

The annexes and the individual company case studies are available separately on the Eurofound website at <http://www.eurofound.europa.eu/emcc/labourmarket/greening.htm>.



# Challenges arising from climate change 1

The most important challenge arising from climate change identified during the literature review and interviews with experts and stakeholders is the so-called ‘employment challenge’, which implies the need for anticipation and management of changes in both the quantity and quality of jobs.

As summarised recently by the International Labour Organization (ILO):

*A shift towards a green economy implies a drastic change in the prevailing development paradigm which requires, in turn, broad social support. Contrary to previous ‘revolutions’, the policy responses, this time, cannot be purely technological or economical in nature. ... This change of paradigm implies that, while environmental risks are to be curbed, social equity and human well-being must be enhanced.*

(ILO, 2012)

This implies that greening is expected not only to mitigate climate change and stimulate the economy, but also to achieve this by maintaining or even increasing employment levels and by securing existing or even improving job quality standards. This is a very tough policy challenge.

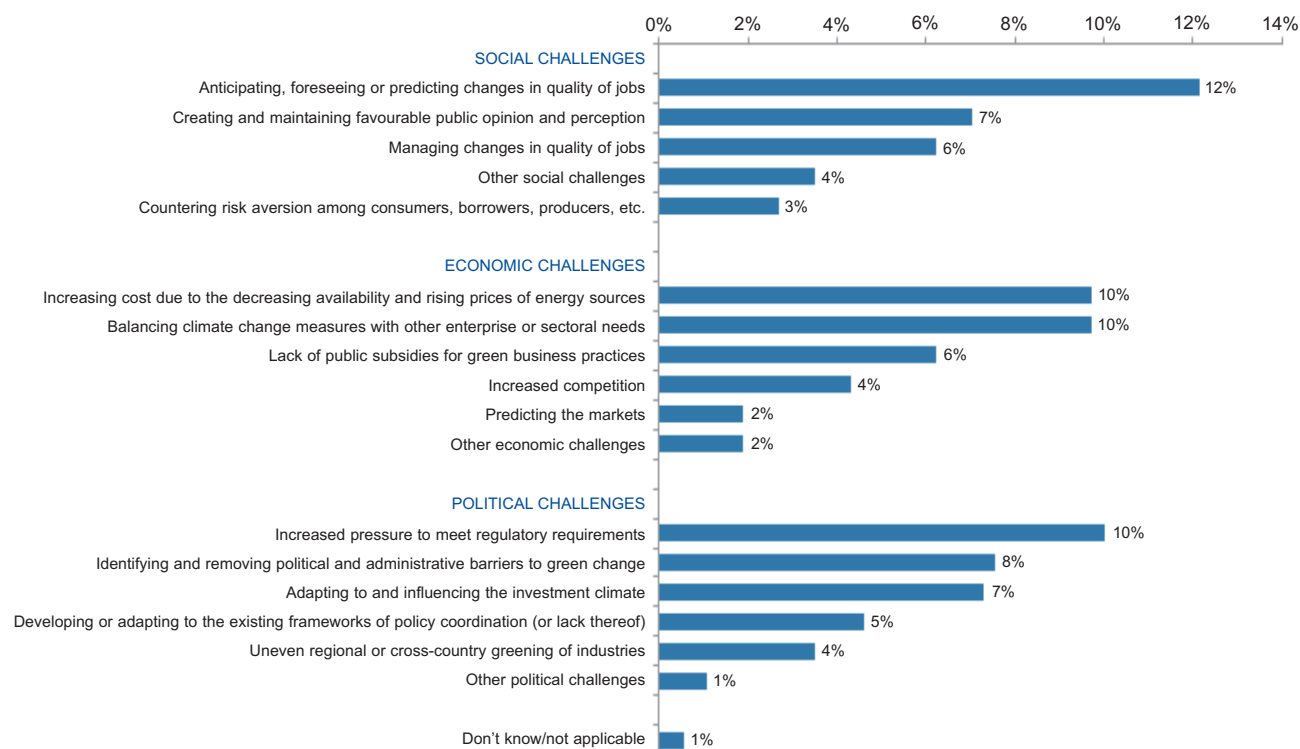
The other key challenges related to employment include:

- preparing new legislation and adapting to existing regulatory requirements related to climate change;
- decreasing availability and rising prices of conventional resources (especially energy);
- increasing competition within industries, including pressures for relocating jobs to non-EU countries with relatively lower environmental standards (carbon leakage);
- technology-related challenges, such as the development and application of new technologies.

These challenges are closely interlinked with each other. For example, the EU adopted climate and energy targets (‘20-20-20’ targets) to be met by 2020 (Council of the European Union, 2007) form the basis of all regulatory requirements related to climate change mitigation and have direct effects on other challenges. For instance, stringent regulatory requirements could induce carbon leakage and, as a result, negatively affect employment levels in the EU. In this case, the scope and depth of the impact of climate change on the quantity and quality of jobs will therefore depend on the feasibility of regulations and their smooth implementation. In general, the cumulative impact of actions to address the challenges identified above will be crucial for employment.

The online survey carried out as part of this study confirmed the importance of employment, regulatory and energy challenges (Figure 2). The results also show that anticipation of changes in the quality of jobs is a more relevant challenge than their management. Furthermore, responses to the survey indicated another potentially important challenge of balancing climate change with other company or sectoral needs. The high importance assigned to this challenge could be related to the recent economic and financial crisis (see below). Other challenges were deemed somewhat less important.

Figure 2: Key challenges arising from climate change



Notes: N = 370 (up to five answers per respondent).

Numbers have been rounded and thus do not add up to 100%.

'Other social challenges' include unemployment, establishing credible models for climate-neutral and sustainable lifestyles, risk of energy poverty, fair distribution of jobs and job contents, assessing changes in quantity of jobs.

'Other economic challenges' include danger of de-industrialisation, developing new business models for climate-neutral and energy-efficient production and services, unfair competition from less-regulated third countries.

'Other political challenges' include justifying policies that may not be favourable for the EU industry in the short term, facing resistance from NIMBYs (those who adopt a 'not in my back yard' position).

Source: *Online survey*

The evidence shows that the recent economic and financial crisis has not reduced the number of green jobs, but has primarily prolonged and weakened the anticipation and management of green change. For example, a recent survey of construction companies showed that the share of sustainable building in the revenue of the companies increased more in the period 2004–2007 than in 2007–2010 (Pauwels et al, 2011). Recent cross-sectoral estimates suggest that job losses in 'green' sectors which could be linked to the impacts of the crisis could so far amount to 1%–2% of the 4 million (net) jobs lost in the EU in 2008–2009 (that is, 40,000–80,000 jobs) (Cambridge Econometrics et al, 2011). This could be an overestimate given that manufacturing and construction, where the losses have been more significant, include only some of the green industries. Yet more significant changes in employment levels might occur over longer periods when the lasting effects of the crisis on employment start to appear.

Despite less significant changes in employment levels than in other sectors, the recent economic and financial crisis had a negative impact on the overall pace of greening across industry and especially in SMEs and in the automotive, construction, textiles and transport sectors, which were the most severely hit by the crisis (Oxford Research, 2010).<sup>2</sup>

<sup>2</sup> For example, between 1 July 2007 and 2010, the largest share of applications to the European Globalisation Adjustment Fund (EGF) were by the automotive (17.5% of total applications) and textile (15.9%) sectors (European Commission, 2010a).

The crisis diminished the resources available to finance green business practices. A large number of businesses and especially SMEs faced the challenge of finding sources of funding to survive, let alone maintain the market, while changing political priorities and a lower carbon price reduced the public funds (within or outside stimulus packages) available to address the challenges of climate change (European Commission, 2010a). Indeed, this study found that as part of austerity programmes, numerous Member States are reducing or cancelling altogether various public support measures (for example, government subsidies, tax incentives and feed-in tariffs) to promote the greening of industry. For example:

- the Belgium government has reduced subsidies for insulating rooftops and installing photovoltaic (PV) cells as well as tax benefits for building passive houses;
- the UK government has reduced the level of feed-in tariffs (payments) to households for energy generated from renewable energy such as solar panels;
- the Spanish government has reduced both tariffs and the number of production hours that PV plants can qualify for subsidies.

Shrinking financial resources for greening resulted in a considerable slowdown in climate change response strategies at both private and public levels. Furthermore, diminishing financial resources may also have affected job quality (for example, income) for employees working with green business practices as many employers cut their business costs to survive the crisis.

According to interviewed experts and stakeholders, the crisis has shifted business focus. Until the crisis, there was an increasing trend for businesses to engage in climate change mitigation activities, but after the crisis, this trend declined significantly, with businesses concentrating on maintaining their current economic activities with no long-term strategic outlook (so-called 'short-termism'). For instance, many of the companies contacted during the course of this study reported that they did not have time to engage in any additional activities related to (the promotion of) green change.

Countries have adopted a number of stimulus packages in response to the recent crisis. According to a recent study by Cambridge Econometrics and Ecorys (2011), the green elements of most of the stimulus packages in the EU countries examined typically accounted for around 10% of total investment and were focused on energy efficiency, transport infrastructure, vehicle scrappage schemes, renewables and eco-innovation. Many of the stimulus packages did not provide sufficient resources for human resource development and demonstrated weak coordination of public policies (for example, environment and employment policies) in addressing green change (Strietska-Ilina et al, 2011). The study by Cambridge Econometrics and Ecorys (2011) estimated that:

- the net impact of stimulus packages was a temporary increase in employment of up to 0.2% during the recession period;
- these jobs were mainly temporary jobs 'saved' (that is, not lost in the recession) rather than new jobs that would have been created, and mainly in the construction and engineering sectors.

Available evidence suggests that the design and implementation of actions aimed at mitigating the negative effects of the crisis, including those on greening, is another challenge to be addressed in the future.



# Business motivation to act against climate change 2

The literature review and interviews suggest that the main motivations of businesses to mitigate climate change are related to most of the key challenges discussed above. These motivations are:

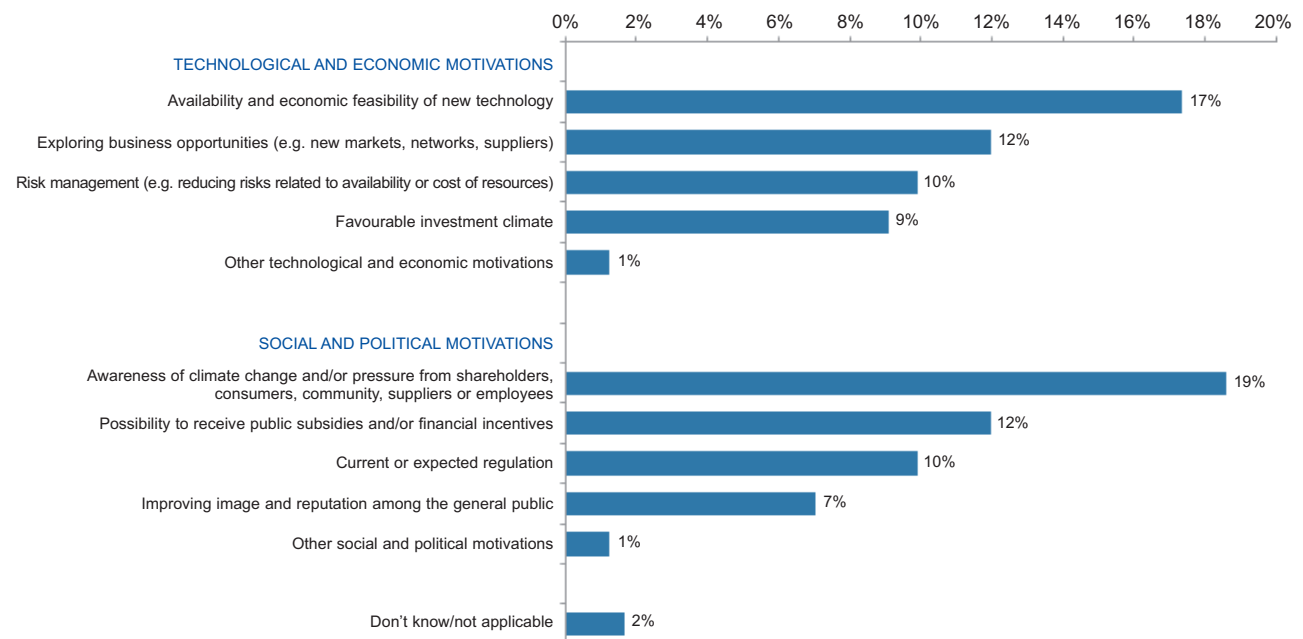
- current or expected regulation;
- risk management (for example, reducing risks related to the availability or cost of resources);
- exploration of business opportunities or maintaining or increasing competitiveness (for example, new technologies such as electric cars and ships fuelled by liquefied natural gas (LNG), markets for the retrofitting of buildings, networks such as the EU Retail Forum for Sustainability<sup>3</sup> and suppliers meeting new green requirements);
- improving the image of their business and increasing awareness of climate change among the general public (for example, through satisfying consumer demand for greener products).

All these motivations were considered important by respondents to the online survey (Figure 3). However, respondents emphasised two motivations:

- availability and economic feasibility of new technologies;
- awareness of climate change among or pressure from internal and external business stakeholders.

These two were most often mentioned in company case studies as the main motivations to implement green change at company level.

Figure 3: *Most important motivations of businesses to act against climate change*



Note: N = 242 (up to three answers per respondent).

Source: *Online survey*

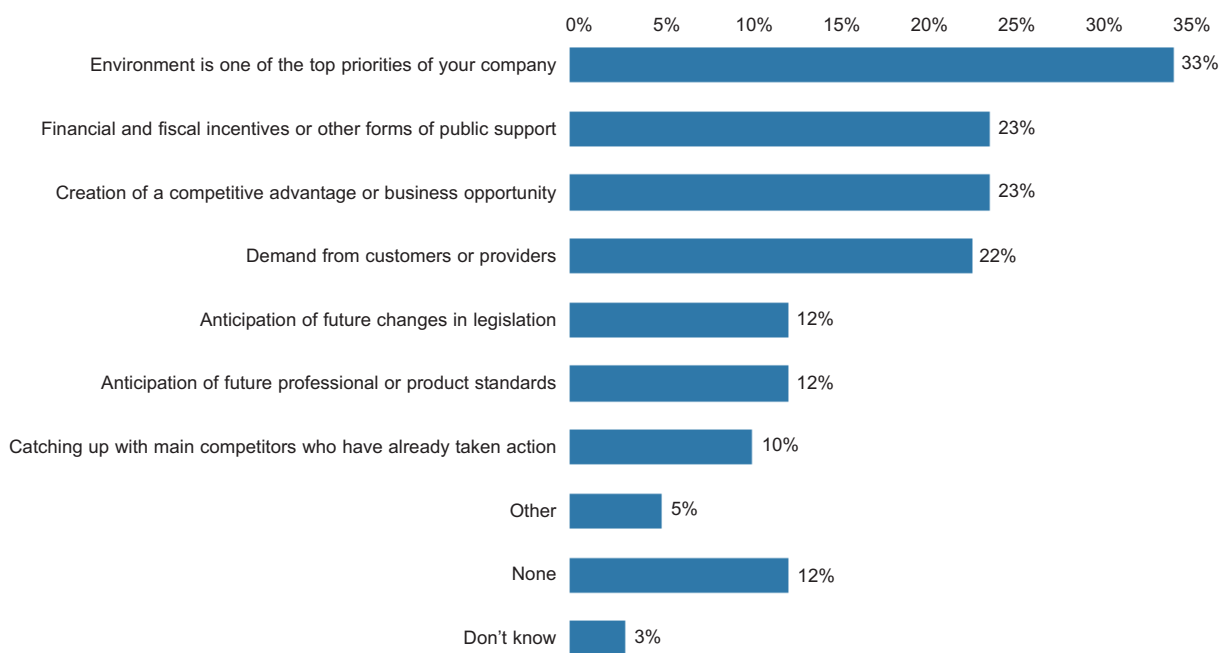
<sup>3</sup> [http://ec.europa.eu/environment/industry/retail/index\\_en.htm](http://ec.europa.eu/environment/industry/retail/index_en.htm)

A favourable investment climate and the possibility of receiving public support were also indicated as being important motivations. Sectors such as construction, transport and energy depend heavily on investment in public infrastructure. Thus, the current and drastic austerity-led reductions in public subsidies, tax incentives, feed-in tariffs and other public support measures have significantly affected further progress in greening in these sectors.

If it is not possible to maintain current levels of public support for greening, public authorities could consider raising climate change-related standards in public investment (for example, green procurement processes). This would enable public authorities to contribute to the greening of industry and possibly increase their job quality standards. Public support could also be a crucial motivation for energy-intensive industries (for example, chemicals and non-metallic materials) in order to avoid carbon leakage. However, this is not likely given the current financial and economic climate in the EU.

The major motivations of businesses to mitigate climate change detailed above are generally confirmed by a recent extensive Eurobarometer survey (the first of its kind) to understand the views and attitudes of SMEs towards resource efficiency and green markets (European Commission, 2012a). This Eurobarometer survey found that the main reasons why SMEs are taking action to become more resource efficient are public support, business opportunities and demand from customers or providers (Figure 4). However, the key motivation for SMEs to become green or greener was related to the fact that the environment had been made one of the company’s top priorities by the company’s directors.

Figure 4: Main reasons why SMEs in EU27 are taking action to be more efficient



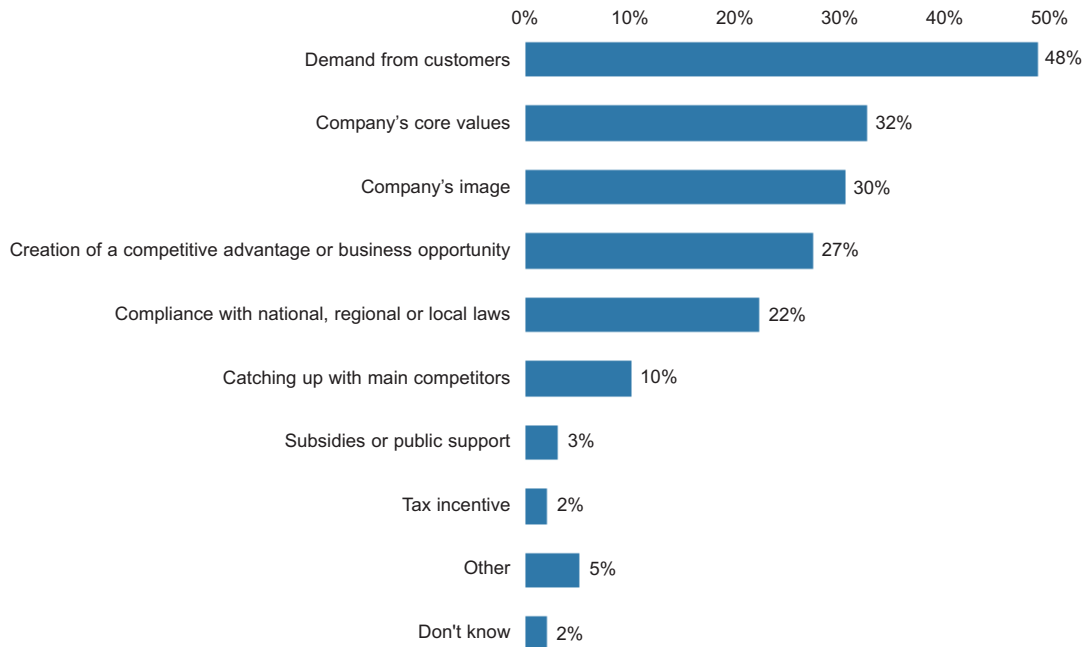
Note: Responses to question 5 of the survey; based on SMEs that answered ‘at least one action to be more resource efficient’ in question 3.

Source: *European Commission (2012a)*

Large companies (250+ employees) were considerably more likely than SMEs to mention the creation of a competitive advantage or business opportunity (36% and 23% respectively), the anticipation of future professional or product standards (22% and 12% respectively) and the anticipation of future changes in legislation (20% and 12% respectively) as reasons for improving resource efficiency.

The Eurobarometer survey also asked SMEs a similar question. The results show that the main reason why SMEs offered green products or services is customer demand (Figure 5). Other reasons were less important.

Figure 5: Main reasons why SMEs in the EU27 offer green products or services



Note: Responses to question 24 of the survey, based on SMEs that answered 'offers green products or services' to question 19.  
Source: *European Commission (2012a)*

Recent research on large companies (PricewaterhouseCoopers, 2011) found that they emphasise the importance of ambitious corporate GHG emissions targets (for example, Tesco aims to cut its emissions by 100% by 2050). But the research found that to set these targets and to invest in longer-term emissions reduction projects:

*Companies need clearer, long-term signals from governments, such as regulations, standards and incentives to invest in longer term emissions reduction projects.*

(PricewaterhouseCoopers, 2011, p. 10)





# Types of green business practices 3

The literature review and company case studies show that companies engage in greening mainly through the following two groups of practices:

- energy saving (for example, optimisation of logistic routes, introduction of more efficient production methods, improvement in the energy efficiency of, for example, buildings or transport, reducing energy use in the workplace);
- greener products or services (for example, development of zero-emission building concepts, production of electric vehicles, provision of electric engine installation services, providing sophisticated recycling services, introducing tiles accompanied with solar cell elements).

Initiatives that addressed consumer behaviour (for example, labelling of eco-products, environmental communication campaigns) were also widespread in most target sectors, but especially in the distribution and trade sector due to its unique position of being closest to customers in the market.

Management-related practices (for example, accounting and reporting GHG emissions, establishing an emission reduction plan) or work with supply chains (for example, raising awareness, including climate change mitigation criteria in procurement policies) were less often found. However, it is unclear whether these green business practices are the least developed or whether the information about them is least well known (this issue is also discussed in Chapter 5). The lower prominence given to these practices in certain sectors may be related to, among other things, the weaker representation capacities of certain target sectors or a change in sectoral priorities due to the recent economic and financial crisis. The available evidence suggests that the size of a company may also be an important factor here. For example, large companies in the UK are very much involved in behavioural change of staff, as this is likely to have a short payback period and lower requirement for investment (PricewaterhouseCoopers, 2011).

Green business practices have been widely applied across the target sectors in this study. However, there is a lack of hard evidence on their effects on the quantity and quality of jobs at sectoral level. Table 1 summarises key patterns that emerged from the company case studies. Anecdotal evidence suggests that companies carrying out energy-saving practices are more likely to be engaged in collaborative approaches in skills development. This could mean that energy efficiency measures require the transformation of skills from more employees than greener products or services. Secondly, companies creating green products or services use the European Social Fund (ESF) and other financial funds (possibly due to a need for greater investment) more often and are more often likely to create jobs. Finally, companies are most often engaged in the anticipation and management of greening effects on skills development and are inactive in other dimensions. The next chapter investigates the effects of greening on employment in more depth.

Table 1: *Tentative reported patterns of greening*

	Quality of jobs				Quantity of jobs
	Skills development	Career and employment security	Health and well-being	Reconciliation of working and non-working life	
<b>Distinctive patterns: Energy-saving practices</b>	Considerably more frequent collaboration with stakeholders in skills anticipation activities	More companies engaged in management approaches (especially collaborative ones)	Slightly more frequent effects	None	None
<b>Distinctive patterns: Green products and services</b>	More intensive use of ESF or other available sources of public financial support	Although more frequent effects, companies are less often engaged in their management	None	None	Considerably more frequent effects

	Quality of jobs				Quantity of jobs
	Skills development	Career and employment security	Health and well-being	Reconciliation of working and non-working life	
<b>Common patterns</b>	More than half of companies experience at least some effects and majority of them manage those	Approximately half of companies experience at least some effects; very few use anticipation approaches	Approximately half of companies experience at least some effects; very few of them use anticipation and management approaches	Almost no effects; very few companies use anticipation and management approaches	Very few companies use management and anticipation approaches

Source: *Company case studies*

# Impact of climate change on employment 4

This chapter examines the impact of climate change on both the quantity and quality of jobs. However, it is first important to stress a number of issues relevant to the analysis.

First, the transition to a low-carbon economy is an example of structural change. The greening of industry is similar to previous technology-driven changes such as the information and communication technology (ICT) revolution in the 1970s and 1980s. However, the current structural change in economies is also influenced by other economic and social trends (for example, increased globalisation, technological progress, lasting effects of the crisis, rising public debt levels and the ageing population) (Cambridge Econometrics et al, 2011). Thus, it is very difficult to disentangle the employment impacts of greening and those of other trends causing restructuring in the economy. The latter have at least as much potential to disrupt jobs as the transition to a low-carbon economy.

Secondly, the impact of climate change on employment is primarily in terms of the greening of all existing jobs rather than the emergence of new green jobs (Cedefop, 2010). However, the quantitative and qualitative employment impacts of climate change are not universal and vary across industries. These variations are caused by objective factors such as:

- energy or labour intensity (the more a sector is energy or labour intensive, the stronger employment effects it may experience);
- unionisation (the less a sector is unionised, the higher negative impact on the various dimensions of job quality – for example, non-unionised construction workers are more likely to be exposed to higher health and occupational risks (ILO, 2012)).

Thirdly, the greening of industry may have different employment effects not only by sector, but also depending on location, type of job, level of skills and occupational structure. The closure of large plants due to environmental legislation or other factors, or region-wide restructuring of the economy (for example, the case of the Navarre region in Spain), could result in significant impacts on both the quantity and quality of jobs (if some are preserved at all). These impacts depend significantly on regional or local conditions, including the status of the regional and national economies, the alternative types of jobs available, the mobility of the labour force and the cooperation between the employer, trade unions and the regional public authorities (Cambridge Econometrics et al, 2011). The evidence gathered in this study suggests that greening may have different employment effects depending on type of job (for example, positive impacts for office work and negative for on-site work), level of skills (for example, the less skilled an employee is, the worse the job quality is) and occupational structure (for example, the higher the share of highly skilled, the more positive are employment effects are). These differences in employment tend to hold across sectors and are explained in more detail in subsequent sections.

Finally, the impact of greening on employment was influenced by the recent economic and financial crisis. Austerity-led reductions in public subsidies, tax incentives, feed-in tariffs and other public support measures did affect employment patterns in the target sectors. The sections below provide some evidence of the impact of the crisis on employment. However, future employment trends will, among other issues, depend on the lasting effects of the crisis and the public strategies in addressing them. Future research needs to explore these developments further.

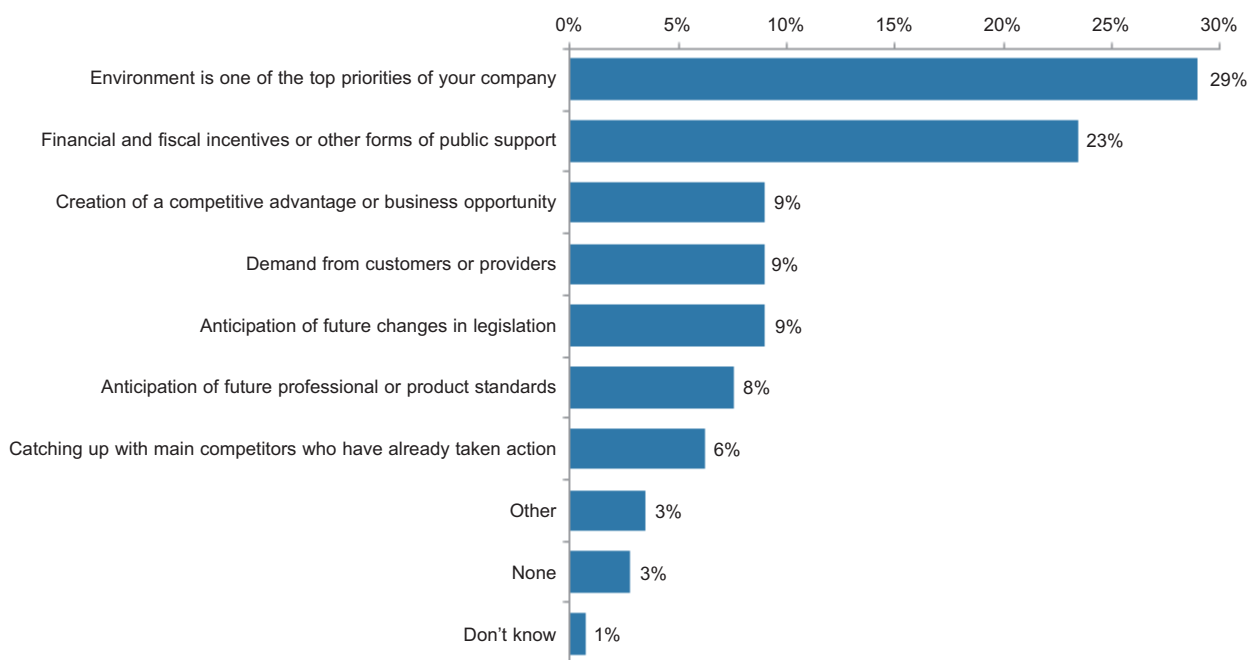
## Impact on quantity of jobs

In general, it is forecast that the policies required to meet the EU 20-20-20 targets will have little impact on the overall level of employment. Most studies indicate a modest positive outcome for employment, increasing by around 1%–1.5% (in net terms) by 2020, while forecasting model results show that, at the aggregate level, the policies had very little impact on total employment levels (Cambridge Econometrics et al, 2011).

### Direct impact of policies

In the online survey, when asked to indicate the likely direct impact of climate change policies on the total number of current jobs (that is, net employment impact), the majority of respondents answered that the impact would be either close to zero (23% of all answers) or small, with up to 2.5% additional jobs of total current jobs (29% of all answers) (Figure 6). However, the share of positive or very positive answers (47%) was significantly larger than that of negative ones (17%); this significant difference indicates that stakeholders' assessment of the climate change impact on job numbers is more positive than the macroeconomic estimates mentioned above. Furthermore, a survey of sector representatives more often (51%) indicated a positive impact than those who did not represent any sector (40%).

Figure 6: *Likely direct impact of climate change policies on total number of current jobs at EU level until 2020*



Notes: N = 145 (only one answer per respondent).

'Other positive' was selected by five respondents – four did not explain further and one added 'impossible to quantify'.

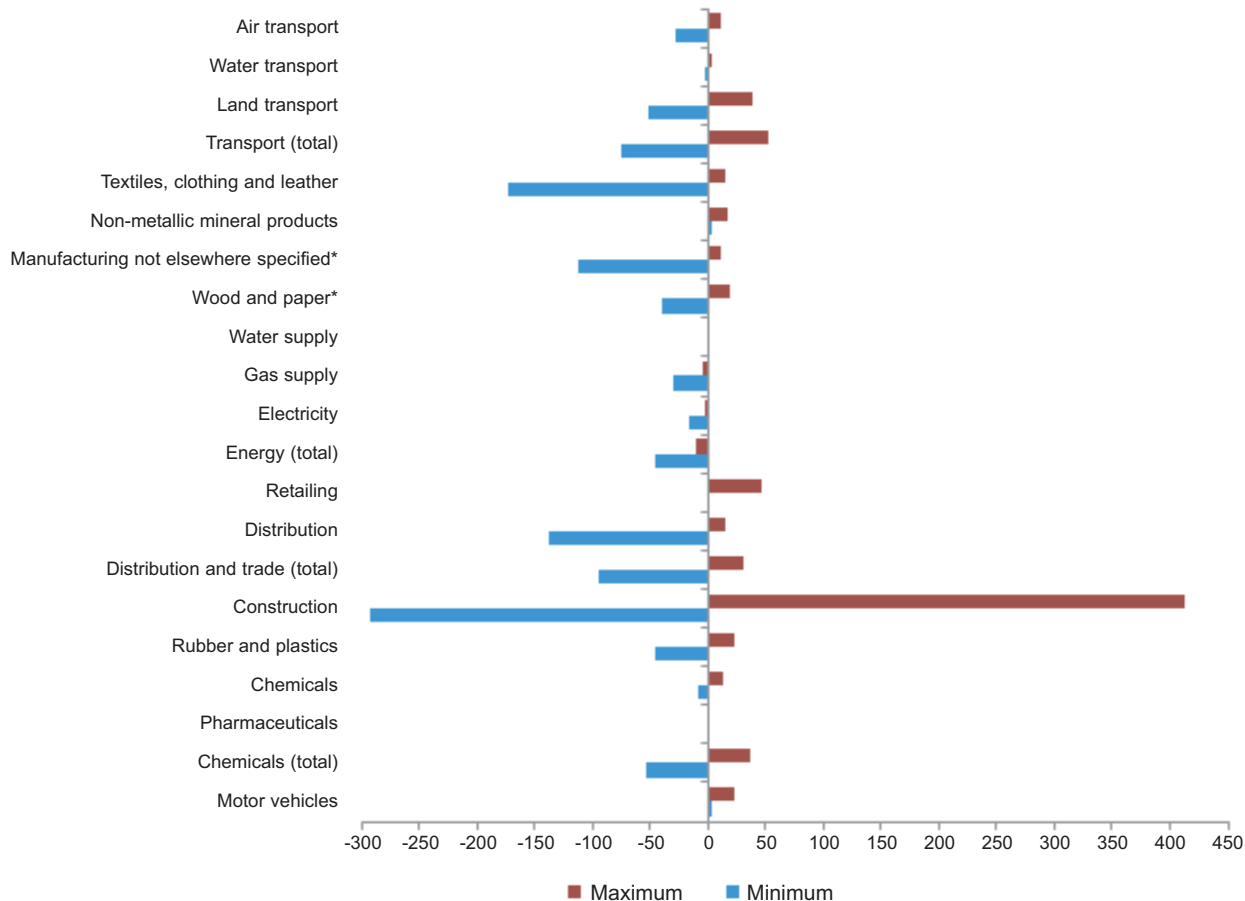
'Other negative' was selected by one respondent, who added 'higher loss than 5%, not sure how high; closures have started, no new investments'.

Source: *Online survey*

However, a general estimation of the impact of climate change on the quantity of jobs hides several important trends. Greening may lead to a significant redistribution of employment levels between sectors. For example, changes in international competitiveness caused by climate change policies can lead to significant flows of jobs in energy-intensive (for example, chemicals and non-metallic materials) and high carbon-emitting sectors (for example, construction, energy and transport) (European Commission, 2009a; European Parliament, 2010).

Figure 7 summarises the results of a recent comprehensive forecast (by Cambridge Econometrics) of the impact of new climate change policies on employment for the 10 target sectors (some of which, where the data allowed, are broken down in this study into smaller subsectors to differentiate the impact of climate change further within the sector). In absolute terms, the impact of new climate change policies on employment compared with the baseline scenario is the largest in the construction, textiles, distribution and trade, transport and possibly furniture sectors. The construction sector is likely to face the largest uncertainty, in absolute terms, compared with the other target sectors.

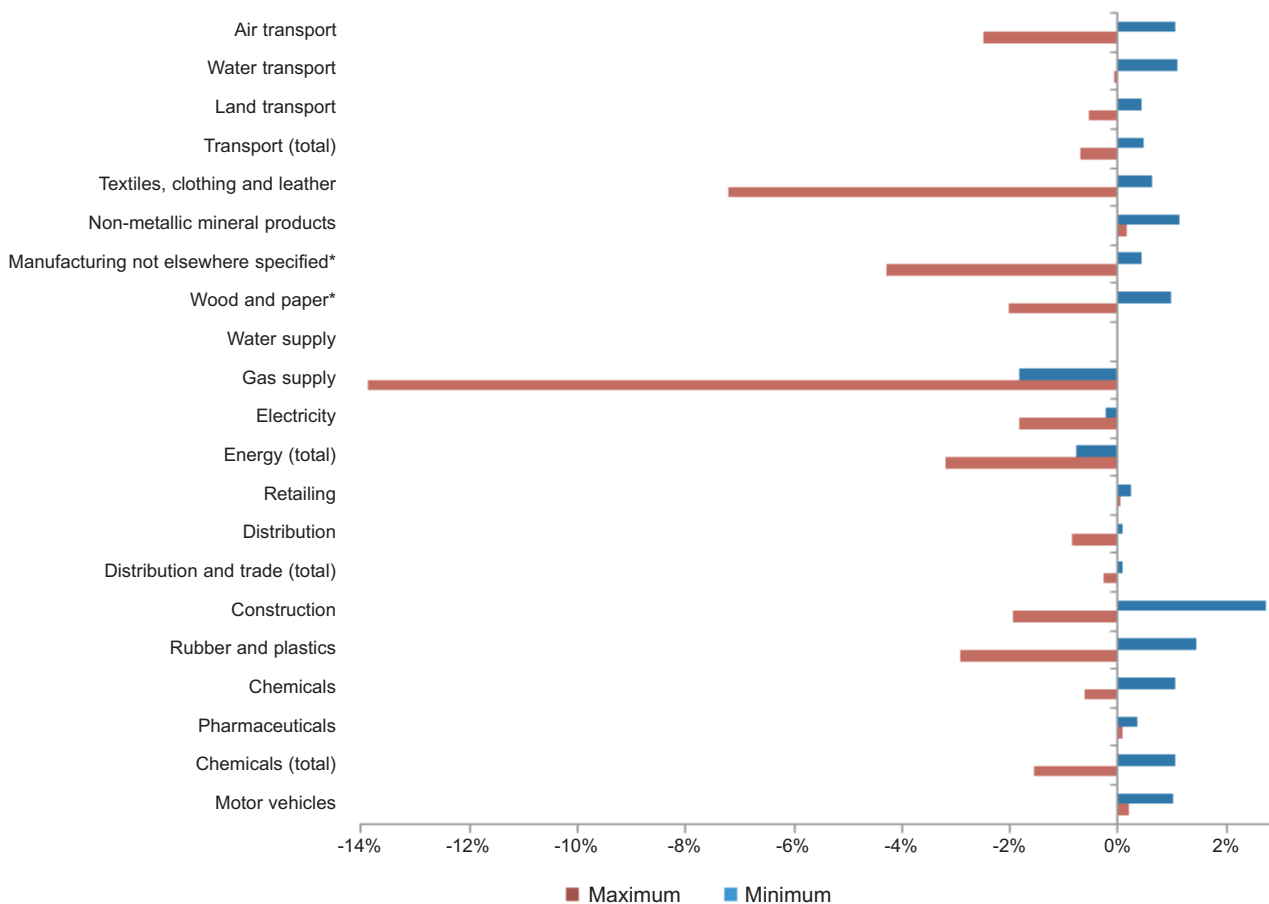
Figure 7: Absolute impact of new climate change policies on EU27 employment with projected maximum and minimum differences (in thousands) from baseline scenario



Notes: \*Contains part of the furniture industry; more detailed data are unavailable. Based on NACE classification, two-digit level data; target sectors are not fully represented as forecast results are based on NACE Rev. 1.1 and not on NACE Rev. 2. Historical employment data based on NACE Rev. 1.1 used to ensure comparability. Baseline scenario is based on PRIMES 2009 forecast. PRIMES is an EU-wide energy model used for forecasting, scenario making and policy impact analysis up to the year 2030; see European Commission (2010b). For the description of other scenarios, see Annex 3. Baseline scenario already includes much existing environmental policy and any related labour market changes that it leads to (roughly half the reduction in CO<sub>2</sub> emissions from 1990 levels required to meet the 20% emissions target is included). Minimum and maximum scenarios include the impacts of new environmental policies rather than the general effects of all environmental measures. See Annex 3 for more detailed explanation. Source: Prepared by the authors on the basis of Cambridge Econometrics et al (2011)

Figure 8 shows the relative impact of new climate change policies on employment compared with the baseline scenario. Based on this forecast, the gas supply, textiles, other manufacturing (part of the sector relates to furniture), energy (all sector in total), rubber and plastics, air transport, wood and paper (part of the sector relates to furniture), construction and electricity sectors could experience the most adverse effects of new climate change policies. Employment in the remaining sectors is likely to be less negatively affected by climate change policies. The largest relative positive impact of new climate change policies may be expected in the construction sector.

Figure 8: Relative impact of new climate change policies on EU27 employment – projected maximum and minimum differences (%) from baseline scenario



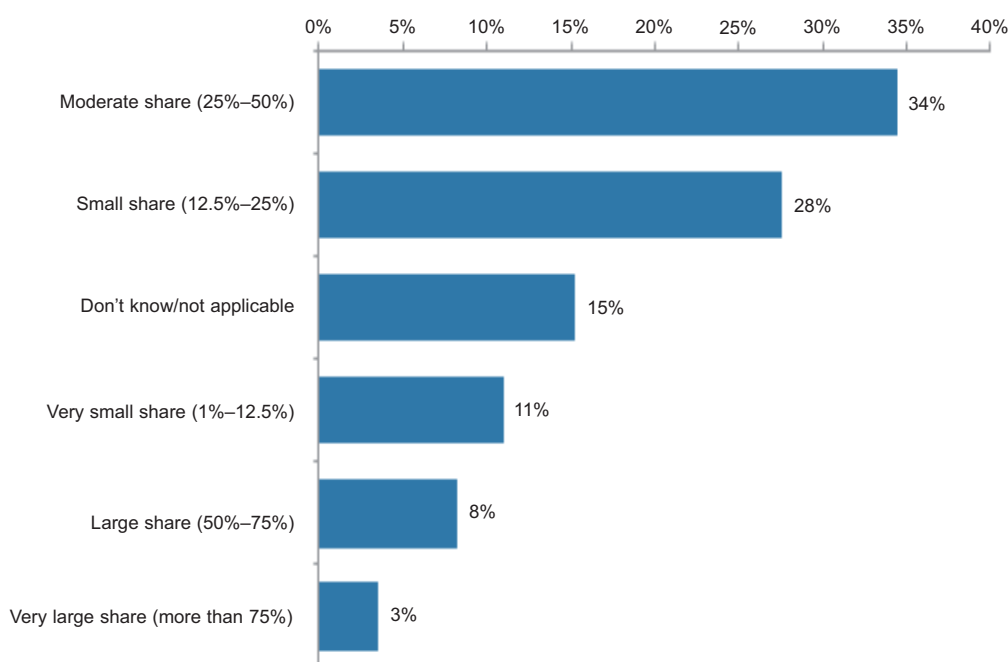
Notes: \*Contains part of the furniture industry; more detailed data are unavailable. Based on NACE classification, two-digit level data; target sectors are not fully represented as forecast results are based on NACE Rev. 1.1 and not on NACE Rev. 2. Historical employment data based on NACE Rev. 1.1 used to ensure comparability. Baseline scenario is based on PRIMES 2009 forecast. PRIMES is an EU-wide energy model used for forecasting, scenario making and policy impact analysis up to the year 2030; see European Commission (2010b). For the description of other scenarios, see Annex 3. Baseline scenario already includes much existing environmental policy and any related labour market changes that it leads to (roughly half the reduction in CO<sub>2</sub> emissions from 1990 levels required to meet the 20% emissions target is included). Minimum and maximum scenarios include the impacts of new environmental policies rather than the general effects of all environmental measures. See Annex 3 for more detailed explanation. Source: Prepared by the authors on the basis of Cambridge Econometrics et al (2011)

**Differences between sectors**

Even at a more detailed level, Figures 7 and 8 do not reveal all the significant differences within subsectors, as some of the changes in EU27 employment in very small subsectors (that is, at NACE classification three- or four-digit level) offset each other. For example, it is estimated that subsectors such as retrofitting in the construction sector, cement in the non-metallic sector, public transport in the transport sector, renewables in the energy sector, and green vehicles in the automotive sector could experience even larger changes. Available forecasts for some of these small subsectors show that changes could reach 100% or more of current employment levels (see Annex 3). However, no comprehensive forecasts at such a detailed level exist for all the target sectors and this is a subject for future research in this field.

Although the overall impact of climate change on the quantity of jobs is not significant, greening may have some effects on large number of jobs within sectors. The literature review indicates that a large share of current jobs in the target sectors will be transformed due to greening, that is, additional training will be needed for employees to top up their current skills (for example, up-skilling employees in the automotive sector to produce low-carbon vehicles) (Cedefop, 2010; ILO, 2011a). This is confirmed by the online survey (Figure 9). Respondents representing sectors expected a more significant transformation of jobs than those who did not represent any sectors; 51% and 38% respectively indicated ‘moderate’, ‘large’ or ‘very large’ shares of current jobs to be transformed.

Figure 9: Share of current jobs that will be transformed as a result of climate change policies at EU level until 2020



Note: N=145 (only one answer per respondent).  
Source: *Online survey*

Transformation of jobs is likely to be different across sectors and occupations. Industry (for example, construction) could experience a somewhat higher transformation of jobs than services (for example, retailing), while highly skilled occupations (for example, engineers and R&D staff) may require more additional training to operate in a low-carbon economy than medium- or low-skilled occupations (for example, operators).

### Influencing factors

The impact of greening on the quantity of jobs will differ across countries and regions. For example, regions with a concentrated conventional energy generation industry may lose jobs because of greening, while coastal regions or regions with certain favourable environmental conditions could benefit from greening due to the development of solar, wind or biomass energy, and increased rail transport intensity. As newer EU Member States have a higher than average energy intensity, they may witness somewhat stronger employment effects because of greening (European Commission, 2009a). Geographical trends of greening depend on a variety of factors (see below) and their detailed and comprehensive analysis is a subject for future research.

The impact of climate change on the quantity of jobs will differ in time, that is, not all new jobs induced by greening will be sustainable (that is, permanent) (European Commission, 2009a; EMCO, 2010). While some green technologies

may initially demand more green jobs, differences in labour intensity are likely to diminish over time once initial investments have been made and new green technologies have matured and become more productive.

For example, a study on the employment perspectives related to the installation of smart meters in the US concluded that there will be significant employment gains during the initial deployment period and losses during the later steady period when positions in meter reading will be cut, reducing net employment gain at the end of the forecasted period (KEMA, 2008). Another example is provided by the Romanian electric power distributor; according to the company, it had commissioned 450 experts in the building, erection and operation of wind park equipment, but the wind park will require only 20 operators to maintain it when it is complete.

Thus, the medium- to long-term impact of climate change on the quantity of jobs in some subsectors (for example, smart meters, offshore and onshore wind energy) may be less due to the lower sustainability of job creation. However, comprehensive analysis of the sustainability of green jobs is a subject for future research.

The impact of greening on the quantity of jobs also differs by size of companies. The recent extensive Eurobarometer survey revealed that, in relative terms, green jobs are mostly created in SMEs rather than in large companies. In 2012, one in eight employees of SMEs had a green job,<sup>4</sup> or almost 13% of all SME jobs (in large companies it was only one in 33, equivalent to 3% of all large company jobs) (European Commission, 2012a). The survey also found that SMEs in the EU are expected to have on average 2.3 green jobs two years from now, which represents an increase of 0.6 points compared with the current average of 1.7. This increase is reflected in all enterprise size class categories. The expected increase is:

- 0.4 jobs for micro companies (0–9 employees);
- 1.5 for small companies (10–49 employees);
- 1.8 for medium-sized companies (50–249 employees);
- 4.3 for large companies (250+ employees).

Greening may induce spill-over effects across the target and other sectors of the economy. For example, if the transport sector witnesses stricter targets on GHG emissions from vehicles, this may have a positive effect on employment in the automotive and air transport industries, as manufacturing more efficient and hybrid vehicles may lead to more eco-innovations; this in turn would lead to more high-skilled jobs and thus higher-quality jobs (European Commission, 2009a).

The medium- to long-term impact of climate change on the quantity of jobs is still very uncertain. Some compare greening with previous restructuring processes (for example, the IT revolution), which did not have a huge impact on employment across sectors. Others argue that greening is or will be a much stronger restructuring force, which, when coinciding with other trends such as a shortage of and rising prices of energy, will ‘force’ significant employment changes. The final answer as to which of the two extreme positions is closer to reality depends on various factors, such as future international agreements in the area of climate change and their economic repercussions for national economies or the adaptability of businesses to the needs of the green economy.

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<sup>4</sup> Eurobarometer understands a green job to be one that works directly with information, technologies or materials that preserve or restore environmental quality.



The impact of climate change on the quantity of jobs very much depends on the role of public authorities and wider cooperation between all relevant stakeholders in the greening process. The job effects of greening will depend on the successful formulation and implementation of climate mitigation policies and instruments, for example carbon tax, a new stage of European Union Emissions Trading System (EU ETS) and standards for products such as smart grids (European Commission, 2010a).

It is vital that decisions taken by public authorities are not only ambitious in order to mitigate climate change, but also stable in order to gain the trust of business in this process. The quantitative effects of the greening of industry will also depend on the lasting effects of the economic and financial crisis and public strategies in addressing them (for example, the implementation of existing and new stimulus packages, restored levels of public support through subsidies, tax incentives, feed-in tariffs and other measures). If these are successful, green restructuring may even help to stabilise the changes in employment in many industries (for example, shipbuilding) caused by the recent crisis or by factors such as wider economic restructuring.

In addition, the sectoral or geographical effects of greening on the quantity of jobs will depend on well-balanced policy decisions; for example, the labour-intensive industries which experience the largest effects in absolute employment terms (ETUC et al, 2007) or the regions most affected by greening will need particular attention in the future.

The role of public authorities and international cooperation will be particularly important in avoiding carbon leakage, that is, the relocation of jobs to non-EU countries with relatively lower environmental standards (European Commission, 2009a).

Finally, the impact of greening on the quantity of jobs will also depend on other factors, such as technology innovations, public debt levels and ageing (Cambridge Econometrics et al, 2011).

### Impact on quality of jobs

This section analyses the impact of greening on both overall job quality (also referred to as ‘quality of work and employment’) and its main dimensions (Eurofound, 2002):

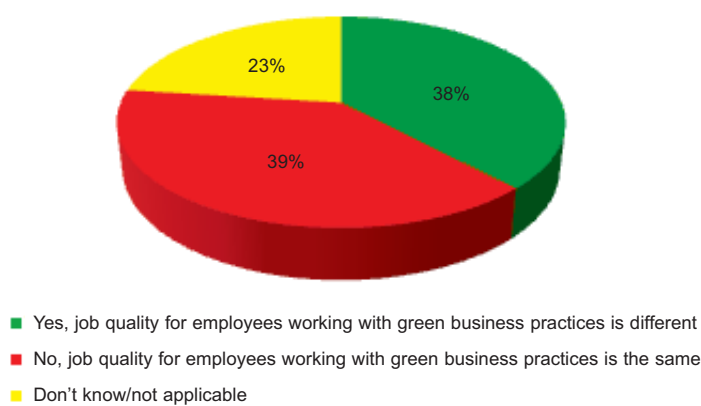
- skills development;
- career and employment security;
- health and well-being;
- reconciliation of working and non-working life.

No straightforward conclusions can be made on the basis of macro analysis of the impact of climate change on job quality.

It is very difficult, if not impossible, to distinguish the impact of climate change from broader contextual factors affecting job quality (EMCO, 2010). In addition, the impact of climate change on job quality (as in the case of job quantity) could be very different across sectors, occupations and even regions. The available literature does not provide sufficient evidence of whether direct or indirect causality exists between climate change and job quality. Finally, a disproportionately large share of trade union representatives might have introduced bias to the online survey results. This section therefore outlines only tentative trends instead of providing hard evidence on this relationship. Further research at sectoral and subsectoral level is needed to verify these trends.

The available evidence suggests that the impact of climate change on the quality of jobs has not been significant so far. Approximately equal shares of online survey respondents indicated that climate change ‘has’ and ‘does not have’ an impact on job quality (Figure 10). A higher share of respondents representing particular sectors identified likely differences in job quality than those who did not represent any sector (41% and 31% respectively). Yet more than half of respondents representing sectors did not think that, or did not know whether, greening has some additional effect on job quality. The low impact of greening on job quality is also evident in the case studies. When asked, many sustainability managers, heads of environment and other senior personnel working with environmental issues in companies were very often unaware of the link between implemented green business practices and their effects on job quality.

Figure 10: *Do employees working with green business practices have different job quality than other employees?*



Note: N = 145 (only one answer per respondent).  
Source: *Online survey*

A number of issues need to be emphasised in any analysis of the impact of climate change on job quality.

Greening may have a more significant impact on job quality in emerging new green industries (for example, wind or solar energy) than in the greening of old industries (for example, automotive or construction sectors). For example, workers in emerging new green industries may not have adequate skills to work safely with new technologies. In addition, evidence shows that the working conditions of such workers are typically worse and less controlled than those of workers in older industries (for example, they may have less access to occupational health and safety services such as health surveillance, labour inspection and so on).

Job quality in emerging new green industries is likely to be worse because of:

- a lower degree of representation, organisation and protection of workers (for example, low trade union density or no trade unions at all, small share of collective agreements, weak organisation and social dialogue) (Fritz et al, 2000; European Commission, 2012b; ILO, 2012);
- relatively more widespread patterns of undeclared/temporary work or self-employment (especially in small-scale or domestic renewable energy applications);<sup>5</sup>
- a larger number of SMEs in the green industries in which working conditions are typically poorer than in large companies (for example, lower awareness and expertise in health and safety, poorer quality of the workplace risk assessment resulting in poorer prevention and so on) (Fritz et al, 2000).

<sup>5</sup> There is evidence that temporary work remains widespread even when the industry has matured (interview with ETUC representatives).

In general, emerging new green industries are very volatile; many small companies are created but also stop functioning, political targets or regulations change relatively quickly and union busting is more frequent (interview with ETUC representatives). This could possibly lead to more uncertainty and thus impede job quality.

The willingness of companies to innovate may have a positive effect on job quality (Fritz et al, 2000). Greening is associated with the development and application of new technologies. Technology transfer is the key process in greening. New technologies require new skills and often offer better working conditions for employees developing or applying them. Evidence shows that job quality may be particularly positively affected for higher-skilled jobs (for example, those working intensively with green technologies) in which companies focus their considerable resources (see also next section).

The timing and speed of change are also important. Some sectors (for example, chemicals) were working on less energy-intensive solutions in production, R&D or management before the EU 20-20-20 targets were adopted and there has been a stronger focus on environmental issues in some cases for quite some time. In these cases, the impact of climate change on job quality may therefore be lower than in sectors recently confronted with significant demands for green restructuring (for example, cement and zero-energy buildings).

Furthermore, relatively new green industries (for example, renewables) may experience a somewhat higher impact on job quality due to the fast pace of green developments within them. For example, in the area of health and well-being, hazards that are well-known in traditional workplaces can be considered 'new' to workers in fast-growing green industries; for instance, some physical hazards that workers face when installing solar panel systems (falls from heights, manual handling, high temperatures, confined spaces and electrocution) are similar to those in the construction industry, but are new to electricians and plumbers installing PV panels or solar water heaters on roofs. Workers in green industries may also be exposed to new hazards that may not have been previously identified; for example, workers in the solar energy industry may be exposed to cadmium telluride, a known carcinogen (ILO, 2012).

Greening may imply a culture that is predisposed to better, higher-quality work standards. Some online survey respondents stated that companies in the green or greening industries care a lot about their reputation and usually provide better working conditions for their employees. This could also be a reaction to pressure from shareholders, employees or other stakeholders; as described earlier, pressure from stakeholders was identified as one of key motivations to mitigate climate change.

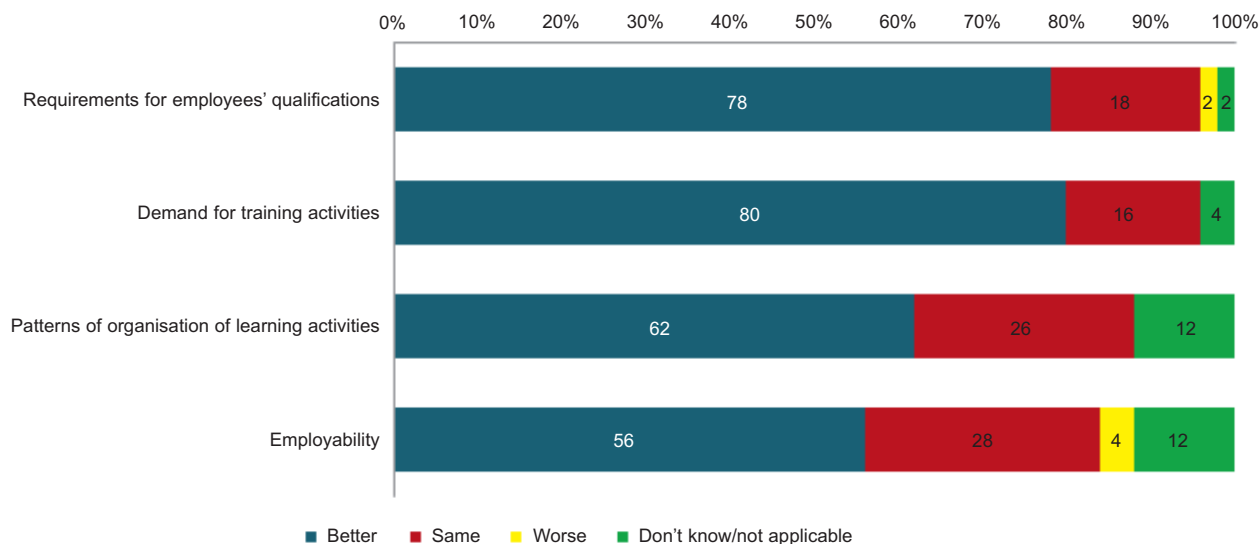
Overall, the impact of climate change on job quality may increase at least in some sectors in the medium to long term. In the longer term, greening may also result in an increased standard of living for everybody (European Commission, 2009a). This will very much depend on the role of public authorities; for example, national and regional governments could play a crucial role in this regard by specifying job quality-related requirements in green public investments.

### Skills development

Skills development includes requirements for employees' qualifications, demand for training activities, patterns of organisation of learning activities and career development-related issues (Eurofound, 2002). Available evidence reveals that skills development is the dimension of job quality most notably affected by climate change. The positive impact of greening on skills development is seen in sectoral reviews, interviews and company case studies.

This positive link is also confirmed by the online survey (Figure 11). Approximately 80% of respondents who agreed that greening affects job quality indicated that employees working with green business practices face higher qualification requirements and greater demand for training. Overall, qualification requirements and demand for training increases for all employees in the EU. Evidence also shows that those employed in green or greening sectors are likely to face somewhat higher requirements and greater demand for training.

Figure 11: Main differences in skills development between employees working with green business practices and other employees



Note: N = 50 per category.

Source: *Online survey*

Importantly, greening is not likely to result in many new occupational profiles. Instead, available evidence suggests that the acquisition of green skills will mainly enhance rather than change the existing skill set and that the job content will not be substantially altered (Cedefop, 2010; Cambridge Econometrics et al, 2011; ILO, 2011a).

Skills development, being the most affected job quality dimension, is also the most important one, as it is positively associated with other job quality dimensions. Current literature (Cedefop, 2011a, 2011b) indicates that the development of skills (in general, with no specification for green skills) can result in higher income, better health, better career progression and higher general satisfaction with working life – albeit indirectly. The majority of respondents, who agreed that greening affects job quality, indicated that employees working with green business practices receive better organised learning and have higher employability (Figure 11). Thus, it can be implied that the higher the level of skill associated with an occupation, the higher the job quality of this occupation (Cambridge Econometrics et al, 2011; European Commission, 2012b).

Sector overview studies such as Fritz et al (2000), European Commission (2009a) and Cambridge Econometrics et al (2011) show that, other things being equal, at least in the short term greening may:

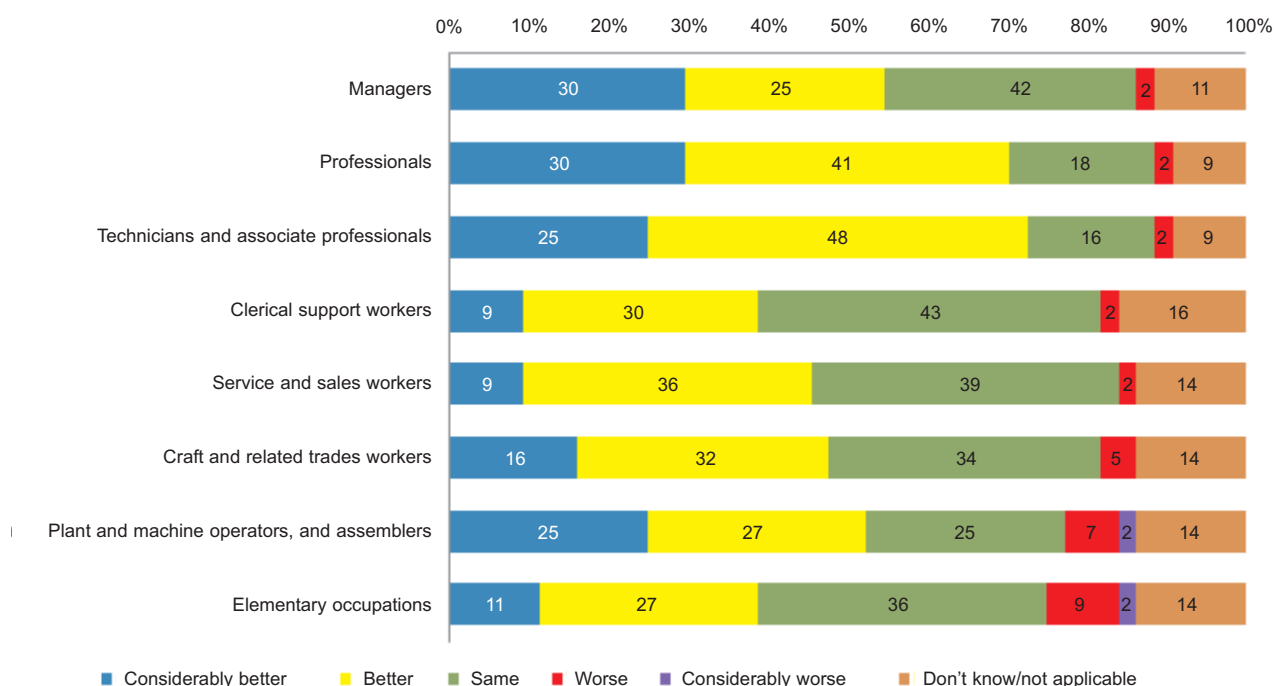
- increase the demand for highly skilled workers (for example, managers, engineers, business and computer professionals and technicians);
- decrease the demand for or have no effect on medium or less skilled ones (for example, clerks, operators and assemblers and labourers).

This is a general trend which may be shifted depending on the sector, framework conditions of country and so on. If this general trend prevails, however, it may imply an increased division between highly skilled and less skilled workers. While high-skilled workers may expect more training, higher income, better health, better career prospects and quality of life, less skilled jobs may involve more difficult manual work, increased exposure to dust, work under increased time pressure, lower wages, higher adaptability costs and so on. Over the medium to long term, when technologies mature,

there could be higher demand for less qualified employees (for example, maintenance workers) (European Commission, 2009a; Cambridge Econometrics et al, 2011). This may reduce this implied division between workers.

The results of the online survey show that overall job quality correlates with occupation, that is, the more skilled the occupation, the better conditions it is expected to face due to greening (Figure 12).

Figure 12: Main differences in quality of jobs between employees working with green business practices and other employees



Notes: Jobs categorised according to ISCO-08 (International Standard Classification of Occupations).

N = 44 per category.

Source: *Online survey*

The impact of greening on skills development depends on a number of factors, including customer demand and institutional cooperation. It is argued that the higher the customer demand, the higher the impact on skills development. However, customer demand is rather slow to develop and is erratic. Thus, it may take some time before the market pushes education and training institutions to provide environmental training programmes. This is not to say that education and training providers have not yet reacted to the green developments in the market. For example, a considerable number of new formal programmes addressing the needs of existing or emerging new green industries have been created in Germany, often on the basis of cooperation with the market actors. For example, the case study of wind energy producer ENERTRAG AG revealed that the company and the University of Applied Sciences in Berlin had together developed a new study programme, Engineering with a Focus on Renewable Energies. However, these positive developments are not yet widely seen across the EU. They could be facilitated by increased cooperation between labour market institutions, which know employers' needs better, and education and training institutions, which, if guided, could adapt their existing curriculums to fit the new green developments within industry.

The development of green skills could also be induced by developments in other dimensions of job quality. For example, the need to meet new regulatory requirements (including licences, certifications and occupational health and safety requirements) usually leads to more intense skill development of employees as companies and self-employed people are

encouraged to obtain appropriate training in order to comply with the new requirements (Cedefop, 2011b). Furthermore, green skills development may lead to higher positions within the same company, which could lead to more training in order to perform a new function or increase the current intensity of work.

Skills development is not only proceeding vertically by developing sector-specific technical/managerial skills, but also horizontally by developing science, technology, engineering and mathematics (STEM) skills and generic (or transferable) green skills – all of which are vital in the future skills agenda (Cedefop, 2010). Generic green skills largely relate to understanding environmental legislation and improving energy and resource efficiency in the workplace. The development of STEM skills is emphasised by many stakeholders in most, if not all, the target sectors, as these provide the basis for high-level low-carbon skills (Cedefop, 2010). In addition, multi-skilling (for example, by combining new environmental and ordinary skill sets) and interdisciplinary skills are likely to become increasingly in demand across industry and especially in high-skilled non-manual and manual occupations.

Demand for certain types of training will differ across the target sectors and especially occupations. For example, formal training is likely to be more important in sectors with a high share of high-skilled employees (for example, chemicals), while non-formal, on-the-job training will dominate in sectors where lower-skilled, self-employed workers dominate (for example, construction).

Greening may disproportionately affect the job quality of particular groups of employees. For example, as qualification requirements and demand for training increases, human resource (HR) managers and training coordinators may face greater challenges in organising training of workers, following related regulations, developing strategic management solutions and taking care of other employee working conditions (Loire et al, 2008; Economix, 2009; Ikei, 2009; TNO et al, 2009a, 2009b, 2009c, 2009d, 2009e, 2009f; Ecorys et al, 2010).

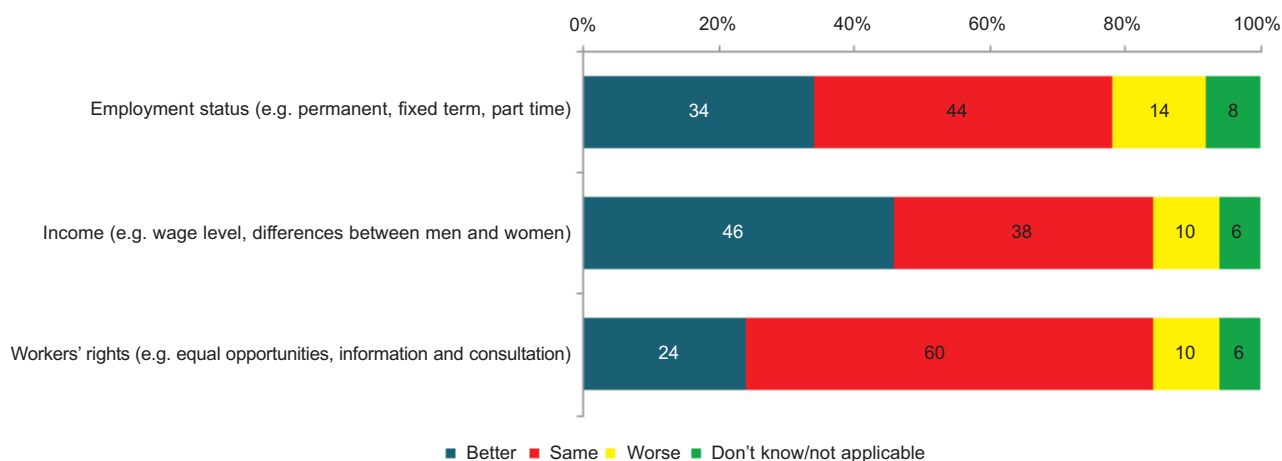
### **Career and employment security**

Career and employment security covers issues such as (Eurofound, 2002):

- employment status (for example, full or part time, temporary or permanent, self-employment);
- wages;
- workers' rights (including equal opportunities, information, consultation and involvement in organisational change);
- social protection (for example, correspondence between working hours and pay).

Collected evidence suggests that the impact of climate change will be less significant on the career and employment security dimension than on the skills dimension. The online survey shows that the majority of respondents who agreed that greening affects job quality expect either no change or a positive change in career and employment security elements (especially income) (Figure 13). This is likely to be related to a positive link between skills development and other job quality dimensions (that is, the more intense the skills development, the better the career and employment security conditions) discussed above.

Figure 13: Main differences in career and employment security between employees working with green business practices and other employees



Note: N = 50 per category.

Source: *Online survey*

However, there were significant differences between sectoral respondents and those who did not represent any sector. The shares of sectoral respondents who thought that employees working with green business practices have worse employment, income and workers' rights conditions were smaller (11%, 6% and 6% respectively) than the shares of those who did not represent any sector (20%, 20% and 20% respectively). The latter were rather more sceptical than sectoral representatives regarding employment status (20% against 40% expected it to be better) and workers' rights (13% and 29% respectively).

Certain vulnerable groups of employees (for example, women, youth, older workers and migrants) may not have the same possibilities to work with green business practices as other employees (see, for example, European Commission, 2012b).

Most green jobs are expected to be in the construction sector, where women are significantly underrepresented. The estimated share of female employees in green jobs in 2009 was 24% in manufacturing and 9% in construction sectors (Stevens, 2009). The share of female workers in green transport jobs could be equal to or slightly larger than that in manufacturing. Meanwhile, the shares of female employees in green jobs in other sectors such as textiles, distribution and trade chemicals could be higher due to their higher shares in general in conventional jobs (Oxford Research, 2010). However, the absolute effect of greening for gender balance is likely to be negative for women. This could particularly be the case for office clerks, an occupation in which women are disproportionately employed, if they are significantly affected by greening (Cambridge Econometrics et al, 2011). Furthermore, women are underrepresented among some professional and associate professional occupations that are forecasted to significantly increase due to greening (see sectoral overviews). A future increase in demand in the latter occupations offers possibilities for women (for example, it is currently estimated that there are slightly more women employees in new technologies and occupations that offer clear, direct environmental benefits). Women's representation could be strengthened by additional policy measures, such as (Stevens 2009):

- anti-discrimination laws;
- quotas and targeted schemes in the recruiting process;
- specialised apprenticeship and training initiatives;



- reductions in gender-based job segmentation and wage gaps;
- increase in the union membership of women in potential green sectors.

Other vulnerable groups may also face barriers to participation in greening. Young people are more likely to be employed in non-green occupations compared to all people in employment (Cambridge Econometrics et al, 2011). Furthermore, young workers are relatively more likely to be employed in lower-skilled jobs (more relevant for relatively ‘younger’ sectors – energy, furniture, non-metallic materials; Oxford Research, 2010). Although young people tend to improve their occupational positions over their life cycle, it appears that the recent economic and financial crisis has had a disproportionately adverse effect on young people and may have worsened their ability to capture higher-skilled jobs in the future (Cambridge Econometrics et al, 2011). Older workers often lack the skills base to adapt to new technologies (more relevant for relatively ‘older’ sectors – automotive, construction, distribution and trade, shipbuilding and transport; Oxford Research, 2010). Meanwhile, research suggests that a higher proportion of migrants most often work in positions demanding only low-skilled or unskilled work, such as waste separation workers (Fritz et al, 2000).

Workers’ rights also depend heavily on the extent and intensity of social dialogue, the spread of collective agreements and other workers’ protection structures within sectors. Workers in SMEs or the self-employed may have lower career and employment security, as they are less organised and protected. The strengthening and harmonisation of workers’ rights across the EU could significantly improve career and employment security in some problematic sectors (for example, the road transport sector) (European Commission, 2009a). For example, a German parcel logistics company reported that although it offered voluntary eco-driving courses to franchisees, the response was not large. According to the company, the main reason for this lack of interest was the time pressures on franchisees.

Some stakeholders expect greening to lead to a higher number of fixed-term contracts, as the new jobs required to build new green infrastructure and to develop new green technologies will be temporary. Some studies also show a spread of temporary employment contracts and/or the introduction of shorter working time arrangements across many sectors (Isusi, 2011). Although some of these trends are also valid for greening sectors, they are also likely to be consequences of the recent economic and financial crisis and not climate change. Furthermore, analysis of Eurostat Labour Force Survey (LFS) data showed that green jobs are much less likely to be part time and slightly less likely to be temporary (Cambridge Econometrics et al, 2011).

The crisis has had a considerable influence on all job quality dimensions, but especially the career and employment security of workers. For example, the construction sector is generally characterised by rather stable social dialogue processes (Pauwels et al, 2011). Alongside more traditional themes such as wages and working time, trade unions in the sector also consider that horizontal issues such as green skills should be included in negotiations. But since the negotiating process always has to deal with concessions, the ‘new’ themes are the first to disappear from the agenda when the economic and financial crisis hits the sector.

In some sectors (for example, waste disposal), physical stresses are not reflected in higher pay for employees (Fritz et al, 2000). Stakeholders also emphasised that considerable energy savings (that is, saved financial resources) achieved in companies due to new technologies, but also due to the work of their employees, are often not reflected at all in employee benefits. As workers see no link between the extra work needed for energy efficiency and their career or employment security, they feel less motivated to contribute to green change in the company. Cultural change both for employers and employees is needed for the successful anticipation and management of greening processes.



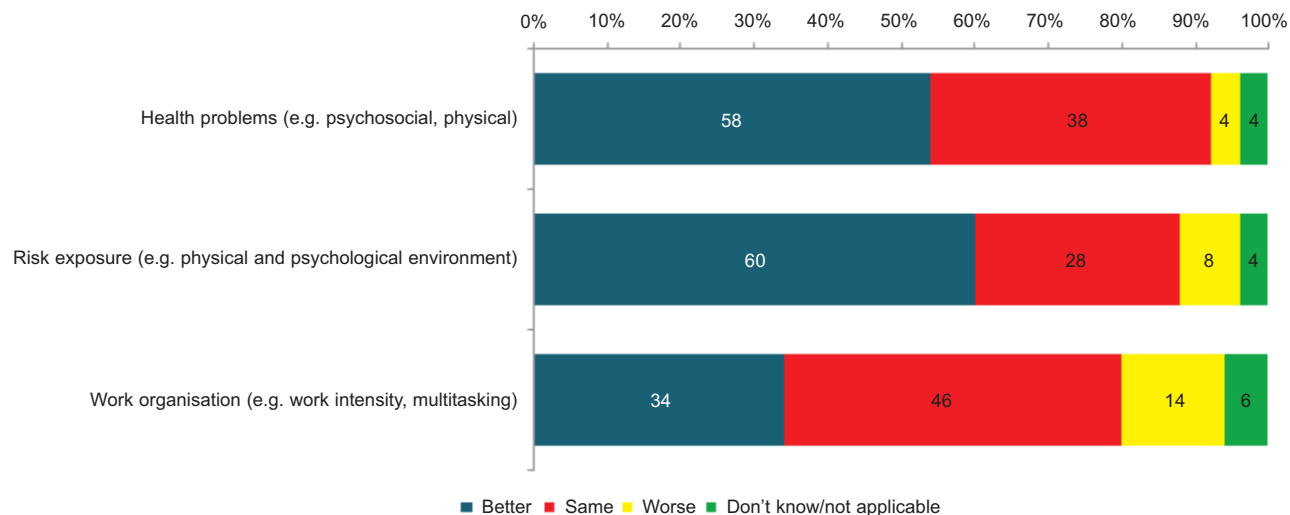
### Health and well-being

The health and well-being of workers encompass (Eurofound, 2002):

- psychosocial and physical health problems;
- risk exposure;
- work organisation (for example, work intensity, share of monotonous tasks, job satisfaction, length and organisation of working hours in relation to health);
- ageing-related issues.

The online survey showed that according to a majority of respondents who agreed that greening affects job quality, employees working with green business practices tend to have better health conditions and are less exposed to risks (Figure 14).

Figure 14: *Effects of greening on health and well-being of employees*



Note: N = 50 per category.  
Source: *Online survey*

The results of the online survey contrast with recent research. A recent ILO publication stresses that green jobs may not necessarily lead to better health in the sense that even if certain jobs are considered to be ‘green’, the technologies used in them may not be ‘green’ at all (ILO, 2012). There is a need to carefully consider all new ‘green’ technologies prior to their implementation. Experience shows that the replacement of some substances harmful to the environment by more environmentally friendly ones have proven to be more hazardous to workers’ health; for example, the substitution of hydrochlorofluorocarbons (HCFCs) for chlorofluorocarbons (CFCs) has increased the risk of exposure to carcinogens as well as to fire hazards.

Other recent studies by the European Agency for Health and Safety at Work (EU-OSHA, 2011a, 2011b) indicate that greening, more intensively than in conventional jobs, creates new combinations of risks that still need to be assessed and managed. The EU-OSHA project, Foresight of New and Emerging Risks to Occupational Health and Safety Associated with New Technologies in Green Jobs, found that by 2020, the most important technologies will be waste and recycling, construction technologies, nanotechnologies and nanomaterials, transport technologies, biotechnologies, manufacturing technologies (for example, smart products, pervasive computing and smart packaging), energy transmission, wind

energy and bioenergy (EU-OSHA, 2011b). Companies across all sectors will have to adapt their current risk anticipation, identification, evaluation and control activities to these emerging technologies. There will also be demand for additional training of relevant employees. Sectoral overviews and case studies show that out of the 10 target sectors, the distribution and trade sector, and possibly the shipbuilding sector (with the exception of shipbreaking), may be less affected by new health risks emerging from greening.

Almost half of the respondents to the online survey did not expect any changes in work organisation due to greening (Figure 14). Again, the opinions of sectoral respondents and those who do not represent any sector diverge, with 9% and 27% respectively responding that the work organisation conditions of employees working with green business practices are worse.

Meanwhile, the sectoral overviews (see, for example, the construction sector overview in Annex 2) suggest that greening may inevitably lead to a higher degree of outsourcing due to the technological know-how required to perform certain tasks (for example, installation of solar panels on roofs, pressurising, and installation of heat pumps). This leads to the emergence of a number of small subcontractors and self-employed workers focusing on specific niches in the market. An increase in subcontracted, self-employed work requires new organisational approaches from training institutions in providing necessary training courses. This may also have some negative repercussions, as subcontracted, self-employed work often tends to be project based, fixed term or seasonal, which may negatively affect most, if not all, dimensions of the job quality of related workers.

Some stakeholders also argue that greening may demand more teamwork, as cross-functional, interdisciplinary tasks will become more common (for example, the complexity of tasks in retrofitting). Others argue that greening may lead to higher work intensity for some groups of employees. For example, workers' representatives and HR managers already have significant responsibilities, such as the coordination of training activities and the management of issues related to health and safety. Greening introduces new responsibilities for them, including:

- the introduction and coordination of energy-saving activities;
- additional related training;
- the management of a socially responsible transition to green business practices.

However, interviews show that although greening creates additional responsibilities for certain employees, employers often do not grant them the time needed to carry out these new responsibilities. Time off for environmental activities is vital if employee (or union) green representatives are to contribute significantly to efforts to reduce emissions. For example, in the UK, only 14% of respondents to a survey by the Labour Research Department (LRD) had been given time off to devote to environmental issues (LRD, 2009). According to the same survey, only a minority of the union representatives surveyed were able to access an environmental training course, while three-quarters said they had been allowed the time for environmental work.

Most current employee-led initiatives to tackle energy and resource use, recycling and green travel still depend on voluntary effort. Increasing environmental responsibilities without adequate time to perform them reduces the job quality of employees and makes green change ineffective. Employees represent a colossal untapped potential for green change within companies, which should be unleashed by providing time off to allow proper training on energy and environmental issues and time to carry out their functions as green representatives.

Work intensity could be further intensified by the economic and financial crisis. Limited financial resources push employers to introduce various saving measures, including greater pressure for higher productivity. This is likely to

affect employees’ work intensity, as often the number of employees is reduced but the scope of projects or tasks the company is engaged in remains the same.

Last but not least, greening may contribute positively to the career and employment security of employees by increasing their job satisfaction. The meaning of work is a critical component of job satisfaction. Thus, knowledge that work contributes to ‘good aims’ creates more satisfaction for employees.

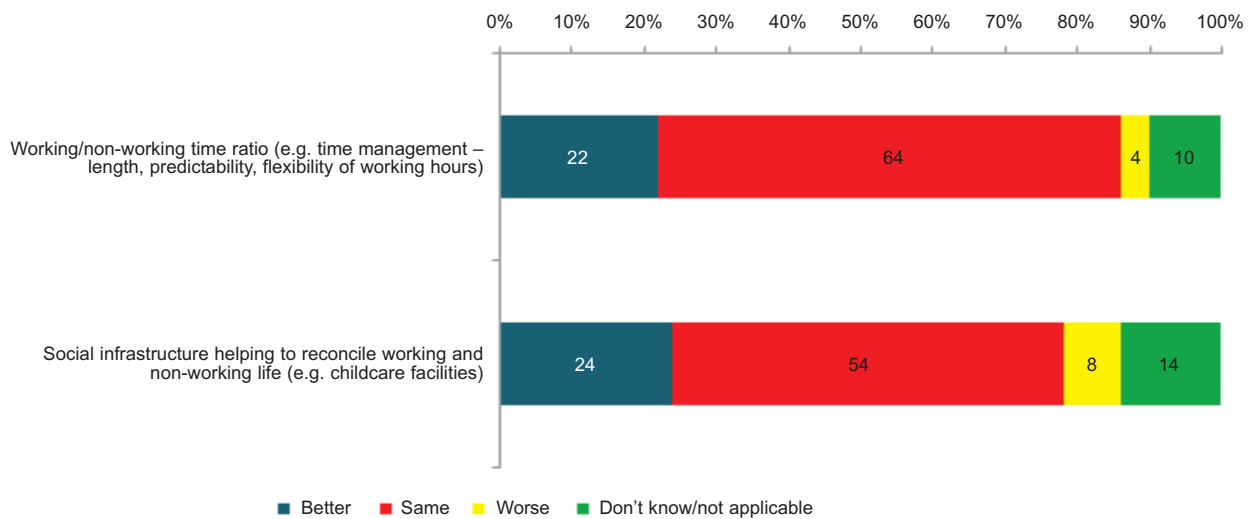
**Reconciliation of working and non-working life**

Reconciliation of working and non-working life includes (Eurofound, 2002):

- length, flexibility and predictability of working time;
- ability to carry out non-work-related tasks;
- social infrastructure, such as day care centres.

The results of the online survey suggest that neither the working and non-working time ratio nor social infrastructure is significantly affected by greening (Figure 15).

Figure 15: Main differences in reconciliation of working and non-working life between employees working with green business practices and other employees



Note: N = 50 per category.  
Source: *Online survey*

Interestingly, 20% of respondents who do not represent any sector(s) indicated that social infrastructure in green jobs may be worse than in other jobs, as opposed to 3% of sectoral respondents who had a similar opinion. However, the study found no other evidence to support the argument that greening has adverse effects on social infrastructure. Issues related to the impact of climate change on work–life balance or social infrastructure are probably the least discussed in the literature.

The greening of industry may affect daily working and family lives in different ways. For example, greening is likely to change patterns of commuting (for example, more intense use of public transport). Teleworking solutions may become more widespread in order to better reconcile working and non-working life. However, they may have not only positive

effects (for example, increased flexibility), but also negative side effects, such as an increase in home energy bills, which could put pressure on some vulnerable groups of employees, or a worse psychological environment due to lack of interaction with their peers.

These trends are likely to differ not only between sectors, but also particularly between occupations within them; for example, teleworking is likely to be more widespread in skilled occupations that are more flexible about the workplace environment. Increased work flexibility in green business practices may create a more favourable environment for female workers whose labour market participation is lower, usually due to family reasons (European Commission, 2008a).

Greening may also have effects on work–life balance in particular occupations. Workers in renewables (for example, in offshore wind turbines or regional solar power generating systems) may have a worse work–life balance, as they are bound to one place or are temporarily isolated from their countries (for example, workers on offshore wind farms, who could be compared to those working on offshore oil or gas platforms). Companies apply different management approaches to attract workers to these much-needed jobs (for example, some companies promote these jobs as an opportunity to combine well-paid work and leisure activities such as windsurfing and power kites).

### **Sectoral effects of greening on job quality**

As mentioned previously, greening has different effects across the target sectors, which also differ across smaller industries and job quality dimensions. Table 2 presents an overview of some sectoral patterns of greening across these dimensions. The table and the insights below are derived from the sectoral overviews and company case studies. They illustrate only the greening effects on job quality across sectors and do not aim to provide a comprehensive overview. This is because the evidence available in this area is still scarce and much more research needs to be carried out in this area.

Within the skills development dimension, the highest impact of greening is likely to be in the construction and energy sectors. In the automotive, chemicals, distribution and trade, furniture and non-metallic materials sectors it is expected to be moderate, and in the remaining target sectors it is expected to be low. This more or less reflects the effects identified by considering the current occupational structures of the sectors (that is, shares of high-, medium- and low-skilled workers in the sector) (Oxford Research, 2010).

The impact of greening on skills development also depends on the role of public authorities. The automotive, construction, energy and transport sectors receive exceptional attention from policymakers, as together they are responsible for the major part of EU final energy consumption (European Commission, 2005a). The development of some of their subsectors (for example, retrofitting, renewables, electric cars and cleaner modes of transport) depends particularly on public investment and/or regulations. The higher standards or requirements associated with new public investment or regulations are likely to stimulate skills development within these sectors.

Career and employment security is likely to be most affected in the construction and renewables sectors, while the automotive, chemicals, traditional energy and shipbuilding sectors will experience a moderate impact and rather minor effects in the remaining sectors.

The impact of greening on health and well-being issues seems to be strongest in the chemicals, construction and emerging energy industries. The automotive, traditional energy, furniture and non-metallic materials sectors seem to be moderately affected by greening, while the effects in the remaining sectors are even lower.

The reconciliation of working and non-working life is likely to be most affected in construction and renewables, and moderately affected in chemicals and traditional industries.

Patterns of greening effects on job quality differ not only by sector, but also by type of job (prevalent positive impacts for office work and mostly negative for on-site work), level of skills (the less skilled the employee, the worse the job quality) and occupational structure (that is, the higher the share of highly skilled jobs, the more positive the impact is likely to be) (see, for example, Martinuzzi et al, 2011). These patterns also differ across countries due, for example, to the availability of public support/favourable investment climate or objective reasons (for example, coastal areas for the construction of wind farms). Thus, specific approaches are needed for the adequate anticipation and management of greening effects on job quality across these different dimensions.

Industry observers also note that the emerging industries within traditional sectors (for example, green construction, renewables and low-carbon vehicles) may experience a rather higher impact on job quality than other sectors due to the exceptionally fast growth of these new industries (see, for example, the construction sector analysis in Pauwels et al, 2011).

However, there is a general lack of evidence on the relationship between greening and job quality in the different target sectors. In contrast to skills development, which is a considerably more researched dimension in terms of greening effects, other job quality dimensions (especially reconciliation of working and non-working life) are significantly less explored. Thus, the findings in this section are tentative and require further investigation.

Table 2: Illustrative patterns of greening across sectors and job quality dimensions

	Skills development	Career and employment security	Health and well-being	Reconciliation of working and non-working life
<b>Automotive</b>	Moderate impact due to strong sector resilience High demand for highly skilled in EU15, for medium- to low-skilled in EU12 Demand for interdisciplinary skills and multi-skilling Highly skilled, especially in demand in emerging industries such as low-carbon vehicle production	Moderate impact Spread of flexible employment contracts Female underrepresentation Low sector attractiveness among young people High worker replacement demand	Moderate effects on health General trend towards cleaner environment compared to the traditional industry	Low impact Widespread flexible work patterns
<b>Chemicals</b>	Moderate to high impact due to rather long period of greening of sector Lower impact on pharmaceuticals sector, which is more driven by climate change adaptation	Moderate to high impact on less-organised subsectors within the green chemical industry	High impact (of emerging new technologies and substitution of chemicals for environmental reasons) due to sector specifics	Moderate to high impact on less organised subsectors within the green chemical industry

	Skills development	Career and employment security	Health and well-being	Reconciliation of working and non-working life
<b>Construction</b>	<p>High impact</p> <p>Move towards more skilled jobs (high demand for, for example, technicians and (associate) professionals)</p> <p>High demand for recognition of green skills, training innovations (for example, on-site training of workers), interdisciplinary (especially in retrofitting) and generic green skills</p> <p>Progress in green skills development is especially needed in SMEs and relatively large informal construction sector</p>	<p>High impact</p> <p>Potentially high negative effects on self-employed workers who are harder to motivate and are less financially able (outsourcing is increasing subcontracting and self-employment due to higher complexity of tasks)</p> <p>Women and youth underrepresented</p> <p>Low sector attractiveness among youth – need to improve image of the sector and overall HR development in companies to attract new staff</p> <p>Likely positive effects on equal opportunities from automation practices</p>	<p>High impact due to, on average, 3–4 times higher possibility than in other sectors of work accidents and higher risk of exposure to dangerous substances causing occupational diseases compared to other workers (ILO, 2011a)</p> <p>Likely positive effects on health from automation practices</p>	<p>High impact</p> <p>Possibly highest negative impact for on-site self-employed workers engaged in project-based, fixed-term and seasonal work. However, standardisation of building elements, tight management of processes and use of eco-friendly materials may reduce occupational accidents and health problems (most likely – in large companies), at the expense of workers’ autonomy and craftsmanship</p>
<b>Distribution and trade</b>	<p>Moderate impact</p> <p>Highest demand for transferable skills such as eco-product knowledge and understanding customers’ needs</p> <p>Likely loss of employment for low-skilled workers</p> <p>High need for multi-skilling</p>	<p>Low impact</p> <p>Greening of the industry is expected to enhance career and employment security (for example, more full-time jobs, reduced turnover of staff)</p> <p>Women underrepresented in managerial positions and highly exposed to involuntary part-time employment</p>	<p>Low impact</p> <p>Likely positive developments in working environment</p>	<p>Low impact</p> <p>Likely higher work intensity</p>
<b>Energy</b>	<p>High impact</p> <p>High demand for hard transferable skills such as STEM</p> <p>Highest need for new skills in renewables</p> <p>Lower impact in waste and gas subsectors</p>	<p>Moderate impact</p> <p>In general, green jobs in the sector are more likely to employ men than women compared with non-green jobs</p> <p>Jobs in traditional subsectors are less likely to be part time or temporary; however, jobs in renewables industries and energy services tend to be less well paid and enjoy less secure employment conditions</p>	<p>Moderate impact</p> <p>Many emerging energy sectors have specific risks related to ‘engineering unknowns’</p> <p>Traditional industries less affected</p>	<p>Moderate impact</p> <p>As typically regionally concentrated, traditional power generation is phased out, workers will face a more pressing need for retraining and regional mobility (for example, longer commuting time)</p> <p>Inflexible working hours and multiple shifts widespread in renewables</p>
<b>Furniture</b>	<p>Moderate impact</p> <p>Most effects are on highly skilled</p>	<p>Likely low impact</p> <p>Significant lack of evidence</p>	<p>Moderate impact</p> <p>Industry is focused on abolition/prevention of workplace hazards and risk exposure</p>	<p>Likely low impact</p> <p>Significant lack of evidence</p>

	Skills development	Career and employment security	Health and well-being	Reconciliation of working and non-working life
<b>Non-metallic materials</b>	In the scenario, characterised by fast economic growth and continued global competitive pressures coupled with harmonised new environmental legislation, impact is likely to be moderate to high  High demand for R&D staff	Likely low impact  More significant effects for highly skilled  Women underrepresented; significant lack of evidence	Moderate impact  Green innovations may lead to new health and safety risks which may negatively affect workers	Likely low impact  Significant lack of evidence
<b>Shipbuilding</b>	Low to moderate impact  Highest impact in new emerging tasks such as those in the construction of specific vessels (for example, LNG-fuelled ships); however, most tasks are based on existing skills  High demand for transferable skills (for example, market intelligence) to enter new markets such as renewables	Moderate impact  Cyclical change affects employment security of all employees in the sector, especially low to medium qualified  Widespread use of temporary low-cost labour in green practices negatively affects employment security in the sector	Likely low impact  Significant lack of evidence	Likely low impact  Significant lack of evidence
<b>Textiles</b>	Low impact  More horizontal (cross-occupational) demand of skills in the sector  Importance of interdisciplinary skills	Low impact  Women underrepresented in managerial, technical and design occupations  Significant lack of evidence	Low to moderate impact  Emergence of novel materials (for example, smart interactive textiles) is likely to exacerbate the risks from potential dangerous substances involved in the manufacture of the materials	Likely low impact  Significant lack of evidence
<b>Transport</b>	Low impact due to low knowledge and high labour intensity  Higher demand for interdisciplinary skills	Low to moderate impact due to widespread outsourcing and offshoring practices and high share of self-employed workers; women underrepresented	Low impact  Some new risks could arise in, for example, the maintenance and operation of low-carbon vehicles	Low to moderate depending on working hours and rest-time legislation  Positive developments could be seen due to the expansion of unaccompanied transport (mostly road-rail)



	Skills development	Career and employment security	Health and well-being	Reconciliation of working and non-working life
<b>Common patterns (N = 46)</b>	<p>More than half of studied companies experience at least some effects and majority of them manage those</p> <p>Most sectors experience higher demand for highly skilled occupations and high-level skills</p> <p>High need not only for soft skills (for example, teamwork), but also hard transferable skills such as STEM</p> <p>Widespread need for multi-skilling and interdisciplinary skills</p> <p>Very few new occupational profiles and mostly improvement of existing skill sets</p>	<p>Around half of studied companies experience at least some effects</p> <p>Few of the studied companies use anticipation approaches</p>	<p>Around half of studied companies experience at least some effects</p> <p>Few of the studied companies use anticipation and management approaches</p>	<p>Almost no effects</p> <p>Very few studied companies use anticipation and management approaches</p>

Source: *Sectoral overviews, company case studies*



# Anticipating and managing green change 5

## Overview of anticipation and management trends

The greening of industry is shaped by a number of policy targets, including the EU's 20-20-20 targets and the target of an 80%–95% reduction of GHG emissions by 2050 (Council of the European Union, 2007; European Commission, 2011a). These targets influence both public and private processes directly. Previous industry restructuring processes (for example, the ICT revolution and the liberalisation of trade) were influenced only indirectly by policy decisions and lacked such explicit targets.

Since the transition to a low-carbon economy is a policy-driven process, the anticipation of green change could be more straightforward and explicit, and management measures can even be planned and launched right at the outset (Galgóczy, 2010). However, it is clear that the market alone will not be able to reach an optimal level of energy efficiency in the desired time due to production and consumption externalities, imperfect information, uncertainty and inertia in decision-making (European Commission, 2009a). Therefore, public authorities need to collaborate with the actors in the market while directing as well as supporting the socially responsible green restructuring efforts of industry. Greening provides all stakeholders with an excellent opportunity to collaborate more intensively in anticipating and managing forthcoming changes than in previous similar processes.

At EU level, a number of initiatives have been implemented to facilitate collaboration in anticipating and managing green change. For example, a number of studies support anticipation and management processes with evidence-based research (Broughton, 2009; OECD, 2009; Cedefop, 2010; Martinez-Fernandez et al, 2010; Cambridge Econometrics et al, 2011; Eurofound, 2011; ILO, 2011a, 2001b, 2011c, 2011d). EU institutions have facilitated these processes by initialising relevant projects, such as:

- the recent European Commission call for proposals (No. VP/2011/010) for projects contributing to exchange of good practices in the area of anticipation and management of green-related skills, including cooperation activities;
- networks such as the Cedefop Green Skills Network.

EU institutions carry out extensive consultations with businesses and other stakeholders in drafting green-related regulations. For example, after public consultation, the skills dimension was incorporated in Directive 2009/28/EC on the promotion of the use of energy from renewable sources. EU institutions also examine the feasibility of contributing to the development of sector councils on employment and skills at the European level that are expected to enhance the capacities of national councils in matching education and labour markets, including in the area of green skills (Ecorys and KBA, 2010).

The European Commission is also promoting greening beyond EU borders. For example, the European Training Foundation (ETF) is actively engaged in promoting greening in its partner countries through the following five focus areas (ETF, 2011):

- the promotion of education geared to the development of values and competences for sustainable development;
- the promotion of appropriate methods for the identification, forecasting and supply of skills for green jobs;
- the provision of support to vocational and educational training (VET) schools as agents for local sustainable development and as stakeholders in local strategies for coping with climate change;
- fostering sustainable development as an element of entrepreneurial learning and business education;
- the inclusion of sustainable development in ETF analyses of human resource development policies through the implementation of appropriate indicators.

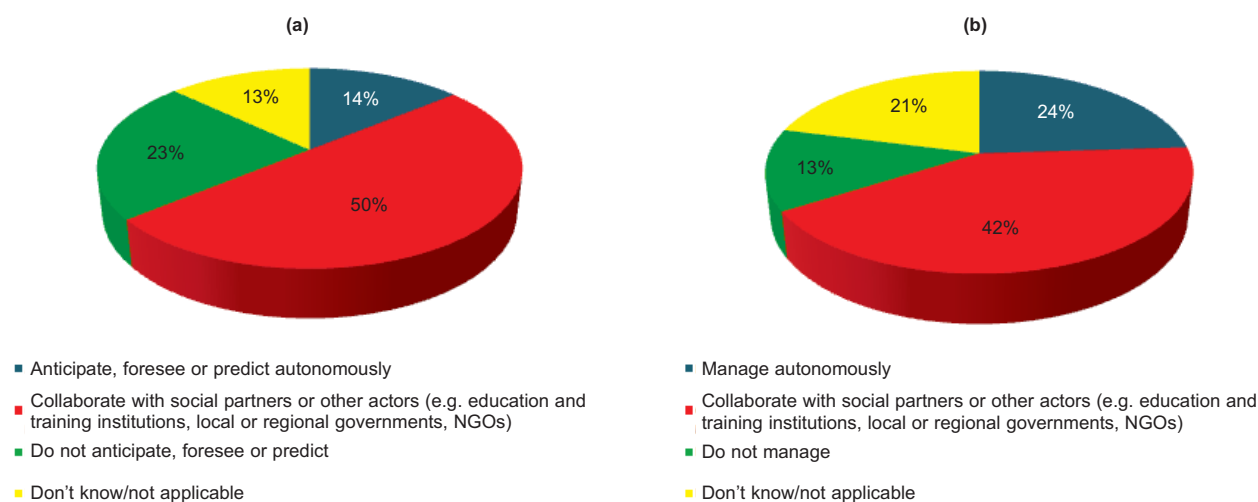
At national level, the anticipation and management of green change has taken different directions across the EU. In some countries (typically older Member States), social partners are engaged in established social dialogue or have created ad hoc collaborations at the sectoral or transversal levels, for example (Eurofound, 2011):

- the Network Resource Efficiency project in Germany;
- the GreenWorkplaces project and the Greener Jobs Alliance Initiative in the UK.

In other countries (usually newer Member States), social partners are less active in the area and more support from government is needed (Broughton, 2009).

The main focus of this study was on the anticipation and management approaches at sectoral and company level. Results from the online survey indicate that businesses are most often likely to collaborate in both anticipating and managing green change (Figure 16). However, the survey also reveals that there may be a larger proportion of companies that manage green change autonomously and do not anticipate it. Stakeholders indicate that companies that adopt environmental management systems, which are subject to continuous improvement, are usually well ahead of other companies in anticipating green change. However, these are usually large companies; the recent Eurobarometer survey showed that only 25% of SMEs in the EU have an environmental management system, compared with 48% of large companies (European Commission, 2012a).

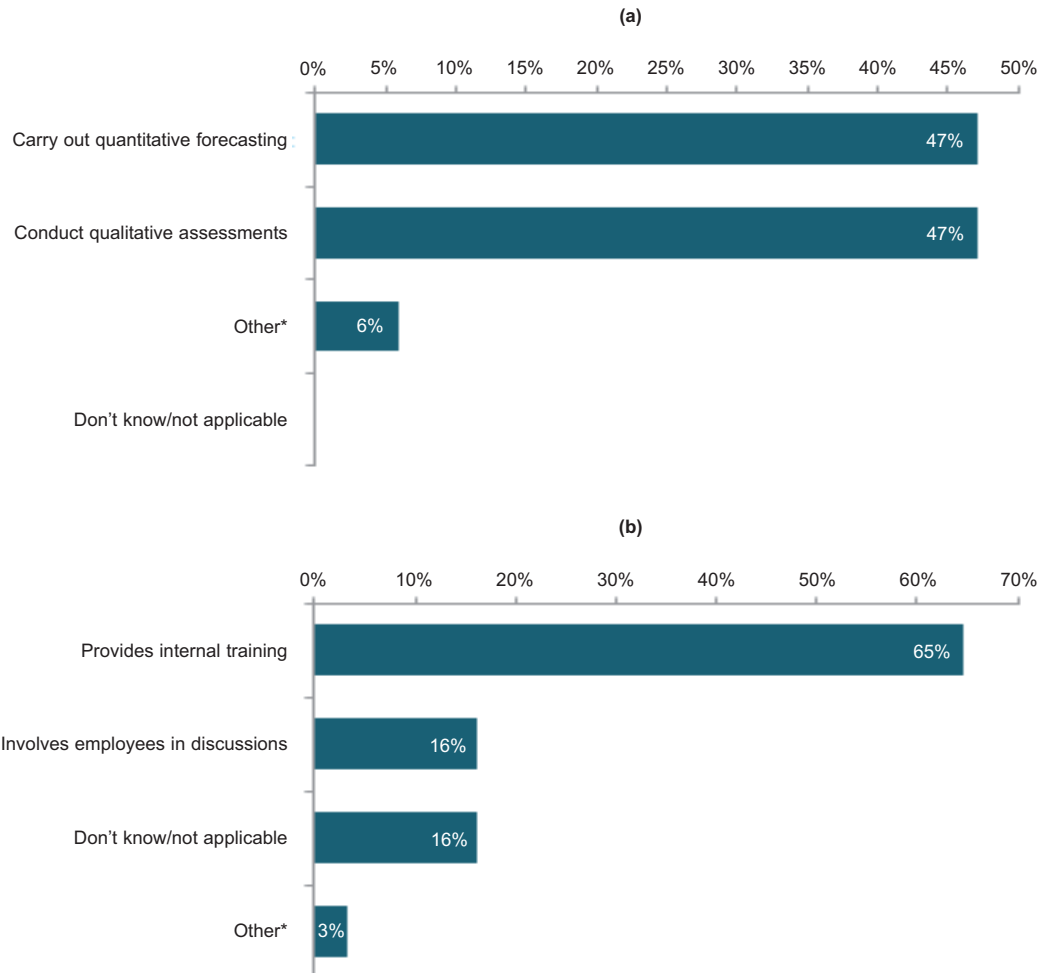
Figure 16: Approaches usually adopted by businesses in (a) anticipating and (b) managing green change and its effects on job quality



Notes: (a) N = 132, one answer per respondent.  
 (b) N = 129, one answer per respondent.  
 Source: *Online survey*

The online survey shows that companies that anticipate green change autonomously tend to apply both quantitative (for example, extrapolation of future trends based on available business data) and qualitative techniques at a similar rate (Figure 17). Those companies that tend to manage green change autonomously usually do so in the form of internal training and only in rare cases do they try to involve employees in discussions regarding green change. Stakeholders also indicate that the usual motive for companies that try to anticipate and manage change autonomously is related to a need to reduce the cost of resources (especially energy).

Figure 17: Business approaches to autonomously (a) anticipate and (b) manage green change and its effects on job quality



Notes: \*In relation to chart (a), one respondent ticked the field 'Other' but did not provide any information; in chart (b), one respondent ticked the field 'Other' and added 'management as part of business strategy'.

(a) N = 17, one answer per respondent.

(b) N = 31, one answer per respondent.

Source: *Online survey*

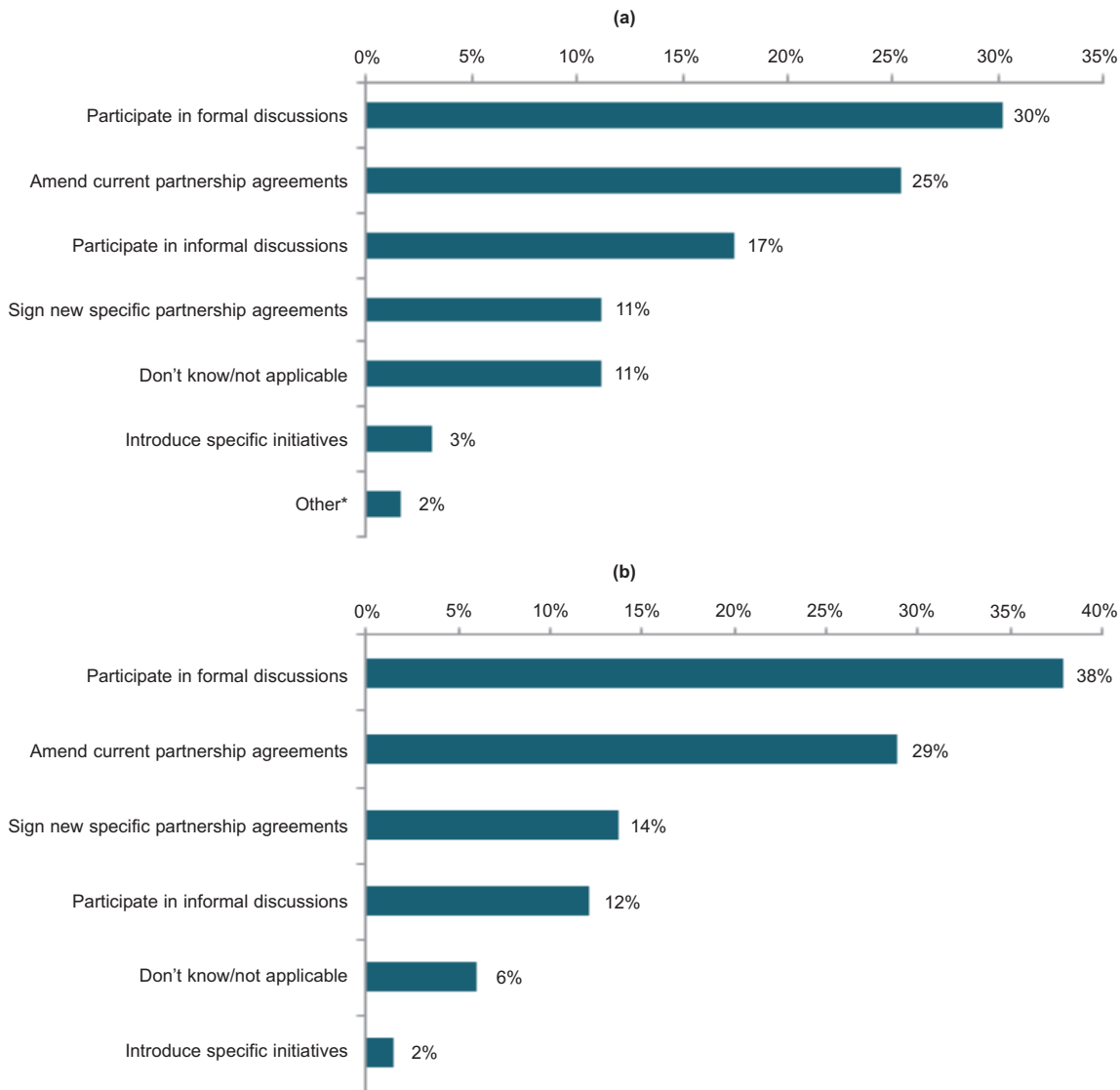
The online survey shows that companies that collaborate with other actors in anticipating and managing change usually tend to participate in formal discussions between representatives of employers, employees and public authorities and to amend current partnership agreements (Figure 18). Specific partnership agreements or particularly specific initiatives (for example, framework agreement on competences in the sector) tend to be far less common. This indicates that:

- greening is still new for businesses and thus not yet dealt with intensively in their agendas; or
- the anticipation and management of green change are not that different from standard processes and thus do not require specific measures.

The lack of greater business involvement in the anticipation of green change may be partly explained by the uncertainty of businesses about future financial and regulatory changes (for example, EU ETS, carbon tax, government subsidies).

In addition, some of the stakeholders surveyed indicated that the anticipation and management of change may be overshadowed by other interests, such as the attraction of investment in green technology.

Figure 18: Business approaches to collaboratively (a) anticipate and (b) manage green change and its effects on job quality



Notes: \*In relation to chart (a), one respondent ticked ‘Other’ but did not provide any information; no respondent ticked ‘Other’ in the case of management.

(a) N = 63, unlimited answers per respondent.

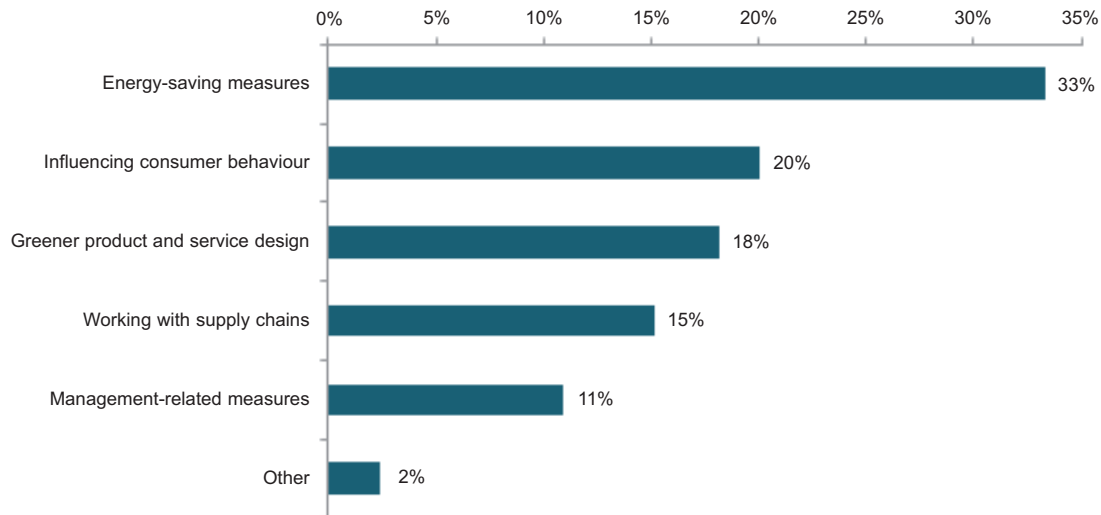
(b) N = 66, unlimited answers per respondent.

Source: *Online survey*

The online survey also showed that most businesses tended to cooperate in anticipating and managing the effects of green change on job quality in energy-saving practices (Figure 19). Management-related measures were identified as the least common. These indications may refer to previously identified trends: the reduction of resource costs (especially energy) is the most evident benefit that it is worthwhile taking some action towards greening, while management changes, including a stronger involvement by employees in green change processes, do not seem so promising. Management-related measures or work with supply chains may have scored lower due to their poorer development or

simply a lack of information on this business practice. Companies may also regard these measures as confidential and thus not appropriate to cooperate on.

Figure 19: *Types of green business practices in which collaborative approaches to anticipate or manage the effects of green change on quality of jobs are most common*



Notes: N = 165 (up to two answers per respondent).

Numbers have been rounded, thus they do not sum up to 100%.

‘Other’ includes four answers not relevant for the study.

Examples of energy-saving measures: reorganisation of work by optimising logistic routes, investing in more efficient technologies, improving the energy efficiency of buildings, improving transport energy efficiency, and reducing energy use in the workplace.

Examples of measures aimed at influencing consumer behaviour: raising awareness and enabling consumers to effectively manage their consumption through instructions or product design.

Examples of greener product and service design: replacing more carbon-intensive inputs with less carbon-intensive ones, replacing fossil fuel with renewable energy, reducing material use per production units, reducing the weight of products, and developing zero-emission building concepts.

Examples of working with supply chains: raising awareness, including climate change mitigation criteria into procurement policies, and identifying the biggest carbon hotspots within a supply chain and reducing carbon emissions.

Examples of management-related measures: accounting and reporting greenhouse gas emissions, producing an emissions reduction plan, and involving other employees in reducing the impact of the business on the environment.

Source: *Online survey*

## Anticipation and management approaches in detail

This section summarises the evidence from the company case studies on the anticipation and management of green change across different job quality dimensions. Future research could extend the evidence by, for example, launching representative surveys at company sector and subsector level and comparing the shares of companies that consider skills development an important effect of greening with those that engage in different skill development activities.

Both autonomous (internal) and collaborative (partnership-based) anticipation and management approaches are analysed.

## Anticipation of greening effects

### Autonomous approaches

The anticipation of greening effects on job quality is not widespread among companies, with very few of the studied companies having carried out anticipation activities. Anticipation activities in most cases related to skills development. Most often, greening effects on skills development were anticipated for a short period (up to several years) and on the basis of estimated business development trends. For example, skills demand is estimated based on a business strategy/plan or concrete action such as planned production facilities or commercial openings and then differentiated by qualification and occupational groups. Less common approaches are outlined in Box 1.

### Box 1: Examples of autonomous approaches to green skills anticipation

**Volvo Penta**, a Swedish manufacturer of engines and power systems for industrial and marine applications, anticipates skills on the basis of a clearly defined strategy outlined in a grid. On one axis, the company estimates how difficult it is if someone leaves to either recruit someone with the needed skill or to up-skill an existing employee with that skill. On the other axis, it assesses the strategic influence of that specific skill for the company. The company then focuses primarily on the anticipation (and management) of skills that are most difficult to replace and have the largest strategic influence.

#### Example of anticipation strategy

		Strategic influence of analysed skill for the company	
		Low	High
Difficulty in recruiting someone with analysed skill or up-skilling existing employee with analysed skill	Low		
	High		

Other companies leave the anticipation of green skills for particular departments. For example, Slovenian heating product manufacturer **Danfoss Trata** has set up a product development management department, which analyses trends and makes suggestions as to what products and processes it should work on in the future, including the new skills needed for them. It carries out systematic idea generation based on a specific target product and geographical area. **Sofiyska Voda AD**, the Environment Protection Department of a Bulgarian water supply company, adheres to established standards (for example, ISO 14001) and has a special procedure called ‘Human resource management: Environment training and sharing information/communications’ to continuously assess the need for particular green skills.

Finally, there are companies that leave the anticipation of skills for so-called organic development; managers then identify relevant skills gaps and plan their management or the employees themselves take care of their up-skilling. For example, the Italian manufacturer of efficient PV solutions on ceramic surfaces, **System Photonics**, encourages workers to develop and share the best methods of production in order to maximise the benefits for themselves and the company. Employees therefore develop a deep knowledge of the whole production process and feel encouraged to anticipate problems, as they know their effort is being reciprocated.

### *Collaborative approaches*

Very few of the analysed companies have cooperated with partners in anticipating greening effects on skills development. Box 2 provides an overview of identified approaches to green skills anticipation.

In the online survey, some stakeholders indicated that companies that adopt an environmental management system are usually well ahead of other companies in anticipating green change. This may be a result of the requirement for continuous improvement present in environmental standards. Nevertheless, companies far more often manage green skills rather than anticipate them.

### **Box 2: Examples of collaborative approaches to green skills anticipation**

Various companies featured in the case studies have cooperated with different actors in anticipating the effects of greening on skills development. For example, Netherlands-based life and materials sciences company **DSM** involved the trade unions in green change development through works council discussions about future employee skills and sustainability-oriented behaviour.

Companies also actively cooperate with various associations. For instance, office furniture producer **Kinnarps** collaborates with the Swedish Forest Stewardship Council in anticipating changes in wood certification standards. This helps the company to prepare for emerging new skills requirements. Via cooperation with the Branch Council (an association of employers in the industry), the Czech branch of construction company **Skanska** is in constant dialogue with schools to ensure that their theoretical education as well as practical training is up to date and that they acquire new green skills that are emerging in the market.

Other businesses collaborate with universities to try to foresee trends in technological advancement. They also provide inputs to shape university curriculums adhering to the latest product developments in the markets. Some companies also commission research at academic institutions to drive green change in their respective sectors.

There are also companies that base their anticipation efforts on information provided by their partners. For example, solar cell manufacturer **Baltic Solar Energy** from Lithuania bases its skills development on technical recommendations provided by its long-term partner from Germany.

### **Management of greening effects on skills development**

#### *Autonomous approaches*

The majority of the companies examined in this study had applied at least some autonomous approaches for the management of greening effects on skills development. Most of these approaches were related to internal training. If its provision is effective, this type of training can significantly reduce a company's need for external services and thus business costs. The internal training in the analysed companies was either provided selectively as a one-off intervention or continuously through on-the-job training, and was often based on educational plans. Table 3 provides a more detailed description of both more and less widespread approaches to green skills development.



Table 3: *Autonomous management approaches to green skills development*

Types	Description and examples
<i>More widespread approaches</i>	
<b>Selective internal training</b>	To save money, green skills are often selectively provided for senior or environmental staff. For example, in construction companies, executives, site managers and production engineers are acquainted with environmental protection standards and environmental regulations related to their jobs. Higher requirements (for example, frequency and extent of training) are placed on environmental specialists (that is, ecologists, green business managers, sustainability department staff, environmental experts and similar positions) who must have up-to-date knowledge of legal and business changes. Senior or environmental staff usually have to carry out additional functions, such as the implementation of energy audits or on-the-job training (see below) for other company employees.
<b>Specific internal training</b>	Specific training is most often provided for senior or environmental staff (see above). Certain companies (for example, wind energy producers) consider specific internal training essential for new employees working in technical positions with an initial education and training but with no prior work experience in the sector. Mercantile occupations (for example, sales and marketing staff) usually receive general training (see below). Small groups are often given preference. For example Swedish furniture retailer IKEA conducts internal training face-to-face with groups of approximately 20 employees. The number of participants is limited to enable a good dialogue on specific training issues.
<b>General internal training</b>	<p>General internal training is usually provided to acquaint non-technical and blue collar staff with generic skills/knowledge, such as:</p> <ul style="list-style-type: none"> <li>• basic concepts of green services/products;</li> <li>• energy saving at the workplace;</li> <li>• main principles of energy efficiency in the production process;</li> <li>• new IT skills related to new tools, such as energy efficiency calculators, sustainability frameworks and score cards.</li> </ul> <p>Often based on on-the-job training, general training usually requires limited intervention; a representative of Netherlands-based life and materials sciences company DSM indicated that ‘in the past our employees had to understand the characteristics of a product and its added value, and now they have to learn that for the new, more sustainable products’.</p>
<b>Introductory internal training</b>	Introductory internal training is often provided by companies with the aim of not only acquainting new employees with sector specifics, but also to provide them with the basic concepts and practices that will allow them to operate in a more ecological way. During this training, new employees get to know all departments of the company, with a focus on the most important units (for example, service/maintenance in the wind energy sector).
<b>Self- or on-the-job training</b>	Companies also promote a high-trust and informal environment, which promotes self-training (for example, learning to provide energy performance certificates for buildings or certification of wood according to established guidelines) or continuous on-the-job training. The latter is provided indirectly by monitoring a colleague’s work advancement and training needs or by direct in-house mentoring, when more experienced employees, who have participated in selective training, instruct their less experienced colleagues. Continuous dialogue transfers knowledge and skills from those who plan the green change process to those who implement it.
<b>Elaboration of education plans</b>	Education (or competence) plans are usually elaborated in collaboration with HR and other relevant departments (for example, production and commercial). The plans summarise the most important skills and foresee measures to ensure their adequate provision. Very often the plans form part of environmental standards, such as the EU Eco-Management and Audit Scheme (EMAS) or ISO 14001. Companies frequently report the positive effects of environmental standards on training – they not only structure training, but also increase its incidence.
<i>Less widespread approaches</i>	
<b>Training abroad</b>	The know-how of companies (particularly large ones) is often scattered across branches due to a variety of reasons, including irregular expansion. Employees in large companies are thus often sent to other branches (possibly in other countries) in order to transfer know-how available in the company. To use this approach, generic skills – both general (such as language skills) and green – are of particular importance for a successful knowledge transfer process.



Types	Description and examples
<i>Less widespread approaches</i>	
<b>Information sessions</b>	Occasionally, sustainability departments in some companies organise information sessions to provide the latest news in the greening agenda and to identify needs for further information/training.
<b>Guidelines/info packs</b>	Companies sometimes prepare computer-based guidelines (for example, eco-driving guidelines) or information packages on environmental impacts (for example, impacts of different modes of transport on climate change).
<b>Training leave</b>	Employees in some companies are allowed a specified period (for example, a few hours per month) of paid or unpaid leave from work in order to have the time to improve their qualification in greening issues. However, training leave is rarely used for green up-skilling.

Some companies do not limit themselves with the rather traditional above-mentioned approaches, but also implement more innovative approaches for green skills management – they establish their own universities, implement complex skills assessment and provision systems or apply innovative IT solutions (Box 3).

### Box 3: Examples of innovative management approaches to green skills development

To meet the internal training needs of its existing workers, the large Portuguese wind energy producer **EDP** maintains a company university. The university, which was set up to manage human resources effectively and appropriately, is split into five business schools to provide specific skills and two transversal schools to provide generic skills. Together, the schools coordinate training, career development, knowledge management and change management in line with the company’s present and future needs.

Large UK construction company **Willmott Dixon** has introduced a skills matrix initiative so that it can identify any skills gaps and address them with the necessary learning interventions. The employees’ performance is gauged against certain sustainability criteria to identify any skills gaps in the company and to signpost areas where an individual requires training. Where gaps are identified, the company has over 200 learning interventions available via its intranet pages to ensure that employees maintain and develop sustainable skills. The training provided via these learning interventions may interface with the different sustainability criteria, such as training in waste handling or refreshing knowledge of BREEAM (Building Research Establishment Environmental Assessment Method) issues. The skills matrix covers all employees in the company and serves as a gateway to training.

Large UK-based retailer **Tesco** trains all its truck drivers in eco-driving skills. They are trained on a one-to-one basis by internal trainers. In addition, company trucks are equipped with telematic monitoring systems, which track vehicle movements and speed, facilitating efficient driving behaviour. After each journey, drivers have a debriefing session with their manager to evaluate their driving performance based on the data from the monitoring system.

#### *Collaborative approaches*

The case studies suggest that most companies that manage green skills development cooperate with various partners in these activities. Cooperation with social partners is twofold: companies frequently collaborate with business associations and networks, while trade unions are less often involved in their collaborative approaches. Examples of collaborative approaches involving social partners are provided in Table 4.

Table 4: *Collaboration with social partners on the management of greening effects on skills development*

Type of partners	Description and examples
<b>Associations, networks</b>	Very often companies (especially SMEs) rely on associations and networks such as the National Passive House Association in their country (affiliates of the International Passive House Association), the Association of Photovoltaic Technology and Business (in Lithuania), the Engineering Industries Association (EIA) in the UK or the Society of Electric Vehicles (in France). Associations are often treated as gateways to relevant knowledge and services; for example, they collaborate with education providers to introduce green skills into the curriculum, organise information events for targeted audiences to raise their awareness of green products/services and discuss green change, and carry out exploratory work aimed at finding, for example, solar energy systems that require considerably smaller amounts of materials to assemble.
<b>Trade unions</b>	Trade unions are involved in formal and informal dialogue or collective bargaining about training with a company’s management. During these processes, the parties agree on requirements for skill development, include them in collective agreement(s) and coordinate the implementation of training. An example of active and innovative involvement of trade unions in providing environmental training is found in the shipbuilding sector. One of the ship repair facilities of the A&P Group, A&P Falmouth, cooperates with the trade unions in providing a specific environmental course for its personnel. The company organises a non-compulsory environmental course. Part of the course is ‘internal’, delivered by the trade union’s ‘green’ representative who attends a specific environmental two-day course twice a year to acquire the qualification necessary to deliver the course. The other part of the course is ‘external’; it is called Energy Saving at Work Training Session and is arranged by the company, the South West Trade Union Congress’s GreenWorkplaces project and GMB (a UK trade union). The course, which is run for staff from different workshops and departments across the dockyard, has led to the development of a long-term green culture of undertaking simple energy-saving actions both at work and at home.

Other partners of companies usually include vocational schools and universities. One of the most popular approaches to skills development is apprenticeships, traineeships or internships established in cooperation with businesses and vocational schools or universities. Examples of collaborative approaches with these and other types of partners are summarised in Table 5. The company case studies do not provide many examples of collaboration between companies and public authorities except for some examples of the latter providing financial support, supporting the development of study programmes or providing training for jobseekers or those changing their job.

Table 5: *Other collaborative management approaches of greening effects on skills development*

Type of partners	Description and examples
<b>Vocational schools</b>	<p>Most often companies cooperate with vocational schools through apprenticeship programmes, during which the students split their time between the school and the company. After completion most of the apprentices are usually hired by the company, while those willing to participate in a university programme after completing vocational education are kept in close contact with the possibility of hiring them in the future. For example, Danish energy distributor EnergiMidt takes on apprentices on a regular basis, allowing them to gain work experience within the specialised fields (including green practices) the company offers. Trainees transfer theoretical knowledge to the company and take part in the ongoing innovation process. If qualified, the apprentices are offered a job at the company when they leave the vocational school.</p> <p>Companies also cooperate actively in the provision of continuing vocational training. For example, German wind energy producer ENERTRAG supports staff training according to a specialised continuing vocational training programme for those with a completed vocational training which is specifically designed for the area of renewable energy.</p>

Type of partners	Description and examples
Universities	<p>A popular form of cooperation is traineeships/internships through which students reinforce and enrich knowledge learned at university and the company gets to know someone who may become a new employee. Traineeships and research collaboration are also good opportunities to attract new staff. However, traineeships are often too difficult to manage for SMEs that do not have employees managing staff's training and other needs.</p> <p>Companies also cooperate with universities in other ways, such as the following:</p> <ul style="list-style-type: none"> <li>• Developing new study programmes, for example: <ul style="list-style-type: none"> <li>• German wind energy producer ENERTRAG together with the bbw University of Applied Sciences in Berlin has prepared a part-time undergraduate engineering programme for its employees, with a focus on renewable energy;</li> <li>• Italian chemicals producer Novamont has developed in cooperation with East Piedmont University a masters in biotechnology for the bioplastics industry funded by regional public authorities;</li> <li>• a masters study programme on PV energy engineering prepared by a Lithuanian solar cell manufacturer in cooperation with universities and partner companies.</li> </ul> </li> <li>• Sponsoring PhD students in examining issues relevant for the companies.</li> <li>• Contributing to competitions for students, for example: <ul style="list-style-type: none"> <li>• the Estonian branch of construction company Skanska has contributed to an engineering competition where the company had to develop an assignment about energy efficiency based on an actual building project and students had to find energy-efficient solutions for this project.</li> </ul> </li> <li>• Co-organising conferences.</li> <li>• Researching green issues, for example: <ul style="list-style-type: none"> <li>• Latvian waste management company Getliņi EKO cooperates with a technological university to elaborate innovative solutions on the management of waste.</li> </ul> </li> </ul>
Employment agencies	<p>Companies use publicly supported services to train their new employees (see Box 4 for an example). German wind energy producer ENERTRAG cooperated with the regional employment agency by recommending suitable continuing vocational training providers to prepare jobseekers for employment in the company.</p>
Private education providers	<p>Private education providers are often contacted to develop training programmes and provide training specific to a company's needs. For example, the Swedish furniture company Kinnarps hired an external education provider to provide training of trainers on the development of the standards of wood certification. Private education providers not only help with training, but also with development of training content. For example, Swedish green transport services provider Green Cargo cooperated with the national organisation of driving schools to perform test drives with the company's diesel locomotives and to measure fuel consumption with different driving behaviours. As a result, a 20% more efficient eco-driving practice, based on changes in driver behaviour, was created and later transferred to the company's staff. A company distributing electricity arranged specialised courses on solar energy with private companies offering this specialised training. Training provided by private education providers is paid for by customers of their services. However, the quality, effectiveness and impact of this training often depends on the willingness of the private providers and smooth cooperation with their clients. The same holds true for suppliers of other products/services (see below).</p>
Suppliers of products/services	<p>Suppliers of equipment or services often provide the training necessary to use them. For example, a small number of dyeing specialists at Lithuanian textiles company Utenos Trikotažas were trained by the machinery suppliers to operate the specialised dyeing program. The trained people then carried out internal training of the remaining staff. Another example is provided by the large UK retailer Tesco, where a few internal trainers were instructed on fuel-efficient driving skills by vehicle manufacturers and afterwards trained company drivers on a one-to-one basis.</p>
Business partners	<p>Skills are also developed in cooperation with partner companies. For example, to be able to build ships fuelled by LNG technology, engineers at the Norwegian shipbuilding company Kleven Maritime AS involved in the supervision of the gas engines have undertaken courses about the specifications of LNG engines provided by employees from an engine-developing partner company and a major customer of Kleven Maritime products. Employees from Lithuanian solar cell producer Baltic Solar Energy have carried out internships at the other company, which has a functioning PV research laboratory.</p>
Consultants	<p>The internal sustainability expert at Swedish green transport services provider Green Cargo has cooperated with an external consultant specialising in freight transport and railway to develop an intranet-based general environmental training programme focusing on transport in relation to climate change and environmental issues concerning daily work processes. This training was then provided to all company employees.</p>

Sectors differ in how often they use collaborative approaches to manage skills. This may be partly due to the implementation of industry-specific green business practices which are based on complex technological improvements. Another reason could be limited access to partners; for example, textiles companies claim that it is hard to find any partner to share ideas or good practice with, since most production has moved companies in the older EU Member States to the New Member States (NMSs) or East Asia, which are less collaborative, while public and social partners have limited knowledge of the issues concerned.

The company case studies revealed that the key driver for cooperation is cultural; the company should believe in long-term intangible benefits arising from such cooperation beyond those visible in the delivery of new products or services to the market.

There are also some more innovative approaches used for green skills management, such as setting up a specialised academy in cooperation with a vocational school to train the company's employees, the creation of specialised research institutions at universities and internships for children of employees. These and other innovative approaches are outlined in Box 4.

### Box 4: Examples of innovative collaborative approaches to green skills management

To manage the training needs of its blue collar workers, Swedish office furniture producer **Kinnarps** cooperates with a local VET school through a specialised division of the company called its academy. The students spend two days per week in the school and three days at the company, where they are provided with all the practical aspects of their training. Each year 16 students are accepted on the three-year-long course. Teachers are employed by the company and the municipality compensates the company for their training. The students learn all the issues related to the industrial production of wooden products so that they are able to work on the production lines at the start of their career. The academy also provides training on sustainability issues, primarily the way in which the company manages environmental issues and green practices.

UK retailer **Tesco** funded the launch of the Sustainable Consumption Institution (SCI) at the University of Manchester. SCI researches major issues associated with sustainability and climate change. The company collaborates with SCI on various projects to understand their possibilities and suitable technologies to pursue its vision of a zero-carbon business.

The large Portuguese wind energy producer **EDP** is very much involved in internship programmes. The company does not simply accept university graduates, but provides the possibility of summer internships for children of its employees currently studying at university. This not only supplies the company with a potentially new workforce, but also reinforces the motivation of existing employees to work for the company.

When French electronic vehicles producer **Mia Electric** hired a number of new employees, these workers received 19 days of training in cooperation with the local branch of the Public Employment Service. Training was carried out within the framework of an 'Action plan for pre-recruit training' (*Action de formation resalable au recrutement*). A plan to secure the career path of various professionals (*plan de sécurisation des parcours professionnels*) was funded by the state, which took charge of those employees in short-time work, and the regional public authority, which had taken responsibility for training those employees affected by unemployment due to the bankruptcy of a former car producer in 2009. The plan aims to avoid having to lay off experienced workers, who are crucial for the production of electric cars, and the costs associated with redundancies. The training plan, with financial support from the government and other actors, has helped some 300 people to acquire the skills necessary for the production of electric cars. In addition, the regional administration encourages the reallocation of workers from different parts of the former producer. The receiving employer may benefit from a training subsidiary of up to €3,000 per employee.

Large UK construction company **Willmott Dixon** is a member of the UK Green Building Council (UKGBC), an organisation set up to provide leadership in sustainable practice in the sector and to influence government policy. UKGBC established the Sustainability Training and Education Programme (STEP), which aims to improve the recognition and awareness of sustainability within the sector and to develop leadership skills in the area. Launched in September 2010, STEP offers an introductory course on sustainability and a course on leadership in the built environment, which is designed to transform the sector by training senior managers, directors and decision-makers in the sector and beyond. Training is provided through the College of Estate Management at the University of Reading and the University of Cambridge. A number of senior managers at the construction company have completed or are undertaking STEP training.

One of the largest shipbuilding companies in the UK, **A&P Group**, has made use of the Knowledge Transfer Partnerships (KTP) programme. KTP helps businesses to improve their competitiveness and productivity through the better use of knowledge, technology and skills. There were three players in this partnership:

- a shipbuilding company provided a two-year job contract,
- a knowledge base partner – in this case a university, but it could also be a public or private college or research organisation;
- a KTP associate – a recent university graduate who worked temporarily at the company and transferred the knowledge the company was seeking into the business via a strategic renewables project.

Part of the KTP associate's salary was paid by the shipbuilding company and part by the university. The KTP associate also had a personal development budget that she could spend on relevant training (for example, on courses or the propulsion of small vessels). The KTP associate, who had a direct link to the academic source, acted as a knowledge transfer agent and helped the company enter the renewables market.

Lithuanian solar cell manufacturer **Baltic Solar Energy** signed a mutual cooperation agreement with three Lithuanian universities – Vilnius University (VU), Kaunas Technology University and Vilnius Gediminas Technical University (VGTU) – for student training abroad. Under this agreement, three top masters students have so far been granted the opportunity to obtain advanced one-year training in PV technologies in Germany. Training was co-funded by the German environmental fund DBU. After the training period is over, the students are obliged to come back to Lithuania to become company employees. In 2013 the enterprise is planning to extend the agreement and to send another one to three Lithuanian students.

### Management of greening effects on other dimensions of job quality

The analysed companies (especially SMEs) have managed greening effects on other dimensions of job quality considerably less often. Information and involvement of employees was the most often applied management approach among other job quality dimensions (Table 6).



Table 6: *Autonomous management approaches of greening effects on other job quality dimensions*

Types	Description and examples
<i>Career and employment security</i>	
<b>Securing existing jobs</b>	German parcel and express logistics service provider <b>DPD</b> has created the position of a waste and sustainability manager at each of its distribution centres. Sometimes the new position was used to secure the employment of someone who was no longer able to do physical work at the centre. They were retrained to give them a new opportunity within the company instead of dismissal.
<b>Information and consultation</b>	Information and consultation are provided to all employees to help them understand the company's philosophy towards the environment and to accept the undergoing green change processes. Services are usually provided by the company's management or senior and environmental staff responsible for ensuring that co-workers have the ability and tools to receive and comprehend relevant information. Companies inform employees during meetings and via newsletters, intranet, regular briefings, booklets and so on. Portuguese wood recycling company Ecociclo, a subsidiary of Portuguese wood-based panel producer Sonae Indústria, uses written messages (often in the form of printed sheets hanging on a wall) as the usual method of addressing its staff with news and recommendations. The staff is mostly made up of blue collar workers and the company finds that simpler approaches tend to work better.
<b>Involvement</b>	<p>Companies involve employees in different ways:</p> <ul style="list-style-type: none"> <li>• by emphasising a flat structure and less hierarchy, with a culture of debate and participation by personnel at workplace level;</li> <li>• by organising a number of moderated discussions to formulate the company's vision on the basis of the ideas of employees and other stakeholders;</li> <li>• by involving trade union representatives in green business initiatives and the company's board.</li> </ul> <p>Portuguese wind energy producer EDP encourages employees' children to visit their parents' workplace. The purpose is to heighten involvement and the feeling of belonging between the company, the workers and their families. Meanwhile, employees in Portuguese wood recycling company Ecociclo, a subsidiary of Portuguese wood-based panel producer Sonae Indústria, once or twice a year attend, along with their families, a one-day event in a green area to plant new trees and to discuss sustainability issues informally. These events help workers to better understand the benefits of the company's wood recycling process.</p>
<b>Employment status</b>	Some companies foresee specific measures to improve the employment status of their employees implementing green change. For example, Luxembourg distribution company Biogros SA supports full-time work (unlike the part-time work prevalent in the sector), which allows their employees to have a decent living in the context of the high prices in the country.
<b>Adapting remuneration</b>	To create a favourable culture for green change, companies offer green bonus schemes. For example, Dutch life and materials sciences company DSM created a remuneration structure for senior employees that incorporated bonuses tied to performance on sustainability targets. The overall income level did not change significantly, but it did increase employee engagement. Large British construction company Willmott Dixon uses a sustainable project criteria system to partly determine the level of employee bonuses. Under this arrangement, managers must meet six out of 10 of the criteria to achieve between 100% and 120% of their bonus. Some other companies, such as retailers, make sure that all employees relate to carbon reduction targets through non-monetary performance appraisal.
<b>Equal opportunities</b>	Equal opportunities policies are rarely managed by companies. Some, like Belgian ecological products manufacturer and distributor Ecover, have more general measures ensuring gender equality in terms of access to employment, training, career development and average wages, and retirement options. Others, such as Austrian bricks manufacturer Wienerberger, have more concrete measures, such as a commitment to increase the share of women by giving priority to a female job applicant over a male one when they are equally qualified and apt for the job.
<i>Health and well-being</i>	
<b>Addressing disability</b>	To facilitate the employment of disabled workers, French electric car producer Mia Electric has introduced special workplaces in the plant which are adapted for the needs of disabled employees, who constitute around 6% of total jobs.
<b>Insurance</b>	The representative of the Italian textiles manufacturer Successori Reda stated: 'When the crisis was announced, we provided a supplementary health insurance to all employees' family members in order to give them a signal against uncertainty.' Other companies often provide pension or life assurance schemes and health benefits.

Types	Description and examples
<i>Health and well-being</i>	
<b>Physical risks</b>	Wood recycling company Ecociclo, a subsidiary of Portuguese wood-based panel producer Sonae Indústria, provides shop floor workers with individual protection gear and encourages them to use it. The company also builds physical barriers at the recycling centre to reduce wind speed and thus airborne dust. With the help of local firefighters, the company also advises its employees about how to reduce the significant fire hazard.
<b>Job satisfaction</b>	Every two years, Portuguese wood-based panel producer Sonae Indústria carries out an internal satisfaction assessment. The results show that (green) wood recycling subsidiary (Ecociclo) workers always rank as the more content and also the more embedded with the company's values than other (non-green) employees in the group.
<b>Psychological risks</b>	Stress usually arises in situations where staff is not sure what to do or lack experience. To reduce stress from the wood auditing procedure, Swedish office furniture producer Kinnarps provides clear guidelines on this task.
<b>Work environment</b>	Large UK building company Willmott Dixon has invested in eco-cabins. These are portable structures that provide on-site offices as well as kitchen, rest, drying and toilet facilities. The eco-cabins have been designed to include a range of energy-saving technologies, such as lighting controls, timed heating controls and double glazing. The eco-cabins provide qualitatively better on-site accommodation for workers than was available previously.
<i>Work-life balance</i>	
<b>Commuting needs</b>	Some green companies (for example, wind or hydro energy producers such as ENERTRAG in Germany) are located in remote areas, sometimes with a distance of more than 100 km between home and the workplace. To address this issue, companies either provide a free shuttle bus for employees who do not have a car or provide extra financial benefits as compensation.
<b>Culture and leisure</b>	Companies located in remote areas, such as German wind energy producer ENERTRAG, sometimes sponsor cultural activities in their region to increase the general attractiveness of the area to residents and new employees. To attract employees, some companies in the offshore wind energy industry aim to promote their jobs as an opportunity to combine well-paid work and leisure activities such as windsurfing and power kites.
<b>Social infrastructure</b>	Employers in remote areas provide financial support to kindergartens in regions around their headquarters to ensure there are enough places for the children of their employees.
<b>Friendly working time</b>	Green companies strive to reconcile the working and non-working time of their employees. For example, Irish green cement manufacturer Ecocem emphasises the flexibility of working time and in, for example, cases of family emergency, allows work from home. However, working time is more flexible for non-manufacturing staff than manufacturing employees (who work shifts).

Employees in the case studies were not only involved in green change internally, but were also engaged in cooperation activities such as training of subcontractors or voluntary work with schools (Table 7).

Cases in which companies have foreseen the need for measures to involve staff showed a positive link between (positive) changes in other job quality dimensions and skills development. More intense skills development was noticed in those companies that tried to integrate greening in the overall culture of their employees and thus overcome their initial scepticism/unwillingness.

Table 7: Collaborative management approaches of greening effects on other job quality dimensions

Type of partners	Description and examples
<i>Career and employment security</i>	
<b>Trade unions</b>	Cooperation between companies and trade unions is usually based on either formal or informal discussions. Discussions often focus on the environmental impacts of the company's activities, the implementation of green business strategies, the creation of sustainability-oriented behaviour and so on. Trade unions are also involved in integrating the sustainability dimension into employee appraisal forms, reward schemes and collective labour agreements to encourage the generation of more sustainable ideas and to create a culture favourable for green change.
<b>Sub contractors</b>	Companies not only use training provided by suppliers, but also train their subcontractors. For example, technical supervisors in Lithuanian zero-energy house construction company Statybos Projektų Sprendimai provide training to their subcontractors' staff on critical issues in this type of construction. Such training ensures that the buildings' design requirements are met and increases the involvement of workers from the contracting company in green change processes.
<b>General</b>	<p>Companies use various ad hoc opportunities to involve employees, including:</p> <ul style="list-style-type: none"> <li>• networking;</li> <li>• organising of information events for the general public, businesses, scientific community and policy actors;</li> <li>• contributing to energy-saving events.</li> </ul> <p>These approaches increase the involvement of relevant employees in green change processes and thus create a corporate culture favourable for green change.</p>
<i>Health and well-being</i>	
<b>Secondary schools</b>	Cooperation with schools can contribute to increased job satisfaction of company employees. Wood recycling company Ecociclo, a subsidiary of Portuguese wood-based panel producer Sonae Indústria, was contacted by a local secondary school asking it to give a presentation for young children on recycling and its benefits. Pleased with the first result, workers continued with more presentations in other local schools. This has boosted their self-esteem and job satisfaction. Workers who participated in these activities have developed a sense of pride about their role in a recycling process.
<b>Work organisation</b>	Some working time arrangements, such as shift or night work, can damage health. At the Swedish green transport company Green Cargo, train drivers were assigned to a particular route and schedule according to their competence to drive a particular type of locomotive. Thus, there was a need for more flexibility from the drivers over their working time arrangements in order to use the locomotives efficiently. The work organisation issue is the subject of continuous discussions between the company, drivers and trade unions to balance staff working time and business needs.
<b>Housing providers and schools</b>	Remotely located companies such as wind energy producers engage in regional cooperation aimed at solving specific problems encountered by their employees. For example, companies cooperate with housing providers to provide pre-selected apartments or houses in the region for new company employees. Similarly, they cooperate with local schools and kindergartens to ensure there are sufficient places for the children of their new employees.

## Key issues

There are a number of key issues when considering the anticipation and management of green change.

Large companies tend to put more resources into the anticipation and management of green change, including:

- forecasting skills needs and other market trends;
- provision of internal and external training for their staff;
- assessment and management of new health and occupational risks;



- launch of new initiatives to improve work–life balance;
- creation of new, or adoption of existing, education and training programmes.

Due to the need for multitasking and limited financial resources, SMEs are unable to appoint staff to coordinate skills development. In addition, SMEs are often unable to send their workers for training during working hours. Thus, they often rely on employers' associations (for example, chambers of commerce, federations) for most of their activities. Sometimes they profit from activities carried out by large companies; for example, by attracting students on programmes created by large companies. According to the representative of the European Association of Craft, Small and Medium-Sized Enterprises (UEAPME), SMEs not only need financial support to improve their anticipation and management of green change, but also guidance demonstrating the need for green change. The recent Eurobarometer survey of SMEs' views and attitudes on resource efficiency and green markets revealed that although most SMEs prioritise financial support, a large proportion also emphasise the role of non-financial incentives (European Commission, 2012a) (see Box 5).

### Box 5: Incentives for SMEs to launch or expand green products and services

In March 2012, the European Commission published the first extensive survey of the views and attitudes of SMEs on resource efficiency and green markets. This Eurobarometer survey addresses a number of core themes, including incentives for SMEs to engage in or expand greening.

Among SMEs that are not currently selling green product or services, 31% cited financial incentives as the main desirable support for developing products, services or new production processes, 15% cited assistance with identifying potential markets or customers for these products or services, 14% cited technical advice and consultancy services for products, services development or production processes, and 10% cited consultancy services for marketing and distribution. However, 31% of SMEs not offering green products or services said that none of these types of support would be useful.

SMEs that already offer green products or services were more positive. Half (49%) said that financial incentives for developing products, services or new production processes would most help them to expand their range of green products or services. A quarter (26%) mentioned assistance with identifying potential markets or customers for these products or services, 22% mentioned technical advice and consultancy services for products, services development or production processes, and 16% mentioned consultancy services for marketing and distribution. Only 12% of SMEs offering green products or services said that none of these types of support would be useful.

Source: *European Commission (2012a)*

The Eurobarometer survey revealed an important trend: once engaged, SMEs tend to be more optimistic about the development of green products or services and appear more willing to use available public support where it is likely to further expand their green activities (European Commission, 2012a). Thus, the role of guidance and information in overcoming the initial reluctance of companies and in promoting greening across European industry is crucial. The transfer of information (for example, explaining the threats and opportunities arising from a low-carbon economy) and details of good practice by the company's peers could become essential for a quick adaptation of SMEs to green business. Networks and their tools (for example, Retail Forum for Sustainability, the trade union national Green Workplaces Network coordinated by the Trades Union Congress (TUC) in the UK and being promoted at the EU level) can also help SMEs to gain the necessary knowledge and skills for the anticipation and management of green change.

If specific knowledge is needed, in some exceptional cases SMEs train one or more employees externally at national or, if local markets cannot provide, at international level. For example, Lithuanian zero-energy house construction company

Statybos Projektu Spendimai sent its project manager on a six-month training course conducted by the Passive House Institute in Germany. Subsequently, the project manager trained his colleagues on the job. External training for only one or a small number of employees who afterwards train remaining staff is the most affordable option for SMEs due to their limited budget.

One of the key prerequisites for successful socially responsible green change at both a company and industry level is general awareness and acceptance of change among employees; to be able to act, employees working with green business practices should understand 'why'. The online survey shows that normally employees are not involved in discussing green change (Figure 17) and companies rarely cooperate with other actors in undertaking management-related practices (Figure 19). To act, employees have to understand the aims of green change and accept them.

Lack of communication may result in lack of motivation and efforts. For example, workers at a Belgian company that specialises in passive building appeared unfamiliar with the definition of a 'passive building' when asked (Pauwels et al, 2011). The management of this company often uses sales arguments to induce its customers to build an ecological house. Meanwhile, its workers are not educated to think 'green'. However, they are even more important for the company than its clients because if they do not know what they are doing, the end product is of lower quality and may impede the company's success in the future. As stated by the ILO in a recent report:

*The right to information, education and training, at all levels, including the workplace, are considered paramount to strengthening workers' and trade unions' capacity to support sustainable development.*

(ILO, 2012)

This was confirmed in an earlier report (UNEP, 2008).

Evidence shows that green change is not clearly associated with higher job quality. Employees need to understand and appreciate that green change is beneficial for them (for example, secures their existing job, leads to higher income/qualifications, provides financial benefits, and ensures better health and safety conditions). These benefits are usually either not communicated clearly or not transferred to employees. In contrast, energy efficiency is often (especially during crisis) invoked to reduce operational business costs (for example, smaller offices, car parking charges, less and more productive staff and so on). Thus, green change may be understood as unfavourable and this may discourage employees from assisting their employers to green the business.

Employee participation can indeed reduce the negative effects of green change on job quality (Fritz et al, 2000; Getzner and Ritt, 2004; UNEP, 2007). Box 6 provides some good examples of employee engagement in green change; both the large companies are trying to mainstream green change across different levels, while the SMEs are promoting greening with the limited resources available to them.

### Box 6: Examples of employee engagement in green change

To be effective, UK-based **Tesco**, one of the world's largest retailers, integrates its climate change strategy into business operations on different levels. At corporate level, there is a climate change team that formulates Tesco's carbon strategy, sets targets for emissions reductions and shares expertise on climate science and policies. Within the property and distribution functions, there are environmental experts specialised in technical knowledge of low-carbon solutions. Corporate carbon reduction targets are cascaded down to country business units, which develop their own programmes to achieve the emission reductions targets assigned to them. Ultimately, carbon reduction measures are implemented by local distribution and property teams, who work closely with environmental experts in their function and the climate change team. On an operational level, thousands of staff running stores, distribution centres and transporting goods are provided with carbon-related key performance indicators (KPI) to induce behavioural change. In this model, the climate

change dimension is embedded in business operations from strategic to operational level. To implement its green strategy, the company applies a number of motivational measures, including financial ones. The green strategy has an impact on the income of senior and middle managers since carbon reduction targets are among the KPIs determining their bonuses; all other employees relate to carbon reduction targets through non-monetary performance appraisal. Tesco's green strategy is supplemented by a collaborative approach, which includes constant communication with the main trade union, the Union of Shop, Distributive and Allied Workers (Usdaw), which represents the majority of Tesco's drivers, warehouse and shop workers. The company seeks to ensure that the trade union understands the challenges associated with its ambitions to become a zero-carbon business and the consequent need for operational changes.

French electric car manufacturer **Mia Electric** was born by the transformation of a large car manufacturer employing 3,300 workers (Heuliez) to a small start-up with initially 35 employees. To implement the far-reaching changes and to anticipate the evolution of Mia's activities, managers communicated with the company's employees via meetings or through newsletters. 'In contrast to Heuliez, where there was no communication with the workforce, the management of Mia Electric communicates a lot in order to convey its message,' comments the employee representative for the French Democratic Confederation of Labour (CFDT). According to the management, the overall social atmosphere is better now than it was before. The transformation, management says, changed the attitude of the workers towards their employer. 'We work on a common project, which is the development of a car that is 100% electric, has 0% emissions, and a positive impact on the environment. These changes calm the social climate. When you walk through the workplace, you see more employees smiling. They are also more committed,' explains the product director. However, new ways of communication based on individual 'employee empowerment' and emphasising communication with the employees directly and not necessarily through the unions pose a challenge for traditional employee representation. This needs to transform to adapt to the constantly changing context of employee representation.

Another electric vehicles manufacturer, **EnerBLU**, based in Italy, promotes the socio-environmental advantages of its products to achieve employee engagement in the green change. The management sees electrification as a natural automotive evolution. Therefore, the company believes it is transforming traditional automotive jobs rather than creating new ones. Being aware of the negative trends and perspectives of the automotive industry, employees share this evolutionary vision. Moreover, they consider their jobs as part of the green change that will bring general environmental benefits together with career opportunities as the car becomes more electric. This stimulates employees to develop new standards and to improve their technical performance. They have the chance to apply their ideas and experiment with new applications: 80% of the e-technology used for the transformation is considered standard, while the remaining 20% varies according to the vehicle's specification and the worker's ability. The high motivation becomes pride when new findings are demonstrated to be valid or presented at meetings and exhibitions.

Some companies have employees who act as green representatives in the company. For example, **A&P Falmouth**, which operates the largest ship repair complex in the UK, has a trade union green representative who promotes greening throughout the company. One of the key activities of the green representative is to improve the green skills of company employees. He does this by organising and delivering part of a non-compulsory environmental course for staff from different workshops and departments across the dockyard. This course has led to the development of a long-term green culture of undertaking simple energy-saving actions both at work and at home. Although green representatives are popular in the UK, the trend for companies to have employees responsible for greening promotion among staff has not yet gained momentum in the rest of Europe.

Employees can be engaged in green change indirectly. A good example is the achievements of **HOCHTIEF Development Poland Ltd (HDP)**, a real estate management company, in managing Leadership in Energy and Environment Design (LEED) certification of a building in Poland. The certification-related activities have also

increased the level of knowledge and the skills related to the environmental practices in the professional and private life of more than 4,500 people who work in the building. Information such as energy-efficient use of facilities and installations in the office and building, healthy eating and sustainable ways of commuting to work has been disseminated regularly with the cooperation of HDP and the building's tenants, and through communication campaigns in the building itself. These green business practices have contributed considerably to the formulation of a green culture within the premises. This culture leads to further greening processes within the companies occupying the building as tenants.

The active involvement of employees in the green change processes could lead to a 'virtuous circle' of positive green developments within their companies (Figure 20).

Figure 20: *Importance of employee involvement in greening processes*



The company case studies and interviews suggest that communication and the interactive involvement of employees in greening processes could be achieved through various approaches, including (the list is illustrative and not exhaustive):

- involving employees' representative(s) (or workplace union representatives) in green management structures and providing them with time off for related activities;
- appointing a green workplace representative or giving an existing representative green responsibilities together with adequate resources to perform them;
- amending current collective agreements or concluding new ones with targets on energy efficiency and benefits associated with their achievement;
- launching a survey of staff on green change which could:
  - provide ideas for further green actions;
  - give the company a mandate to act;
  - encourage employees/provide them with a sense of ownership of the process;
  - help to formulate a strategic vision of greening in the company.

Greater employee engagement in green change processes would help to ‘save on resources and not on wages’. This is illustrated by the German Network Resource Efficiency project, which relied on cooperation between associations to boost information exchange among companies (Eurofound, 2011). This project led to job-preserving cost savings while also boosting the capacity of workers to exercise their judgment and skills by identifying ways to improve energy efficiency. Thus, the involvement of employees in the green change process in companies could increase the financial benefits from energy saving and reduce pressure to cut wages.

There may be tensions between the greening of industry and productivity. A recent revision of existing economic models applied to greening (Jaeger et al, 2011) argues the need to emphasise the ‘virtuous circle of additional investment, learning-by-doing and expectation formation’. According to the study, substantial additional investment induces productivity gains via ‘learning by doing’; the latter in turn increases competitiveness and thus spurs economic growth, thereby improving the expectations of investors.

However, productivity does not always go hand in hand with greening, as shown in this example from the construction industry (Pauwels et al, 2011). Construction workers are required to tape up the ends of insulation to reduce heat loss in the wall, clean it and carry out other activities that are time consuming but are necessary for an optimal result. But when a company is stressing productivity and puts pressure on its workers to work as fast as possible, these additional insulation tasks are the ones most likely to be left undone, as neither the customer nor the employer sees the quality of the insulation when it is covered with a final outer layer of, say, bricks. Thus, too much stress on productivity can result in lower-quality products/services and a slowdown in the greening of the sector.

To be able to act, employees working with green business practices should also know ‘how’. Evidence suggests that employees still lack transferable or generic green skills (for example, knowledge of sustainable materials, environmental impact assessment skills, understanding of environmental legislation and certification, resource efficiency improvement skills). Companies usually focus on developing the green skills of highly skilled employees and few emphasise the generic green skills of remaining employees working with the green business practices. This impedes the green change in the company, as the ‘green’ performance of employees is worse due to the lack of generic green skills. Better access to the development of generic skills could facilitate green change processes within the companies. Thus, it is important for businesses to:

- include generic green skills in their internal and external training;
- provide those skills to all groups of employees.

‘How’ also relates to clear procedures and adherence to them (for example, sorting waste into different containers, switching off electricity in unused premises, sorting wood supplies for production). Established procedures should not only reduce carbon emissions, but also induce safe and healthy behaviour by workers, resulting in fewer occupational accidents and a more attractive working environment. However, procedures tend to be problematic due to:

- difficulties in their enforcement (they have to be simple, short and clear to be followed and this needs to be constantly monitored to make them become a habit);
- possible negative effects in terms of reduced autonomy (less room for independent decision-making) and craftsmanship.

Despite the difficulties associated with the procedures associated with environmental management standards, the promotion and improvement of these standards could significantly contribute to the shift towards a low-carbon economy.

## Role of public authorities

Among all the stakeholders involved in greening processes in business, public authorities have an exceptional role to play in addressing the barriers to greening discussed above. Public authorities are often regarded as the key facilitators of green change anticipation and management processes. The online survey reveals that to facilitate the development of job quality of employees working with green business practices, public authorities are primarily expected to:

- ensure an effective regulatory framework;
- adopt existing/create new education and training programmes;
- promote partnerships;
- provide financial support;
- provide forecasts (Figure 21).

The survey results and evidence from the company case studies indicate the need for a balance between regulatory, financial and non-financial measures of public authorities.

For regulatory policy measures, particular attention should be paid not only to drafting the legislation, but also its active and stable enforcement. Clear tools and procedures and a stable institutional, financial and legal framework need to be provided in order for climate change targets to be achieved.

Public authorities play an exceptional role in promoting environmental standards in public procurement (so-called green public procurement, or GPP) across industry. However, recent evidence suggests that GPP is not as widespread as was intended by the European Commission when in 2008 it set an indicative target that by 2010, 50% of all public tendering procedures should be green in the EU (European Commission, 2008b). ‘Green’ in this case means compliance with an endorsed common core of EU GPP criteria for 10 priority product/service groups, such as construction, transport, cleaning products and services.

A recent study by the Centre for European Policy Studies (CEPS) and the College of Europe (2012) concluded that instead of the expected 50%, only 26% of the last contracts signed in the 2009–2010 period by public authorities in the EU included all surveyed EU core GPP criteria.

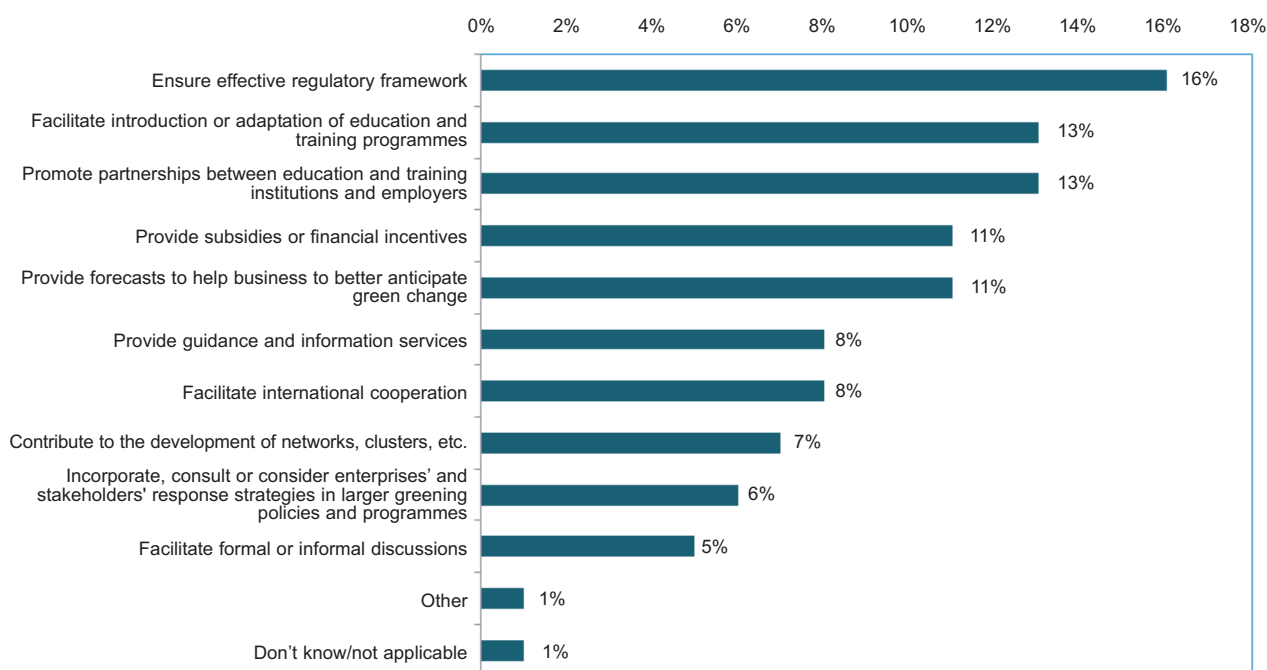
The recent Eurobarometer survey on the views and attitudes of SMEs towards resource efficiency and green markets indicates that there is still much room for manoeuvre for Member States to involve companies in green public procurement. According to the survey, only 11% of SMEs and 16% of large companies in the EU have bid for a public procurement tender that included environmental requirements (European Commission, 2012a). Scandinavian countries are showing the way in GPP and demonstrate the potential of this tool to further stimulate the greening of industry; for example, 24% of SMEs in Sweden, 21% in Norway and 14% in Finland have participated in public tenders with specific environmental requirements.

Financial measures need to be well balanced and targeted at those most in need of support (for example, SMEs or vulnerable groups of employees). Public authorities can mobilise regional, national and EU funding to facilitate the green change process. A good example of government involvement in the use of public funding to stimulate environmental behavioural change at work is exemplified by the UK government’s decision to set up a Union Modernisation Fund (UMF) to support the TUC’s Green Workplaces project. ESF funds are also supporting green activities and could be used more actively by EU Member States, especially given the shrinking public funds available



for greening as a result of the implementation of austerity measures.<sup>6</sup> Additional financial incentives could expand the scope of greening and include those companies that would otherwise not participate in greening, as market pressures are insufficient (for example, in the construction sector, where companies require financial incentives to close the gap between short-term financial losses due to greening and long-term gains). Public funding is distorting the market but, importantly, it also provides a long-term perspective to green change, which is the key to major investment and not just incremental business developments in this area.

Figure 21: *Activities public authorities could undertake to facilitate the development of job quality of employees working with green business practices*



Notes: N = 535 (up to five answers per respondent).

'Other' includes the following activities proposed by respondents: revising EU policies that are less favourable for green investment and the creation of green jobs; securing competitiveness of core industries; promoting the involvement of unions and employers' associations (social dialogue instead of public-private partnership); setting up a global price for carbon emissions; and increasing the participation of trade unions.

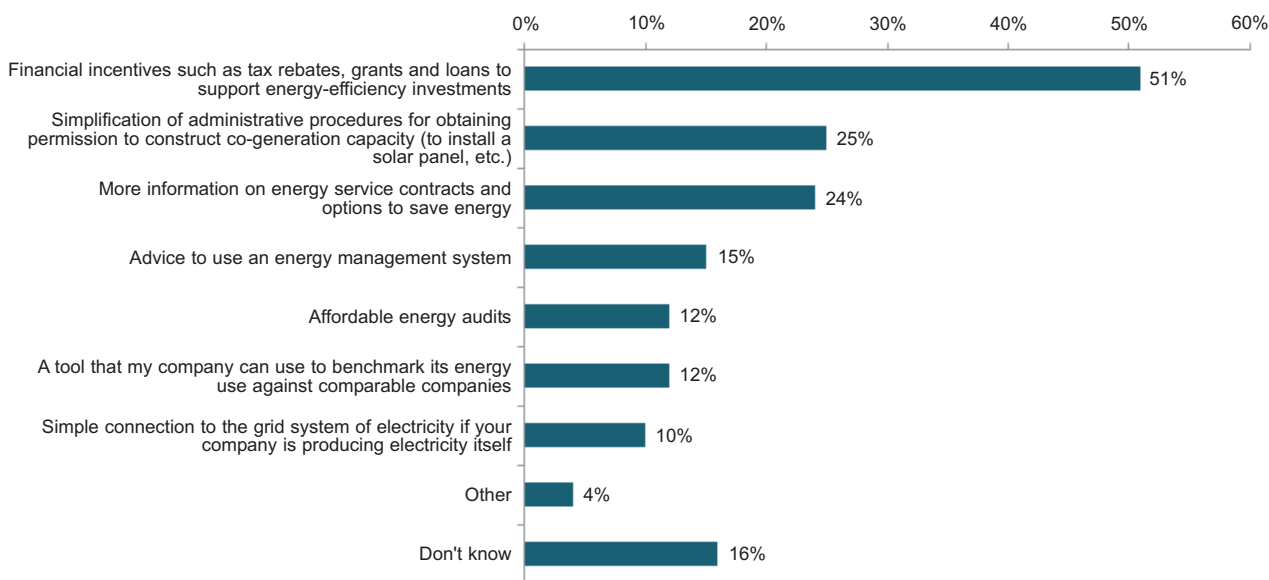
Source: *Online survey*

The need for a balance between regulatory, financial and non-financial measures of public authorities is emphasised by SMEs – probably the major target group of public initiatives due to its characteristics and importance for the national economies. The Eurobarometer survey on the views and attitudes of SMEs towards resource efficiency and green markets revealed that although half of SMEs choose financial incentives as the most effective policy measure to promote

<sup>6</sup> For example, ESF has contributed to the training modules for SMEs on energy consumption/saving and on climate protection in Denmark and Germany. In Poland, ESF is currently supporting a post-graduate course aimed at employees of companies dealing with environmental engineering and the management of environmental protection in enterprises (European Commission, 2010c). Several case study companies reported the use of EU funds for environmental training of their employees: for example, a Czech construction company implemented a project, Training of Employees in the Construction Sector, which also covered environmental management training; bioplastics producer Novamont in Italy has received EU support for two research projects in the bioplastics industry; and a Maltese waste treatment company has carried out several ESF projects aimed at enabling and encouraging environmental awareness through the empowerment of socially disadvantaged persons by adequate training and skills transfer.

energy efficiency, the other two most important measures are simplification of administrative procedures and information support (European Commission, 2012a) (Figure 22).

Figure 22: Policy measures to promote energy efficiency that SMEs in the EU consider particularly effective



Note: Based on question 18 of the survey.

Source: European Commission (2012a)

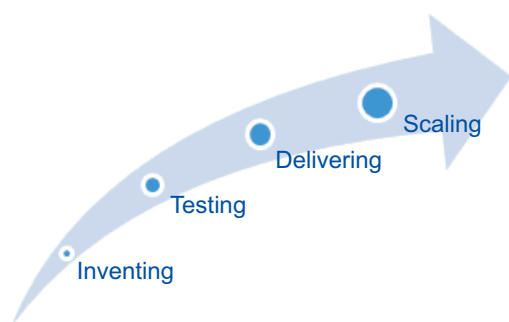
Although very important for the market, there is evidence that traditional regulatory and financial measures may be only partly effective in facilitating the development of the workforce for a low-carbon economy. In this sense, greening is very similar to social innovation – to reach a desired impact, it is not enough to invent ideas, test and implement them. For greening to have significant impact across industry, selected green business practices need to be scaled from one or a small number of companies implementing them to the majority of businesses within a sector or even the whole economy (Figure 23).

Furthermore, many countries are currently locked into high-carbon technologies and ways of working, making the shift towards a low-carbon economy costly and difficult (Nesta, 2008). It is argued that disruptive innovations (ones that cause a shift in behaviour) and not radical innovations (ones that utilise a significant technical advance) can help break this deadlock. Such innovations are cheaper, easier-to-use alternatives to existing products or services that can enable the rapid introduction of low-carbon technologies or the carbon-conscious behavioural changes that will make the transition easier (Nesta, 2008).

Regulatory and financial measures significantly contribute to scaling and breakthrough, but they are not sufficient. Successful scaling and breakthrough should also be supported with non-financial measures, such as extensive and intensive guidance services or networking to create a favourable environment for disruptive innovations to emerge.



Figure 23: Steps in mainstreaming green business practices



Source: Adapted from O'Sullivan et al (2011)

Public authorities are key intermediaries in a large group of relevant stakeholders and are ideally positioned to drive scaling and breakthrough processes forward with a number of accompanying measures providing information, guidance and other support, and encouraging collaborative approaches.

Public authorities could devote significant resources to raising public awareness of green change and particularly of the importance of green skills and overall cultural change within the green change processes. Increased awareness of green change among company shareholders and employees as well as by contractors, investors and clients would strengthen the need for green change within companies. Particular attention should be paid to those groups least motivated to participate in greening, such as the self-employed, blue collar workers and employees in SMEs.

Additional guidance services for companies (especially SMEs) by, for example, providing information on relevant support schemes or tools on how to implement green change (for example, eco-innovation inventories) could increase the share of greening companies.

Public authorities could support networks of SMEs aimed at facilitating green change. Networks such as the Retail Forum for Sustainability and the trade union national Green Workplaces Network coordinated by the TUC in the UK (and their tools) could help SMEs gain the necessary knowledge and skills for green change, and could become vital for a quick adaptation of SMEs to the green business. Sectoral training funds linking SMEs in a particular sector with pre-determined green skills providers could also be a critical initiative.

Public authorities could also play a significant role in adapting education and training policy for green change. At present there are not many education and training providers or specialised new or adapted programmes for the green skills necessary for the market. The recognition, validation and certification of competences are yet to be developed for new green or greening occupations. Furthermore, the coordination of education and training policy with environmental, labour market and other public policies needs to be strengthened to achieve higher coherence and synergy of different policy efforts. Public authorities could also encourage relevant training innovations to facilitate greening management processes (for example, the development of on-site training for large construction sites and providing e-learning solutions for generic green skills).

The list of accompanying measures public authorities could pursue (in addition to financial and regulatory initiatives) to facilitate greening across industry is very long. However, available evidence indicates rather limited involvement of public authorities in greening processes. As mentioned previously, studies (Cambridge Econometrics and Ecorys, 2011; Strietska-Ilina et al, 2011) argue that stimulus packages for greening are small, with limited resources for HR development and weak coordination of public policies in addressing greening. The company case studies revealed that

only approximately a quarter of all private companies received some kind of public support (financial, regulatory or other) for their green development.

Even fewer companies reported on accompanying measures that public authorities have used to promote greening (examples of public accompanying measures identified in company case studies are given in Box 7). This evidence, although not representative, may signal the impact of the crisis and significant changes in the policy priorities of national governments.

### Box 7: Examples of accompanying measures of public authorities for greening

**Ecociclo** in Portugal, a subsidiary of **Sonae Indústria**, which recycles wood for its panel factories, receives information support for its workers from local authorities, including the city administration, water and sewage authorities, and especially from firefighters. A wood recycling process constitutes a significant fire hazard by combining wood particles with running machines, engines and fuel containers in the same facility. Local firefighters provide advice on the training of workers and the use of firefighting equipment.

Environmental teams at UK-based **Tesco**, one of the world's largest retailers, are supported by public authorities in anticipating trends in future technologies and legislation, and in determining strategic directions of green change.

**CEZ Group**, a Romanian company developing a large onshore wind park, also used information and guidance support available from public authorities. Environmental experts from CEZ collaborated not only with the training providers, but also government authorities such as the National Energy Regulatory Agency and local environmental protection agencies in obtaining the latest knowledge and developments in the wind energy field.

French electric vehicle producer **MiA Electric** has made use of the state-funded plan to secure the career path (*plan de sécurisation des parcours professionnels*) for employees affected by unemployment due to the bankruptcy of former car manufacturer Heuliez in 2009. Within the framework of this plan, public authorities provided financial support and took responsibility for training around 300 people so that they could acquire the skills necessary for the production of electric cars. Further details on the plan are provided in Box 4.

**EnergiMidt** is a Danish energy company that distributes electricity but also delivers green business solutions involving solar heat and energy-saving heat pumps. EnergiMidt received both initial support for the development of green business practices and support for its further implementation from the Electricity Research Fund (Elforsk). The fund was set up to encourage entrepreneurship among companies in the field of alternative energy sources. The state helped the chosen applicants (including EnergiMidt) with financial support and provided relevant consultancy services. This fund has supported several of the company's projects. As well as its involvement with Elforsk, EnergiMidt has cooperated with Go' Energi, an impartial public organisation under the Ministry of Climate, Energy and Construction. Go' Energi, which was set up in 2010, is expanding the activities of the former Danish Electricity Saving Trust with the remit to promote energy efficiency (including consultations on potential energy savings) in households, the public sector and the commercial and industrial sectors for all forms of energy use, other than transport.

Public authorities could also encourage relevant public companies to anticipate and manage green change (that is, on the basis of leadership by example). Private sector companies are more active in this regard, as the amounts saved during green change can be reinvested in other activities, while savings in public companies are usually transferred back to the state budget.

The company case studies provide some positive examples of green business practices implemented by public companies (some examples are provided in Box 8). As public companies account for considerable shares of some markets (for example, energy, waste and transport), their active role in promoting green change could provide an impetus for the markets to move towards a low-carbon economy. However, the role of public companies in greening is increasingly dependent on the strength of a country's public sector and overall national economy.

**Box 8: Examples of green business practices implemented by public companies**

**AENA Airports Inc.** (AENA) is a Spanish state-owned company that operates Barcelona's El Prat airport. Along with public agencies and trade unions, AENA has promoted the development of a mobility plan to boost sustainable mobility for the 21,000 commuters who travel daily to workplaces within the airport's facilities. Barcelona airport is one of the top mobility zones in Barcelona's metropolitan area, making actions taken to promote green transport even more exemplary and relevant. The case study showed that the development of the mobility plan, as opposed to mobility patterns dominated by private motor vehicles, clearly improved and increased public transport services, reduced harmful environmental effects, generated social and economic benefits and created new jobs in transport companies. AENA has managed to induce a cultural shift among airport employees. It encouraged a move from a culture based on the use of private vehicles to a sustainable mobility culture based on public transport – a suitable and effective alternative to private vehicles due to their environmental and economic advantages. Sustainable mobility could not become a reality without the active participation of the different agents in the mobility commission, including workers' representatives, employers, public agencies, transport operators, the Association for the Promotion of Public Transport (an NGO) and the external mobility consultant (ALG).

**Green Cargo** is a Swedish government-owned company providing railway-based freight transport services. This public company has positioned its business as the greenest transport service provider by promoting its high proportion of trains powered by electricity derived from renewable sources. It is constantly striving to reduce its remaining use of fossil fuels through the following efficiency measures:

- development of eco-driving practices for diesel locomotives (the eco-driving practice consisted of changes related to the driver's behaviour and was estimated to be about 20% more efficient);
- investment of about €100 million in new engines for the diesel locomotives, which are about 20% more efficient than the old ones;
- increase in use of electric trains (currently 94%).

This case study illustrates how a public company can exploit and promote its advantage to provide environmentally superior services, thus providing a positive impetus for greening in the local transport market.

**Getliņi EKO, Ltd** was set up in Latvia in 1997 to run the Getliņi landfill, the largest waste treatment project in the Baltic states. This public company has focused on three interrelated practices:

- reducing pollution of the air by methane gas;
- preventing groundwater pollution;
- modernising the Getliņi landfill.

The company has implemented technology to collect methane, which it uses to produce electricity. The heat created during the process of energy production has been used in the company's greenhouses for the production of agriculture

products. The company implements EU Cohesion Fund infrastructure projects and collaborates with a number of actors, including:

- Latvian Ministry of Environment and Regional Development;
- Swedish regional cooperation in waste management, which provided twinning assistance;
- Swedish technological partners;
- project consultants from Canada and Latvia.

The introduction of new innovative technologies in power generation and waste treatment has not only facilitated the creation of new jobs for qualified specialists and improved their working conditions, but also promoted greening in the Latvian waste treatment market and beyond.

**WasteServ Malta** is Malta's major operator in the waste management sector. WasteServ is committed to establishing and maintaining innovative waste management practices that also protect the environment and society. Alongside other related initiatives, the company introduced the first facility in Malta for sorting dry recyclable waste. The green business practices contributed, directly and indirectly, to energy efficiency and energy saving in the company and to an overall reduction in the share of GHG emissions from the waste sector in Malta. For instance, biogas generated in one of the company's plants is used to generate electricity which is utilised on-site with the excess fed into the national grid. There are plans to use part of the heat generated by this facility to heat the swimming pool belonging to a neighbouring philanthropic organisation. The company's innovative practices encourage its employees to learn green skills and to enhance their way of green thinking. Through public consultations and collaborative arrangements, the green ideas also spread to the business community and wider society in Malta.

Lastly, there are innovative capacities and barriers to the greening of industry at the local level. This is due to differences in the local macroeconomic environment, macroeconomic policy settings, industry structure and dynamics, labour markets, institutional capacity and governance (Miranda and Larcombe, 2012).

To facilitate greening processes evenly across the country, central government should both intensively and extensively coordinate its actions with local authorities and involve local institutions in the process. For example, local labour market authorities could be involved in the formulation of a national greening strategy and related activities. Greater engagement of local labour market authorities in such processes would lead to better awareness of greening on their part; it also has implications for the labour market and more constructive actions in this respect. The European Commission could facilitate greening processes at a local level by, for example, introducing an eco-innovation scoreboard to monitor eco-innovation progress at local level.<sup>7</sup>

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<sup>7</sup> For work carried out so far in monitoring eco-innovation, see <http://www.eco-innovation.eu/>.

# Conclusions and recommendations 6

## Conclusions

The main policy challenge arising from climate change is the employment challenge, which implies the anticipation and management of both the quantity and quality of jobs; that is, how to simultaneously mitigate climate change, maintain or even increase employment levels, and secure or improve job quality standards. The other key challenges related to employment are associated with regulation, the availability and rising prices of conventional resources, increasing competition, including risks of carbon leakage, and new technologies.

The recent economic and financial crisis has not reduced the number of green jobs, but has primarily slowed down the overall pace of greening across industry. Companies are finding it hard to balance climate change with their other needs (for example, how to cope with the crisis). The green elements of the stimulus packages of most EU countries did not have significant positive effects on employment, and there is not much evidence of the significant role of stimulus packages in stimulating green jobs either. On the contrary, it seems that recent austerity-led reductions in public subsidies, tax incentives, feed-in tariffs and other public support measures have slowed down greening. Thus, it seems that the design, implementation and monitoring of actions aimed at mitigating the lasting effects of the crisis on greening is another challenge to be addressed in the future.

Most often, companies adopt green business practices due to the availability and economic feasibility of new technologies and the awareness of climate change among, or pressure from, internal and external business stakeholders. A recent Eurobarometer survey on the views and attitudes of SMEs towards resource efficiency and green markets confirms these motivations and adds another two – the high priority given to the environment among the company's values and public support.

Companies usually engage in greening mainly through either energy-saving practices (for example, the development of more efficient production technologies, diminishing material use per production unit, reducing energy use in the workplace, replacing more carbon-intensive inputs with less carbon-intensive ones) or the production of greener products or the provision of greener services (for example, the development of zero-emission building concepts, producing e-vehicles or providing electric engine instalment services, providing sophisticated recycling services, introducing tiles accompanied with solar cell elements). Management-related practices (for example, accounting and reporting GHG emissions, establishing an emissions reduction plan) and work with supply chains (for example, raising awareness, including climate change mitigation criteria into a company's procurement policy) are less prevalent.

Implementation of green business practices seems to have redistributed jobs between sectors (especially smaller ones) and not altered absolute employment levels. Available studies suggest that climate change could contribute to overall employment levels up to 1%–1.5% (in net terms) by 2020, although stakeholders interviewed as part of this study suggest a more positive assessment of the employment potential of the green economy. Available quantitative forecasts show that the largest effects, in absolute numbers, of new climate change policies on employment could be expected in the construction (particularly), textiles, distribution and trade, transport and possibly furniture sectors. The relative loss of jobs (measured as a percentage difference from a baseline scenario) resulting from the implementation of new climate change policies is likely to be largest in the gas supply, textiles, other manufacturing (part of which relates to furniture), energy (the sector in total), rubber and plastics, air transport, wood and paper (part of which relates to furniture), construction and electricity sectors. The largest relative gain of jobs due to the realisation of new climate change policies may be expected in the construction sector. The recent Eurobarometer survey indicates that green jobs are largely created in SMEs rather than in large companies but that absolute growth in green jobs will be highest in large companies.

No straightforward conclusions can be drawn on the overall impact of climate change on job quality because of a number of factors, including:

- difficulties in distinguishing the impact of climate change from broader contextual factors affecting job quality;
- significant variations of impacts in time and across sectors, occupations and regions;
- lack of evidence regarding direct or indirect causality between climate change and job quality;
- possible bias in the online survey results.

The study therefore identified only tentative trends, which need to be researched further at a more detailed sector and subsector level.

Evidence gathered in this study suggests that the impact of climate change on the quality of jobs is moderate. Skills development is the job quality dimension most notably affected. The study confirms the finding of other research that greening results in very few new occupational profiles and mostly stimulates the improvement of existing skill sets across industry. The study also reveals that skills development is likely to be positively associated with other job quality dimensions – the higher the level of skills associated with an occupation, the better the career and employment security, health and well-being, and work–life balance of this occupation. At least in the short term, greening is likely to increase the demand for highly skilled workers (and thus their job quality) and decrease the demand (and thus job quality) for (or have no effect on) workers with medium-level or low skills. Of the 10 sectors targeted by this study, it is expected that the demand to develop green skills will be highest in construction and energy, somewhat moderate for automotive, chemicals, distribution and trade, furniture and non-metallic materials, and low for textiles, transport and shipbuilding. Over the medium to long term, when technologies mature, demand for high-, medium- and low-skilled workers may even out. Generic, STEM (science, technology, engineering and mathematics) and interdisciplinary skills as well as multi-skilling are increasingly important in facilitating this process.

The effects of greening in other job quality dimensions are less widespread. Roughly half the companies featured in the company case studies have experienced at least some effects on career and employment security, and health and well-being. For career and employment security, the key effects are underrepresentation of certain groups (for example, women, young workers and older workers) and lack of involvement of employees in the green change processes. For the health and well-being dimension, the key effect is a more intense development of new combinations of risks (than in conventional jobs) that still need to be anticipated, assessed and managed. The greatest impact of greening on career and employment security is likely to be in construction and renewables, while on health and well-being, it is likely to be in construction, emerging energy industries and chemicals. The reconciliation of working and non-working life is likely to be the least affected job quality dimension, in which greening effects are still the most contested.

Companies are more often likely to manage rather than anticipate green change. Most management approaches, both autonomous and collaborative, are applied to skills development and career and employment security dimensions, and only a few to the other dimensions. However, most companies are likely to use conventional approaches (for example, participation in formal discussions, amendment of current partnership agreements, provision of (traditional) internal training courses) and not engage in eco-innovations (for example, new types of training, such as training on-site for large construction sites, innovative partnership agreements with education providers, new ways of involving employees in green change processes).

Several key issues need to be stressed for the anticipation and management of green change. Firstly, SMEs are less able than large companies to become green and need to be supported by public authorities with regulatory, financial and non-financial measures (see recommendations). Secondly, employees are not sufficiently engaged in green change processes



and not fully convinced of ‘why’. Greening a workplace is often not clearly associated with higher job quality. As a result, the green end-product or service is of lower quality than it could be. Good practice company case studies demonstrate that the active involvement of employees in the green change processes could lead to a ‘virtuous circle’ of greening within the companies; providing information and consultation result in higher awareness and involvement, which in turn lead to greater employee motivation to up-skill and implement green change, higher job quality and greater job satisfaction. Thirdly, to be able to act, employees working with green business practices need to know ‘how’. The role of environmental management standards and procedures and the role of generic green skills in designing, implementing and monitoring them are of paramount importance for green change.

Since the transition to a low-carbon economy is a policy-driven process, the anticipation of green change could be more straightforward and explicit, while management measures can even be planned and launched at the outset. However, the market alone will not be able to reach an optimal level of energy efficiency in the economy. Public authorities therefore need to collaborate with actors in the market and direct, as well as strengthen, the socially responsible green restructuring efforts of industry. Although regulatory and financial measures are crucial in boosting the greening of industry, stakeholders who took part in this study argue the need for balance between regulatory, financial and non-financial measures by public authorities. Public authorities should engage in a number of non-financial initiatives (see recommendations) to effectively facilitate the development of the workforce for a low-carbon economy and to scale greening innovations across industry. Local-level, innovative capacities and barriers to greening all need to be considered.

### Recommendations

The greening of industry provides many opportunities for businesses. Based on the study’s findings, the following suggestions are made to help businesses and all relevant stakeholders to further facilitate greening processes across industry.

The key prerequisites for successful, socially responsible green change at company and industry levels are:

- regulations and financial support that raise standards and drive industry gradually towards greening;
- the building up of internal company know-how;
- the general awareness and acceptance of change among employees.

Organisational innovations aimed at clear communication and the involvement of employees could facilitate the greening of industry. This could be done through various organisational eco-innovations, including:

- involving employees’ representatives or trade union representatives in green management structures;
- amending current collective agreements or concluding new ones with energy efficiency targets and benefits for employees associated with their achievement;
- launching a survey of staff on green change, which would provide ideas for further green actions, give the employer a mandate to act, give employees a sense of ownership of the green change processes, and help to formulate a strategic vision of greening in the company.

Appointing a green workplace representative or providing existing representative(s) with green responsibilities would also enhance employee involvement. The representative would have responsibility for:

- training on environmental issues at work, including teaching specific and generic green skills (such as energy and resource efficiency, undertaking audits and relevant legislation);
- performing a range of agreed green activities, ranging from energy audits to joint surveys with employers and union members to identify energy and resource hotspots where interventions are needed.

Public authorities are often regarded as the key facilitators of green change anticipation and management processes in the economy. To ease the greening of industry, both by creating jobs and raising the quality of existing and new green jobs, public authorities could provide a well-balanced framework of regulatory, financial and accompanying non-financial measures.

For regulatory policy measures, particular attention should be given not only to the drafting of legislation, but also its active and stable enforcement. Social partners expect clear tools and procedures, together with a stable institutional, financial and legal framework, in order to achieve climate change targets. Public authorities could more actively introduce environmental standards in their green public procurement policies. The EU could follow the example of Scandinavian countries, which are well advanced in this field. Environmental management standards such as ISO 14001 could be more intensively promoted for businesses and especially for SMEs, which, according to the recent Eurobarometer survey, are twice less likely to use them than large companies.

Financial measures need to be well balanced and targeted at those most in need of support (for example, SMEs or underrepresented groups of employees, such as women in certain subsectors, and young, blue collar and older workers). Available public funds should be targeted not only at technological innovations, but also at environmental behaviour change at workplace level. Shrinking public support due to austerity measures suggests the need to seek alternative financial sources. ESF funds could be more often programmed and used to anticipate and manage green change, especially by social partners in the NMS, which are less active in greening processes. To secure or even improve job quality, public authorities could introduce horizontal job quality-related requirements in their green public investments.

Accompanying non-financial measures should be initiated on a vast scale to promote greening across industry. First, public authorities could devote significant resources to raising public awareness of green change and particularly the importance of green skills and overall green culture within green change processes. Most efforts today need to be aimed at convincing and informing stakeholders in the different sectors of industry of the reasons for greening (that is, the 'why' question). Once these key questions have been answered, company shareholders, employees, contractors, investors and clients will become more eager to consider the question of 'how' to green. Secondly, additional guidance services for companies and especially SMEs (for example, providing information on relevant support schemes, forecasts of greening trends and tools on how to implement green change) could increase the proportion of greening companies within industry. Particular attention in providing information and guidance services should be paid to facilitate greening-driven organisational and behavioural innovations at company and especially workplace levels. Thirdly, public authorities could support networks of SMEs aimed at facilitating green change, such as forums on sustainability, skills councils and green-oriented sectoral training funds. Finally, public authorities could play a significant role in adapting education and training policy for green change, for example by:

- introducing new programmes or adapting existing ones for green skills;
- developing recognition, validation and certification systems for green competences;



- coordinating education and training policy with environmental, labour market and other public policies (for example, by introducing a green skills component in every related public initiative);
- encouraging relevant training eco-innovations to facilitate greening management processes.

Innovative capacities and barriers to the greening of industry concentrate at the local level. To facilitate greening processes evenly across the country, central government should therefore coordinate its actions with local governments and involve local institutions in the process. Greater engagement of, for example, local labour market authorities in such processes would lead to their better awareness of greening, positive labour market effects and more constructive actions in this respect. Meanwhile, the European Commission could facilitate greening processes at local level by, for example, introducing an eco-innovation scoreboard to monitor eco-innovation progress at local level.

The study has outlined tentative trends at cross-sectoral and sectoral levels that need to be supported with new and more detailed research. Future research is particularly needed to:

- provide forecasts at detailed industry level (at NACE three- or four-digit level) and covering all relevant sectors;
- investigate the greening effects on employment at the subsector level, including representative surveys of companies to gather reliable and in-depth evidence on the relationship between greening and employment and especially job quality (for example, surveys comparing the proportion of companies that consider skills development an important effect of greening with the proportion of those that engage in different skill development activities);
- examine the sustainability of future green jobs and their geographical trends;
- analyse whether the economic and financial crisis has had any significant effects on employers' perception of greening and what measures could prevent or mitigate this;
- verify identified links between greening and the various dimensions of job quality and to formulate a sound theoretical framework on this theme;
- investigate greening strategies across whole value chains (with both direct and indirect employment implications) to obtain a better view of greening processes in industry;
- inspect eco-innovations at organisational and institutional levels to anticipate and manage green change (especially those involving SMEs and public authorities);
- explore reasons behind successful and less successful collaborative approaches that social partners adopt to anticipate and manage green change.

Finally, some of the company case studies clearly demonstrate that implementation of green business practices, whether aimed at energy saving, manufacturing of green products or provision of green services or others, can result in a 'triple win' situation:

- benefits for companies in terms of, for example, higher competitiveness or profitability;
- benefits for employees in terms of, for example, number of jobs and higher job quality standards;
- a stronger economy and a healthier environment.

It is vital to brand the greening process so that the positive aspects of greening are communicated clearly to all stakeholders and urge industry forward in the non-stop loop of eco-innovation.



# Bibliography

All Eurofound publications are available at [www.eurofound.europa.eu](http://www.eurofound.europa.eu).

Albrecht, J. and Arts, B. (2005), 'Climate policy convergence in Europe: An assessment based on national communications to the UNFCCC', *Journal of European Public Policy*, Vol. 12, No. 5, pp. 885–902.

Baumert, K.A., Herzog, T. and Pershing, J. (2005), *Navigating the numbers: Greenhouse gas data and international climate policy*, World Resources Institute, Washington, DC.

Belgian Presidency of the European Union (2010), 'A European plan for the creation of “green” jobs and for the “greening” of the economy: The conclusions of the ministerial conference', press release, 29 September 2010, available at <http://www.eutrio.be/sites/default/temp/13487.pdf>.

BiPro, Enviroplan and Umweltbundesamt (2009), *Services on monitoring retailers' REAP commitments*, Final report, European Commission, Brussels.

Boston Consulting Group (2008), *Assessment of the impact of the 2013–2020 ETS proposal on the European cement industry*, European Cement Association (Cembureau), Brussels.

Bouwer, M., Jonk, M., Berman, T., Bersani, R., Lusser, H. and Nappa, V. (2006), *Green public procurement in Europe: Conclusions and recommendations*, European Commission, DG Environment, Brussels.

BPIE (Buildings Performance Institute Europe) (2011), *Europe's buildings under the microscope: A country-by-country review of the energy performance of buildings*, Brussels.

Broughton, A. (2009), *Greening the European economy: Responses and initiatives by Member States and social partners*, Eurofound, Dublin.

Cambridge Econometrics and Ecorys (2011), *Assessing the implementation and impact of green elements of Member States' National Recovery Plans*, Final report for the European Commission, DG Environment, Cambridge Econometrics, Cambridge.

Cambridge Econometrics, GHK and Warwick Institute for Employment Research (2011), *Studies on sustainability issues – Green jobs; trade and labour*, Final report for the European Commission, DG Employment, Cambridge Econometrics, Cambridge.

Cedefop (2009), *The dynamics of qualifications: Defining and renewing occupational and educational standards*, European Centre for the Development of Vocational Training, Luxembourg.

Cedefop (2010), *Skills for green jobs: European synthesis report*, Publications Office of the European Union, Luxembourg.

Cedefop (2011a), *The economic benefits of VET for individuals*, Research paper No. 11, Publications Office of the European Union, Luxembourg.

Cedefop (2011b), *The anatomy of the wider benefits of VET in the workplace*, Research paper No. 12, Publications Office of the European Union, Luxembourg.

Cembureau (European Cement Association) (2009a), *Building a future, with cement and concrete: Adapting to climate change by planning sustainable construction*, Brussels.

Cembureau (European Cement Association) (2009b), *Sustainable cement production: Co-processing of alternative fuels and raw materials in the European cement industry*, Brussels.

CEPS (Centre for European Policy Studies) and College of Europe (2012), *The uptake of green public procurement in the EU27*, Brussels.

CerameUnie (2010), *NOx and SO<sub>2</sub> emissions trading: Not an appropriate tool for the ceramic industry*, European Ceramic Industry Association, Brussels.

CESA and Granger, N. (2008), *Report of the HR workshop, 'Demographic change & skills requirements in the European shipbuilding and ship repair industry' held at the Golden Tulip Hotel, Koudkerke, The Netherlands, on Thursday 5 June 2008*, European Shipbuilding Social Dialogue Committee, Brussels.

Clotefi (Clothing Textile & Fibre Technology Development) (2010), *Sustainable innovation for textile in south east Europe: Supply and demand analysis of textile products: Greece, Hungary, Italy, Romania*, South East Europe Transnational Cooperation Programme, Budapest.

Council of the European Union (2007), Brussels European Council 8/9 March 2007: Presidency conclusions (7224/1/07), European Commission, Brussels.

Council of the European Union (2010), *Council conclusions: Employment policies for a competitive, low-carbon, resource-efficient and green economy*, 3053rd Employment, Social Policy Health and Consumer Affairs Council meeting, Brussels, 6 December 2010, European Commission, Brussels.

CPIV (Standing Committee of the European Glass Industries) (2010), *CPIV position paper on the design of CO<sub>2</sub> benchmarks and fall back options under the ETS for the glass sector*, Brussels.

CSI (Cement Sustainability Initiative) (2009), *CSI model: Scenarios and results overview*, World Business Council for Sustainable Development, Geneva.

DB Advisors (2008), *Economic stimulus: The case for 'green' infrastructure, energy security and 'green' jobs*, Deutsche Bank Group, New York and London.

DECC (Department of Energy and Climate Change) and BIS (Department for Business, Innovation & Skills) (2010), *Meeting the low carbon skills challenge: A consultation of equipping people with the skills to take advantage of opportunities in the low carbon and resource efficient economy*, BIS, London.

DTI (Danish Technological Institute) (2009), *Future qualification and skills needs in the construction sector*, Taastrup, Denmark.

Dupressoir, S. (2009), *Climate change, the environment and jobs in UNI Europa's sectors*, Report 109, European Trade Union Institute, Brussels.

Econ (2008), *Forecasting skill needs: A review of national and European practices*, Report 2008-125, Prepared for the Norwegian Ministry of Education and Research, Oslo.

Economix (2009), *Skills scenarios for the textiles, wearing apparel and leather products sector in the European Union. Comprehensive analysis of emerging competences and economic activities in the European Union*. European Commission, Directorate-General Employment, Social Affairs, and Equal Opportunities, Brussels.

Ecorys Research and Consulting (2008), *Environment and labour force skills. Overview of the links between the skills profile of the labour force and environmental factors*, European Commission, Directorate-General Environment, Brussels.

Ecorys Research and Consulting (2010), *Programmes to promote environmental skills, Final report*, Prepared for European Commission, DG Environment, ECORYS Nederland, Rotterdam.

Ecorys Research and Consulting and KBA (2010), *Sector councils on employment and skills at EU level: A study into their feasibility and potential impact*, Prepared for European Commission, DG Employment, Social Affairs and Equal Opportunities, ECORYS Nederland, Rotterdam.

Ecorys Research and Consulting, Danish Technological Institute, Cambridge Econometrics, CES ifo and IDEA Consult (2008a), *Competitiveness of the glass sector, Final report*, Prepared for the European Commission, Directorate-General Enterprise and Industry, ECORYS Nederland, Rotterdam.

Ecorys Research and Consulting, Danish Technological Institute, Cambridge Econometrics, CES ifo and IDEA Consult, (2008b), *Competitiveness of the ceramics sector, Final report*, Prepared for the European Commission, Directorate-General Enterprise and Industry, ECORYS Nederland, Rotterdam

Ecorys Research and Consulting, Danish Technological Institute, Cambridge Econometrics, CES ifo and IDEA Consult (2009), *Study on competitiveness of the European shipbuilding industry, Final report*, Prepared for the European Commission, Directorate-General Enterprise and Industry, ECORYS Nederland, Rotterdam.

Ecorys Research and Consulting, Danish Technological Institute, Cambridge Econometrics, CES ifo and IDEA Consult (2010), *Sustainable competitiveness of the construction sector, Final report*, Prepared for the European Commission, Directorate-General Enterprise and Industry, ECORYS Nederland, Rotterdam.

Ecotec Research & Consulting (2006), *Employment trends in all sectors related to the sea or using sea resources*, Prepared for the European Commission, Directorate-General Fisheries and Maritime Affairs, ECOTEC Research & Consulting, Birmingham.

EESC (European Economic and Social Committee) (2008), *The future of the textile, clothing and footwear sectors in Europe*, Brussels.

EMCEF (European Mine, Chemical and Energy Workers' Federation) and ECEG (European Chemical Employers Group) (2011), *European framework agreement on competence profiles for process operators and first line supervisors in the chemical industry*, Brussels.

EMCO (Employment Committee) (2010), *Towards a greener labour market – The employment dimension of tackling environmental challenges*, Final report endorsed by EMCO on 10 November 2010, EMCO Reports Issue 4, Brussels.

EPSI (European Platform for Sport Innovation) (2010), *Designed to surprise. Towards a strategic roadmap for research and innovation in the European design-based consumer goods sectors*. A collaboration of the European Textile, Footwear and Sports Technology Platforms, Brussels.

EPSU (European Federation of Public Service Unions), Eurelectric and EMCEF (European Mine, Chemical and Energy Workers' Federation) (2011), *Towards a low carbon electricity industry: Employment effects and opportunities for the social partners*, Brussels.

EREC (European Renewable Energy Council) (2010), *RE-thinking 2050: A 100% renewable energy vision for the European Union*, Brussels.

ERRT (European Retail Round Table) (2010), *Post-Copenhagen Retail 20:20 vision: Report on the 2008 Retail Energy Declaration*, Brussels.

ESSDC (European Shipbuilding Social Dialogue Committee) (2005), 'Qualification and Training Forum, 21 October 2005, Trieste', available at <http://www.emf-fem.org/Areas-of-work/Social-Dialogue/Shipbuilding/Qualification-and-Training-initiative>.

ETF (European Training Foundation) (2011), *ETF position paper: Sustainable development and education and training*, Turin.

ETUC (European Trade Union Confederation), ISTAS, SDA, Syndex and Wuppertal Institute (2007), *Climate change and employment. Impact on employment of climate change and CO<sub>2</sub> emission reduction measures in the EU-25 to 2030. Synthesis*, Brussels.

EU-OSHA (European Agency for Safety and Health at Work) (2011a), *Foresight of new and emerging risks to occupational safety and health associated with new technologies in green jobs by 2020. Phase I – Key drivers of change*, Publications Office of the European Union, Luxembourg.

EU-OSHA (European Agency for Safety and Health at Work) (2011b), *Foresight of new and emerging risks to occupational safety and health associated with new technologies in green jobs by 2020. Phase II – Key technologies*, Publications Office of the European Union, Luxembourg.

Euratex (European Apparel and Textile Confederation) (2010), *Comments of EURATEX on DG Enterprise and Industry report entitled 'Manufacturing industry: What are the challenges and opportunities for the coming years?'*, Brussels.

EuroCommerce and ERRT (European Retail Round Table) (2010), *Retail environmental sustainability code*, Brussels.

Eurofound (2002), *Quality of work and employment in Europe: Issues and challenges*, Foundation paper no. 1, Publications Office of the European Union, Luxembourg.

Eurofound (2004), *Balancing conflicting pressures: The automotive sector of tomorrow*, Dublin.

Eurofound (2005), *The chemicals sector – What future, sector futures*, Dublin.

Eurofound (2011), *Industrial relations and sustainability: The role of social partners in the transition towards a green economy*, Dublin.

European Commission (2001), 'European research delivers safer, cleaner, more efficient production processes in chemical industry', press release 14 November 2011, Brussels, available at <http://ec.europa.eu/research/press/2001/pr1411en.html>.

European Commission, Directorate-General for Energy and Transport (2005a), *Doing more with less. Green Paper on energy efficiency*, Publications Office of the European Union, Luxembourg.

European Commission, DG Environment (2005b), *EMAS case studies: Leonardo 1502 Ceramica S.p.A. – Italy*, Brussels.

European Commission, Directorate-General for Employment, Social Affairs and Equal Opportunities (2008a), *Employment in Europe 2008*, Publications Office of the European Union, Luxembourg.

European Commission (2008b), *Public procurement for a better environment*, COM(2008) 400 final, Brussels.

European Commission, DG Environment (2008c), *EMAS case studies: Ahrend Produktiebedrijf Sint-Oedenrode – The Netherlands*, Brussels.

European Commission, Directorate-General for Energy and Transport (2008d), *European energy and transport: Trends to 2030*, Publications Office of the European Union, Luxembourg.

European Commission (2008e), *Communication staff working document. Accompanying document to the proposal for a recast of the Energy Performance of Buildings Directive (2002/91/EC)*. Impact assessment, SEC(2008) 2864, Brussels.

European Commission, Directorate-General for Employment, Social Affairs and Equal Opportunities (2009a), *Employment in Europe 2009*, Publications Office of the European Union, Luxembourg.

European Commission, DG Environment (2009b), *EMAS case studies: Kinnarps AB – Sweden*, Brussels.

European Commission, DG Environment (2009c), *EMAS case studies: Verallia – Portugal*, Brussels.

European Commission, Directorate-General for Employment, Social Affairs and Equal Opportunities (2009d), *Investing in the future of jobs and skills. Scenarios, implications and options in anticipation of future skills and knowledge needs for the furniture sector. Policy summary*, Brussels.

European Commission (2010a), *Analysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakage*, COM(2010) 265 final, Brussels.

European Commission, Directorate-General for Energy (2010b), *EU energy trends to 2030: Update to 2009*, Publications Office of the European Union, Luxembourg.

European Commission (2010c), *The European Social Fund: Sustainable development and eco-technologies*, Summary fiche, Publications Office of the European Union, Luxembourg.

European Commission, Directorate-General for Employment, Social Affairs and Equal Opportunities (2010d), *European sectorial social dialogue. Recent developments. 2010 edition*, Brussels.



European Commission (2010e), 'Commission decision of 24 December 2009 determining, pursuant to Directive 2003/87/EC of the European Parliament and of the Council, a list of sectors and subsectors which are deemed to be exposed to a significant risk of carbon leakage (2010/2/EU)', *Official Journal of the European Union*, L1, 5.1.2000, pp. 10–18.

European Commission (2010f), *Retail market monitoring report. 'Towards more efficient and fairer retail services in the internal market for 2020'*, Brussels.

European Commission, Directorate-General Enterprise and Industry (2010g), *EU manufacturing industry: What are the challenges and opportunities for the coming years? First tentative findings of a sector-specific analysis carried out in DG Enterprise and Industry*, Brussels.

European Commission, Directorate-General for Employment, Social Affairs and Equal Opportunities (2010h), *Statistical portrait of the EGF 2007–2010*, Brussels.

European Commission, Directorate-General for Employment, Social Affairs and Equal Opportunities (2010i), *Commission staff working paper: Industrial relations in Europe 2010*, SEC(2011) 292, Brussels.

European Commission (2011a), *A roadmap for moving to a low-carbon economy in 2050*, COM(2011) 112, Brussels.

European Commission (2011b), *Energy efficiency plan 2011*, COM(2011) 109 final, Brussels.

European Commission (2011c), 'Energy efficiency: Buildings', available at [http://ec.europa.eu/energy/efficiency/buildings/buildings\\_en.htm](http://ec.europa.eu/energy/efficiency/buildings/buildings_en.htm).

European Commission (2011d), 'Climate action. Reducing CO<sub>2</sub> emissions from cars through eco-innovation', available at [http://ec.europa.eu/clima/news/articles/news\\_2011072501\\_en.htm](http://ec.europa.eu/clima/news/articles/news_2011072501_en.htm).

European Commission (2011e), 'Climate action. CO<sub>2</sub> labelling of cars', available at [http://ec.europa.eu/clima/policies/transport/vehicles/labelling/index\\_en.htm](http://ec.europa.eu/clima/policies/transport/vehicles/labelling/index_en.htm).

European Commission (2012a), *Eurobarometer survey: SMEs are important for a smooth transition to a greener economy*, MEMO/12/218, Brussels.

European Commission (2012b), *Commission staff working document. Exploiting the employment potential of green growth, accompanying the communication 'Towards job rich recovery'*, SWD (2012) 92 final, Strasbourg.

European Parliament (2009), Regulation (EC) No 443/2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO<sub>2</sub> emissions from light-duty vehicles, *Official Journal of the European Union*, L140, 5.6.2009, pp. 1–15.

European Parliament (2010), *The impact of climate change policies on the employment situation. Summary of evidence note*, Brussels.



European Partnership for the Anticipation of Change in the Automotive Sector (2007), 'Restructuring forum, 'The challenges of the automotive industry – Towards a European partnership for the anticipation of change', 17–18 October 2007, Brussels, available at

<http://www.emf-fem.org/Projects/Anticipation-of-Change-Project/Forum-on-restructuring-in-the-EU-automotive-industry>.

Eurostat (2010), *Using official statistics to calculate greenhouse gas emissions: A statistical guide, 2010 edition*, Luxembourg.

EWEA (European Wind Energy Association) (2009), *Wind at work. Wind energy and job creation in the EU*, Brussels.

Faber, J., Markowska, A., Nelissne, D., Davidson, M., Eyring, V., Cionni, I. et al (2009), *Technical support for European action to reducing greenhouse gas emissions from international maritime transport*, Prepared for the European Commission, CE Delft, Delft.

FIEC (European Construction Industry Federation) and EFBWW (European Federation of Building and Wood Workers) (2011), 'Paritarian social funds in the construction industry', available at <http://www.paritarian-funds-construction.eu/page.php?id=1>.

Fritz, O., Getzner, M., Mahringer, H. and Ritt, T. (2000), *Umwelt und Beschäftigung: Strategien für eine nachhaltige Entwicklung und deren Auswirkungen auf die Beschäftigung* [Environment and employment: Strategies for sustainable development and their impact on employment], Institut für Wirtschaft und Umwelt der Arbeiterkammer Wien, Vienna.

Galgóczi, B. (2010), *The harsher employment effects of a necessary paradigm shift in climate policy will need active transition management*, ETUI Policy brief: European Economic and Employment Policy, Issue 7/2010, ETUI, Brussels.

Getzner, M. and Ritt, T. (2004), 'Quantitative and qualitative employment impacts of environmental innovations', *International Journal of Environmental Technology and Management*, Vol. 4, No. 4, pp. 375–99.

Ghani-Eneland, M. (2009), *Low carbon jobs for Europe: Current opportunities and future prospects*, WWF, Brussels.

GHK (2009a), *The impacts of climate change on European employment and skills in the short to medium-term: A review of the literature*, Final Report (Volume 2), London.

GHK (2009b), *The impacts of climate change on European employment and skills in the short to medium-term: Company case studies*, Final Report (Volume 1), London.

GHK (2009c), *Thematic expert work on green jobs for DG EMPL/DI*, London.

GHK, Cambridge Econometrics and Institute for European Environmental Policy (2007), *Links between the environment, economy and jobs*, GHK, London.

Goldbach, M. and Schneidewind, U. (2005), 'Ecomtex – Ecological mass textiles', 10th International Conference of the Greening of Industry Network, 23–26 June, Gothenburg, Sweden.

Groupe Alpha, University of St Andrews and WZB (Wissenschaftszentrum Berlin für Sozialforschung GmbH) (2009), *Anticipation of change in the automotive industry. Study 1: Good practices of anticipation and management of change within companies and regions*, European Partnership for the Anticipation of Change in the Automotive Sector, Brussels.

Hart, P. and Schotte, D. (2008), *HR research study: Demographic change and skills requirements in the European shipbuilding and ship repair industry*, European Shipbuilding Social Dialogue Committee, Brussels.

Heymann, E. (2007), *Climate change and sectors: Some like it hot!*, Deutsche Bank Research, Frankfurt am Main.

IFM (Institut Français de la Mode) (2007), *Study on the competitiveness, economic situation and location of production in the textiles and clothing, footwear, leather and furniture industries*, Final report, European Commission, Directorate-General Enterprise and Industry, Brussels.

IIASA (International Institute for Applied Systems Analysis) (2006), *Modelling opportunities and limits for restructuring Europe towards sustainability (MOSUS)*, Final report, Prepared for the European Commission, Research Directorate-General, Laxenburg, Austria.

Ikei (2009), *Comprehensive sectoral analysis of emerging competences and economic activities in the European Union: Building and repairing of ships and boats sector*, European Commission, Directorate-General Employment, Social Affairs and Equal Opportunities, Brussels.

ILO (International Labour Organization) (2011a), *Promoting decent work in a green economy. ILO background note to 'Towards a green economy: Pathways to sustainable development and poverty eradication'*, United Nations Environment Programme, Nairobi.

ILO (International Labour Organization) (2011b), *Comparative analysis of methods of identification of skill needs on the labour market in transition to the low-carbon economy*, International Labour Office, Geneva.

ILO (International Labour Organization) (2011c), *Skills and occupational needs in green building*, International Labour Office, Geneva.

ILO (International Labour Organization) (2011d), *Skills and occupational needs in renewable energy*, International Labour Office, Geneva.

ILO (International Labour Organization) (2012), *Promoting safety and health in a green economy*, International Labour Office, Geneva.

IMF (International Metalworkers' Federation) and EMF (European Metalworkers' Federation) (2011), *Proceedings of IMF-EMF Global Conference on Safe, Sustainable and Green Jobs in Shipbuilding and Shipbreaking*, 13–14 September 2011, Istanbul, available at <http://www.imfmetal.org/index.cfm?c=27563&l=2>.

ISTAS (Instituto Sindical de Trabajo, Ambiente y Salud) (2011), 'Study on employment associated to the promotion of renewable energies in Spain 2010', ITUC/GURN Workshop, A green economy that works for social progress, 24–25 October 2011, Brussels.

Isusi, A. (2011), *Preparing for the upswing: Training and qualification during the crisis*, Eurofound, Dublin.

Italcementi Group (2007), 'Cement sector in the European Union environment, health and safety', Bergamo, Italy, available at

[http://www.italcementigroup.com/NR/rdonlyres/379EE596-42B4-4680-BAB0-F1D7AF548BF7/0/Environmental\\_protection.pdf](http://www.italcementigroup.com/NR/rdonlyres/379EE596-42B4-4680-BAB0-F1D7AF548BF7/0/Environmental_protection.pdf).

Jackson, T. (2009), *Prosperity without growth: The transition to a sustainable economy*, Sustainable Development Commission, London.

Jaeger, C.C., Paroussos, L., Mangalagiu, D., Kupers, R., Mandel, A. and Tabara, J.D. (2011), *A new growth path for Europe: Generating prosperity and jobs in the low-carbon economy. Synthesis report*, Prepared for the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, European Climate Forum, Potsdam.

Kauffmann, C. and Less, C.T. (2010), *Transition to a low-carbon economy: Public goals and corporate practices*, Organisation for Economic Co-operation and Development, Paris.

KEMA (2008), *The US smart grid revolution: KEMA's perspectives for job creation*, Prepared for the GridWise Alliance, KEMA Inc., Burlington, MA.

Loire, P., Paris, J.-J., Ward, T. and Weis, C. (2008), *Comprehensive analysis of the evolution of the automotive sector in Europe*, Groupe Alpha and Alphametrics, Paris.

LRD (Labour Research Department) (2009), *Unions and climate change: The case for union environmental reps*, LRD Publications, London.

Macdonald, D. and Vandenabeele, C. (1996), *Glossary on industrial relations and related terms*, ILO/EASMET, Bangkok.

Martinez-Fernandez, C., Hinojosa, C. and Miranda, G. (2010), *Greening jobs and skills: Labour market implications of addressing climate change*, Organisation for Economic Co-operation and Development, Paris.

Martinuzzi, A., Kudlak, R., Faber, C. and Wiman, A. (2011), *CSR activities and impacts of the construction sector*, RIMAS Working Papers No. 1, Research Institute for Managing Sustainability, Vienna University of Economics and Business, Vienna.

Matsuzaki, K. (2011), 'Background data on shipbuilding and shipbreaking', conference presentation, IMF-EMF Global Conference on Safe, Sustainable and Green Jobs in Shipbuilding and Shipbreaking, 13-14 September 2011, Istanbul, available at <http://www.imfmetal.org/index.cfm?c=27563&l=2>.

Miranda, G. and Larcombe, G. (2012), *Enabling local green growth: Addressing climate change effects on employment and local development*, OECD Local Economic and Employment Development (LEED) Working Papers 2012/01, OECD Publishing, Paris.

NEPSI (European Network for Silica) (2006), *Good practice guide on workers' health protection through the good handling and use of crystalline silica and products containing it*, Brussels.

Nesta (2008), *Innovation against climate change*, Policy briefing ICC/19, London.

Neuwahl, F., Loschel, A., Mongelli, I. and Delgado, L. (2008), *Employment impacts of EU biofuels policy: Combining bottom-up technology information and sectoral market simulations in an input-output framework*, Centre for European Economic Research (ZEW) Discussion Paper No. 08-049, ZEW, Mannheim [cited in Cambridge Econometrics et al, 2011].

OECD (Organisation for Economic Co-operation and Development) (2009), *Eco-innovation in industry: Enabling green growth*, Paris.

OECD Council Working Party on Shipbuilding (2010), *Environmental and climate change issues in the shipbuilding industry*, OECD, Paris.

O'Sullivan, C., Rucker, S., Ramsden, P., Mulgan, G., Norman, W. and Vasconcelos, D. (2011), *Financing social impact. Funding social innovation in Europe – Mapping the way forward*, Social Innovation Europe Initiative, Brussels.

Oxford Research (2010), *Transversal analysis on the evolution of skills needs in 19 economic sectors*, Prepared for European Commission, Directorate-General for Employment, Social Affairs and Equal Opportunities, Oxford Research A/S, Frederiksberg, Denmark.

Pauwels, F., op Den Kamp, H. and Ramioul, M. (2011), *Greening in construction and the impact on work: New challenges or more of the same?* WALQING Social Partnership Series 2011.4, HIVA, Leuven.

PricewaterhouseCoopers (2011), *CDP FTSE 350 Report 2011: Can UK Plc help meet the carbon budgets?* Carbon Disclosure Project, London.

Ragwitz, M., Schade, W., Brietschopf, B., Walz, R., Helfrich, N., Rathman, M. et al (2009), *EmployRES: The impact of renewable energy policy on economic growth and employment in the European Union*, Prepared for the European Commission's Directorate-General for Energy and Transport, Fraunhofer ISI, Karlsruhe.

Scorpecci, D. (2011), 'Safe, sustainable and green jobs in shipbuilding and shipbreaking', conference presentation, IMF-EMF Global Conference on Safe, Sustainable and Green Jobs in Shipbuilding and Shipbreaking, 13-14 September 2011, Istanbul, available at <http://www.imfmetal.org/index.cfm?c=27563&l=2>.

Seifert, J. (2009), *The European green collar economy: Achievements so far – Forecasts for the future*, Paper 1/2009, Green European Foundation, Brussels.

Seligson, D. (2011), 'International rules and standards in shipbuilding and shipbreaking', conference presentation, IMF-EMF Global Conference on Safe, Sustainable and Green Jobs in Shipbuilding and Shipbreaking, 13-14 September 2011, Istanbul, available at <http://www.imfmetal.org/index.cfm?c=27563&l=2>.

Slingenberg, A., Rademaekers, K., Sincer, E. and van der Aa, R. (2008), *Environment and labour force skills. Overview of the links between the skills profile of the labour force and environmental factors. Final report*, ECORYS, Rotterdam.

Soria, M.L. (2010), 'Spanish Industrial Observatory of the Automotive Equipment and Component Manufacturers' Sector (Sernauto)', conference presentation, Forum on Electro-mobility, 30 June 2010, Brussels, European Partnership for the Anticipation of Change in the Automotive Sector, Brussels.

Stevens, C. (lead author) (2009), *Green jobs and women workers: Employment, equity, equality*, International Labour Foundation for Sustainable Development (Sustainlabour), Madrid.

Strietska-Ilina, O., Hofmann, C., Durán Haro, M. and Jeon, S. (2011), *Skills for green jobs: A global view. Synthesis report based on 21 country studies*, International Labour Office, Geneva.

SusChem (2011), *Tomorrow starts with chemistry: Innovation for a sustainable, smart and inclusive Europe*, Cefic, Brussels.

Syndex (2011), *Initiatives involving social partners in Europe on climate change policies and employment*, Integrated programme of the European social partners, Summary report for the conference on 1–2 March 2011, Brussels.

Syndex, S.Partner and WMP Consult (2009), *Climate disturbances, the new industrial policies and ways out of the crisis*, Prepared for European Trade Union Confederation (ETUC) in partnership with European Metalworkers Federation and European Mine, Chemical and Energy Workers' Federation, ETUC, Brussels.

Thorsten, L. (2011), 'Green ships for green shipping – Future market for shipbuilding industry', conference presentation, IMF–EMF Global Conference on Safe, Sustainable and Green Jobs in Shipbuilding and Shipbreaking, 13–14 September 2011, Istanbul, available at <http://www.imfmetal.org/index.cfm?c=27563&l=2>.

Tirone, L. (chair) (2003), Background paper for the Stakeholder Platform Event, 23–24 June, Brussels, Working group 'Sustainable construction methods and techniques', EU Expert Group on the Urban Environment, Brussels.

TNO, ZSI and SEOR (2009a), *Investing in the future of jobs and skills. Scenarios, implications, and options in anticipation of future skills and knowledge needs. Sector report: Chemicals, pharmaceuticals, rubber and plastic products*, European Commission, Directorate-General Employment, Social Affairs and Equal Opportunities, Brussels.

TNO, ZSI and SEOR (2009b), *Investing in the future of jobs and skills. Scenarios, implications, and options in anticipation of future skills and knowledge needs. Sector report: Distribution and trade*. European Commission, Directorate-General Employment, Social Affairs and Equal Opportunities, Brussels.

TNO, ZSI and SEOR, (2009c), *Investing in the future of jobs and skills. Scenarios, implications, and options in anticipation of future skills and knowledge needs. Sector report: Electricity, gas, water and waste sectors*. European Commission, Directorate-General Employment, Social Affairs and Equal Opportunities, Brussels.

TNO, AIDEMA, ZSI and SEOR (2009d), *Investing in the future of jobs and skills. Scenarios, implications, and options in anticipation of future skills and knowledge needs. Sector report: Furniture*. European Commission, Directorate-General Employment, Social Affairs and Equal Opportunities, Brussels.

TNO, ZSI and SEOR (2009e), *Investing in the future of jobs and skills. Scenarios, implications, and options in anticipation of future skills and knowledge needs. Sector report: Non-metallic materials*. European Commission, Directorate-General Employment, Social Affairs and Equal Opportunities, Brussels.

TNO, ZSI and SEOR (2009f), *Investing in the future of jobs and skills. Scenarios, implications, and options in anticipation of future skills and knowledge needs. Sector report: Transport and logistics*. European Commission, Directorate-General Employment, Social Affairs and Equal Opportunities, Brussels.

UEA (European Furniture Manufacturers Federation), EFBWW (European Federation of Building and Woodworkers) and EFIC (European Furniture Industries Confederation) (2010a), *Best practices to improve workplace environment and working conditions*, Brussels.

UEA (European Furniture Manufacturers Federation), EFBWW (European Federation of Building and Woodworkers) and EFIC (European Furniture Industries Confederation) (2010b), *Best practices to reduce the number of accidents in the furniture sector*, Brussels.

UNEP (2007), *Labour and the environment: A natural synergy*, Nairobi.

UNEP (2008), *Green jobs: Towards decent work in a sustainable, low-carbon world*, Worldwatch Institute, Washington, DC.

UNEP (2011), *Towards a green economy: Pathways to sustainable development and poverty eradication*, Nairobi.

UNFCCC (United Nations Framework Convention on Climate Change) (2011), *Fact sheet: Climate change science – The status of climate change science today*, available at [http://unfccc.int/press/fact\\_sheets/items/4987.php](http://unfccc.int/press/fact_sheets/items/4987.php).

Ward, T. and Coughtrie, D. (2009), *Restructuring in the construction sector*, Eurofound, Dublin.

WCED (World Commission on Environment and Development) (1987), *Our common future*, Oxford University Press, Oxford.

Wolfram, M. (2004), *Expert Working Group on Sustainable Urban Transport Plans. Final report*, Rupprecht Consult, Cologne.

Wolfram, M., Bührmann, S., Martino, A. and Brigati, E. (2005), *Sustainable urban transport plans (SUTP) and urban environment: Policies, effects, and simulations. Review of European references regarding noise, air quality and CO<sub>2</sub> emissions*. Final report, Rupprecht Consult, Cologne.

UK Leather Foundation (2010), *Social and environmental report of the UK leather industry*, COTANCE, Brussels.



## Annex 1: Definitions used in the report

**Climate change** In the environmental policy context, this refers to the change of climate system caused by increased concentrations of greenhouse gases in the atmosphere due to human activities. Human activities that contribute to climate change comprise:

- (1) main activities producing carbon dioxide emissions: burning of carbon-based fuels for energy production, industrial processes, transport fuels, residential uses (home heating), land use change and deforestation;
- (2) main activities producing methane emissions: agriculture (for example, raising cattle and paddy rice farming), fossil fuel retrieval, waste disposal and treatment, land use and wetland changes;
- (3) main activities producing nitrous oxide emissions: agriculture (especially use of fertilisers), land use change and forestry, industrial processes.

(based on UN Framework Convention on Climate Change (UNFCCC) and Emissions Database for Global Atmospheric Research (EDGAR)<sup>8</sup>)

**Climate change adaptation** Process consisting of deliberate actions undertaken to reduce the adverse consequences of climate change as well as to harness any beneficial opportunities. (based on Martinez-Fernandez et al, 2010)

**Climate change mitigation** Process including all measures to reduce the negative impacts of human activities on the environment and achieved by reducing both the energy intensity of gross domestic product (GDP) and the carbon intensity of energy used. (based on Martinez-Fernandez et al, 2010)

**Climate change policies** Climate change policies in this study are perceived as EU- and national-level sector-specific initiatives that aim to utilise the potential of climate change transformation to generate employment and other economic benefits as well as the green change in individual companies. The main types of the climate change policies implemented are:

- (1) traditional regulation (energy standards, energy efficiency standards, building codes and emissions standards, public education);
- (2) carbon pricing (carbon tax or cap-and-trade);
- (3) innovation policy via (i) knowledge management: technology transfer; funding of R&D collaboration in industry or public private collaboration; funding for public R&D and so on; and (ii) adjustment assistance: direct subsidies; tax incentives; concessionary financing; public procurement and other demand-side measures.

**Energy efficiency** Technically the term means using less energy inputs while maintaining an equivalent level of economic activity or service. Examples of energy efficiency measures are technological improvements or new technologies in transport, buildings or energy production. (based on European Commission, 2011b)

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<sup>8</sup> <http://edgar.jrc.ec.europa.eu/>

**Energy savings** This is a broader concept than ‘energy efficiency’ and is defined as an absolute decrease of energy consumption that can be achieved through increased energy efficiency, but also through behaviour changes or even reduced economic activities. Examples of energy savings without efficiency improvements are heating a room less in winter, using the car less or enabling energy-saving modes on a computer. In practice the two terms are difficult to disentangle, and they are often used in the case studies interchangeably. (based on European Commission, 2011b)

**Green business practices** Internal (within company) or external (outside company) changes in business activities, processes and occupations that contribute to climate change mitigation by minimising GHG emissions from economic activities or using fewer natural resources.

**Green change (or greening)** Changes in business activities, processes and occupations occurring at the company level, while moving towards a low-carbon economy or in other ways reducing business impacts with respect to climate change. Green change is usually undergone during the implementation of separate green business practices.

**Green economy** An economy that results in improved human well-being and social equity while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy is one which is low carbon, resource efficient and socially inclusive (UNEP, 2011). The process of industry moving towards a low-carbon economy is considered as ‘green growth’. (based on Miranda and Larcombe, 2012)

**Green jobs** Jobs that contribute to protecting the environment by reducing the harmful effects human activity has on it (mitigation) or to helping to better cope with current climate change conditions (adaptation) (based on Miranda and Larcombe, 2012). Green jobs can be (a) ones in businesses directly producing goods and services that benefit the environment; and (b) ones in which workers’ duties involve making their company’s production less carbon intensive and in general less harmful for the environment. Study focuses on green jobs that both directly and indirectly contribute to climate change mitigation.

**Green restructuring** Company reorganisation activities including bankruptcy and closure, insolvency, merger and acquisition, downsizing, expansion, outsourcing, offshoring or delocalisation, and other activities driven by climate change or climate change policies or related drivers and motivations.

**Green skills** Skills required to tailor products, services, processes or operations due to climate change or low-carbon adjustments, mitigation, requirements or regulations (based on Miranda and Larcombe, 2012). Green skills can be vertical or sector specific (for example, solar panel installation, wind turbine design, carbon trading) and horizontal, transferable or generic (for example, green management, knowledge of sustainable materials, environmental impact assessment skills, understanding of environmental legislation and certification, resource efficiency improvement skills).

**Industrial relations** The individual and collective relations between workers and employers at work and arising from the work situation, as well as the relations between representatives of workers and employers at the industry and national levels, and their interaction with the state. Such relations may encompass legal, economic, sociological and psychological aspects and include issues related to pay or working conditions. (based on Macdonald and Vandenabeele, 1996)

**Job quality** The concept of job quality is based on the following four dimensions developed by Eurofound (2002):

- skills development, including requirements for qualifications, demand for training, patterns of organisation of learning activities, career development issues;



- career and employment security, which includes such issues as employment status (for example, full or part time, self-employment), wages, workers' rights (including equal opportunities, information, consultation and involvement in organisational change) and social protection;
- health and well-being of workers, which encompass psychosocial or physical health problems, risk exposure, work organisation (for example, work intensity, share of monotonous tasks, job satisfaction, length and organisation of working hours in relation to health) and ageing-related issues;
- reconciliation of working and non-working life (for example, length, flexibility and predictability of working time, ability to carry out non-working tasks, availability of social infrastructure such as day-care centres).

**Low-carbon economy** An economy that is more sober in carbon emissions (based on Miranda and Larcombe, 2012). The process of industry moving towards a low-carbon economy is termed 'greening'.

**Social dialogue** Includes all types of informal or institutionalised dialogue involving discussions, consultations, negotiations, joint actions and other collaboration in certain activities undertaken between or among representatives of employers, workers, social partners (trade unions and employer organisations) and government on issues of common interest related to minimising environmental impact and inducing green change at company level. It can exist as a tripartite process with the government as an official party to the dialogue, or it may consist of bipartite relations only between employers and employees or their respective organisations, with or without indirect government involvement. It can take place at European, national, regional or local, sectoral or company level. (based on ILO definition)

**Sustainable development** Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. (WCED, 1987)

## Annex 2: Overview of the target sectors

The overall impact of climate change on the quantity and quality of jobs is likely to be small. However, some sectors (particularly small industries) may experience more severe effects of climate change. This annex provides overviews of the 10 economic sectors targeted by the study. Each sectoral overview discusses:

- the main challenges arising from climate change;
- the main motivations of business to mitigate climate change;
- examples of widespread green business practices in the sector;
- the impact of climate change on employment, split into two subsections – impact on quantity of jobs and impact on quality of jobs;
- approaches to anticipation and management of green change.

### Automotive sector

#### *Challenges arising from climate change*

- Complying with the regulatory requirements to reduce CO<sub>2</sub> emissions during production and exploitation processes (interview with representative of the European Association of Automotive Suppliers (CLEPA); Groupe Alpha et al, 2009; Syndex et al, 2009).
- Safeguarding competitiveness at the expense of greener production.<sup>9</sup>

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<sup>9</sup> <http://www.ourclimate.eu/ourclimate/ourclimate/ourclimate/cocars.aspx>

- Green restructuring of the companies' operations and materials used in the production (IIASA, 2006; Syndex et al, 2009; Cedefop, 2010).
- Decreasing availability of certain materials (new polymers will replace iron, steel and other metals) necessary for greener auto production (EU-OSHA, 2011b) and rising prices of raw material (Groupe Alpha et al, 2009).
- Ensuring safety of the new types of produced vehicles (Groupe Alpha et al, 2009).

### *Motivations of business to mitigate climate change*

- Complying with the EU regulations (for example, to avoid penalty payments) (Eurofound, 2004).
- To receive recognition (for example, for CO<sub>2</sub> savings achieved by fitting new cars with approved eco-innovations that reduce emissions) (EC Climate Action)<sup>10</sup> and to promote public image through environmental commitment.
- To maintain competitive advantage and maximise profits by enriching innovative capacities (Oxford Research, 2010).
- Satisfying customer and societal demand for cleaner vehicles (Syndex et al, 2009; interview with CLEPA representative).
- Rising energy prices (Oxford Research, 2010).

### *Examples of green business practices*

- CO<sub>2</sub> labelling of cars (EC Climate Action).
- Eco-innovation initiatives: production of hydrogen fuel cells, internal combustion cars; introduction of hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), electric vehicles (EVs) and bio-fuelled vehicles (Syndex et al, 2009); adapting produced vehicles to clean energies such as electricity, natural gas for vehicles (NGV) or liquefied petroleum gas (LPG) (ETUC et al, 2007); using novel materials to reduce the weight of vehicles (important for fuel economy and used materials in manufacturing) (EU-OSHA, 2011b); engine downsizing (Syndex et al, 2009).
- Remanufacturing of vehicle components (UNEP, 2011).
- Optimisation of company's activities and use of natural resources, use of pollution-free technologies (for example, in Volkswagen AG, Shaeffler Group and Audi Hungaria Motor Kft).

### *Impact of green business practices on employment*

#### **Impact on quantity of jobs**

The estimated impact of new climate change policies in the automotive sector is small and positive and ranges from +4,200 to +23,700 (+0.18%–1.02% compared to the baseline scenario (Cambridge Econometrics et al, 2011); see Annex 3).<sup>11</sup> It is also ambiguous. Fuel efficiency measures to reduce CO<sub>2</sub> emissions are assumed to have a relatively marginal impact on the automotive sector, while they could stimulate growth and employment in the upstream component supply sectors. For instance, the increase in demand for electric vehicles could enhance employment in the

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<sup>10</sup> [http://ec.europa.eu/clima/news/index\\_en.htm](http://ec.europa.eu/clima/news/index_en.htm)

<sup>11</sup> The baseline scenario already includes much existing environmental policy and any related labour market changes that it leads to (roughly half of the reduction in CO<sub>2</sub> emissions from 1990 levels required to meet the 20% emissions target is included). Minimum and maximum numbers include the effects of new environmental policies (in addition to the baseline scenario), rather than the general effects of all environmental measures. See Annex 3 for a more detailed explanation.

manufacture of inputs such as batteries or charging stations (Cambridge Econometrics et al, 2011). The development of HEVs and PHEVs and the boost in demand for manufacturers of batteries could lead to the creation of additional jobs at companies specialising in this type of production (Ghani-Eneland, 2009). Currently the green vehicle sector is estimated to employ around 150,000 people out of the 2 million who work in the automotive sector in the EU (UNEP, 2008). Therefore, due to small current markets, it is nearly impossible to forecast employment in this branch of the automotive sector in Europe.

More new jobs are expected in vehicle maintenance and servicing rather than in manufacturing (for example, fuel refining, wholesaling and retailing, freight services, rental and repair activities) (Cambridge Econometrics et al, 2011). The bulk of automotive materials are produced by sectors that are among the most energy intensive and least labour intensive (UNEP, 2008). Energy-intensive sectors are predicted to incur the worst negative impacts on employment (Cambridge Econometrics et al, 2011). The recent recession and rising energy prices fostering companies to cut back their fixed costs by, for example, moving plants further to Brazil, Russia, India and China (the so-called BRIC countries) may also have a negative impact on employment in the industry. Finally, another possible future tendency is fewer employees due to the fact that newly produced vehicles have fewer components (parts) and thus fewer workers are needed (interview with CLEPA representative).

### Impact on quality of jobs

#### Skills development

In the automotive sector, manual workers still represent the majority of the workforce (approximately 60% in the EU15 and over 70% in the EU12). Under a scenario of a high level of coordination in European environmental policies and an increase in new green technologies, most structural changes are observed due to technological advancement, changing processes of production (for example, more automated processes), innovation policies and relocation of production processes and jobs from the EU15 to the EU12. For instance, in the EU15 the relative number of managers, engineers, other professionals and technicians increases, while the demand for manual workers (especially skilled workers) declines (Loire et al, 2008). Among manual workers, only the demand for electricians is likely to increase in the EU15: demand is likely to increase for expertise in electronics to produce new equipment, emission control systems, in creating specific electrical know-how (for example, for the electric drive, various material technologies). Besides electricians, in the EU12 jobs for semi-skilled or low-skilled workers will continue to expand relatively rapidly (Loire et al, 2008).

The key green skills needs of the automotive sector relate to the combination of electrical and mechanical skills required in the production of electric or hybrid cars. New and emerging green occupations include design, driver aids and emission control engineers, motor vehicle mechatronics technicians, automotive engineering technicians and automotive engineers (Cambridge Econometrics et al, 2011; interview with CLEPA representative).

In the future, there will be increased demands to integrate other types of knowledge, know-how and skills. This poses challenges to skilling issues in two aspects (Groupe Alpha et al, 2009):

- technical challenges arising from integrated solutions such as electromechanics, which requires cross-functional and interdisciplinary capabilities from engineers (for example, an Italian company transforming cars into electrical ones requires its workers to have a combination of technical as well as managerial skills, including the ability to collaborate autonomously with suppliers, clients and licensees nationally and abroad);
- multi-skilling challenges, which require more flexibility from the workforce in the production processes.

The automotive industry has substantial experience in managing organisational and technical change (this occurs every time a brand new model is introduced to the market), and so the introduction, for example, of electric cars is unlikely to

pose a substantial threat to skills development in the sector (Cedefop, 2010; Cambridge Econometrics et al, 2011). According to the Aldersgate Group (a high-level coalition group of UK businesses), the fundamental skills for most low-carbon jobs already exist. This is why the emphasis of skills investment should be to develop training to improve existing skills rather than creating new ones (Cedefop, 2010).

### *Career and employment security, health and well-being and reconciliation of working and non-working life*

The greening of industry is likely to have only a small impact on career and employment security (for types of employment and participation of certain groups of workers) and health and well-being in the sector. At present there is a spread of flexible employment contracts in green jobs in the automotive industry. However, it is too early to forecast whether contracts will become permanent or temporary in the future; the future situation depends on the demand and thus the future volume of production (interview with CLEPA representative).

The current share of female and male workers is unequal in the sector: women employees make up approximately 6% of the workforce, and women in managerial positions comprise approximately 10% (Oxford Research, 2010). Female representation in the sector is lower than the average in all manufacturing sectors. Recruiting more women is seen as one of the possible ways to overcome potential problems arising from skills shortages. However, there is little evidence that this is actually happening (Loire et al, 2008). To attract more women into the automotive sector, changes in work organisation should be made (for example, the introduction of flexible working time arrangements so that women can balance employment and family responsibilities) (Loire et al, 2008). Members of CLEPA (for example, Bosch and Valeo) implement programmes to attract more women into the sector (interview with CLEPA representative).

If the industry grows, there will be a crucial need to slow down the rate of exit of older skilled workers (given the increasing difficulty in replacing their skills due to the falling numbers of young people entering the sector) (Loire et al, 2008; interview with CLEPA representative). More initiatives are needed to attract large numbers of young talent into the industry. A recent project, *Our Future Mobility Now* (initiated by the European Automobile Manufacturers' Association), is an example of good practice in this area. The aim of the project is to raise interest in young people of issues facing the overall transport industry.

The main health and safety issues in green automotive jobs are related to the use of new materials (for example, the potential for toxic and irritant effects, risks from potential dangerous substances involved in manufacturing), hydrogen and fuel cells (for example, fire and explosion hazards, electrical hazards from fuel cells, risks arising due to potentially widespread hydrogen handling) and batteries (for example, electrical risks from the high voltage or currents of large batteries, potential of explosion, exposure to toxic substances) (EU-OSHA, 2011b). Investment in more stringent health and safety standards could create more attractive working conditions for all. For example, the e-vehicle production industry is considered to be cleaner compared with the conditions on traditional production lines.

### *Approaches to anticipation and management of green change*

Observatories are one of the good practice examples of the cooperative anticipation of change at the regional level. They are either independent (for example, industry representative, consultants and universities), government oriented or collaborative (for example, university staff, employer associations, worker representatives and government ministries). The aims of observatories are to:

- investigate recruitment, mobility, trends in employment and skills needs at national level;
- inform stakeholders on current trends in the industry in such areas as human resources, sales and production (Groupe Alpha et al, 2009).

For example, the Spanish Industrial Observatory of the Automotive Equipment and Component Manufacturer’s Sector prepares forecasts on innovation in skills and processes, conducts surveys on the industry’s needs and so on (Soria, 2010).

To manage green change and its effects on skills development, businesses cooperate with education and training institutions. For instance, in Spain there are special engineering and technical degrees, specific master studies and specialised training in new technologies for energy storage, e-motors, power electronics, energy management, eco-design and so on (Soria, 2010).

Cooperative links are also visible between representatives of different business associations. For example, the European Partnership for the Anticipation and Management of Change in the Automotive Sector was initiated by the European Automobile Manufacturers Association (ACEA), the European Association of Automotive Suppliers (CLEPA) and the European Metalworkers Federation (EMF). Under this initiative, together with subcontracting universities in France, Germany and the UK, three different studies were prepared to identify the trends and main drivers for change in the sector, to investigate how companies are managing this change and to anticipate changes in the future (interview with CLEPA representative).

Cooperation agreements are also signed between the representatives of business and public authorities. The content of these agreements varies from strategic to financial matters. For instance, in 1998, the European Automobile Manufacturers Association entered into a voluntary agreement with the European Commission to reduce the amount of carbon emission from new passenger cars (UNEP, 2008). In 2007, the German Metalworkers’ Union (Industriegewerkschaft Metall) and the German environment ministry issued a joint statement which claimed that the European automotive industry is not achieving its corporate responsibility to reduce CO<sub>2</sub> emissions voluntarily and that rules and regulations need to be developed to ensure sustainable development and employment growth (Broughton, 2009). In France, car manufacturer Heuliez received financial support (€5 million) from the Poitou Charente region to support the training of employees for the production of new electric cars. The Association for Training in the Automobile Sector (ANFA) is supporting companies where the main objective is to raise the competence levels of the automotive sector’s staff (Cedefop, 2010).

Table A1 gives examples of anticipation and management approaches adopted by companies in skills development.

Table A1: *Examples of anticipation and management of green change at company level in the automotive sector*

<b>Audi AG (Germany)</b> Car manufacturer	<b>Robert Bosch GmbH (Group) (Germany)</b> Global supplier of technology and services in different areas, including automotive
<ul style="list-style-type: none"> <li>• One of the anticipation mechanisms – gathering of mixed teams composed of workers with few years’ company experience in various units.</li> <li>• Audi set up taskforces for training and further training. The role of the taskforces is to figure out what kind of qualifications employees need to be able to realise the e-drive and lightweight concepts, which competences are needed, and do they have to be developed internally or do they have to be acquired externally.</li> <li>• There is a strong tradition of codetermination and a high level of unionisation among the workforce, which results in extensive representation of workers’ interest.</li> <li>• Audi closely cooperates with universities and vocational colleges.</li> </ul>	<ul style="list-style-type: none"> <li>• Since 2006, Bosch has been testing a pilot qualification management system that has been applied for all employees across the Bosch Group (what kind of skills and qualifications employees already have and what skills they need for their jobs).</li> <li>• Annual systematic analyses are supposed to give an idea about future qualification demands at department level.</li> </ul>

<p><b>Stoja (Slovenia)</b> Developer and producer of components for electric cars and vessels</p>	<p><b>EnerBLU (Italy)</b> Transformer of conventional cars into electric cars</p>
<ul style="list-style-type: none"> <li>• Helped the university to establish the faculty for the development of electric vehicles and vessels. The team has trained 10 teachers, but also the faculty staff who started with offering the services of converting the cars and buses into electric vehicles.</li> <li>• Trains young and dynamic students and trainees interested in the subject of electric vehicle production.</li> <li>• Is involved in events to increase awareness of green transportation and innovative solutions.</li> </ul>	<ul style="list-style-type: none"> <li>• Workers are invited to apply their creativity to set up technical advances and to make use of business relationships to find out their applicability (for example, contacting suppliers). This autonomy enables a better control of emerging trends on the market.</li> <li>• The learning-by-doing process starts with coaching. As two is the right number to operate the electrification of a vehicle, the new entrant works together with an experienced one (tutor) for a few months. After the training, the new worker takes wider responsibilities, becoming a potential tutor as well.</li> </ul>
<p><b>Mia Electric (France)</b> E-vehicles producer</p>	

- When hired, workers receive a 19-day training course in cooperation with the local branch of the Public Employment Service in the framework of an Action of Pre-Recruit Training (*action de formation préalable au recrutement*, AFPR). A plan to secure the career path (*plan de sécurisation des parcours professionnels*) of employees was funded by the state, which took charge of the employees in short-time work, and the Poitou-Charente region, which had taken the responsibility to train the employees affected by unemployment due to the bankruptcy of Heuliez in 2009. This plan is supposed to avoid lay-offs of experienced workers, who are essential for the production of electric cars, and the costs associated with redundancies. The training plan, with financial support from the regional administration and other actors, helped some 300 people to acquire the skills necessary for the production of electric cars. At the same time, the actors involved tried to avoid the withdrawal of human resources from Heuliez's core activities (under new management) or other employers in the region. The regional administration also encourages the reallocation of workers from different parts of Heuliez; the receiving employer may benefit from a training subsidy of up to €3,000 per employee.

Source: Compiled by the authors on the basis of company case studies and EMAS case studies available online at [http://ec.europa.eu/environment/emas/casestudies/index\\_en.htm](http://ec.europa.eu/environment/emas/casestudies/index_en.htm)

## Chemicals sector

### Challenges arising from climate change

- The Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) Regulation represents the main regulatory challenge to the chemicals sector (European Commission, 2010d). For example, 95% of European fertiliser plants will have to purchase emissions allowances from 2013, which will add a significant amount (more than €200 million) to annual costs (Cambridge Econometrics et al, 2011).
- Development of the mechanisms to adapt the industry to carbon reduction measures without posing any risks and placing associated costs on employment (Syndex et al, 2009).
- Based on the combined impact of low world market prices, unfair commercial practices from producers in certain third countries, unfavourable public opinion on certain products (for example, genetically modified organisms) and a large and still increasing share of imports, the sector is deemed to be exposed to a significant risk of carbon leakage (European Commission, 2010e; interview with European Mine, Chemical and Energy Workers' Federation (EMCEF) representative).
- Developing materials that can easily be reused (UNEP) or have better environmental characteristics; this is a particular challenge for SMEs, which lack funds to research and register new products (interview with EMCEF representative).

### Motivations of business to mitigate climate change

- The EU chemicals industry is significantly affected by a the Directive on Integrated Pollution Prevention and Control (IPPC), the Environmental Liability Directive (ELD) (TNO et al, 2009a), the European Union Emissions Trading System (EU ETS), the Regulation on Classification, Labelling and Packaging of Substances and Mixtures (CLP) and the REACH Regulation.



- Responsible use of natural resources limits the risks of carbon leakage, reduces the impact on consumers and the environment, and preserves competitiveness in the market (European Commission, 2010d).

### *Examples of green business practices*

- The chemical industry's international Responsible Care initiative (with high participation of companies) improves work security, environmental and health protection.<sup>12</sup>
- Green chemistry (EU-OSHA, 2011a): for example, responsible use of raw materials, reduced use of non-renewable resources, reduced product toxicity, reduced waste and emissions during manufacturing (use of supercritical fluids that reduce waste generated mainly in plastic manufacturing) (European Commission, 2001); efficient fertilisation of biomass crops in fertiliser manufacturing; and creation of biodegradable and compostable plastic materials.
- Innovations in procedures that help to increase energy efficiency, for example the increase in global chemicals production since 1990 by 3.2% per year with just a 1.7% increase in GHG emissions (Syndex et al, 2009).

### *Impact of green business practices on employment*

#### **Impact on quantity of jobs**

The chemical industry is one of the major contributors to GHG emissions in overall manufacturing (4.8% of the global total and 23% of global manufacturing GHG emissions in 2005; Baumert et al, 2005) and is critical for greening, as its products are widely used in other industries (for example, in insulation of buildings or additives for cars to reduce fuel consumption). Overall, the number of jobs in the chemical sector has been declining over the years (from 2.2 million in 1991 to 1.8 million in 2008) (Syndex et al, 2009). However, existing estimates show that the estimated impact of new climate change policies in the chemicals sector is relatively small and ranges from -53,400 to +36,300 (-1.58% to +1.07% compared to the baseline scenario (Cambridge Econometrics et al, 2011); see Annex 3).<sup>13</sup>

As the industry is heterogeneous, there will be different distributional effects of greening within it (Heymann, 2007). Jobs in pharmaceuticals are likely to increase significantly, though mainly due to other trends and not greening (for example, greater demand for various medicines, progress towards genetic and biotechnologies). The chemicals subsector is negatively affected by rising prices for essential (fossil fuel) raw materials and factors that increase the risk of carbon leakage, although rising demand for pesticides and fertilisers and the wide application of chemical products in climate technologies and related innovations (for example, PV, fuel cells, light-emitting diodes (LEDs), surface coatings) may offset negative future impacts. Finally, negative tendencies such as decreasing demand for tyres (due to, for example, rising fuel prices, advances in efficiency and durability), increasing competition and rising prices for crude oil (the main material for plastics) will reduce jobs in the rubber and plastics subsector. Innovations in the plastics industry (for example, reductions in material weight) are not likely to offset the general negative employment trend within this subsector. Overall, employment in the industry will very much depend on future regulation, as most of the costs are associated with it (interview with EMCEF representative).

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<sup>12</sup> <http://www.icca-chem.org/en/Home/Responsible-care/>

<sup>13</sup> The baseline scenario already includes much existing environmental policy and any related labour market changes that it leads to (roughly half of the reduction in CO<sub>2</sub> emissions from 1990 levels required to meet the 20% emissions target is included). Minimum and maximum numbers include the effects of new environmental policies (in addition to the baseline scenario), rather than the general effects of all environmental measures. See Annex 3 for a more detailed explanation.

### Impact on quality of jobs

#### Skills development

Due to the lack of skills in the industry, the social partners in 2006 approved a joint declaration on skills for chemical businesses (European Commission, 2010d). Existing literature shows that an increase in environmental issues, the REACH Regulation and carbon reduction measures have made a significant impact on skills development (Syndex et al, 2009). Under a scenario of international global competition, high energy prices and market-driven adoption of green technology and innovation, an increase in jobs is predicted for engineers (both in production and in R&D) and for supply chain managers (TNO et al, 2009a). Under this scenario, most of occupations in the sector will be required to have legislative and regulatory knowledge of (environmental) legislation and strong e-skills. Quality management and process-optimising skills will also be relevant for managers, engineers, accountants and production workers. Finally, the skills of understanding consumer and supplier needs will also be more important in the future; this will require up-skilling for managers, engineers, sales and marketing workers as well as supply chain managers. The discussed scenario applies to the chemicals, rubber and plastics products subsectors, but not to the pharmaceuticals subsector because the greening driver is far less of a driver in this subsector.

Legislative and regulatory knowledge is especially emphasised by the studied companies. Other green skills such as green marketing, environmental impact assessment, life cycle analysis, ecology of products and environmental communication were also stressed.

#### Career and employment security, health and well-being and reconciliation of working and non-working life

New industries emerging in green chemistry (for example, genetic and biotechnologies) are less organised and many companies in these industries have no collective agreements (interview with EMCEF representative). Thus, the quality of jobs in these industries may be somewhat less protected than in conventional ones.

There is little other evidence of the impact of greening on other dimensions of job quality except for health issues. Literature shows that there is a major need to improve occupational health in the industry (Syndex, 2011). This is related to the emerging new technologies (for example, novel solvents, novel catalysis, industrial biotechnology, materials technology), which, although they increase production efficiency and reduce GHG emissions and pollution, also pose new risks for employees. EU-OSHA concluded that workers in green chemistry may potentially be exposed to unknown hazards from new processes and materials (EU-OSHA, 2011b). Substitution of chemicals for environmental reasons could result in greater risks to workers (for example, chemicals obtained from renewable sources can still be toxic, potential risks at the recycling stage). Overall, chemical risks are relevant across a number of sectors, including renewable industries such as wind, solar or marine energy, carbon capture and storage, battery development, environment remediation and waste treatment (EU-OSHA, 2011b).

#### Approaches to anticipation and management of green change

The social partners support the EU in its efforts to address climate change and the sector intends to be a key player with ambitious targets for a low-carbon economy (European Commission, 2010d). There are several examples of approaches that help the main actors in the industry to anticipate and manage green change.

To contribute to sustainable development, the European Technology Platform for Sustainable Chemistry (SusChem) aims to advance chemistry, biotechnology and chemical engineering research, development and innovation in Europe (TNO et al, 2009a; SusChem, 2011). An initiative called Initial Training and Continuing Training in the field of skills linked to sustainable development and carbon reduction supports the contribution made by the chemical industry in the rise of eco-industry and promotes green chemistry through skills development in the fields of research and scientific expertise (Syndex et al, 2009).



In April 2011, EMCEF and the European Chemical Employers Group (ECEG) signed a framework agreement on competence profiles in the industry that aims to ensure conformity of competences, to seek further development of skills and training systems and to encourage dialogue between employers and workers in the field of job design and development (EMCEF and ECEG, 2011). Organisations representing the industry have also examined the feasibility of setting up a European chemical sector skills council.

The International Chemical Secretariat (ChemSec) and Chem Trust are examples of the organisations that also support green change. ChemSec, a non-profit organisation, has its main focus on achieving a toxic-free environment by 2020.<sup>14</sup> Chem Trust aims to ‘prevent man-made chemicals from causing long-term damage to wildlife or humans by ensuring that chemicals which cause such harm are substituted with safer alternatives’.<sup>15</sup>

In general, companies are working to minimise the health and occupational risks associated with new technologies, which should help to retain existing workers and attract new talents to the sector. In addition, companies have introduced various measures to attract or retain women in the sector; for example, they organise kindergartens to keep talented women at work (interview with EMCEF representative).

Germany integrated the elements of Responsible Care into all training modules aimed at implementing environmental protection in all areas of the chemicals industry. The German chemicals industry has not only modified all its working processes to be essentially cleaner and more energy efficient, but also raised awareness of environmental and climate issues in the sector. Overall, the German chemical industry is one of the leading examples in terms of the integration of environmental aspects into apprenticeship training (Strietska-Ilina et al, 2011).

Table A2 gives examples of the anticipation and management approaches adopted by companies in the chemicals sector.

Table A2: *Examples of anticipation and management of green change at company level in the chemicals sector*

Novamont (Italy) Bioplastics producer	Anwil (Poland) Conventional chemical materials producer	DSM (Netherlands) International life and materials sciences company
<ul style="list-style-type: none"> <li>• Since the start, has developed its role as a training centre, working in collaboration with universities, academic partners, bank-created foundations and research centres.</li> <li>• In cooperation with East Piedmont University, established a masters programme in biotechnology for the bioplastics industry.</li> <li>• Hires a relatively high share of apprentices who are trained within the company.</li> </ul>	<ul style="list-style-type: none"> <li>• Provides training and instructions at work to maximise effectiveness, curb wasteful spending, use measuring devices properly and optimise actions performed by every employee.</li> <li>• Produces educational materials that show its impact on health and environment and measures undertaken to reduce it.</li> <li>• Organises monthly meetings with trade unions operating in the company to provide full information about greener process innovations, among others.</li> </ul>	<ul style="list-style-type: none"> <li>• Product development department collaborates with universities to foresee trends in technological advancement and to shape the curriculum of students adhering to the latest developments in the market.</li> <li>• Shares ideas with customers and suppliers. There is much informal collaboration in the market, which company perceives as an enormously important source of information and puts much effort into promoting it.</li> </ul>

<sup>14</sup> <http://www.chemsec.org/about-chemsec>

<sup>15</sup> [http://www.chemtrust.org.uk/About\\_us.php](http://www.chemtrust.org.uk/About_us.php)

Novamont (Italy) Bioplastics producer	Anwil (Poland) Conventional chemical materials producer	DSM (Netherlands) International life and materials sciences company
<ul style="list-style-type: none"> <li>• Voluntarily increased the number of periodic meetings and reviews of health and safety.</li> <li>• Three times higher than legally required number of people involved in the compulsory and optional periodic meetings.</li> <li>• Higher share of permanent contracts than in national chemical industry.</li> <li>• Membership in national and international associations, for example the Kyoto Club and the national industry union, Federchimica.</li> </ul>	<ul style="list-style-type: none"> <li>• Member of associations at national level (Polish Chamber of Chemical Industry) and European level (Fertilisers Europe, Plastics Europe, European Council of Vinyl Manufacturers and EuroChlor).</li> </ul>	<ul style="list-style-type: none"> <li>• Joint efforts with trade unions to integrate the sustainability dimension in employee appraisal forms and collective labour agreements, and to work on the best reward schemes to encourage generation of new sustainable ideas.</li> <li>• Sustainable thinking promoted through internal communication: employee training, workshops, business review meetings, intranet communication.</li> </ul>

Source: Prepared by authors on the basis of company case studies

## Construction sector

### Challenges arising from climate change

- The change of anticipating and managing changes in the quality of jobs was stressed by most sector respondents to the online survey.
- Pressure to meet regulations: complying with environmental standards is costly (especially administratively) (Tirone, 2003; Ecorys et al, 2010). It was also emphasised by sector stakeholders. For example, some green public procurement criteria pose requirements (for example, various certificates) which are too expensive for SMEs to meet. Too strict standards on eco-products (for example, windows and doors) or high-quality labelling requirements pose administrative and financial challenges, especially for small companies.
- Managing rising operational costs and costs of resources due to, among other factors, the decreasing availability and rising prices of energy sources (for example, wood).
- Lack of adequate and stable public subsidies for greening was emphasised by sector representatives; payment delays in public contracts negatively affecting companies but especially SMEs.
- Countering risk aversion (for example, lack of political will, political and administrative barriers, lack of awareness of benefits of green construction and available technologies, presumed economic constraints) and raising awareness of greening in the sector.
- Difficulties for SMEs (accounting for more than 90% of all companies in the sector) in becoming one-stop shops, such as locally organised energy services companies (ESCOs).
- Raising awareness of clients to access energy services at a reasonable quality to price ratio.

### Motivations of business to mitigate climate change

- Awareness of climate change and pressure from shareholders, consumers and other actors was indicated as the most important motivation by sector respondents.
- Exploring business opportunities: greener buildings are one of the key elements to reduce energy use and related costs across all sectors (Ecorys et al, 2010).

- Current or expected regulation: higher efficiency standards through the implementation of Energy Performance of Building Directive (EPBD) 2002 and EPBD 2010 are likely to make ‘near-zero energy’ buildings mandatory by 2021 (Ecorys et al, 2010; BPIE, 2011). Europe’s 2050 target of an 80%–95% cut in CO<sub>2</sub> emissions also implies greening of the sector (European Commission, 2011a). The proposed measures under the ambitious Energy Efficiency Directive (for example, obligatory energy-saving schemes, renewal of public buildings, energy savings for consumers) are likely to boost retrofitting and energy service projects – for example, develop energy performance contracting through local ESCOs, encouraging the networking of local companies.
- Risk management: less public and private investment in new buildings during the crisis partially shifted the focus on retrofitting (interview with European Construction Industry Federation (FIEC) representative).
- Public sector support: both direct financial support through grants or subsidies as well as support through loans, tax incentives and other indirect measures (BPIE, 2011).

### *Examples of green business practices*

- Greener product and service design: design and management of sustainable buildings; cooperation with education providers in improving energy efficiency of buildings; improving inspection approaches.
- Retrofitting, including insulation, efficient heating installations, cooperation with public authorities and so on (particularly large influence on employment numbers and one of the most popular practices).
- Substitution of inputs and materials, for example use of eco-cement and coated glass.
- Integration of renewable energy solutions (for example, PV elements on the roof), creation of less-polluting building sites.
- Energy performance contracting, networking of SMEs to become ESCOs.
- Influencing customer and supplier behaviour: energy management and monitoring systems and standards; promoting energy performance contracting; creating associations for the promotion of, for example, low- or zero-energy houses; green public procurement.

### *Impact of green business practices on employment*

#### **Impact on quantity of jobs**

Buildings are responsible for 36% of European CO<sub>2</sub> emissions and 40% of all energy consumption (European Commission, 2011c) and about 15.4% of global CO<sub>2</sub> emissions (Baumert et al, 2005). Thus, the impact of climate change on employment in construction (as in the energy sector) is one of the most significant.

Impacts of greening may be twofold. New climate change policies could have significant positive effects on the construction sector; it is projected that up to 413,000 new jobs may be created in this sector if the 20% energy efficiency objective is reached (Cambridge Econometrics et al, 2011; see Annex 3).<sup>16</sup> Energy-related refurbishment of existing buildings is likely to dominate the sector not only because of public but also private investments increasing due to rising energy prices (BPIE, 2011). The expansion of renewable energy sources will also stimulate the demand for construction activities (for example, building infrastructure for wind turbines, solar panels). Suppliers that can make a contribution to increasing the energy efficiency of buildings (for example, by producing intelligent control systems for heating or cooling) are also likely to profit from climate change (Heymann, 2007).

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<sup>16</sup> The baseline scenario already includes much existing environmental policy and any related labour market changes that it leads to (roughly half of the reduction in CO<sub>2</sub> emissions from 1990 levels required to meet the 20% emissions target is included). Minimum and maximum numbers include the effects of new environmental policies (in addition to the baseline scenario), rather than the general effects of all environmental measures. See Annex 3 for a more detailed explanation.

However, it is also estimated that due to, for example, rising energy and fuel prices, energy-intensive areas may witness gross job losses (Cambridge Econometrics et al, 2011); it is estimated that the construction sector could lose up to 291,000 jobs under a high oil prices scenario (see Annex 3). This could also be caused by increasing labour productivity and long-term changes in labour demand: demand for construction workers in new power generation technologies, retrofitting of old buildings and the development of green buildings may be large initially, but it is likely to decrease over time (Cambridge Econometrics et al, 2011). Although it is presumed that extensive retrofitting could create many additional jobs in the sector, this is not likely due to the lack of funds after the financial crisis and political will at both national and international levels (BPIE, 2011). Stimulus packages adopted in response to the crisis did not have a significant effect; it was estimated that green elements in recovery plans in EU countries had a positive effect on construction employment of around 0.1%–0.2% during the recession period and these were mainly ‘saved’ jobs rather than newly created ones (Cambridge Econometrics and Ecorys, 2011). The general tendency is that overall employment (including effects of other trends and not only climate change) in the construction sector may slightly decrease (to 91%–96% of 2009 levels; see below and Annex 3).

The role of public authorities in maintaining employment within the sector is very important in this regard. For example, public authorities could begin implementing greener building policies in public buildings such as schools, hospitals or social housing units or more actively promote green public procurement policies (UNEP, 2011).

### Impact on quality of jobs

Some industry observers note that the emerging green construction sector may experience a relatively high impact on job quality due to the fast growth of this new industry (Pauwels et al, 2011).

### Skills development

The Cedefop study (2010) showed that greening of the construction sector leads to a movement towards more skilled jobs; this was confirmed in interviews with representatives from FIEC and the European Builders Confederation (EBC). The majority of this study’s online survey respondents representing the construction sector indicated that either a small (12.5%–25%) or a moderate (25%–50%) share of all jobs will be transformed as a result of climate change. In addition, respondents emphasised that employees working with green business practices will be subject to higher requirements for qualifications and greater demand for training, especially for professionals, technicians and associate professionals and craft and related trades workers.

The informal construction sector is still significant, especially in the NMS. Due to the lack of systematic training in this market there is a risk of (a) low-quality performance that does not meet relatively high sustainability standards and (b) lower quality of these jobs, as low skills impact on productivity and other job quality dimensions, including health, income and overall job satisfaction and security (ILO, 2011c). In this respect, recognition of green skills acquired through non-formal and informal training and new approaches to training (for example, on-site training for workers in large building sites, innovative e-learning approaches) will become an increasingly important issue in the sector (see also ILO, 2011c).

The green skills that will be relevant to workers include knowledge of new materials and technologies, sustainable construction processes and energy efficiency-adapted technical solutions, planning and management skills, including client counselling and advice to meet new market demands, design evaluation and calculation of carbon footprint (DTI, 2009). A lack of skilled technicians, managers and operators is reported. As in green construction, it is important to retain sustainability at all levels, coordination of different trades, understanding of other occupations related to one’s own and cross-cutting knowledge of energy and sustainability issues as well as an ability to clearly communicate ideas and concepts at all levels, which will become more and more important transferable skills. Cross-cutting knowledge is especially important in retrofitting projects involving many different occupations (ILO, 2011c). Due to increasing

collaboration in green construction, the development of generic green skills enhancing both employment security and inter-occupational and geographical mobility becomes very significant (Cedefop, 2010).

Due to the lack of workers with an adequate set of green skills, much effort is likely to be put into improving, among other things, apprenticeship schemes, companies' HR policies and the sector's overall image. Skills development is regarded by academics and industry observers as the key success factor for the sector. However, many practitioners of the industry, which is characterised by relatively low job quality (see below), often do not see skills as an issue (Martinuzzi et al, 2011). Thus adequate skills development of all sector employees is a significant challenge for the industry.

### Career and employment security, health and well-being and reconciliation of working and non-working life

Greening may have a certain impact on career and employment security, and the health and well-being of workers.

A large proportion of workers in the sector in some countries is made up of self-employed (often undeclared) workers, who are harder to motivate and who are less financially able to take up the training activities necessary to better adapt to the greening of the construction sector. Self-employed workers are also particularly subject to project-based, fixed-term and seasonal work, which may be even higher in some green building subsectors. Such types of work negatively affect most, if not all, dimensions of the job quality of self-employed workers (Martinuzzi et al, 2011).

There may be effects on the representation of certain vulnerable groups of employees typical of the whole sector. The more skilled occupations remain male dominated in all countries, as women comprise only 8% of all employees (Ward and Coughtrie, 2009). Women are better represented in administrative and service employment, but their opportunities in green construction still remain unused (Stevens, 2009). Youth is also underrepresented in the sector (Pauwels et al, 2011). Furthermore, some of the additional jobs that will be created to meet the 2020 targets, such as the construction of renewable electricity plants, may not be suitable for older workers (and they have not attracted a large proportion of the growing female workforce) (Cambridge Econometrics et al, 2011). According to the EBC representative, increasing automation of the green construction processes could not only improve the image of the sector among underrepresented groups, but also positively affect workers' health.

Greening may affect the health of construction workers. Construction is one of the most hazardous sectors (ILO, 2012) and construction work is sometimes called '3D', meaning dirty, dangerous and degrading (Martinuzzi et al, 2011). Overall, workers in construction are three to four times more likely to suffer from accidents and are more exposed to dangerous substances causing occupational diseases than other workers (ILO, 2011a; confirmed by EBC representative).

Green construction witnesses a combination of known risks in new situations (for example, installation of renewable energy equipment at heights, installation of new technology, such as feed-in to smart grids) (ILO, 2012). Potential risks also arise from dangerous substances used in new construction materials (for example, when polishing, grinding bricks and paints containing nanoparticles, and so on) and are confronted in maintenance, demolishing and retrofitting activities. Workers participating in retrofitting are still at risk of exposure to harmful materials (for example, asbestos). Off-site construction could reduce risks on site, but transfer risks to other groups of workers (EU-OSHA, 2011b). Importantly, some groups of construction workers, such as non-unionised or migrant workers, are also more likely to be exposed to higher health and occupational risks (ILO, 2012). The interview with the FIEC representative revealed that health and safety legislation and standards, as well as company policies, will need to be assessed against these new risks.

In contrast to the view outlined above, most sector respondents to the online survey indicated that workers involved in green construction have fewer health problems and lower risk exposure. This may hold true in some large companies that standardise building elements, manage construction processes tightly and use eco-friendly materials, and thus could expect fewer occupational accidents and health problems. These seemingly positive developments may, however, also have some negative repercussions, such as decreased autonomy of workers and their craftsmanship.



Finally, it should be noted that the effects of greening in the construction sector differ according to the type of job (mostly positive impacts for office work and negative for on-site work) and level of skills (the less skilled the employee, the worse the job quality) (Martinuzzi et al, 2011). Furthermore, these effects tend to concentrate in geographical areas, due, for example, to availability of public support or a favourable investment climate or objective reasons (for example, coastal areas for the construction of wind farms). Thus, specific approaches are needed for the adequate anticipation and management of green processes in different contexts.

### *Approaches to anticipation and management of green change*

Recently, stakeholders have become highly engaged in improving the traditionally weak skills development in the sector. This has contributed to a large number (compared with other sectors) of programmes to promote environmental skills (Ecorys, 2010). However, according to sector representatives, SMEs find it hard to fund training due to financial (loss of profit) or organisational (proximity of learning) reasons, to name but a few. Also, due to the sector's relatively poor image, it is reportedly difficult for companies to find and retain skilled (especially young) employees (interviews with FIEC and EBC representatives). A very significant role in managing these risks (especially for SMEs) is played by paritarian funds; these are funds jointly established, funded and managed by social partners and often fulfilling a complementary role to existing governmental funding. The paritarian funds are especially involved in the management of health and safety, vocational training and cyclical unemployment issues – very often closely related to sustainable construction activities (FIEC and EFBWW, 2011).

These company needs, as well as skill-related requirements, are being addressed by a new European initiative, BUILD UP Skills. This three-year initiative (2011–2013) focuses on the provision of continuing education and training for craftspeople and other on-site construction workers and system installers. The initiative aims to initiate national discussion processes, identify and quantify the need for a workforce, set up and agree national qualification roadmaps, and support concrete qualification schemes. It is based on, and will seek to further boost, the strong cooperative efforts of all major stakeholders in the sector.

In certain countries, the management of green change in the sector has been subject to social dialogue. In France, the Jointly Approved Collection Agency (OPCA) collects money from companies to fund green training programmes for workers (a mandatory levy in France) and there is a construction industry training system jointly managed by social partners. In Romania, a transnational initiative, Euroeneff, dedicated to training the construction sector workforce in energy-efficient technologies, has been launched (Eurofound, 2011).

Recently, there have also been some efforts from the European social partners in the sector to anticipate green change. Both the European Federation of Building and Woodworkers (EFBWW) and FIEC have prepared a number of relevant documents estimating the potential of the green developments and green employment in the sector (for example, a position paper on a greater role for construction and wood sectors in EU climate change policy, the Platform of Action for a Social and Green Europe). A feasibility study on the establishment of a European construction skills council is currently being carried out (interview with FIEC representative).

Public authorities play an especially vital role in the sector, primarily through financial support and regulation, which were primary activities stressed by online survey respondents and interviewees representing the sector. Besides specific national financial initiatives (for example, the promotion of retrofitting activities through VAT rate reduction, targeted funds), there are a number of European measures relevant in boosting the greening of the sector:

- Europe Energy Efficiency Fund (EEE-F), launched in 2011 to finance, among other things, retrofitting projects;
- Intelligent Energy – Europe (IEE) programme and its specific European Local Energy Assistance (ELENA) facility helping EU regions and cities to set up large-scale sustainable energy programmes demanding significant construction works.

It was also stressed by sectoral respondents that besides financial support and smooth and stable regulation, public authorities are expected to play a significant role in:

- the introduction of new education and training programmes and the adaptation of existing ones;
- the promotion of partnerships between education and training institutions and employers (for example, the provision of on-site training, as mentioned above).

Public support is very much needed in improving the overall image of the sector. National governments could use structural fund support to implement the above-mentioned measures (for example, greening the ESF by stressing investments in much-needed green skills). The role of public support in the supply of trainers to adequately respond to rapidly changing skills requirements is also important (ILO, 2011c).

Table A3 gives examples of anticipation and management approaches adopted by companies in the construction sector. Most of the sector respondents to the online survey confirmed that companies usually collaborate in this context and that they usually participate in formal discussions between social partners and government and amend current partnership agreements to facilitate green change.

Table A3: *Examples of anticipation and management of green change at company level in the construction sector*

<b>Statybos Projektu Sprendimai (Lithuania)</b> Zero-energy houses developer	<b>OHL ŽS (Czech Republic)</b> Conventional construction company	<b>Skanska EMV (Estonia)</b> Conventional construction company
<ul style="list-style-type: none"> <li>• Established NGO to promote energy efficiency in buildings, accelerate use of renewable energy sources and educate society about responsible and rational energy use. Attracts potential customers by organising seminars, disseminating information on passive houses and energy use, and building the first demonstrative passive house district in Lithuania.</li> <li>• One project manager has attended a half-year training course conducted by the Passive House Institute and acquired a certificate as a passive house designer. Later a team for passive building projects was formed and trained on the job by the same project manager.</li> <li>• Member of the National Passive House Association.</li> </ul>	<ul style="list-style-type: none"> <li>• Hired more ecologists to supervise environmental protection measures, ensure that company meets with relevant regulations and train staff on green issues.</li> <li>• Implemented ESF project aimed at training of construction administrators and related occupations.</li> </ul>	<ul style="list-style-type: none"> <li>• Cooperates with Tallinn University of Technology (TTU) in organising competition among TTU students to find energy-efficient solutions for project proposed by the company; and green building conference held at TTU.</li> <li>• Skills needs are anticipated in a one-year perspective.</li> <li>• Estonian employees are trained in other branches of the group.</li> </ul>
<b>HOCHTIEF Development Poland Ltd (Poland)</b> Real estate management company	<b>Velux Hungary Ltd (Hungary)</b> Roof windows producer	
<ul style="list-style-type: none"> <li>• About eight white collar company employees were seconded to the preparation and implementation of the building certification process. Training and conferences have taken place over two years and had an average dimension of about four days for each of the eight professionals and managers taking part in them.</li> </ul>	<ul style="list-style-type: none"> <li>• Training is specific to the job in which the particular employee works: engineers planning workflow received specific knowledge for their work (the training was given by an external company), while other employees received general training and a lecture about environmental problems and sustainability (given by environmental staff of the company itself).</li> </ul>	



<b>HOCHTIEF Development Poland Ltd (Poland)</b> Real estate management company	<b>Velux Hungary Ltd (Hungary)</b> Roof windows producer
<ul style="list-style-type: none"> <li>• A much larger group of low- and medium-skilled employees performing work related to the maintenance, cleaning, monitoring and security in the building has been trained and gained new knowledge and skills in connection with the certification process. This was, however, only a few hours of training on greening materials and methods of cleaning and maintenance.</li> <li>• Certification activities have also influenced the level of knowledge and skills related to the environmental practices in professional and private life of more than 4,500 people whose workplaces are located in the building. Information on energy-efficient use of facilities and installations in the office and building, healthy eating and sustainable ways of commuting to work has been regularly disseminated through various communication campaigns.</li> </ul>	<ul style="list-style-type: none"> <li>• Another initiative for social collaboration of the company to enhance the commitment of the employees towards energy awareness was a call for employees called Sustainability at Home. Employees could send in pictures about a practice that reduces CO<sub>2</sub> emissions or energy consumption in their own household and which can be a good practice for other employees. Around 50–60 employees took part. The management organises exhibitions in every working area to promote the ideas represented by the photos. It is also planned to move this exhibition to schools and self-governments near the factory sites.</li> </ul>

Source: *Prepared by authors on the basis of company case studies*

## Distribution and trade sector

### *Challenges arising from climate change*

- Growing trade flows and the subsequent lengthening of supply chains (for example, the growing ‘mileage’ of food).
- Competitive pressure, pressure from the public to reduce food and water waste and excessive packaging.
- Rising costs of goods, buildings management and transportation due to rising energy and commodity prices and increasing uncertainty about food production levels.

### *Motivations of business to mitigate climate change*

- Management of risks related to rising cost of, for example, energy resources.
- Growing demand for eco-goods and related pressure from consumers and the community.
- Improvement of image and reputation as a socially and environmentally aware retailer.

### *Examples of green business practices*

- Use of eco-labels and sustainable packaging.
- Increasing energy and resource efficiency through more efficient store lighting, refrigeration, air conditioning and so on; working with auditors to carry out carbon footprint measurements.
- Optimising distribution routes and shortening supply chains; use of less carbon-intensive transport such as rail for moving supplies.
- Initiating environmental communication campaigns (for example, promotion of eco-friendly vehicles, drawing attention to sourcing issues).

- Retail Forum for Sustainability initiative launched in 2009 to exchange good practice on sustainability and to discuss the way forward to sustainable consumption and production.

### *Impact of green business practices on employment*

#### **Impact on quantity of jobs**

The overall effects of new climate change policies in the distribution and trade sector would be rather small and range from -95,200 to +30,000 (-0.27% to +0.09% of baseline scenario, Cambridge Econometrics et al, 2011; see Annex 3), despite the possible increase in energy prices, which may reduce real incomes and thus affect the retail and other consumer sectors.<sup>17</sup> In part, the positive impact on employment may be explained by the low elasticity of demand for food products and some other retail product groups (Dupressoir, 2009). As a result, the demand for certain retail goods will remain fairly stable, irrespective of the price changes. However, sector employment will be under increased pressure as a result of climate change. For example, in some activities of the wholesale and retail sectors, the more intensive use of bio-energies is likely to cause more pronounced price fluctuations or rising prices, which companies will have to manage (Heymann, 2007). Furthermore, as prices of fossil fuel increase, transport costs will rise even more for wholesale and retail companies that have their own extensive fleets of vehicles.

The largest effects of new climate change policies are likely for the wholesale trade sector (up to -139,000 or -0.84% compared to the baseline scenario), while those on the retail trade sector will be positive (400–45,700 or 0%–0.24% compared to the baseline scenario (Cambridge Econometrics et al, 2011); see Annex 3). Overall employment trend will remain positive in the distribution and trade sector if companies are able to successfully anticipate and manage such greening effects.

#### **Impact on quality of jobs**

##### **Skills development**

Under the scenario of a stronger focus on sustainability, stricter regulation on shop locations, labour and shopping hours, and preference for locally produced products (TNO et al, 2009b), there will be higher demand for managers of SMEs, clerks and service workers (the largest group in the sector) as well as mechanics, fitters and craft-related trades workers. Most workers in the sector will be required to possess social perceptiveness skills and have a good understanding of changing customers' needs (especially of those affected by the growing environmental concern among the public) and to build up strong relationships with suppliers and customers. Technical and product knowledge will be of key importance for virtually all occupations within the industry, as 'selling' eco-products will require more in-depth knowledge about their sourcing and environmental impact (TNO et al, 2009b). Overall, the greening of the sector will require the replacement of many traditional jobs with more demanding occupations, leading to the loss of employment for some low-skilled workers (European Commission, 2010f; Strietska-Illina et al, 2011).

##### **Career and employment security, health and well-being and reconciliation of working and non-working life**

Greening does not have a significant impact on other dimensions of job quality in the sector. At a global scale, with no specific relation to greening, the vertical and horizontal integration of the retail industry is identified as generally leading to lower-paid, less green and, overall, less decent jobs as opposed to a disintegrated/localised approach (UNEP, 2008). The greening of the retail industry is expected to improve job quality through enhanced career and employment security (for example, more full-time jobs, reduced turnover of staff) and a better working environment (UNEP, 2008).

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<sup>17</sup> The baseline scenario already includes much existing environmental policy and any related labour market changes that it leads to (roughly half of the reduction in CO<sub>2</sub> emissions from 1990 levels required to meet the 20% emissions target is included). Minimum and maximum numbers include the effects of new environmental policies (in addition to the baseline scenario), rather than the general effects of all environmental measures. See Annex 3 for a more detailed explanation.

Employment in the retail sector is characterised by high female participation (more than 60% of the workforce) and a high share of part-time workers (29% of the workforce). The corresponding figures for the wholesale sector are rather more balanced at 49% and 10% respectively. Women, who comprise more than 80% of the part-time workforce, remain underrepresented in managerial positions and are highly exposed to involuntary part-time employment (European Commission, 2010f).

*Approaches to anticipation and management of green change*

Sustainable retailing has traditionally been an important strand of retailers’ corporate social responsibility (CSR) (ERRT, 2010) and hence voluntary schemes promote the use of green management approaches (GHK, 2009a). A prominent example of a ‘soft’ scheme is the Retailers’ Environmental Action Programme (REAP), which facilitates benchmarking of achievements and exchange of good practices through the Retail Forum for Sustainability (BiPRO et al, 2009). The basic principles of good company conduct are outlined in the Retail Environmental Sustainability Code, including retailers’ commitments to green sourcing, resource efficiency, sustainable transport and distribution, reduction of waste, and raising environmental awareness (EuroCommerce and ERRT, 2010). The code stipulates the active involvement of customers (through external communication) and employees (mainly through internal training) as a means to an environmentally sustainable business.

Other good practices include green training of employees in the sector, including guidebooks on environmental good practices, eco-driving courses and programmes encouraging staff to commute to work via public transport, by bike or on foot (BiPRO et al, 2009). Innovative incentives schemes, such as eco-vouchers in Belgium, provide allowances for employees which they can spend on certain eco-products. At the same time, certain green skills gaps remain unfilled. In particular, there are recognised skills gaps for project managers who specialise in delivering a set of mitigation solutions. The traditional skills are not sufficient to allow a transition to a ‘greener’ position, which is why retail staff often cannot ‘sell’ an environmentally relevant good (Ecorys, 2008).

Meeting future skills needs in the sector will require robust anticipatory approaches, involving companies, trade unions, education and training providers, and other key stakeholders (TNO et al, 2009b). An example of such cooperation can be found in the UK, where retailer associations are working closely with the relevant government and educational authorities to ensure that school leavers have the minimum skill sets required for integration into the modern retail environment (European Commission, 2010f).

Table A4 gives examples of anticipation and management approaches adopted by companies in the distribution and trade sector.

Table A4: *Examples of anticipation and management of green change at company level in the distribution and trade sector*

<p><b>METRO (Cyprus)</b> Small chain of retail stores</p>	<p><b>Tesco (UK)</b> Large retailer</p>
<ul style="list-style-type: none"> <li>The job tasks relating to the implementation of green business practices have been simplified as much as possible for two main reasons. First, work in the stores can be very intensive. Simplification thus aims to avoid an additional workload which could also lower productivity and service quality. Secondly, simplification is linked with objective constraints resulting from the usually low educational level of workers.</li> </ul>	<ul style="list-style-type: none"> <li>The company assigned some responsibilities to its corporate affairs personnel, who later formed a separate climate change department. Company uses own resources to formulate its activities in the sustainability direction and to anticipate green changes in its business.</li> <li>Anticipates and manages green change not only ‘top-down’ (climate change department), but also ‘bottom-up’ when every employee is encouraged to provide their ideas to reduce the company’s carbon footprint.</li> </ul>

<p><b>Ecover (Belgium)</b> Producer and seller of ecological products</p>	<p><b>Biogros (Luxembourg)</b> Bio-products wholesaler</p>
<ul style="list-style-type: none"> <li>• Company has innovation manager who works on long-term innovations, studies and so on.</li> <li>• Each partner (supplier or distributor) has to sign a kind of ‘green charter’ before contracting with the company: company has a stakeholder management system, from which a supplier screening scheme has been extracted. All major suppliers are subjected to this policy. On top of this, all suppliers receive the company’s environmental policy declaration and are asked to act in accordance with it.</li> </ul>	<ul style="list-style-type: none"> <li>• Employees’ delegates (two people for the company) participate in the debates and facilitate problem-solving by discussions with those involved.</li> <li>• Recently the company organised a number of discussions to formulate its vision on the basis of the ideas of employees and stakeholders (shareholders, farmers and so on). This process was moderated by an external facilitator. A steering group was chosen by all employees. This steering group was supposed to carry the process.</li> </ul>

## Energy sector

The energy sector is unique, as the impact of greening on it is one of the strongest and most uneven across its subsectors. Each of these has its own characteristics with many specific issues. However, a detailed analysis of each of these subsectors is beyond the scope of this study and therefore this overview provides a more general picture of greening of the sector, including some specifics of traditional and emerging industries.

### *Challenges arising from climate change*

- Rising energy prices and likely future auctioning of emission certificates (making CO<sub>2</sub> a real cost factor) may push conventional producers to invest in energy efficiency measures.
- The subsidy dependency is particularly large (especially for renewables) and this is also a risk, as a major change in subsidies could lead to a crisis; as renewables approach the same levels of competitiveness with fossil fuels, public subsidies could be phased out (Heymann, 2007).
- A likely increase in prices for the raw material (biomass) and a shift in relative prices (depending on the use) could significantly affect subsectors within the energy sector (for example, bio-energies); it may be reinforced by unstable regulation in the area (Heymann, 2007).
- Emerging occupations (for example, wind turbine operator) face skill shortages; some of the skills can be transferred from phasing out subsectors (for example, conventional energy industry).
- Energy generation is regionally concentrated and dependent on the resources and infrastructure available. Thus, it is very difficult to provide new jobs for redundant staff in subsectors being phased out. Workers’ representatives at all levels are supportive of greening as long as it does not threaten jobs.
- Renewables are bound to location and thus depend highly on policy decisions. However, this subsector is not yet fully embedded in the large national schemes of energy production.
- While greening is widely discussed in the electricity and waste subsectors, there is a lack of data on the water and sewerage subsectors, which are largely overshadowed by the others.

### *Motivations of business to mitigate climate change*

- Many energy companies in conventional power generation, transmission and distribution as well as water and waste subsectors are public companies and thus under direct influence of political priorities. Regulation and rising input prices significantly affect companies in this sector.
- For newcomers, new energy efficiency and alternative power generation technologies are attractive business opportunities, allowing them to access additional funding and the latest innovations (particularly relevant in renewables).

- Greening of the energy sector, particularly renewable energies, receives considerable financial support from public authorities (EREC, 2010). Energy security is an important motivator in this process.
- Awareness of climate change and pressure from the public was indicated to be one of the most important motivations by online survey respondents representing the energy sector.

### *Examples of green business practices*

- Energy-saving measures: improving technology in power generation, minimising carbon footprint ('clean coal'), power and heat co-production, grid optimisation in conventional energy generation, transfer and distribution facilities (for example, smart grids and smart meters).
- Greener product and service design: promoting 'energy mix' in power generation, adoption of solar, wind, tidal and so on; energy technologies; transfer to the renewables sector from other sectors (for example, oil refineries, agriculture for biomass production).
- Management-related measures: for example, accounting and reporting GHG emissions, establishing an emissions reduction plan, energy audit.
- Influencing consumer behaviour: introducing smart energy and water consumption measurement systems for users (for example, smart meters).

### *Impact of green business practices on employment*

#### **Impact on quantity of jobs**

Electricity and heat is the highest GHG-emitting sector worldwide: it accounts for 24.6% of global GHG emissions (for comparison, the whole of manufacturing accounts for 21.1%) and for 40% of all energy-related global GHG emissions; in addition, the waste subsector accounts for 3.6% of global GHG emissions (Baumert et al, 2005). Green restructuring in the sector is thus the most pressingly important.

Projections of the impact of climate change on jobs in the energy sector are extremely contradictory. For example, GHK et al (2007), Slingenbergh et al (2008), UNEP (2011) (global projections) and respondents to the online survey representing the energy sector (majority expect up to 2.5% additional jobs) argue for positive growth, while Cambridge Econometrics et al (2011) and ETUC et al (2007) argue for the decline of employment in the sector (see Annex 3).

However, it seems that at the general level there are more negative than positive trends. For example, it is possible that reduction of energy consumption by 20% until 2020 could result in a stronger decoupling of economic growth and energy consumption and, consequently, falling demand for electrical and heat energy. Furthermore, likely auctioning of currently free-of-charge emission certificates could make CO<sub>2</sub> a real cost factor for conventional energy producers, forcing them to invest in energy efficiency measures (Heymann, 2007). Indeed, construction of new energy production facilities and modernisation of current ones is likely to be increasingly focused on energy efficiency (for example, low-CO<sub>2</sub> coal-fired power stations). Energy efficiency measures could have positive but temporary employment effects; for example, it is estimated that approximately 280,000 jobs will be required in 2005–2012 in smart meters' installation and around 140,000 jobs in 2012–2018 in smart meters' maintenance (EPSU et al, 2011). Overall, more energy-efficient production could in the end require fewer jobs than before.

However, an immediate and strong positive impact on jobs is expected in the renewable energy subsector, which accounted for about 1.4 million jobs, or 0.64% of the EU workforce, in 2005 (DB Advisors, 2008; Ragwitz et al, 2009). In the EU, for example, renewables should increase to 20% of primary energy supply by 2020 – three times the current percentage (Heymann, 2007). Renewables also may decentralise energy supply, reduce dependence on fossil energies

and increase security of supply. Renewables should increase their competitive advantage over fossil fuels through constant technological improvements, the achievement of economies of scale, the more efficient application of renewables (for example, large wind turbines, better choice of locations for wind turbines or solar energy installations) and as a result of the expected higher prices for fossil fuels (DB Research, 2007).

Overall, employment in renewables is estimated to increase to up to 50% of current levels (see Annex 3). Most of this is expected for bio-energies (for example, second-generation biofuels) and wind power subsectors (especially offshore) (see Annex 3). However, location is very important for these subsectors. Public authorities play an important role in utilising renewable energy sources in locations where natural conditions are favourable (for example, coastal or fertile areas).

### Impact on quality of jobs

#### Skills development

Overall, greening will have a significant impact on skills development in the sector. Around half of the online survey respondents representing the energy sector indicated that a moderate (25%–50%) proportion of all jobs will be transformed as a result of greening. Transformation will be especially relevant for a number of occupations. Under the green efficiency scenario (based on fast globalisation, technological change, scarce natural resources, liberal trade and market regulation, and advanced environmental regulation), it is estimated that up to 2020 there will be high demand for managers, business and finance professionals, engineers, ICT professionals, construction workers and plant operators (TNO et al, 2009c). Under this scenario, the number of estimated emerging competences is the largest if compared with scenarios with poor environmental regulation.

It is estimated under the green efficiency scenario that the occupations most in demand will be required to have legislative and regulatory knowledge as well as technical knowledge (for example, cradle-to-cradle technologies, new production technologies) and the following skills (TNO et al, 2009c):

- social skills (communication, language, intercultural, networking);
- problem-solving skills (analytical, multi-skilling, creativity);
- self-management skills (stress and time management, flexibility);
- entrepreneurship skills (spotting new markets and trends, understanding suppliers and customers);
- management skills (change management, project management and human resource management skills, process optimisation and risk management to reduce costs).

The information given above is largely confirmed by other studies. For example, a study by the European Federation of Public Service Unions (EPSU) indicates that in 10 years' time, managers, professionals and technicians will be most in demand, while demand for plant and machine operators may be lower (EPSU et al, 2011). According to this study, the greatest need in the future will be for STEM skills (science, technology, engineering and mathematics).

Skills demand and development will differ between sectors. The largest skills development component is expected in 'traditional' power generation subsectors, where greening will affect jobs at all levels. The impact on skills will be strongest in occupations with high qualification requirements (for example, energy consultancy, engineering and energy service provision, energy auditing and efficiency services) (Cedefop, 2010). A relatively moderate impact on skills is expected in gas, steam and related systems (ETUC et al, 2007).



Installation of renewables will require new skills, but in the future, their operation and maintenance can proceed with existing skills or those absorbed from other sectors. Unlike other subsectors, renewables are likely to absorb workers from other industries (for example, offshore oil and gas extraction or shipbuilding workers for offshore wind turbine maintenance). Overall, employability of workers in the renewables industry will be enhanced if they have technical, operation and maintenance skills (Strietska-Ilina et al, 2011).

The impact of greening on skills in the waste treatment subsector is expected to be lower, as waste management is less knowledge intensive than other subsectors. Operators in the recycling industry will be expected to have knowledge of energy recovery from waste, waste classification, transformation, monitoring and so on (Strietska-Ilina et al, 2011).

### Career and employment security, health and well-being and reconciliation of working and non-working life

Greening is likely to have at least some effects across all other dimensions of job quality in the sector. Green jobs resulting from increased demand are more likely to employ men than women compared to non-green jobs, and are less likely to be part time or temporary according to some sources (Cambridge Econometrics et al, 2011) but not others (ETUC representative voiced reservations regarding renewables in interview).

In the renewable energies sector in Spain, 84% of workers were on permanent contracts. Of these, as many as 94% of managers and senior engineers, 95% of supervisors and 97% of engineers, but only 62% of non-qualified assistant operators and 75% of qualified officers, were permanent employees (interview with ETUC representative). There is evidence that jobs in renewable energies and energy services tend to be less well paid and enjoy less secure employment conditions (ETUC et al, 2007; company case studies), as temporary work agencies are more widespread and social dialogue lags behind even when the industry matures (interview with ETUC representative).

Health and well-being is closely related to skills and is different between green and non-green jobs, mainly in energy production (for example, renewables). Many emerging energy sectors have specific risks related to ‘engineering unknowns’: mechanical failure, insufficiently tested technology, unavailability of guidance and training for workers, and infrastructure deficits (EU-OSHA, 2011b). Wind, solar, marine and bioenergy and battery technologies are listed among the top technologies with implications for occupational health and safety due to physical hazards, including in offshore installation and maintenance (EU-OSHA, 2011b). Occupational hazards exist in the manufacturing, installation and end-of-life waste disposal processes of renewables. For example, more than 15 hazardous materials are used in the manufacture of PV panels (ILO, 2012). Manual handling of waste and exposure to hazardous substances remains an issue and public pressure is likely to mean that less waste is exported to developing countries (Fritz et al, 2000; EU-OSHA, 2011a). For example, solar PV panels also have the potential to create a significant new wave of electronic waste at the end of their useful lives (estimated to be 20–25 years) and they also contain a growing number of new and emerging materials (such as cadmium telluride and gallium arsenide) that present complex recycling challenges in terms of technology, safety and health and environmental protection (ILO, 2012).

No reliable data are available on the reconciliation of working and non-working life in the sector. Yet it can be assumed that as typically regionally concentrated traditional power generation phases out, workers will face a more pressing need for retraining and regional mobility. Unless compensation and support mechanisms are in place, the change may entail longer commuting hours. Offshore wind turbine maintenance is likely to have inflexible working hours and multiple shifts. In ‘traditional’ energy sectors, unless a proactive position is taken up by companies, workers may have to attend training after working hours.



### *Approaches to anticipation and management of green change*

While large companies such as ENEL, SWM and STATKRAFT cooperate to identify and improve the skills of their staff, a survey identified that only 39% of employers had undertaken initiatives to forecast their skills needs (EPSU et al, 2011). Eesti Energia, a state-owned company in Estonia, started providing in-service training for its staff to re-skill them into new occupations, including operators and managers in wind and hydro plant, heat coproduction, energy auditing and so on (Cedefop, 2010). The Italian Renewable Energy Producers Association (APER) provides assistance and training to its associates, external stakeholders and professionals, including management and technical staff (Ecorys, 2010).

However, the same opportunities are not available for smaller companies. In this regard, public authorities have taken lead in many countries and regions.

The autonomous regions in Spain have been proactive in identifying skill needs for new green occupations and the greening of existing occupations in the energy sector, such as the region of Navarre, which has organised a major expansion of training provision for the renewables sector since the mid-1990s (Strietska-Ilina et al, 2011). Unemployed workers in the water and renewable energy sectors and SME employees can benefit from national and regional funds in Spain. Spanish authorities also subsidise projects in enterprises, particularly SMEs, to train workers to improve their environmental skills, including installation of equipment for alternative power sources and diversification in electricity companies (Cedefop, 2010). Sectoral roundtables have been set up at the national level, which discuss challenges and solutions in energy and refining, among other sectors. In Spain, the National Skills Institute identifies new industrial skills.

In France, a mobilisation plan for green jobs was adopted (EPSU et al, 2011). In the French region of Aquitaine, the regional authority started creating an eco-park with a training centre focusing on wind energy and eco-construction to complement companies' initiatives to diversify their activities to make use of wind energy (a notable example is Ford Aquitaine) (Strietska-Ilina et al, 2011).

Nearly all trade union officials surveyed and over a half of employers' representatives believed that public authorities should take up the role of promoting partnerships between training providers and employers (EPSU et al, 2011). Energy sector representatives responding to the online survey indicated that the main activities that public authorities could undertake to raise job quality in the sector were the introduction of new education and training programmes and the adaptation of existing ones, and the promotion of partnerships between education and training institutions and employers. In the Spanish region of Navarre (population 620,000), over 6,000 new jobs in renewable energies were created in 2007 alone due to a proactive and collaborative policy of local authorities. Unemployment remained the lowest in Spain even in the economic downturn (Strietska-Ilina et al, 2011). According to the interviewee at EWEA, the region's employment structure was transformed due to renewable energy.

The apprenticeship system in Germany, which connects the education and labour market, is a successful tool for anticipating and managing green skills needs (Cedefop, 2010). The renewable energy sector is exceptional in this, as companies prefer employing workers with initial training rather than offering dual apprenticeship courses. Most newly recruited workers have to be trained on the job (Strietska-Ilina et al, 2011).

Table A5 gives examples of anticipation and management approaches adopted by companies in the energy sector.

Table A5: Examples of anticipation and management of green change at company level in the energy sector

<p><b>Slovenské Elektrárne (Slovakia)</b> Conventional energy producer opting for hydro energy</p>	<p><b>ENERTRAG (Germany)</b> Wind energy producer</p>	<p><b>Arginta (Lithuania)</b> Renewables and wastewater treatment company</p>
<ul style="list-style-type: none"> <li>• Company has trained 19 internal lecturers who are continually broadening employees' knowledge.</li> <li>• Via programme Induction Training for New Employees, employees are introduced to the company structure, mission, vision, values and strategy, including green business. They get an opportunity to have discussions with the company's top managers, to understand the goals and challenges of the organisation, as well as to develop working relationships with colleagues from various sites and plants within Slovakia.</li> <li>• Demands on skill development are agreed and included in company collective agreement.</li> </ul>	<ul style="list-style-type: none"> <li>• Regularly updates information on age distribution in the company to detect replacement demands and to set up training activities accordingly.</li> <li>• Financially supports kindergartens in the region around its headquarters, ensuring that there are enough places available for the children of employees.</li> <li>• Provides a free shuttle bus for employees.</li> <li>• Trains employees in programmes specifically designed for the area of renewable energies offered by external training provider.</li> </ul>	<ul style="list-style-type: none"> <li>• In cooperation with LINPRA (Engineering Industries Association of Lithuania), company frequently holds seminars for employees from other companies.</li> <li>• Developed employee health and safety guide which lays down the functions, procedures, precautions and work policy for all workers exposed to hazardous materials.</li> </ul>
<p><b>Danfoss Trata (Slovenia)</b> Supplier for heating, ventilation and air-conditioning systems</p>	<p><b>WasteServ (Malta)</b> Waste management company</p>	
<ul style="list-style-type: none"> <li>• Around 45 employees have regularly visited Finland for training related to the establishment of the new competence centre in Slovenia.</li> <li>• Series of introductory training sessions in various areas are prepared, which new employees complete in the first few weeks on agreement with their immediate leader.</li> <li>• Traineeship has become a regular process, through which students reinforce and enrich the knowledge learned at the faculty and the company gets to know a person who may become its employee.</li> </ul>	<ul style="list-style-type: none"> <li>• To anticipate the changes in employment, company holds strategic meetings. Every 6–12 months, the HR department and the head of departments meet to prepare a capacity-building exercise to identify necessary requirements for the coming months.</li> <li>• Secured funds from ESF 2004–2006 to improve the employability of 29 jobseekers who, after the training, started visiting households throughout the Maltese Islands to explain the concept of waste separation at home to the general public. Jobseekers are given the opportunity to work and learn, while also raising awareness on waste management to the general public.</li> <li>• Another ESF project to encourage environmental stewardship through the empowerment of socially disadvantaged participants via adequate training and skills transfer. The intention is to enhance the employability of the trainees within the sector.</li> </ul>	
<p><b>EDP (Portugal)</b> Wind energy producer</p>		
<ul style="list-style-type: none"> <li>• Project Valuing Experience for workers aged over 50 years and with 30 years of working experience to share knowledge acquired, to identify personal motivations and to plan their future tasks.</li> <li>• Developing On Top – Recruitment Programme to position the company as an employer of first choice, to reinforce communication with the academic community and to attract young talent.</li> <li>• Established internal university to coordinate training, career development, knowledge management and change management in line with the present and future needs of the group.</li> <li>• Developed + Conciliar programme to improve quality of life of employees (for example, organised children visiting their parents' workplaces to heighten involvement and connection between company, its workers and their families).</li> <li>• Launched Life Choices Today project, which organises working life simulation games for workers' children and grandchildren.</li> </ul>		

## Furniture sector

### *Challenges arising from climate change*

- Deforestation, illegal logging, inefficient use of resources, pollution and irresponsible use of waste are major threats which may exacerbate the negative effects of climate change.
- Very high reliance on raw materials and production inputs, estimated at approximately 70% of total production value.
- Rising energy prices increase production costs, while intense competition in the sector does not allow passing on of the costs to the final products; thus profits and employment could suffer.

### *Motivations of business to mitigate climate change*

- Regulation significantly affects the sector: EU furniture manufacturers are obliged to adhere to a number of EU regulations, including the VOC Solvents Directive (of particular importance to the sector), the IPPC Directive, the REACH Regulation and the Waste Framework Directive.
- The greening of EU public procurement: environmental issues are increasingly considered in tender specifications and in criteria for furniture products (Bouwer et al, 2006).
- Increasing demand for eco-products: an EU eco-label for wooden furniture is being discussed which, once introduced, would lead to better informed purchasing decisions.

### *Examples of green business practices*

- Use of eco-labels: due to the complexity of the products, the exact definition of an eco-friendly furniture product is still a long way from reaching a consensus.
- Sustainable use of raw materials and application of Best Available Techniques (BAT) (that is, the most effective techniques in achieving a high general level of protection of the environment, as outlined in the IPPC Directive), such as use of wood waste from production for heating.
- Sustainable sourcing and setting of environmental standards for subcontractors (for example, IKEA activities).
- Measure for increasing energy efficiency throughout the manufacturing process (for example, use of waste energy to heat production facilities).

### *Impact of green business practices on employment*

#### **Impact on quantity of jobs**

Most of the related research is of a qualitative nature. The only available estimation of new green jobs in the sector suggests that the effects of new climate change policies could be more significant in other manufacturing industry (-112,000 to +10,800 or -4.28% to +0.41% compared to the baseline scenario) than in the wood and paper industry (-38,900 to 18,500 or -2.03% to 0.96% compared to the baseline scenario);<sup>18</sup> both industries contain elements of the furniture sector (Cambridge Econometrics et al, 2011; see Annex 3).

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<sup>18</sup> The baseline scenario already includes much existing environmental policy and any related labour market changes that it leads to (roughly half of the reduction in CO<sub>2</sub> emissions from 1990 levels required to meet the 20% emissions target is included). Minimum and maximum numbers include the effects of new environmental policies (in addition to the baseline scenario), rather than the general effects of all environmental measures. See Annex 3 for a more detailed explanation.

The furniture sector is under increasing international competition, as constantly rising prices for the raw materials (also used in renewable energy) and the strong market power of furniture retailers put heavy pressure on profits. The recent shifts of employment in the sector are the result of the gradual and consistent movement of production from western Europe to eastern and central Europe (TNO et al, 2009d) as well as the subcontracting and outsourcing of basic manufacturing activities to third countries (Bouwer et al, 2006). This process has resulted in a net job loss in the sector, as subcontracting and outsourcing typically relocate occupations with the largest number of workers, including skilled handicraft workers and labourers (TNO et al, 2009d). These negative trends may be partly offset with rising demand for the use of timber as a building material in both conventional buildings and especially in zero-energy houses (Heymann, 2007). In the future, timber as a building material may receive support from the public authorities. This rise in demand could provide a positive stimulus for employment in the sector.

### Impact on quality of jobs

#### Skills development

The generally observed trend is that the sector is experiencing medium level of up-skilling (European Commission, 2010g). The undergoing restructuring in the sector is projected to increase the demand for managers, ICT professionals, industrial designers, sales and marketing employees, supply chain managers and plant and machinery maintenance and repair staff, and decrease the demand for labourers and skilled handicraft workers (TNO et al, 2009d). Besides a number of other key factors, environmental regulation, demand for ecological products and use of non-traditional materials are viewed as important determinants of skills development in the sector. Due to restructuring, virtually all job functions will be increasingly required to possess regulatory knowledge of (environmental) legislation and utilise e-skills at the workplace. Social skills (communication, language and intercultural), creativity and innovation, understanding of suppliers and customer needs, management skills (planning, flexibility, process optimisation, quality management and strategic and visionary skills) are likely to be required.

#### Career and employment security, health and well-being and reconciliation of working and non-working life

The efforts to improve job quality in the sector have so far been concentrated on the abolition and prevention of workplace hazards and risk exposure (UEA et al, 2010a, 2010b). This concerns machine safety, exposure to chemical agents, hardwood dusts, physical pressure and manual loads, internal transport and traffic, risks arising from noise and chemical agents, risks of fires and explosions as well as exposure to volatile organic compounds (VOCs) due to the use of solvents. In particular, the latter is seen as a key component of efforts to improve the atmospheric environment (that is, the VOC Solvents Directive) and initiatives to enhance health and safety measures in the furniture sector (UEA et al, 2010b).

#### Approaches to anticipation and management of green change

Continuous technological change in the sector creates the need to equip workers with emerging competences in sector-specific innovations and research activities. Practice shows that the successful management of green change involves a range of approaches, including regular internal training of staff and active involvement of employees in the dialogue on environmental issues (European Commission, 2008c, 2009b). Such measures not only help to improve resource and material efficiency, but they also increase the joint responsibility of employees in applying environmental principles in the management of green change (European Commission, 2009b).

The prevalence of SMEs in the sector and its dependence on regional knowledge networks makes cooperation vital for initial and continuing vocational education and training (TNO et al, 2009d). Companies have reacted to the changes in skills development not only by setting up internal training programmes, but also through cooperation and partnerships with education and research institutes. However, in many cases, the existing capacities and networks of schools and training centres are not sufficient to provide initial education for workers. In addition, training periods have been significantly reduced due to competitive and resource pressures to make workers operational as quickly as possible.

Employment issues are easier to solve for companies located in areas where there are clusters of firms and/or education institutions specialising in the furniture sector. This is the case, for example, in Romania, where the tradition and history of wood furniture are particularly strong, or in Slovakia, where the University of Zvolen leads innovation and qualitative competitiveness in the furniture sector (Bouwer et al, 2006). At the in-company level, the transfer of essential know-how is hampered by the lack of pedagogical skills and established teaching methods within the companies. However, some good examples of anticipation and management approaches adopted by companies exist (see Table A6).

Table A6: *Examples of anticipation and management of green change at company level in the furniture sector*

<b>IKEA (Sweden)</b> Furniture company	<b>Kinnarps (Sweden)</b> Office furniture manufacturer
<ul style="list-style-type: none"> <li>• In general, the training is conducted through face-to-face training with groups of approximately 20 employees. The number of participants is limited in order to have a good dialogue concerning criteria and the tallying. During the training, IKEA highlights why the company is using the score card and what the benefits for each business areas are in using the score card.</li> <li>• Each manager within the company is responsible for ensuring that co-workers have the ability and tools to receive and comprehend relevant information concerning the sustainability work.</li> <li>• Competence development is available to all employees within the company in the form of on-the-job training, courses and web-based training.</li> <li>• Company engages in dialogue with WWF to promote responsible forestry.</li> </ul>	<ul style="list-style-type: none"> <li>• Heavily engaged in sustainable sourcing of wood. Top managers of the company are involved in Swedish FSC certification board and report directly the changing certification requirements and related impacts on employees.</li> <li>• About 95% of the training (less advanced and medium-level training) needed is provided internally, but external support is hired to provide training of trainers (for example, on development of standards).</li> <li>• Company works closely with customers, designers, architects and competitors on the question of sustainable wood to raise the awareness and importance of the question.</li> <li>• To manage the needs for blue collar workers, there is also collaboration with a local VET school through the specified division of the company, called Kinnarps Academy. The students spend two days per week in the school and three days in the company, where they are provided with all the practical aspects of their training.</li> </ul>
<p style="text-align: center;"><b>Ecociclo (Portugal)</b>                      Wood recycling company, subsidiary of wood-based panel producer Sonae Indústria</p>	
<ul style="list-style-type: none"> <li>• Both raising awareness of workers and some formal training were done on the job by Sonae Indústria personnel. Ecociclo's tasks rely a great deal on experience and less on formal training. Direct experience has been the most effective training method by far and has reduced the need to outsource formal training.</li> <li>• Sonae Indústria struggles to motivate its workforce to improve sustainability levels, either by specific training, daily written messages or occasional informal activities. Written messages, often printed sheets hanging on a wall, are the usual method of informing staff of news and recommendations. Ecociclo's centres are mostly a blue collar environment and simpler approaches tend to work better.</li> <li>• Once or twice a year, Sonae Indústria workers (including Ecociclo's) attend, along with their families, a one-day event in a green area, somewhere in Portugal, to plant new trees. Sustainability issues are also informally discussed then. Through such events, Sonae Indústria and Ecociclo's workers and family members get to better understand the benefits of the wood recycling process undertaken by Ecociclo.</li> <li>• Ecociclo also seeks training and advice for its workers from local firefighters. A wood recycling process constitutes a significant fire hazard, as it has wood dust and chips with running machines, engines and fuel containers.</li> <li>• Ecociclo workers have given presentations for young children in local schools. These presentations were about recycling and its benefits for the future. This was not initially anticipated by HR management; the process started when one school asked for a specific presentation from Ecociclo. However, it has now become part of the agenda. Sonae Indústria is pleased with the results and workers themselves are asking to do more of this type of approach.</li> </ul>	

## Non-metallic materials sector

### *Challenges arising from climate change*

- The non-metallic materials sector is one of five sectors identified as having the most sensitive CO<sub>2</sub> intensity to energy prices alongside wood and paper, mining, water supply, and textile products (GHK et al, 2007); high CO<sub>2</sub> intensity is most alarming in the cement manufacturing industry, where each tonne of cement produced emits 0.8 tonne of CO<sub>2</sub> (Syndex et al, 2009).
- Future auctioning of emissions certificates could considerably increase the cost for business, and if not politically managed, could reduce EU competitiveness in this area (Heymann, 2007); considering high competitive pressure, low future profit margins limit the capacity of installations to invest and reduce emissions and a large share of SMEs in the sector experience a significant risk of carbon leakage (European Commission, 2010e).
- The non-metallic materials sector is one of the most energy-intensive sectors in the economy (third after air transport and metals) and is thus negatively affected by rising energy prices (Eurostat, 2010).
- Regulatory pressure to reduce CO<sub>2</sub> (especially for cement and lime sectors) and sulphur oxide (SO<sub>x</sub>) emissions (especially for the ceramics and glass subsectors).
- Pressure for innovation and replacement of existent technologies with long operational lives (for example, lime kilns are designed to last for 40 years) (Cambridge Econometrics et al, 2011).

### *Motivations of business to mitigate climate change*

- Regulation – for example, IPPC Directive, European Emissions Trading Scheme and REACH regulation on chemicals use – significantly affects the sector.
- Improving energy and resource efficiency to reduce production costs.
- Demand growth for greener, less energy-intensive construction materials, glass and ceramics (Cembureau, 2009a).

### *Examples of green business practices*

- Production of low-clinker, low-carbon cement (Cembureau, 2009b).
- Sustainable use and sourcing of raw materials, production inputs and chemicals.
- Application of the Best Available Techniques in production processes.
- Possible application of carbon capture and storage technologies to cement production.
- Cooperation with companies in other sectors to seek integral solutions (for example, using innovative cement, ceramic products in construction of energy-efficient buildings).

### *Impact of green business practices on employment*

#### **Impact on quantity of jobs**

The impact of climate change on the quantity of jobs in the sector is twofold.

Overall employment (including other trends and not only those due to climate change) in the sector is forecasted to slightly decline (4%–5% of 2009 levels) (see Annex 3). However, this will be caused more by overall restructuring processes in the sector. The major likely climate change-related reasons for this are related to energy efficiency and productivity improvements (for example, automation) within subsectors and future auctioning of emissions certificates that could considerably increase the cost for the business and increase the risk of carbon leakage. This would be



especially relevant for the very energy- and CO<sub>2</sub>-intense production of cement. The effect of greening on the cement industry ranges from an employment loss of 1% in the EU15 (IIASA, 2006) to a complete relocation of the industry's activities to non-EU countries (Boston Consulting Group, 2008) (see Annex 3). The adoption of Border Carbon Adjustments (essentially, a mechanism for environmental restrictions on imported goods) is critical to preventing a severe loss of European cement manufacturing (that is, an output loss of 4% under the adoption scenario versus an output loss of 41% under the no-adoption scenario) (CSI, 2009).

But as the sector is the supplier of essential construction materials, it can benefit from the forthcoming energy-related modernisation and refurbishment of buildings and the development of energy-efficient conventional or new renewable energy infrastructure. Indeed, forecasts show that new climate change policies could positively contribute to employment levels in the sector (from 2,600 to 17,900 or 0.17%–1.14% compared to the baseline scenario, Cambridge Econometrics et al, 2011; see Annex 3).<sup>19</sup> This could at least partly offset the negative trends in the industry outlined above.

### **Impact on quality of jobs**

#### **Skills development**

The impact of greening on skills development will very much depend on future tendencies. In the scenario of global protectionist tendencies leading to slow economic growth and easing external competitive pressures, coupled with European harmonisation of environmental regulation and the enactment of new environmental legislation, the demand for new workers and up-skilling will be moderate (TNO et al, 2009e). The number of engineers and R&D staff, other professionals and plant and machinery maintenance and repair workers could increase, while that of other occupations remains stable or decreases. Most of the employees under this scenario would be required to have legislative and technical knowledge (especially materials science, process and mining, health and safety, environmental and technical risk management) and strong social (teamworking, communication and networking), problem-solving (analytical, interdisciplinary and creativity), flexibility, understanding (of clients and suppliers) and management (process optimising and quality management) skills.

However, in the scenario of further integration of markets leading to fast economic growth and continued global competitive pressures, coupled with European harmonisation of environmental regulation and the enactment of new environmental legislation (especially in relation to climate change and carbon dioxide emissions), there will be a considerable need for new staff and up-skilling in the sector (TNO et al, 2009e). In addition, there will be very strong demand for R&D staff (for example, environmental engineers and agronomists working on technical solutions regarding energy efficiency and on developing sustainable products). There will also be demand for managers, IT professionals, accounting and finance, sales and marketing, other professionals and truck drivers. In addition, social (social perceptiveness, intercultural, language), stress and time management, trend setting and spotting, and management (strategic and visionary, change and project management) skills will be deemed necessary for most employees.

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<sup>19</sup> The baseline scenario already includes much existing environmental policy and any related labour market changes that it leads to (roughly half of the reduction in CO<sub>2</sub> emissions from 1990 levels required to meet the 20% emissions target is included). Minimum and maximum numbers include the effects of new environmental policies (in addition to the baseline scenario), rather than the general effects of all environmental measures. See Annex 3 for a more detailed explanation.



### Career and employment security, health and well-being and reconciliation of working and non-working life

No hard evidence has been found on the impact of greening on other dimensions of job quality.

Employability and job security is generally considered to be higher for workers with green skills due to their increased demand in the sector.

Green innovations may lead to new health and safety risks which may negatively affect workers. At an EU level, the *Good practice guide on worker's health protection through the good handling and use of crystalline silica and products containing it*, drawn up by the European Network for Silica (NEPSI), is the principal document facilitating health and well-being at work in the sector (NEPSI, 2006). This guidance, prepared with the participation of social partners and industrial organisations, describes good practice techniques for various common tasks, leading to potential improvement and protection of workers' health through the reduction of cancer risks, silicosis and other negative health effects. At the same time, health and safety regulation is identified as potentially distorting labour-intensive and less automated subsectors, such as wall and floor tiles, tableware and ornamental ware, brick and roof tiles (Ecorys et al, 2008a) as well as domestic glass (Ecorys et al, 2008b).

Greening could be used to improve gender equality in the sector, as women are currently underrepresented and comprise only 28% of workforce (TNO et al, 2009e).

### Approaches to anticipation and management of green change

The cement industry is a highly globalised industry; hence global initiatives such as the Cement Sustainability Initiative facilitated by the World Business Council for Sustainable Development (WBCSD) are essential in promoting the use of green management approaches in the sector. The initiative aims to reduce CO<sub>2</sub> emissions, protect natural habitats, reduce pollution and improve resource efficiency in the sector. At a European level, the management of green change is facilitated mainly through ISO 14001 or the EU Eco-Management and Audit Scheme (EMAS) management tools (Italcementi Group, 2007). The tools invoke and encourage the active involvement of employees in establishing proactive mechanisms for the reduction of GHG emissions, pollution and health risks (European Commission, 2005b, 2009a). However, as the management tools are voluntary, they tend to be scarcely applied in the sector, partly due to the perceived burdensome effect of green change by the European cement, glass and ceramics industries (Boston Consulting Group, 2008; CerameUnie, 2010; CPIV, 2010).

Anticipation of green change is equally fragmented across the EU and lacks a clear European strategy for including the latest developments of sustainable production and processes in education and training provision (TNO et al, 2009e). Nevertheless, good practice examples can be found in Germany, where the Initiative for Sustainability in the Cement Sector<sup>20</sup> facilitates a sustainable development approach within the cement sector, defines and develops projects for the exchange of good practises, and disseminates information on sustainable development practices in the sector. In Spain, social consultation on climate change mitigation is facilitated through tripartite roundtables for the cement, glass and ceramics industries. The roundtables have a strong regional impact, for example by providing assistance in the Castilla y León region, which is designed to allow the creation of alternative jobs and re-skilling to enable the transition to new industries. However, their scope remains limited owing to a lack of specific commitment by the government and a shortage of evidence measuring the employment effects of the implemented policies (Syndex, 2011).

At the company level there are some interesting examples of managing green change (Table A7).

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<sup>20</sup> <http://www.initiative-nachhaltigkeit.de/>

Table A7: Examples of anticipation and management of green change at company level in the non-metallic materials sector

<b>Ecocem (Ireland)</b> Cement producer	<b>Wienerberger (Austria)</b> Brick manufacturer
<ul style="list-style-type: none"> <li>• A few white collar staff employed by company are hired specifically to spend 100% of their time researching green issues. The company also utilises the services of some specialist ‘green consultants’.</li> <li>• Training consists of a mixture of in-house and external training for all workers. For example, internally all employees are given guidance about CO<sub>2</sub> emissions and energy efficiency. The engineering department trains employees in the analysis of alternative energy resources.</li> <li>• The company does not anticipate skills but emphasises ongoing training and skills provision.</li> <li>• Collaborates with Trinity College Dublin and University College Dublin, where company is involved in collaborative research agendas and is sponsoring a PhD (at Trinity).</li> <li>• Considerable emphasis is placed on flexible working time and balancing work and personal life (for example, some people work from home, there are no set working times).</li> </ul>	<ul style="list-style-type: none"> <li>• Employees in sales department participated in external training courses, after which they received a certification as trained energy consultants. They provide information to the buyers and share acquired knowledge integrity of systems and efficient building of houses.</li> <li>• Launched the platform Engineering Academy Advanced, which is intended to bring the plant managers together in order to discuss good practice on energy saving and energy efficiency.</li> <li>• Provides internal training to workers on the production lines on the control and composition of the right admixtures for bio-enriched bricks.</li> <li>• Commits to increase the share of women in the company by giving priority to a female job applicant over a male when they are equally qualified and apt for the job.</li> </ul>
<p style="text-align: center;"><b>System Photonics (Italy)</b> Ceramic PV panels producer</p>	
<ul style="list-style-type: none"> <li>• Cooperation is very developed: from a direct observation, employees look regularly at work advancement and colleagues’ needs. Such a high-trust environment favours informal exchanges and thus competence development by means of extensive and almost continuous on-the-job training, either as learner or as teacher.</li> <li>• Workers are encouraged to develop and share the best methods in order to maximise the comfort for all. They therefore develop a deep knowledge of the whole production process and feel encouraged to anticipate problems, as they know their efforts are reciprocated.</li> </ul>	

## Shipbuilding sector

### Challenges arising from climate change

- Retrofitting and ship recycling industries are expected to benefit from the regulatory pressure to reduce the industry’s environmental impact. The demand for specialised vessels for renewable energy is also expected to increase significantly.
- Manufacturing of conventional ships and boats is expected to contract due to the greening of the industry, although the exact scope of this is unknown (Strietska-Illina et al, 2011).
- Growing regulatory pressure to reduce emissions: the 15 largest ships in the world are estimated to emit more sulphur per year than 760 million passenger cars (Thorsten, 2011).
- Pressure to move from cheap but highly pollutant fuel sources (that is, heavy oil) to fuels with less sulphur content; the sector may require significant investments to replace the current fleets with less-pollutant technologies.

### Motivations of business to mitigate climate change

- International Maritime Organization (IMO) regulation on sulphur content in ship fuels (Thorsten, 2011), the EU IPPC Directive and the Air Quality Directive are the most significant.

- Climate change is both a threat and an opportunity: enforcing green measures is expected to lead to further contraction of the sector (Strietska-Ilina et al, 2011), while there will be growing demand for new types of vessels (for example, specialised ships for the erection of offshore wind turbines) or retrofitting of old vessels to make them less polluting (Thorsten, 2011).
- Fuel efficiency measures: an improvement of fuel efficiency by 10% for a large container ship is estimated to save some USD 120 million (€99 million as of 26 July 2012) throughout 30 years of its use (Thorsten, 2011).

### *Examples of green business practices*

- Retrofitting of ships by installing greener technologies (for example, ships fuelled by liquefied natural gas (LNG)) into existing vessels, which make them more energy efficient, less polluting or emit less GHG.
- Manufacturing of specialised vessels or conversion of old ones for use in the renewable energy industry (Faber et al, 2009); active cooperation with companies working in the renewable energy industry.
- Moving away from ship scrapping to ship recycling (for example, through voluntary EU CSR schemes such as DEMOLISHCON).
- Involvement in steel fabrication for marine, offshore and onshore applications (for example, experiments with wave and tidal energy devices in the UK).

### *Impact of green business practices on employment*

#### **Impact on quantity of jobs**

The shipbuilding sector is a highly cyclical industry, which means that the employment levels in the sector are largely determined by overall economic performance (Ecorys et al 2009; Oxford Research, 2010). Consequently, employment levels including effects of climate change (no forecasts distinguishing specific effects of climate change policies are available) are forecast to either expand by 32% or contract by 10% of 2006 levels, depending on the scope and duration of the economic slowdown (see Annex 3). The greening of the shipbuilding industry (primarily through energy efficiency and lower energy consumption) is likely to cause employment shifts towards other industries and market opportunities such as offshore wind turbines and wave and tidal energy (Strietska-Ilina et al, 2011). Forecasts that estimate the greening effect in the related industries (that is, manufacturing of other transport equipment, which also includes ship construction and repair activities) predict up to an 18% reduction of 2009 employment levels (Cambridge Econometrics et al, 2011).

#### **Impact on quality of jobs**

##### *Skills development*

Greening may positively affect the skills development in the sector in the case of favourable economic tendencies. The ‘optimistic’ scenario<sup>21</sup> foresees an overall increase in employment and very high demand for marketing, R&D, design and production management occupations (Ikei, 2009). Less relevant expansion in this scenario is estimated for finance and administration, logistics, quality and production workers. Production jobs are forecasted to increase, particularly among suppliers and in the EU12. All jobs will require up-skilling under this scenario (Ikei, 2009). Change and network management, knowledge of the environmental framework, a focus on customised products, flexible production processes and ICT skills are expected to be in demand for highly skilled occupations. Low-skilled occupations may require applied knowledge of new materials, technologies and the regulatory framework.

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<sup>21</sup> The economic slowdown is short; the EU economy grows and world trade grows at a similar rate as before 2009; moderation of fuel prices; EU technological advantage is preserved; the regulatory framework including environmental regulations helps compensate for the short slowdown and fosters demand for specialised ships.

At the moment a general lack of skills persists in particular sectors, such as the construction of specialised vessels such as LNG-fuelled ships (Thorsten, 2011). Conversion of already built vessels to service the renewables industry is not likely to demand many new skills from workers.

#### Career and employment security, health and well-being and reconciliation of working and non-working life

Career and employment security is hampered by the high cyclical change in the sector (Ecotec, 2006). This challenge can be partly offset by exchange of workers, as is done via the Employment Pool initiative in Germany, or by attempts to increase the average retirement age, for example in the Aker Finnyard (Finland) shipyards (ESSDC, 2005). Overall, it is considered that greening is one of the biggest opportunities to safeguard jobs and employment security in the sector (for example, most employees are already on permanent contracts due to skill needs) (interview with Community of European Shipyards Associations (CESA) representative). Meanwhile, health and well-being in shipbuilding are not likely to change due to greening (interview with CESA representative). Shipbreaking could be considered an exception; due to the characteristics of the ships and the highly polluting materials they carry, shipbreaking activities are sources of serious environmental and occupational health hazards (for example, exposure to hazardous substances and wastes such as asbestos, oils and oil sludge, toxic paints, polychlorinated biphenyls (PCBs), isocyanides, sulphuric acid, lead and mercury). However, the health risks associated with shipbreaking are less relevant for the EU, as 90% of shipbreaking in the world is carried out in Bangladesh, China, India, Pakistan and Turkey (ILO, 2012).

#### Approaches to anticipation and management of green change

The shipbuilding sector has been rather reluctant to address green change in its activities to date (OECD Council Working Party on Shipbuilding, 2010). The main industry representative body, the CESA, has conducted a prominent forecasting exercise for skills needs to date. The exercise analyses demographic and economic factors in the sector but makes no specific references towards the greening of the industry (Hart and Schotte, 2008).

At national and company level, the growing need for skills is contributing to the development of technological clusters. For example, in Italy shipbuilding companies such as Fincantieri actively contribute to the initiatives undertaken by districts (privileged sites, networked structures), which facilitate the transfer of knowledge and technologies to SMEs and the diffusion of innovation aligned to specific company needs (CESA and Granger, 2008). Separate companies adopt various approaches in managing their green change processes (see Table A8).

Table A8: *Examples of anticipation and management of green change at company level in the shipbuilding sector*

A&P Falmouth, part of A&P Group (UK) Ship repair facility	Kleven Maritime (Norway) LNG-fuelled ships builder
<ul style="list-style-type: none"> <li>• Company mostly provides ad hoc and on-the-job internal training. All employees undergo an annual assessment and any identified training needs are addressed through suitable training.</li> <li>• Cooperates with regional universities and the government within Knowledge Transfer Partnership (KTP) programme. Programme helps business to improve their competitiveness and productivity through the better use of knowledge, technology and skills. In this case it involved the following actors: A&amp;P, knowledge base partner – University of Exeter and a recent university graduate in renewables (KTP associate) working mainly in market intelligence tasks on the basis of a two-year contract.</li> <li>• Plans to launch several apprenticeships to acquire much-needed knowledge on new shipbuilding technologies.</li> <li>• Organised energy-saving at work training sessions for staff from different workshops and departments across the dockyard. Aim is to develop a long-term culture within the yard of undertaking simple energy-saving actions.</li> </ul>	<ul style="list-style-type: none"> <li>• Kleven’s engineers have an ongoing dialogue and discussion with the manual operators who are responsible for connecting the LNG engines to the propeller shaft of the ship. This way, knowledge is shared between the technical and the manual staff.</li> <li>• The operators also go through in-house courses on working with LNG engines run by Kleven’s most experienced operators. This type of training is a continuous process in the company.</li> <li>• Trade union representatives have been involved in all the company’s green business initiatives; two trade union representatives are members of the company’s board.</li> </ul>

### Volvo Penta (Sweden) Manufacturer of engines and power systems

- The company uses a grid where one axis shows how difficult it is to recruit or rebuild certain skills if someone leaves and the other axis shows the strategic influence that a specific skill or competence has. The grid has four areas and the company focuses on the areas that are difficult to replace and have a large strategic influence.
- The key issue with the training of employees is that those involved in product development are themselves largely innovative and the skills are often developed through work and innovation rather than through training.
- The company has a three-year strategic competence plan which summarises its overall point of view on what the most important skills are and focuses on existing gaps.
- Uses internship and research collaboration with universities. This can sometimes act as an opportunity for skills development for employees, as it helps them to keep up with the latest research that may be useful in their work. Both the internships and research work collaboration are also opportunities to attract new employees.

## Textiles sector

### *Challenges arising from climate change*

- Climate change is a major threat for the textiles sector, as it is one of the five sectors that has the most sensitive CO<sub>2</sub> intensity to energy prices alongside wood and paper, mining, water supply and non-metallic materials (GHK et al, 2007).
- Based on the combined impact of increased international competitive pressure, the significant drop in production in the EU over the past years and negative or only very modest profit margins, which limit the capacity of installations to invest and reduce emissions, the sector is deemed to be exposed to a significant risk of carbon leakage (European Commission, 2010e).
- Insufficient cost management: very high reliance on raw materials and production inputs, estimated to exceed 70% of production value; ecological textiles have small batch sizes, high switch costs as well as necessary coordination efforts (Goldbach and Schneidewind, 2005).
- Immediate pressure to innovate and replace established inefficient production technologies.

### *Motivations of business to mitigate climate change*

- Regulation: the IPPC Directive, the European Union Emissions Trading System and the REACH Regulation significantly affect the sector.
- Surge in the demand for more environmentally friendly (for example, eco-friendly textiles, wearing apparel and leather products) and innovative (for example, technical textiles for sealing of disposal sites or for filter systems for the precipitation of dust) products.
- Eco-products drive innovation and product customisation, which helps reduce the cut-throat price competition with manufacturers from low-cost countries (EESC, 2008; EPSI, 2010; Euratex, 2010).

### *Examples of green business practices*

- Introduction of an eco-label for textile products (in 1999).
- Minimising the use of raw materials, production inputs and chemicals; reuse of textiles.

- Energy-efficient manufacturing that protects the environment and human health (for example, application of Best Available Techniques, generating renewable energy for own manufacturing, optimisation of textile auxiliaries, chemicals and dyestuffs, implementation of Voluntary Emissions Control Action Programme (VECAP)<sup>22</sup>).
- Giving preference for organic farming to eliminate the use of agro petrochemicals and minimise GHG emissions.
- Using low-emission sea and road freight and limiting or banning air freight.
- Advising and instructing consumers to adjust their use and domestic laundry habits to reduce the impact on climate; marketing ecological textiles.

### *Impact of green business practices on employment*

#### **Impact on quantity of jobs**

Employment forecasts for the textile sector suggest one of the largest negative effects of new climate change policies among the 10 target sectors, reaching up to -172,000 or -7.2% compared to the baseline scenario (Cambridge Econometrics et al, 2011; see Annex 3).<sup>23</sup> Overall employment (including other trends and not only climate change) in the sector is projected to decrease by 20%–27% of 2009 levels. The contracting production levels and the declining investment rates (the EU is a net divestor in the textiles industry) are in part to blame for the observed developments in employment (Oxford Research, 2010). Major climate change-related reasons behind these trends are related to certain factors that increase the risk of carbon leakage, for example international competitive pressure and negative or only very modest profit margins which are insufficient for the sector to sustain current levels of production with higher efficiency demands. Increase of jobs is likely in high-quality technical textile activities with specific characteristics, for example new types of materials to reduce weight and therefore energy costs, such as special textiles in vehicle construction (Heymann, 2007).

#### **Impact on quality of jobs**

##### **Skills development**

In general (with no particular attention to greening), the textiles sector falls under the category of industries that are experiencing a low level of up-skilling (Oxford Research, 2010). However, under the scenario of high impact of climate change, increasing energy prices, weakening globalisation and intensive greening of the industry, partial relocation of production back to Europe is expected, which could reinforce production activities and up-skilling processes (Economix, 2009). More technologically advanced niche markets (for example, protective or technical textiles) are expected to be the key drivers of change in the future and will require more specialists; next to textiles and apparel engineers, chemists, physicists and computer professionals will be highly demanded on the market. Innovation will require creativeness, unconventional thinking and cross-functional and interdisciplinary capabilities. Meanwhile, the traditional textiles subsectors are expected to experience high specialisation in craft-related production knowledge; besides fashion designers there will be a great need for craftspeople (for example, textile, garment, pelt, leather and shoemaking and related trades workers) who will revitalise old production technologies and promote repair and reuse activities. Occupations in production, marketing and business management will have to acquire strong ecological competences.

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<sup>22</sup> <http://www.vecap.info/>

<sup>23</sup> The baseline scenario already includes much existing environmental policy and any related labour market changes that it leads to (roughly half of the reduction in CO<sub>2</sub> emissions from 1990 levels required to meet the 20% emissions target is included). Minimum and maximum numbers include the effects of new environmental policies (in addition to the baseline scenario), rather than the general effects of all environmental measures. See Annex 3 for a more detailed explanation.



Technological development in the sector will heavily rely on eco-products and eco-technologies that will demand engineers and designers with a sound knowledge of both past and future technologies. Overall, a return of production will not increase the share of high-skilled people in the sector, but rather, will extend present skills to include knowledge of production processes and ecological impact.

**Career and employment security, health and well-being and reconciliation of working and non-working life**

No evidence for the significant impact of greening on other dimensions of job quality has been found. Greening may impact the gender composition and health of workers.

The textiles industry has been traditionally dominated by women, although they remain substantially underrepresented in managerial, technical and design occupations (Economix, 2009). Social partners could use the opportunity provided by greening to attract more women in the sector.

The sector is characterised by exposure to hazardous chemicals and materials. The emergence of novel materials (for example, smart interactive textiles) is likely to exacerbate the risks from potential dangerous substances involved in the manufacturing of the materials (EU-OSHA, 2011b).

**Approaches to anticipation and management of green change**

From a management perspective, the EU Eco-performance and Audit Scheme (EMAS) is an important tool for textile enterprises as it helps them monitor and improve the management processes for better environmental performance (Clotefi, 2010). Such focus on eco-performance can help attract skilled talent to the industry, particularly by improving the sector’s image as a sustainable industry that complies with environmental standards. As an integral part of greening, vocational training should promote the sustainability-based orientation through knowledge transfer in the areas of environmental protection and crafts-related skills (Economix, 2009). Technological clusters, such as the British School of Leather Technology and the BLC Leather Technology Centre, are shown to be effective at facilitating the knowledge and technology transfer (UK Leather Foundation, 2010). Examples of possible approaches to anticipate and manage green change at company level are provided in Table A9.

Table A9: *Example of anticipation and management of green change at company level in the textiles industry*

<b>Utenos Trikotazas (Lithuania)</b> Textiles producer	<b>Successori Reda (Italy)</b> Woollen clothing producer
<ul style="list-style-type: none"> <li>• Most information about opportunities to upgrade its production systems is obtained from the company’s suppliers and clients. Company representatives also participate in various exhibitions, especially international ones. Green business practices were initialised after participation in international exhibitions.</li> <li>• Company addresses green change through internal adaptation and instruction processes. Most of the changes represent technological improvements, which are addressed through manuals, instructions and quality control methods.</li> </ul>	<ul style="list-style-type: none"> <li>• Actions put in place to update employees’ skills are devised accordingly, with a clear difference between technicians (including research laboratories and technical assistants) with medium–high qualifications and blue collar workers at shop floor level, with medium–low qualifications. While the former undergo regular formal training as their process-related competences are mainly recognised skills (especially when new equipment is introduced), the latter develop long extensive experience-based tacit knowledge.</li> <li>• Task rotation is gaining wider ground as it allows workers to improve process knowledge and thus awareness while carrying out assigned tasks and cooperation with colleagues, thus increasing their employability in the unlikely case of company turmoil, and also increasing productivity and final product quality.</li> </ul>



**Marchi & Fildi (Italy)**  
Textiles producer

- Company actively trains new employees. The training of new craftspeople is a form of work shadowing where new craftspeople follow expert personnel who teach on the job how to work the material and issue the yarns. During the six-month training, two expert workers are particularly relevant: (a) the material specialist, a technician expert in evaluating the properties of raw materials, teaches the darning of material from different production batches and the selection of the colours most appropriate for their blending; and (b) the quality controller, a technician expert in evaluating the quality of each issued yarn, teaches how to assess the quality of single Ecotec yarns.
- Company also actively cooperates with the following local education institutes in implementing green business practice – an ecological line of products labelled Ecotec: (a) the state technical and industrial high school, ‘Q.Sella’ of Biella, which provides young and promising recruits as well as most of the company’s technicians; and (b) the Politecnico di Torino (University of Turin), which prepares engineers who later come to work at Marchi & Fildi.
- The company stresses the role of the local association of Biella’s industries, Unione Industriale Biellese (UIB), in providing information, courses and recruiting services. Marchi & Fildi carries out the training of its personnel internally, as its know-how is a unique strategic asset to properly transmit its textile art.

## Transport sector

### *Challenges arising from climate change*

- Demand for mobility (longer commuting distances, more international travel) leads to growing transport flows (especially in road and air transport) and hence more CO<sub>2</sub> emissions.
- Public pressure for cleaner and more energy-efficient transport, especially road and public transport (Wolfram, 2004) and road haulage.
- Rising energy prices, particularly pressuring the air transport sector (GHK, 2009b).
- Environmental policies – both a challenge and an opportunity for sector companies (Oxford Research, 2010), particularly in road transport; CO<sub>2</sub> pricing will particularly affect haulage and air transport (TNO et al, 2009f).

### *Motivations of business to mitigate climate change*

- Regulations such as the regulation setting emissions performance standards for new passenger cars (European Parliament, 2009) pose significant pressure for the sector and even more stringent regulatory measures are expected in the next few years.
- Rising prices of fuels and health and safety concerns encourage companies to introduce technological improvements to their products (EU-OSHA, 2011a).
- Increasing availability of innovative green technologies are incentives to introduce green change; in subsectors with intense competition, even small differences can matter in building a competitive advantage (interview with WWF representative).

### *Examples of green business practices*

- Intelligent transport systems, promotion of public transport over passenger cars, car sharing, travel avoidance strategies (for example, using teleconferences instead of meeting face to face with business partners and clients), rationalisation of movement in cities and transfer of transport from road to waterway or rail (Wolfram et al, 2005).
- Influencing consumer behaviour, working with supply chains (GHK, 2009b).
- Application of ICT-based training simulations to avoid using real vehicles for training and hence reduce fuel consumption (TNO et al, 2009f).
- Minimisation of land take for infrastructure.

### *Impact of green business practices on employment*

#### **Impact on quantity of jobs**

The transport sector accounts for 13.5% of global GHG emissions, of which 9.9% are produced by vehicles and 1.6% by aviation (Baumert et al, 2005). GHG emissions in the sector are probably the fastest growing due to the increasing international division of labour, the liberalisation of trade relations and the basic human need for mobility (Heymann, 2007). However, the impact of new climate change policies in the sector is likely to be small, ranging from -75,700 to +51,500 or -0.72% to +0.49% compared to the baseline scenario (see Annex 3).<sup>24</sup> The overall employment (including all trends and not only climate change) growth in the sector is forecasted to be positive: from 5%–6% of 2009 levels in the EU to 13%–21% growth in global sectoral employment (see Annex 3).

However, the impact of climate change on the quantity of jobs will be very different for each subsector due to different shares of environment-related employment in these sectors – approximately 7% for land transport, 25% for water and 25% for air (GHK et al, 2007).

The majority (approximately 65%) of transport workers are employed in the land transport subsector, which is continuously growing (especially cross-border freight transport) and responsible for 72% of total GHG emissions in the sector (Baumert et al, 2005). However, political actions (for example, likely further increases in petroleum tax, introduction of ecological tax for cars, application of road tolls even for cars) may curb growth and thus employment in the subsector. It is estimated that a more sustainable transportation policy could lead to fewer jobs in fuel refining and distribution, but will offer jobs in infrastructure development and the planning, running and maintenance of transit systems (for example, bus drivers, conductors, operators, route planners, maintenance staff) (UNEP, 2008). The estimated employment effects of new climate change policies in the road transport sector are relatively small and range from -50,600 to +38,000 or -0.55% to +0.41% compared to the baseline scenario; in general, overall employment (including all trends) in land transport is estimated to grow at 3%–4% of 2009 levels (see Annex 3). Eco-political measures (for example, possible reduction of VAT for rail, exemptions from the eco-tax for rail and public transport, infrastructure grants) and economic factors (for example, increasing urbanisation, rising fuel prices) may significantly increase jobs in the public and rail transport subsectors.

Employment forecasts of climate change policies for air transport (approximately 6% of all transport workers) are negative. For example, the estimated effects of new climate change policies range from -27,800 to +11,700 (-2.48% to +1.04% compared to the baseline scenario, see Annex 3). Negative employment scenarios may be more likely, as political actions in this area (for example, the aviation sector was included in EU ETS from January 2012) will make this mode of transport more expensive and this may curb the sector's growth potential and international competitiveness (if similar policy actions are not adopted by third countries), and thus result in fewer new jobs or even job losses. In general (including all trends), overall employment in the sector is expected to grow by 28%–33% of 2009 levels (Cambridge Econometrics et al, 2011; see Annex 3).

Employment in water transport (approximately 3% of all transport workers) is forecasted to decrease by 6%–7% of 2009 levels (see Annex 3). Although employment in the water transport subsector is around two-thirds of that in the air transport subsector, amounts of GHG emissions emitted by each subsector are roughly similar (Baumert et al, 2005).

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<sup>24</sup> The baseline scenario already includes much existing environmental policy and any related labour market changes that it leads to (roughly half of the reduction in CO<sub>2</sub> emissions from 1990 levels required to meet the 20% emissions target is included). Minimum and maximum numbers include the effects of new environmental policies (in addition to the baseline scenario), rather than the general effects of all environmental measures. See Annex 3 for a more detailed explanation.

International shipping often uses low-grade fuels (heavy oils with a high sulphur content) that are still largely exempt from taxes (Heymann, 2007). Thus, employment growth in the sector could be curbed by the likely introduction of new eco-political measures (for example, there are plans to include shipping emissions in the existing EU reduction commitment). However, forecasts show a rather positive impact of new climate change policies in the subsector, ranging from -200 to +2,700 (-0.08% to +1.07% compared to the baseline scenario, see Annex 3). This may suggest that cost structure and thus employment in the sector are rather insensitive to climate change policies (for example, further expansion of international trade and thus long-distance freight transport could offset negative effects of higher GHG emissions costs).

Regional impacts on the quantity of jobs must be also considered as, for example, expansion of rail or air transport activities could significantly contribute to an increase in employment in particular locations where it is concentrated (for example, large intermodal freight or passenger transport areas).

### Impact on quality of jobs

#### Skills development

The transport sector is one of the least knowledge intensive and one of the most labour intensive. In general (with no particular attention to greening), up-skilling in the sector is expected to be low (Oxford Research, 2010). However, greening could lead to a relatively high demand for certain groups of workers and to significant up-skilling of both new and existing workers. In the case of the green growth scenario, all subsectors are forecasted to experience an increased demand for business and logistics professionals, mechanics, drivers or pilots (except road transport) and freight handlers (except air transport) (TNO et al, 2009f). New types of fuel may require fuel retrofitting and conversion technicians, supervisors and workshop technicians, while increased use of car leasing schemes may lead to higher demand for car leasing clerks and managers (Strietska-Ilina et al, 2011).

Legal and regulatory knowledge in environmental issues, knowledge in handling clean fuels (for example, natural gas for vehicles (NGV), LPG, bio-fuels) and hybrid vehicles, flexibility, planning and process-optimising skills will become increasingly relevant during green growth (TNO et al, 2009f; GHK, 2009c). Under this scenario, business and logistics professionals will require skill improvements in nearly every area. Other occupations in demand will require certain sets of skills:

- analytical, interdisciplinary, technical and language abilities – for mechanics;
- intercultural competencies will be especially important for pilots, international ship officers and freight handlers;
- energy-efficient driving, dealing with alternative fuels and motor systems, new vehicle designs and reacting to vehicles that produce less noise – for road drivers;
- more new technological knowledge and high-speed driving skills – for rail drivers.

In the air transport subsector, greening may require strong R&D skills and new skills in carbon offsetting to compensate for flights taken (for example, project selection, carbon accounting and marketing) (Strietska-Ilina et al, 2011).

Overall, greening in the sector does not seem likely to create many new occupational profiles, but rather will demand considerable skill change within existing occupations (Strietska-Ilina et al, 2011). There may be some exceptional cases. For example, in some countries the expansion of public transport leads to the retraining of workers for new jobs. Managers of transport flows and logistic chain optimisers are the new green occupations (Strietska-Ilina et al, 2011). However, workers in some subsectors (such as haulage) may be very difficult to include in green training schemes due to widespread self-employment practices (interview with ETUC representatives).

### *Career and employment security, health and well-being and reconciliation of working and non-working life*

Some effects of greening are noticed across the other dimensions of job quality. The transport sector is heavily affected by outsourcing and offshoring (Oxford Research, 2010), which potentially compromises social dialogue and adequate social as well as health protection of the sector's increasingly globalised labour force. Although new jobs are likely to offset job losses, the new green jobs are not likely to be available for workers who lost their jobs, particularly those who are low skilled (Strietska-Ilina et al, 2011). Greening is not likely to change the dominance of self-employment in some subsectors (for example, haulage transport) with its negative effects on the career and employment security of such workers.

EU-OSHA identified that risks and health issues in green jobs in the sector are the same as in other jobs, as the major tasks do not change. However, new risks can be expected from electrical and hybrid vehicles during maintenance and operation (for example, due to the use of hydrogen) (EU-OSHA, 2011b). Deutsche Bahn, a transport company in Germany, includes health aspects such as train hygiene, noise, vibration and clean air management and radiation control in its environmental training for employees (Ecorys, 2010).

Work in the transport sector is very intensive, with low job autonomy, flexibility and safety in some subsectors (for example, haulage) (TNO et al, 2009f). Mostly large companies address this issue. Deutsche Bahn has an extensive environmental skills training system for its employees, which does not require overtime – training is offered within working hours (Ecorys, 2010). If working hours and rest time legislation is applied effectively in the road transport sector, this could have positive effects on job quality in this subsector. Furthermore, this could help society to opt for cleaner modes of transport, as competitiveness of rail and intermodal transport, in comparison with road, would increase in the case of effective application of legislation (ETUC et al, 2007).

Work–life balance and attracting more women to the sector (women are still very underrepresented) will partly depend on the development of unaccompanied transport (mostly road–rail transport) (ETUC et al, 2007). If unaccompanied transport expands, more drivers could be able to go home every evening, which would constitute a benefit for their work–life balance and could encourage the employment of women as drivers. Meanwhile, accompanied combined road–rail transport carries the risk of downgrading working conditions as, for example, the time spent in the train may be legally regarded as rest time for the driver, that is, unpaid (ETUC et al, 2007).

### *Approaches to anticipation and management of green change*

Anticipation and management approaches are often sectoral, involving public authorities and social partners. Public authorities are particularly interested in the development of public transport. One important challenge is including self-employed workers in the haulage subsector in the training scheme. Sectoral training funds in the sector try to address this issue (interview with ETUC representatives).

In Italy, public authorities, social partners and NGOs have agreed on better health and safety regulation, environmental risk management and new training for seafarers. In addition, a new trade union figure emerged at company level – workers' representative for health, safety and the environment, creating a synergy between health and environmental concerns (Syndex, 2011). In Germany, a cooperation of private companies and relevant authorities led to the development of integrated training solutions for bus drivers to equip them with fuel-efficient driving skills (TNO et al, 2009f).

Companies also try to collaborate with other actors in searching for more efficient transport modes and techniques (see Table A10).

Table A10: Examples of anticipation and management of green change at company level in the transport sector

<b>DPD (Germany)</b> Parcel service provider	<b>Green Cargo (Sweden)</b> National and international logistics company
<ul style="list-style-type: none"> <li>• In each distribution centre, DPD has created the position of a waste and sustainability manager. Sometimes, the new position was used to secure employment of persons who were no longer able to do physical work in the centre. They were retrained to give them a new opportunity in the company instead of having to dismiss them.</li> <li>• Cooperation with Aschaffenburg University has been established to strengthen ties between the company and research.</li> <li>• DPD has offered eco-driving courses for franchisees. The aim was to raise awareness of the company's franchisees concerning environmental responsibility and methods to save energy.</li> <li>• Environmental issues (especially energy efficiency in logistics and recycling techniques) have been made an integral part of every training activity, especially in the training for new apprentices in the fields of logistics, business accounting and communications.</li> </ul>	<ul style="list-style-type: none"> <li>• Member of international railway working group (Business to Business), which is working to develop CO<sub>2</sub> calculator to measure CO<sub>2</sub> impact of different transport modes for a given route. Working group meets regularly to improve this project and share their experience of positioning railway as a sustainable transport solution.</li> <li>• Cooperated with a local driving school to develop efficient driving practices for diesel locomotives. During the meetings, experiments and measurements of different driving techniques were carried out and the most efficient way of driving determined.</li> <li>• All Green Cargo employees go through an intranet-based general environmental training focusing on transport relation to climate change and relating the environmental issues to their daily work. It was developed by the internal sustainability expert and a hired external consultant specialising in freight transport and railway.</li> <li>• Company is a member at the Swedish Association for Environmental Management, which organises discussion meetings, trainings, seminars and conferences, providing ample opportunities for networking and anticipation of new green business concepts.</li> </ul>
<b>AENA (Spain)</b> Airport management and air navigation service provider	
<ul style="list-style-type: none"> <li>• Workers from AENA's Barcelona facility have attended training courses on efficient driving as part of the measures included in its business plan. Workers who attended these courses drive airport vehicles on a daily basis. These courses aim at changing driving patterns and habits, which might be reflected in a 10% fuel saving.</li> </ul>	

### Annex 3: Evidence for the impact of climate change on the quantity of jobs

<b>Impact of climate change on quantity of jobs, by sector, until 2020 (unless stated otherwise)</b>	
<b>Sector overview*</b> Employment (15–64-year-olds) in 2010: Absolute number and share of EU27 workforce <sup>a</sup>	<b>Projected change in job numbers</b>
<b>Automotive</b> Total: 2.8 million, 1.34%	<p><b>Syndex et al (2009):</b> Predicts net employment gain of 33,361 (1.17% of total EU sectoral employment in 2010) under a 'low hypothesis' scenario, 71,839 or 2.52% under 'median hypothesis' scenario and 120,552 or 4.24% under 'high hypothesis' scenario.</p> <p>Note: The low hypothesis scenario relies on a strong concentration among industry players to improve conventional engine types and existing technologies. It also rests on limited penetration by hybrids and minimal penetration by electric vehicles. The median hypothesis scenario relies on a big improvement to alternative technologies and engines rendered possible in part by a reduction in additional production costs. It also rests on a surge in hybrids and still limited penetration by electric vehicles. The high hypothesis scenario relies on a significant improvement to alternative technologies and a serious reduction in additional production costs. It also rests on a significant penetration by hybrids and modest penetration by electric vehicles.</p> <p><b>Cambridge Econometrics et al (2011):</b><sup>b</sup> Predicts sectoral employment levels to increase, maximum to 2,343,000 (105.4% of total EU sectoral employment in 2009)<sup>c</sup> under SS22 scenario and minimum to 2,319,000 (104.3%) under baseline scenario. The impact of new<sup>d</sup> climate change policies on employment ranges from +4,200 (+0.18%) under S3 to +23,700 (+1.02%) under SS22 scenarios compared to baseline scenario.</p>



Impact of climate change on quantity of jobs, by sector, until 2020 (unless stated otherwise)	
Sector overview* Employment (15–64-year-olds) in 2010: Absolute number and share of EU27 workforce <sup>a</sup>	Projected change in job numbers
<b>Automotive</b> Total: 2.8 million, 1.34%	<p><b>Short description of scenarios used:</b> Baseline (Base) – PRIMES Dec 2009 baseline (PRIMES – EU-wide energy model, is used for forecasting, scenario-making and policy impact analysis up to the year 2030 (see European Commission, 2010b)); the economic crisis and subsequent recession are included in the baseline scenario; Reference (Ref) – PRIMES April 2010 reference scenario; Regulation (S3) – Same targets as reference case but achieved purely through regulation; Market-based instruments (MBI) (S4) – Same targets as reference case but achieved purely through MBIs; 30% target (S5) – GHG reduction target of 30% instead of the 20% targets in the reference case using the same mix of policies. ETS and non-ETS split information from Directorate-General for Climate Action (DG CLIMA) communication; Energy-efficiency objective (S6) – Additional to the reference scenario, the 20% energy-efficiency objective is met through a mixture of MBIs and regulation; Rest of the world action (SS1) – Reference case run with rest of the world taking similar environmental actions to the EU (reflected in increase in extra-EU import prices); Baseline with high oil price (SS21) – Baseline run with a higher oil price assumption; Reference case with high oil price (SS22) – Reference case run with a higher oil price assumption.</p>
<b>Chemicals</b> Total: 3.8 million, 1.77% Chemical products: 1.4 million, 0.64% Pharmaceuticals: 0.8 million, 0.38% Rubber and plastics: 1.6 million, 0.75%	<p><b>Cambridge Econometrics et al (2011):</b> Predicts sectoral employment levels to change from 3,424,000 (100.5% of total EU sectoral employment in 2009) under S6 scenario to 3,334,000 (97.9%) under SS21 scenario. The impact of new climate change policies on employment ranges from -53,400 (-1.58%) under SS21 to +36,300 (+1.07%) under S6 scenarios compared to baseline scenario. For scenario description, see automotive section.</p> <p><b>Chemical products:</b> Maximum increase to 1,249,000 (102.7% of 2009 levels) under S6 scenario and minimum to 1,228,000 (101%) under SS21 scenario. The impact of new climate change policies on employment ranges from -7,800 (-0.63%) under SS21 to +13,200 (+1.07%) under S6 scenarios compared to baseline scenario.</p> <p><b>Pharmaceuticals:</b> Maximum increase to 576,000 (112.7% of 2009 levels) under S4 and S5 scenarios and minimum to 574,000 (112.3%) under baseline scenario. The impact of new climate change policies on employment ranges from 400 (+0.07%) under S6 to +2,000 (+0.35%) under S5 scenarios compared to baseline scenario.</p> <p><b>Rubber and plastics:</b> Maximum decrease to 1,532,000 (91.2% of 2009 levels) under SS21 scenario and minimum to 1,603,000 (95.3%) under S6 scenario. The impact of new climate change policies on employment ranges from -46,200 (-2.93%) under SS21 to +22,700 (+1.44%) under S6 scenarios compared to baseline scenario.</p>
<b>Construction</b> Total: 16.4 million, 7.72% <sup>e</sup> Construction of buildings: 5.6 million, 2.61% Civil engineering: 1.8 million, 0.83% Specialised construction: 9.1 million, 4.27%	<p><b>Cambridge Econometrics et al (2011):</b> Predicts sectoral employment levels to decrease maximum to 14,794,000 (91.4% of total EU sectoral employment in 2009) under SS21 scenario and minimum to 15,499,000 (95.7%) under S6 scenario. The impact of new climate change policies on employment ranges from -291,000 (-1.93%) under SS21 to +413,000 (+2.74%) under S6 scenarios compared to baseline scenario. For scenario description, see automotive section.</p> <p><b>ETUC et al (2007):</b> Alternative Eurima (European Insulation Manufacturers Association) scenario: 0.7–2 million gross jobs (4.27%–12.2% of 2010 sector employment created across the EU25 by 2017 (that is, over 10 years), owing to extended reach of regulation.</p> <p><b>IIASA (2006):</b> 1.6% employment gain in EU15 construction sector in 2020. Scenario: strong sustainability (reduced material and energy use of 30%–40%) versus baseline (no additional policy measures implemented for sustainable resource management).</p>
<b>Distribution and trade</b> Total: 29.94 million, 14.1% Wholesale, retail, repair of motor vehicles: 3.9 million, 1.86% Wholesale trade except motor vehicles: 7.3 million, 3.42% Retail trade except motor vehicles: 18.7 million, 8.82%	<p><b>Cambridge Econometrics et al (2011):</b> Predicts sectoral employment levels to increase maximum to 35,164,000 (105.2% of total EU sectoral employment in 2009) under S5 scenario and minimum to 35,047,000 (104.8%) under SS22 scenario. The impact of new climate change policies on employment ranges from -95,200 (-0.27%) under SS21 to +30,000 (+0.09%) under S5 scenarios compared to baseline scenario. For scenario description, see automotive section.</p> <p><b>Distribution (wholesale, retail, repair of motor vehicles) and wholesale trade (except motor vehicles):</b> Increase maximum to 16,439,000 (106.6% of 2009 levels) under S4 scenario and minimum to 16,286,000 (105.7%) under SS21 scenario. The impact of new climate change policies on employment ranges from -139,000 (-0.84%) under SS21 to +14,700 (+0.09%) under S4 scenarios compared to baseline scenario.</p> <p><b>Retail trade:</b> Maximum increase to 18,756,000 (104% of 2009 levels) under SS22 scenario and minimum to 18,710,000 (103.8%) under baseline and SS1 scenarios. The impact of new climate change policies on employment ranges from +400 (+0.00%) under SS1 to +45,700 (+0.24%) under SS22 scenarios compared to baseline scenario.</p>

Impact of climate change on quantity of jobs, by sector, until 2020 (unless stated otherwise)	
Sector overview*	Projected change in job numbers
<p>Employment (15–64-year-olds) in 2010: Absolute number and share of EU27 workforce <sup>a</sup></p>	
<p><b>Energy</b> Total: 3.2 million, 1.51% <sup>f</sup> Electricity, gas, steam and air conditioning supply: 1.6 million, 0.78% Water collection, treatment and supply: 0.4 million, 0.21% Sewerage: 0.2 million, 0.07% Waste collection, treatment and disposal activities; materials recovery: 0.9 million, 0.42% Remediation activities and other waste management services: 0.1 million, 0.03% Renewable energy (direct and indirect): 1.4 million or 0.64% of EU27 workforce in 2005 (Ragwitz et al, 2009)</p>	<p><b>UNEP (2011):</b> Rise of global energy sector employment from 5% under business as usual scenarios (resource exploitation; fossil fuels; job creation) to 10.5% under green scenarios (resource efficiency; renewable energy; job creation).</p> <p><b>Slingenberg et al 2008:</b> +1,040,000 direct and indirect jobs in resource management (water supply, recycled materials, renewable energy production and non-energy-related occupations) – approximately +32.5% of total EU employment in energy sector in 2010.</p> <p><b>Electricity, gas, steam and air conditioning supply and water collection, treatment and supply</b> <b>Cambridge Econometrics et al (2011):</b> Predicts sectoral employment levels to maximum decrease to 1,368,000 (81.7% of EU sectoral employment in 2009) under S6 scenario and minimum to 1,413,000 (84.4%) under baseline scenario. The impact of new climate change policies on employment ranges from -44,900 (-3.18%) under S6 to -11,000 (-0.79%) under S4 scenarios compared to baseline scenario. For scenario description, see automotive section.</p> <p><b>Electricity, gas, steam and air conditioning supply</b> <b>Cambridge Econometrics et al (2011):</b> Predicts sectoral employment levels to decrease maximum to 1,027,000 (79.6% of EU sectoral employment in 2009) under S6 scenario and minimum to 1,072,000 (83%) under baseline scenario. The impact of new climate change policies on employment ranges from -44,900 (-4.19%) under S6 to -11,000 (-1.04%) under S6 scenarios compared to baseline scenario.</p> <p><b>GHK et al (2007):</b> +251,000–277,000 direct full-time equivalent (FTE) jobs (15.24%–16.82% of EU sectoral employment in 2010) and about 27,000–30,000 indirect FTE jobs in electricity sector.</p> <p><b>ETUC et al (2007):</b> -65,000 FTE jobs (3.95% of EU sectoral employment in 2010) in energy generation.</p> <p><b>EPSU et al (2011):</b> from 2005 to 2030: +0.1 (baseline) to -4.6% in solids; -50% (7,000 jobs) in power plants with heavy fuel oil; -0.1 to -1% in nuclear; +1.5 to +2.9% in gas. +278,600 jobs from 2005 to 2012 in smart meters installation, +139,700 jobs in 2012 to 2018 in smart meters maintenance, with -26,000 in obsolete jobs.</p> <p><b>Gas supply</b> <b>Cambridge Econometrics et al (2011):</b> Predicts sectoral employment levels to decrease maximum to 108,600 (67.6% of EU sectoral employment in 2009) under S6 scenario and minimum to 209,700 (78.5%) under baseline scenario. The impact of new climate change policies on employment ranges from -29,100 (-13.88%) under S6 to -3,800 (-1.81%) under S4 scenarios compared to baseline scenario.</p> <p><b>Water collection, treatment and supply</b> <b>Cambridge Econometrics et al (2011):</b> Predicts sectoral employment will decrease to 341,100 (89.1% of EU sectoral employment in 2009). The impact of new climate change policies on employment is 0.</p> <p><b>Seifert (2009):</b> +5,500 jobs (approximately 1.25% of EU sectoral employment in 2010) under consumption reduction policy.</p> <p><b>Sewerage</b> No climate change-related projections are available.</p> <p><b>Waste</b> <b>UNEP (2011):</b> 10% increase in global job numbers (over business-as-usual figures) in waste sector.</p> <p><b>Renewable energy</b> <b>Slingenberg et al (2008):</b> +650,000 jobs (46% of EU sectoral employment in 2005) in renewable energy.</p> <p><b>EREC (2010):</b> +490% if the most optimistic scenario (30%–36% annual growth) is followed.</p> <p><b>Strietska-Ilina et al (2011):</b> +400,000–500,000 jobs (direct and indirect).</p> <p><b>UNEP (2008):</b> +1.4–1.5 million direct and indirect jobs.</p> <p><b>ETUC et al (2007):</b> +50% jobs.</p> <p><b>Biofuels</b> +300,000 (Neuwahl et al for ZEW, 2008, cited in Cambridge Econometrics et al, 2011) +30% FTE (Seifert, 2009).</p>



Impact of climate change on quantity of jobs, by sector, until 2020 (unless stated otherwise)	
Sector overview* Employment (15–64-year-olds) in 2010: Absolute number and share of EU27 workforce <sup>a</sup>	Projected change in job numbers
<p><b>Energy</b> Total: 3.2 million, 1.51% <sup>f</sup> Electricity, gas, steam and air conditioning supply: 1.6 million, 0.78% Water collection, treatment and supply: 0.4 million, 0.21% Sewerage: 0.2 million, 0.07% Waste collection, treatment and disposal activities; materials recovery: 0.9 million, 0.42% Remediation activities and other waste management services: 0.1 million, 0.03% Renewable energy (direct and indirect): 1.4 million or 0.64% of EU27 workforce in 2005 (Ragwitz et al, 2009)</p>	<p><b>Wind</b> +329,000 (EWEA, 2009), or +16% (Seifert, 2009), or +5.3%–21.2% from 2005 to 2030 (EPSU et al, 2011).</p> <p><b>Solar thermal</b> +14% (Seifert, 2009).</p> <p><b>Hydro</b> +0.3%–0.4% (EPSU et al, 2011) or 1% (Seifert, 2009).</p> <p><b>PV</b> +12% (Seifert, 2009).</p> <p><b>Biomass</b> +26% (Seifert, 2009), or +4.3%–8.1% from 2005 to 2030 (EPSU et al, 2011).</p>
<p><b>Furniture</b> Total: 1.2 million, 0.58% <sup>g</sup></p>	<p><b>Wood and paper subsector</b> <b>Cambridge Econometrics et al (2011):</b> Predicts sectoral employment levels to increase maximum to 1,937,000 (104.5% of total EU sectoral employment in 2009) under S6 scenario and minimum to 1,880,000 (101.4%) under SS21 scenario. The impact of new climate change policies on employment ranges from -38,900 (-2.03%) under SS21 to 18,500 (+0.96%) under S6 scenarios compared to baseline scenario. For scenario description, see automotive section.</p> <p><b>Manufacturing NES sector</b> <b>Cambridge Econometrics et al (2011):</b> Predicts sectoral employment levels to increase maximum to 2,635,000 (116.2% of total EU sectoral employment in 2009) under S6 scenario and minimum to 2,512,000 (110.8%) under SS21 scenario. The impact of new climate change policies on employment ranges from -112,000 (-4.28%) under SS21 to +10,800 (+0.41%) under S6 scenarios compared to baseline scenario. For scenario description, see automotive section.</p>
<p><b>Non-metallic materials</b> Total: 1.4 million, 0.66% EU25 employment in cement industry: 53,300 or 0.03% of overall employment in 2003 (Cambridge Econometrics et al, 2011)</p>	<p><b>Cambridge Econometrics et al (2011):</b> Predicts sectoral employment levels to increase maximum to 1,574,000 (94.9% of total EU sectoral employment in 2009) under baseline scenario and minimum to 1,592,000 (96%) under SS22 scenario. The impact of new climate change policies on employment ranges from +2,600 (+0.17%) under SS1 to +17,900 (+1.14%) under SS22 scenarios compared to baseline scenario. For scenario description, see automotive section.</p> <p><b>Cement subsector</b> <b>Boston Consulting Group 2008 (industry-sponsored research):</b> Loss of up to 35,000 direct jobs (~87% of expected employment in 2020). Key model assumption: enforcement of the EU ETS Directive (dated January 2008) for the 2013 to 2020 period: 20% of cement industry emissions permits will be auctioned in 2013 and then linearly increased up to 100% by 2020.</p> <p><b>ETUC et al (2007):</b> Net employment loss of 8,000–20,000 (15%–37.5% of total EU25 employment in the industry in 2003) expected by 2030.</p> <p><b>IIASA (2006):</b> Employment loss of 1% in the EU15 in 2020. Scenario: strong sustainability (reduced material and energy use of 30%–40%) versus baseline (no additional policy measures implemented for sustainable resource management).</p>
<p><b>Shipbuilding</b> Total: 0.3 million and 0.14% in 2006 <sup>h</sup></p>	<p>No climate change-related projections are available.</p> <p><b>Ikei (2009) (general projection):</b> 400,000 (132.32% of 2006 levels) under scenario 1. The economic slowdown is short, with a rapid recovery of world and EU economy; European economy grows at similar pace as recently (2% a year); world trade keeps on growing at a similar rate as in the last 5–10 years; moderation of fuel prices; regulatory framework helps compensate the short slowdown and fosters demand of specialised ships; no major financial restrictions for shipbuilding activity; high investment in R&amp;D activities in EU, cooperation and intellectual property rights (IPR) safeguard; capacity and production of third countries keeps on growing at high level; but their technological level lags behind that of European shipyards.</p> <p>270,000 (89.31% of 2006 levels) under scenario 4. Long-term crisis (recession); growth of world trade is severely affected; regulatory framework is not able to compensate (other sectors' demands); financial restriction particularly affects a sector such as shipbuilding; reduction of R&amp;D sectoral investments; capacity and production of third countries keeps on growing at high pace; their technological level develops rapidly (especially in China).</p>
<p><b>Textiles</b> Total: 2.5 million, 1.19% <sup>i</sup> Textiles: 0.7 million, 0.34% Wearing apparel: 1.4 million, 0.64% Leather and related products: 0.4 million, 0.21%</p>	<p><b>Textiles, clothing and leather subsector</b> <b>Cambridge Econometrics et al (2011):</b> Predicts sectoral employment levels to decrease maximum to 2,213,000 (73.4% of total EU sectoral employment in 2009) under SS21 scenario and minimum to 2,400,000 (79.6%) under S5 scenario. The impact of new climate change policies on employment ranges from -172,000 (-7.2%) under SS21 to 15,100 (+0.63%) under S5 scenarios compared to baseline scenario. For scenario description, see automotive section.</p>

Impact of climate change on quantity of jobs, by sector, until 2020 (unless stated otherwise)

Sector overview* Employment (15–64-year-olds) in 2010: Absolute number and share of EU27 workforce <sup>a</sup>	Projected change in job numbers
<p><b>Transport</b> Total: 9 million, 4.24% Land transport and transport via pipelines: 5.8 million, 2.75% Water transport: 0.3 million, 0.14% Air transport: 0.5 million, 0.22% Warehousing and support activities for transportation: 2.4 million, 1.13%</p>	<p><b>UNEP (2011):</b> Rise of global transport sector employment from 12.9% under business as usual scenarios (resource exploitation; fossil fuels; job creation) to 21.4% under green scenarios (resource efficiency; renewable energy; job creation).</p> <p><b>Cambridge Econometrics et al (2011):</b> Maximum increase to 10,628,000 (106.5% of total EU sectoral employment in 2009) under S6 scenario and minimum to 10,501,000 (105.2%) under SS21 scenario. The impact of new climate change policies on employment ranges from -75,700 (-0.72%) under SS21 to +51,500 (+0.49%) under S6 scenarios compared to baseline scenario. For scenario description, see automotive section.</p> <p><b>Land transport</b> <b>ETUC et al (2007):</b> Employment in public road transport decreases from 1,949,048 in 2010 to 1,892,348 in 2020 (97.01% of 2010 levels) under reference (business as usual) scenario and increases from 3,192,419 in 2010 to 4,610,354 (144.42% of 2010 levels) under extended policy scenario.</p> <p><b>ETUC et al (2007):</b> Employment in rail passenger transport increases from 2,068,220 in 2010 to 2,216,943 in 2020 (107.19% of 2010 levels) under reference (business as usual) scenario and from 3,457,852 to 5,312,926 (153.65% of 2010 levels) under extended policy scenario.</p> <p><b>ETUC et al (2007):</b> Employment in rail freight transport increases from 292,207 in 2010 to 306,309 in 2020 (104.83% of 2010 levels) under reference (business as usual) scenario and from 370,276 in 2010 to 537,756 in 2020 (145.23% of 2010 levels) under extended policy scenario.</p> <p><b>ETUC et al (2007):</b> Employment in truck transport increases from 3,994,428 in 2010 to 4,882,571 in 2020 (122.23% of 2010 levels) under reference (business as usual) scenario and from 3,518,240 in 2010 to 3,775,150 in 2020 (107.3% of 2010 levels) under extended policy scenario.</p> <p><b>Land transport and warehousing</b> <b>Cambridge Econometrics et al (2011):</b> Maximum increase to 9,242,000 (104.4% of 2009 levels) under S6 scenario and minimum to 9,153,000 (103.4%) under SS21 scenario. The impact of new climate change policies on employment ranges from -50,600 (-0.55%) under SS21 to +38,000 (+0.41%) under S6 scenarios compared to baseline scenario. For scenario description, see automotive section.</p> <p><b>Water transport</b> <b>Cambridge Econometrics et al (2011):</b> Maximum decrease to 251,000 (92.7% of 2009 levels) under SS1 scenario and minimum to 254,000 (93.8%) under SS1 and SS2 scenarios. The impact of new climate change policies on employment ranges from -200 (-0.08%) under SS1 to 2,700 (+1.07%) under SS21 scenarios compared to baseline scenario.</p> <p><b>Air transport</b> <b>Cambridge Econometrics et al (2011):</b> Maximum increase to 1,132,000 (133.1% of 2009 levels) under S6 scenario and minimum to 1,093,000 (128.4%) under SS21 scenario. The impact of new climate change policies on employment ranges from -27,800 (-2.48%) under SS21 to 11,700 (+1.04%) under S6 scenarios compared to baseline scenario.</p>

Notes: \* 2010 employment data by sector in left column is based on EU LFS and NACE rev. 2 classification. However, most, if not all, available forecasts are based on NACE rev. 1.1.

<sup>a</sup> Eurostat: overall employment (15–64 years) in the EU27 is approximately 212.4 million (see LFS data at [http://epp.eurostat.ec.europa.eu/portal/page/portal/employment\\_unemployment\\_ifs/data/database](http://epp.eurostat.ec.europa.eu/portal/page/portal/employment_unemployment_ifs/data/database)).

<sup>b</sup> Target sectors are not fully represented in these forecasts as they are based on NACE rev. 1.1 and not on NACE rev. 2 classification. Most recent (2009) employment data based on NACE rev. 1.1 and used in Cambridge Econometrics et al (2011) are therefore applied to ensure comparability of results against historical data.

<sup>c</sup> Historical Eurostat national accounts employment data used in E3ME model forecasts in Cambridge Econometrics et al (2011) and based on NACE rev. 1.1 (ensures comparability of historical and forecasted employment figures).

<sup>d</sup> Baseline scenario (based on PRIMES December 2009 baseline, see scenario description in the table) already includes much existing environmental policy and any related labour market changes that it leads to. Roughly half of the reduction in CO<sub>2</sub> emissions from 1990 levels required to meet the 20% emissions target is included in the baseline case. Other scenarios (Ref, S3, S4, S5, S6, SS1, SS21 and SS22, see scenario description in the table) include the impacts of new environmental policies, rather than the general effects of all environmental measures. If a starting point in which there is no environmental policy had been used, the impacts would undoubtedly have been larger but within the same order of magnitude and thus general trends and conclusions from the exercise would not be changed (Cambridge Econometrics et al, 2011).

<sup>e</sup> Eurostat: includes only F41 Construction of buildings, F42 Civil engineering and F43 Specialised construction activities. Data are available only at NACE rev. 2 two-digit level. Therefore, other activities (at three- or four-digit level) are not included in the numbers.

<sup>f</sup> Eurostat: includes all activities, including E38.31 Dismantling of wrecks, which is not possible to take out as data at NACE rev. 2 three- or four-digit level are not available.

<sup>g</sup> Eurostat: includes only C31 Manufacture of furniture. Data are available only at NACE rev. 2 two-digit level. Therefore, other activities (at three- or four-digit level) are not included in the numbers.

<sup>h</sup> Eurostat: data are not available at NACE rev. 2 three- or four-digit level. Therefore, 2006 employment data are provided based on Ikei (2009).

<sup>i</sup> Eurostat: includes only C13 Manufacture of textiles; C14 Manufacture of wearing apparel; and C15 Manufacture of leather and related products. Data are available only at NACE rev. 2 two-digit level. Therefore, other activities (at three- or four-digit level) are not included in the numbers.

#### Annex 4: List of interviewed stakeholders

No.	Surname, name	Organisation	Position	Date
1.	SZOVIČS, Peter	Institute of Banking Education of the National Bank of Slovakia (formerly Cedefop)	Director; formerly Project Manager (responsible for the Skills for Green Jobs study)	16.08.2011
2.	POLLITT, Hector	Cambridge Econometrics	Associate Director, International Modelling	06.10.2011
3.	WILSON, Robert A.	Institute for Employment Research, University of Warwick	Professorial Fellow and Deputy Director	07.10.2011
4.	MOCCIA, Jacopo	EWEA (European Wind Energy Association)	Head of Policy Analysis	11.10.2011
5.	KOULOURI, Angeliki	EWEA (European Wind Energy Association)	Research Officer	11.10.2011
6.	LUKEN, Reinhard	CESA (Community of European Shipyards' Associations)	Secretary General	11.10.2011
7.	LUCA, Lidia	CESA (Community of European Shipyards' Associations)	Policy Advisor	11.10.2011
8.	D'HAESELEER, Steven	BusinessEurope	Director Social Affairs Department	12.10.2011
9.	LENA, Guido	UEAPME (European Association of Craft, Small and Medium-sized Enterprises)	Director for Sustainable Development	13.10.2011
10.	DI STEFANO, Amalia	CLEPA (European Association of Automotive Suppliers)	Deputy CEO	13.10.2011
11.	CAMPOGRANDE, Domenico	FIEC (Federation de l'Industrie Européenne la Construction)	Director for Social Affairs	13.10.2011
12.	STRIETSKA-ILINA, Olga	Skills and Employability Department, International Labour Organization	Specialist in Skills Policies and Systems	13.10.2011
13.	PANNEELS, Anne	ETUC (European Trade Union Confederation)	Advisor	14.10.2011
14.	KIRTON-DARLING, Judith	ETUC (European Trade Union Confederation)	Confederal Secretary	14.10.2011
15.	ANDERSON, Jason	WWF Europe	Head of European Climate and Energy Policy	14.10.2011
16.	WOLTERS, Michael	EMCEF (European Mine, Chemical and Energy Workers' Federation)	Secretary General	14.10.2011
17.	GALGOCZI, Bela	European Trade Union Institute (ETUI)	Senior Researcher	18.10.2011
18.	STRAUSS, Robert	European Commission, DG EMPL, Unit - Employment Analysis	Head of Unit, EC delegate for OECD LEED programme	18.10.2011
19.	WHITE, Stephen	European Commission, DG ENV, Unit - Chief Economist, Impact Assessment and Evaluation	Socio-economic Analyst - Impact assessment, socio-economic assessments	19.10.2011
20.	BEVERS, Tom	FPS Employment, Labour and Social Dialogue, Belgium	Advisor	19.10.2011
21.	LAMBERT, Jean	European Parliament	Green MEP for London	19.10.2011
22.	STOYNOVA, Damyana	European Commission, DG CLIMA	Policy Officer, Strategy and Economic Assessment	20.10.2011
23.	PEARCE, Sarah	UNISON Centre (formerly TUC)	Assistant National Officer, Local Government, Police and Justice Section (formerly Green Workplaces project leader)	03.11.2011

<b>No.</b>	<b>Surname, name</b>	<b>Organisation</b>	<b>Position</b>	<b>Date</b>
24.	VELIKONJA, Monika	European Commission, DG EMPL, Unit A1 - Employment Analysis	Policy Officer	04.11.2011
25.	DE TURCK, Bart	European Furniture Manufacturers Federation (UEA)	Secretary General	30.11.2011
26.	SPELKENS, Jacques	GDF SUEZ	CSR Manager for Belgium	19.12.2011
27.	VIAGGI, Riccardo	European Builders Confederation (EBC)	Secretary General	27.01.2012

