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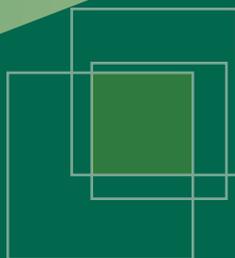


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## **TOWARDS A GREENER ECONOMY: THE SOCIAL DIMENSIONS**

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# **TOWARDS A GREENER ECONOMY: THE SOCIAL DIMENSIONS**

INTERNATIONAL LABOUR ORGANIZATION  
INTERNATIONAL INSTITUTE FOR LABOUR STUDIES

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# FOREWORD

Economic growth has entailed a deterioration in global climate conditions which now threatens to undermine prosperity. However, as countries grapple with persistent unemployment, rising fiscal deficits and uncertainties in the global economic outlook, a window of opportunity has opened up to reshape the patterns of growth. In particular, policy-makers have realized that promoting a transition towards a green economy can not only help to address climate change but, if the right policies are put in place, can also pave the way to a more inclusive and sustainable global economy.

This report is the result of a cooperation project between the Directorate-General for Employment, Social Affairs, and Inclusion of the European Commission and the International Institute for Labour Studies of the ILO. Its purpose is to better understand the nature of the green economy and the implications for labour markets. It shows that a double dividend – encompassing greater decent work opportunities and a greener economy – is possible, provided that adequate complementarities between environmental, economic and social policies are created. The report draws upon a series of background discussion papers also produced as part of the cooperation project.

The report has been prepared by Daniel Samaan (International Institute for Labour Studies) with contributions from Matthieu Charpe, Ekkehard Ernst, Byung-jin Ha and Steven Tobin (International Institute for Labour Studies) as well as Unurjargal Nyambuu and Stephen Stolte (external collaborators). The

formatting and layout of the publication has been prepared by Thuy Nguyen Couture (International Institute for Labour Studies). The report has been prepared under the supervision of the Director of the Institute, Raymond Torres. The authors would like to thank Peter Poschen, Director of the Jobs Creation and Enterprise Development for his valuable comments. A preliminary draft of the findings was presented at a seminar organized in cooperation with the European Commission on 31 March 2011 in Brussels. The final report takes into consideration many of the comments received from experts, the social partners and other stakeholders during and following the seminar.

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# LIST OF ABBREVIATIONS

ARRP	American Recovery and Reinvestment Plan
BAU	Business as usual (scenario)
CEU	Central European University
CGE	Computable general equilibrium (model)
CO <sub>2</sub>	Carbon dioxide
DDH	Double-dividend hypothesis
EC	European Commission
EESA	Emergency Economic Stabilization Act
EGS	Environmental goods and services
EPPA	Emissions Prediction and Policy Analysis
ETR(s)	Environmental tax reforms
ETS	Emissions Trading System
EU	European Union
GEL	Global Economic Linkages (model)
GHG	Greenhouse gas
HCII	High-carbon-intensive industries
HSBC	Hongkong and Shanghai Banking Corporation
ICT	Information and communications technology
IGSM	Integrated Global System Model
IILS	International Institute for Labour Studies

ILO	International Labour Organization
IO	Input–output (techniques)
IPCC	Intergovernmental Panel on Climate Change
LCIS	Low-carbon-intensive sector
MIT	Massachusetts Institute of Technology
NAP(s)	National Allocation Plans
OECD	Organisation for Economic Co-operation and Development
PPRP	Public–private research partnerships
RBC	Real business cycle
SEIA	Solar Energy Industries Association

# EXECUTIVE SUMMARY AND POLICY RECOMMENDATIONS

*It is crucial to reduce CO<sub>2</sub> emissions and thus mitigate climate change . . .*

Policy-makers are acutely aware of the need to move to a greener economy – national science institutions and international networks of researchers have amply documented the phenomenon of global warming. Recent research confirms the damaging effects of climate change and points to the risk of a sudden shift in the world climate balance, leading to exponentially increasing costs in terms of individual well-being and economic activity.

Research also suggests that the speed and extent of climate change observed over the last 40 years is largely due to human economic activity, notably the use of carbon-intensive sources of energy for the production of goods and services, particularly in advanced economies. Indeed, changes in world temperature are closely linked to emissions in carbon dioxide (CO<sub>2</sub>) and other greenhouse gases. Slowing, and eventually controlling global warming will require significantly lowering the rate at which these gases are being emitted.

*...which can be achieved only through significant structural change.*

Moving to a greener economy requires a major structural change, which broadly takes two forms. First, new sources of clean energy need to be developed and widely disseminated. Second, the global economy will need to emit less CO<sub>2</sub>, which will entail significant shifts of production and consumption patterns

across industries and enterprises as well as within them. In particular, energy and resource efficiency of production processes need to increase considerably and consumption habits have to become more sustainable. Significant reductions in CO<sub>2</sub> emissions can also be obtained through technological and operational innovations within industries. In both instances, the shift to a greener economy will necessarily mean a reallocation of some resources from higher- to lower-carbon-intensive sectors, which will entail considerable employment and income shifts.

*Market forces alone will be insufficient in bringing about a reduction in CO<sub>2</sub> emissions ...*

To date, markets alone have been inadequate in addressing climate change – global emissions increased by more than 40 per cent between 1990 and 2008. For emissions to fall in a substantial manner and to a sustainable level, governments must take comprehensive actions. An effective strategy must combine market-based instruments with direct public intervention. In the first instance, CO<sub>2</sub> emissions must be allocated prices that properly take into account their environmental damage and the economic costs they cause. In this respect, the European Union (EU), which introduced the Emission Trading System (ETS) in 2005, should be commended. The ETS represents a significant step forward in pricing emissions and is one of few such systems in the world. Yet, a harmonized EU-wide CO<sub>2</sub> tax could complement the ETS and increase overall effectiveness while helping to address a number of shortcomings. In addition, these market-based measures could benefit from other instruments like regulations, public investment and increased promotion of research and development that encourage the development of new technologies and innovations.

*...and careful consideration must be given to the employment and income dynamics of the shift to a greener economy.*

Such a structural change is neither automatic nor painless. Indeed, the shift to a greener economy will entail significant changes for labour markets and incomes. Much of the adjustment in the high-carbon sector will occur in only a few industries – the report highlights the fact that the vast majority of emissions (90 per cent) in the EU-25 from production stems from only 15 industries. Approximately 12 per cent of total employment in the Member States – or some 24 million workers – are employed in these top polluting industries. The gap between EU-15 and EU-10 Member States is particularly striking – more than one-fifth of all employees in the EU-10 are working in the top 15 emitting industries, more than double the rate (9.5 per cent) than in EU-15 Member States.

At the same time, however, the report shows that a move to a more climate-friendly industry mix can generate positive net employment effects. Low-carbon industries tend to have a significantly larger share of the high-skilled workforce and are, on average, more productive. Moreover, the wage share in low-carbon-intensive industries has fallen less quickly than is the case in the top 15 emitting industries. The promotion of new technologies and process innovations will also lead to new products and new business opportunities, and ultimately, to greater employment opportunities.

*Economic, social and environmental goals can be consistent with one another if, first, environmental reforms are broadened...*

Making the transition to a green economy a success requires moving away from isolated environment reforms. So far, environmental policies have mainly focused on measures to mitigate climate change. Environmental tax reforms (ETRs) and regulations have been implemented in various European countries

aiming to remedy the market failures through changes in the tax structure in favour of less carbon-intensive production, or directly by requiring the use of certain technologies or the respect of maximum emission rates. Important as they are, however, these efforts will not be successful unless (i) they focus also on emissions arising from the production process (not only households' energy consumption); and (ii) labour market policies and social policies become an integral part of the policy package.

In terms of the former, re-orienting the current structure of the ETRs to also tax production processes would improve efficiency. Currently, the focus is narrowly restricted to households' energy consumption, despite the fact that over 80 per cent of emissions originate from firms' production of goods. Equity can also be improved by introducing personal energy allowances within the tax structure, that is, a certain amount of energy per household would be exempt from taxation, and reducing the regressive nature of the current ETRs in place.

The double-dividend hypothesis, from which ETRs were inspired, claims that the benefits to the environment and employment can be simultaneously achieved through a properly designed policy mix. However, a necessary condition for achieving the double dividend is that the revenue from taxing emissions is re-channelled to the labour market – which is not sufficiently the case. To achieve the economic and employment gains of environmental change, increased emphasis on labour market measures and knowledge development strategies will be necessary.

*...and second, emphasis is placed on improving employment prospects of the most vulnerable...*

A green transition is not unlike other structural adjustments with the exception that the adjustment process can be foreseen and thus, with the right policy mix, can be managed. Nevertheless, labour market adjustments and employment transitions are often particularly acute for certain groups of workers, for instance low-skilled and older workers. In order for the adjustment process to

be fair and equitable, the existing suite of policies will need to be re-oriented to address the challenges of those most affected by a green transition process.

With this in mind, first, governments and worker representatives can work with employers to take preventative action to identify early potential adjustment pressures in the top emitting industries. In particular, public authorities could work closely with vulnerable sectors to examine potential skills deficiencies and develop preventative strategies to ease the transition process. Second, greater emphasis will have to be placed on skills upgrading and training as many of the workers in the top emitting industries will have to adapt their skills and worker practices to a new, environment-friendly technology, or move to less carbon-intensive sectors. In fact, nearly 30 per cent of the workers in the top 15 emitting industries are low skilled. Third, some workers are also likely to incur earnings losses that can persist over time. As such, governments need to ensure that adequate income support systems are in place and are consistent with employment objectives. Finally, the successful delivery of these programmes will hinge on having a well-resourced, effective public employment service that has a firm grasp on the employment needs of a greener economy.

*... and third, strategies are developed to leverage the positive employment potential of a greener economy.*

There is considerable upside potential to leverage greener jobs to the benefit of the economy. First, new and decent jobs can be created in the environmental sector. Second, the transition itself from high-carbon industries to low-carbon industries can also yield employment benefits. Low-carbon industries provide already the largest portion of income in most EU Member States and tend to employ a higher-skilled labour force, while at the same time producing only a very small proportion of CO<sub>2</sub> emissions.

This will require that the existing education system and vocational training system be capable of equipping future workers and small and medium-sized businesses with the requisite breadth of competences needed to take full advantage of

the new technologies. In particular, mechanisms to facilitate the effective generation and transmission of knowledge between higher education institutions and business will be central. In particular, increased research and development activities need to be complemented by support for new technical skills, mainly related to the natural sciences and engineering. If the right human capital strategies are implemented, a green economy can unlock the potential of higher employment, better employment conditions and higher resource productivity.

*A fair and sustainable transition to a greener economy can only be achieved through effective social dialogue.*

Tripartite social dialogue can play an important role during the transition. Climate policies induce a long-term structural change in the economy that can only be successful and just if social partners support the transition and accompany government actions by adequate, employment-friendly measures. Vulnerable groups have to be given opportunities to participate in the structural change and to at least maintain their incomes during and after the transition. Long-term industrial policies need to be communicated to and coordinated with social partners. On the other hand, social partners can help to identify skills needs by encouraging research in certain areas, interpreting findings and informing policy and implementing recommendations in institutions that provide skills and vocational guidance. In cooperation with governments, social partners can ensure job security, working conditions and adequate compensation for researchers, engineers and other professions that are urgently needed to drive the necessary technological change for a successful green transition.

Greening of enterprises occurs within firms and can be promoted by social partners. Governments can support this process by developing knowledge platforms at the industry level and by implementing financial incentives in coordination with social partners. Social dialogue will also be central to setting incentives for more investment in resource productivity and making sure that efficiency gains are distributed in a just manner. Without the prospect of a successful and just green transition on a national level, the chances for binding international agreements on climate change issues remain very low.

# THE TRANSITION TO A GREENER ECONOMY

# 1

## Key findings

- The move towards a greener economy, i.e. one with lower CO<sub>2</sub> emissions, is essential for environmental sustainability. As part of this transition, the employment and income consequences need to be better understood and adequately considered.
- The vast majority of carbon emissions stems from the production of goods and services, rather than household consumption of energy, and emissions are caused by a relatively small group of industries:
  - Approximately 80 per cent of all CO<sub>2</sub> emissions occur in the production process and not from the direct energy consumption of households.
  - Among the emissions from production in the EU-25, roughly 85 per cent come from the top 15 polluting industries.

- The top four polluting industries – which remain unchanged over the past decade – include: electrical energy, gas, steam and hot water, coal and lignite, products of agriculture, hunting and related services and other non-metallic mineral products.
- Lowering CO<sub>2</sub> emissions is likely to be associated with significant change for firms and workers, especially those concentrated in the high-carbon industries:
  - Among the EU-25, close to 12 per cent of total employment – or some 24 million workers – are concentrated in the top 15 high-carbon industries. These industries also account for roughly a similar share of GDP in the EU-25, i.e. 12 per cent.
  - These shares are considerably higher among new EU Member States, i.e. the EU-10. In fact, although the top 15 CO<sub>2</sub>-emitting sectors account for roughly 13 per cent of GDP – similar in magnitude to the EU-25 – more than one-fifth of all jobs in the EU-10 are concentrated in these industries.

## Introduction

The purpose of this chapter is to look in more detail at the characteristics and structure of the “green” and “non-green” economy and give an overview of a number of policy considerations related to the green economy, notably as regards the implications on employment and income. In particular, Section A will begin briefly by defining the green economy, taking into consideration the diversity with which various international organizations have attempted to define “green” and highlighting the importance of being able to empirically measure the size of the green economy in order to better understand the implications of climate change. And while the process of greening the economy is in the first place an attempt to react to climate change and other environmental challenges, it will inevitably bring about a restructuring of the economy, affecting employment and income in many sectors. With this in mind, Section B discusses the potential labour market consequences associated with shifts

towards a greener economy. In particular, it examines in detail the industries that would be most affected by such a transition, including their employment and growth content. Finally, Section C concludes by introducing the different mechanisms that can trigger and drive the transition towards a green economy and the important role of policy in facilitating and managing change.

## A. A green economy is one where CO<sub>2</sub> emissions are low

Several definitions of green have been suggested by various organizations but no commonly accepted definition exists currently. It is, however, important to find working definitions of “green policies”, the “green economy” and “green jobs” so that comparability of different studies over time is possible and the impacts of environmental policies are measurable. As such, indicators and statistics are needed. Against the background of the existing definitions and taking into account the various considerations and limitations, this report equates the term “green” to the environmental function of a stable global climate and uses CO<sub>2</sub> intensity and CO<sub>2</sub> emissions as indicators for greenness.<sup>1</sup> Thus, a green economy is one where CO<sub>2</sub> emissions are consistent with environmental sustainability.<sup>2</sup>

It is important to note that one can think of a green economy in terms of other criteria of sustainability, but in the case of the European Union (EU), many economic aspects relating to the environment, such as greater efficiency of sewage systems and improved water quality have already been adequately addressed at the policy level. Additionally, in the context of the EU, levels of CO<sub>2</sub> emissions pose one of the most serious environmental challenges to the 27 Member States: although emissions fell by 5 per cent between 1990 and 2008,

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1. The limitations imposed by the proposed definition are rather small. For more information regarding aspects related to definitions and various employment categories of green and “green jobs” please see INST-EC Discussion Paper No. 10, 2011.

2. In this report, CO<sub>2</sub> emissions refer to all greenhouse gas (GHG) emissions. In environmental accounting, it is common practice to express other GHGs in terms of CO<sub>2</sub> equivalents in order to have one common accounting unit.

total emissions remain high by international standards.<sup>3</sup> In 2008, the EU-27 represented the third largest share of global emissions, behind only China and the United States.<sup>4</sup>

## 1. Identifying high-carbon-intensive industries

Accurate determination of industry-specific CO<sub>2</sub> intensity, that is, the carbon emissions per unit of value, requires summing-up both direct and indirect CO<sub>2</sub> emissions from industrial activity. Direct emissions refer to those emissions that stem from production processes within a given industry and indirect emissions refer to the emissions from the production of inputs used in those production processes (in other words, emissions from other industries). Determining total CO<sub>2</sub> intensities on an industry level, however, is quite data intensive and as such is not available for most countries. This report uses direct or production CO<sub>2</sub> intensities which are in fact a good proxy for total CO<sub>2</sub> intensities if used to determine a relative ranking of industries (see box 1.1).<sup>5</sup>

In terms of CO<sub>2</sub> emissions, it is important to highlight that most emissions (about 80 per cent) stem from the production process and not from the direct energy consumption of households (figure 1.1, left). In this regard, production has the largest impact on CO<sub>2</sub> emissions and thus, the largest potential for emissions reduction. This ratio is also remarkably stable over time and remains little changed since 1995. In addition, the high-carbon-intensive sector (HCIS) – which includes all industries above the median of CO<sub>2</sub> intensity – accounts for roughly 90 per cent of the emissions from production (figure 1.1, right).

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3. Based on calculations from the International Energy Agency (IEA) (2010), published in the report CO<sub>2</sub> Emissions from Fuel Combustion. Estimates of CO<sub>2</sub> emissions vary across organizations and agencies, based on differences in calculation methods.

4. In a global context, global emissions continue to rise, having increased by 40.1 per cent from 1990 to 2008.

5. See Samaan (2011).

**Box 1.1 Direct vs. total carbon intensity: The case of Germany**

Time-consistent, industry-specific data on the decomposition of direct and indirect CO<sub>2</sub> emissions are not available for most EU Member States. Data on CO<sub>2</sub> emissions have to be combined with annual input–output tables in which the industry classification matches with the classification of the emissions data. Few countries provide such detailed and time-consistent data. Germany, however, has comprehensive data from which direct CO<sub>2</sub> intensities can be calculated over time at the industry level.

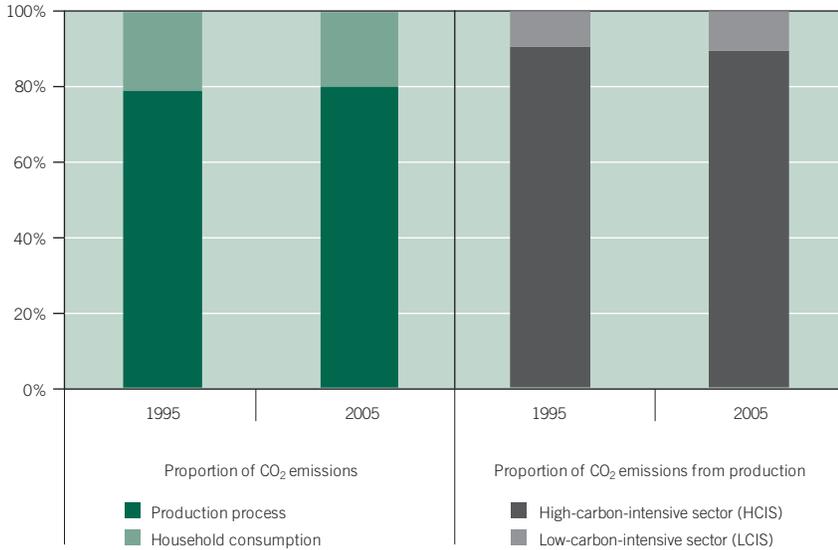
Given that similar data do not exist across most EU Member States, a detailed, comprehensive computation of total and direct CO<sub>2</sub> intensities has been performed on the basis of the German data set in order to determine an industry ranking according to levels of CO<sub>2</sub> emissions, i.e. a ranking of industries by level of carbon intensity. With this ranking, by establishing the median of CO<sub>2</sub> emissions across industries, industries can then be categorized belonging to the “high-carbon-intensive” sector or HCIS (above the median) and to the “low-carbon-intensive” sector or LCIS (below the median).

In addition, the *relative* ranking of industries is more-or-less preserved across countries, given that the carbon intensity of their production relative to other sectors remains comparable. This is largely due to the fact that the level of technological advancement in a given industry is usually similar to that of the same industry in another EU country. Indeed, similar rankings among countries with available industry-level CO<sub>2</sub> intensity data (the Netherlands, the United Kingdom and the United States) reveal that the relative rankings remain consistent across countries.

In terms of direct versus total CO<sub>2</sub> intensity, their values may differ considerably in absolute terms, and these differences can matter in analyses in which the actual value of the intensity is of importance. However, for a relative ranking, as applied in this report, direct and total CO<sub>2</sub> intensities lead to very similar results in terms of the compositions of high-carbon-intensive sectors. Therefore, only direct CO<sub>2</sub> intensities have been used to determine the relative intensities of industries within the economy.<sup>6</sup>

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6. More details about the calculation of CO<sub>2</sub> intensities can be found in the INST-EC Discussion Paper No. 16, 2011.

**Figure 1.1 Proportion of CO<sub>2</sub> emission, total and by production, 1995 and 2005**

Source: ILS estimates based upon EU KLEMS.

Moreover, a select few industries within the HCIS account for the bulk of these emissions. In fact, the top 15 emitting industries (among 36 high-carbon industries) account for approximately 85 per cent of all emissions arising from production.<sup>7</sup> Among these 15 industries, topping the list is the electrical energy, gas, steam and hot water industry, followed by coal, with air transport services ranking fifteenth (table 1.1). Moreover, these rankings appear very stable over time – the top four industries have actually remained the same since 2001 and only minor adjustments in the ranking of the others have occurred over this period.<sup>8</sup>

7. Overall, the HCIS accounts for 70 per cent of total emissions in the economy.

8. See also INST-EC Discussion Paper No. 16, 2011, Table 3.

**Table 1.1 Industry ranking, carbon intensity\***

Rank (from highest to lowest)	Industry
1	Electrical energy, gas, steam and hot water
2	Coal and lignite, peat
3	Products of agriculture, hunting and related services
4	Other non-metallic mineral products
5	Crude petroleum and natural gas
6	Basic metals
7	Sewage and refuse disposal services
8	Glass and glass products
9	Coke, refined petroleum products, nuclear fuel
10	Other land transportation services
11	Articles of paper and paper board
12	Manufactured gas and distribution services of gas
13	Pharmaceuticals, medicinal chemicals, botanical prod.
14	Chemicals, chemical products, manmade fibres
15	Air transport services

\* Refers to direct carbon intensity ( $\text{CO}_2/\text{output}$ ), which does not account for the  $\text{CO}_2$  emissions of inputs in production (total carbon intensity). Total carbon intensity is data intensive and direct carbon intensity serves as a good proxy.

Source: IILS estimates based upon EU KLEMS.

## B. Employment and social aspects of a greener economy

The move towards an economy associated with lower  $\text{CO}_2$  emissions is likely to bring forth a number of challenges and opportunities, notably regarding employment and income effects and also productivity and growth. At the outset, the net effect of these challenges – much like previous shifts in production, e.g. the impact of information and communication technologies during the 1990s – is ambiguous. In the first instance, it is likely to be associated with significant change for industries and workers concentrated in the HCIS, especially in the top 15 emitting industries. However, there may be employment gains (above

and beyond the environmental gains) in industries that contribute directly to achieving a sustainable economy, that is, industries that primarily seek to reduce CO<sub>2</sub> emissions and industries that operate at a low-carbon-intensive level.

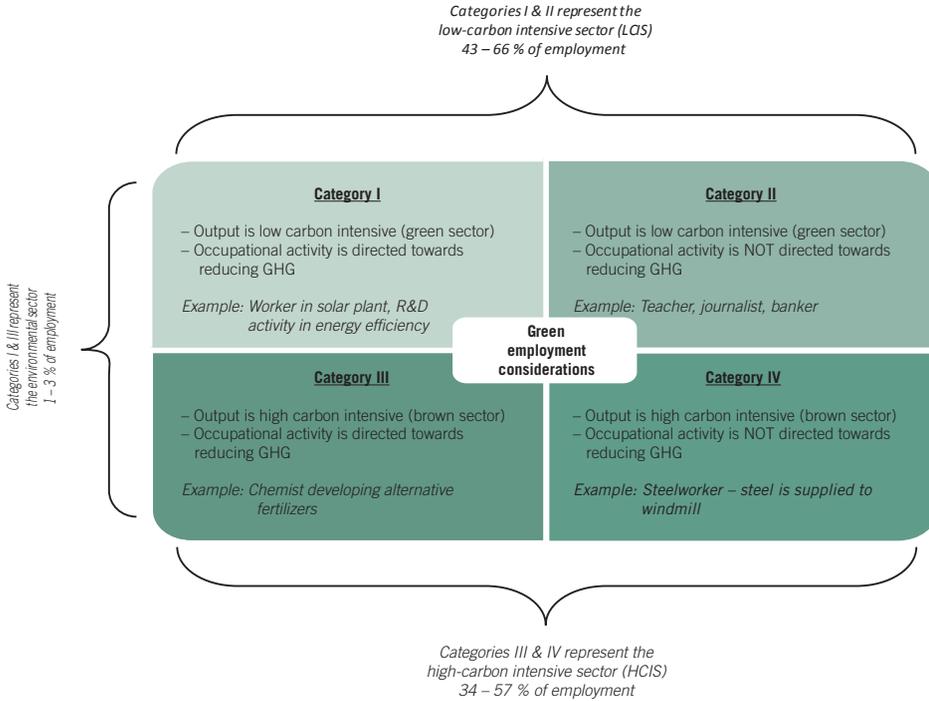
## 1. The environment and employment: key considerations

One of the main concerns for policy-makers is the overall employment effects of greening the economy. In this respect, categorizing employment into “green”, “less green” and “not green” will help to better understand the main characteristics of the transition process and the related challenges and opportunities. In particular, employment can be grouped into four main categories that take into consideration carbon output and the intended purpose of the activity (Figure 1.2):

- *Category I*: Enterprises or industries that produce low-carbon intensive output which directly serves to reducing CO<sub>2</sub> emissions.
- *Category II*: Enterprises or industries that produce low-carbon intensive output which does not serve the direct purpose of reducing CO<sub>2</sub> emissions.
- *Category III*: Enterprises or industries that produce high-carbon intensive output which serves the direct purpose of reducing CO<sub>2</sub> emissions.
- *Category IV*: Enterprises or industries that produce high-carbon intensive output which does not serve the direct purpose of reducing CO<sub>2</sub> emissions.

Within these employment categories, I and II are considered to be strictly green jobs as they are associated with output that is low-carbon intensive and therefore sustainable. Jobs in category I are the greenest in that they adhere to both the environmental impact of the output and the nature of the activity, i.e. both are directed to reducing CO<sub>2</sub> emissions. Jobs from category II are included as green since they are not associated with any negative long-term impacts on the global climate.

Figure 1.2 The green economy and employment considerations



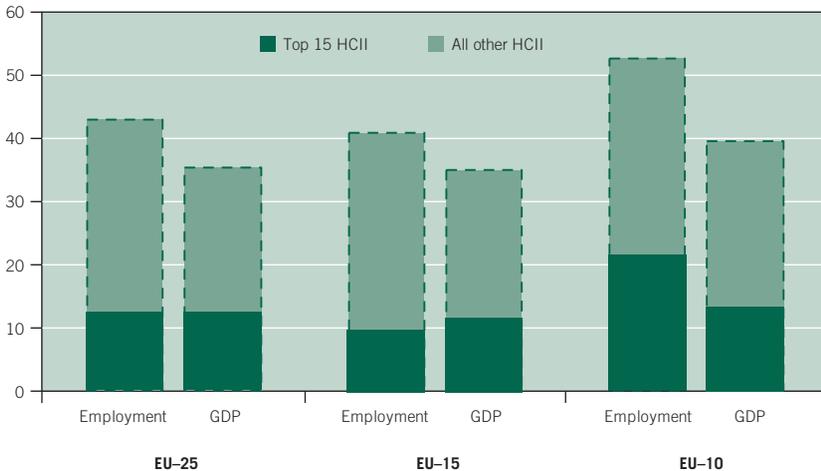
Categories III and IV are considered to be “brown” given that they are associated with high-carbon output. However, it is important to note that jobs in category III – albeit within the HCIS – are related to activities which are intended to reduce CO<sub>2</sub> emissions and could thus be included into a broader definition of green jobs. In fact, the environmental goods and services sector as defined by Eurostat (2009) includes enterprises that supply green products and services, independent of CO<sub>2</sub> emitted in the process, thus categories I and III. More generally, jobs in category III could be viewed as necessary intermediate solutions or steps towards promoting structural change. In the long run, however, a shift of category III jobs to category I is desirable.

## 2. Employment and income content of high-carbon-intensive sectors

The size of these categories of jobs is important in determining the potential employment effects of green policies. However, detailed breakdowns of employment by each employment category are not readily available. Estimates from the United States and Germany indicate that only 2 to 3 per cent of total employment is related to activities to reduce CO<sub>2</sub> emissions (categories I and III) (see U.S. Department of Commerce, 2010 and ECOTEC Research & Consulting Limited, 2002).

However, in terms of jobs in the HCIS – of which category IV accounts for the vast majority – more detailed country-level estimates of employment and GDP are possible through the relative CO<sub>2</sub> ranking discussed above. According to figure 1.3, the HCIS accounts for roughly 43 per cent of total employment (or

**Figure 1.3** Employment and GDP shares in HCIS (percentages)



Note: EU-15 refers to Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. EU-10 refers to new Member States since 1 May 2004, namely: Cyprus, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Malta, Poland, Slovak Republic and Slovenia. EU-25 refers to EU-15 and EU-10 together.

Source: ILS estimates based on EU KLEMS.

87 million workers) in the EU-25. However, in examining only the top 15 industries which, as discussed above, contribute to the vast majority of emissions, approximately 12 per cent of total employment in the EU-25 – or some 24 million workers – are employed in these top polluting industries.

Similarly, among EU-25 countries, the top 15 emitting industries account for close to 12 per cent of GDP as measured by value-added. This represents approximately 1,250 billion euros in terms of GDP. For new EU Member States, i.e. EU-10, the shares are considerably higher, especially in terms of employment. In fact, in the EU-10, although the top 15 CO<sub>2</sub>-emitting industries account for roughly 13 per cent of GDP – similar in magnitude to the EU-25 – more than one-fifth of all jobs are concentrated in these industries.

### 3. Net employment and income effects

It is important for policy-makers to understand the overall employment and income effects in the economy. In fact, greening the economy is likely to lead to shifts in employment and income, i.e. changes within some sectors and gains and losses in others. All aspects of this transition – both positive and negative – need to be taken into consideration. However, well-designed policies will be key to smoothing these transitions and ensuring overall job growth and the achievement of a low-carbon economy.

In particular, promoting the environmental sector will continue to play an instrumental role as an engine for this structural change, but policies should not focus on this sector alone, since it would neglect many of the expected employment and income effects. In the first instance, policies need to be oriented more generally towards jobs that are low-carbon intensive since the need for green jobs arises from the need for greater environmental sustainability in the economy.

Secondly, there is a need to address the employment and income effects in sectors where no environmentally related output is generated, since reallocation of labour and income among these sectors is expected (i.e. from the brown sector, HCIS, to the green sector, LCIS). Indeed, the purpose of Chapter 3 is to explore these issues in greater detail. It will be first important to understand better the potential factors underlining the shift to a greener economy and the potential role of policies to ease this transition.

## **C. Forces behind the transition towards a green economy**

A transition towards a green economy can be triggered and driven by several factors. Currently, few incentives exist in the market system to initiate such a transition, making an exogenous shock necessary for a structural change. Such a shock could mainly come from the following four areas.

### **1. Energy prices**

One possible driver of a transition is a supply shock on fossil energy markets. Under favourable circumstances, markets anticipate long-term shortages and smooth price increases, allowing for a controlled adjustment by firms and consumers to higher energy prices. However, past experience has shown that energy markets tend to go through periods of erratic price movements and are prone to speculation and price bubbles. Commodity markets tend to be even more volatile than the stock market. Therefore, a more likely scenario would include abrupt price shocks, as already experienced before the 2008 crisis and has since resumed. An adjustment to such a cost shock would ultimately force the economy to higher resource productivity and increased investments into green technology. But a transition caused through sudden price shocks would cause painful short-term impacts on GDP and employment.

## 2. New technology

Another trigger for a green transition could be a major technological breakthrough, for example the invention of a low-cost renewable energy source that is applicable on a large scale. In this case, fossil energy would become less competitive and firms and consumers would have an incentive to switch to the renewable energy source. Of course, discovery of a new technology could happen at any time without government support. However, a breakthrough in terms of a green technology is likely to require government incentives for research and development – especially given the importance of spreading any new technology as quickly and widely as possible, which weakens private incentives to invest.

## 3. Shifts in preferences and demand

Changing consumption patterns can also play an important role in triggering a transition towards a green economy. Increased awareness and environmental responsibility can lead consumers to shift their average consumption bundle to more sustainable products. These changed preferences can lead to a higher willingness to pay and encourage profit-seeking firms to invest in green production facilities and to offer sustainable products and services.

## 4. Role of policies

In many instances, government policy can affect and facilitate these transitions. Indeed, there exist a number of green instruments that if carefully designed and implemented could promote greener technologies and encourage a reduction in emissions. These green policies are discussed in more detail in Chapter 2.



# GREENING THE ECONOMY: POLICY DEVELOPMENTS AND EFFECTIVENESS

# 2

## Key findings

- Markets alone have been inadequate in addressing climate change. As a result, governments must take decisive and comprehensive action to encourage a reduction in CO<sub>2</sub> emissions and promote environmental sustainability.
- An effective strategy must combine market-based instruments with direct public intervention. In particular:
  - CO<sub>2</sub> emissions must be allocated prices that adequately take into account their environmental damage. In this regard, the EU's Emission Trading System (ETS), in place since 2005, is welcome step in the right direction.
  - Market-based measures need to be complemented by other instruments like regulations, public investment and increased promotion of R&D that can – if well designed – contribute to greening the economy.

- Moving forward, it will be important to monitor the effectiveness of the ETS in reducing CO<sub>2</sub> emissions. Moreover, consideration should also be given to broadening and in some instances re-orienting the suite of existing green policies. In particular:
  - Greater efforts are needed to address CO<sub>2</sub> emissions arising from the production process. This could be achieved via a carbon tax which would encourage polluting industries to reduce emissions and incentivizes innovation and investment in R&D – the current tax structure focuses too narrowly on the consumption of energy. Moreover, revenue received through a CO<sub>2</sub> tax could be used to finance accompanying policies.
  - The development of new technology and new products is a necessary condition for a successful green transition. Yet, the R&D activities of private enterprises alone are insufficient – governments have to support adequate R&D activities and make green investments in order to boost and accelerate the green transition.
- To be successful, the approach to environmental change needs to be both longer term and coordinated. The latter is particularly relevant given that emissions cannot be contained to any one country or region. Each instrument must also establish long-term signals to producers and consumers. Indeed, increased innovation, green product markets and higher resource productivity in the EU can only be achieved if policies succeed in inducing consistent behavioural changes in the long run.

## Introduction

Despite the modest results of the 2009 UN Climate Change Conference in Copenhagen, the urgent need for international cooperation for sustainable development remains a top priority in many countries. Theoretically, a structural economic change can occur by itself, and often does, without any government intervention. The transition towards a green economy, however, is unlikely to

occur through free, unregulated markets alone since the current price mechanism does not adequately reflect the future cost of today's CO<sub>2</sub> emissions. It is thus critical that governments play an active role in this process in order to correct market inefficiencies. Environmental pollution, such as greenhouse-gas emissions, is indeed a negative externality and the cost must be internalized through policy mechanisms.

Dealing with this particular externality (CO<sub>2</sub> emissions) is a very complex problem, however. First, much pollution has occurred in the past, while most of the damage will arise only in the future. Second, the aggrieved parties are to a large extent unborn future generations and hence their preferences cannot be properly reflected in the political outcome to deal with climate change. Third, the magnitude of future damages is highly uncertain, since the complexity of the climate system is not yet fully understood. In other words, the cost of the externality is difficult to quantify. Finally, the greenhouse effect is a global problem as emissions are dispersed across national borders and regions.

The purpose of this chapter is to examine the suite of available environmental policy instruments. In particular, Section A will analyse the effectiveness of a range of potential green policy instruments in reducing CO<sub>2</sub> emissions. Against this theoretical background of different instruments, Section B will detail the variety of green policies that EU countries have implemented to address environmental sustainability, including those recently adopted as part of green stimulus measures. Finally, Section C will conclude by discussing policy considerations and examining the gaps between theory and practice of green policy instruments.

## **A. Environmental policies for a green transition**

As discussed in Chapter 1, greenhouse-gas emissions are principally associated with production and as such, policies that target only a single sector in the economy will be less effective in addressing climate change. The interconnectedness of sectors in the economy is particularly relevant in the context

of energy, since it is used as an input in virtually every product or service. Reducing CO<sub>2</sub> emissions therefore involves taking a broad-based approach to encourage behavioural adjustments throughout the entire economy, and not just in the energy sector.

Principally, there are two ways to reduce CO<sub>2</sub> emissions: (i) substitution to a more energy-efficient good or service and (ii) change techniques of production. Green policies may principally target the energy sector (production of energy),<sup>1</sup> all other sectors (consumption of energy for production), and/or households (final consumption of energy). From an economic point of view, the primary goal of policy instruments is to reduce the damage to the environment at minimum economic cost.

With this in mind, this section looks in more detail at instruments that may be used by policy-makers to promote the green transition, notably: (i) regulations; (ii) tax instruments; (iii) trading scheme; (iv) R&D and technological development; and (v) public investment (see also, for example Feess 2007). These instruments can impact a variety of factors involved in CO<sub>2</sub> emissions, including among others, fuel efficiency, renewable energy, increased energy efficiency, material efficiency and final demand. The first three of the options available – regulations, tax instruments and trading systems – are often considered as the main approaches to addressing climate change (see Uzawa 2003; Bertram 1992; Samaan 2011). Based upon the literature, the effectiveness each of these instruments varies according to different sets of criteria which are explored in more detail in the following sub-sections (figure 2.1).

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1. More accurate would be the term “generation of power”, since energy cannot be “produced”. For simplicity, we use the term “production of energy” throughout the report

Figure 2.1 Characteristics of main green policy instruments

Characteristics of green policy instruments			
	Regulation	Tax	Trading Scheme
Pareto efficiency	Low	High	High
Ecological effectiveness	High	Low	High
Cost efficiency	Low	High	High
Political feasibility	Moderate	Low	High
Revenues	Low	High	Low

## 1. Regulations

Regulations are norms implemented and enforced by government institutions to directly influence the behaviour of economic agents. In the context of climate change, regulations usually refer to some type of direct quantitative emission restrictions, usually targeting the production process. Regulations can take a variety of forms, but are mainly “command and control” in nature, i.e. implemented via legislation that sets the standards for such activities and designating relevant authorities that are responsible for monitoring compliance (although in some instances compliance may be self-reported by industry).

Regulations are often viewed as rather inefficient instruments to deal with environmental problems due to the relative high administrative burden associated with the need for detailed, technical descriptions that specify the exact activities necessary to cope with the environmental goals. Standards must also be continually updated to reflect changing conditions, e.g. technical standards or social conventions, in regulated industries. Monitoring and ensuring compliance are a key component of the effectiveness of regulations

but the costs associated with this can be quite steep, often resulting in arrangements that allow industry to self-report compliance which can dampen the overall effectiveness.

However, in those cases in which governments have superior knowledge (for example, expertise of a government agency) and if regulations can be controlled and enforced relatively easily (for example, a speed limit on highways), the use of regulations is appropriate and can be effective.

## 2. Tax instruments

There is a growing literature that gives preference to market-based instruments like taxes (price solutions) and tradable emission permits (see for instance, Pearce and Turner 1990; Bertram 1992; Feess 2007; Uzawa 2003). The idea to use taxes to internalize environmental externalities has a long tradition, dating back to the work of Pigou (1925). Instead of encouraging a certain behaviour through regulation, tax approaches aim to assign correct prices to environmental resources and, by default, let market forces determine the optimal level of greenhouse-gas emissions.

Taxes are versatile instruments as they can take many forms. Taxes related to environmental issues can target consumption and production (and inputs in production). The overall effectiveness of energy taxes varies based upon where the tax is applied. Taxes that are applied far from the target source (or pollutant) are not ideal, since the indirect price signals they create are less effective in influencing behaviour. It is best to apply the tax at the beginning of the value chain, where the widest impact can then occur in the economy. For example, taxes on electricity create incentives to reduce energy use but fail to acknowledge that electricity can also stem from renewable sources. A tax on the actual externality in question – CO<sub>2</sub> emissions – would be a better policy approach because it more directly increases the cost of those emissions. Moreover, a tax on emissions that internalizes the externality is in fact welfare-improving given that the current situation is sub-optimal. Since the overall difficulty of

identifying polluting industries continues to impede this approach, policy-makers have often taken energy use as a proxy.

Taxes are widely used in environmental policy due to their relatively low administrative burden and ease of implementation. A carbon tax, for example, does not require the same level of detailed information as a regulation and yet can accomplish the same end goals by relying on the market. The main responsibility of administrators is to determine the appropriate tax level to reduce overall CO<sub>2</sub> emissions – although this is not an easy task and often requires that taxes be adjusted over time to produce the desired impact. In fact, taxes (as well as regulations) can take up to 10 years to come into full effect (European Environment Agency (EEA) 1996). Taxes are also easily enforced and adjusted to changing market conditions. Furthermore, a carbon tax not only encourages polluting industries to reduce emissions, it also incentivizes innovation and investment in R&D. This is an important characteristic since innovation is necessary for the wider transition towards a green economy. Also, the revenue generated by a carbon tax represents a powerful tool in helping to achieve other goals (see Chapter 4).

While a carbon tax allows market participants to make their own decisions on emissions reductions, it does not specify the overall level of emissions reductions to occur. This can lead to fluctuations in CO<sub>2</sub> emissions over time. However, carbon taxes do send clear signals to *all* actors in an economy, not just polluting industries, due to the ubiquitous use of energy.

Energy taxes, however, can produce perverse effects if market conditions are not favourable. In particular, energy taxes can have a regressive effect on income distribution, as households with lower income are forced to spend higher proportions of that income on energy consumption (OECD 2007). Taxes of this nature can also hamper investments in the areas of eco innovation and new technology (OECD 1997).

The unique nature of energy markets across countries renders EU-level tax policy complex. Obviously the tax rate must be high enough to induce the

desired changes, and policy-makers must address unintended effects of green taxes. However, setting tax levels at the appropriate level is a challenge that is exacerbated by other issues including, for instance carbon leakage, i.e. CO<sub>2</sub> emissions increase and remain high in non-taxed areas (that is, neighbouring countries). This can have important implications on competitiveness as domestic enterprises are disadvantaged by international firms due to differences in price structures.

Indeed, the political reality of taxes, however, can act as an impediment to their use. Public acceptance of taxes is rather low, especially following the economic crisis. Policy-makers often find it easier to introduce technical regulations, which may ultimately also lead to higher consumer prices of certain products, than to introduce new taxes. The same applies to the issuance of CO<sub>2</sub> certificates to producers. The impacts of these policies are less transparent to the average consumer household and may provoke less political resistance.

### 3. Cap and trade

The main idea of trading systems is to fix a certain quantity of acceptable emissions (or other pollution) and make potential polluters pay for the right to pollute (see, for example Feess 2007; Pearce and Turner 1990; Pearce 1990). Thus, the total quantity of allowable emissions must be broken down into small amounts that are securitized and can be traded. Typically, enterprises are thought of as polluters, but the system is also applicable to consumers and households. Every enterprise has to choose between purchasing certificates in order to pollute and avoiding pollution by reducing output or investing in abatement technology. The idea is that here, as in any market solution, decentralized decision-making produces more efficient outcomes.

The main role of the government is to determine the total allowable level of emissions. Thus, the quantity of emission is directly addressed by trading systems, unlike carbon taxes, which focus on the *price* of carbon. Administrations are not burdened by heavy information requirements, but are tasked with coordinating the system across a range of countries and industries. This task,

however, is bureaucratically complex and contributes to high administrative burden. And while trading systems must be re-evaluated each year when new sets of permits are issued, they are more easily adapted to changing conditions in polluting industries than taxes. The implementation of trading systems can be challenging as it is difficult to identify polluters and coordinate a large group of industries. However, generally speaking, they are more widely accepted by the private sector, since the price of carbon is left to the market rather than the government.

Enforcement of the cap is difficult and trading of emission certificates is exposed to speculative investments, generating a high volatility of the carbon price as the European example shows. According to an estimate by Nell et al. (2009), the carbon price, in cases of emission trading, is ten times more volatile than stock prices, which are already about seven times more volatile than GDP.

#### 4. R&D and technological development

Structural change towards low-carbon economies requires considerable technological advancement. The ratio of CO<sub>2</sub> emissions to the total amount of energy produced can be reduced through implementation of low- or zero-carbon energy sources. Clearly, policies that encourage R&D show a great capacity to influence the direction of technological advancement. While R&D policy cannot alone solve the global climate-change problem, it can very effectively complement major market-based mechanisms in reducing CO<sub>2</sub> emissions.

Questions naturally arise as to which policy instruments governments can implement to increase R&D activities in the economy and the extent to which R&D should be public or private. In the case of green technologies, there are two peculiarities: first, R&D activities have to be carried out on a large scale, and major breakthroughs are necessary – notably as regards power generation. Second, current, competitive fossil fuel-based technologies must be replaced, but no short-term profit motive exists for private enterprises to pursue green R&D. The role of the government in promoting R&D efforts becomes therefore essential.

Governments have several options to support R&D activities. On the one hand, they can attempt to provide attractive conditions for green R&D investments in the private sector by establishing long-term price signals (green taxes); by maintaining an efficient system of intellectual property rights; or by introducing tax deductibility for green R&D investments. On the other hand, governments can get involved directly, for example by providing direct financial support to private green R&D efforts or by strengthening public research in that direction.

Policies that promote R&D can also be ones that aim to improve human capital (see also Chapter 3). Indeed, a main determinant of necessary innovation is a high level of technical specialists, e.g. scientists and engineers. One common approach is to address the supply side, i.e. introduce incentives and programmes to encourage a greater number of students to obtain science and technology graduate and postgraduate degrees (see Jaumotte and Pain 2005). Equally important, however, is the demand side and to ensure the promotion of green sectors that can offer career opportunities to such specialists (see Roberts 2002). In some instances, increased recourse to immigration can be an effective means of increasing the share of skilled scientists and engineers in the workforce (see OECD 2001; Hansen 2004).

The diversity of approaches in policies to support R&D implies different levels of government involvement, but the overall administrative burden is relatively low. Policies to support R&D also have the potential to induce more widespread effects in the private sector, as government funding for specific activities sends clear signals to the market. When industries receive signals that the government is promoting specific technical change, the private sector may be more likely to realign its own priorities and move in the same direction.

The administrative burden mostly concerns coordination between the government and research centres and educational institutions. Implementation of such policies may usually involve the transfer of government funds to R&D activities.

## 5. Public investment

Public investment is another tool that can help to facilitate the reduction in greenhouse gas emissions. Governments can either increase total public investment, or – perhaps more practically, given the strained public budgets in many countries – shift public investments from “brown” capital to “green” capital. Countries can directly invest in renewable energy projects if the private industry is hesitant or unwilling. And more innovative investment schemes can also draw on partnerships with the private sector, further strengthening signals for transition to low-carbon technology. For instance, in the transportation sector, governments can promote public mass transit systems over individualized transit systems, for example. They can also invest in energy efficiency upgrades of public transit. In the construction sector, public construction projects can adhere to the latest developments in energy and material efficiency. Requirements for state-of-the-art green standards in these projects would not only reduce carbon emissions, but also send reliable, long-term policy signals.

A major challenge to greater public investment is budget constraints induced by the economic crisis. The need for fiscal prudence has severely reduced the capacity of governments to appropriate funds for “green” goals. Yet, looking forward public investments of this nature can play a strong role in influencing the market and encouraging the private sector towards a green transition, and play a complementary role to larger market-based mechanisms.

## B. Green policies in the EU

Based on the suite of policy options, this section details the extent to which countries have used the various measures to address climate change. Generally speaking, EU countries have used a variety of the previously discussed measures to promote energy saving and reduce CO<sub>2</sub> emissions (table 2.1). The majority of these policies have focused, in some way, on reducing the combustion of fossil

**Table 2.1** Examples of major policy instruments in the EU

TAX/DUTY	FEE/CHARGE	SUBSIDY
Energy production, consumption (e.g. the Netherlands and the United Kingdom)	Road tax for use of highways, alpine roads, and on heavy goods vehicle (e.g. Czech Republic and Slovak Republic)	Energy efficiency, clean energy including biofuels, biomass (e.g. Lithuania and Spain)
Mineral oil production, sales, consumption (e.g. Denmark, Greece and Luxembourg)	User fee on parking (e.g. Austria and Finland)	Feed-in tariffs (e.g. Germany, Italy and Luxembourg)
Transportation <ul style="list-style-type: none"> <li>– Vehicle registration/usage/purchase (e.g. France)</li> <li>– Import duty (e.g. Romania)</li> <li>– Weight based (e.g. Germany)</li> <li>– Emissions based (e.g. Ireland and Spain)</li> <li>– Sticker tax on use of new/old cars (e.g. Finland)</li> <li>– Vehicle insurance (e.g. Australia and the United Kingdom)</li> <li>– Air transport (e.g. Bulgaria)</li> </ul>	Fee on CO <sub>2</sub> emissions (e.g. Denmark and Estonia)	Transportation <ul style="list-style-type: none"> <li>– Clean vehicles (e.g. Cyprus and Sweden)</li> <li>– Purchase of eco-friendly vehicles such as bicycles (e.g. Belgium and Italy)</li> <li>– Energy labelling scheme (e.g. Finland and the Netherlands)</li> <li>– Scrapping payment (e.g. Austria and France)</li> </ul>
CO <sub>2</sub> emissions, air pollution (e.g. Estonia, Denmark and Poland)	Air pollution fee on small/medium/major stationary sources (e.g. Poland and Slovenia)	Environmentally friendly equipment (e.g. Hungary and Italy)
	Environmental sanction fee for violations of the environmental code (e.g. Sweden)	Ecological buildings (e.g. Czech Republic, Germany, the United Kingdom)

fuels and thus, the main source of CO<sub>2</sub> emissions.<sup>2,3</sup> While many of these policies were not originally implemented as a response to global climate change, they remain relevant to this report due to their effects.

EU Member States have relied heavily on tax instruments and its trading system in addressing climate change. Taxes are by far the most widely used instruments in the EU and include a range of measures and are targeted at a variety of sectors and activities. For example, energy taxes target all actors in the economy, making the breadth of some tax policies very wide. In addition, the EU Emissions Trading System (EU ETS) represents a huge policy scheme that targets production at a regional scale. R&D policies and public investment have also been wide-reaching but have been comparably small in scale.

2. A detailed listing of green policies enacted in EU countries is provided in the INST-EC Discussion Paper No. 14.

3. The three main activities responsible for CO<sub>2</sub> emissions in the EU are: the combustion of fossil fuels, animal husbandry and the use of nitrogenous fertilizers.

## 1. Regulations

Currently, the use of emission-restricting regulations is not widely prevalent across EU countries, which have opted for more market-based approaches to the climate-change problem. Nevertheless, regulations have been used, in particular, to address emissions from vehicles and transport. For instance, emissions standards have existed since the 1970s and currently target four groups of emissions: nitrogen oxides, hydrocarbons, carbon monoxide and particulate matter.<sup>4</sup> While emissions standards are a common feature of environmental policies in many advanced economies, the EU has only recently begun to address the issue of CO<sub>2</sub> emissions from vehicles. Recent legislation has set the timeline for the implementation of new standards in this area.

Legislation was adopted in 2009 and set emission performance standards for new passenger cars, aiming to cap average emissions from these vehicles at 120 g CO<sub>2</sub>/km. Furthermore, the standards seek to reduce the fleet average for all cars in the EU by 19 per cent by 2012 with a limit-value curve that will allow heavier cars to emit more than lighter cars, while maintaining the fleet average. Standards will be gradually phased in to allow for a smoother adjustment, starting in 2012 with 65 per cent of each manufacturer's newly registered cars in compliance with the standard, 75 per cent in 2013, 80 per cent in 2014 and 100 per cent after 2015. Manufacturers will be required to pay a premium if they fail to meet the standard requirements.

In December 2010, the EU also made progress on forming regulations for CO<sub>2</sub> emissions from vans, as a consensus was finally reached on the regulation text. Regulations on vans seek to cut CO<sub>2</sub> emissions by 14 per cent (to 175 gCO<sub>2</sub>/km) by 2017. The regulations are modelled after those for new passenger vehicles, and will be phased in, with a cut in emissions of 28 per cent intended by 2020 (to 147 gCO<sub>2</sub>/km). Again, a limit-value curve is employed to set emissions limits by mass of vehicles and aiming to create a fleet average of 175 gCO<sub>2</sub>/km. Premium payments will also be required of manufacturers

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4. Recent emissions standards for vehicles include Euro 4 (2009), Euro 5(2010) and Euro 6 (2014). None of these standards has addressed CO<sub>2</sub> emissions. These standards are set at the EU level and compliance is left to member countries.

that do not comply with emissions restrictions. Additional incentives to manufacturers are also included. For instance, super credits, which allow manufacturers to count extremely low-emitting vans (below 50g/km) as more than one vehicle, will be offered on a phased-out schedule. And, manufacturers will be able to pool together to meet emissions targets collaboratively.

Recently passed legislation introduced a CO<sub>2</sub> labelling scheme for cars, in an effort to better inform consumer choices. Labels will provide information on fuel efficiency and CO<sub>2</sub> emissions at the point of sale. Finally, legislation has also required a reduction in the greenhouse gas intensity of fuels by 10 per cent by 2020, with phasing-in of requirements. Again, fuel suppliers also have the option to pool together to meet standards.

## 2. Tax instruments

Environmental taxes and charges are currently the most widely used market-based green policy instruments in the EU. The focus has principally been on fuel and renewable energy,<sup>5</sup> with EU Member States imposing a variety of taxes on transport, emissions and air pollution, energy and mineral oil (figure 2.3). As far back as 1950, a duty had been imposed on petrol in Denmark). The rest of the EU started implementing different taxes on oil and petrol from the early 1990s, with further differentiation of the taxes on different types of fuel undertaken thereafter. Furthermore, Denmark introduced duties on energy in the early 1980s based on purpose of usage, while duties on coal, electricity and natural gas were imposed in 1995. Other EU countries started implementing taxes on energy products in the early 1990s.

While the original purpose of mineral oil taxes was to raise revenues, today they can be regarded as climate-change policies. Indeed, several EU countries raised mineral oil taxes in the course of their environmental tax reforms (see Chapter 4). Taxes have also been imposed on different types of vehicle based

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5. Fuel is differentiated in three ways: by type (including petrol, diesel, gas oil, kerosene, liquefied petroleum gas, heavy fuel oil, natural gas coal and coke), by electricity and by its use, such as whether it is used for heating or a propellant or for industrial or commercial purposes.

on weight, purpose and emissions. Finland was one of the first countries to introduce a vehicle-related tax, with a tax on passenger cars and vans in 1958 (updated in 2009) and a tax on registered cars in 1967 (updated in 2004). Many EU countries, such as Austria, Hungary, Latvia and the Netherlands, started levying vehicle-related taxes in the early 1990s. Around the same time, many countries, such as Ireland, introduced CO<sub>2</sub>-emission-based vehicle taxes. Other types of transport taxes have differentiated between old and new cars, imported vehicles and road transport.

Air pollution fees and air emissions charges are used in a number of EU countries as a means to reduce CO<sub>2</sub> emissions. The first general CO<sub>2</sub> tax was imposed in Finland in 1990 and applied to most sectors with – originally – few exceptions. Other countries followed by introducing fees or taxes on CO<sub>2</sub> emissions from air transport. Figure 2.2 summarizes various tax approaches on fuel that have been applied in Member States.

Renewable feed-in tariffs (FITs) were also introduced in an effort to promote the renewable energy sector (box 2.1). FITs offer guaranteed sales prices to producers of renewable energy which normally lie at least at the level of production cost. Some EU countries, particularly France and Germany, have started

**Figure 2.2 Common taxes in the EU**

<b>Fuel tax/fuel excise tax</b> E.g. Bulgaria, the Netherlands, Romania, Slovenia, Cyprus, Lithuania, Estonia, Finland, Latvia					
<b>Energy Tax</b> E.g. the Netherlands, Italy, Sweden, the UK, Austria, Slovenia				<b>Mineral oil tax</b> E.g. Denmark, the Netherlands, France, Germany, Italy, the UK, Spain, Austria, Greece, Ireland, Luxembourg, Slovak Republic	
<b>Electricity</b> E.g. Germany, Denmark, Spain, Italy, Sweden, Czech Republic, Slovak Republic, Luxembourg, Malta, the UK, Finland	<b>Coal</b> E.g. Denmark, the Netherlands, Denmark, Slovak Republic, Czech Republic	<b>Natural Gas</b> E.g. Denmark, France, Czech Republic, Italy, Slovak Republic	<b>Heating</b> E.g. Luxembourg	<b>Petrol</b> E.g. Denmark, the Netherlands, Italy, Sweden, the UK	<b>Diesel</b> E.g. The UK, Sweden, Ireland, Finland

Source: IILS.

**Box 2.1 Renewable energy feed-in tariffs**

Feed-in tariffs (FITs) promote market development of renewable energy technologies, such as solar-wind or geothermal-generated electricity. FITs offer producers of renewable energy long-term purchase contracts on favourable prices, usually at least the cost of production. Investments in renewable energy provide then a stable and calculable return. Producers of energy can be companies but also house owners who install solar panels on their roofs and can sell excess energy at a guaranteed price. In the long run, advanced technology and economies of scale are expected to decrease production cost so that renewable energy sources become competitive with their fossil-fuel-based counterparts. FITs are one of the most effective policy instruments in terms of overcoming cost barriers.

Through effective implementation of FIT law, several European countries like Germany (solar energy) and Denmark (wind energy) have successfully developed a renewable energy industry. Benefits of FIT include reduction of CO<sub>2</sub> emissions, secured domestic energy supply, promotion of technological innovation, fair market conditions for renewable technologies and creation of jobs.

The first Feed-In Law in Germany in 1990 supported producers of electricity from small hydro stations and wind energy installations. Since that time, the adoption of the Energy Supply Industry Act in 1998 and the Erneuerbare-Energien-Gesetz (EEG) (further amended in 2004), or the 2000 Renewable Energy Sources Act, indicated a commitment to raising the share of renewable energy in total electricity supply in Germany to 12.5 per cent by 2010, and to at least 20 per cent by 2020.

Other EU countries like Bulgaria, France, Italy, Spain and the United Kingdom have introduced FITs for different types of renewable energy since the beginning of 2000. The French government offered a series of new FITs in the biogas and mechanization, wind power, solar photovoltaic PV, hydro and geothermal sectors since 2001. The FITs for most technologies in France were superseded by subsequent regulations and further new tariffs were introduced in the area of hydropower (2007), biomass (2009) and solar PV (2010).

In April 2010, the UK government provided FITs for small-scale low-carbon electricity produced from a wide range of renewable energy technologies including bio-energy, hydropower, solar PV and wind. Italy stimulated the production of electricity from solar thermodynamic plants, connected to the electricity grid and plants had to be equipped with thermal accumulation systems the relative intensities of industries within the economy.

promoting energy efficiency and the use of renewable energy in the renovation and construction of buildings by taking initiatives such as setting a new norm for the public and private buildings and providing zero-interest loans. For example, through an environmental policy called *le Grenelle de l'Environnement*, the French government aims at cutting the energy consumption of existing buildings by at least 38 per cent by 2020. Additionally, in 2012 the government

**Box 2.2 Energy efficiency policies in the EU**

The EU has adopted the “20-20-20” plan, which sets climate and energy targets of cutting GHGs by 20 per cent by 2020 compared with 1990 levels, achieving 20 per cent of primary energy from renewable resources and improving energy efficiency by 20 per cent by 2020. As part of the strategy, many governments in the EU have imposed taxes on usage of electricity, mineral oils, roads and vehicles, which varied based on weight, purpose and emissions (see figure 2.3 above). European countries have also designed a wide range of taxes including a tax on plastic bags in Ireland, the nutrient surplus charge in the Netherlands, waste disposal and batteries taxes in Denmark. The plan also includes conducting surveys and feasibility studies while launching educational programs to provide information concerning renewable energy, energy efficiency and pollution.

is planning to reduce the existing public buildings’ energy consumption by 40 per cent and GHG emissions by 50 per cent. The norm for new offices and public buildings will be 50 kWh/m/year starting in 2010. The French government also established agreements with the banking and construction sectors to provide zero-interest loans to owners who are willing to improve the energy efficiency of their buildings (see Barbier 2009).

In other instances, special tax provisions are used to increase the energy efficiency of environmentally friendly house equipment, buildings, vehicles and heating systems (box 2.2). The tools used include subsidies, grants, tax credits, tax deductions and exemptions.

### 3. Trading systems

The EU Emissions Trading Scheme (ETS), launched in 2005, is the first and largest international scheme that aims at combating climate change and reducing industrial greenhouse gas (GHG) emissions in a cost-effective manner. The EU ETS targets production through its focus on polluting industries: it covers over 10,000 installations in the energy and industrial sectors, which generate almost half of the EU’s total CO<sub>2</sub> emissions and 40 per cent of its total GHG emissions. Emissions in the power sector are covered, including all fossil fuel

generators over 20 MW, iron and steel manufacture, oil refining, cement, glass, ceramics, and paper and pulp production. The aviation sector will be added to the system starting in 2012.

The EU ETS allows participants to buy and sell allowances within the trading limit determined by the ETS. The holder of an allowance has the right to emit 1 tonne of CO<sub>2</sub> or the equivalent amount of another GHG. The first trading phase of the EU ETS was from 2005 to 2007, with a second phase occurring from 2008 to 2012. On 1 January 2008, the 27 EU Member States under the ETS were joined by Norway, Iceland and Liechtenstein. During these trading periods, Member States had to draw up National Allocation Plans (NAPs), which determined the total quantity of GHG emission allowances that the companies in EU Member States are granted. Each Member State had to decide the total quantity of allowances for the trading period and allocate the allowances among the installations covered by the ETS. For the third trading period, starting in 2013, the allocation will be set directly at the EU level, suspending the use of national allocation plans. Progressive changes including the auctioning of allowances will be introduced in 2013.

After 2005, Member States were permitted to “opt in” smaller installations within the above-mentioned sectors, and under the second phase from 2008 to 2012, new sectors were added and include non-CO<sub>2</sub> GHG emissions. From 2005 to 2007, Member States could apply to “opt-out” specified installations, but after 2008 all eligible installations were required to be covered under the ETS. Between 2005 and 2009, the global carbon market grew to a total value of USD 144 billion, of which the EU ETS accounted for USD 123 billion (see Robins et al. 2009).

By allowing participating companies to trade emission allowances, the EU ETS assists EU Member States in fulfilling their commitments to reduce GHG emissions at least cost. It has been shown that emissions from installations included

in the scheme are falling. This suggests that the EU ETS is effective in terms of the trading of GHG emissions. The successful implementation of the EU ETS has encouraged other countries to adopt comparable cap-and-trade schemes.

#### 4. Research and development

Several EU countries have funded research programmes on renewable and environmentally friendly energy generation since the 1970s. For example, Denmark implemented the Energy Development and Demonstration Programme in 1976 and actively subsidized R&D in environmentally friendly electricity generation and efficient use of electricity since the late 1990s. It was not until the early 1990s, however, that governments really began stressing the importance of investing in green R&D. Governments are now also providing grants and subsidies in R&D for sustainable development, environmental education, renewable energy sources and protection of air and water through special funds and programmes, such as the State Environmental Fund of the Czech Republic (SEFCR) and the 500 million euro Austrian Climate and Energy Fund (2007).

In other cases, for example in France, governments are supporting clean energy development by providing subsidies for multiple renewable energy sources under programmes such as the Renewable Energy Market Development (1999). Additionally, France provides crediting and loan guarantees for energy efficiency and renewable energy investment since 2001. Similarly, in the United Kingdom the Carbon Trust provides an interest-free loans scheme for small or medium-sized enterprises for acquiring and installing energy efficient technologies.<sup>6</sup> There is also an effort to leverage public–private research partnerships in order to fund a wide range of climate change and renewable energy investments (see box 2.3).

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6. Refer to Appendix I of the INST-EC Discussion Paper No. 14.

**Box 2.3 Public-private partnerships**

Although public investment plays an important role in green R&D, private corporations and consumers are also encouraged to finance the development of a low-carbon economy. Several EU Member States have announced Public-private Research Partnerships (PPRP) to fund a wide range of climate change and renewable energy investments.

For example, the Renewable Energy and Energy Efficiency Partnership (REEEP) was established in 2002 and is funded by the governments of Australia, Austria, Canada, Germany, Ireland, Italy, the Netherlands, New Zealand, Norway, Spain, the United Kingdom, the United States and the European Commission. In addition to governments and governmental organizations, several non-governmental organizations like the North American Insulation Manufacturers Association (NAIMA) and business organisations like the National Australia Bank are involved as donors. This partnership targets clean energy by providing policy and regulatory initiatives and facilitating financing for energy projects.

France is one of the major countries that rely on partnerships to encourage private funding in climate change projects. Through the Hydropower Revival Plan of July 2008, the French government intends to increase the capacity and efficiency of hydropower and by 2020, raise the share of renewables in final energy consumption to 23 per cent. The plan involves large-scale public investment in hydropower dams as part of *le Grenelle de l'Environnement*. The renewable process of the plan encourages the participation of private sector. Other PPRP programmes provide public funding through the Agency for Industrial Innovation for energy efficiency in buildings, a "green chemistry" initiative and energy-efficient subway cars.

In 2010, the UK government announced its plan to establish a private- and public-funded commercial Green Investment Bank (GIB) that would include a public investment of up to 1 billion pounds (see UK GIBC 2010). The GIB's main role is to facilitate the delivery of the UK's emission reduction targets as set by the Climate Change Act 2008. By helping to overcome barriers that constrain investments, the GIB could lead to a substantial increase in investments in the low-carbon technologies and infrastructure in the UK (see UK GIBC 2010).

## 5. Public investment

In addition to promoting R&D, a variety of public investments have been included in government programmes to achieve emissions reduction targets and increase energy efficiency. Some of these plans include Italy's *Provisions on GHG Emissions Reduction* (1998), Denmark's *Climate Change Strategy* (2003), the Netherlands' *Energy Efficiency Action Plan* (2007), Austria's *New Energy 2020 programme* (2008), the United Kingdom's *Low Carbon Transition Plan* (2009) and Finland's *Long-term Climate and Energy Strategy* (2008). The Austrian Climate and Energy Fund of 2007 also increased energy efficiency and reduced CO<sub>2</sub> emissions in transport.

In order to reduce energy consumption in the transport sector, governments took additional measures within the framework of national programmes and plans by increasing investment in public transportation and road construction, as well as updating heavy goods vehicle tolls and reforming vehicle taxes to address CO<sub>2</sub> emissions. In Germany, for instance, the government introduced these measures through the Transport Initiative of 2001, Future Investment Programme (2008), the National Energy Efficiency Action Plan (2007) and the Integrated Energy and Climate Change Programme (2007).

It is clear that certain countries in the EU have taken a more active role in implementing green policies. The following countries stand out: Belgium, Czech Republic, France, Italy, the Netherlands, Spain, Sweden and the United Kingdom. These countries have each implemented over 30 different green policy instruments. Topping the list of countries included in this report, Italy, the Netherlands and the United Kingdom each implemented approximately 50 policies. The following sections will detail the various policies enacted by EU Member States by category.

## 6. Green stimulus measures adopted since the 2008 crisis

Following the global economic crisis, many governments announced stimulus measures that included efforts directed at environmental goals. And while in some instances, the measures are characteristically short-term, they have potential to encourage structural change towards a green economy, since they consider the environment a vital component in the economic recovery process.<sup>7</sup>

In total, HSBC (2010) estimated that around 16.3 per cent or US\$521 billion of all fiscal measures were dedicated to green stimulus by the end of 2009, with China and the United States as the main contributors (figure 2.3, panel A). In terms of the emphasis placed on green measures, the Republic of Korea – at close to 80 per cent – devoted the largest share of stimulus to environmental

7. In the context of green stimulus, another version of the so called double-dividend hypothesis can be stated: well-designed green stimulus measures can both stabilize the economy (output and employment) and improve environmental quality.

issues (figure 2.3, panel B). Still, China spent over one-third of its stimulus package on green measures (mostly on rail, grids and water infrastructure, along with spending on environmental improvement).

In terms of overall composition, the majority of measures adopted were primarily related to tax instruments and public investment. Major tax schemes focused on promoting greater fuel efficiency in vehicles and have included road and motor taxes, tax exemptions on electric vehicles and tax incentives for energy efficiency in buildings. Government spending included a variety of investment schemes to encourage R&D and innovation in green technologies and also promote infrastructure development. Major policies have encouraged R&D in low-carbon vehicles, energy-labelling on vehicles, scrappage payments, renewable-energy investments and a wide variety of infrastructure investments.

In the EU, over two-thirds of total stimulus was spent on energy efficiency (figure 2.4). Most investment was directed towards the efficiency of buildings, followed by grid and low-carbon vehicles, where several countries aided struggling vehicle industries with support for more energy-efficient models. Among European countries, Germany's fiscal package was the largest, of which 13.2 per cent focused on climate protection and energy efficiency, with most of the spending devoted to energy efficiency of buildings (75 per cent) and the rest on the expansion of the railroad system<sup>8</sup> (20 per cent) and on promoting low-carbon vehicles<sup>9</sup> (5 per cent).

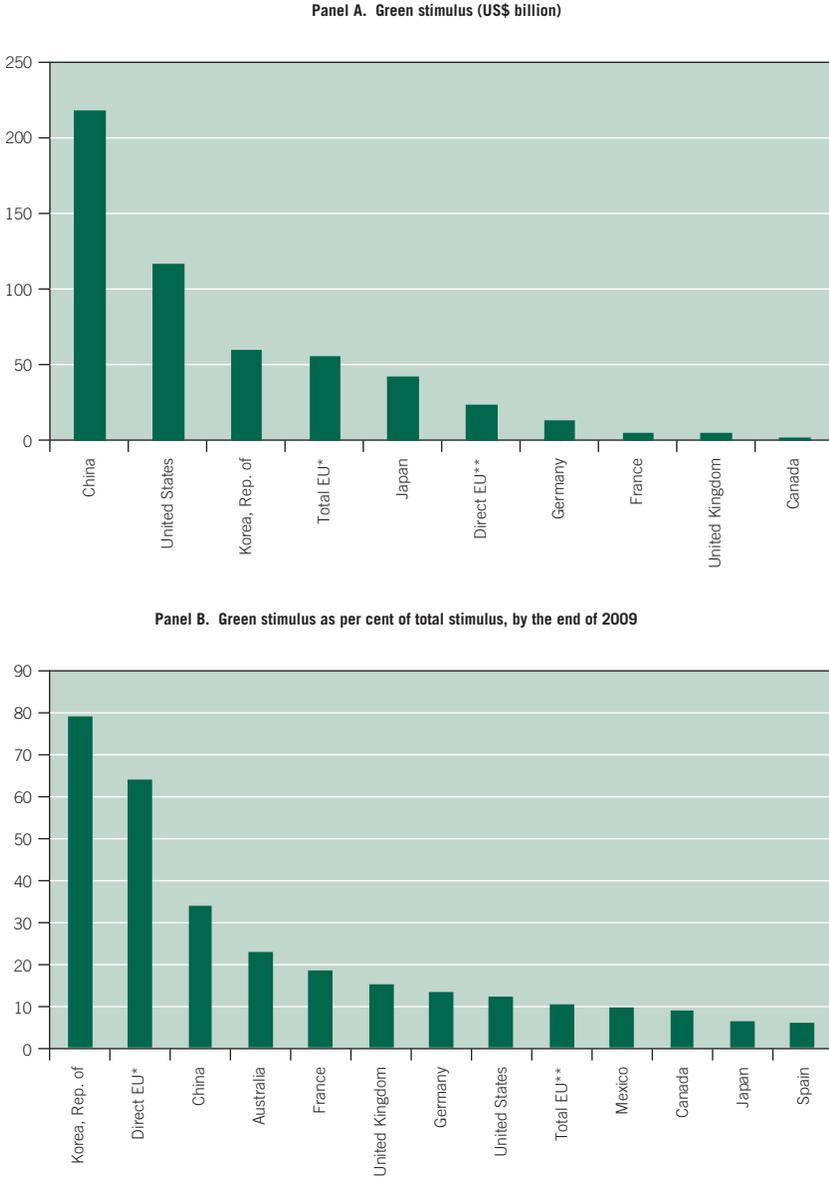
## C. Policy considerations

Of the five environmental policy instruments presented in this chapter, the market-based approaches, i.e. taxes and cap and trade, primarily cause changes in the price system and allow market participants to adjust. This is a major advantage of these two approaches as they promote dynamic efficiency. The EU has made major strides in this area by introducing the Emissions Trading

8. For example infrastructure development and high-speed rail.

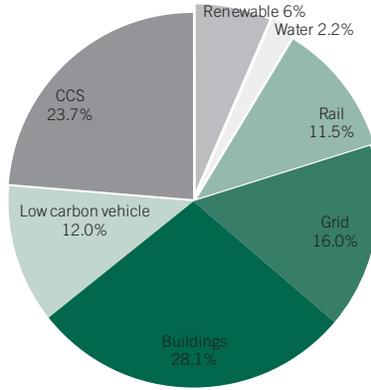
9. For example hybrid cars or low-carbon-emitting fossil fuel vehicles.

**Figure 2.3 Green stimulus by countries, by the end of 2009**



\* Includes direct EU contribution and Member States; \*\*: Direct EU contribution.

Source: HSBC.

**Figure 2.4 Green stimulus spending in the EU**

Source: HSBC.

Scheme (ETS) in 2005. The ETS is still in its developing phase but a substantial proportion of European CO<sub>2</sub>-emitting production facilities are covered by the system. No practical experience exists with a trading system of this magnitude and due to its rather recent implementation it is too early to evaluate its effectiveness.

In the future, however, policy-makers may wish to give further consideration to a carbon tax as a complement to the existing trading scheme. First, carbon taxes are, like trading schemes, particularly effective in sending price signals that encourage innovation and investment in new technologies. Second, carbon taxes are simple and cost effective. Third, the existing tax structure is primarily focused on household consumption which is both regressive and the least effective means of reducing CO<sub>2</sub> (the most effective being taxing production at the source as discussed in Chapter 1). Finally, the ability to leverage tax revenue to facilitate adjustment in areas affected by the transition to a greener economy, e.g. employment and incomes, boosts the case for carbon taxes (see Chapter 4).

These market-based solutions need to be complemented with other means, including regulations, research and development and public investment. With respect to the former, regulations are most appropriate when regulators possess a great deal of information; the targeted activity is similar for all agents; and compliance is easily controlled by the regulating authority. At the same time, a successful transition to a green economy must be accompanied with new technology and changes in consumption patterns. R&D policies and public investment are therefore useful complementary policies that can amplify and accelerate the transition. The diversity of policy options in these categories is large. In practice, these types of policies require public funding, which has become increasingly limited following the economic crisis. Some countries have taken creative steps to overcome limited budgets, such as private–public partnerships that have encouraged the private sector to fund R&D as well. The overall size of the programmes remains relatively small, however, and they are not coordinated among Member States. Indeed, efforts to support R&D in energy efficiency and renewable energy need to be part of an overall coordinated European energy policy.

Together, these policies can help to achieve environmental sustainability. However, adjusting the relative prices of energy can alter the competitiveness of industries and lead to behavioural adjustments of producers and consumers. This process will bring forth both opportunities and challenges for the labour market – an issue which is discussed in more detail in the following chapter.



# EMPLOYMENT AND INCOME CONSIDERATIONS OF A GREENER ECONOMY

# 3

## Key findings

- A greener economy will bring forth both employment challenges and opportunities. In both instances, however, the right policy mix will be needed to ensure that the impacts on the most vulnerable are mitigated and that the upside potential of greener, more productive jobs is fully realized. Only then will the transition to a greener economy be economically successful and socially fair.
- On the downside, 12 per cent (or 24 million) of all workers in the EU-25 are employed in the top 15 emitting industries (the most likely to undergo adjustment). In addition, workers in these industries have on average a lower skill level in comparison to those in low-carbon industries:
  - In terms of the magnitude, the disparity between EU-15 and EU-10 Member States is notable – more than one-fifth of all employees in the EU-10 are working in the top 15 emitting industries, more than double

the rate (9.5 per cent) in EU-15 Member States. The shares are lowest among Sweden and Denmark (under 9 per cent) and are highest in Poland and Slovenia (at roughly 28 and 20 per cent, respectively).

- In the EU-15, nearly 30 per cent of workers in the top 15 emitting industries are low skilled compared with less than 20 per cent in the low-carbon-intensive sector (LCIS). The gap between the top 15 emitting industries and the LCIS tends to be greatest in Poland and Slovenia, although the overall incidence is in line with the EU-15 average.
- Given the somewhat predictable nature of the adjustment process, there is considerable scope for governments and social partners to work together to develop strategies to smooth this transition over time for both workers and employers. In particular, active labour market policies can help manage the green transition for those workers affected most. Emphasis should be given to skills upgrading in order to facilitate the adaptation of new technologies within sectors. Adequate income support must accompany activation measures and be delivered through well-resourced public employment services.
- There is also considerable upside potential to leverage greener jobs to the benefit of the economy (higher productivity), workers (improved wage shares) and the environment (lower CO<sub>2</sub> emissions):
  - Low-carbon sectors tend to have higher labour productivity and a higher share of the skilled labour force.
  - In the EU-15, wage shares of the LCIS have tended to fall less than in the top 15 emitting industries, especially in recent years.
  - Yet, the environmental goods and service sector is relatively small (between 1 and 3 per cent of total employment in select EU countries with available information).

- Governments and social partners must develop a medium- to longer-term knowledge development strategy that complements investments in research, development and technological innovations. Governments and educational institutions need to adapt and better reflect the technical needs of green industries and of a low-carbon economy more generally.

## Introduction

The transition towards a greener economy will have important implications for the labour market, notably in terms of job creation and destruction as well as income dynamics. This transition can be mainly described as a structural change and thus the employment and income effects cannot be studied solely at the aggregate level, that is, there are important considerations as to how any gains or losses are distributed. Similarly, the discussion regarding employment policies should not be concerned with strictly green jobs per se, i.e. environmental change will affect employment across a range of activities.

With this in mind, the purpose of this chapter is to identify some of the potential challenges confronting workers and highlight areas where labour market and social policies can support workers to make a successful transition – all the while supporting green structural change. In particular, Section A examines the nature and composition of employment by the carbon intensity of the sector, looking in particular at skill levels and wage share trends in the top 15 emitting industries compared with other parts of the economy. Against the backdrop of these considerations, Section B examines how labour market and social policies can help address challenges specific to the green transition, highlighting opportunities to smooth the necessary structural changes. Section C discusses a number of policy considerations, including the important question of possible net employment effects.

## A. Employment transitions: Challenges and considerations

Structural change is not a new phenomenon, and past periods of adjustment can be helpful in understanding the green transition. In particular, previous experiences indicate that employment shifts occur along three main axes: (i) across sectors (or industries); (ii) across enterprises within the same or similar sector (industry); and (iii) within enterprises. In addition, job transitions are often most difficult for certain workers, e.g. low-skilled workers. However, governments have at their disposal various labour market instruments that can help mitigate any negative effects of job loss and facilitate employment transitions, especially for vulnerable workers.

### 1. Potential magnitude of employment challenge

Adjustment pressures arising from a green transition would mainly arise in the high-carbon-intensive sector (HCIS).<sup>1</sup> The IILS estimates that among EU-25 countries, roughly 43 per cent of all workers are employed in this sector, which amounts to approximately 87 million workers and a little more than one-third of GDP (table 3.1). There is considerable variation among Member States with the share rising to over 52 per cent among newer members, i.e. EU-10, compared with just over 40 per cent among EU-15 Member States. These figures tend to overstate the challenge given that the top 15 emitting industries within the HCIS account for roughly 95 per cent of total CO<sub>2</sub> emissions and approximately 85 per cent of all emissions arising from production. With this in mind, only 12 per cent of all workers are employed in the top 15 emitting industries (24 million workers). However, the disparity between EU-15 and EU-10 Member States is now more notable – more than one-fifth of all employees in the EU-10 are working in the top 15 emitting industries, more than double the rate (9.5 per cent) in EU-15 Member States. The shares are lowest

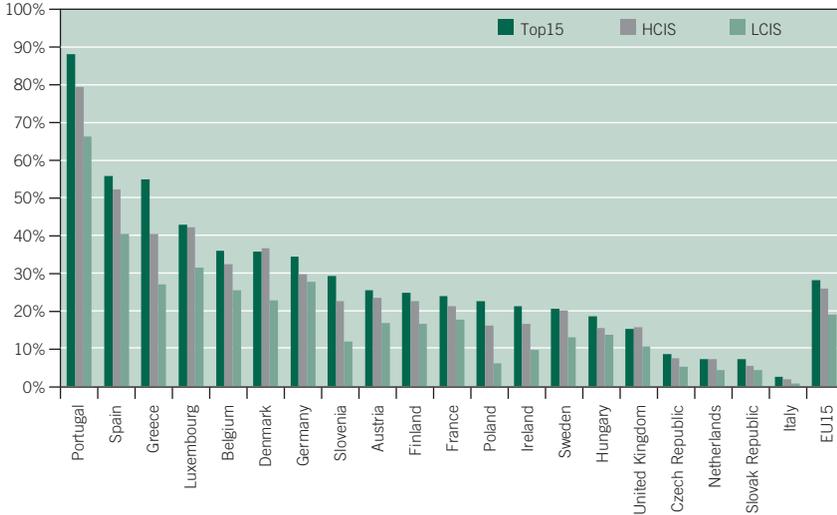
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1. All high-carbon-intensive industries (those above median) taken together constitute the high-carbon-intensive sector (HCIS).

**Table 3.1 Employment and GDP shares of high-carbon-intensive industries, 2005**

	Country	Employment (%)		GDP (%)	
		Top 15	HCIS	Top 15	HCIS
1	Austria	18.7	50.0	13.0	37.8
2	Belgium	9.7	40.5	12.9	35.7
3	Cyprus	11.8	52.0	8.0	42.5
4	Czech Republic	14.5	46.2	17.7	42.5
5	Denmark	8.8	36.6	13.8	36.4
6	Estonia	13.2	49.3	13.5	42.9
7	Finland	12.7	40.9	14.7	36.9
8	France	9.3	38.7	10.0	31.9
9	Germany	8.8	41.0	10.4	32.5
10	Greece	19.6	56.8	12.8	48.4
11	Hungary	15.2	50.0	16.3	41.9
12	Ireland	12.2	42.3	15.4	35.1
13	Italy	12.4	41.5	13.0	37.5
14	Latvia	14.8	55.3	12.3	42.5
15	Lithuania	17.1	51.4	22.2	52.1
16	Luxembourg	10.1	34.2	9.4	25.0
17	Malta	10.0	45.6	9.2	39.7
18	Netherlands	9.0	37.0	14.3	35.2
19	Poland	28.3	56.1	19.1	46.4
20	Portugal	16.7	50.8	10.8	40.9
21	Slovak Republic	14.5	46.0	21.0	46.6
22	Slovenia	19.8	47.1	15.3	39.5
23	Spain	11.9	44.5	12.5	39.4
24	Sweden	8.6	34.8	12.7	33.0
25	United Kingdom	6.7	38.5	11.2	32.8
	EU-25	11.7	42.8	11.8	35.2
	EU-15	9.8	40.7	11.6	34.8
	EU-10	21.2	52.4	13.6	39.3

Source: ILS estimates based on EU KLEMS.

**Figure 3.1 Share of low-skilled employment by industry classification, 2005**

Note: Shares have been calculated based on hours worked. See footnote 2.

Source: ILS estimates based on EU KLEMS.

among Sweden and Denmark (under 9 per cent) and are highest in Poland and Slovenia (at roughly 28 and 20 per cent, respectively).

## 2. Skill challenges and opportunities

The skill composition of workers in high- and low-carbon-intensive sectors will influence the employment transition.<sup>2</sup> An examination of total hours worked in the economy by sector reveals that in all but two countries, the share of low-skilled labour in high-carbon sectors is higher (figure 3.1). For instance in the EU-15, nearly one-fifth of workers in the low-carbon-intensive sector (LCIS) is

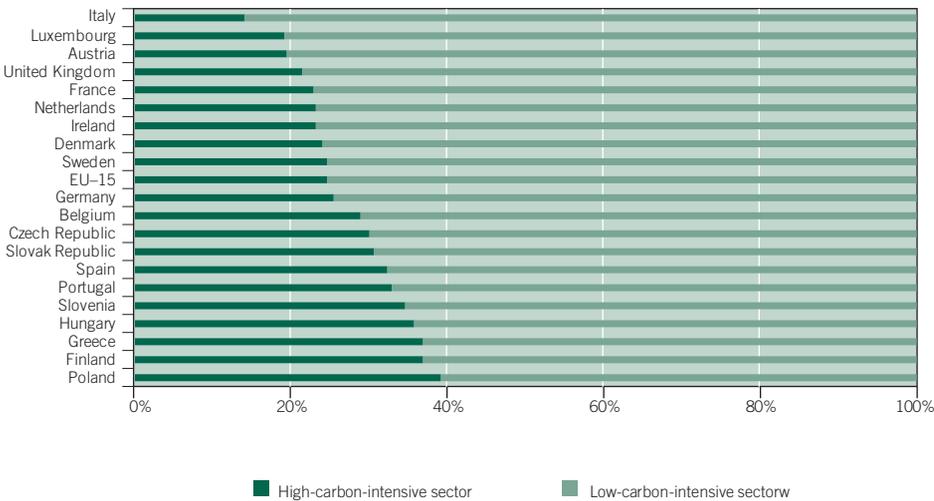
2. Skill levels are measured according to high, medium and low education levels and therefore strict comparisons across country should be made with some caution. For a detailed discussion of the methodology used in the EU KLEMS database to distinguish different skills level see O'Mahony and Timmer (2009). Moreover, the definitions of hours differ across data sources for different countries.

low skilled compared with 27 per cent in the HCIS – the figure rises to nearly 30 per cent in the top 15 emitting industries. Similar trends are apparent across EU Member States. The gap between the top 15 emitting industries and the LCIS tends to be greatest in Poland and Slovenia, although the overall incidence is in line with the EU-15 average.

Looking at the skills composition in slightly different manner, i.e. distribution of high-skilled labour by sector, reveals that the vast majority of high-skilled persons is employed in the LCIS (figure 3.2). In fact, in the EU-15 more than three-quarters of high-skilled workers are engaged in low-carbon-intensive activities. Moreover, labour productivity tends to be higher (although the growth rate of labour productivity is lower) in the LCIS.

### 3. Wage share development and income considerations

**Figure 3.2 Share of high-skilled workforce, 2005**



Note: Shares have been calculated based on hours worked. See footnote 2.

Source: IILS estimates based on EU KLEMS.

**Figure 3.3** Change in wage shares (1995 – 2005)

Note: Wage shares were calculated using the ratio of compensation of employees to value added, yielding percentages for high- and low-carbon industries.

Source: ILS calculations based on EU KLEMS.

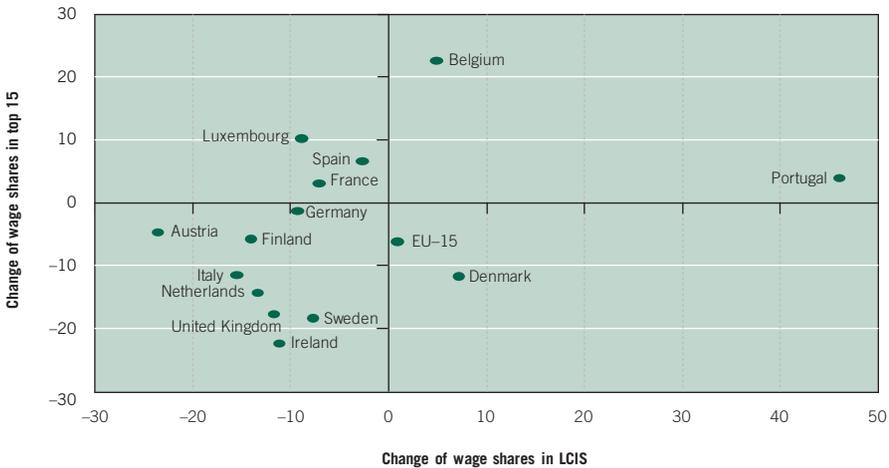
Income loss due to job separation is also an important consideration in the context of structural adjustment (see for example Von Wachter et al. 2009; Butcher & Hallock 2004). For instance, job displacements that occurred during mass layoffs in the 1980s led to large (up to 30 per cent) earnings losses that tended to persist – albeit not to the same extent – over decades. Developments of this nature can affect overall income distribution and the share of income being allocated to workers, i.e. the wage share (Belsler 2011).

Recent trends in the EU show a mixed picture with respect to wage shares (figure 3.3). While wage shares in the HCIS tend to be higher in comparison with the LCIS, across EU groups, wage shares in the top 15 emitting industries are systematically lower and have incurred slightly larger declines in the decade between 1995 and 2005 in comparison with both the LCIS and the HCIS, especially in the EU-10. And while a number of factors are said to influence wage shares, e.g. trade liberalization, labour market institutions, prevalence of

unions, these findings are consistent with ILS research, which has shown that the wage shares of low-skilled workers has tended to decline on average more than the wage share of high-skilled workers, which in some instances has risen (International Institute for Labour Studies (IILS) 2008).

Analyzing the trends over a longer period of time reveals that for the EU-15 on average, the evidence is consistent with the recent changes, i.e. the wage share in the LCIS remains little changed since 1970, whereas it has fallen in the top 15 emitting industries (figure 3.4). At the country level, however, the trends are a little more ambiguous. In fact, in the majority of EU Member States the wage shares in both sectors have fallen between 1970 and 2005. Only in a small set of countries (Denmark, Ireland, the Netherlands, Sweden and the United Kingdom) has the wage share of the top 15 emitting industries fallen faster.

Figure 3.4 Change of wage shares from 1970 to 2005 (percentages)



Source: IILS estimates based on EU KLEMS.

## B. Facilitating adjustment and the role of policy

The existing suite of active and passive labour market policies can play a significant role in helping facilitate employment adjustments. In fact, the OECD (2011) finds that active labour market policies can boost the adaptive capacity of labour markets and is key to addressing the green transition from the supply side. These can range from job search assistance to training measures to income support and in-work benefits. And while a green transition is not unlike other structural changes, policies and programmes can nevertheless be tailored to address specific challenges and specific industries. Along these lines, the existing European Globalisation Adjustment Fund could be re-oriented to include elements to address the adjustment pressures associated with greening the economy (box 3.1).

### Box 3.1 European Globalisation Adjustment Fund

The European Globalisation Adjustment Fund (EGF) was set up by the EU in late 2006 to support workers who have been made redundant as a result of trade liberalization, so that they can either remain in employment or find a new job quickly. It funds active measures, such as counselling, job search and mobility allowances, new information and communications technology (ICT) skills and other forms of training, and entrepreneurial support, including micro-credits. Applications are made by Member States and funding is co-shared with the European Commission. Upon review of the application, the European Commission makes a proposal to disburse funds, and the European Parliament and the Council jointly take the final decision. Since January 2007, the EGF has received 77 applications from 19 Member States and spent over 350 million euros to help around 77,000 workers to find new jobs (as of May 2011, table 3.2).

**Table 3.2 EGF applications and contributions, 2007–2011**

	2007	2008	2009	2010	2011 (as of May)	Total
Number of applications	8	5	29	31	4	77
EGF amount (million euros)	51.8	20.6	132.9	137.9	14.8	357.9
Number of targeted workers	10 679	5 435	28 909	29 507	2 450	76 980
Average EGF per person (euros)	4 847	3 795	4 596	4 672	6 053	4 650

Source: European Commission, European Globalisation Adjustment Fund.

## 1. Policies to address skills upgrading

In the short term, some workers will need skills upgrading as sectors move to lower carbon emissions by using renewable energy or energy-efficient technologies. In other cases, however, workers in the HCIS will need to transition to new employment that might be completely unrelated to their previous employment. This transition will be particularly challenging for the low-skilled workforce in the top 15 emitting industries. One of the keys to facilitating this transition for workers will be early identification and effective public–private partnerships. In particular, the adjustment process for workers is often exacerbated by the fact that (i) the job loss is unexpected and (ii) there is little awareness regarding policies and programmes that are available to them. However, unlike some structural adjustments, a green transformation can be somewhat controlled. For instance, this report has already highlighted the top 15 industries most likely to be affected by the greening of the economy. Together, governments and worker representatives can work with these employers to indentify early potential adjustment pressures, notably regarding skills deficiencies, and develop preventative strategies to ease the transition process. Moreover, public authorities could work closely with vulnerable sectors to inform workers well ahead of any job separations or layoffs of the suites of training (and other active programmes) that are available to workers – a similar example that exists in Canada, the Adjustment Advisory Program, could be altered to address the needs of firms likely to be affected by the shift to a greener economy (box 3.2).

## 2. Supporting knowledge development

Over the medium term, one challenge facing policy-makers in the context of the shift to a greener economy is whether the existing education system and vocational training system is capable of equipping future workers with the requisite breadth of competences needed to take full advantage of the new technologies associated with a greener economy. In particular, effective

**Box 3.2 The Ontario Adjustment Advisory Program in Canada**

The Ontario Adjustment Advisory Program (AAP) was designed to help workers, organizations, communities, and sectors affected by workplace closure, downsizing or the threat of job losses by allowing them to manage and anticipate changes in the labour market.

Individual firms, employees, communities or industrial sectors can participate in the programme. Communities and industrial sectors requesting assistance in managing and anticipating adjustment issues are also eligible.

The AAP provides assistance by: (1) surveying needs, skills and goals, (2) offering workshops and seminars, (3) finding training services, government programs and funding opportunities, (4) contacting potential employers, and (5) establishing placement action centres. Also the AAP assists firms in re-orienting their activities in order to remain viable.

The AAP helps employees being laid-off deal with the effects of losing their jobs by helping them review their options and plan their next steps through vocational and educational counselling, job search assistance, etc. For industrial sectors, the programme helps develop a competitive edge through partnerships or industry associations, employee associations, employers and unions to properly identify common industry needs and goals.

mechanisms to facilitate the effective generation and transmission of knowledge between higher education institutions and business will be central.

One way to address future knowledge requirements is to identify and forecast skill needs (box 3.3). In this respect, further skills research across a range of levels, including the macroeconomic, sectoral, occupational and skills, and training and education levels will provide valuable insights (ILO & EC 2011a). It is important to note that no single skills research approach can capture skills needs across these various levels but just some elements of both quantitative and qualitative components.

Most countries have in place a variety of surveys that can be adapted to skill issues related to the green economy. On the demand side, enterprise surveys can help to yield information on skill shortages, while amendments (or special supplements) to labour force surveys can be made to collect data on the supply side, for instance, education levels of workers in green jobs. In other instances, entirely new surveys can be developed to address a particular knowledge gap. Qualitative studies of skill needs at the sectoral level, e.g. by utilizing expert opinions, can also provide valuable insights. Social dialogue and social partners

**Box 3.3 Skill needs in renewable energy sectors**

The ILO (ILO & EC 2011b) has identified skills needs in renewable energy sectors. For example, the wind energy sector lacks a supply of workers because demand is increasing faster than supply. Demographic change, unattractive working conditions and a lack of practical skills have led to a demand for project developers, service technicians and data analysts. While some countries are not currently facing labour shortages in the wind energy sector due to the global economic crisis, shortages are expected once investments return to pre-crisis levels.

In general, across countries, the wind energy sector has filled vacancies with workers from other sectors and then offered a variety of training programmes to adapt competencies to the industry's specific requirements. In countries with higher shares of wind energy, specialized higher education degrees (mostly engineering) are increasing. Other specialized training programmes in renewable energy are increasingly offered in advanced economies.

Skill needs in other renewable energy sectors show similar trends. Occupations that require more specialized training are often more difficult to match with potential workers, especially in countries where the industry in question is growing very fast, thus outpacing supply of labour. For all renewable energies, the ILO has recommended the use of special training and courses, apprenticeships and in-service training as tools for adapting the workforce to new green jobs. There is also a clear need for technology-specific engineering skills.

play an important role in identifying skill needs by encouraging research in certain areas, interpreting findings and informing policy and implementing recommendations in institutions that provide skills and vocational guidance.

At the same time, efforts will be needed to ensure that the education system is responsive to the development of new technologies, notably in the renewable energy sector. In particular, increased research and development activities – discussed in Chapter 2 – need to be complemented by support for new technical skills, mainly related to the natural sciences and engineering (box 3.4). One common approach is to introduce incentives and programmes to encourage a greater number of students to obtain science and technology graduate and postgraduate degrees (Jaumotte & Pain 2005). Attracting students to degree programmes in the engineering and natural sciences is particularly important and can be supported through government-introduced incentive programmes. An important consideration is the wage determination process. For example, enrolment decisions of engineering students in the United States, are very sensitive to expected career opportunities (Ryoo & Rosen 2004). In this respect, changes in real wages for R&D workers can have a significant positive impact

### **Box 3.4 The role of knowledge development in fostering the ICT economy in the Republic of Korea**

In response to the Asian financial crisis in 1997–1998, the Korean Government invested heavily in its ICT infrastructure. The Government focused on ICT ventures and formation of industrial clusters where interactions among various actors are used to induce dynamic innovation.

In support of ICT activities, the Government financed a range of research and training activities. To foster greater adoption of ICT, the Government also launched an ICT training programme targeted at unemployed people and women outside the workforce. A range of institutions were established that offered free ICT skills training.

on labour supply (Marey & Borghans 2000). Collective bargaining and labour market institutions can play an important role in this context.

Another possibility to increase the share of skilled scientists and engineers in the workforce is through increased immigration. Several policies are available to influence migration decisions (OECD 2001). Many developed countries offer selective immigration packages for potential immigrants who are scientists and engineers. Hansen (2004) finds that many skilled postgraduate migrants are often attracted by centres of excellence in research and better opportunities for research funding (Hansen 2004). Moguero & Di Pietrogiacomio (2008) provide a recent report about the current status of researchers' stock, flow, career and mobility in the EU.

### **3. Mobility assistance: Across and within firms**

In looking at the top 15 emitting industries, many of them (e.g. coal, agriculture and mining) are often located in remote or rural areas. Governments can provide mobility assistance, for example through direct financial support or tax deductions of moving costs. Yet, a shift away from these industries will place acute pressures on low-skilled and older workers for whom geographic mobility is often quite limited.

Another way to address this issue is to encourage the greening of the enterprise, a process that occurs within the firm. This “greening” entails reorganization of production processes by making greater use of renewable energies and retraining workers and shifting them to new jobs over time. The role of government in this process may be to focus on the development of knowledge platforms at industry level, with particular focus on social dialogue and the role of social partners. At the industry level, it is possible to identify common reallocation processes among firms to better inform skills development, especially retraining programmes, since similar firms will face similar challenges. An example of a policy encouraging the greening of enterprises can be found in German smart grids. Smart grids play a central role in German renewable energy policy, allowing companies to adapt their energy needs with fluctuations in energy demand. Peak energy usage can be reduced if companies avoid energy consumption during critical times of the day. The participating firms save on energy costs and at the same time, may receive a premium from the government. Certain workers in participating firms are gradually taking on greener roles and assuming responsibilities over new, energy-efficient operations or using new technologies.

#### 4. Effective public employment service

The successful delivery of these programmes will hinge on having a well-resourced, effective public employment service (PES). Training provisions and active labour market programmes more generally have a greater likelihood of success if delivered through an efficient PES. These agencies must have a firm grasp on the employment needs of a greener economy and an efficient method of reaching out to unemployed workers – in some instances even before they become laid-off (see above).

An equally important consideration is that downsizing and retransformation of carbon-intensive industries will not proceed at the same pace in all industries. As such, workers laid-off in one high-carbon firm or industry often find

a new job in another high-carbon industry. The PES and the orientation of activation policies should, however, attempt to promote – to the extent possible – a transition of workers from high-carbon industries towards low-carbon industries. This requires an acute awareness of green policy choices by public employment services.

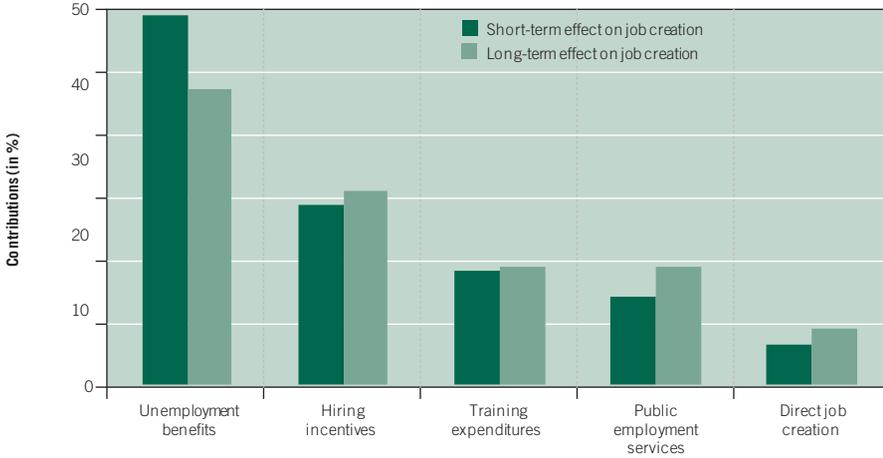
## C. Policy considerations

### 1. Tailoring the existing suite of policies and programmes to smooth downside adjustment

Chapter 2 was able to identify the top 15 emitting industries that would be most likely affected by the shift towards a greener economy. The analysis in this chapter has narrowed further that challenge in identifying the potential impact on employment in terms of both magnitude (size of employment in these industries) and composition (skill level). In this regard, the green transition is in many ways not unlike previous structural adjustments, especially as regards the potential implications on the labour market. One of the major aspects, however, that sets it apart is that there is at least some level of predictability. As such there is, first, considerable scope for governments and social partners to work together well before the onset of adjustment to develop strategies to smooth this transition over time for both workers and employers. For instance, early identification of skills, challenges and needs – which can be enhanced through skills surveys – as well as informing workers of the suite of active and passive programmes that are available to them can help to ease the process.

In terms of the actual design of specific programmes, the current suite of policies and programmes could be tailored to the challenges of these workers and delivered through a well-resourced public employment service that is akin to the issues associated with a green transition. Indeed, active labour market programmes have a greater likelihood of success when targeted to a particular disadvantage. Moreover, if well-designed, their impact on employment, especially in the long-run can be sizeable (figure 3.5).

**Figure 3.5 The effects of different labour market policy options on job creation (percentages)**



Note: The chart presents the contributions (in %) to job creation (measured by outflows out of unemployment) of different labour market policies in a panel of 14 OECD countries. Contributions are measured relative to the total variance of cross-country job creation rates and are calculated with respect to the average spending shock across the country sample for each individual policy. Each bar corresponds to a single estimation of the respective policy, taking several control variables into account. Short-term effects are based on exogenous interest rates, long-term effects take the impact of an increase in government debt on real long-term interest rates into account.

Source: ILS.

## 2. Leveraging potential net employment effects of “green” jobs

The shift to a green economy also offers considerable upside potential in terms of employment. Jobs in the LCIS tend to be higher skilled and empirical evidence shows that average labour productivity in the LCIS is higher than the HCIS, although it grows at a slower rate (Samaan 2011).<sup>3</sup> In a greener economy one would also observe higher resource productivity.<sup>4</sup> Given that labour is abundantly available, while resources like energy and raw materials will become

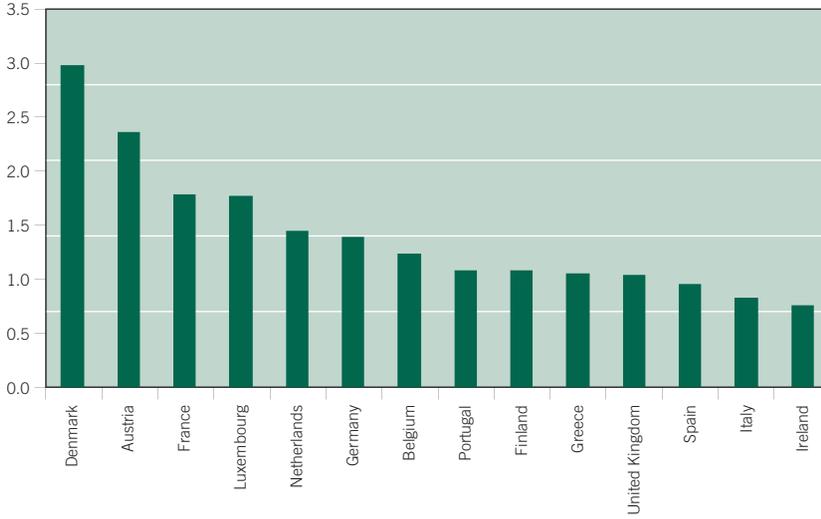
3. The empirical evidence is only based on inter-industry movements between the high-carbon sector and the low-carbon sector. Based on the available data, it cannot be determined whether total productivity in a green economy is higher or lower.

4. In this report, the economy becomes “greener” by emitting less CO<sub>2</sub>. This goes along with a lower CO<sub>2</sub> intensity which is equivalent to a higher CO<sub>2</sub> productivity. If other dimensions of “green” were considered, “greening” would, for example, imply a lower ratio of GDP to waste and higher productivity in resources.

much scarcer in the following decades, a switch of focus from labour productivity to resource productivity can be expedient. In addition, some case studies confirm that moving towards a green economy results in a higher labour intensity on average. For example, research commissioned by the European Climate Foundation (2010) provides a case study in the construction sector in Hungary in which it compares the employment impacts of the construction of ordinary buildings with the construction of green buildings.

Technological change which is both required and desirable in the green transition will impact considerably **output growth, labour productivity and employment**. In particular, when high job destruction rates increase unemployment, higher productivity growth can reduce the level of unemployment, as long as the costs of adopting new technology are low (Mortensen & Pissarides 1998). The costs of new technology are a function, among other things, of the internal costs of adjustment, like retraining – highlighting the importance of cultivating skilled scientists and engineers and supporting knowledge development more broadly as a complement to research and development.

Overall, this suggests that there is a potential for positive employment effects from the green transition, on condition that the right policy mix is put in place. Moreover, employment in the environmental goods and services sector (EGSS: industries that directly contribute to reducing CO<sub>2</sub> emissions) remains low, i.e. between 1 and 3 per cent of total employment (figure 3.6). As such, there is considerable potential to leverage further green jobs to the benefit of the economy (higher productivity), workers (higher wage share) and the environment (lower CO<sub>2</sub> emissions).

**Figure 3.6 Share of environmental sector employment (percentages)<sup>5</sup>**

Note: Environmental sector corresponds to Category I in figure 1.2. Share of the environmental sector employment out of total employment.

Source: ECOTEC Research & Consulting Limited, 2002.

5. Employment shares are based on 1999 data, the most current indicator of the size of the environmental sector. Overall it is difficult to determine the share of environmental sector employment due to data constraints.



# THE DOUBLE DIVIDEND AND ENVIRONMENTAL TAX REFORMS



## Key findings

- Theoretical and empirical findings indicate that a double dividend, i.e. both a reduction in CO<sub>2</sub> emissions (environmental sustainability) and improvements in the labour market (job growth and improved equity) are possible if policies are well-designed.
- EU Member States have made important strides in recent years to introduce environmental tax reforms (ETRs) aimed at broadening the overall tax base and at shifting taxation from labour to energy.
  - Formal ETRs have been implemented by Denmark, Finland, Germany, the Netherlands, Sweden and the United Kingdom. Environmental tax revenue is higher in these countries than across other EU Member States and CO<sub>2</sub> intensity has fallen faster – though more work is needed to investigate this relationship.
  - A general shift away from labour taxation towards green taxation can also be observed in some of these countries, notably Denmark, Germany and (to some extent) the Netherlands. However, the magnitudes of these tax shifts are still relatively small.

- In order to fully realize the potential of the double dividend EU Member States could give further consideration to improving the delivery and scope of existing ETRs:
  - *Broadening ETR tax base:* Like other taxes on energy, the focus has been narrowly restricted to households' energy consumption. Re-orienting ETRs to tax production would not only improve efficiency but expand the current revenue base: environmental tax revenue has been trending downward and accounts for roughly 7 per cent of all tax revenue in the EU-27.
  - *Increased emphasis on labour market measures:* A necessary condition of the double dividend is that the revenue from taxing emissions is re-channelled to the labour market in the form of lower taxes on work and increased emphases on other labour market measures, e.g. training. This, as discussed in previous chapters, is critical to facilitating adjustments in the labour market. However, in a number of instances, the revenue collected through ETRs has been used to finance broader government expenditures.
  - *Improving equity through targeted initiatives:* Introducing personal energy allowances within the tax structure, i.e. a certain amount of energy per household would be exempt from tax could improve equity. In addition, labour market measures could also be designed in such a way as to improve equity, e.g. by cutting taxes on labour for low-income earners as was the case in Denmark.
- The success of leveraging further ETRs in the context of the EU will require that efforts are harmonized among Member States and that reforms are undertaken with a longer-term perspective. Indeed, communication of long-term price signals to markets will yield lasting behavioural changes of producers and consumers.

## Introduction

Taking into consideration environmental reform on the one hand, and labour market policies on the other, the purpose of this chapter is to explore how the two can complement each other to achieve both objectives simultaneously. In particular, Section A will examine the case of the double-dividend hypothesis, i.e. possibility to achieve increased environmental quality and reduced unemployment through a properly designed mix of climate and labour market policies. Section B reviews ETRs, which were implemented across a range of Member States in the 1990s and which were often inspired by the theoretical considerations of the double-dividend hypothesis. This section also reviews, as far as possible, the effectiveness of these reforms. Finally Section C reviews a number of policy considerations with the aim of improving the role of ETRs in realizing the double dividend.

### A Double dividend

The double-dividend hypothesis (DDH) claims that the benefits to the environment and employment can be simultaneously achieved through a properly designed policy mix. In the context of the DDH, benefits from the environmental perspective are realized through emission reductions and on the employment side are understood as quantitative increases in employment (qualitative aspects of employment, such as decent work characteristics of jobs created, are generally neglected in the academic discussion of the DDH).

#### 1. The double-dividend hypothesis

Currently three versions of the DDH can be distinguished in the literature (see Goulder 1995b; IILS 2011b), based on the size of the cost reduction of the

implemented carbon tax.<sup>1</sup> The “weak” version claims that cost savings (or welfare improvements) are achieved if the tax revenues are used to reduce the marginal tax rates of a distortionary tax, e.g. taxes on labour or reductions in social security contributions. The “intermediate” form claims that it is possible to find a distortionary tax such that the revenue-neutral substitution of the carbon tax (environmental tax) involves a zero or negative gross costs, i.e. no overall welfare losses (or gains) through taxation. The strong form claims that a carbon tax that is redistributed through a reduction in distortionary tax rates would always yield benefits in terms of output and employment. On theoretical grounds, the claims of a weak double dividend are widely accepted and considered relatively uncontroversial (see Goulder 1995b). However, the strong form is generally rejected in the literature due to the unlikelihood of some of the necessary conditions, e.g. negative wage elasticity of labour supply (Bovenberg and de Mooij 1994).

The Organisation for Economic Co-operation and Development (OECD) has undertaken several reviews of studies about the employment effects of environmental policies over the last few decades (see OECD 1978, 1997b, 2004). In examining top-down approaches, i.e. when macroeconomic policy is implemented at the “top” level by policy-makers and institutions, the OECD finds generally that the extent of any double dividend depends largely on the existing tax system of an economy and the state of the labour market:

A strong double dividend cannot occur if the existing tax structure is revenue-optimal. If, as is likely in practice, the existing tax structure is not revenue-optimal, a strong double dividend will occur if the environmental tax reform moves the tax structure in the direction of revenue-optimality. In a situation with involuntary unemployment, employment will only increase if the use of environmental taxes to partially replace existing taxes results in an increased demand for labour. If the labour market is in equilibrium, additional employment could only be caused by increasing labour supply (OECD 2004).

1. It is important that the terms “cost reduction” and “zero or negative cost” be understood here in a general way to refer to all kinds of welfare gains. Often these welfare gains are specified in concrete economic terms, such as reduced unemployment or increased profits (see Bovenberg and van der Ploeg 2002).

The findings generally support that an increase in environmentally related taxes combined with a reduction in, for example payroll taxes, will increase employment. In addition, when there is involuntary unemployment, the prospects of increased employment are higher if: (i) the environmental tax can be passed on to factors that are inelastically supplied and relatively undertaxed; (ii) non-working households are large enough in number, and are significant as consumers of goods produced with the environmentally intensive inputs that are taxed; (iii) through international market power, the environmental tax can raise the price of goods produced with a relatively intensive use of the taxed environmental input; (iv) capital is relatively immobile internationally (in this case it can absorb some of the environmental tax and less of the tax burden falls on factors such as labour); (v) the elasticity of substitution between the environmental input and labour is greater than the elasticity of substitution between energy and capital; (vi) the real wage rises little when unemployment falls, so that the reduction in the taxes on labour is not offset by wage rises.

When there is only voluntary unemployment, conclusions (i) to (iv) still hold, but conclusions (v) and (vi) are replaced by another factor: the environmental tax is levied on goods that are more complementary to leisure in consumption than the goods whose taxes are reduced.

## 2. Empirical evidence for the double dividend

Several empirical studies have attempted to address the DDH. In the United States, Shackleton et al. (1992) take three different methodological approaches in an effort to quantify the double dividend.<sup>2</sup> In all three modelling frameworks, a phased-in carbon tax is accompanied by a cut in the personal income tax rate or labour tax rate. The results indicate that a strong double dividend is only present when labour taxes are reduced.<sup>3</sup> The studies generally exclude however welfare gains resulting from improvements in environmental conditions.

2. The authors employ the DRI and LINK econometric macroeconomic models, as well as the Goulder and Jorgenson–Wilcoxon intertemporal general equilibrium model.

3. As pointed out by Goulder (1995b), the varying results might be related to the considerably higher marginal excess burden of capital taxation and the assumption of perfect capital mobility in the Jorgenson–Wilcoxon model.

Other studies conducted by Goulder (1995a) and Shah and Larsen (1992) introduce a constant carbon tax, or fossil-fuel tax, accompanied by reductions in the personal income tax rate. Both find that a double dividend, at least in its strong form, is elusive.

Simulations based on data of European economies tend to be a little more optimistic about the strong version of the double dividend, especially as regards the potential positive impact on employment. A study by Bossier et al. (1993), analysing eight sectors across the EU, shows that a carbon tax would both reduce CO<sub>2</sub> emissions and increase employment, driven by factor substitution between labour and capital. A similar model used by Hayden (1999) illustrates that when the carbon tax burden is placed on industries, a small, positive employment effect (0.1 per cent) is observed, although GDP falls by 1 per cent.<sup>4</sup>

In addition, a series of empirical studies have evaluated the effectiveness of recent ETRs undertaken in some EU Member States. For example, Germany introduced both energy taxes (albeit with some exceptions, e.g. air traffic) and a constant increase in the existing petroleum tax. The tax revenue has been used to subsidize social security contributions levied on labour, thereby reducing the effective wage cost. Bach et al. (2001) conclude that the reforms in Germany not only increase employment and reduce emissions, but also slightly boost GDP growth. However, the impact on employment and the environment are rather small and inadequate in fully addressing either the challenges of climate change or high unemployment.

A similar study of the German reform by Frohn et al. (2003) confirms the results of Bach et al. (2001), i.e. a slightly positive employment effect and a small reduction of emissions. The highest reduction in CO<sub>2</sub> emissions was achieved in a scenario with a hypothetical CO<sub>2</sub> tax (as opposed to an energy tax). However, in this scenario, the (still) positive employment effect was the weakest and the decelerating effect on macroeconomic activity was the strongest.

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4. When the tax burden falls on consumers, employment increases by 0.9 per cent, due to the substitution of capital for labour.

The Emissions Prediction and Policy Analysis (EPPA) model is a component of the Massachusetts Institute of Technology's (MIT) Integrated Global System Model (IGSM) (see Babiker et al. 2001). EPPA, which is also designed to evaluate the economic impacts of policies for limiting greenhouse-gas emissions, belongs to a class of economic simulation models known as computable general equilibrium (CGE) models.<sup>5</sup> Based on the EPPA, Babiker and Eckaus (2007) are hesitant to give exact measures of the effects due to the limitations in availability of data and the capacity of the EPPA model. However, their analysis indicates, "There would be a real, direct depressing effect from the imposition of emissions restrictions". The employment effects they anticipate would be small and negative, caused mainly by a reduction in GDP growth under the implemented climate policies. Thus, in their modelling framework they cannot find support for the DDH. They recommend that other policy measures, such as wage subsidies, be implemented to mitigate the negative employment effects of climate policies.

The ILO's Institute for Labour Studies also conducted a study of the double dividend of carbon taxation. In the World of Work Report 2009, the ILS models the employment effects of a carbon tax for nine countries, including

France, Germany, Hungary, Sweden and the United Kingdom from the EU. When tax revenue is used to cut social security contributions, employment rises in all sectors. The increase in employment in low-carbon-intensive industries is three times larger than that in the high-carbon-intensive sector. In particular, the ILS estimates that roughly 1.7 million jobs would be created under this scenario in the nine countries studied. In the case that the tax revenue is used to subsidize green sectors, the gains in employment rises to approximately 3.9 million jobs in the nine countries.

As such, the empirical evidence with respect to the DDH is mixed. However, there is little evidence to suggest any large negative impact on employment. Indeed, in some instances the impact on employment is positive, albeit mild.

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5. See EC-IILS Joint Discussion Paper Series No. 11 for an overview of different modelling methodologies.

These positive effects though are conditional on having the right set of policies in place, i.e. comprehensive ETRs that tackle the source of carbon emissions while redirecting tax revenue to reduce labour taxes and to finance other labour market instruments, for example active labour market policies, to facilitate the transition towards a green economy.

## **B. Environmental tax reforms: Trends and effectiveness in the EU**

### 1. Environmental tax reforms across the EU

The principles underlying the DDH inspired several countries in Europe to undertake ETRs during the 1990s.<sup>6</sup> As discussed above, the main idea behind ETRs is to broaden the overall tax base and to shift taxation away from income to consumption. In particular, taxes on energy consumption<sup>7</sup> and CO<sub>2</sub> emissions should be increased while taxes and social security contributions levied on labour should be decreased. Moreover, it is often argued that ETRs should be revenue neutral. In this way, a shift in the tax system can increase efficiency without creating additional deadweight loss through higher taxes (see Weizsäcker 2010). ETRs are therefore the practical application of the considerations of the DDH as discussed previously. It follows that, if the strong version of the DDH holds, and if ETRs are implemented accordingly (i.e. revenue neutral, reducing distortionary taxes, etc.), ETRs should have a positive effect on net employment.

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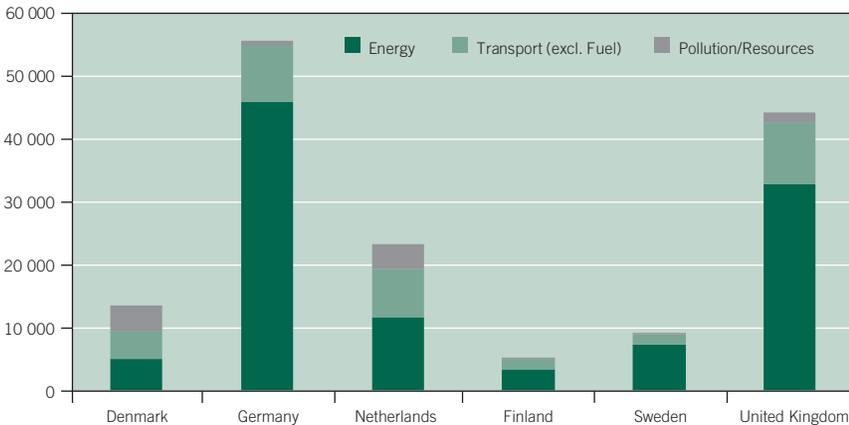
6. This section is based in part on Speck and Jilkova (2010) and Eurostat & European Commission (2010).

7. Energy consumption and CO<sub>2</sub> emissions refers here to any energy used in the economic system, not necessarily through households' consumption. In fact, as has been shown in Chapter 1, the potential for most efficiency gains lies in the production process, not final household consumption.

ETRs were first implemented by Denmark, Finland and Sweden, followed by the Netherlands, the United Kingdom and Germany in the late 1990s. Most ETRs focus on taxing the use of energy (figure 4.1). Indeed, it is estimated that about three-quarters of environmental tax revenue in the EU arises from energy taxation (see Eurostat and European Commission 2010). The most common scheme is to levy quantity taxes or ad valorem taxes on the consumption of energy by households and to some extent producers. Denmark and Finland also introduced CO<sub>2</sub> taxes directly targetting emissions. The remaining revenue is derived principally from taxes on transportation of goods and people and the use or extraction of resources. The total tax revenue generated by environmental taxes varies between about 5 billion euros (Finland) and 55 billion euros (Germany).

With respect to the relative importance of environmental taxes in the EU, figure 4.2 illustrates that environmental tax revenue has been trending

**Figure 4.1 Environmental tax revenue in 2008 (millions of euros)**



Source: ILS.

downwards in the past 13 years – both in terms of its share in GDP and share in total tax revenue.<sup>8</sup> On average, environmental tax revenue in the EU fell from roughly 3 per cent of GDP in 1995 to 2.5 per cent in 2008 (figure 4.2, panel A). Similarly, environmental taxes accounted for 7 per cent of total tax revenue in 2008, compared to more than 8 per cent in 1995.

The countries that have adopted ETRs show somewhat of a diverging trend: environmental tax revenue as a share of total revenue has increased in all countries with the exception of the United Kingdom. It is important to interpret these trends with some caution. Indeed, as pointed out by Speck and Jilkova (2010), the numbers alone cannot determine whether the quantity and quality of environmental policy in a country are appropriate. It is not possible to determine the quality of environmental policy (“greenness”) of a country without incorporating additional information. In fact, high environmental tax revenues could indicate intense use of the environment.

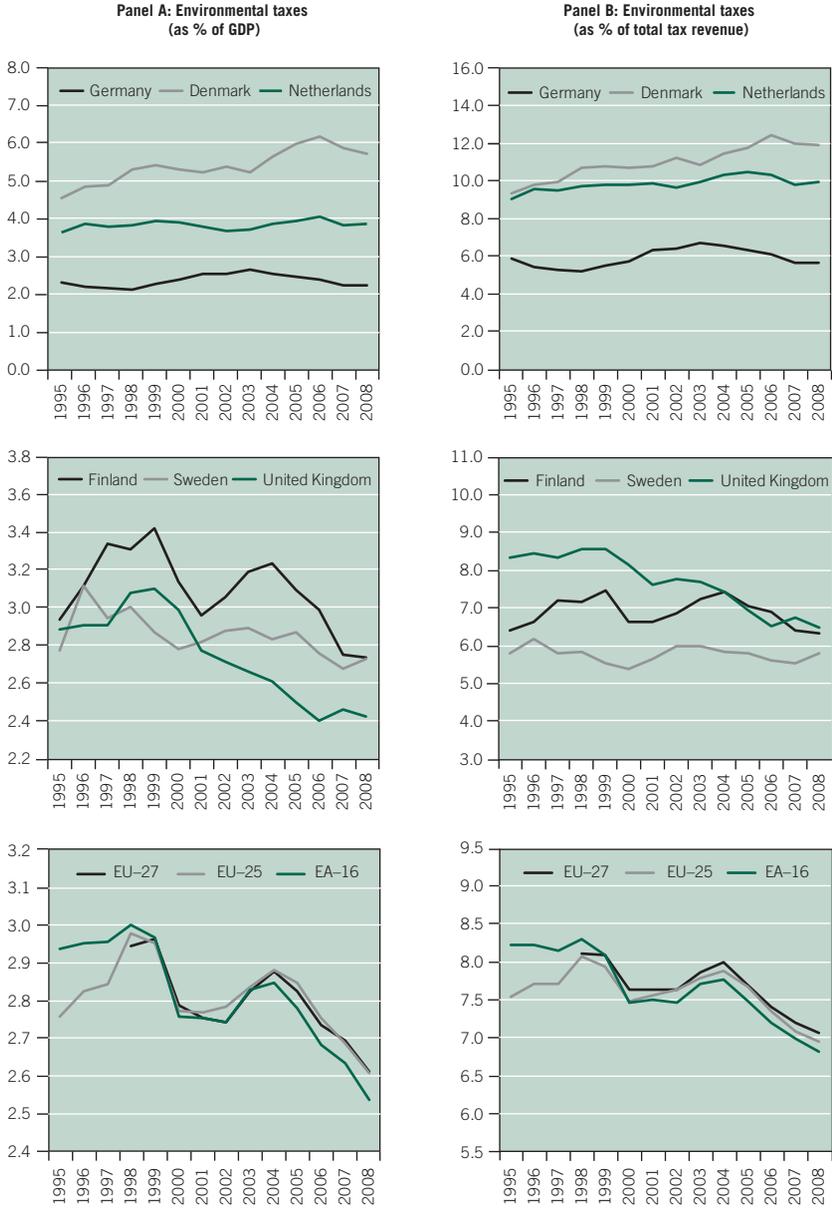
The trend decline in the relevance of environmental taxes may be due to a number of factors. First, given that many environmental taxes are essentially quantity taxes, they tend to fall over time if not adjusted for inflation. Second, energy demand has a tendency to grow more slowly than income, such that the share of taxes paid on energy decreases as the economy expands (see for example, Eurostat and European Commission 2010). Third, energy tax increases in recent years may have affected energy consumption. Depending on the price elasticities in energy markets, increasing taxes may result in a reduction of the tax base. Fourth, governments may be unwilling to continually raise tax rates on products that could affect energy costs of households and industry.

Looking at labour taxation – the counterpart of environmental taxes in ETRs – figure 4.3 shows that a general trend decline is also present among EU Member States. Post-2007, there was a sharp increase in labour taxation – although this is likely a result of the economic crisis rather than a break in

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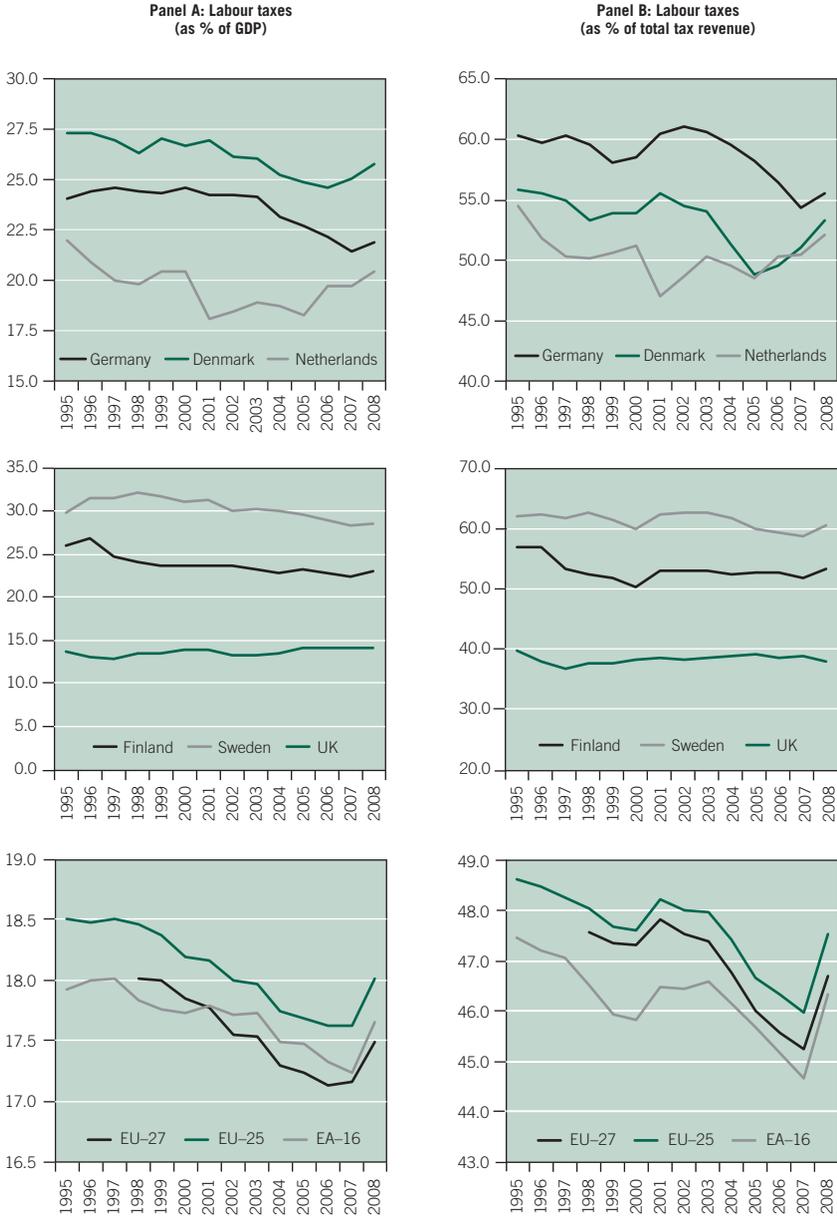
8. Due to data limitation, the figures employ a broader definition of “green” than the definition used in this study, by including all kinds of environmental taxes – not only those related to climate change. Thus, the share of environmental taxes only referring to climate change measures is likely to be somewhat smaller.

Figure 4.2 Environmental tax trends in the EU, 1995 – 2008



Source: IILS estimates based on Eurostat.

Figure 4.3 Labour taxes in the EU, 1995 – 2008



Source: ILS estimates based Eurostat.

the trend. This is explained by the fact that GDP decreased more quickly than revenues from labour taxes. Indeed, revenues from taxes on profits or consumption tend to be more volatile (and procyclical) than revenues from labour taxes.

A general shift away from labour taxation towards green taxation can be observed only for Denmark, Germany and (to some extent) the Netherlands. In all cases, however, the magnitudes of these tax shifts are relatively small. The figures show the most consistent and forceful implementation of the ETR concept in Denmark, where increasing environmental taxation is accompanied by decreasing labour taxes. Moreover, in the case of Denmark, tax rates were decreased for low- and medium-income earners, and revenue was also distributed to retirees. In Germany, stable environmental taxation goes along with a sharp decline in labour taxation. Only in the United Kingdom has labour taxation increased while environmental taxation has declined.

## 2. Effectiveness of ETR: Environment and employment considerations

Measuring the environmental impact of green policies can be a challenging task, due to their complex interactions with the economy. In the climate-change context, a common indicator used to measure the degree of “greenness” of an economy is (aggregate) CO<sub>2</sub> intensity (CO<sub>2</sub>/GDP). This indicator expresses how much CO<sub>2</sub> is emitted per produced value. The lower this ratio, the more efficient is the economy in terms of its environmental impact. Using this measure, table 4.1 indicates that from 1990 to 2005, the CO<sub>2</sub> intensity of production in the EU-27 has fallen by 28 per cent – significantly more in comparison with other regions and large economies like Japan and the United States. Green policies implemented in the EU over this time period may have encouraged this efficiency increase. While efficiency increases are important, it is the total level of emissions that is decisive for the global climate, and as has been discussed in Chapter 1, total CO<sub>2</sub> emissions in the EU have only slightly decreased.

**Table 4.1 CO<sub>2</sub>/GDP, kg/US\$ (2000 prices), 1990 and 2005**

	1990	2005	2005 (% change)
World	0.87	0.74	-14.9
EU-27	0.60	0.43	-28.3
United States	0.69	0.53	-23.2
Japan	0.26	0.24	-7.7
China*	4.01	2.43	-39.4

\* Including Hong Kong.

Source: IEA.

A new way to evaluate the success of green policies may be to use the CO<sub>2</sub> intensity of labour as indicator of the level of “greenness” of an economy. In particular, the CO<sub>2</sub> intensity of labour represents the average amount of CO<sub>2</sub> emitted per worker engaged in an economy. And while relationships between ETRs and CO<sub>2</sub> intensity should be interpreted with caution, table 4.2, which presents CO<sub>2</sub> output intensities for the year 2005 and the change from 1990, shows that countries that implemented ETRs (shown in bold) have experienced the largest declines in CO<sub>2</sub> intensities per person engaged. These countries also have among the lowest CO<sub>2</sub> intensities. Other EU Member States that have not implemented ETR, notably Lithuania, Latvia, Poland and Ireland, also experienced large reductions in CO<sub>2</sub> intensity per person engaged but for the most part levels remain comparably high (especially in terms of GDP) – highlighting the difficulty in making comparisons across countries that differ in stage of development or industrialization.

Table 4.2 CO<sub>2</sub> intensities of output and employment

EU countries	CO <sub>2</sub> /GDP		CO <sub>2</sub> per number of persons engaged	
	2005	% change from 1990	2005	% change from 1995
1 Denmark	0.28	-0.32	0.018	-0.21
2 Finland	0.4	-0.26	0.024	-0.17
3 Sweden	0.18	-0.31	0.012	-0.13
4 Lithuania	0.81	-0.6	0.005	-0.13
5 Germany	0.41	-0.33	0.022	-0.11
6 United Kingdom	0.32	-0.33	0.019	-0.1
7 Netherlands	0.44	-0.2	0.021	-0.1
8 Latvia	0.65	-0.63	0.014	-0.1
9 Poland	1.47	-0.49	0.024	-0.1
10 Ireland	0.35	-0.45	0.025	-0.09
11 Belgium	0.45	-0.22	0.029	-0.08
12 Luxembourg	0.46	-0.45	0.04	-0.08
13 Hungary	0.95	-0.37	0.016	-0.07
14 Slovak Republic	1.47	-0.51	0.02	-0.06
15 France	0.27	-0.16	0.017	-0.04
16 Estonia	1.97	-0.68	0.028	-0.03
17 Italy	0.4	-0.07	0.02	-0.01
18 Czech Republic	1.76	-0.37	0.025	-0.01
19 Malta	0.67	-0.3	0.017	0.01
20 Spain	0.5	0.07	0.019	0.02
21 Slovenia	0.66	-0.17	0.018	0.12
22 Austria	0.36	-0.05	0.019	0.16
23 Portugal	0.53	0.15	0.014	0.17
24 Greece	0.61	-0.12	0.027	0.2
25 Cyprus	0.64	0.03	0.025	0.3
26 Romania	1.88	-0.51	n/a	n/a
27 Bulgaria	2.81	-0.44	n/a	n/a

Note: Countries are ordered from lowest to highest in terms of the change in CO<sub>2</sub> intensity per person engaged.

Source: IEA; European Environment Agency (EEA) and EU KLEMS.

The impacts of ETRs on employment are equally challenging to assess from an empirical perspective. As discussed in Chapters 1 and 3, an unambiguous positive effect on jobs that are strictly green can be expected with potential benefits to be accrued in other low-carbon-intensive sectors.<sup>9</sup> However, the magnitude of a potential increase in employment depends on the level of unemployment at implementation of the policy, the growth potential of the respective sectors, and the relative size of these sectors. The employment effects of a reduction in income taxes and a combined increase on energy taxes are more difficult to estimate. On the producer side, higher factor input prices on energy may result in reduced output and possibly reduced employment, if the shift from fossil fuels to other factor inputs like labour or renewable energy is limited.

A recent empirical study by Mittnik et al. (2010) indicates that low-carbon sectors have a higher growth potential in terms of output and employment growth. In all nine countries<sup>10</sup> surveyed, output and employment growth have been significantly higher on average in low-carbon-intensive sectors. Based on these findings, it is expected that a reduction in average labour costs across the entire economy would be disproportionately beneficial to boosting employment growth in these industries. The impact on high-carbon-intensive industries varies but tends to be negative. And the overall impact on employment is country-specific – positive for some countries and slightly negative for others.

Empirical studies of this kind usually ignore possible behavioural changes triggered by ETRs, like increased innovation and other adjustments as predicted by Porter (1990) and Porter and van der Linde (1995) in the “Porter Hypothesis”. Such behavioural responses would mitigate negative effects on output and employment even further. Indeed, these effects of ETRs on employment will depend greatly on the response function of enterprises, since firms will have an incentive to employ abatement technologies, for example to use solar technology or environmental technology to reduce their tax burden (see Chapter 5

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9. Green in this context refers to category I, as defined in Chapter 1, i.e. jobs which are in enterprises or industries that produce low-carbon-intensive output and directly serve to reduce CO<sub>2</sub> emissions.

10. Australia, France, Germany, Hungary, Japan, Republic of Korea, Sweden, the United Kingdom and the United States.

for a simulation of the impact of abatement investments on output). Output and employment in these sectors would therefore benefit from higher demand in abatement or backstop technologies.

## C. Policy considerations

### 1. Improving design

Environmental tax reforms are the first serious and commendable attempts to translate the theoretical ideas of the DDH into practice, yet their current design still poses some challenges to the requirements of an efficient resource allocation. Of particular concern is the fact that all countries created special provisions for certain industries that are generally energy-intensive, while no exceptions exist for households. This is all the more striking given that, as discussed in Chapter 2, 80 per cent of the CO<sub>2</sub> emissions stem from the production process. The exemptions are in fact a subsidy for polluting industries and result in an inefficient allocation of resources. One argument for such exemptions, however, is that ETRs should be phased in over time to avoid any abrupt shocks to the economy. Indeed, temporary exemptions for this purpose are justified. However, these exemptions should be eliminated gradually – as has been planned in several countries.

### 2. Sending clearer market signals

ETRs, in their current form, are not sufficient to fully address climate change. Even though several countries have attempted to boost the importance of their ETRs over time, the developments have been rather slow – already two decades have passed since the first ETRs were implemented. Currently, environmental taxes account for a small share of total tax revenue, yet countries that have adopted ETR tend to be the most efficient in terms of CO<sub>2</sub> intensities.

Two major barriers to increasing the relevance of ETR is concern that it will damage competitiveness in certain energy-intensive industries and the unpredictability of the direction of reforms in the longer term. With respect to the former, the impact of green taxes on competitiveness has been widely debated and it is unclear whether the effect on competitiveness is necessarily negative (see, for example Enevoldsen et al. 2010). Negative short-term impacts on certain sectors are likely but can be mitigated by adopting a range of policies that have been discussed at length in this report. Moreover, any concerns about competitiveness could be allayed if ETRs were implemented and harmonized across EU Member States. A common understanding among EU Members about the revenue-recycling potential of taxes on environmental externalities would allay some of the fears regarding competitiveness. An understanding that revenue from environmental taxes could decrease taxes on labour would reduce the incentives to move production abroad. And if a common environmental tax structure existed (for example a tax on the consumption of CO<sub>2</sub>-intensive goods), the EU could apply the same tax rules on imported goods, ensuring that imported goods and components do not receive a competitive advantage.

Regarding the unpredictability of the direction of tax reforms in the long run, it is important that a long-term strategy be developed and that these details are communicated to both consumers and producers (see Weizsäcker 2010). The most important effect of an ETR is behavioural change – which can only be achieved if reliable, long-term trends in the tax structure are communicated. For instance, a strategy of this nature would send a clear signal to entrepreneurs in EU Member States that investments in energy and resource productivity have high profit potential, while investments in labour productivity may become less essential. Indeed, the ability of firms to undertake long-term planning is essential for technological innovation. The long-term reliability of ETR also extends benefits to consumer decision-making, such as for homeowners who might choose to install energy-saving technology, like certain heaters or isolations.

### 3. Emphasizing the employment dividend and improving equity

The current ad valorem taxes on energy are regressive and place a greater burden on low-income households. One possible mechanism for addressing the regressive nature of these taxes is to introduce personal energy allowances within the tax structure (see also von Weizsaecker et al. 2010). In other words, a certain amount of energy per household would be exempt from tax, but energy used beyond the threshold is taxed, possibly with a progressive rate. The threshold amount could be tailored to improve distributional concerns further, e.g. increasing the threshold depending on income and family size.

Another possible way to ensure that ETRs are more efficient (and progressive) is to ensure that the tax revenue collected is redistributed to the labour market and done so in a manner that is well targeted, e.g. by cutting taxes on labour for low-income earners as was the case in Denmark. Similarly, reductions in social security contributions and increased recourse to training initiatives should be channelled to those most in need. The effectiveness of targeted measures of this nature is greater when they are aimed at addressing a particular disadvantage, e.g. low skilled.

For the time being, however, efforts are still needed to ensure that the tax revenue is directed towards employment in the first instance. In practice, there have been considerable differences among the six countries with respect to the revenue-neutral behaviour of ETRs. The Finnish ETR, for example, was never designed to be revenue neutral. And while the German ETR was planned to be revenue neutral, some of the revenues were later used to consolidate the federal budget. The realization of the double dividend hinges on the condition that funds are used to reduce labour market taxes, or alternatively, are used to finance necessary active labour market policies as discussed in Chapter 3.



# POLICY DILEMMAS AND RESEARCH GAPS



## Key findings

- Moving forward, one of the main challenges for future research is to develop a consistent and widely accepted framework of definitions and indicators for a green economy. Based on these concepts, governments and governmental institutions need to provide more detailed national statistics that allow for a deeper analysis of the green economy. A major improvement would be input–output tables that include certain “green” sectors. With this information, a more rigorous approach to quantifying the economic and employment consequences of a transition to a greener economy will be possible. This would always help to improve the knowledge base in a number of research areas, for which there are a number of gaps:
  - *Modelling employment dynamics*: The Global Economic Linkages (GEL) model illustrates the impact of climate policies on output and how the transition can be facilitated through other policies, e.g. accommodative monetary policy. However, the model does not yet allow for an assessment of the distributional consequences of policy interventions for different categories of workers (high skilled vs. low skilled) or different sectors (brown industries vs. green industries).
  - *Quantifying the double dividend*: While policies that are well designed and implemented in a coherent and coordinated manner can unleash the

potential for a double dividend, to date the exact size of this dividend is unknown, in particular with regard to the employment impact (both in terms of quantity and quality). In this regard, further research is needed on the feasibility of the double dividend, in particular in relation to country-specific labour market characteristics within the framework of structural and macroeconomic policies.

- *Productivity implications:* The shift to a greener economy is also likely to bring shifts in total and labour productivity, which can affect overall competitiveness. An open question is to what extent labour productivity growth can be substituted for higher productivity growth in resources and what role social dialogue can play in this regard.
- Social dialogue will be central to setting incentives for more investment in resource productivity and making sure that efficiency gains are distributed in a just manner. In particular, effective social dialogue is needed in order to manage a just transition to a green economy within a particular country. Without the prospect of a successful and just green transition on a national level, the chances for binding international agreements on climate change policies are very low.

## A. Policy dilemmas

Identifying, and ideally remedying, research gaps is essential for policy-makers to making informed decisions. This section illustrates several policy dilemmas, among which are the use of nuclear energy and the question of double dividends of green policies, and demonstrates how the research undertaken in the framework of this joint management project can be leveraged further to address them.

As this report has demonstrated, greening the economy can be achieved through a combination of lower energy intensity and a change in the mix of energy sources. The type of adjustment that predominates depends on the relative price of energy sources, the speed of technological progress and changes in environmental regulation. Several policy dilemmas can arise in this context, however. For instance, technological progress with energy efficiency may be eroded by faster GDP growth as energy prices decline (at least in relative terms), leading to an increase in energy consumption rather than a decrease. This phenomenon is called the rebound effect or Jevons paradox: Parts of or even the full efficiency gain are used for additional consumption so that the overall effect of economic activity on the environment remains the same after the new technology is introduced. More recently, the debate surrounding the energy mix has resurfaced as several countries engaged in expanding their capacity in nuclear energy.

### 1. How green is green? The case of nuclear energy

Yet, nuclear power entails several policy trade-offs. It is an attractive energy source since it produces negligible CO<sub>2</sub> emissions. Accordingly, nuclear power is considered “green” under the definition of this study but the sustainability of nuclear power is often questioned. Uranium, which is the raw material for nuclear fuel, is a finite resource, and debate over its peak production continues. Accordingly, nuclear power is not a renewable energy source. In fact, should nuclear power be adopted more widely across countries, increased demand for uranium would quicken the pace towards peak uranium, i.e. the point in time when the maximum rate of global extraction is reached. As the discussion about the complexities in finding a proper definition of green has shown,<sup>1</sup> nuclear power may not be regarded as green if the chosen definition were to include multiple dimensions, e.g. those related to safety, health and waste

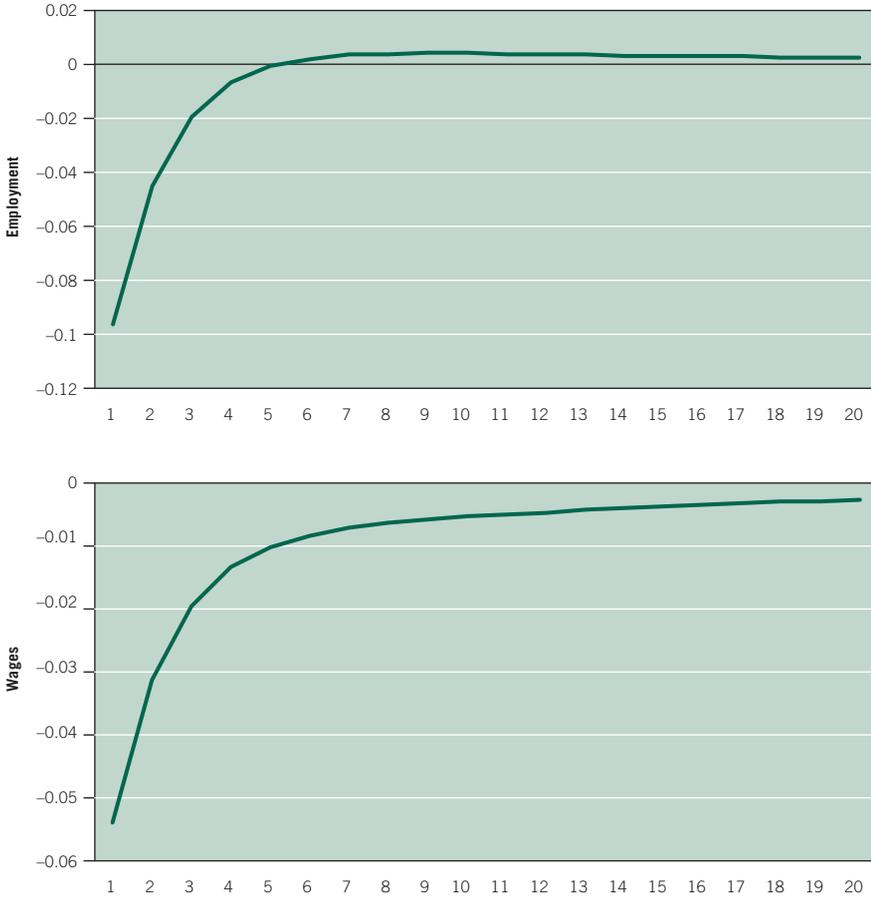
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1. See also INST-EC Discussion Paper No. 10 (IILS 2011a).

disposal. For example, nuclear power produces radioactive waste that will challenge future generations for many millennia to come. This waste questions the sustainability of nuclear power as a green option, since the burden clearly falls upon future generations to store and manage highly contaminated disposal sites. Nuclear power activities can also pose a great deal of risk in terms of safety. The potential for radioactive releases and even environmental catastrophe clearly exists, as highlighted by recent events in Japan. Together, these concerns should open up a wider discussion on refining the different dimensions covered by the green concept, something which is beyond the scope of this report.

## 2. Supportive policies for double dividends

As demonstrated in previous chapters, carefully designed and implemented policies can help achieve a double dividend, lowering the ecological footprint and improving labour market conditions and equity. The conditions under which such a double dividend arises, and the exact size of it, remain open to debate and research. Based on the available research studies, positive employment gains appear possible, if green policies are executed with the right policy mix. But studies also show that ambiguities exist in terms of the conditions that encourage a double dividend, primarily related to labour market institutions, tax systems and other country-specific criteria. A major obstacle to achieving a double dividend in the short run is the time span between economic gross costs today and positive effects in the future. Often, the benefits to greening the economy only accrue over a long time span due to the slow decay of the stock of CO<sub>2</sub>. Damage related to global warming depends on the concentration of CO<sub>2</sub> in the atmosphere. The half-life of atmospheric CO<sub>2</sub> lies between 83 years (Reilly 1992) and 139 years (Nordhaus 1991). A half-life of 83 years, for example, implies that the stock of CO<sub>2</sub> decays very slowly at a rate of 0.2 per cent per quarter (Heutel 2011).

**Figure 5.1** Short-term effect on employment and wages of a carbon tax (quarters)

Research results vary depending on modelling methodology, choice of data sets and simplifying assumptions. With this in mind, in this section, an extension of the ILS Global Economic Linkages (GEL) model is presented in order to illustrate some of the policy dilemmas that arise with the transition to a green economy (box 5.1). In particular, an extension of the GEL model show that an economy with a lower level of pollution reaches a higher long term growth rate than an economy with a higher steady-state level of pollution, yielding positive

**Box 5.1 GEL model and climate change**

The GEL model with green policies considers environmental damage arising from CO<sub>2</sub> emissions to affect multi-factor productivity. Countries can mitigate these costs by spending on abatement, reducing the emission intensity of production. Abatement spending is either done by governments directly (for instance through infrastructure spending) or at the level of each individual company. To the extent that abatement is publicly financed, governments need to levy a tax, which can be in the form either of a lump-sum (that is, not affecting marginal profitability) or a pollution tax linked to a firm's output. Furthermore, the economy's growth rate is determined endogenously, taking into account the general equilibrium repercussions of environmental damage, distortionary taxation and the resource use of abatement spending. Additionally, the model allows aggregate demand effects to impact output and growth over the medium run. Finally, governments can intervene to stabilize the economy via monetary policy, thereby limiting any transitory costs arising from the green transition ("accommodative monetary policy" scenario).

returns on employment. There exist, however, short-term costs related to the implementation of green policies, for instance, a CO<sub>2</sub> tax. For a given technology, a tax of this nature increases the costs of production for high-carbon-intensive firms leading at least initially to lower levels of employment and wages (figure 5.1). In particular, the introduction of a carbon tax leads to a decline in employment of 0.1 per cent and in wages of 0.5 per cent. However, the effect is temporary and both employment and wages recover. Moreover, the simulation does not include, at this stage of the modelling, the gains in employment that will accrue over the long term as the economy moves to a higher growth path as discussed above.

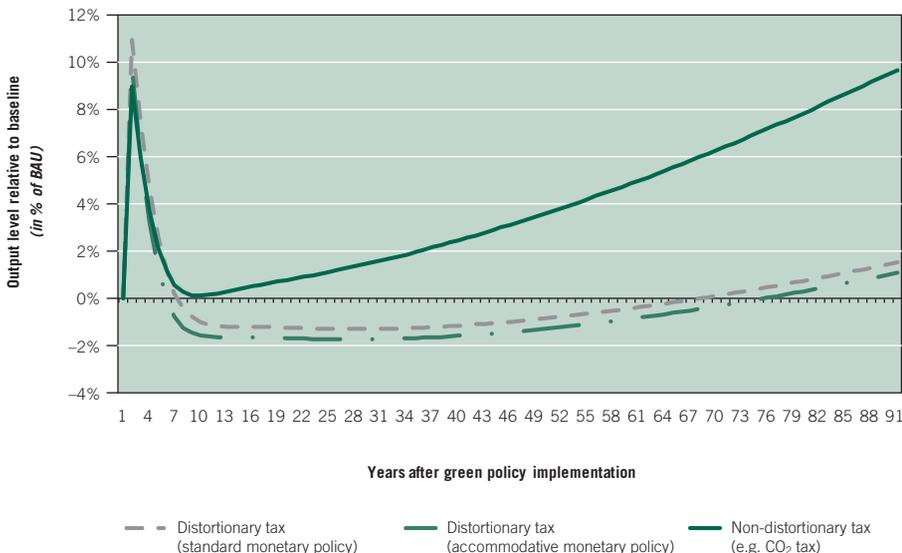
The results highlight the fact that despite the potential medium- to longer-term benefits, there are short-term trade-offs. However, as discussed throughout this report, the full benefits of the double dividend are achieved through the implementation of other complementary employment policies to reduce and to mitigate these costs.

Other policies can also help to facilitate the transition towards a greener economy, e.g. abatement spending by public authorities and monetary fiscal policy. With this in mind, figure 5.2 displays three different scenarios of such policies. All scenarios are depicted relative to a business-as-usual (BAU) case which assumes that in the absence of any green policies, pollution will reduce

the economy's growth rate by one percentage point. In contrast, all three green scenarios assume a significant and permanent increase in abatement spending that will prevent further accumulation of pollutants beyond a certain maximum threshold. Irrespective of the type of financing, this public abatement spending creates a – short-lived – economic boom at the beginning of the implementation period.

Importantly, the medium- to longer-term impacts are very much a function of how the public spending on abatement is financed. If the investments are financed through a non-distortionary tax, e.g. CO<sub>2</sub> tax, the results are unambiguously positive compared with the BAU case yielding a double dividend in terms of environmental quality and output (and in turn employment). The fiscal stimulus of abatement causes the initial increase in output which fades

**Figure 5.2** Output developments with green policies



Note: The figure depicts the relative output level with respect to the business-as-usual case of three different green policy interventions. The “lump-sum taxation” scenario assumes abatement spending financed through non-distortionary taxation, the “accommodative monetary policy” and the “standard monetary policy” scenario both assume distortionary taxation, with the latter assuming no temporary stimulus by monetary authorities.

Source: IILS estimates.

out rather quickly (in about 5–6 years). But even after this period the green scenario shows a significantly higher level of output over the longer term.

However, in cases in which the abatement spending is financed through a distortionary tax, there is a significant period of transition following the initial boost before output eventually rises above the BAU due to environmental improvements via emission reductions. Yet, as the simulations illustrate, a more accommodative monetary policy stance, i.e. one that is not limited to inflation targeting, can reduce the transition time towards a greener economy.<sup>2</sup>

### 3. Productivity issues and the role of social dialogue in the green economy

Closely related to the question of the double dividend is the question of the effect of green policies on the productivity of certain sectors and the economy as a whole. IILS estimations have shown that low-carbon-intensive industries are on average more labour productive than high-carbon industries but that labour productivity growth in low-carbon industries is slower. The economic reasons for these findings are still unknown. Knowledge about possible labour productivity differentials within industries, for example those between fossil-fuel-based energy suppliers and renewable energy suppliers, could help foster a greater understanding of the employment effects of intra-industry transitions.

It is not only labour productivity that matters, however. In the future, more attention needs to be given to resource productivity in certain industries and in the green economy as a whole. Productivity affects competitiveness of industries and international competitiveness of the economy. It is unclear at this time what the effect of a greening economy will be on overall productivity. If positive employment effects are desired, slower labour productivity growth can be expedient when compensated for by productivity gains in the use of resources.

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2. The extent to which monetary policy can act to smooth the transition is sensitive to assumptions regarding the discount rate.

In this context, the role social partners can play in promoting a shift from investments in labour productivity gains towards investments in resource productivity gains needs to be explored. Traditionally, social partners have played a part in achieving productivity increases and their distribution between labour and capital. On the one hand, increases in labour productivity have served as justification for wage increases, but this mechanism works also in the other direction: anticipated wage increases can create an incentive for entrepreneurs to seek investments that increase labour productivity. An important question concerns which institutional mechanism is necessary to create incentives for resource productivity and how to distribute achieved productivity gains. This problem is especially delicate, since the resources are not owned by labourers and reduced labour productivity could mean lower wage increases. The problem is further complicated by the fact that not all of the productivity gains can be distributed if environmental improvements are to be achieved. This complex situation requires a high level of long-term coordination among social partners and the government if gains in resource productivity are to be realized and shared.

To date, the practical implementation of climate change measures has proved to be rather difficult. One of the main reasons for the failure of established mechanisms to address the challenge of climate change is due to the global dimension of the problem and the impact on different generations. It is unclear which national and international institutions or mechanisms are necessary in order to realize the achievable global welfare gains of reduced emissions. This realization of the welfare gains is tightly linked to the question of distribution of welfare gains among different regions in the world and different generations. Thus, dialogue is necessary on two levels. First, dialogue among countries is necessary to establish a political mechanism such that intergenerational global welfare gains can be obtained. Second, social dialogue within countries is necessary for successful negotiations on an international level. As the slow progress of the international climate negotiations has shown, binding international agreements only have a chance if road maps for a successful green transition within countries exist, which in most cases is not the case to date.

Social dialogue can play an important role in helping determine who bears the bulk of the adjustment burden, the investment cost and how potential losers of a green transition can be compensated by winners. Without these issues being properly addressed the chances for successful national transitions and international agreements are very low.

## **B. Research gaps**

Several research gaps remain. In particular, an understanding of the features of the green economy requires a strong analytical framework, which has not currently been defined or standardized across countries. Such a framework must be based on adequate definitions of the subject matter. As discussed in Chapter 1 there exists a trade-off between having a precise, measurable concept of green and the subsumption of many environmental functions under the term green.

The determination of proper definitions is more than a philosophical problem, since accounting and statistical data are also based on commonly accepted definitions. Standardized statistics about the green economy – especially those about different employment aspects – do not yet exist, making an empirical analysis difficult. A challenge for the future is to adjust economic statistics to facilitate data analyses of the green economy. A concrete example is the construction of green input–output tables in which the linkage of certain green industries with other parts of the economy is addressed; that is, the energy sector consists of a fossil-fuel-based subsector and a renewable energy subsector. Green input–output tables must be designed and constructed based on theory and reflect country-specific industry structures.

A second research gap relates to efforts to quantify the economic and employment consequences of a transition to a greener economy (see Nordhaus & Boyer 2000). The degree of complexity of the equations describing the green dimensions varies across models and ranges from simple emission functions with no stock of pollution to more complex greenhouse-gas emission and thermodynamic equations. In most cases, these models consider only the

consequences of environmental changes on growth. Their perspective is to look at the evolution of growth and pollution over a 20–50-year horizon.<sup>3</sup> Broadly speaking, these models can be classified into two categories, depending on the agents affected by pollution. The first model category includes a direct effect of the level of pollution on households' utility. Pollution is seen as reducing the level of satisfaction of households because of its negative impact on health and life quality in general. In contrast, the second model category emphasizes the adverse effects of pollution on firms' output. This case captures that pollution generates costs, which penalize the production of firms. Pollution can be seen as reducing the overall productivity of labour and capital inputs.

The green component of the IILS GEL model illustrated above allows us to better understand the implications of both environmental costs and policies on macroeconomic stability and the policy interaction between green and stabilization policies. These are important considerations from a political economy perspective. However, here too, the model does not yet allow for the full integration of employment impacts and an analysis of the distributional consequences of policy interventions for different categories of workers (high skilled vs. low skilled) or different sectors (brown industries vs. green industries) making it difficult at this stage to fully assess the total labour turnover that green policies would bring – an issue to be taken up in further research.

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3. See Rezai et al. (2011).



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