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Preface

Over the last decade, Germany has continued to promote ambitious environmental policies. While experiencing robust economic growth during most of the 2000s, Germany has made further progress in reducing the carbon, energy and resource intensities of its economy, bringing down emissions of air pollutants and greenhouse gases, and improving waste and water management. In some areas, such as water and air quality and biodiversity, progress has nevertheless not been sufficient to reach domestic and international objectives. Overall, Germany's environmental policies enjoy strong public support, and citizens are relatively satisfied with their environmental quality of life.

Strict technology-forcing regulations remain at the core of Germany's environmental policy. However, Germany has made greater use of market-based instruments and is one of the few OECD countries that have effectively implemented an environmental tax reform. Germany has also pioneered the use of feed-in tariffs to support the development of renewable energy sources, which are an integral part of the country's green growth and sustainable development strategies. These policies have helped stimulate the development of an internationally competitive environmental goods and services sector, and to create a new engine for economic growth and job creation. Going forward, further efforts are needed to enhance the coherence and effectiveness of existing policies, as well as continued policy innovation.

This third Environmental Performance Review of Germany *aims to provide further support for the country's environmental progress. The Review's main recommendations with special emphasis on climate change, environmental innovation and green growth are:*

- *Strengthen the environmental assessment of economic policies, as well as the economic assessment of environment-related policies, and continue to deepen and broaden the participation of stakeholders in environmental decision making.*
- *Carefully design instruments aimed to financially support environment-related innovation so as to achieve policy objectives efficiently and effectively, promote diversity, avoid picking winners, and maximise the leverage of private capital.*
- *Continue to monitor the costs of feed-in tariffs for renewable energies and ensure that the mechanisms to keep those costs under control are effective and efficient.*
- *Use energy taxation to effectively complement the EU Emissions Trading System and to provide a consistent carbon price signal across the economy.*
- *Systematically assess the environmental impact of existing and proposed subsidies with a view to phasing out those that are environmentally harmful and economically and socially inefficient.*

This Review is the result of a rich and co-operative policy dialogue between Germany and other members and observers of the OECD Working Party on Environmental Performance. We are confident that this collaborative effort will be useful to advance the policy debate on how to tackle the shared environmental challenges faced by OECD members and their partners.

Angel Gurría
OECD Secretary-General

Foreword

The principal aim of the OECD Environmental Performance Review programme is to help member and selected partner countries to improve their individual and collective performance in environmental management by:

- helping individual governments to assess progress in achieving their environmental goals;
- promoting continuous policy dialogue and peer learning;
- stimulating greater accountability from governments towards each other and the public opinion.

This report reviews the environmental performance of Germany since the previous *OECD Environmental Performance Review* in 2001. Progress in achieving domestic objectives and international commitments provides the basis for assessing the country's environmental performance. Such objectives and commitments may be broad aims, qualitative goals, or quantitative targets. A distinction is made between intentions, actions and results. Assessment of environmental performance is also placed within the context of Germany's historical environmental record, present state of the environment, physical endowment in natural resources, economic conditions, and demographic trends.

The OECD is indebted to the government of Germany for its co-operation in providing information, for the organisation of the review mission to Berlin and Bonn (4-9 April 2011), and for facilitating contacts both inside and outside governmental institutions.

Thanks are also due to all those who helped in the course of this review, to the representatives of member countries participating in the OECD Working Party on Environmental Performance, and especially to the examining countries: Austria, Israel and Japan.

The team that prepared this review comprised experts from reviewing countries: Mr. Gerhard Omersu (Austria), Mr. Yossi Inbar (Israel) and Mr. Koji Shimada (Japan); members of the OECD Secretariat: Ms. Ivana Capozza, Mr. Brendan Gillespie, Mr. Ivan Haščič, Mr. Krzysztof Michalak, Mr. Tappei Tsutsumi and Ms. Frédérique Zegel; and Mr. Joeseph Curtin and Mr. William Kennedy (consultants). Ms. Carla Bertuzzi and Mr. Shayne MacLachlan (OECD Secretariat), and Ms. Rebecca Brite (consultant) provided statistical and editorial support during the preparation of the report. Preparation of this report also benefitted from background materials prepared by the Ecologic Institute, and from comments provided by Ms. Caroline Klein and other members of the OECD Secretariat.

The OECD Working Party on Environmental Performance discussed the draft *Environmental Performance Review of Germany* at its meeting on 19 January 2012 in Paris, and approved the assessment and recommendations.

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General notes

Signs

The following signs are used in figures and tables:

. .: not available

–: nil or negligible

.: decimal point

Country aggregates

OECD Europe: This zone includes all European member countries of the OECD, *i.e.* Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

OECD: This zone includes all member countries of the OECD, *i.e.* the countries of OECD Europe plus Australia, Canada, Chile, Israel, Japan, Korea, Mexico, New Zealand and the United States.

Country aggregates may include Secretariat estimates.

Currency

Monetary unit: Euro (EUR).

In 2010, USD 1.00 = EUR 0.751.

In 2011, USD 1.00 = EUR 0.716.

Cut-off date

This report is based on information and data available up to the end of January 2012.

Executive summary

Germany is the third largest economy in the OECD. It experienced strong GDP growth and robust performance on many economic and social indicators during the 2000s. It has also been resilient to the global economic crisis. Along with economic and social progress, Germany has continued to play a proactive role in environmental policy within the European Union and internationally. It consolidated and further developed an already comprehensive environmental policy framework. There has been a shift from sector-specific to more comprehensive and cross-cutting policies, including the development of a National Sustainable Development Strategy and important initiatives on biodiversity, climate change, energy and resource efficiency.

Ambitious environmental policies helped considerably reduce emissions of air pollutants and greenhouse gases (GHGs), as well as the carbon and energy intensities of the economy. Energy efficiency improvements and the rapid development of renewable energy sources were among the key drivers of these trends. Material and resource productivity also improved. An effective waste management policy partly contributed to this, through the increased rate of material recycling and waste recovery. However, while the German people are generally satisfied with their environmental quality of life, some concerns remain, including ambient air quality in some cities and freshwater quality. Continued efforts are needed to bring access to wastewater treatment in eastern *Länder* up to western *Länder* levels. Relatively high population density, dispersed settlements and a variety of industrial and agricultural activities have continued to exert strong pressures on ecosystems and biodiversity. The intensity of use of agricultural inputs remains among the highest in OECD, which results in a high nitrogen surplus.

Using environmental policy to promote economic growth, innovation and job creation

Strict technology-forcing regulations and standards remain at the core of German environmental policy. In addition to improving the country's environmental performance and quality of life, this has helped stimulate environmental innovation and the development of an internationally competitive environmental goods and services (EGS) sector. Depending on the definition used, the EGS sector is estimated to account for between 1.9% and 5% of GDP in 2009. A strong national innovation framework, a broad industrial base, and a high level of participation in international trade have also been key factors underpinning these trends.

The development of renewable energy sources is the growth engine of the EGS sector. The mix of feed-in tariffs, public and private research and development (R&D), and other forms of support has helped significantly increase the share of renewable energy in electricity

generation without placing the public budget under undue strain. This has also helped German industry achieve a significant share of domestic and international markets for various renewable energy technologies. Employment in the renewables sector more than tripled between 2002 and 2010, reaching more than 370 000 employees.

Overall, Germany's policy on renewables is better designed than in many other countries. It has provided predictable signals and a continuous incentive for innovation. At the same time, questions have been raised about the cost borne by electricity consumers and the cost-effectiveness of this policy. Continuous efforts are needed to control the relatively high costs of the feed-in tariffs, and their impact on electricity prices, and to shield them from unpredictable developments in the renewable energy market. This is challenging because of the fast pace of such developments and the high information requirements on the regulator. To improve cost-effectiveness, the policy mix aimed to financially support environment-related innovation should be designed so as to promote diversity, avoid picking winners, and maximise the leverage of private capital. The subsidy component of financing instruments, such as the feed-in tariffs, should be adjusted in light of market developments, and subsidies should be phased out as technologies become commercially viable.

Continued technological progress and productivity gains will be key factors in Germany maintaining its global competitive advantage in the EGS sector. Promoting environmental technologies has become more difficult as the nature of innovation has increasingly shifted from end-of-pipe to integrated technological solutions. It requires greater co-ordination and coherence between policies to promote environment-related innovation and sectoral policies, as well as between central government and the *Länder*. Labour, education and migration policies should be part of the co-ordination effort, as shortages of skilled labour could impede the further development and diffusion of some environment-related technologies.

Maintaining Germany's leadership in climate change policy

Germany is one of the few OECD countries that managed to absolutely decouple GHG emissions from economic growth in the 2000s. In particular, transport-related GHG emissions fell steadily in the same period, despite a significant increase in overall transport activity and contrary to the trend observed in many other OECD countries. Overall, domestic GHG emissions have declined more than required by the Kyoto target. However, Germany's energy and electricity mixes remain heavily dependent on fossil fuels, which results in slightly higher GHG emissions per unit of GDP than the average for OECD Europe. While the economic recession in 2008-09 contributed to reducing emissions, progress in curbing GHG emissions can be also attributed to a strong political commitment and to an effective climate policy cycle based on regular evaluation and adjustments.

Germany pledged to reduce GHG emissions by 40% by 2020, which goes beyond what would be required under current agreements at EU level. While this level of ambition is in line with broader international goals, it will require accelerating the pace of emission reductions in the 2010s. In addition, a number of uncertainties remain to be resolved, not least how the target is to be achieved in the context of the EU Emissions Trading System (EU ETS).

The EU ETS, launched in 2005, covers about 60% of Germany's CO_2 emissions. However, as in most EU countries, emission allowances were systematically over-allocated and resulted in the sectors involved benefitting from substantial windfall profits. These factors contributed to the volatile and persistently low allowance price. While the revision of the EU ETS is expected to address these issues to some extent from 2013, free allocations will continue for some sectors. Uncertainty remains about whether the ETS will lead to a sufficiently stable and high CO_2 allowance price to provide incentives for reducing GHG emissions in line with Germany's targets, including through the further development of renewable energies and other low-carbon technologies.

Increased use of renewable energy sources and improved energy efficiency are at the core of Germany's strategy for achieving climate- and energy-related goals. A wide range of initiatives to foster energy efficiency helped keep energy consumption nearly stable over the 2000s, although further efforts are needed to improve the energy performance of buildings. As indicated above, a well-designed feed-in tariff system was the main driver behind a dramatic increase in the share of renewables in electricity generation (from 7% in 2000 to 17% in 2010). This contributed to meeting the multiple objectives of reducing domestic CO_2 emissions and fossil fuel imports, and promoting technology development. However, the implicit CO_2 abatement cost is estimated to be well above the CO_2 allowance price in the EU ETS. The interactions between Germany's feed-in tariff system and the EU ETS should also be kept under review, as the promotion of renewables, particularly in a large EU country like Germany, can lead to lower allowance prices and the displacement of emissions. Achieving the targets outlined in the 2010 Energy Concept – at least 35% of gross electricity consumption from renewables by 2020 and at least 80% by 2050 – also implies considerable investment to expand the electricity transmission and distribution network, as well as storage capacity, in order to ensure the security and reliability of the grid.

Enhancing the cost-effectiveness of the environmental policy mix

In addition to participating in the EU ETS, Germany has increasingly used market-based instruments for its environmental and climate policies. It is among the few OECD countries that have implemented an ecological tax reform. Estimates indicate that this reform helped reduce energy consumption and GHG emissions, while having positive employment and economic effects. Vehicle taxation is now based on vehicles' CO_2 emission performance, and emission-based road tolls for heavy goods vehicles are in place on German highways. Effective pricing has been a key factor in the development of increasingly comprehensive, high-quality waste and water services, in accordance with the polluter-pays and user-pays principles.

However, potential synergies among instruments have not been fully exploited. Environmentally related tax revenue has declined since 2000; in 2009, it accounted for 2.3% of GDP and 6% of total tax revenue, slightly below the respective OECD Europe averages. As in other EU countries, energy taxation and the EU ETS should be better combined to provide an effective and consistent carbon price signal across the economy, so as to avoid gaps and double regulation between the ETS and non-ETS sectors. Energy tax rates, such as those on diesel and petrol, do not consistently reflect the environmental externalities of fuel use.

While Germany has made progress in cutting direct subsidies to coal production and other tax breaks on energy use, the amount of subsidies that have potentially negative impact on the environment remains large, at about 1.9% of 2008 GDP. These include subsidies that can encourage fossil fuel consumption and ownership and use of private cars. Germany's public finances, and the cost-effectiveness of its environmental policy, would benefit from the reform of support measures with perverse environmental effects. At the same time, further extending the use of environmentally related taxes – and other economic instruments – could make the tax system more growth-friendly if revenue is used to reduce more distortionary taxes such as those on labour and capital.

PART I

Progress towards sustainable development*

* In the review period, since 2000.

PART I

Chapter 1

Key environmental trends

During the 2000s, Germany experienced robust performance on many economic and social indicators and continued to improve its overall environmental performance. This chapter provides a snapshot of some key environmental trends in Germany over the decade. It highlights some of the main environmental achievements and the remaining challenges on the path towards a greener economy and sustainable development. This chapter briefly describes Germany's progress in reducing the carbon, energy and material intensities of its economy; in managing its natural asset base, including its water and biodiversity resources; and in improving the environmental quality of life.

1. Introduction

Germany is among the largest economies in the OECD and in the world. It has experienced strong GDP growth and robust performance on many economic and social indicators during the 2000s. It has also been resilient in responding to the global economic crisis (Box 1.1). Along with economic and social progress, Germany has continued to promote ambitious environmental policies at home and internationally. These have helped improve the country's overall environmental performance, enhance the quality of life of its people, and stimulate the development of an internationally competitive environmental goods and services sector.

This chapter provides a snapshot of some key environmental trends in Germany over the review period, 2000-10. It highlights some of the main environmental achievements and the remaining challenges on the path towards a greener economy and sustainable development. The chapter is based on indicators from national and international sources, and broadly follows the OECD framework to monitor progress towards green growth (OECD, 2011a). Accordingly, it describes Germany's progress in using energy and natural resources efficiently, in managing its natural asset base, and in improving the environmental quality of life of its people. It provides a baseline for subsequent chapters which assess how effective German environmental policies have been in affecting these trends and in using environmental objectives to generate economic opportunities.

Box 1.1. **The economic and social context**

- Germany's GDP increased by about 9% in the period 2000-10, although it fell by 3.3% between 2008 and 2009 due to the global economic recession. Following a rapid and forceful recovery, growth decelerated in 2011 and is expected to slow further in 2012 (OECD, 2012).
- The gap in living standards compared to the better performing OECD countries has further narrowed. In 2009, Germany's GDP per capita (in purchasing power parities) ranked 15th in the OECD (Reference I.A). The economic convergence of the eastern *Länder* with the western *Länder* has continued in the last decade, though at a slower pace than in the 1990s (OECD, 2010a). GDP per capita in the eastern *Länder* was still about 70% of that in the western *Länder* in 2008.
- Germany has a strong industrial base. In 2009, industry accounted for 26.5% of value added, above the OECD Europe average (24.9%). Services made up for nearly 73% of value added and agriculture for 1% (Reference I.A). The role of the environmental goods and services sector in the economy has increased. Depending on the definition used, it is estimated that it accounted for between 1.9% and 5% of GDP in 2009 (Chapter 3).
- International trade plays a significant role in the German economy. In 2009, exports of goods and services accounted for 41% of GDP, and imports for 36%, well above the respective OECD averages. Road vehicles account for the largest share of exports; electrical machinery and petroleum and related products make up the largest share of imports.
- Taxation remains skewed towards labour, which accounts for 64% of total tax receipts, well above the OECD average of 50%. At 37.3% in 2009, Germany's tax-to-GDP ratio was above the OECD average (33.8%).

Box 1.1. **The economic and social context** *(cont.)*

- Revenue from environmentally related taxes (mostly on energy products and vehicles) has decreased since 2003. In 2009, it accounted for 2.3% of GDP and 6% of total tax revenue, slightly below the respective OECD Europe averages (Figure 3.1).
- Responding to the global economic crisis, Germany implemented two fiscal stimulus packages for a total of EUR 80 billion. Environment-related measures were estimated at some 13% of the recovery package (Table 3.3).
- Public finances deteriorated with the economic crisis. The budget deficit grew to above 3% of GDP in 2009, although it remained the lowest among G7 countries. The public debt increased by almost 20% between 2007 and 2010, reaching 83% of GDP (OECD, 2012).
- Unemployment did not significantly grow as a result of the economic crisis. In 2009, it was 7.5%, below the OECD average (Reference I.B). However, unemployment in the eastern *Länder* is significantly higher than that in the western *Länder*.
- Germany's population was 82 million in 2009. Germany is one of the most densely populated countries in the OECD (Reference I.B). Population density (inhabitants per km^2) was 229 per km^2 in 2009.
- The population growth rate is projected to decrease over time. The ratio of elderly population (aged 65 and over) to the whole was 20.4% in 2010, making Germany the third most aged society among OECD countries. In 2009, life expectancy at birth for the whole population in Germany stood at 80.3 years, almost a year more than the OECD average.
- Germany's population is generally well educated. About 85% of the population aged 25-64 years have at least upper secondary education, among the highest rates in the OECD (Reference I.B). The graduation rate has also increased in recent years. However, tertiary attainment rates are below the levels seen in most other OECD countries for 25- to 34-year-olds, which signals a potential shortage of skilled workers.

2. Transition to a low-carbon, energy- and resource-efficient economy

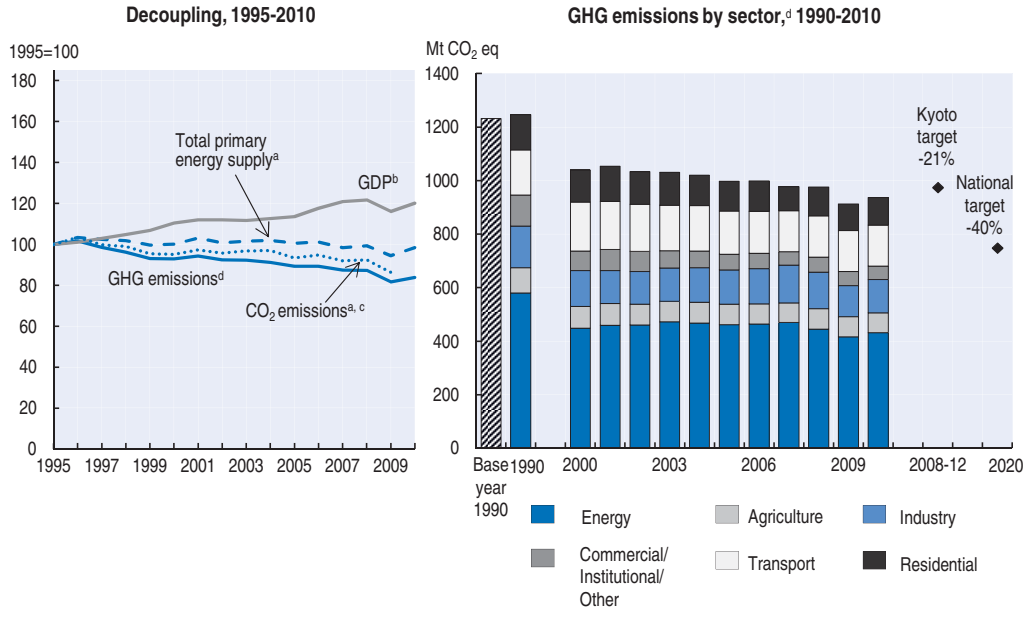
2.1. *Carbon and energy intensities*

Germany has made considerable progress in reducing the carbon and energy intensities of its economy. It is one of the few OECD countries that managed to absolutely decouple greenhouse gas (GHG) emissions from economic growth in the 2000s. Domestic GHG emissions declined more than required by the Kyoto target. Energy efficiency improvements and the rapid development of renewable energy sources were among the key drivers of this decline. However, Germany's energy and electricity mixes remain heavily dependent on fossil fuels, which results in slightly higher GHG emissions per unit of GDP than the average for OECD Europe.

Greenhouse gas emissions

- Germany is the largest GHG emitter in the European Union, and the third largest in the OECD, after the United States and Japan.
- On current trends Germany will more than meet its Kyoto target (–21% from the 1990 level) exclusively through domestic emission reductions. In 2010, Germany's total GHG emissions[1] were 24% below the 1990 Kyoto Protocol base year level (Figure 1.1).
- Germany is one of the few OECD countries that absolutely decoupled GHG emissions from economic performance in the 2000s (Figure 1.1). However, when the GHG emissions embedded in imported products are considered, Germany's decoupling performance appears less successful (Box 5.2).

Figure 1.1. **CO_2 and GHG emissions**



a) Excludes international marine and aviation bunkers.
b) GDP at 2005 prices and purchasing power parities.
c) CO_2 emissions from energy use only. Sectoral approach.
d) Excluding CO_2 emissions/removals from land use, land-use change and forestry.
Source: OECD-IEA (2011), *CO_2 Emissions from Fuel Combustion;* OECD-IEA (2011), *Energy Balances of OECD Countries*; OECD (2010), *OECD Economic Outlook No. 88;* UBA.

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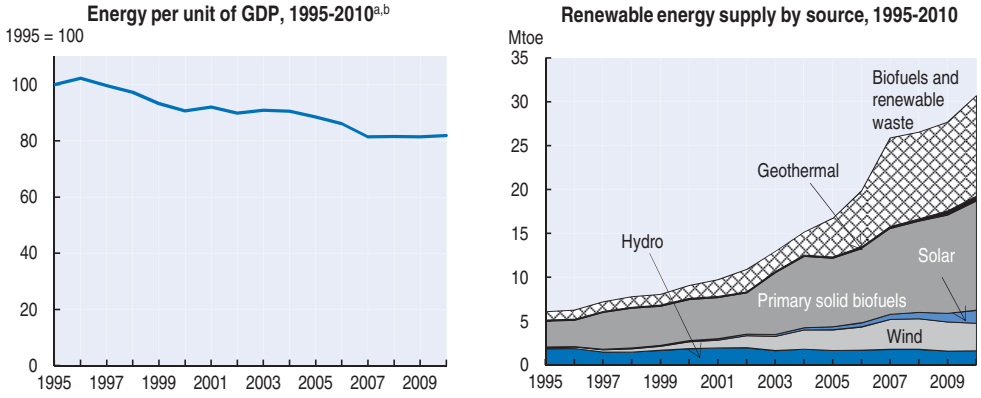
- GHG emissions decreased by 12% between 2000 and 2009, which is among the largest declines in the OECD (Reference I.C). However, slightly over half the reduction occurred between 2008 and 2009, and can be attributed to the global and domestic economic downturn. Emissions increased by 2.7% in 2010 as a result of economic recovery and cold weather.
- Emissions have declined in all sectors of the economy since 2000, most noticeably in the transport and waste sectors. Industrial emissions remained stable until 2009, when they declined as a result of the economic recession (Figure 1.1; Box 5.1).
- Many factors have contributed to reducing GHG emissions. These include the global and domestic economic performance (Box 1.1); the delocalisation of manufacturing activities to the new EU member states; the dramatic growth of oil prices; the implementation of a mix of regulatory and market-based policies to promoted renewable energy sources and energy efficiency; and, last but not least, strong political commitment to climate change policy (Chapter 5).
- However, at 11.2 tonnes of CO_2 eq per inhabitant in 2009, GHG emissions per capita remain above the OECD Europe average, as do emissions per unit of GDP (0.35 t CO_2 eq/1 000 USD), albeit marginally (Reference I.C).
- This reflects both the structure of the German economy, which is highly industrialised and remains dependent to some extent on energy-intensive manufacturing and processing, and the relatively carbon-intensive energy mix (see below).

Energy intensity and renewables

- While Germany's economy grew between 2001 and 2008, both primary energy supply and final energy consumption remained relatively stable (Figure 5.5). This resulted in a further decline in energy intensity, which is in line with the OECD average despite Germany's heavy industrial base (Figure 1.2; Reference I.A). Energy use sharply declined in 2009 due to the economic recession.
- Germany has a relatively diversified, albeit carbon-intensive, energy mix. Fossil fuels account for nearly 80% of the mix, a share that is slightly below the OECD average but above that in many European countries. The energy supply still depends to a significant degree on hard coal and other solid fossil fuels (23%) (Reference I.A).
- Coal also accounts for the largest share of electricity generation (nearly 45% in 2010), followed by nuclear power (23%), renewable sources (17%) and natural gas (14%) (Figure 5.5). A marked increase in electricity production occurred in response to increased domestic electricity demand.

Figure 1.2. **Energy intensity and renewable energy sources**



a) Total primary energy supply. Excludes international marine and aviation bunkers.
b) GDP at 2005 prices and purchasing power parities.
Source: OECD-IEA (2011), *Energy Balances of OECD Countries*; OECD (2010), *OECD Economic Outlook No. 88.*

StatLink http://dx.doi.org/10.1787/888932591672

- The use of renewable energy sources more than tripled in the last decade (Figure 1.2). In 2010, renewables accounted for 10% of primary energy supply and were the third largest source of electricity. Biomass was the most used primary renewable fuel (40%), whereas wind was the largest source of renewable electricity (36%). Electricity generation from solar photovoltaics has dramatically increased since 2000, and it accounted for nearly 12% of electricity from renewables in 2010 (Figure 5.6).
- Renewable energy sources are expected to account for an increasingly large share of energy supply as Germany progressively phases out nuclear power by 2022.
- The residential sector is the largest energy user (29% of final energy consumption), followed by transport (24%) and industry (21%). Between 2000 and 2009, energy consumption declined in all economic sectors, except in the agricultural, residential and commercial sectors (Figure 5.5).

- In particular, consumption in the transport sector declined by 10% over the last decade, in contrast to the trend observed in most OECD countries, and despite the increase in overall transport activity.
- Between 1999 and 2008, freight transport volume (as measured by tonne-kilometres) grew by 35%, more than GDP (+13.8%). Freight transport by rail has increased, although road remains the dominant mode for freight haulage (Federal Statistical Office, 2010) (Figure 5.7; Reference I.A).
- In contrast, passenger transport increased at a slower rate than GDP in the same period, by 3.4% (Federal Statistical Office, 2010) (Figure 5.7). Vehicle stock has continued to increase; Germany remains among the OECD countries with the highest private car ownership rates (Reference I.A). The share of diesel vehicles in the total automobile fleet also rose significantly, from 14.5% to 24.4%, between 2001 and 2008.

2.2. Resource efficiency

Germany has made considerable progress in reducing the resource intensity of its economy. It is among the OECD countries with the lowest material consumption on a per capita basis and per unit of GDP. Material productivity has improved, mainly due to structural economic changes and the reduction of domestic extraction of construction minerals and coal. An effective waste management policy has also contributed to this, through the growing rate of material recycling and recovery of waste. On the other hand, intensity of use of agricultural input remains among the highest in OECD, which results in a high nitrogen surplus.

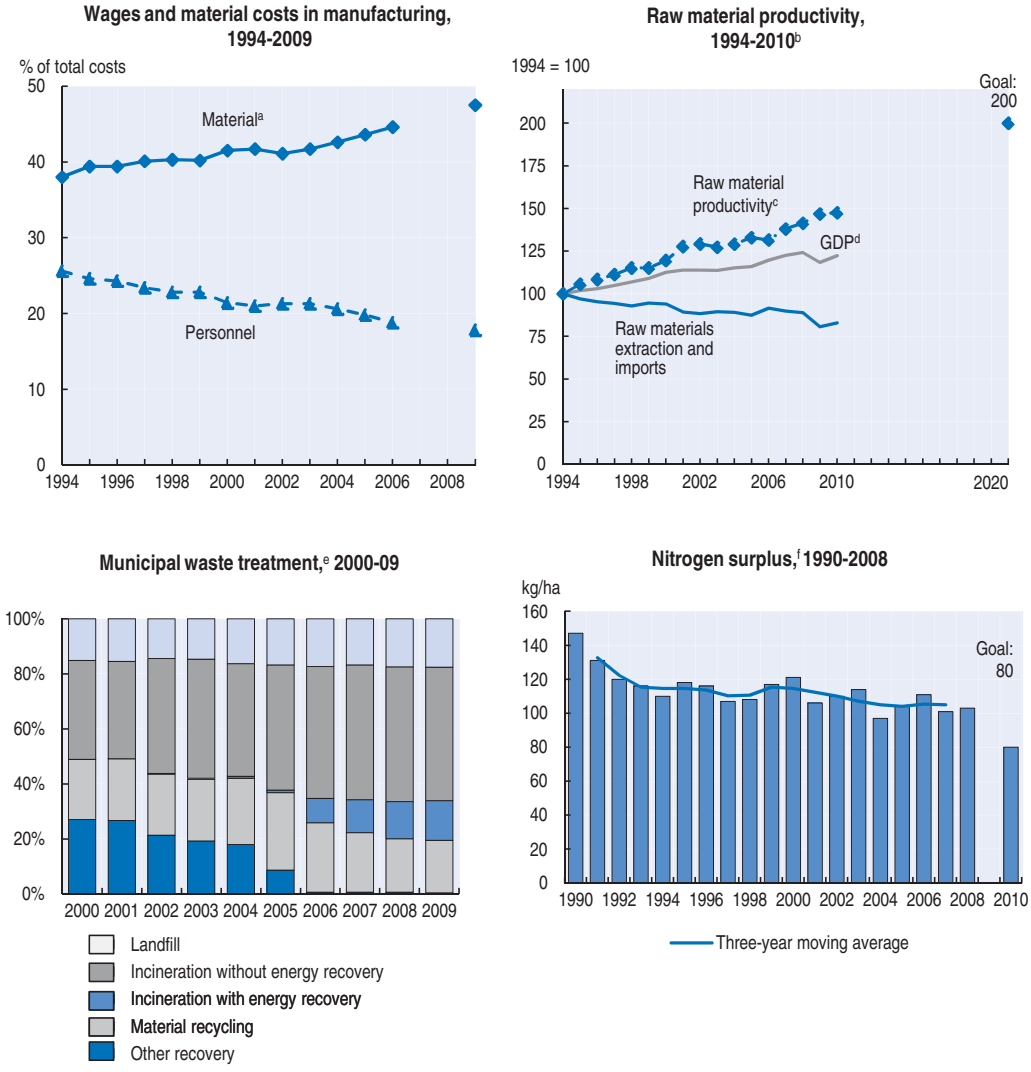
Material productivity

- Germany is largely dependent on imports of raw materials, which have accounted for a larger and growing share of the manufacturing industry's costs compared to labour costs (Figure 1.3, top left panel). Reducing the cost of these inputs is, therefore, a critical factor for industrial competitiveness.
- In the OECD, Germany is among the countries that decoupled, in absolute terms, their domestic material consumption from GDP growth between 1995 and 2008.[2] It has a relatively low material intensity on a per capita basis, and generates more economic wealth from each unit of materials used than the average (OECD, 2011b) (Reference I.C).
- Between 1994 and 2010, while GDP grew, the use of abiotic materials decreased.[3] As a result, abiotic material productivity (GDP per unit of material input) rose by 48%. At this pace, in 2020 it will be around 90% above the 1994 level, falling short of the target of doubling abiotic material productivity set by the National Sustainable Development Strategy (NHS) (Figure 1.3, top right panel).
- Between 2000 and 2008, abiotic material productivity grew by 18%. However, if the materials embedded in imported products were accounted for, the increase would be much lower (7%).[4]

Waste generation and recovery

- Between 2000 and 2009, total waste generation decreased by about 20%, mainly due to the reduction of construction and demolition waste. However, with the exception of municipal waste, the amounts of waste generated broadly followed trends in sectoral

Figure 1.3. **Resource productivity**



a) Including energy (2.1% in 2009).
b) Data for 2010 are preliminary.
c) Raw material productivity designates the amount of GDP generated per unit of abiotic raw materials used. It refers to the ratio of GDP to (DMI-biotic materials), where DMI (or direct material input) is the sum of domestic raw materials extraction imports of raw materials and manufactured products.
d) At constant prices.
e) Municipal waste is waste collected by or for municipalities, waste directly delivered and separate collection for recycling by the private sector. It includes household, bulky and commercial waste and similar waste handled at the same facilities. 2000-2001: including OECD estimates for light packaging.
f) Nitrogen surplus per hectare of agricultural land.
Source: Federal Statistical Office (2010), *Sustainable Development in Germany, Data Relating to the Indicator Report 2010*; OECD, Environment Directorate.

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economic activities. Hazardous waste generation grew by 16% and accounted for about 5% of the total amount of waste generated in 2009.

- While private final consumption slightly increased, municipal waste generated declined from 640 to 590 kg per capita between 2000 and 2009. However, it remains above the OECD Europe average (Reference I.C). Since 2006 municipal waste generation has grown in Germany, in contrast with the trend observed in some other OECD economies.

- Over the last decade, waste recovery improved significantly, while waste disposal to landfill sharply decreased. In 2009, about three-quarters of total and municipal waste was pretreated and sent for recovery (Figure 1.3, bottom left panel).
- In 2009, Germany was among the best performers in recycling municipal waste (63% including composting) in the European Union (EU15 average 46%). It also had one of the highest rates of recycling for various types of waste in the EU, including packaging, end-of-life vehicles, and waste electrical and electronic equipment (Box 3.5). Germany has largely exceeded the related national and European targets on recovery and recycling (BMU, 2010a).
- Drivers of these achievements include the ban on landfilling of untreated municipal waste (since 2005), ambitious recycling targets, waste-stream-specific legislation, waste charging systems and the willingness of the population to separate waste (Chapter 3). All this also contributed to developing capacity of thermal, mechanical and biological waste treatment.

Nutrient balance

- Several measures taken to improve the environmental performance of agriculture (Box 3.4) helped reduce concentrations of phosphorus and nitrates in the main German rivers, although at a slower pace than in the 1990s. The phosphorus surplus from agriculture in soil further declined in the 2000s.
- However, the nitrogen surplus, at 100 kg per hectare, is still high, about 20 kg per hectare higher than the objective established by the NHS for 2010 (Figure 1.3, bottom right panel). The nitrate threshold (50 mg/l NO_3) was exceeded at 15% of monitoring sites in 2008.
- Even though the sales of nitrogenous fertilisers decreased during the review period, their use per hectare is still higher than the OECD Europe and OECD averages (Reference I.C).

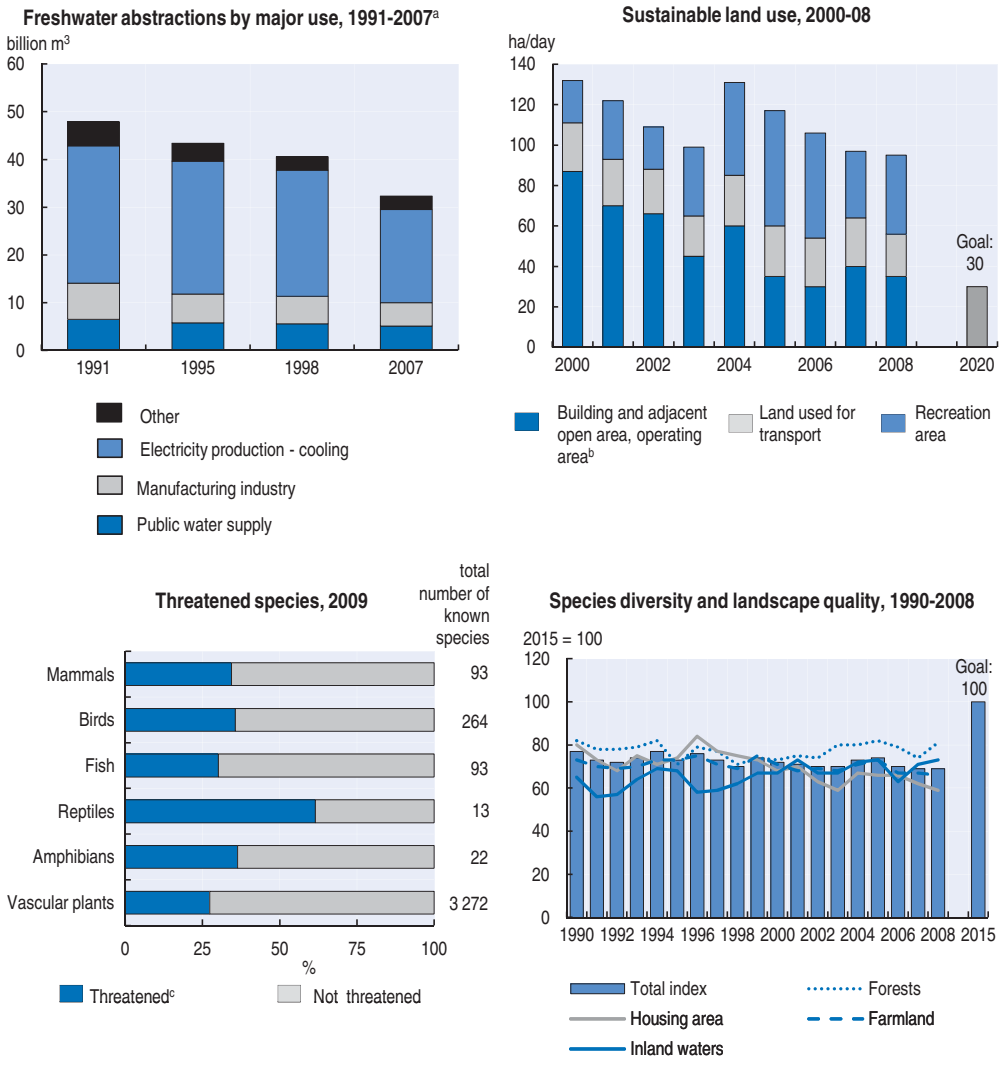
3. Managing the natural asset base

Germany has made progress in managing some of its natural resources. Pressure on water quantity is relatively low, but reaching water quality objectives is a major challenge. Relatively high population density, dispersed settlements and a variety of industrial and agricultural activities have exerted strong pressures on ecosystems and biodiversity. While a large share of land area is under some form of nature protection, most indicators show that Germany is far from achieving its biodiversity policy objectives.

Water resources

- Germany's water resources are relatively abundant, although there are shortages in some regions due to low groundwater levels and high demand from industry (UBA/BMU, 2010). Annual abstractions are about 18% of total available renewable water resources.
- Water use continued to decrease between 2000 and 2007 (by around 12%). Germany's annual water abstraction per capita of 430 m^3 is well below the OECD Europe average (Reference I.C). Industry accounts for 84% of total water abstracted, the bulk of which is used for cooling in thermal power stations (Figure 1.4, top left panel). Agriculture is mostly rain fed.

Figure 1.4. **Natural asset base**



a) Break in time series in 2007.
b) Excluding exploitation area.
c) IUCN categories "critically endangered", "endangered" and "vulnerable" in % of known species.
Source: OECD, Environment Directorate; Federal Statistical Office (2010), *Sustainable Development in Germany, Data relating to the Indicator Report 2010.*

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- Effective water pricing, supported by awareness raising campaigns and the restructuring of water utilities, was particularly important in reducing the demand for water by households (Box 3.2).
- The extension and modernisation of wastewater facilities (Section 4), together with strict regulations and wastewater charges (Chapter 3), helped reduce the amount of pollutants discharged into water bodies, although at a slower pace than in the previous decade.
- However, 82% of surface water and 36% of groundwater bodies are not expected to achieve the required water quality objectives under the EU Water Framework Directive by 2015. Excessive nutrient loads (Section 2.2) and micro-pollutants (*e.g.* pharmaceuticals) are considered growing threats.

- The quality of coastal and freshwater bathing waters, already good before 2000, was further improved. All coastal bathing waters were compliant with mandatory values in 2009, and only 0.5% of freshwater bathing waters exceeded mandatory values. Some problems in coastal waters are still linked with some substances that biodegrade slowly.[5]

Biodiversity and ecosystems

- About half of Germany's land area is classified as arable land, 14% as grassland and nearly 32% as forest. As in most European countries, the intensity of forest resource use has decreased in Germany, which has one of the largest growing stock in forest and other wooded land among OECD countries (Reference I.C).
- The conversion of undeveloped land for housing and transport slowed down during the last decade: on average in 2007-10, 87 hectares were converted per day, compared to 129 in the early 2000s. However, this is still far from the target set by the NHS of limiting such conversion to 30 hectares per day by 2020 (Figure 1.4, top right panel).
- From 1994 to 2008 the share of farmland accounted for by organic farming increased from 1.6% to 5.4%, although the long-term ambition is to reach 20%. In 2010, 14% of arable land was used for the cultivation of crops for energy production (biofuels).
- More than 40% of total area is under some form of protection. This is the second highest share among OECD countries (Reference I.C). However, the areas under a strict level of protection (IUCN Categories I and II) account for only 0.4% of the area. There are currently 14 national parks, 16 biosphere reserves and about 100 nature parks; the Natura 2000 network comprises 15.3% of the land area (BMU, 2010b).
- Compared with many other countries, Germany has a relatively small number of endemic species. The levels of endangered mammals, birds and vascular plants are relatively high compared to other OECD countries (Figure 1.4, bottom left panel; Reference I.C). Nevertheless, the population status of some species has improved and some have been removed from Germany's Red List of endangered species.
- More than 70% of biotope types are classified as endangered according to the Red List for Germany; marine and coastal biotopes and certain habitats typical of the Alps have a particularly large share of endangered biotope types.
- Species diversity has not improved in the last decade,[6] and the current situation remains far from the 2015 target value that would bring species diversity back to the 1975 level. Forests are the only habitat in which species diversity has improved (Figure 1.4; bottom right panel).

4. Improving the environmental quality of life

Implementation of effective pollution prevention and control policies has helped improve the quality of life associated with the environment. However, ambient air quality in some cities exceeds standards established to protect human health. Continued efforts are needed to bring access to wastewater treatment in eastern *Länder* up to western *Länder* levels. On a range of indicators, German citizens are relatively satisfied with their environmental quality of life.

Air quality

- Air emissions fell by about 15% in the 2000s, or by 1.2% per year on average (Figure 1.5, top left panel). Emission reductions have been registered for virtually all pollutants and in all sectors of the economy.
- Emission intensities also declined, indicating that Germany managed to absolutely decouple air pollutant emissions from GDP growth. Germany has one of the lowest levels of emissions per capita and per unit of GDP among OECD countries, despite its strong industrial base (Reference I.C).
- Stringent environmental requirements, traffic restrictions in urban areas (Box 5.6) and economic instruments, such as vehicle taxes and road tolls, have helped curb emissions and develop internationally competitive, low-emission vehicle technologies (Chapter 3; Chapter 4).
- However, in 2009 the pace of emission reduction was not sufficient to meet the 2010 target set in the NHS of reducing the combined emissions of the four major air pollutants by 70% from the 1990 level (Figure 1.5, top left panel).[7]
- In particular, despite progress, emissions of nitrogen oxides (NO_x) – mostly from road transport – and ammonia – mainly from agriculture – remain of concern. As of 2009, Germany was still far from reaching the respective 2010 targets set by the EU National Emission Ceilings Directive.
- Also, while emissions of small particles from vehicle use have considerably declined, those from small furnaces (*e.g.* small factories and residential heating) have remained virtually unchanged and contribute to poor air quality in some urban areas (UBA, 2009) (Box 3.3).
- German cities compare favourably with many other European cities in terms of population exposure to air pollution (Figure 1.5, top right panel). However, concentrations of NO_x, particulates and ozone have not consistently decreased since 2000. They have often exceeded the limit values for the protection of human health in urban areas.

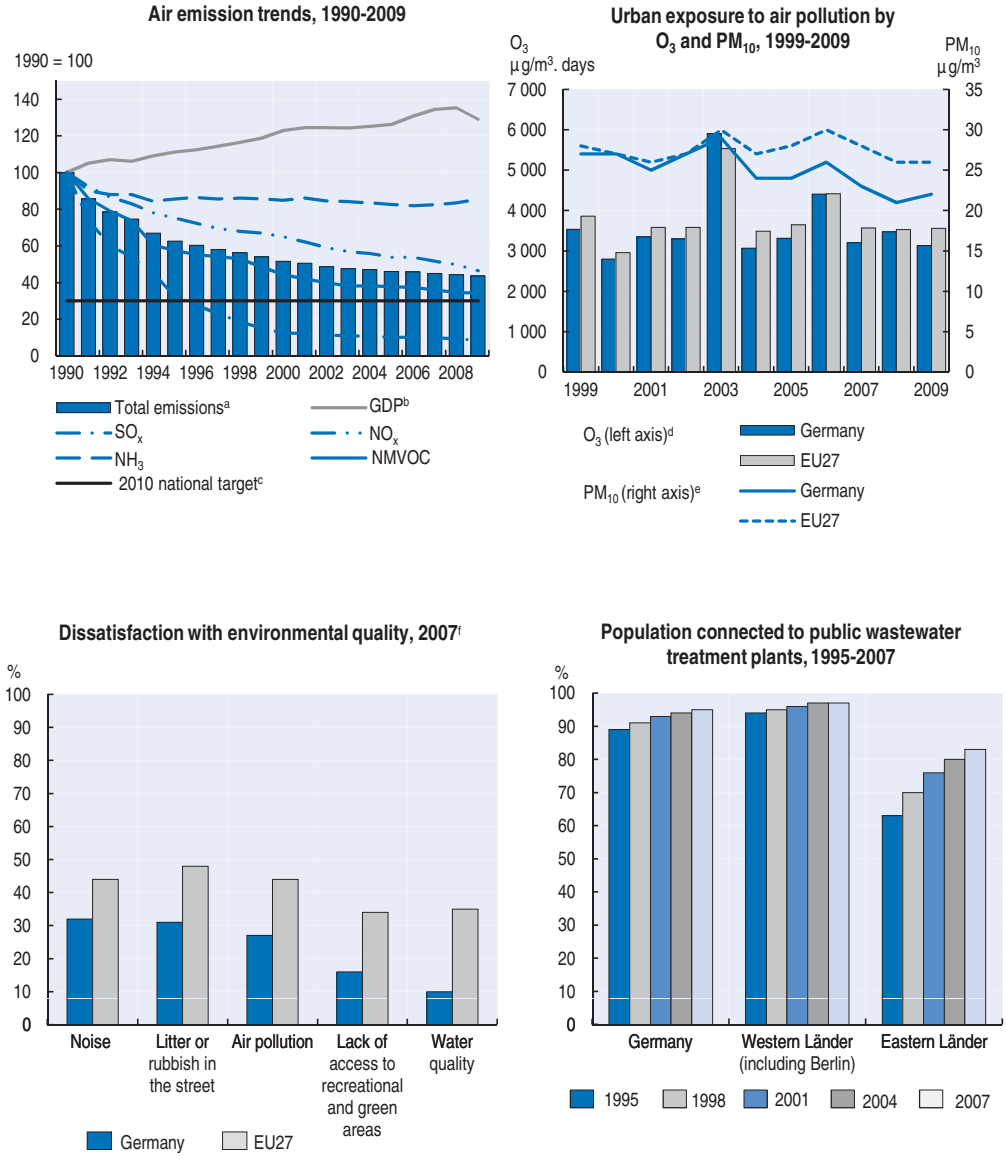
Water supply and sanitation

- In 2008, 95% of the German population was connected to public wastewater treatment plants, up from around 91% in 1998. Most of the plants provide tertiary treatment, which places Germany among the best performers in the OECD (Reference I.C). The rate of connection in the eastern *Länder* increased from 70% to 83% in the same period, thereby converging with that in the western *Länder* (Figure 1.5, bottom right panel).
- As in most OECD countries, the entire population has long had access to improved drinking-water sources in both urban and rural areas.[8]

Health impacts

- Progress in addressing air and water pollution has resulted in reduced health impacts. According to estimates by the World Health Organization (WHO), in 2008 13 deaths per 100 000 inhabitants were attributable to outdoor air pollution in Germany, down from 17 in 2004. The burden of disease associated with poor water sanitation and hygiene is among the lowest in the world. In 2004, 13% of the overall burden of disease in Germany was attributable to the environment, below the OECD Europe average of 14.5% (WHO, 2009).[9]

Figure 1.5. **Environmental quality of life**



a) Unweighted average of total air emission of SO_x, NO_x, NMVOC and NH_3.
b) At 2005 prices and exchange rates.
c) 70% emission reduction compared to 1990 levels, as set by the National Strategy for Sustainable Development.
d) Population weighted annual sum of maximum daily 8-hour average ozone concentrations greater than 70 µg/m³ at urban background stations.
e) Population weighted annual mean concentrations of particulate matter at urban background stations.
f) Percentage of respondents reporting complaints about environmental problems in their area.
Source: EEA; European Foundation for the Improvement of Living and Working Conditions (2009), *Second European Quality of Life Survey: Overview*; Federal Statistical Office (2010), *Sustainable Development in Germany, Data relating to the Indicator Report 2010*, OECD, Environment Directorate.

StatLink http://dx.doi.org/10.1787/888932591729

- Overall, the German population appear to be among the most satisfied with their country's environmental quality in Europe: only 16% of the German population is dissatisfied with its access to recreational and green spaces and 10% by the quality of water. However, around 30% of the people are dissatisfied with the noise, litter and air pollution in their area (Figure 1.5, bottom right panel).

Notes

1. Without emissions/removals from land use, land use change and forestry.
2. Domestic material consumption is the sum of domestic extraction of the raw materials used by the economy and the physical trade balance (imports minus exports of raw materials and manufactured products).
3. Material used, whether from domestic origin or imported in the form of raw materials, semi-finished and finished products excluding agricultural and forestry products.
4. Materials extracted abroad and imported into Germany are also used to manufacture exported goods which are used by consumers in other countries.
5. These include dichlorodiphenyltrichloroethane (DDT), polychlorinated biphenyls (PCB), hexachlorocyclohexane (HCH) and hexachlorobenzene (HCB).
6. The indicator is calculated on the basis of the development of the population of 59 bird species representing the main landscape and habitat types in Germany (farmland, forests, settlements, rivers and lakes, coasts/seas and the Alps). For each bird species, a population target to 2015 was defined. The indicator aggregates the distance-to-target of all the considered bird species.
7. Sulphur dioxide, nitrogen oxides, volatile organic compounds and ammonia.
8. This is the percentage of population with access to an improved drinking water source in a given year. Improved drinking water sources are defined in terms of the types of technology and levels of services that are more likely to provide safe water than unimproved technologies. According to the World Health Organization (WHO) definition, improved water sources include household connections, public standpipes, boreholes, protected dug wells, protected springs, and rainwater collections.
9. The burden of disease is measured by WHO in number of years lost due to ill health, disability or early death (disability-adjusted life years or DALYs).

Selected sources

The government documents, OECD documents and other documents used as sources for this chapter included the following:

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PART I

Chapter 2

Policy-making environment

Since 2000, Germany has built upon what was an already ambitious environmental policy framework. There has also been a shift from sector-specific to more comprehensive, cross-cutting policies. This chapter reviews the main strategies and initiatives that were launched during the decade in the areas of sustainable development and environmental management, including on biodiversity, water, resource efficiency, energy and climate change. It examines Germany's environmental governance, the mechanisms in place to improve horizontal and vertical co-ordination, and the instruments used to systematically evaluate the environmental impacts of economic and sectoral policies. Progress in promoting environmental democracy, through open access to information and improved public participation in decision making is also discussed.

Assessment and recommendations

Germany has continued to play a proactive role in environmental policy within the EU and internationally. At the national level, it has consolidated and further developed what was already an ambitious environmental policy framework. There has been a shift from sector-specific to more comprehensive and cross-cutting policies; for example: the National Sustainable Development Strategy (NHS) (2002) and its progress reports (2004, 2008), the National Strategy on Biological Diversity (NSBV) (2007), the Integrated Energy and Climate Programme (2007), the German Strategy for Adaptation to Climate Change (2010), and the Energy Concept (2010), which was jointly developed by the federal ministries of environment and economy. Opportunities exist to further exploit potential synergies between policy areas, for example in the area of resource productivity. The National Resource Efficiency Programme (2012) may contribute to achieving this objective.

As in other countries, obstacles to horizontal co-operation persist. Some important steps have been taken to overcome some of these as, for example, the horizontal bodies and mechanisms established to support the NHS implementation. The greater use of targets and indicators to monitor progress has also helped make the role of different ministries in implementing cross-cutting programmes more transparent. Policy coherence could be further enhanced by strengthening the assessment of the environmental impacts of economic and sectoral policies (*e.g.* in the transport and agricultural sectors), and of the economic aspects of environmental policies (*e.g.* biodiversity). In 2009, a sustainability criterion was included in the existing regulatory impact assessment procedure for new legislation. However, after the first two years of implementation, there is little evidence that such checks have resulted in changes to draft legislation. Environmental Impact Assessment, Strategic Environmental Assessment and tools such as cost-benefit analysis could be more systematically integrated into decision making. This would help assess the inter-linkages between sectoral policies and the environment. Continued attention should also be given to ensuring that independent, high-quality analysis supports the development of environment-related policies.

A 2006 amendment to the Basic Law that governs constitutional affairs helped streamline the transposition of EU environmental directives into German law. The *Länder* continue to have the primary responsibility for policy implementation. There are concerns that resource and capacity constraints are leading to an "implementation deficit" in some *Länder*. Amongst other things, this results in a divergence in environmental performance at sub-national level. The private sector is playing a greater role in providing environmental services. Some *Länder* are relying more on voluntary approaches to promote compliance with environmental requirements.

Over the last decade, there have been a number of developments involving more participatory and transparent approaches to decision making. Non-governmental actors have played important roles in connection with the NHS, the NSBV, and other recently developed strategies. The federal ministries consult frequently with non-governmental

organisations and the business community. However, some existing legal provisions for access to justice regarding environmental decision making appear to be not fully in line with the Aarhus Convention. There are plans to amend the relevant legislation in light of a 2011 ruling by the European Court of Justice.

Recommendations

- Further promote the policy co-ordination approaches and implementation tools embedded in the National Sustainable Development Strategy.
- Further integrate the results of environmental assessments and sustainability checks on legislation in decision making; strengthen support for the more effective implementation of Environmental Impact Assessment and Strategic Environmental Assessment, particularly at the local level; reinforce the quality and independence of the economic assessment of environment-related policies.
- Promote the use of independent mechanisms to monitor and report on how federal environmental legislation is implemented by the *Länder*, with a view to benchmarking and disseminating good practice approaches.
- Continue to deepen and broaden the participation of stakeholders in environmental decision making; review provisions for access to justice in environmental matters in order to ensure consistency with the Aarhus Convention.
- Further promote synergies and coherence among policies related to resource productivity (*e.g.* waste, raw material, energy, climate and innovation policies).
- Build upon the ongoing assessment of the economics of ecosystems and biodiversity to guide implementation of the National Strategy on Biological Diversity and to strengthen inter-institutional co-operation in this area.

1. Key environmental and sustainable development initiatives

By the turn of the century, Germany had established a sophisticated and ambitious environmental policy framework. To a large extent, environmental policy was shaped by EU environmental directives. However, Germany also played a proactive role in anticipating and shaping a number of EU environmental initiatives. Its proactive role extended to the broader international community. Among other things, Germany hosted conferences of the parties to the UN conventions on climate change (1999) and biodiversity (2008). In November 2011, Germany hosted a conference on the water-energy-food security nexus with a view to contributing to discussions at the Rio+20 Conference in June 2012. Together with the European Commission, Germany launched the project on The Economics of Ecosystems and Biodiversity (TEEB).

Since 2000, Germany has continued to play a proactive, leadership role in environmental policy. Increasingly, policies have become more comprehensive and cross-cutting. A major step in this regard was the adoption of the National Sustainable Development Strategy (NHS) in April 2002, subsequently updated. The NHS significantly changed the policy and institutional framework for environmental protection, and established sustainability as a major new principle in German policy (BMU, 2010a).

The NHS established an overarching institutional framework and management mechanism, and incorporated goals, targets, indicators and management rules as well as horizontal and vertical co-ordination mechanisms. Its main goals are inter-generational

equity (including resource protection, climate protection, renewable energy, land use, species diversity and innovation), a good quality of life (including mobility, farming and air quality), social cohesion and international responsibility. To achieve these, 35 medium- and long-term objectives in 21 fields of action were identified. The Federal Statistical Office publishes monitoring reports on progress towards the objectives every two years. One innovative development involved a peer review of the NHS in 2009 by experts from seven countries (Canada, Finland, India, the Netherlands, Sweden, the United Kingdom and the United States), chaired by a representative of the business sector (RNE, 2009).

In 2000 and 2007, Germany launched two major programmes to address climate change (Chapter 5). In particular, the 2007 Integrated Energy and Climate Programme set the objective of achieving a 40% reduction of greenhouse gas (GHG) emissions by 2020 compared with 1990. This goes beyond EU requirements under current agreements. The 2010 Energy Concept builds on the previous two programmes by identifying additional measures to achieve the 40% reduction by 2020. It presents the government strategy to achieve an environmentally sound, reliable and affordable energy supply. The Energy Concept envisages renewable forms of energy representing a major share of the energy mix in the future, gradually replacing fossil fuels and nuclear energy. In addition, in 2008, Germany adopted its Strategy for Adaptation to Climate Change.

In November 2007, the German government adopted a comprehensive national strategy on biological diversity. Embedded in the NHS, it is linked to several sectoral strategies and is intended to facilitate implementation of the UN Convention on Biological Diversity. It contains some 330 concrete targets and about 430 measures which call upon various government and non-governmental actors to take action. The government has undertaken to present a comprehensive progress report during the term of every parliament (Box 2.1). Germany also consolidated its legislative framework with the revision of the Federal Nature Conservation Act in 2010.

Resource efficiency is the third major environmental and sustainable development initiative that Germany has undertaken over the last decade. It has received renewed impetus in recent years due to the increasing environmental impacts of resource use and the volatility of raw material prices, which has made reducing the cost of these inputs a critical factor in the competitiveness of manufacturing. In October 2011, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) presented a draft national resource efficiency programme, building upon the results of the Material Efficiency and Resource Conservation (MaRess) project (Box 2.2). The programme, adopted in 2012, aims to support the achievement of the overall target, set in the 2002 NHS, of doubling raw material productivity between 1994 and 2020.

The transposition of the EU Water Framework Directive in 2002, its subsequent implementation, and the adoption of the 2010 Water Act led to important re-orientation and strengthening of German water policy. A river basin management plan was developed for each of Germany's ten river basins, with ambitious targets and stronger institutional arrangements, including more effective stakeholder involvement. These plans include measures to reduce diffuse and point-source water pollution and to improve the ecological and chemical status of surface water bodies and the chemical and quantitative status of groundwater.

Box 2.1. **The National Strategy on Biological Diversity**

The National Strategy on Biological Diversity (NSBV) provides an ambitious and comprehensive new framework for the sustainable use and conservation of biodiversity in Germany, in line with the objectives of the UN Convention on Biological Diversity. It aims to significantly minimise, and eventually halt and reverse, the loss of biological diversity in the country. It seeks to mobilise all stakeholders, including government institutions at federal, *Land* and local level, business and civil society.

Germany is a country with high population density and many competing claims on its territory. Balancing biodiversity with other interests has not been easy, and current indicators show the strong pressures that apply to ecosystems and biodiversity (Chapter 1). Integrating biodiversity into other sectoral policies is therefore an important part of the NSBV. Progress has been made, for example, with the 2007 Agro-biodiversity Strategy, prepared by the Federal Ministry of Food, Agriculture and Consumer Protection, which identifies a series of sector-specific objectives and targets. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) has established an inter-ministerial working group to support implementation of the NSBV. Co-operation with *Länder* will also be crucial, particularly in developing an integrated national monitoring system.

In December 2007, the BMU launched the First National Forum on Biological Diversity, as part of a multi-year process for implementing the NSBV that relies heavily on dialogue with stakeholders. Seven regional forums on key topics were subsequently held in various parts of Germany. In the same year, Germany also launched the Biodiversity in Good Company initiative. Businesses which join the initiative sign a Leadership Declaration. In doing so, they undertake to embed biodiversity conservation in their business policy in the future and, among other things, to lay down measurable targets for improved protection and sustainable use of biological diversity, which are reviewed and updated every two to three years.

The NSBV stipulates that progress must be monitored, using a set of 19 indicators. The set of indicators is divided into five topic areas: there are seven indicators on biodiversity components, two on settlements and transport, eight on economic uses, one on climate change and one on social awareness. A progress report is to be submitted in each legislative period, with the first one due in 2012. Twelve of the indicators give information on progress towards certain quantitative time-bound targets (to 2010, 2015 or 2020). The government prepared an initial indicator report in November 2010. It revealed that, for nearly all indicators, there was a wide gap between the actual values and the respective target values, highlighting the need for accelerating the NSBV implementation. In May 2011, Germany launched the preparation of a national study on the economics of ecosystems and biodiversity (national TEEB study). This can help Germany develop and implement more efficient and effective policy instruments for biodiversity conservation and sustainable use.

Source: BMU (2010b).

Box 2.2. **Resource efficiency initiatives**

The MaRess project (2007-10) was initiated by the Federal Ministry for the Environment, Nature Conservation and Nuclear safety (BMU) and the Federal Environment Agency. It was carried out by 31 project partners under the direction of the Wuppertal Institute to identify the potential for improving resource efficiency. Six core strategies emerged from the project, along with the instruments proposed for their implementation: *i)* mobilising institutions (*e.g.* launching a federal programme and using the Resource Efficiency Agency to speed up the diffusion of resource-efficient technologies, particularly to small and medium-sized enterprises); *ii)* giving innovation a direction to stimulate related R&D; *iii)* promoting resource-efficient products and services (*e.g.* encouraging eco-design); *iv)* creating incentives for resource efficiency solutions through the financial sector (*e.g.* creating resource-related performance indicators); *v)* changing practices of government as a consumer and provider of infrastructure (*e.g.* with procurement criteria based on life-cycle costs); and *vi)* changing attitudes (*e.g.* raising awareness and developing networks). The cost of the MaRess policy options was estimated at EUR 1.3 billion per year. Financing options included a tax on primary construction materials and reductions in the cost of public procurement.

A key outcome of the project was the evidence that integrating climate and material productivity policies could lead to significant synergy. Simulations showed that implementing selected instruments could further reduce material consumption by 20%, increase GDP by 14% and employment by 1.9%, and cut the public debt by EUR 33 billion in 2030 as compared to a reference scenario with ambitious targets on climate. Introducing "best practice" technology for reducing resource consumption was found to be the instrument with the largest impact on both the economy and the environment. Public-private partnerships providing consultancy services for this purpose were created in some *Länder*, such as North-Rhine-Westphalia (OECD, 2008).

The National Resource Efficiency Programme (2012) has four guiding principles: combining ecological needs with economic opportunities, innovation support and social responsibility; global responsibility as a key focus of the national resource policy; making economic and production practices less dependent on consumption of newly extracted non-renewable raw materials; and assuring long-term sustainable use of resources by guiding society towards quality growth. Strategic approaches include securing a sustainable raw material supply, improving resource efficiency of production and consumption, enhancing closed-cycle material management and using cross-cutting instruments. The programme focuses on market incentives, information, consulting, education and research, and on intensifying voluntary measures in industry and society.

Source: Kristof and Hennicke (2010); BMU (2012).

2. Institutional framework for environmental and sustainable development policies

Germany is a federal country, with 16 states or *Länder*. At the federal level, the main institutions responsible for developing and implementing environmental policies are the BMU and its three subordinate agencies: the Federal Environment Agency (UBA), the Federal Agency for Nature Conservation and the Federal Office for Radiation Protection.

The institutional structure in the *Länder* varies. Many of the larger states (*e.g.* North-Rhine Westphalia, Bavaria) have a three-tier administration with an environment ministry (sometimes coupled with agriculture or consumer protection) as well as district (county)

administrations, with cities at the lowest level. Other *Länder* have a two-tier system, with no intermediate (district) tier.

Environment and sustainable development were established as fundamental national objectives in 1994 by amendment to the Basic Law (Constitution). Since then, German environmental policy has been guided by three basic principles: the polluter-pays, precaution and co-operation.

The Basic Law was further amended in 2006. As a result, the execution of both federal and state law is still almost exclusively a matter for the *Länder*. The *Länder*, meanwhile, have transferred the execution of many laws to cities and counties, which now have the right to regulate themselves regarding local affairs within the framework of federal law. The *Länder* also exercise a significant influence on industry and commerce through planning and zoning decisions. As a result, the *Länder* are responsible for a wide range of issues that are important for the environment, including local public transport, public road building, water, gas and electricity supplies, waste management and sewage disposal services, town planning, and the planning and maintenance of public parks and municipal forests. Due to their ownership of many forests, the *Länder* play a major role in forest management and the use of forest products. The *Länder* have little responsibility with respect to climate change policies, in contrast with other areas of environmental policy.

The *Länder* play a key role in policy development through their representation in the second chamber of the German parliament, the Bundesrat. All government legislative proposals must be presented to the Bundesrat before they are submitted to the Bundestag (the national parliament). The Bundesrat must approve all legislation in which it is specifically assigned a responsibility by the Basic Law. It can also veto all other legislative acts, although the Bundestag can overrule the Bundesrat's decisions. Both chambers have permanent committees dealing with environmental matters.

Twice a year, a Conference of Environment Ministers brings together the environment ministers and senators of the *Länder* with the federal minister for the environment, nature conservation and nuclear safety to discuss cross-cutting themes. While resolutions adopted at the conference are not legally binding on the federal government, they set the agenda with regard to environmental policy. An important mechanism for co-operation between the federal and *Länder* authorities is through joint federal-*Länder* working groups under the aegis of the Conference of Environment Ministers. Currently there are eight such groups: on chemical safety; climate-energy-mobility; soil protection; genetic engineering; waste; emission control; nature conservation, landscape management and recreation; and water.

2.1. Horizontal and vertical co-ordination

The trend towards more comprehensive, cross-cutting environment-related policies requires close co-ordination among relevant ministries to ensure overall policy coherence. In some countries, this issue has been addressed by creating "super-ministries" in charge of a range of issues, such as environment, energy and infrastructure, or environment, food and rural affairs. At the federal level, Germany has chosen to strengthen inter-institutional co-ordination mechanisms and has made progress in this regard, although challenges remain.

To facilitate horizontal co-operation related to sustainable development, three bodies have been established:

- The State Secretaries Committee on Sustainable Development, created in 2005 and chaired by the head of the Federal Chancellery, meets four to six times a year and is composed of representatives of each of the 14 departments of the Chancellery.
- The Parliamentary Advisory Council on Sustainable Development, set up by the Bundestag in 2004, plays a pivotal role in broadening the political basis of the NHS. Its 22 members come from all political parties represented in the parliament. It meets regularly and is responsible for quality control of the "sustainability check" (Section 3) for legislative initiatives.
- The German Council for Sustainable Development was set up in 2001 and comprises 15 members from various arenas of politics and society. It is independent but collaborates closely with the federal government. Like the German Council of Environmental Advisors (SRU) and the German Advisory Council on Global Change, it plays a key role by formulating suggestions and criticisms of strategy, making proposals and encouraging social dialogue.

The development of climate policy has also prompted institutional innovation. An inter-ministerial body was first set up in 1990, and inter-ministerial co-operation has become closer as the need for more economy-wide policies has become stronger. The 2010 Energy Concept represents an important step in this regard as it was jointly developed by the BMU and the Federal Ministry for Economy and Technology (BMWi). The government is required to report regularly to the Bundestag on implementation of the Energy Concept, including on the actions of the various ministries involved.

In the field of resource efficiency, the BMU and BMWi have developed programmes reflecting their respective responsibilities. The BMWi established a Mineral Resources Agency whose responsibilities include promoting coherent policies related to raw materials. In the field of biodiversity, the implementation of the NSBV will require environmental institutions to co-ordinate with a variety of other ministries and agencies, such as those responsible for agriculture and forestry. The BMU has established an inter-ministerial working party to support implementation of the NSBV. Progress in achieving the strategy's objectives is monitored through a set of indicators (Box 2.1).

Given the important role played by the *Länder* in environmental policy development and implementation, priorities and interests at the subnational level also have a bearing on horizontal co-ordination. It had been hoped that the changes to the Basic Law outlined above would speed up the implementation of EU directives and increase efficiency and expediency in the implementation of environmental law and policy. However, the fact that environmental policy making is centralised at the federal level but implementation and enforcement are delegated to state and local authorities, which often face budget constraints, represents a special case of a principal-agent problem.[1] While any legislation is subject to an *ex ante* assessment of related implementation costs, designing policies in a manner that allows cost-effective implementation at state level remains challenging.

A 2007 study by the SRU concluded that reform pressure, brought about by budget cuts and efforts to streamline decision making, had resulted in an "implementation deficit" of German environmental law and policy (SRU, 2007). Other problems it identified include the combination of sectoral ministries with environment ministries (as well as individual administrative units within ministries) to reduce costs, and a general shift of

responsibilities downwards from *Land* level to regions and municipalities, coupled with a general movement towards acceleration, deregulation, privatisation and voluntary approaches to enforcement.

While the Conference of Environment Ministers took note of the SRU report after its release, neither the *Länder* nor the federal government officially responded to its assessment or reacted to its recommendations. In addition, in 2009, new debt restrictions on the Basic Law and on federal legislation were passed, imposing a more rigid debt regime on federal and *Länder* fiscal policies than previous constitutional provisions entailed. These give the *Länder* until 2020 to eliminate their deficits. Some observers, including environmental non-governmental organisations (NGOs) and the SRU, say these debt restrictions have resulted in the *Länder* not having sufficient resources to fully implement environmental policies and programmes. There still are significant differences in the implementation capacity and environmental performance of the various *Länder*.

Decision-making processes for climate change do not appear to follow the general pattern. The recent changes to the Basic Law reinforced the top-down nature of decision making on energy policy, but apparently this complicated system of multi-level governance seldom leads to serious stalemates in climate policy making. This fact has been attributed to long-standing institutionalised co-operation networks among policy makers within Germany, as well as to shared goals in climate policy between the respective administrative levels in the federal government and the European Commission (Weidner and Mez, 2008).

3. Evaluation mechanisms

The Federal Environmental Impact Assessment Act was most recently updated in February 2010. The Act implements the EU Environmental Impact Assessment (EIA) Directive (85/337/EC) and its two amendments, as well as the UNECE Espoo Convention (on transboundary EIA), the EU Strategic Environmental Assessment (SEA) Directive and the UNECE SEA protocol. Implementation of the 2009 amendment to the EU EIA Directive is under way. Unlike many other OECD countries (*e.g.* Canada, the Netherlands and the United States), Germany has no legal requirement to collect statistical data on the number of EIAs carried out, their content, the scope, the results obtained or their effect on decision making. The BMU estimates that more than 1 000 EIAs are carried out in Germany each year.

A recent study examined 105 EIAs carried out between 1999 and 2005 in six regions (Führ *et al.*, 2009). One of the main findings, in line with the discussion of *Länder* above, was that staff members of the licensing agencies feel overburdened, especially by larger and more complex cases, and criticise the lack of financial, personnel and time resources. The study concluded that, to improve EIAs, staff members needed more standardised procedures and support from higher levels of government. Regarding biodiversity, the German authorities have acknowledged that further progress is needed to assess impacts on biodiversity, with the aid of clear criteria, in the context of EIA and SEA (BMU, 2010b).

Germany's experience with implementing SEA is mixed (Weiland, 2010). The legal implementation is quite far advanced and it has been increasingly used in regional and local land-use and landscape planning. However, SEA has been less frequently applied to sectoral plans, including those related to transport, waste management, water resource management and air quality, partly because fewer such plans have been revised or developed since the adoption of the SEA Directive. In addition, the impact of SEA

procedures remains open to question as regards its influence on decision making and the share of planning procedures or planned areas that actually undergo SEA.

The monitoring and reporting of progress against quantitative targets has become a common feature for major environmental and sustainable development policies. In 2009, a "sustainability check" was included in the existing regulatory impact assessment procedure as a criterion for assessing new laws or regulations. In addition, sustainability was included in the standing orders of the federal government, and the Parliamentary Advisory Council on Sustainable Development was made responsible for the quality of sustainability checks. The objective of sustainability checks is to provide a comprehensive examination, at an early (draft) stage, of the long-term, cross-sectoral implications of legislation as regards sustainable development. There is no evidence to date that such checks have resulted in changes to draft legislation.

Environmental NGOs maintain that EIA, SEA and other assessment mechanisms, such as cost-benefit analysis, are not being fully implemented but are rather "add-ons" to existing planning procedures, particularly in the transport sector. Similarly, a recent OECD report on regulatory impact assessment suggested that the assessments tended to be captured by the sponsoring ministry, lacked transparency and reflected a general reluctance to reveal internal discussions underlying decision making (OECD, 2011).

4. Stakeholder involvement

Germany's ambitious environmental policies have been underpinned by strong public support. Moreover, the public often expects industry and government to act proactively on environmental issues in the expectation of first-mover economic gains. For example, a poll conducted in the spring of 2010 revealed that, despite the economic and financial crisis, nearly two-thirds of those surveyed believed that the state should do more to protect the environment: 61% of respondents were in favour of Germany assuming a pioneering role in international climate protection policy, and about 90% thought that industry and energy suppliers could adopt cleaner production processes (UBA, 2010). Such attitudes have been attributed in part to the positive experiences in Germany in dealing with air pollution in the 1970s (Weidner and Mez, 2008). Despite the strong interest and high expectations, however, it has not always been easy for the public to be involved in the complex policy process at the federal level or between federal and *Länder* authorities.

There were several important developments regarding environmental information over the last decade. The Environmental Information Act was updated in 2004 to implement the EU Environmental Information Directive and the first pillar of the Aarhus Convention (which Germany ratified in 2007). The Act gives citizens the right to obtain environmental information from public authorities (Box 2.3). The 2009 Geodata Access Act requires federal agencies to ensure public availability of information with a geographical frame of reference, such as data on soil conditions, water levels or settlement structures. In addition, a pollutant release and transfer register was established, enabling citizens to get information via the Internet on a wide range of pollutants.

Over the last decade, a number of policy initiatives adopted a more participatory and transparent approach to decision making. As mentioned earlier, non-governmental actors played an important role in the development and implementation of the NHS, and the BMU launched a multi-year, dialogue-oriented approach for the implementation of the

Box 2.3. **The Environmental Information Act**

The 2004 Environmental Information Act contains a number of important improvements with regard to public access to environmental information. In particular, it extends the definition of "authorities" to include federal government authorities as well as selected private agencies which perform environment-related public duties under the control of federal authorities. The definition of environmental information has also been extended, and the grounds for exemption restricted. The deadline for responding to information requests has been reduced to one month as a general principle, except where particularly extensive and complex environmental information is involved. Considerable improvement has also been made in the use of modern information technology and the active, systematic dissemination of environmental information by the authorities. Corresponding provisions apply at *Länder* level.

NSBV. The BMU and other ministries consult frequently with NGOs and the business community.

As in a number of OECD countries, there are continuing discussions about access to justice concerning decisions related to the environment. For example, in May 2011, the European Court of Justice (ECJ) reviewed a case about whether an NGO was legally entitled to challenge a decision to permit the construction of a power plant because of its potential environmental impact. The ECJ ruled that NGOs should have standing to challenge projects likely to have a significant effect on the environment (Box 2.4). This raises questions about existing legal provisions for access to justice regarding environmental decision making. There are plans to amend the relevant legislation in light of the ECJ ruling.

Box 2.4. **European Court of Justice ruling on access to environmental justice**

Local authorities in Lunen reviewed a request for a permit for the construction and operation of a coal-fired power station, which was to be located eight kilometres from several protected nature areas. Following a preliminary favourable decision, the local branch of the environmental NGO Friends of the Earth sought to challenge the decision. The organisation claimed that the decision violated the EU Habitat Directive in that the EIA of the project did not show that the power station was unlikely to have a significant effect on the protected nature areas. However, the NGO did not have legal standing to challenge the decision in the German administrative court. German law allows an administrative measure to be challenged only if it directly affects the claimant's public law rights. The German court decided to ask for a preliminary ruling by the ECJ on the matter.

In its ruling (Case C-115/09 Trianel Kohlekraftwerk Lünen 12/05/2011), the ECJ explained that an NGO has the right to challenge projects likely to have a significant effect on the environment. It considered German procedural laws counter to the objective of "wide access to justice" as laid down in the 1998 Aarhus Convention and in the EIA Directive as amended to implement the convention. Special rights are provided in the EIA Directive to environmental NGOs. They are considered to have sufficient interests and rights which may be impaired. In this case, the Habitat Directive and the national laws implementing it were alleged to have been infringed. According to the ECJ, this provided sufficient grounds for an NGO to have standing to pursue its claim in national courts.

Source: European Court of Justice.

Note

1. In political science and economics, the principal-agent problem refers to the problem of motivating one party to act on behalf of another. It arises when a principal compensates an agent for carrying out activities that are useful to the principal and costly to the agent.

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PART I

Chapter 3

Towards green growth

Germany has developed a range of environmental policies that support green growth. The use of economic instruments has been extended to improve pricing of environmental externalities and complement traditionally strict environmental regulations. This chapter examines Germany's use of taxation policy to pursue environmental objectives and progress in removing fiscal incentives that can encourage environmentally harmful activities. Opportunities to further "green" fiscal policy are also assessed. The chapter also looks at other pricing mechanisms to implement the polluter-pays and user-pays principles and to recover the cost of providing environmental services. This includes a discussion of public and private investment in environment-related infrastructure. The growth of an internationally competitive environmental goods and services sector is examined along with its potential to serve as a source of economic growth and jobs. Finally, the chapter reviews the international dimensions of Germany's environmental policy, with a focus on mainstreaming the environment in development co-operation programmes.

Assessment and recommendations

Germany has made major progress in establishing an environmental policy framework that is supportive of green growth. While strict technology-forcing regulations and standards remain at the core of German environmental policy, the use of economic instruments has been extended to improve pricing of environmental externalities. However, potential synergies among instruments have not been fully exploited. Further extending the use of environmentally related taxes (and other economic instruments) could make the tax system more growth-friendly if revenue is used to reduce more distortionary taxes such as those on labour and capital.

The ecological tax reform, implemented in 1999-2003, confirms this view. Revenue from increased energy taxation was mostly recycled to reduce social security contributions. Estimates indicate that this mechanism helped reduce energy consumption and greenhouse gas (GHG) emissions, while having positive employment and economic effects. A number of design features, however, have reduced the effectiveness of the reform. The eco-tax (*i.e.* the additional tax applied to the original excise duties) is neither based on the carbon content of fuels nor on other environmental externalities. The reform allows for several tax exemptions, in particular for coal products and export-oriented industrial sectors; this has resulted in areas of the economy not being subject to any GHG-related price signal (*i.e.* neither the eco-tax nor the CO_2 allowance price under the EU Emissions Trading System), as well as in some forms of double taxation or pricing. Finally, failure to adjust the tax rates for inflation has reduced their incentive effect. Since 2003, the overall increase in energy efficiency can be attributed more to higher global oil prices than to the incentive provided by the eco-tax. While total energy use has not declined, revenue from energy taxation has decreased since 2003. As a result, environmentally related taxes revenue has also declined. In 2009, it accounted for 2.3% of GDP and 6% of total tax revenue, slightly below the respective OECD Europe averages.

Germany relies less on vehicle taxation than most other OECD countries. The annual motor vehicle tax has not provided sufficient incentives to renew the car fleet towards more efficient and less polluting cars. In 2009, the tax was restructured to promote a shift towards cars with lower CO_2 emission levels. However, the CO_2-related component accounts for a relatively low share of the tax, which, in turn, represents a minor share of the total costs of vehicle ownership and use. This suggests that the incentive provided by the new tax remains relatively weak. On the other hand, the emission-based highway toll for heavy goods vehicles has helped increase the uptake of low-emission freight vehicles. However, it is not applied to light duty vehicles or to passenger cars. In addition, incentives that encourage private car ownership and use, and hence emissions of GHGs and air pollutants, remain in place. These include the preferential tax treatment of company cars and the commuting allowance.

Overall, Germany spends large amounts on support measures that have a potentially negative impact on the environment. These were estimated at EUR 48 billion (1.9% of GDP)

in 2008. Germany has made progress in cutting direct subsidies to coal production with a view to gradually phasing them out by 2018. Nevertheless, support to production and consumption of fossil fuels accounts for a large part of environmentally harmful subsidies and runs contrary to Germany's ambitious climate change policy. Much of this support goes to energy-intensive sectors, often in the form of tax exemptions. Germany's public finances, and the cost-effectiveness of its environmental policy, would greatly benefit from the reform of support measures with perverse environmental effects.

The government started to reduce some of these exemptions and introduced new environmentally related taxes (*e.g.* the air travel tax) in the framework of its fiscal consolidation programme for 2011-14. Prior to this, public finances had deteriorated, partly due to the fiscal stimulus launched to address the 2008-09 economic crisis. While Germany's stimulus package was smaller than in other G7 countries, its environment-related share was relatively large. Increased investment in energy-efficient buildings and innovative transport, and the above mentioned revision of the vehicle tax, were measures intended to promote a low-carbon economy. The package also included a car scrapping programme, which helped stabilise production and employment in Germany's large automobile industry. However, it could have been designed to provide better environmental outcomes.

Over the past decade, investment in traditional environmental domains declined while environment-related financing became more focused on climate change mitigation. In both the water and waste sectors, investment, operation and maintenance costs are mostly borne by consumers through water and waste charges, in line with the user-pays principle. This has allowed greater participation of the private sector; most providers of water and waste services now involve private operators in some form. However, there are some concerns about insufficient transparency in setting water tariffs, potential inefficiencies of water utilities, and the related impacts on water prices. Electricity consumers have also been the primary financier of increased investment in renewable energy. The government also provided investment grants and soft loans through the development bank, KfW, to leverage private investment in energy saving and renewable energy.

Water and waste pricing, together with strict regulations, have provided incentives for reducing water consumption and municipal waste generation, and for increasing waste recycling and recovery. Water abstraction fees are in place in several, but not all, *Länder*. The existing wastewater charges could be made more effective by adjusting their scope and level. The implementation of some extended producer responsibility systems (*e.g.* waste electrical and electronic equipment) could also be improved to enhance waste prevention. The use of economic instruments could also be broadened to help reduce the environmental impacts of agriculture and to strengthen, *inter alia*, biodiversity conservation. Such measures could provide potentially large gains in cost-effectiveness compared to indirect payments or regulatory approaches.

Germany's emphasis on technology-forcing environmental policies has helped generate new domestic and export markets in the environmental goods and services (EGS) sector. The Federal Statistical Office estimated the turnover of the EGS sector at about 2% of GDP in 2009 with the development of renewable energy sources being the main growth engine. Most EGSs were sold on the domestic market, while manufacturing of renewable components was more export-oriented. As conventional industries are increasingly

implementing environmental technologies and improving energy and resource efficiency, defining the scope of the EGS sector has become more complex. Using a broader definition, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety came up with an estimate of the EGS market size almost three times as large as that of the Federal Statistical Office. Clarification of the correspondence of these definitions would help inform the debate on the economic impacts of environment-related policies and on the economic opportunities associated with the EGS sector. Technological progress and productivity gains will be key factors in Germany maintaining its global competitive advantage in the EGS sector.

In 2010, Germany was the fourth largest provider of Official Development Assistance (ODA). Over the previous decade, ODA increased significantly from 0.27 to 0.38% of gross national income (GNI). However, Germany fell short of its 2010 target of 0.51% of GNI and further efforts are needed to attain the target of 0.7% by 2015. Bilateral aid for the environment more than tripled in the same period, reaching nearly half of the (screened) sector-allocable aid in 2008-09, a very high percentage compared to other countries participating in the OECD Development Assistance Committee. Climate protection gained further prominence. In 2008-09, Germany was the second largest donor of both bilateral and multilateral climate-related assistance. This support will continue to increase following the pledge made at Copenhagen to provide fast-start climate financing. In addition to public finance, Germany has pioneered innovative instruments for leveraging and mobilising private capital. It has also consistently supported access to water and sanitation: since 2000, bilateral aid has increased by 46% and Germany provided the largest imputed multilateral contribution to the Water and Sanitation sector in 2008-09. Nevertheless, striking a balance between the current emphasis on climate change and supporting other environment and development priorities is a challenge. As from 2011, all ODA projects are systematically subject to a Joint Environment and Climate Assessment at both strategic and operational levels.

Recommendations

- Consider creating an effective carbon tax in the sectors not covered by the EU Emissions Trading System and ensure that other, non-carbon related, externalities are adequately priced.
- Reduce perverse incentives for car use by revising the tax treatment of company cars and the commuting allowance; consider extending the current system of road tolls to light duty vehicles and eventually passenger cars; consider adjusting the rates of the annual motor vehicle tax and complementing it with a vehicle purchase tax.
- Introduce a mechanism to systematically screen existing and proposed subsidies against their potential environmental impact, with a view to phasing out environmentally harmful and inefficient subsidies.
- Strengthen the incentive effect of wastewater charges and promote water abstraction fees in all *Länder* and all sectors, including mining; consider introducing taxes on agricultural inputs.
- Strengthen coherence between agriculture and water policies, including by: ensuring effective cross-compliance with environmental requirements (Pillar 1 of agriculture payments); and expanding nature protection payments (Pillar 2 payments).

Recommendations *(cont.)*

- Reinforce the benchmarking of water utilities to increase their efficiency, as well as the transparency of tariff setting.
- Strengthen waste prevention, for instance by: broadening and strengthening extended producer responsibility systems; expanding the use of economic instruments to promote primary resource substitution (*e.g.* incineration tax); and expanding knowledge networks and dissemination of best practices.
- Maintain a strong, balanced commitment to environment within an expanded volume of official development assistance, in line with international commitments.
- Continue to provide international leadership on climate-related development assistance including by promoting innovative instruments for leveraging and mobilising private capital.

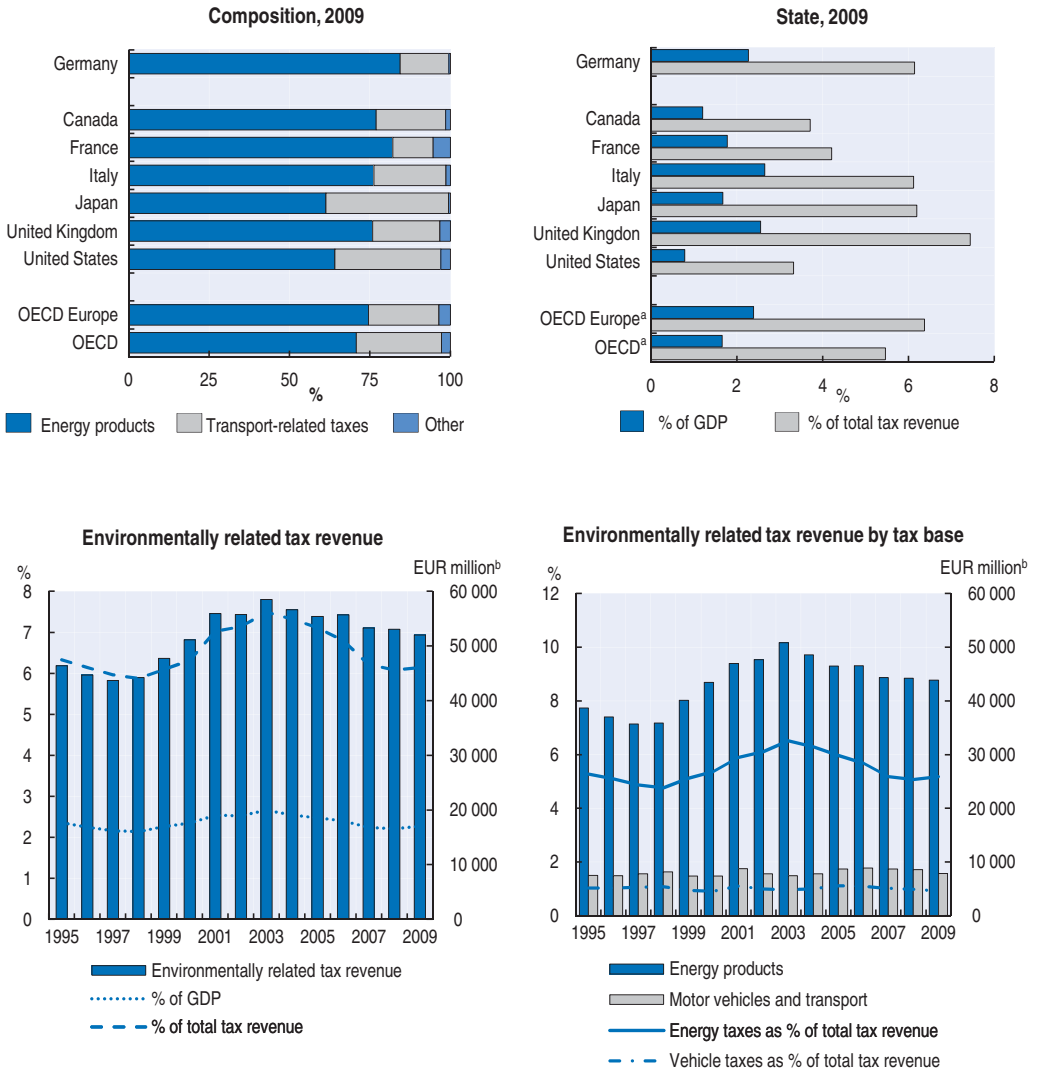
1. Greening the tax system

Germany has made significant steps in extending the use of taxes to improve pricing of environmental externalities. The steps include the 1999-2003 ecological tax reform and the 2009 restructuring of vehicle taxation on the basis of vehicles' CO_2 emission performance. These taxation measures can be seen as part of a broader package including other market incentives for environmental policy, such as participation in the EU Emissions Trading System (EU ETS), the use of emission-based road tolls for heavy goods vehicles (HGVs), the removal of some environmentally harmful subsidies and the introduction of feed-in tariffs to support electricity generated from renewable sources. Some commentators have argued that this package could be considered a "green budget reform" (Görres, 2006; OECD, 2011a), although the measures were introduced at intervals and not in a co-ordinated manner. The lack of an overarching policy reform framework is one reason for some inconsistencies and hence inefficiencies in the policy mix. Synergy among instruments has not been fully exploited, as the following sections explain.

As in all other OECD countries, environmentally related taxes largely coincide with taxes on energy products and vehicles. In Germany, in 2009 most environmentally related tax revenue (84.5%) came from energy taxation, including transport fuels and electricity; 15% was generated by the motor vehicle tax and about 0.5% by other taxes, such as hunting and fishing taxes. Energy taxes accounted for a larger share of environmentally related tax revenue than the average in the OECD (Figure 3.1). Revenue (in real terms) rose sharply between 1999 and 2003 as a consequence of the progressive increase in energy taxation. However, real revenue has since decreased by about 11%: the slight increase in revenue from vehicle taxes has only partly compensated for the strong decline in revenue from energy taxes (Section 1.1). Environmentally related taxes have declined as a share of GDP and total tax revenue. In 2009, environmentally related tax revenue accounted for 2.3% of GDP and 6% of total tax revenue, slightly below the respective OECD Europe averages (Figure 3.1).

Germany should consider further extending the use of environmentally related taxes. Such taxes should be introduced in clearly defined stages so the economy can adapt to changes in relative prices. Distributional impacts (*e.g.* on low-income households) should be addressed by means of targeted social support. The country's experience with the

Figure 3.1. **Environmentally related taxes**



a) Weighted average.
b) At constant 2005 prices.
Source: OECD/EEA Database on instruments used for environmental policy; OECD (2010), *OECD Economic Outlook No. 88.*

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eco-tax reform, while to a certain extent incomplete, shows that environmentally related taxes can make the tax system more growth-friendly if revenue is used to reduce more distortionary taxes such as those on labour and capital (Section 1.1). Germany's tax system remains skewed towards labour, notably because of the still high social security contributions (OECD, 2012). In addition, increased revenue from such taxes could contribute to the government's fiscal consolidation efforts (Section 5.1).

Steps have been taken in this direction with the introduction of taxes on nuclear fuel and air travel as part of the 2011-14 fiscal consolidation package. Germany's unique nuclear fuel tax is an excise duty on nuclear fuel used for power generation.[1] The air travel tax is applied to tickets for passenger flights departing from German airports, with rates depending on the flight distance.[2] The interaction of this tax with the EU ETS, which includes the aviation sector as from 2012, needs to be considered.

1.1. Energy taxation and the eco-tax reform

The ecological tax reform (*Ökologische Steuerreform*) was introduced in 1999 with the objectives of mitigating CO_2 emissions, providing incentives for job creation and boosting innovation. It introduced a tax on electricity consumption and gradually increased the excise duties on fossil fuels between 1999 and 2003 (Table 3.1). The tax rates have remained virtually unchanged since then. A key feature of the eco-tax reform was the use of about 90% of energy tax revenue to lower payroll contributions by employers and employees. A small share of tax revenue was recycled to support renewable energy.[3] A second feature was the provision of generous eco-tax exemptions for energy-intensive manufacturing sectors exposed to international competition (see below for further discussion). This meant that small manufacturing businesses and the residential, commercial, public services and road transport sectors mainly bore the cost of the eco-tax.

As a result of the reform, revenue from energy taxation rose by 27% in real terms between 1999 and 2003, and from 5.1% to 6.5% as a share of total tax receipts (Figure 3.1). The deflated implicit tax rate (ITR) on energy,[4] which measures taxation per unit of fuel used, also increased sharply, in line with the increases in tax rates and in revenue (Figure 3.2). While the taxation burden on energy increased, that on labour income, measured by the ITR on labour,[5] decreased (although to a much lesser extent), which partly offset the impact on businesses and households. Overall, despite the increase in energy tax revenue (and overall environmentally related tax revenue) until 2003, the tax-to-GDP ratio declined (Figure 3.2).

Estimates indicated that the decrease in social contributions by employers and employees had positive employment and economic effects, of the order of 250 000 jobs and +0.5% of GDP by 2003, compared to a reference scenario without the eco-tax reform (Görres, 2006; Knigge and Görlach, 2005). Overall, the net cost of the reform to the economy was estimated at EUR 0.3 billion in 2002 and EUR 12 billion in 2003, well below the additional energy tax revenue (EUR 18.7 billion in 2003). The work-intensive service sector benefited from a lower tax burden (Knigge and Görlach, 2005). The net burden, taking into account the value of the revenue recycling of social security contributions and the tax-induced energy efficiency measures, was estimated at below 2% of gross operating

Table 3.1. **Eco-tax reform schedule**

Tax base	Original tax	Stages of reform				
		1999	2000	2001	2002	2003
Electricity (EUR cents/kWh)	–	1.02	1.28	1.54	1.8	2.05
Transport fuels (EUR cents/litre)						
Diesel	31.7	34.77	37.84	40.91	43.98	47.04
Petrol	50.11	53.18	56.25	59.32	62.39	65.45
Natural gas	6	7	7	8	8	8
Liquid gas	6	7	7	7	8	8
Heating fuels						
Light heating oil (EUR cents/litre)	4.09	6.14	6.14	6.14	6.14	6.14
Heavy heating oil (EUR cents/kg)	1.53	1.53	1.79	1.79	1.79	2.5
Natural gas (EUR cents/kWh)	0.18	0.344	0.344	0.344	0.344	0.55

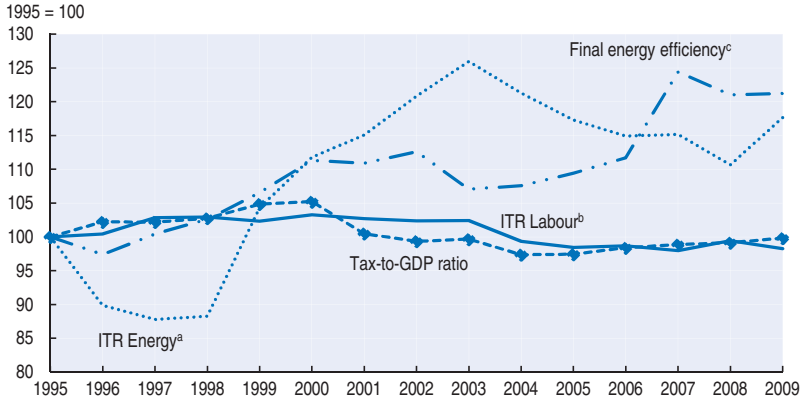
Source: BMU (2004).

surplus for the most negatively affected sectors (ferrous and non-ferrous metals). Estimates indicated a burden of about 1% of gross operating surplus for other energy-intensive industries such as glass and cement (Andersen *et al.*, 2007).

Between 1999 and 2003, final energy use fell by 8.6% in transport and by 3.5% in the residential sector, possibly due to the incentive provided by the eco-tax reform. On the other hand, energy use in industries, many of which were shielded from the energy tax rise, continued to increase. An analysis by Ecologic and the German Institute for Economic Research (DIW) indicated that the reform helped decrease Germany's CO_2 emissions (Chapter 5) and improve the market penetration of energy-saving technologies (Ludewig *et al.*, 2010). Air emissions from transport also decreased partly as a consequence of the reform.

Final energy efficiency (or GDP generated per unit of energy used) improved in the first years of the eco-tax reform implementation, but less than in previous years (Figure 3.2). It returned to the 1999 level in 2003, when tax rate adjustments ended, and rose at a higher rate between 2003 and 2007. The decrease in consumption of the taxed energy products, especially transport fuels, was mainly due to soaring world market oil prices rather than to the energy-saving incentive provided by the eco-tax. Other factors underlying increased energy efficiency include the introduction of HGV road tolls and participation in the EU ETS (Section 3; Chapter 5). The consumption share of diesel, which is taxed at a lower rate than petrol, also grew (see below). All this resulted in a decline of revenue from energy taxation; by 2009, the share of energy taxes in total tax receipts had returned to 1999 levels (Figure 3.1). Overall, the taxation burden on energy use has declined since 2003: the decline of the deflated ITR on energy indicates that revenue from energy taxation decreased faster than final energy consumption, mainly due to the lack of adjustment of tax rates to inflation and the introduction of further tax exemptions (Figure 3.2).

Figure 3.2. **Implicit tax rates on energy and labour**



a) The implicit tax rate (ITR) on energy is the ratio between the revenue from energy taxes (2000 prices) and final energy consumption.
b) The ITR on labour is the ratio between the revenue from taxes on labour income and social contributions and overall compensation of employees.
c) Final energy efficiency is the ratio between GDP (2000 prices) and total final energy consumption; it is the inverse of final energy intensity.
Source: EC (2011), *Taxation trends in the European Union;* OECD-IEA (2011), *Energy Balances of OECD Countries;* OECD (2010), *OECD Economic Outlook No. 88.*

StatLink http://dx.doi.org/10.1787/888932591767

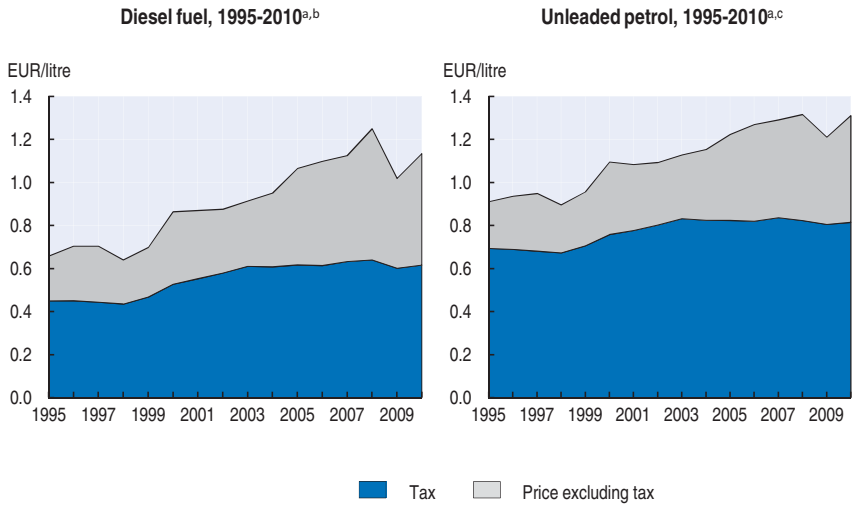
Some design issues of the eco-tax reform have undermined its cost-effectiveness. First, tax rates do not adequately reflect environmental externalities. They vary by energy source and user group, reflecting concerns about competitiveness and distributive impact rather than cost-effectiveness (Kohlhaas, 2000). For example, when expressed per tonne of carbon, variations of tax rates are often difficult to justify from an environmental perspective (Chapter 5). The eco-tax rates (*i.e.* the additional tax applied to the original excise duties) on fuel oils for heating have usually been lower than the average emission allowance price under the EU ETS, which had hovered around EUR 15-20 per tonne of CO_2 for most of the second trading period (since 2008), before plummeting to below EUR 10 in late 2011. Hence, they have not reflected the value of CO_2 emissions, let alone that of other environmental externalities such as air pollution generated by fossil fuel combustion.

On the other hand, as everywhere in the OECD, fuels for transport are taxed at a much higher level than fuels for stationary combustion. Additional negative externalities related to the transport sector, such as noise, accident and congestion, could justify the higher rates, although excise duties are not well designed to address such externalities. In particular, diesel is taxed less than petrol (Table 3.1), but it has a higher carbon content than petrol, and diesel-powered vehicles generate higher levels of nitrogen oxides and fine particles than comparable petrol-fuelled vehicles. The higher vehicle tax applied to diesel passenger cars is an inadequate substitute for the reduced fuel tax, as shown by the increasing share of diesel cars in the fleet (Section 1.2; Chapter 5). Revenue losses resulting from the favourable tax treatment of diesel are considerable: the Federal Environment Agency (UBA) quantified such losses at EUR 6.6 billion in 2008, or about 13% of the sum of environmentally harmful subsidies as calculated by the agency (UBA, 2011). All this argues in favour of bringing the diesel tax rate at least to the same level as that of petrol, although concerns about fuel tourism could make this difficult in practice. If diesel-petrol tax parity is achieved, the vehicle tax for diesel cars could be set at the same level as for petrol cars, as suggested by the UBA (Section 1.2). Overall, eco-tax rates should be based at least in part on the CO_2 content of the fuel taxed, with the CO_2 component made explicit so as to provide a clear price signal.

Another problem with the eco-tax is that its rates have remained virtually unchanged since 2003, undermining its incentive function. Combined with the increase in world market oil prices, this has resulted in a declining share of taxation in fuel prices. For example, after having increased in the early 2000s, the share of taxes in prices decreased from 74% in 2003 to 62% in 2010 for petrol and from 67% to 54% for diesel (Figure 3.3). Nevertheless, the share of taxes in transport fuel prices remains among the highest in the OECD. While the eco-tax rates were initially set at levels too low to induce substantial energy savings, their scheduled increases in the first years of the reform allowed the economy to adjust gradually to the change in relative prices (Kohlhaas, 2000). Continued adjustments would have sent clear price signals and helped maintain the energy tax as a stable revenue source. However, as in many countries, world oil price increases made such adjustments politically difficult. Some form of tax indexing, therefore, merits consideration.

Finally, a number of exemptions and partial derogations were granted to some fuels (notably coal) and economic sectors, mostly agriculture and energy-intensive manufacturing. While some tax exemptions have recently been made less generous, most of them are still in place (Section 2). They have distorted the price signal given by the eco-tax. As a result, existing low-cost abatement options have not been sufficiently

Figure 3.3. **Road fuel prices and taxes**



a) At constant 2005 prices.
b) Automotive diesel for non-commercial use.
c) Unleaded premium (RON 95)
Source: OECD-IEA (2011), *Energy Prices and Taxes*.

StatLink http://dx.doi.org/10.1787/888932591786

exploited (OECD, 2012). Exempted sectors have tended to postpone the necessary adjustments and investments despite their substantial potential for energy savings. For instance, the energy intensity of industrial production (ratio of industrial energy consumption to industrial production), which decreased moderately during the first years of the eco-tax reform, has declined much more significantly since 2003 with the increase in pre-tax market energy prices. Also, energy use in the agriculture and forestry sectors has increased: in 2009 it was 6% above the 2000 level, while agricultural production increased by 4% in the same period.

Exemptions and tax relief were intended to mitigate the impact of the eco-tax on energy- and capital-intensive sectors (such as chemicals and iron and steel), which could have been hit harder by energy taxation than other sectors and benefited less from cuts in social contributions (Kohlhaas, 2000). While concerns about international competitiveness are legitimate, the risk of reduced competitiveness in some exempted enterprises is likely to have been overstated (OECD, 2012). As the 2012 OECD Economic Survey of Germany suggests, competitiveness concerns need to be addressed by means of payments or refunds that are not proportional to the level of energy consumption, so that incentives for energy savings and emission reductions are maintained (see also Section 2).

1.2. Vehicle taxes

Germany relies less on vehicle taxation than most other OECD countries. Vehicle taxes accounted for about 0.35% of GDP and 1% of total tax revenue in 2009, and have hovered around these levels since 2000. Germany is one of the few European countries that do not apply a tax on vehicle purchase or registration. Instead, an annual motor vehicle tax has long been in place.

Until 2009, the motor vehicle tax was based on vehicles' cylinder capacity and emissions according to Euro standards, with higher rates for diesel-powered vehicles and

those without particle filters. However, the average engine size of newly registered passenger cars continued to increase. Cars in Germany tend to be bigger and more powerful than in many other European countries. There has been only a marginal shift of the fleet towards smaller vehicles. This phenomenon is linked to the relatively low level of taxation and tax differentiation across car types, as well as to the large number of company cars, which tend to be larger and to have above-average fuel consumption (Kalinowska *et al.*, 2009; UBA, 2011; see also Section 2). Also, the share of diesel cars in sales has steadily increased, from 30% in 2000 to 44% in 2008 (ACEA, n.d.). It is therefore likely that fuel taxes and prices influenced vehicle purchase decisions more than vehicle taxes. Still, the shift to diesel cars, along with technology advances, helped improve the fuel efficiency of the fleet and reduce greenhouse gas (GHG) emissions from road transport, even if the vehicles were bigger (Chapter 5). The Euro vehicle standards helped reduce new cars' average emissions of local air pollutants and overall transport-related emissions (Chapter 1). In addition, a subsidy for retrofitting in-use diesel cars with particulate filters has been granted since 2006 and contributed to the retrofitting of about 500 000 cars in 2007-09 (BMU, 2010).[6] This incentive was extended to light commercial vehicles in 2010 and relaunched in 2012.

In July 2009, the annual motor vehicle tax was restructured to include a CO_2 component in addition to cylinder capacity, with the aim of reducing per-vehicle CO_2 emissions. The CO_2 tax is proportional to emissions (above a certain threshold).[7] In line with recommended practice, the CO_2 component of the tax is not differentiated according to fuel type, but the cylinder capacity part is nearly five times higher for diesel vehicles than for petrol vehicles because the former have a greater impact on local air pollution.[8]

The CO_2-based differentiation of vehicle taxation can provide car owners with an incentive to choose low CO_2 emission vehicles, thereby affecting fleet composition. In addition, recurrent taxes, such as the German annual vehicle tax, can, in principle, provide stronger incentives to change cars, since they must be paid annually rather than only at the moment of purchase (OECD, 2009a). While evidence to this effect is limited,[9] Vance and Mehlin (2009) found that German car owners take into account the lifetime costs of car ownership and use in their car purchasing decisions, implying that annual vehicle taxes, and even more so fuel costs (and taxes), significantly affect the composition of the car fleet. However, taxes on vehicle ownership are theoretically less efficient than fuel taxes and road charges in reducing GHG and air pollutant emissions since they are more removed from actual vehicle use.

OECD analysis suggests that in many countries the incentive to abate CO_2 emissions that is implicit in vehicle taxation is disproportionally strong compared to incentives provided in other sectors of the economy (*e.g.* those covered by the EU ETS). In this respect, the implicit incentive provided by Germany's vehicle taxation appears to be more balanced than those in many other OECD countries (OECD, 2009b).[10] However, it also appears to be relatively weak. For instance, the motor vehicle tax decreased on average through the reform (Ludewig *et al.*, 2010). The absolute amount of the vehicle tax remains small compared to the total cost of vehicle ownership and use, ranging from 1% to 5%. Furthermore, the CO_2-related component accounts for a relatively low share of the tax and, while the tax differential across vehicle categories is higher under the new system, it remains among the lowest applied in European countries (Kalinowska *et al.*, 2009). Vehicles registered before the tax reform remain subject to the old annual tax until 2013, which may also undermine the incentive to change cars.

It is too early to assess the impact of the new tax, especially because car sales in 2009-11 were heavily influenced by the economic crisis and the car scrapping incentive launched in 2009 as part of the stimulus package (Section 5.1). The car scrapping programme led to a shift towards smaller and less powerful cars, although this trend was quickly reversed as soon as the subsidy was removed. While these effects are typical of such incentive programmes, the shift back to bigger and more powerful cars in 2010 (ACEA, n.d.) was swifter than in other countries with similar programmes (Box 3.1). This fact suggests that the new CO_2-based vehicle tax rates are too low to provide an incentive towards smaller, more fuel-efficient vehicles. This could be addressed by adjusting the rates of the annual tax and complementing it with a moderate registration or purchase tax also based on CO_2 emission performance.

Box 3.1. **The 2009 car scrapping programme**

The automobile industry plays a very significant role in the German economy. In 2010, it accounted for more than 20% of the total turnover, and 14% of the employment, of German industry (VDA, 2011). The industry was expected to suffer heavily from the global economic crisis in relation to both domestic and external demand. In the last quarter of 2008, sales of passenger cars dropped by 11% on a year-to-year basis (IHS, 2010). As part of its fiscal stimulus package, in 2009 the government launched a car scrapping programme with the objective of stabilising the German automobile industry's production and employment. The programme granted a fixed payment of EUR 2 500 to any private consumer who purchased a new or used car (up to 14 months old) to replace a car over nine years old. The only environmental requirement was that the purchased vehicles should at least comply with the Euro 4 emission standard; however, this requirement had been mandatory for all new car registrations in the EU since 2005. Nevertheless, the programme was named *Umweltprämie* (eco-premium) to emphasise the expected positive side-effects of fleet renewal on GHG and air pollutant emissions (IHS, 2010). The programme budget was EUR 5 billion, enough to support the purchase of 2 million cars. In addition, a vehicle tax rebate was granted for new vehicles meeting Euro 5 or Euro 6 standards.

The programme was effective in supporting short-term demand for new cars: new registrations from January to November 2009 were 25% higher than in the same period of the previous year, boosting GDP by 0.15% (IHS, 2010). The programme spurred renewal of the car fleet: vehicles scrapped were more than 14 years old, on average. There was also a shift towards smaller cars, although sales of middle-size cars also increased. For the first time in 15 years, the average engine size and power output of cars sold in Germany sharply decreased, as did the share of newly registered diesel cars. Due to the fixed payment, the scrapping incentive favoured demand for small, cheaper cars; in addition, sales of company cars (which tend to be larger and diesel-powered) dropped because they did not benefit from the subsidy. These trends were reversed in 2010 with the phase-out of the subsidy, as had been expected, but the reversal was swifter than in other countries that implemented similar programmes, such as France and Italy (ACEA, n.d.).

Box 3.1. **The 2009 car scrapping programme** *(cont.)*

About 98% of the scrapped cars were in compliance with the Euro 2 emission standard or below. Average carbon efficiency of new registered cars also improved, reaching 155 g CO_2/km, compared to 160 g CO_2/km in a business-as-usual scenario (IHS, 2010). Hence, the programme helped reduce CO_2 and air pollutant emissions on a per-vehicle basis. Estimates of total CO_2 emission savings vary widely. IHS (2010) estimates 540 kt CO_2 saved in 2009 (equivalent to 0.35% of CO_2 emissions from transport in 2009 or to 88% of the emission reduction in the transport sector in 2009) and 351 kt CO_2 in 2010. ITF (2011) estimates a lower impact in 2010 (66 kt CO_2 saved or 0.04% of 2009 transport emissions) and a cumulative impact of a 200 kt CO_2 emission reduction to 2030. According to the latter analysis, more lighter and smaller vehicles were scrapped and traded in for medium-sized vehicles than *vice versa*, even though the number of new small cars purchased was above the average of previous years. This reduced the total positive impact. The cost-effectiveness of the programme in achieving the quantified CO_2, NO_x and safety benefits is modest: the benefits represent only around 25% of the estimated cost. The introduction of a CO_2 emission or fuel efficiency requirement, as in the French and US programmes, would have helped increase cost-effectiveness.

Overall, the scrapping programme had some positive stimulus and spillover effects. However, as in other countries with similar programmes, from a medium- and long-term perspective, the economic and environmental benefits were limited (Pollit, 2011). The main effect of scrapping incentives is to advance car purchases, which often results in lower than average sales in future years, once the programme is phased out. Such programmes create market distortions that can prevent necessary structural adjustments and discriminate among manufacturing sectors and consumers, for instance to the disadvantage of low-income households that cannot afford new cars. From an environmental perspective, such programmes are not a cost-effective way to reduce GHG and air pollutant emissions; in addition, the environmental impact over the whole lifecycle of a vehicle should be considered, including, for example, increased demand for steel and disposal of end-of-life vehicles (OECD, 2010a).

2. Removing environmentally perverse incentives

Germany spends large amounts on support measures that have a potentially negative impact on the environment. The UBA, which regularly reviews federal subsidies, estimates that in 2008, EUR 48 billion (1.9% of GDP) in subsidies had negative primary or secondary effects on the environment (Table 3.2).[11] This is comparable to the revenue from energy taxes. Many long-time subsidies are no longer justified on economic or social grounds (UBA, 2011). In general, they contravene the polluter-pays and user-pays principles, distort competition, lock in inefficient technology and lead to inefficient allocation of resources. As direct transfers or various forms of tax breaks, subsidies weigh on current public finances, and can entail additional future expenditure to remediate the potential environmental and health damage. Germany's public finances, and the cost-effectiveness of its environmental policy, would greatly benefit from the reform of support measures with perverse effects. A systematic screening of existing and proposed subsidies against their potential environmental impact could facilitate such reform.

Table 3.2. **Environmentally harmful subsidies in Germany, 2008**

Sector		Environmental asset						
	EUR million	Climate	Air	Water	Soil	Biodiversity and landscape	Health	Resources
1. Energy supply and use								
Reductions in electricity and energy taxes for manufacturing, agriculture and forestry	2 415	*	*	**	**	**	*	*
Peak equalisation regime for eco-tax in the manufacturing sector	1 962	*	*	**	**	**	*	*
Tax reduction for certain energy-intensive processes and techniques	886	*	*	**	**	**	*	*
Coal subsidies	2 454	*	*	*	*	**	*	*
Privileges for the lignite industry	min. 195	*	*	*	*	*	*	*
Energy tax reductions for coal	154	*	*	**	**	**	*	*
Manufacturer privilege for producers of energy products	270	*	*	**	**	**	*	*
Energy tax exemption for non-energy uses of fossil fuels	min. 1 600	**	**	**	**	**	**	*
Free allocation of CO_2 emission trading allowances	7 783	*	*	**	**	**	*	*
Subsidies for nuclear power	n.q.	**	**	**	**	**	*	*
2. Transport								
Energy tax reduction for diesel fuel	6 633	*	*	**	**	**	*	*
Distance-based income tax deduction for commuters	4 350	*	*	**	*	*	*	*
Exemption of kerosene from energy tax	7 232	*	*	**	**	**	*	*
Energy tax exemption for inland waterway transport	118	*	*	**	**	**	*	*
VAT exemption for international flights	4 237	*	*	**	**	**	*	*
Flat-rate taxation of privately used company cars	500	*	*	**	*	*	*	*
Tax exemption for biofuels	n.q.	*	**	*	*	*	**	**
3. Construction and housing								
Home ownership grant	6 223	**	**	*	*	*	**	*
Promotion of saving for building purposes	467	**	**	*	*	*	**	*
Promotion of social housing	518	**	**	*	*	*	**	*
Joint agreement for the improvement of regional economic structures	n.q.	**	**	*	*	*	**	*
4. Agriculture, forestry, fisheries								
EU agricultural subsidies	n.q.	*	**	*	*	*	**	**
Joint agreement for the improvement of agricultural structures and coastal protection	n.q.	*	**	*	*	*	**	**
Tax rebate for agricultural diesel	135	*	*	**	**	**	*	*
Exemption of agricultural vehicles from vehicle road tax	55	**	**	**	*	**	**	**
Subsidies for production of spirits	80	*	**	*	*	*	**	**
EU fishery subsidies	n.q.	*	**	*	*	*	**	**
Total	**48 267**							

n.q.: not quantifiable; *: Primary effects; **: Secondary effects.
Source: UBA (2011).

2.1. Energy subsidies

Support to production and consumption of fossil fuels accounts for a large part of environmentally harmful subsidies. For 2008, estimates vary between EUR 7.5 billion and EUR 24 billion, depending on the methodology used and the kind of subsidies included (OECD, 2011b; UBA, 2011).[12] Much of this support goes to energy-intensive sectors and coal, often in the form of tax exemptions, such as the exemptions from the eco-tax (Section 1.1).

In particular, coal is virtually tax-free, and tax rates are reduced for heating fuels. As in many other countries, aviation fuel is also exempt, though the government introduced an air travel tax in 2011 (Section 1.1). Under the so-called peak equalisation regime, many energy-intensive manufacturing sectors and those exposed to international competition benefit from a 90% refund of the eco-tax payment that exceeds the relief on social contributions. Exemptions were further extended in 2006 so that specific energy-intensive processes in the steel and chemical sectors are totally exempt from energy taxation (OECD, 2011b). In addition, the manufacturing, agriculture and forestry sectors pay reduced rates on electricity and heating fuels. In many cases, these exemptions are granted to businesses that are not exposed to strong international competition (UBA, 2011). Such tax benefits reduce energy prices, thereby encouraging energy use and reducing incentives to adopt energy-efficient technology, with negative implications for GHG emissions. Also, they distort competition among energy sources and can favour the use of dirtier fuels.

Some tax exemptions have recently been made less generous (OECD, 2012). For example, the German fiscal consolidation package for 2011-14 includes the reduction of some eco-tax and energy tax exemptions.[13] Relief for energy-intensive firms will be conditioned on investments in energy savings from 2013 onwards. However, many of these exemptions remain unjustifiable on economic grounds and should be phased out. Tax breaks should only be used to avoid double taxation/pricing. For example, companies participating in the EU ETS face a carbon price and should not be subject to the part of the eco-tax or energy tax that is clearly referable to CO_2 emissions (Chapter 5). If needed to preserve industry competitiveness, the tax benefits could be replaced by better targeted public support, ideally linked to energy savings (OECD, 2012).

Coal production is supported through direct subsidies covering the difference between production costs and the world market price of coal exports. Germany has made progress in cutting these subsidies with a view to gradually phasing them out by 2018. Subsidies to hard-coal mining fell from EUR 4.9 billion in 1999 to EUR 2.1 billion in 2009 (OECD, 2011b). Yet coal subsidies, including the support for coal use, remain substantial and run contrary to Germany's ambitious climate change policy (Chapter 5). As the OECD (2012) suggests, Germany should consider accelerating the phase-out of coal subsidies and use active labour market policies to facilitate labour mobility and promote employment in traditional mining regions.

Since 2007, Germany has promoted the use of biofuels through mandatory blending quotas and with partial tax exemptions for first-generation biofuels and total exemptions for second-generation ones. This kind of support is common to many other European countries. It has led to dramatic growth in biofuel consumption and helped reduce GHG emissions from road transport. However, the cost of abating a tonne of CO_2 by using biofuels is considerably higher than that of other abatement measures (Chapter 5). The tax revenue loss alone cost the budget EUR 580 million in 2008 (UBA, 2011). Nor does this take account of the cost associated with potential environmental damage to land and water linked to biofuel production (Table 3.2). Biofuel sustainability criteria have been in force in Germany since 2011, but it is too early to assess their impact.

2.2. Vehicle use

The tax treatment of personal road transport tends to encourage car use over public transport, as does the lack of tolls for passenger cars on German highways (Section 3). Company cars used for private purposes are taxed at a flat, low rate (1%), encouraging

employers to pay their employees partly in the form of a car. As a result, in 2008 30% of new car registrations in Germany were company cars, which tend to be bigger, more powerful and more polluting (UBA, 2011). This tax treatment should be made less advantageous and possibly differentiated on the basis of vehicles' CO_2 emission levels. Distance-based income tax deductions for commuters also promote use of cars and encourage workers to live further away from their place of work. Germany is one of the few European countries to have such a system in place. In addition to its cost for the public budget (Table 3.2), it is estimated that this system will account for 2 million tonnes of CO_2 emissions by 2015 (UBA, 2011). This concession should be revised by making the allowance not conditional on distance driven and/or linking it to environmental criteria (*e.g.* car fuel efficiency).

2.3. Housing and construction

Germany has traditionally supported the housing sector and home ownership through various subsidies (Table 3.2). Progress has been made in reducing these. In particular, the home ownership grant, a direct transfer to new homeowners, will be completely phased out by 2013. The subsidies have contributed to urban sprawl and to increasing land-take for settlement and transport infrastructure, with negative consequences for resource and energy use as well as traffic flows. Substantially reducing the conversion of undeveloped land for housing and transport is an objective in the National Sustainable Development Strategy. Germany should consider making any remaining support to home ownership and social housing conditional on environmental parameters, such as energy efficiency or use of existing buildings and built-up areas. The property tax could also be restructured to reflect environment-related criteria.

2.4. Agriculture and fisheries

Support to agriculture in Germany follows the rules of the EU Common Agricultural Policy. Support to EU farmers, as measured by the OECD Producer Support Estimate, declined from 33% of farm receipts in 2000-02 to 23% in 2007-09, broadly in line with the OECD average. Direct aid to farmers has been progressively untied from agricultural production and input use by shifting from production- to area-based subsidies (Single Farm Payment under Pillar 1): 44% of EU support to farmers in 2007-09 was based on output and input quantities, the forms of support that most encourage production, compared to about 65% in 2000-02. In particular, Germany adopted "compulsory modulation", *i.e.* cutting direct payments by 3% (2005), 4% (2006) and 5% from 2007 to 2012 and channelling the funds into subsidy programmes for the development of rural areas (including the agro-environmental programmes). Direct aid to farmers is also conditional on meeting environmental standards (cross-compliance) and adopting good farming practices (defined as levels of environmental quality to be achieved at farmers' own expense). Yet there are cases where support to farmers is linked to production and thus can negatively affect the environment. For example, in 2008 German companies received about EUR 100 million from the EU to export surplus agricultural products (UBA, 2011).[14] These subsidies are to be phased out by 2013. German farmers also benefit from reductions in input costs, with implications for the environment. These include tax concessions on diesel used in agriculture and vehicle tax exemptions for farm vehicles (Table 3.2). These benefits should be reviewed in the framework of a broader review of energy subsidies (Section 2.1).

The EU Common Fisheries Policy provides the framework for German support to fisheries. Government financial transfers to the fishing industry continued to decline in

recent years. They averaged about EUR 9 million per year in 2005-07, or about 3.5% of the value of the total catch from capture fisheries, well below the EU average. Direct aid to fishermen represented a minor part of total support to fisheries (OECD, 2010b). Like other EU countries, Germany provides subsidies to fishermen for fleet reduction (scrapping of vessels) and renewal of existing vessels, *e.g.* to improve safety and working conditions, promote use of more selective and environment-friendly gear and increase fuel efficiency. Aid is not linked to production or to investment in new vessels, which have the greatest potential to reduce fish stocks. Nevertheless, as in other EU countries, productivity gains due to renewal and modernisation of the fleet are likely to have offset measures to limit fishing efforts (OECD, 2011c).

3. Extending the use of pricing mechanisms

Germany has made progress in using non-tax pricing mechanisms to encourage more environmentally friendly behaviour and to recover the cost of water, waste and transport infrastructure (Section 5).

A significant change in Germany's approach to climate change mitigation, traditionally based on regulatory and voluntary instruments and financial assistance, was the launch of the EU ETS in 2005. It covers about 60% of total CO_2 emissions. A number of issues linked to the design of the EU ETS have been identified and will be addressed, to some extent, in the trading period starting in 2013. A key challenge for Germany is combining energy taxation (Section 1.1) and the EU ETS to provide a clear price signal across the economy. Currently, there are areas of the economy that do not face a price signal and others that are subject to double regulation. The interaction between the EU ETS and the feed-in tariffs for electricity generation from renewables should also be taken into account. When a carbon price exists, applying other policy tools can lead to overlap and undermine cost-effectiveness. These issues are analysed in more detail in Chapter 5.

In 2005, Germany launched an electronic toll system for heavy goods vehicles (HGVs) on the national highway network. Proceeds are used to finance road infrastructure. However, light-duty vehicles and passenger cars are not subject to the system; in practice, they are exempted from paying the costs of using road infrastructure, including the environmental costs. The toll is based on driving distance, number of axles and the vehicle's emission category. In 2009, the toll was raised and made more dependent on vehicle emission levels. This emission- and distance-based toll has provided incentives to renew the vehicle fleet towards less polluting HGVs and to improve efficiency of freight transport (*e.g.* better load factors) (Gustaffson *et al.*, 2007). Just in the first year after its introduction, the share of freight mileage accounted for by low-emission HGVs rose from 1% to 6%, with a corresponding reduction in distance driven by high-emission HGVs (Erdmenger *et al.*, 2010). A shift from road to rail has also been observed, although it was mainly triggered by fuel price rises (Gustaffson *et al.*, 2007; see also Figure 5.7). As some traffic diverted to toll-free roads, the system was extended to a few national roads. All this has helped reduce GHG and air pollutant emissions from transport (Chapters 1 and 5). Given the results achieved, extending the toll to roads other than highways and to all freight and passenger vehicles should be considered.

The polluter-pays principle is well anchored in municipal waste management. Waste charging systems have been used throughout the country for about two decades. They have helped reduce waste generation and increase recycling rates (Chapter 1). The systems

vary among municipalities, many of which apply fixed waste fees. There is room to further develop weight-based charging systems to promote waste minimisation. Hybrid systems, composed of a small fixed fee for the service provided and a variable fee depending on the amount collected, have proved the most effective in ensuring both environmental (waste reduction) and economic (revenue stability) benefits (Schlegelmilch *et al.*, 2010). Deposit-refund systems are also in place for some beverage containers. While the use of economic instruments is well established for municipal waste management, it is much less so for the management of other waste streams. Such instruments could help German waste management move up the waste hierarchy and provide better incentives for preventing and reducing waste generation. For example, a tax on primary construction materials, as applied in the UK, could strengthen incentives for recovery of secondary materials.

Germany's long-standing water pricing policy has been effective in reducing water demand (Chapter 1). While unit water tariffs paid by German households are relatively high, annual domestic water bills are comparable with those in other OECD countries (Box 3.2). However, there has been criticism that tariffs have been set in a non-transparent manner, which may have led to overcharging of consumers and inefficiency in utility operations. Household water use (including water used in small enterprises) declined from 129 litres per capita per day in 2000 to 122 litres per capita per day in 2009. This is one of the lowest per capita water consumption rates among OECD countries, though there are sizable differences between western and eastern *Länder*. Paradoxically, the lower water consumption, also due to demographic changes, has negatively affected water supply infrastructure, which was built on the basis of forecasts of higher water use.[15]

Wastewater charges are imposed on all direct discharges by local authorities (as operators of public wastewater treatment facilities) and by industrial and domestic wastewater treatment installations. Levies are based on effluent pollution level, expressed in units of toxicity. They are collected at *Land* level and proceeds are used to finance the preservation and improvement of water quality. The existing wastewater charges could be made more effective by adjusting their scope and level, however. Final customers' water bills also include wastewater fees to cover the cost of operating and maintaining wastewater treatment facilities. About 10% of utilities charge a fixed annual amount. In other cases, the wastewater fee is based on freshwater consumption and quality. A distinction between freshwater and precipitation water may also be made. On average, in 2010, consumers paid EUR 116 for wastewater treatment (BDEW, 2010). These charges, already in place for several decades, together with modernisation and construction of municipal and industrial wastewater treatment plants, have contributed to significantly reducing water pollution (Chapter 1).

Other than charges in the water sector, Germany has made little progress in using economic instruments for biodiversity conservation and sustainable use. Experience with payments for ecosystem services (PES) has been essentially limited to the so-called Natura 2000 payments provided for by the EU Common Agricultural Policy.[16] In line with the 2004 OECD Council Recommendation on the Use of Economic Instruments in Promoting the Conservation and Sustainable Use of Biodiversity, further consideration should be given to expanding the use of PES and other market-based instruments, as they can provide potentially large gains in cost-effectiveness compared to indirect payments or regulatory approaches (OECD, 2010c).

Box 3.2. **Water pricing**

The majority of households (97%) pay a two-component tariff for drinking water supply: a basic monthly charge (EUR 5.13 on average) designed to cover the fixed costs of maintaining the infrastructure, and a consumption-based charge (EUR 1.6 per cubic metre, excluding taxes), which is relatively high by OECD standards. Tariff levels vary by municipality. After substantial increases in the early 1990s (*e.g.* 11.7% in 1992-93), the rate of tariff increase was much slower between 2000 and 2010, at around 1.2% per year, and generally below the inflation rate. On average, in 2010, consumers paid EUR 82 per year for drinking water supply. Taxes and levies account for about 21% of drinking water prices, which is high compared, for example, to France and the United Kingdom.

In 11 out of 16 *Länder,* a resource fee is applied for groundwater abstraction for various purposes, such as drinking water, irrigation, mine draining, cooling and industrial use. The fee for abstraction for public water supply ranges from EUR 0.02 per cubic metre in Saxony to EUR 0.31 per cubic metre in Berlin. Utilities pass on this fee to consumers. The fee generates revenue of EUR 200 million to EUR 400 million per year, which is earmarked in some *Länder* for water management measures. In eight *Länder,* a fee is also applied for withdrawal of surface water.

About 99% of the capital and operational costs for drinking water, and 96% for wastewater treatment, are directly borne by consumers. The cost of water supply, including the fixed cost of the capital-intensive, high-quality infrastructure, has to be covered by fewer cubic metres of water sold than in many countries. This means German households pay relatively high unit tariffs, though annual domestic water bills are lower than in neighbouring countries.

Source: BDEW (2010).

4. Ensuring a consistent regulatory framework

As previous sections show, Germany has made progress in using market-based instruments for environmental policy. Yet it relies heavily on strict regulatory instruments and standards, which have helped stimulate the development and diffusion of cleaner technologies (Chapter 4). Voluntary instruments have also been used in some policy areas, such climate change, although their cost-effectiveness in achieving environmental targets remains open to question. German environmental legislation has developed over many years, to respond to specific environmental problems as well as to comply with EU directives. This pattern, together with the partial lawmaking autonomy of the *Länder*, has resulted in relatively fragmented legislation and in some implementation problems. Despite several attempts, including in 2009, no agreement has been reached on a comprehensive federal environment code. Nevertheless, the 2010 federal Acts on water and on nature conservation marked a key step in the direction of harmonising the legislative framework at federal and *Land* levels. Education and awareness-raising initiatives at all levels of government have helped build strong public support for ambitious environmental policies (Chapter 2).

The management of air emissions and air quality is well-established. German air management policy is fully consistent with EU policy and has often served as a model to develop it. The 1974 Federal Immission Control Act (1974) remains the framework air policy legislation,[17] supplemented by the Technical Instructions on Air Quality Control. Some economic instruments have been used to address air pollution from transport, such as

emission-based vehicle taxes and road tolls (Sections 1.2 and 3) and tax rates differentiated on the basis of motor fuels' sulphur content. As emissions from industry and transport have declined, policy attention has focused on addressing urban air quality through instruments such as low-emission zones (Chapter 5) and regulation of small stationary sources (Box 3.3).

Box 3.3. **Regulation of small stationary sources of air emissions**

Small firing installations in households and small companies are a major source of emissions of harmful substances such as fine particles and polyaromatic hydrocarbons. In 2010, the 1988 Ordinance on Small and Medium-sized Firing Installations was extended to cover smaller installations (from 4 kW to 1 MW of thermal power). The revised ordinance establishes emission limits for new installations, in line with best available technologies. It requires all existing stoves and boilers to be retrofitted with particulate filters or decommissioned by 2024 if emission standards cannot be met. Emission limits will be tightened from 2015 to reflect technology development. Compliance with the limit values is established either by a manufacturer's certificate or by on-the-spot measurements. Installations and fuel quality will be checked regularly within the framework of other monitoring tasks.

The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) estimated that the revised ordinance would reduce particulate emissions to 16 000 tonnes by 2025 from some 24 000 in 2005, equivalent to about a 50% decline compared with the "without amendment" scenario (31 000 tonnes in 2025). The revised ordinance is also important for addressing the trade-off between climate change and air pollution objectives that characterises the promotion of biomass-fired heating systems (Chapter 5): while generating heat (and electricity) from burning renewable fuels is expected to help reduce GHG emissions, emissions of hazardous air pollutants from such facilities are expected to increase unless more efficient technologies become more widely used.

The transposition of the EU Water Framework Directive in 2002 and the 2006 amendment to the Basic Law (Constitution) that enlarged legislative responsibilities at the federal level for water management, along with the adoption of the Water Act of 2010, led to a reorientation and reinforcement of German water policy. Ten river basin management plans have been developed with ambitious targets and stronger institutional arrangements, including more effective stakeholder involvement. Implementing these plans effectively and coherently, particularly at the *Länder* level, is a key challenge: 82% of surface water and 36% of groundwater bodies will not achieve the good status targets under the Water Framework Directive before 2015, also due to changes in rivers' hydromorphology. Many deadlines have been extended from 2015 to 2017 or 2027. A mix of regulatory and pricing measures (Section 3) has helped reduce pollution and water consumption (Chapter 1) and provide a robust financing framework (Section 5). Yet despite various measures, agricultural pollution continues to be a challenge, as indicated by the high nutrient surplus and slow compliance with the EU Nitrate Directive (Box 3.4).

With the approval of the National Strategy on Biological Diversity in 2007 and the revised Federal Nature Conservation Act in 2010, Germany consolidated its policy and legislative frameworks for biodiversity conservation and sustainable use. The new Act

Box 3.4. **Addressing water pollution from agriculture**

Structural reforms, including German reunification, have helped reduce pressures on water resources, for example by reducing the size of cattle herds. In addition, a range of policy measures has played a role. As a result, the number of samples detecting pesticides above the threshold value decreased by nearly 50% between 1996-2000 and 2006-08. However, the nitrogen surplus, at 100 kg per hectare of agricultural land, is still high, about 20 kg/ha higher than the objective established by the federal government for 2010. Even though the sales of nitrogenous fertilisers decreased during the review period, their use per hectare is still higher than the OECD Europe and OECD averages (Reference I.C). Despite various measures, about 75% of nitrate and 55% of phosphorous pollution originates from agriculture. A significant expansion of areas devoted to the cultivation of crops for biofuel is expected to intensify pressures. Policy measures that have helped reduce pressures on water resources include:

- The restructuring of subsidies under the EU Common Agricultural Policy to reduce environmental pressures (Section 2.4). In particular, under the cross-compliance mechanism, the standards to be met to receive payments include those under the EU Nitrate Directive and the EU Groundwater Directive.
- The 2007 amendment to the Fertiliser Act set a minimum distance to water bodies for fertiliser application, limited the application of animal-based fertilisers (to 170 kg of nitrogen/ha/year), limited the maximum area nutrient surpluses and set requirements on black-out periods and application of fertilisers.
- The 2010 Federal Water Act specified further requirements for buffer zones for use of pesticides and fertilisers near river banks.
- In a number of *Länder,* agricultural landowners and land users have long been part of farm management contracts with suppliers of drinking water, thereby committing themselves to use less polluting practices in exchange for financial compensation. Water suppliers are entitled to pass the costs of such payments on to final customers.

provides a nationwide legal basis and will help harmonise nature management across the *Länder*. Protected areas are at the core of Germany's nature management policy. They represent a larger share of the territory than in most other OECD countries (Reference I.C), although the form of protection is often weak (Nolte *et al*., 2010).[18] Germany still lacks nationally binding quality criteria to match international classifications of protected areas. As required by the EU, the Natura 2000 network, which covers more than 15% of land area, was completed in 2009. Landscape planning and an "impact regulation" have been applied for decades and remain key instruments for preserving nature and biodiversity in and outside protected areas.[19] Voluntary instruments have also been extensively applied, for example with farmers and tourism operators. However, indicators suggest that these measures have not been sufficient to achieve Germany's targets on biodiversity loss and land degradation (Chapter 1). Mainstreaming of biodiversity concerns in other policy areas, including agriculture, transport and climate change, remains insufficient.

Germany has been at the forefront of waste management policy. It was one of the first countries to adopt the principle of closed cycle material management. Germany banned the disposal of municipal waste in landfills from 2005. It was the first European country to adopt legislation establishing producer responsibility for packaging waste; this served as a model for the related EU directive and was broadened to other waste streams (Box 3.5).

Box 3.5. **Extended producer responsibility: waste electrical and electronic equipment**

Extended producer responsibility programmes are based in law and have been applied to packaging (1991), end-of-life vehicles (1997), batteries (1998), waste oil (2002) and waste electrical and electronic equipment (WEEE) (2005). Legal provisions include an obligation to take back (usually at no additional cost to consumers) and to recycle (usually in combination with a target quota), substance restrictions on certain harmful components, and product design to allow good recyclability. Financial mechanisms differ according to waste stream. The producer bringing the product onto market has the responsibility to take back the waste product and assure its environmentally sound recovery and disposal. The objective is to provide producers with incentives to minimise the end-of-life costs of their products by designing them so as to use less material and improve recyclability.

Before 2005, WEEE was not subject to specific requirements. Public waste management authorities were responsible for collection and treatment, and households were charged for the service. In 2005, the Electrical and Electronic Equipment Act (ElektroG), transposing the 2003 EU WEEE and RoHs directives,[1] shifted responsibilities to the producers. Since 2006, consumers can bring WEEE free of charge to municipal collection points. Municipalities are responsible for separate collection in containers supplied free of charge by producers. The producers are responsible both physically and financially for recovery, recycling, treatment and disposal of WEEE, and usually contract with end-of-life service providers. Producers must achieve certain minimum targets for recovery and recycling of the e-waste. Since 2006, new equipment put on the market should not contain hazardous substances such as lead, mercury and cadmium.

The German system is characterised by a competition-oriented compliance approach. Producers' take-back obligations are based on their market share, calculated centrally by the EAR Foundation, a partnership of industry and manufacturer associations supervised by the UBA. A financial guarantee is required from all producers registering with the foundation to cover the management cost for orphan products. The ElektroG allows producers to set up individual brand-selective or non-selective take-back systems as well as collective ones. In practice, many producers choose non-selective systems, unlike in other EU countries, where collective take-back systems are preferred. This stems from the experience of the Duales System Deutschland (DSD) for packaging materials, a system that was criticised for limiting competition[2] and for economic inefficiency (OECD, 2001, 2006). While individual WEEE take-back systems have proved effective in promoting competition (though there is no benchmark for cost comparison), they impose a high administrative burden on small producers. In addition, non-selective systems provide little incentive for eco-design.

In 2008, 1.9 million tonnes of new equipment was put on the market in Germany – the largest amount in Europe – and about 700 000 tonnes of WEEE was collected (8 kg per capita from households). Although this represents nearly twice the collection rate required by the EU directive, Germany is behind Nordic countries and has potential for improvement. Between 2006 and 2008, the percentage of WEEE collected and treated by the German system was estimated at 40% to 50% of generated amounts. Little is known about the remainder, which does not enter the official system. The UBA estimated that more than 155 000 tonnes of WEEE was exported to non-European countries with lower environmental standards in 2008, much of it illegally exported as reusable equipment (UBA, 2010).

1. The WEEE Directive (2002/96/EC) promotes the collection and recycling of large and small household appliances, computer and telecommunications equipment, consumer equipment, lighting equipment, electrical and electronic tools (except large stationary industrial tools), toys, leisure and sports equipment, medical devices, monitoring and control instruments, and automatic dispensers. The RoHS Directive (2002/95/EC) is on restricting the use of certain hazardous substances in electrical and electronic equipment.
2. The DSD, responsible for collection, treatment and disposal of packaging materials, was a monopoly until 2008. The packaging ordinance was amended in 2008 to promote competition. Nine systems have operated since 2009.

Source: Deubzer (2011); UBA (2010).

In line with the revised EU Waste Framework Directive (2008/98/EC), the federal government amended the legislation to further improve waste recovery (*e.g.* of bio-waste and construction and demolition waste), although questions have been raised as to whether this revision contradicts the waste hierarchy.[20] In accordance with the Waste Framework Directive, Germany must develop a waste prevention programme by the end of 2013. The UBA made a comprehensive review of the broad range of measures already implemented (labelling, information, research on product development, green procurement, substitution of hazardous substances) and recommended that existing projects should be further co-ordinated (UBA, 2010). The mix of regulatory and pricing measures (Section 3) has helped reduce municipal waste generation, significantly improve waste recovery and dramatically reduce landfilling (Chapter 1). However, generation of other waste streams (*e.g.* hazardous waste) grew. There are also concerns that policies have stimulated incineration overcapacity, and this can act as a disincentive for increased reuse and recycling.

5. Investing in the environment to promote economic growth

5.1. *Environment-related components of the stimulus and consolidation packages*

Responding to the global economic and financial crisis, Germany introduced discretionary measures in November 2008 and February 2009. The combined fiscal package amounted to EUR 80 billion or 3% of 2008 GDP, less than the G7 average of 3.6%. Equal priority was given to tax cuts (equivalent to 1.6% of GDP, concentrated on personal income taxes) and spending measures (about 1.4% of GDP, mostly investment programmes) (OECD, 2009c). Environment-related measures were estimated at 13% of the total recovery package (Table 3.3).

Table 3.3. **Environment-related components of the recovery package**

Measure	Description	Budget
Housing refurbishment	Funding for energy efficiency measures in buildings	EUR 3.3 billion
Green tax reduction	R&D targeting alternative mobility concepts (especially electro-mobility)	EUR 500 million
Car scrapping	Car scrapping programme	EUR 5 billion
Green tax reduction II	Revision of the tax on passenger cars (from 1 July 2009): new calculation based on CO_2 emissions	EUR 1.8 billion
Total		EUR 10.6 billion

Source: Pollitt (2011).

Overall, the green part of the German stimulus package was relatively large, averaging EUR 129 per capita. It clearly targeted sectors that were particularly affected by the recession, including vehicles, engineering and construction. Assessments indicate that the measures likely saved or created a significant number of jobs (Pollitt, 2011). The increase in GDP was assessed as much larger than the stimulus package due to the co-financing involved in the car scrapping programme, which effectively converted savings to spending. However, the impact was short term and private consumption contracted at the end of the programme. The development and diffusion of efficient vehicles had a longer-term objective. The investment in energy efficiency in public buildings will have taken slightly longer to implement but still had an impact on rates of economic activity.

Environmental outcomes of the car scrapping programme are unclear as the fleet would have been renewed anyway (Box 3.1). Changes in vehicle taxation could have more lasting effects and R&D is expected to provide efficiency gains after 2020. The improvements to efficiency in public buildings should provide steady and permanent reductions in energy consumption.

Crisis-related revenue shortfalls and recovery measures have resulted in serious deterioration of the fiscal position: the general government budget shifted from being in balance in 2008 to showing a deficit of more than 3% of GDP in 2009. However, the fiscal situation improved rapidly due to both structural and cyclical factors. In 2011, the government started implementing a consolidation package of around EUR 80 billion to 2014. On the expenditure side, the bulk of the retrenchment effort will concentrate on social and family benefits and cost savings in the public sector. Importantly, the additional expenditure on education and R&D investment (around 0.5% of GDP from 2010 to 2013) is exempt from cuts (EC, 2011b). Tax measures include the reduction of energy tax relief and the introduction of an air travel tax (Section 1).

5.2. Pollution abatement and control and environment-related expenditure and financing

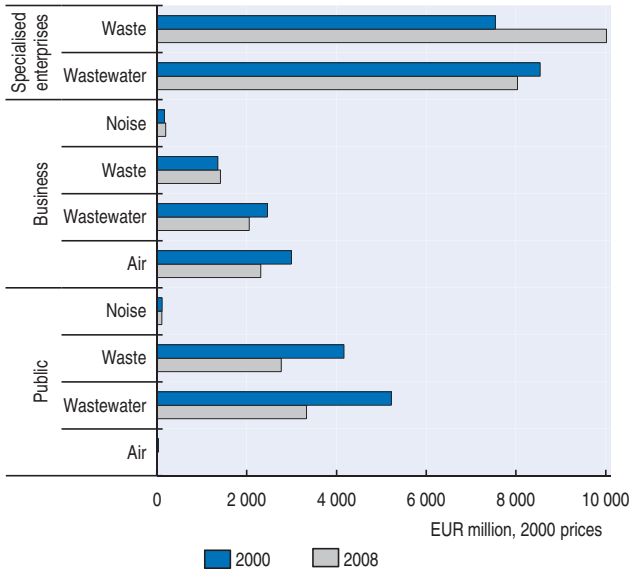
Since 2000, pollution abatement and control expenditure[21] has slightly decreased in constant prices, implying a sharper decline in its share of GDP, which indeed went from 1.6% to 1.3% over 2000-08. The decrease was observed in both the public and business sectors, and in all environmental domains except waste and noise. In contrast, operating expenditure of specialised enterprises has risen significantly, in particular for provision of waste services. This reflects increasing use of subcontractors to provide environmental services as well as rising spending to maintain the infrastructure installed over the past two decades. Overall, wastewater treatment and waste management remain the biggest items of expenditure, although the business sector continues to have relatively high spending on air protection (Figure 3.4).

Investment in public water supply decreased by more than 20% over 2000-10 because the need for network improvement declined once water infrastructure in the eastern *Länder* converged with that in their western counterparts. Over the decade, the German water sector underwent important reform, leading to increased efficiency and enhanced private sector participation: in 2008, about 60% of services were provided by private companies. Almost the full cost of water supply and wastewater treatment services is directly borne by consumers, as required by the EU Water Framework Directive (ATT *et al.*, 2011; see also Box 3.2).

The waste management sector is generally governed by the polluter-pays principle. Implementation of producer responsibility programmes shifted the financial responsibility for waste management from local governments to industry, then consumers (Section 3). Despite differentiated VAT treatment between the public and private sectors in the provision of environmental services, private sector participation in waste management services has expanded over the past decade. It now represents about 65% of municipal waste management companies. Some waste management facilities have been built by private companies or in public-private partnerships.

As German environmental policy was shifting from traditional domains to more global issues like climate change, the government amended the Environmental Statistics Act to

Figure 3.4. **Pollution abatement and control expenditure by sector and domain, 2000 and 2008**



Source: Federal Statistical Office.

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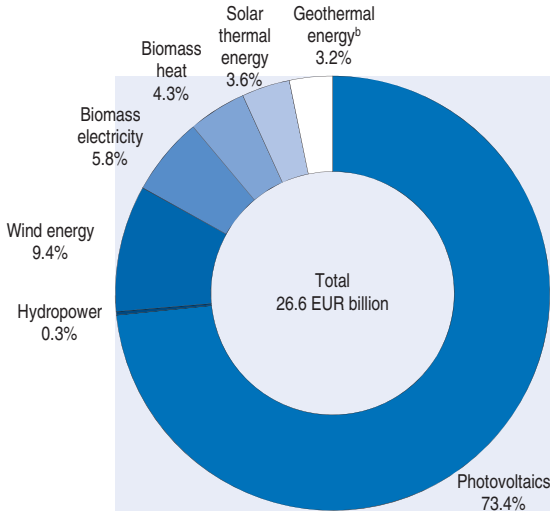
monitor related expenditure. This change was also motivated by the need to capture integrated technologies in addition to end-of-pipe investment. According to the Federal Statistical Office, industries, mostly in the energy sector, invested EUR 1.6 billion in climate protection in 2009, of which 39% was in GHG emission prevention and reduction, 36% in energy efficiency improvement and 25% in renewable energy sources (Federal Statistical Office, 2011a). However, this figure excludes investment by the construction sector for building renewables facilities and renovating buildings. When these activities are considered together with trade, commerce and household spending, investment in the construction of renewables installations totalled nearly EUR 27 billion in 2010 (Figure 3.5), almost three times the 2000 level (BMU, 2011a).

The most important mechanism for financing renewables development is the programme of feed-in tariffs, in use for 20 years (Kalamova *et al.*, 2011) (Chapters 4 and 5). The cost of the system is passed on to end-users through the so-called EEG surcharge on the electricity price. Between 2000 and 2010, the cost of the feed-in tariff programme amounted to EUR 46 billion (in 2010 prices).[22] In addition, the government has made extensive use of direct financial transfers in the form of investment grants and soft loans to finance environmental and climate protection (Boxes 5.4 and 5.5). KfW, the state-owned bank, has played an important role in this effort. In 2010, the volume of its activity for domestic environmental and climate protection reached nearly EUR 21 billion. Of this total, EUR 9 billion was spent on renewables and another EUR 9 billion on energy-efficient construction and modernisation (KfW, 2010).

Figure 3.5. **Investment in domestic construction of renewable energy installations,[a] 2010**



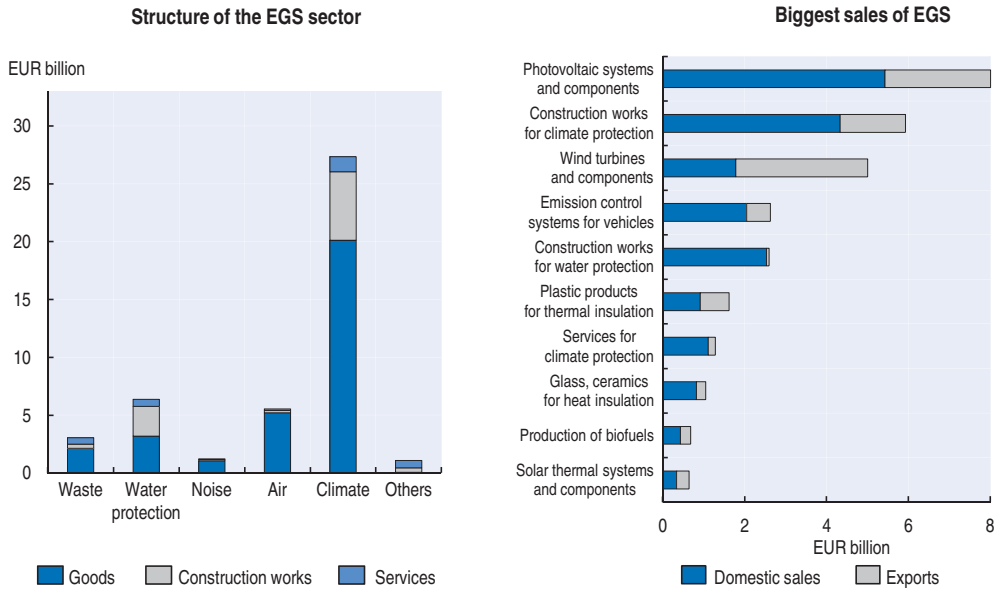
a) Includes construction of new installations and, to a smaller extent, expansion or refurbishment of installations, such as the reactivation of hydropower plants; includes investments by energy supply companies, industry, trade, commerce and private households.
b) Large installations and heat pumps.
Source: BMU (2011), *Renewable Energy Sources in Figures*.

6. Environmental goods and services

The Federal Statistical Office has collected information on the environmental goods and services (EGS) sector since 1997 (Federal Statistical Office, 2011b). Originally, the definition covered goods, construction operations and services aiming at avoiding, reducing or remediating damage to the environment caused by production and consumption. The environmental domains involved were waste management, water protection, noise abatement, air quality control, nature and landscape conservation, and soil decontamination. In 2006, a climate protection category was introduced in the survey and the definition of "environmental protection" was broadened to include resource conservation and renewables.

The Federal Statistical Office reported that turnover in the EGS sector totalled EUR 44.6 billion in 2009 (about 1.9% of GDP), nearly twice the 2006 level. Two-thirds of products and services in the sector were sold in Germany and one-third was exported. Goods accounted for 71% of the sector's sales, followed by construction (21%) and environmental services (7%) (Figure 3.6). Climate protection turnover far exceeded that in other categories, driven by a boom related to renewables. Manufacturing industries were the dominant producers of environmental goods for climate protection, including photovoltaic systems, wind turbines, control systems for vehicles and insulation products. Renewables facilities generated the major part of revenue from construction work for environmental protection, followed by installations for wastewater treatment. Waste management and water protection each accounted for slightly less than 20% of sales of environmental services, compared with 40% for climate protection services.

Figure 3.6. **Turnover in the environmental goods and services sector, 2009**



Source: Federal Statistical Office.

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The cross-cutting nature of the industry and related statistical problems has resulted in significant differences among estimates of the impact of the EGS sector on the economy (OECD, 2011d). The question is particularly relevant as the growth of this sector is an important factor in discussions about support for development of renewables. While the Federal Statistical Office collects information on the EGS sector as described above, the BMU investigates how to assess the market size of a more broadly defined industry. Although there are good reasons to measure activities with environmental benefits outside the internationally defined EGS sector (such as water supply, ecotourism, energy and resource savings from information technology, and goods and services which have not been produced for environmental purposes but have a favourable impact on the environment), improving the methodological link between the various national sources would help improve the credibility of the information. The BMU reported that turnover of a broadly defined environmental technology services sector amounted to EUR 123 billion in 2008, or 5% of GDP (compared with the Federal Statistical Office estimates of EUR 44.6 billion in 2009, and about 1.9% of GDP). The BMU analysis suggests that the market volume could grow by an average of around 7.7% annually to reach EUR 300 billion by 2020. Similarly, estimates on employment range from 180 000 people to 1.8 million people, depending on whether the narrow or broad definition of the EGS sector is used and whether indirect employment is considered.

Development of renewables is considered the growth engine of the sector. Evaluations generally conclude that renewables development in Germany has had a positive impact on growth and employment. Support to renewables stimulates the economy by boosting investment and creating demand for green technology, particularly in the electricity sector. Gross employment in renewables sectors has increased sharply over the past two decades, with around 370 000 people employed in 2010, more than twice the 2004 level (BMU, 2011a). However, the cost of renewables development can have impacts on other

sectors of the economy. Indeed, the development of the renewables industry may be associated with declines in conventional energy sectors. Technological progress and productivity gains will be key factors in determining the extent to which renewables are a source of growth for Germany (OECD, 2012).

The growth of green sectors is projected to continue, with global markets for solar thermal energy, photovoltaics and wind power expected to rise by 20% per year until 2020 (BMU, 2009). Being among the largest producers of EGS and having a more than 5% share in global trade in renewables-related products, Germany would benefit substantially from this growth (BMU, 2011b). Germany is a leader in the wind and photovoltaic sectors, with two firms among the world's ten main producers of wind turbines and three of the top ten solar panel producers. However, competition is developing quickly in these markets, and Germany has lost export market share, particularly in photovoltaics. Still, three-quarters of wind power equipment bought in Germany is produced by German manufacturers.

7. Environment, trade and development

7.1. Official development assistance

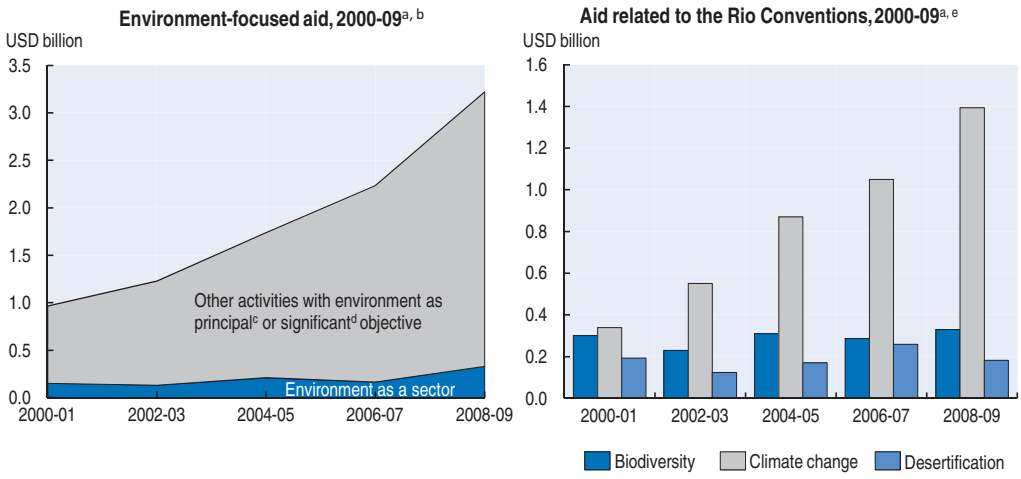
Since 2000, Germany's net official development assistance (ODA) has increased by nearly 60% in real terms to reach USD 12.7 billion in 2010, equivalent to 0.38% of gross national income (GNI). As a result, Germany was the fourth largest donor of the OECD Development Assistance Committee (DAC), providing 10% of DAC members' total ODA. Germany met the National Sustainable Development Strategy target of allocating 0.33% of GNI to ODA in 2006, but fell short of its 2010 target of 0.51%, and further efforts are needed to attain the target of 0.7% by 2015.

Germany has a strong track record in mainstreaming climate and environment in development programmes (OECD-DAC, 2010). Over the past decade, bilateral aid for the environment[23] more than tripled, reaching USD 3.3 billion in 2008-09. Although this figure is an upper-bound estimate, it represents nearly half of the sector-allocable aid,[24] a very high percentage compared to other donors (OECD-DAC, 2011a). Environment has been increasingly reported as an objective in the energy sector, reflecting the growing emphasis on climate change in Germany's development co-operation, particularly since adoption of the 2007 Bali Action Plan[25] (Figure 3.7). This scaling up of funding has been matched by increased capacity: in 2008 the Federal Ministry for Economic Co-operation and Development (BMZ) created a division for climate policy and climate financing, doubling the number of staff responsible for environment and climate.[26]

Addressing climate change in developing countries is an integral part of Germany's climate policy framework. Germany actively promoted this issue during its EU and G8 presidency and during preparations for the 2009 Copenhagen summit. In 2008-09, Germany was the second largest donor of climate-related finance, after Japan (OECD-DAC, 2011b). Germany is also the second biggest bilateral donor in the water sector. From 2000-01 to 2008-09, bilateral aid to water supply and sanitation (which partly overlaps with environment-focused aid) increased by 46% to reach USD 854 million.

Germany is a major contributor to multilateral funds for the environment. It is the third largest donor to the Global Environment Facility (GEF), which allocates about one-third of its funding to climate change.[27] German commitments for the 2010-14 programming period total EUR 347 million, significantly higher than in previous phases. The German government also supports the GEF's Least Developed Countries Fund and Special Climate

Figure 3.7. **Bilateral aid in support of the environment**



a) Average commitments of bilateral ODA expressed at 2009 prices and exchange rates.
b) The coverage ratio for activities screened against the environment policy marker is 83% of total sector allocable aid. Excludes activities on water and sanitation not targeting environment as a principal or significant objective.
c) Activities where environment is an explicit objective of the activity and fundamental in its design.
d) Activities where environment is an important, but secondary, objective of the activity.
e) Most activities targeting the objectives of the Rio Conventions fall under the definition of "environment-focused aid" but there is no exact match of the respective coverage. An activity can target the objectives of more than one of the conventions, thus respective ODA flows should not be added.
Source: OECD-DAC (2011), *Creditor Reporting System: Aid Activities Database.*

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Change Fund, having pledged EUR 40 million to the former and EUR 20 million to the latter by 2011. Between 2000 and 2009, Germany recorded the largest imputed multilateral contributions to the water and sanitation sector, the bulk of it channelled through the EU.

Support to climate change mitigation and adaptation is expected to continue to increase in the next few years following the pledge to provide EUR 1.26 billion for climate fast-start financing over 2010-12.[28] At least one-third of total funding will be allocated to adaptation and about 30% to reducing emissions from deforestation and forest degradation (REDD). The German government says it has exceeded the 2010 target for fulfilling this pledge, with EUR 361.5 million disbursed (Table 3.4).

Table 3.4. **Germany's contribution to fast-start financing, disbursements 2010**[a]

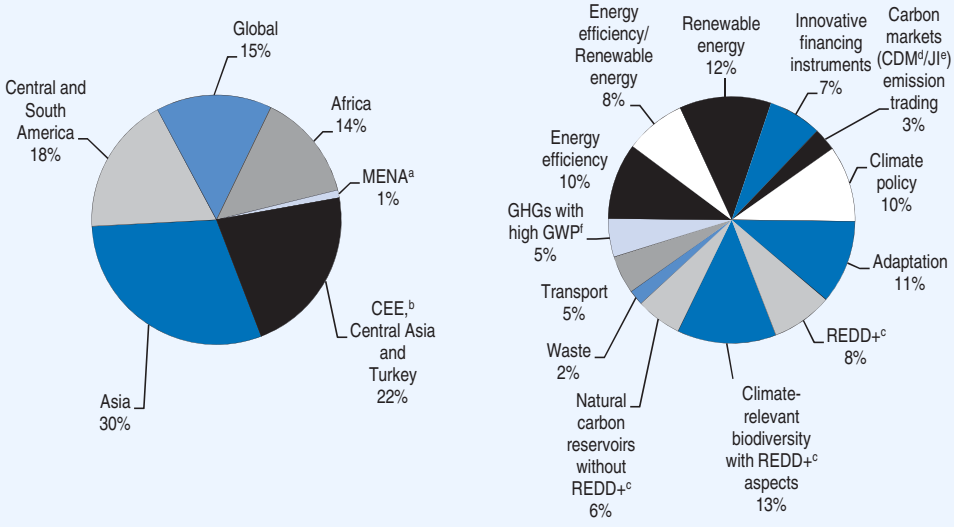
	Mitigation	Adaptation	REDD+[b]
Multilateral	Clean Technology Fund: EUR 125 million	Pilot Programme for Climate Resilience: EUR 8 million	Forest Carbon Partnership Facility: EUR 34 million
	EU-UNDP Capacity Building Programme on Climate Change: EUR 5 million	Adaptation Fund: EUR 10 million	
		UNEP/UNDP Ecosystem-based Adaptation Flagship: EUR 10 million	
Bilateral	EUR 87.4 million	EUR 47.7 million	EUR 34.4 million
Total: EUR 361.5 million	EUR 217.4 million (60%)	EUR 75.7 million (21%)	EUR 68.4 million (19%)

a) As of 31 December 2010.
b) Includes conservation, sustainable management of forests and enhancement of forest carbon stocks.
Source: BMU and BMZ (2011).

Box 3.6. **Innovative instruments for international climate financing**

Since 2008, the German government has made a portion of the revenue generated by auctioning the EU CO_2 emission trading allowances available for international climate protection. Through the International Climate Initiative (ICI), the BMU supports climate protection measures in developing countries, emerging economies and countries in transition in eastern Europe. In 2009, the BMU and BMZ signed an agreement governing the use of funding from the ICI that provides for close and early consultation on programmes and projects. ICI funding is provided for mitigation and adaptation measures, and for preservation and sustainable use of natural carbon sinks as part of the REDD+ programme. Between 2008 and July 2011, the ICI supported 242 projects in over 60 countries with funding totalling around EUR 518 million. The ICI is a significant innovation in climate finance and a model of inter-ministerial co-operation that could be useful for other countries. The German Advisory Council on Global Change has called for scaling up climate funding using revenue from the new air travel tax. It has also advocated a tax on international financial transactions for this purpose.

Figure 3.8. **International Climate Initiative, projects by region and subject, 2008-10**



a) Middle East and North Africa.
b) Central and Eastern Europe.
c) Reducing Emissions from Deforestation and Forest Degradation.
d) Clean Development Mechanism.
e) Joint Implementation.
f) Global Warming Potential.
Source: BMU and BMZ (2010), *Climate Challenges, Germany's International Approach.*

The Global Climate Partnership Fund, facilitated by the ICI, is an instrument to mobilise public and private capital for investment in climate change mitigation in developing and emerging countries. The fund primarily supports commercial banks and non-bank financial institutions such as leasing companies in the target countries. It aims to support provision of funding for investment by small and medium-sized enterprises and households for energy efficiency, renewables and GHG reduction. Unlike conventional loan facilities, the fund is revolving, its capital replenished by repaid loans. At the same time, the publicly provided capital acts as a risk buffer to mobilise additional, especially private, capital. The Global Climate Partnership Fund was set up in December 2009 by KfW Entwicklungsbank on behalf of the federal government. Its professional fund manager, Deutsche Bank, was selected through international tender. The fund has secured pledges from investors of over USD 100 million and is set to exceed USD 500 million by 2014 (BMU and BMZ, 2010).

Germany is one of the few countries to have provided a definition for "additional" funds in its Copenhagen pledge: they should be additional to 2009 climate funding and/or derive from innovative financing mechanisms such as the International Climate Initiative (Box 3.6). However, as is the case for other major donors, this financing is also counted as a contribution towards achieving the 2015 Millennium Development Goals, and includes amounts that were committed or pledged before the Copenhagen agreement (Oxfam, 2010). Striking a balance between the current emphasis on advancing the climate agenda and supporting other environment and development priorities is a challenge. Germany could further support the international effort on climate change by continuing to promote better monitoring and reporting of climate-related assistance (for example through its participation in the task team on tracking aid financing for the environment using the Rio markers).

Since 1988, all development projects have been subject to environmental impact assessment (EIA). In addition, a climate check was introduced in 2009 to assess projects' GHG emission saving potential and to address the impact of climate change. In 2011, these two instruments were merged in a Joint Environment and Climate Assessment, together with elements of strategic environmental assessment. Guidelines have been developed to support the systematic consideration of environmental and climate aspects at both the strategic and operational levels in the new instrument.

Recently, Germany has investigated opportunities to develop incentive programmes, build capacity, provide investment funding and encourage mainstreaming of the green economy in developing countries. Key criteria for project selection were defined, including: *i)* steering effect and inclusiveness; *ii)* focus on German comparative advantage (*e.g.* in renewables and energy efficiency); *iii)* innovative methods; and *iv)* active private sector participation. Examples include support for disseminating efficient stove technologies in Ethiopia, introducing sustainability standards along the value chain of the coffee industry in Kenya and instituting eco-taxes in Vietnam (BMZ, 2011). Germany has funded African Development Bank work on green growth in Africa. It has supported private sector initiatives in the Donor Committee on Enterprise Development and hosted the conference on the Water, Energy and Food Security Nexus: Solutions for a Green Economy in November 2011.

7.2. Corporate social responsibility

Germany promotes the OECD Guidelines for Multinational Enterprises.[29] It is among the OECD countries with the largest number of specific instances reported to the national contact point (NCP) (OECD, 2010d). The NCP is a department in the Federal Ministry of Economics and Technology (BMWi) which works in close co-operation with other federal ministries,[30] the social partners and NGOs. In specific instances, procedures, NCP decisions and recommendations are agreed by all ministries represented in the Ministerial Group on the OECD Guidelines, with the particular involvement of the federal ministry or ministries primarily concerned. In addition, participating ministries meet regularly to discuss issues relating to the OECD Guidelines, how to improve dissemination of the Guidelines and NCP working methods.

Since the establishment of a complaints procedure in 2001, the NCP has accepted five complaints[31] out of seventeen and had concluded four of them by June 2011. Among the rejected inquiries were two cases related to the environment. In 2007, a complaint was filed against a German car company accused of not giving sufficient consideration to the impact of its products on climate change. In 2009, a complaint against a Swedish electricity company alleged that it had undermined German environmental law by constructing coal

and nuclear power plants in Hamburg. More recently, a complaint alleged that the rights of indigenous people in Sweden were affected by a large windmill project financed by a German institution. The case was referred to the Swedish NCP.

A broad range of initiatives in corporate social responsibility (CSR) have been taken and networks established, the majority organised by the private sector and civil society. Recently, greater attention has been paid to promoting synergy between the promotional activities of the *OECD Guidelines for Multinational Enterprises* and other CSR instruments, including the International Labour Organization's Tripartite Declaration on Multinational Enterprises and Social Policy and the United Nations Global Compact. In 2010, responding to a recommendation of the German Council for Sustainable Development, and building on the work of the National CSR Forum, the German government adopted a national CSR strategy. It seeks to: *i)* promote CSR in small and medium-sized enterprises; *ii)* increase the visibility and credibility of CSR; *iii)* optimise the political framework for CSR; and *iv)* make a contribution towards shaping the social and environmental dimensions of globalisation.

The OECD Guidelines are also promoted in investment guarantee programmes. Companies applying for investment guarantees are referred to the Guidelines directly on the application form. They have to confirm their awareness of this by signature.

7.3. Export credits

Germany has implemented the revised 2007 OECD Recommendation on Common Approaches on the Environment and Officially Supported Export Credits to minimise the adverse impacts of German investments abroad. Euler Hermes,[32] which manages the German export credit programme, has established a special sustainability unit to assess environmental issues. It publishes information on all covered projects above EUR 15 million and discloses information on all category A projects with EIA description at least 30 days prior to final commitment. Between 2004 and 2010, Germany reported the highest number of projects with high and medium potential environmental impacts. Category A and B projects reported by Germany represented about one-fifth of the total volume reported to the OECD in 2010 (OECD, 2010e). Category A projects were concentrated in the energy (43%) and infrastructure (38%) sectors, while Category B projects were concentrated in other industries (36%) and infrastructure (29%).

In 2010, 14 projects for the promotion of renewables and water supply were covered, totalling about EUR 600 million. According to the revised OECD arrangements for these sectors adopted in 2009, the projects can be insured with more flexible repayment conditions and credit periods for up to 18 years. Guarantees were granted for projects on biomass power stations, solar cell projects and wind turbine plants. The biggest project (involving a EUR 462 million guarantee) concerned a wind farm installed off the Belgian coast (Euler Hermes, 2010).

The effects on the competitiveness of German companies produced by the 2007 OECD Council Recommendation on Common Approaches on the Environment and Officially Supported Export Credits were analysed in 2009. It was shown that disadvantages of the environmental assessment procedure, in particular in terms of time for approval, were compensated by the reduction of reputational risks and the positive impact on competitiveness (Schaltegger *et al.*, 2009). Germany supports OECD efforts to establish global standards on export credits and the environment that would avoid competitive disadvantages for OECD exporters.

Notes

1. The rate is set at EUR 145 per gram of nuclear fuel. Revenue was originally estimated as EUR 2.3 billion per year. However, the early phase-out of nuclear power plants, with eight plants shut down in 2011, lowered revenue expectations.
2. EUR 8 for short journeys, EUR 25 for medium distances and EUR 45 for long distances. The tax is expected to generate annual revenue of EUR 1 billion.
3. Electricity produced from renewables was also subject to the electricity tax.
4. The ITR on energy is the ratio between the revenue from energy taxes and final energy consumption (EC, 2011).
5. The ITR on labour is the ratio between the revenue from taxes on labour income and social contributions and overall compensation of employees (EC, 2011).
6. A vehicle tax exemption of EUR 330, later changed to a direct payment, is granted for retrofitting vehicles registered before January 2006.
7. The tax rate is linear at EUR 2 per gram of CO_2/km over 120 g CO_2/km, falling to 110 g in 2012-13 and 95 g thereafter. By comparison, EU Directive 2009/33/EC requires average emissions for new cars registered in the EU to be 130 g CO_2/km by 2012. Electric vehicles receive a tax exemption over five years from first registration; afterwards they are assessed on the basis of total weight, with tax relief of 50%.
8. The base tax is EUR 2 per 100 cc for petrol vehicles and EUR 9.50 per 100 cc for diesel vehicles.
9. There is some evidence that car purchases are more affected by retail prices than by lifetime costs, implying that vehicle registration taxes are more effective in reducing the average CO_2 emissions of new cars than annual circulation taxes (Vance and Mehlin, 2009).
10. The OECD (2009b) calculated the values per tonne of CO_2 emitted over the lifetime of vehicles that are implicit in the CO_2 component of vehicle taxes (assuming that each vehicle is driven 200 000 km in its lifetime). According to this analysis, the implicit CO_2 tax rate is high in most OECD countries. In Germany it is zero for vehicles emitting up to 120 g CO_2/km and EUR 30 to 103 per tonne of CO_2 for vehicles with emission levels between 150 and 380 g CO_2/km.
11. The UBA (2011) defines primary effects as environmentally harmful effects resulting directly from the subsidised activity or product, and secondary effects as those that the subsidy triggers indirectly via cause-and-effects chains.
12. For example, the UBA (2011) considers the allocation of CO_2 emission allowances in the EU ETS and the lower taxation of diesel as fossil fuel subsidies, whereas the OECD (2011b) does not.
13. From 2011, the tax reduction for industry and agriculture is reduced from 40% to 25%, and the peak equalisation is reduced from 95% to 90% of the tax payment exceeding the relief of social contributions.
14. Farmers indirectly benefit from EU export refunds, which are paid to export companies to help stabilise the EU market of agricultural products. Such subsidies can have environmentally harmful consequences, since they encourage production and transport of agricultural produce (UBA, 2011).
15. From a public health perspective, there are concerns about contamination of drinking water due to low flows. In some cities, such as Berlin, water tables are rising due to decreased pumping of groundwater, causing damage to building foundations. In addition, sewers have to be flushed occasionally with injected drinking water to prevent stagnation of raw sewage.
16. Such payments are provided to compensate farmers and landowners who operate in Natura 2000 sites and have to meet certain requirements to maintain the sites' biodiversity and good ecological status. Similar payments are available for forest managers.
17. The Federal Immission Control Act defines "emissions" as air pollution, noise or odour originating from an installation and "immission" as the effect of air pollutants on plants, animals, human beings and the atmosphere.
18. The Federal Nature Conservation Act defines several categories of protected area, each with its own statutory requirements: nature conservation areas, national parks, national natural monuments, biosphere reserves, nature parks, landscape conservation areas, biotopes with statutory protection and Natura 2000 protected areas.

19. The regulation requires developers to avoid negative impacts on natural balance, landscape and biodiversity. When this is not possible, developers should take compensatory nature conservation measures.

20. The amendment deems energy recovery to be equivalent to material recovery when the waste has a calorific value of at least 11 000 kj/kg.

21. Investment and current expenditure by the public and business sectors and by public specialised producers (publicly owned enterprises specialised in the provision of environmental protection services, and waste and wastewater departments in large municipalities). Excludes expenditure by the agriculture and construction sectors, part of the service sector (purely private waste and wastewater disposal enterprises) and private households, as well as expenditure on nature conservation and soil decontamination.

22. This cost is referred to as "differential cost", *i.e.* the difference between the fixed average tariffs paid to the electricity generated from renewable sources and the procurement prices for the conventionally generated electricity.

23. In the OECD Creditor Reporting System Aid Activity Database, countries use a policy marker to identify activities that have environmental objectives. Germany screened 83% of its sector-allocable aid against the environment marker in 2008-09.

24. Bilateral aid activities that can be allocated to a specific sector, and that have been screened against the environment marker.

25. The Bali Action Plan, adopted during the climate change negotiations in 2007, mandates parties to the UN Framework Convention on Climate Change to negotiate a post-2012 instrument, including possible financial incentives to reduce emissions from deforestation and forest degradation in developing countries.

26. The BMZ already had a division for environment and natural resources.

27. About 33% of total GEF-4 (2006-10) funds were allocated to climate change and about 32% of total GEF-5 financing will go to climate change.

28. At the Copenhagen climate change conference in December 2009, developed countries pledged to provide new and additional resources approaching USD 30 billion for 2010-12, with a balance between adaptation and mitigation, and endorsed a long-term goal of providing USD 100 billion per year by 2020. Under the 2010-12 pledge, Germany's targets are EUR 356 million in 2010, EUR 433 million in 2011 and EUR 471 million in 2012.

29. The *OECD Guidelines for Multinational Enterprises* provide a global framework for responsible business conduct covering all areas of business ethics, including tax, competition, disclosure, anti-corruption, labour and human rights, and environment. While observance of the Guidelines by enterprises is voluntary and not legally enforceable, 42 adhering governments are committed to promoting them and making them influential among companies operating in or from their territories.

30. The Foreign Office, the BMU and the federal ministries of Justice, of Finance, of Economic Co-operation, of Labour and Social Affairs, and of Food, Agriculture and Consumer Protection.

31. The other inquiries were not accepted either because the case fell within the jurisdiction of another OECD member country or because the OECD Guidelines did not apply.

32. As part of a consortium composed of Euler Hermes Kreditversicherungs-AG and PricewaterhouseCoopers AG.

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PART II

Progress towards selected environmental objectives*

* In the review period, since 2000.

PART II

Chapter 4

Environmental innovation

Germany's environmental innovation performance has been supported by a strong national innovation framework, a broad industrial base, a high level of participation in international trade, and strict environmental regulations. This chapter discusses the country's rich experience in promoting innovation to reduce negative environmental impacts. It covers environmental and general innovation policies and the cross-cutting issue of policy co-ordination. Indicators of patenting activity, and examples from different areas such as air and waste management, energy, and transport, are presented. The chapter also analyses policies to promote renewable energy, including feed-in tariffs, which have helped German industry achieve a significant share of domestic and international markets for various renewable energy technologies.

Assessment and recommendations

Germany is a rich source of experience on policy-induced environmental innovation. A strong national innovation framework, a broad industrial base, and a high level of participation in international trade have underpinned Germany's environmental innovation performance. Strict environmental regulations have also been key drivers. While this approach has been criticised by some for not being cost-effective, others have seen it as a way of driving down compliance costs and a source of new investment and markets. Waste management legislation, for instance, enacted over several decades helped improve the resource productivity of the economy and generate an internationally competitive waste management equipment industry. Stringent emission standards, complemented by market-based instruments, stimulated technological improvements that reduced pollution from motor vehicles and spurred the development of Germany's renowned automotive industry.

By the turn of the century, innovation rates in the traditional environmental domains (air, water and waste) were levelling off and even declining. In part this was because further innovation in these areas required more challenging institutional, behavioural and structural changes. At the same time, the focus of environmental policy was shifting from the traditional to a more complex global environmental agenda including, most notably, climate change. Promoting environmental technologies has become more difficult as the nature of innovation has increasingly shifted from end-of-pipe to integrated technological solutions. In these circumstances, environmental policy instruments should be, more than ever, carefully designed. In particular, more account should be given to how environmental policy instruments could induce innovation and thereby contribute to reducing the costs of reaching environmental objectives. In addition to establishing a given level of ambition, environmental policy should also provide predictable signals, allow flexibility in achieving objectives, provide a continuous incentive for innovation, and, as far as possible, directly target the causes of environmental problems.

German policy on renewable energy exhibits many of these characteristics. Policy in this area, namely the feed-in tariff, has helped significantly increase the share of renewable energy in electricity generation without placing the public budget under undue strain. Ensuring that renewable energy producers had guaranteed access to the electricity grid was one of the key factors underlying this development; another was passing the costs on to consumers. Public R&D and other support provided by the broader innovation framework have also helped German industry achieve a significant share of domestic and international markets for various renewable energy technologies. At the same time, questions have been raised about the cost borne by German consumers of electricity. Questions remain about whether the policy instruments applied to reduce greenhouse gas emissions are sufficiently stringent, consistent and stable to provide incentives for the further development of renewable energies and other low-carbon technologies.

The complexity of the policy challenge requires a learning-by-doing approach, and adjustments which can generate uncertainty for investors.

A key issue in promoting environment-related innovation is the role of public support. Germany has a wide range of research and development (R&D) support programmes such as the framework programme "Research for Sustainable Development". However, the disbursement of public R&D funding does not seem to be subject to adequate critical assessment. Compared to some other highly innovative OECD countries, Germany has a relatively low share of gross domestic expenditure (public and private) on R&D in GDP, although the trend has been increasing recently. At the same time, the share of gross investment in GDP has been decreasing. It is therefore particularly important that public support (*e.g.* for large-scale projects such as those identified in the Energy Concept) is carefully designed so as to avoid crowding out private investment, to ensure that public funds maximise the leverage of private capital, and, as far as possible, to avoid attempts to pick winners.

The changing nature of environmental innovation requires greater co-ordination among ministries and between central government and the *Länder*. The Master Plan on Eco-Innovation is an example of policy and institutional co-ordination among branches of government. However, more needs to be done to assure coherence between policies to promote environment-related innovation and sectoral policies. This is particularly true in relation to transport-related policies, which provide a range of incentives that favour existing technologies, manufacturers and modes of transport. Labour, education and migration policies should be part of the co-ordination effort, as shortages of skilled labour could impede the further development and diffusion of some environment-related innovations.

Recommendations

- Establish a clear, predictable policy framework that provides continuous innovation incentives, *e.g.* by providing a clear signal about the long-term future taxation of energy carriers; promote greater coherence between policies for environment-related innovation and related sectoral policies, particularly transport policy.
- Carefully design instruments aimed to financially support environment-related innovation so as to achieve policy objectives efficiently and effectively, promote diversity, avoid picking winners, and maximise the leverage of private capital; adjust the subsidy component of financing instruments in light of market developments, and phase out subsidies as technologies become commercially viable.
- Systematically assess the effectiveness and efficiency of environmental and innovation policies in terms of measurable outcomes (*e.g.* environmental benefits, patented inventions, rate of mobilisation of private capital).
- Assess possible shortages in high-skilled labour needed for the development and diffusion of environment-related innovation, and develop measures to fill gaps.
- Make further efforts to improve policy co-ordination at the EU level and beyond to strengthen incentives and support for environment-related innovation (*e.g.* labour mobility, energy pricing, and infrastructure development).

1. Encouraging technological innovation in German environmental policy: an overview

Historically, Germany has used stringent environmental policy to encourage innovation and thereby significantly improve environmental quality while also advancing its economic objectives. It has largely achieved these dual purposes.

The first set of environmental policies, dating back to the 1970s-80s, aimed primarily to reduce airborne pollutant emissions from power plants and other sources. In the 1980s-90s, waste management policies aimed to improve the rates of material recycling. In both cases, stringent environmental regulations led to domestic development of technologies that today are widely used internationally. These policies turned out to be very effective in inducing innovation (see *e.g.* Popp, 2006).

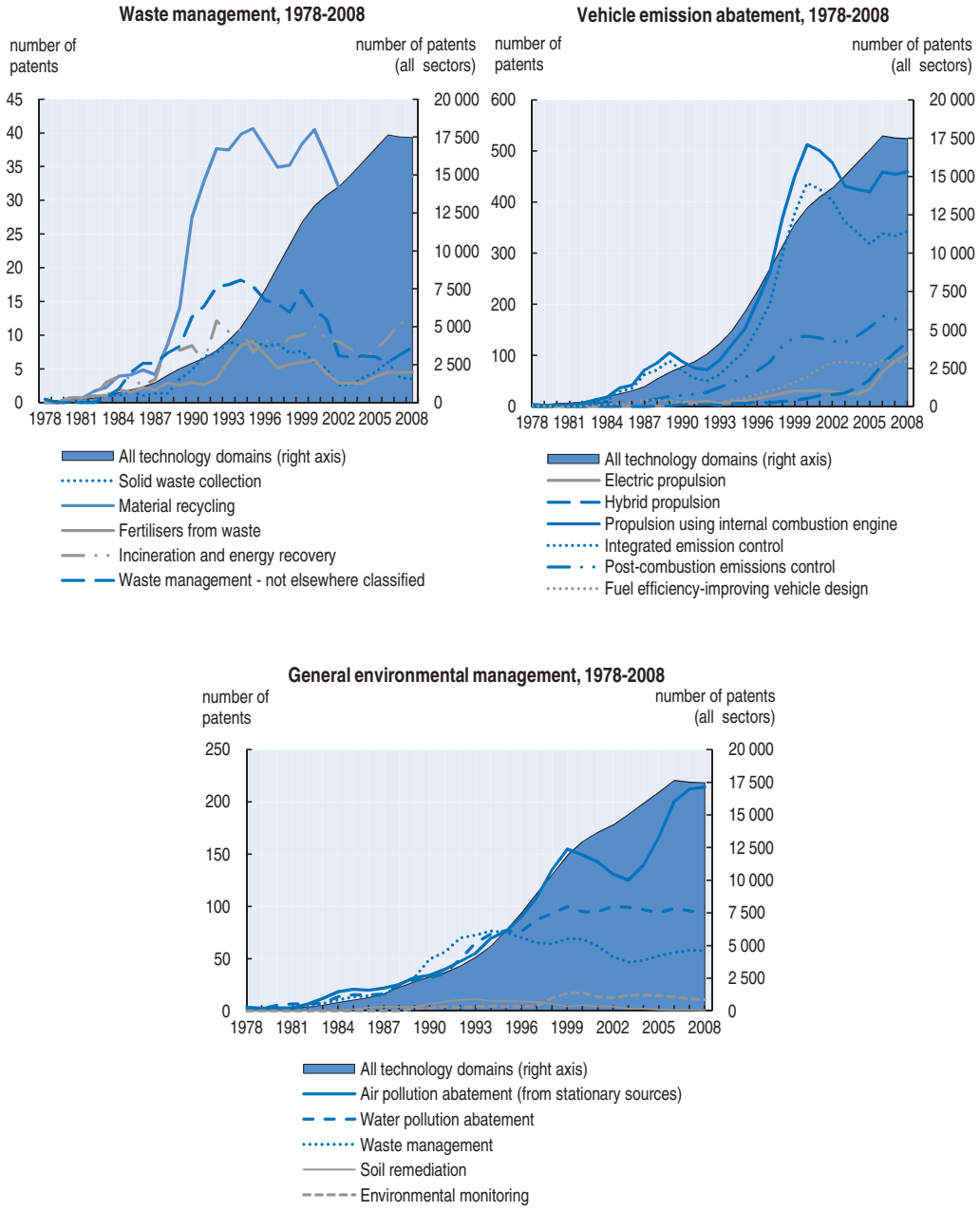
Figure 4.1 shows that the rate of inventive activity (measured using patent data) in material recycling increased significantly following major policy developments: mandatory waste recovery (1986), packaging waste recycling (1991) and the extended producer responsibility law (1996). More recently, the ban on landfilling of untreated waste (2005) was another step towards achieving the goal of near-zero landfilling by 2020.

As a result of these policies, Germany achieved one of the highest recycling rates of municipal waste in Europe in 2009 (63%). In addition, it is among the best performers in the world for recovery of industrial and commercial waste (80%) and of construction and demolition waste (90%) (Chapter 1). The German waste management sector is thus an important contributor to resource efficiency. Moreover, according to estimates by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), it has become a powerful economic sector, with annual turnover of EUR 50 billion, high export rates (25% of the world market for closed-cycle management technologies) and strong growth potential (exports are expected to generate production in Germany worth about EUR 9.7 billion by 2020).[1]

The 1980s-90s also witnessed the onset of stringent emission standards for motor vehicles, later implemented at the EU level through the Euro standards (starting with Euro 1 in 1992). Again, these policies were very effective in encouraging inventive activity in motor vehicle emission control technologies, especially for integrated approaches involving innovative engine design (Figure 4.1). However, since 2000 the rate of innovation has levelled off and even declined. Several factors may have played a role, including a relative decline in the tax share of automotive fuel prices, although Germany's tax share is still considerably higher than the OECD average (Chapter 3).[2] Another factor that may explain innovation trends is an increasing focus on alternative vehicle technologies, which may have reduced the R&D effort on conventional vehicles: as Figure 4.1 shows, inventive activity in electric and hybrid cars increased significantly in the late 2000s (see also Section 4).

Since the late 1990s, the traditional domains of environmental policy (air, water, waste) have seen innovation rates flattening off or even declining – a phenomenon common to many countries. In Germany, this is particularly evident in solid waste management and in water/wastewater treatment. The evidence is mixed for air pollution abatement technologies (Figure 4.1). Probable factors in this phenomenon include changes in the nature of innovations, with less after-treatment and more process-type innovations (which are, by definition, more difficult to identify in data), and the fact that these technological fields may have reached a certain degree of maturity. Further improvements

Figure 4.1. **Patenting activity in selected environment-related technologies**[a, b]



a) Patent counts are based on patent applications filed under the Patent Co-operation Treaty (PCT) at international phase (EPO designations), using priority date and inventor's country of residence (fractional counts).
b) Three-year moving average data.
Source: OECD (2011), *OECD Patent Statistics Database.*

StatLink http://dx.doi.org/10.1787/888932591862

in environmental performance are now more likely to arise through organisational or behavioural innovations, introduction of policies abroad to improve recyclability of imported products, or structural changes such as development of complementary technologies that would allow, for example, fossil fuels to be phased out or energy and material efficiency to be improved. Such structural changes are discussed in greater detail below.

More generally, it should be noted that stringent environmental policy is a necessary condition for technological innovation. Strong innovative capacity and a broad industrial base (or a high degree of integration in international trade) are also needed. All these elements have historically been present in Germany.

Germany has largely continued using technology-forcing policy to achieve environmental improvements while advancing economic objectives. However, this task has become more complex. This is partly because forcing technology solely through stringent environmental policy becomes increasingly difficult as the nature of innovation shifts from end-of-pipe (after-treatment, post-combustion) to integrated approaches (product design, change in production processes).[3]

This trend reflects the shift in German environmental policy away from the traditional domains of environmental policy (air, water and waste) towards more cross-cutting goals such as addressing climate change mitigation and biodiversity protection. The decade up to 2010 was marked by the introduction of policies aimed at renewable energy sources, energy efficiency of buildings and, more recently, alternative-fuel vehicles. For example, the 2010 Energy Concept, establishing Germany's energy policy framework to 2050, includes several measures designed to encourage diffusion of technologies that can help reduce greenhouse gas emissions (Box 4.1).

Box 4.1. **The 2010 Energy Concept: Selected measures to encourage technology development**

The 2010 Energy Concept for an Environmentally Sound, Reliable and Affordable Energy Supply includes measures to encourage diffusion of energy-efficient technologies, for example by considering life-cycle costs in awarding public contracts and by further strengthening the energy performance labelling of cars and buildings. In practice, such measures tend to harvest the low-hanging fruit (*i.e.* exploit the most cost-efficient opportunities) but have only a limited potential to encourage more radical innovation because making them truly binding is usually not politically feasible. To induce further technology development, complementary policy instruments are needed to provide a stringent and credible long-term policy signal (see Chapters 3 and 5 for a discussion of the German eco-tax reform and the EU Emissions Trading System).

The Energy Concept thus also foresees establishing an energy efficiency fund to be used for actions such as supporting market introduction of highly efficient cross-application technologies (*e.g.* engines, pumps, refrigeration), funding efficiency-enhancing technologies to support their demonstration and encouraging development of model projects by local authorities. In addition to addressing environmental externalities, these measures are intended to deal with some of the other market failures leading to suboptimal rates of innovation.

The Energy Concept also endorses the testing of carbon capture and storage (CCS) technology in the energy and manufacturing sectors. Besides addressing global warming, and hence providing a push by the government for closer international co-operation in CCS, support for domestic CCS development is viewed as creating a potentially attractive export opportunity for German industry to countries that continue to use coal. However, it has been suggested that supporting CCS development could be suboptimal because nurturing expectations of future CCS development could lead polluters to "postpon[e] some of their emission reduction efforts awaiting the silver bullet technology on the horizon" (Löschel and Otto, 2009), thus diverting investment away from renewables.

Source: Bundesregierung, 2010.

The implications of this shift include not only a reinforcement of the trend towards process-type innovations, but also an increased need for horizontal policy co-ordination. Another consequence is the sheer volume of investment required to achieve the objectives set, which implies a "crowding in" of more private capital. Effective management of both these aspects requires, more than ever, broad public support. Involvement of the public in goal setting, policy planning and policy assessment is thus essential. The shift also has important implications for the day-to-day business of the BMU, with growing involvement of non-governmental organisations, consumer groups and industry associations.

2. Environmental policy instruments to foster innovation

Germany has introduced a number of policy measures intended to reduce the negative environmental impact of economic activity. In principle, any environmental policy will, to some extent, spur an innovative response (although the rate and direction of innovation may be more or less optimal). This is because if governments affect relative input prices, or otherwise change the opportunity costs associated with the use of environmental resources, they alter the incentives for firms to seek improvements in their production technology. Indeed, since markets often fail to put a price on environmental resources, the price of many environmental assets is to a large extent formed by government regulation. Depending on the stringency of regulation, the change in opportunity costs of pollution translates into increased cost for some factors of production, and thus into incentives to innovate in a manner which saves on the use of these factors. Table 4.1 gives selected examples of the major policies in Germany aimed at environmental innovation. It lists both environmental policies (covered in this section) and general innovation policies (discussed in the following section).

Table 4.1. **Innovation-oriented policy instruments and main innovation phases**

Instrument	Phase		
	Invention	Market introduction	Diffusion
General innovation-related policy instruments			
Programmes meant specifically to promote technology development	High-Tech Strategy		
Promotion of business networks, technology transfer	PRO INNO InnoNet		
Environment-related policy instruments to promote innovation			
Taxes and charges		Ecological tax reform	
Tradable rights		EU Emissions Trading System	
Financial support measures		Renewable Energy Sources Act (EEG)	
Liability law			Environmental liability law
Regulatory law			Regulation on heating and energy efficiency in buildings
Voluntary commitments			Climate change declaration by German industry
Environmental management systems			EMAS, ISO 14001
Product labelling			Blue Angel
Green public procurement			Government purchases

Source: Adapted from Rennings *et al.* (2008).

2.1. *Measures targeting relative prices*

Pricing measures should be a cornerstone of environmental policy. In Germany, the most significant steps towards better pricing of environmental externalities include the

ecological tax reform, progressively introduced between 1999 and 2003 (Chapter 3), and the EU Emissions Trading System (EU ETS), which at first met with much resistance in Germany (Chapter 5). Both provide incentives for energy efficiency improvements in targeted sectors. Unfortunately, the 2010 Energy Concept (Box 4.1) is weak on pricing and taxation measures even though it contains over 100 measures (Chapter 5). In the electricity market, it introduces a nuclear fuel tax to be levied for the six years to 2016. It was expected to raise some EUR 2.3 billion a year (Bloomberg, 2010), about 36% of the expected annual increase in nuclear industry profit.[4] In the heating market, the Energy Concept envisages a revenue-neutral reform of the energy tax so that it differentiates by fossil fuel used and by CO_2 emissions. The German government also plans to examine further adjustment of the emission-based vehicle tax and fuel taxes. While reforming automotive fuel taxation to at least equalise diesel and petrol tax rates should be a priority (Chapter 3), the intentions remain vague.[5] The Energy Concept also lists a number of administratively costly tax exemptions and tax rebates.[6]

2.2. Measures targeting market diffusion: the case of renewable energy technologies

In the early 2000s, emphasis was placed on increasing the penetration of renewable energy sources in electricity and heat generation, complemented with support for diffusion of fuel-efficient heat generation technologies (combined heat and power), building renovations and performance standards for new buildings. Among these measures, the renewables feed-in tariffs (FITs) typify German financial incentive programmes.[7] Germany pioneered the initial version in 1991. It was reformulated in 2000 and contributed to a boom in renewables. As a result, by 2010 the shares of renewables had risen to about 17% in electricity generation and 9.5% in heat generation (Chapter 5). This helped Germany reduce its fossil fuel imports and achieve its CO_2 mitigation targets. The growing renewables industry also attracted investment and generated new employment opportunities (Chapter 3), although the net (general equilibrium) effects are difficult to assess.

The key features of the programme are:

- Guaranteed price for producers: the FITs are paid at a defined, declining rate over a period of 20 years (the formula for calculating the payments is fixed at the time of commissioning and does not change thereafter).
- Guaranteed market for producers: grid operators[8] must provide priority grid access to producers using renewables, and purchase and transmit all electricity fed into the grid (except in emergency situations).
- Independence from general budget revenue: the cost of the FITs is apportioned to the electricity price paid by end-use consumers (the burden falls on electricity users rather than on taxpayers) through what is referred to as the EEG surcharge.

The combination of these features means that the programme provides a predictable and credible long-term price signal to potential investors.[9] In broad terms, these features are not unique to the German system and are included in support programmes of many other countries. However, the greater uptake of the German system may be explained by several important differences, including: the stability of the system and predictability of the price signal provided; the introduction of the grid access mandate in 2004, which reduced investment uncertainty and made it easier for investors to raise the necessary financing; the lack of major administrative barriers in permitting (*e.g.* construction

permits), at least with respect to the situation in other countries; and finally, the cross-subsidy (the third bullet above), which insulates the system from public budgets, thus increasing its credibility in the eyes of potential investors as well as innovators (R&D being a risky and slow process, a long-term planning horizon is helpful).[10]

In contrast, FIT programmes in some countries (*e.g.* Spain, the Czech Republic) dramatically downscaled the tariff rates offered (sometimes retroactively) – a phenomenon known as stop-and-go policies. Indeed, Germany has been the only country without any interruption in its FITs since their introduction in 1991. The cross-subsidy is one of the key factors in the system's survival and predictability.[11] Nevertheless, there are critics of the FIT programme because of the costs incurred by German electricity consumers.

The differences between the rates of the tariffs supporting various renewables are intended to reflect the current state of the art in the technology as well as expected market developments that could drive down investment costs (Figure 4.2; Table 4.A1 in the Annex to this chapter).

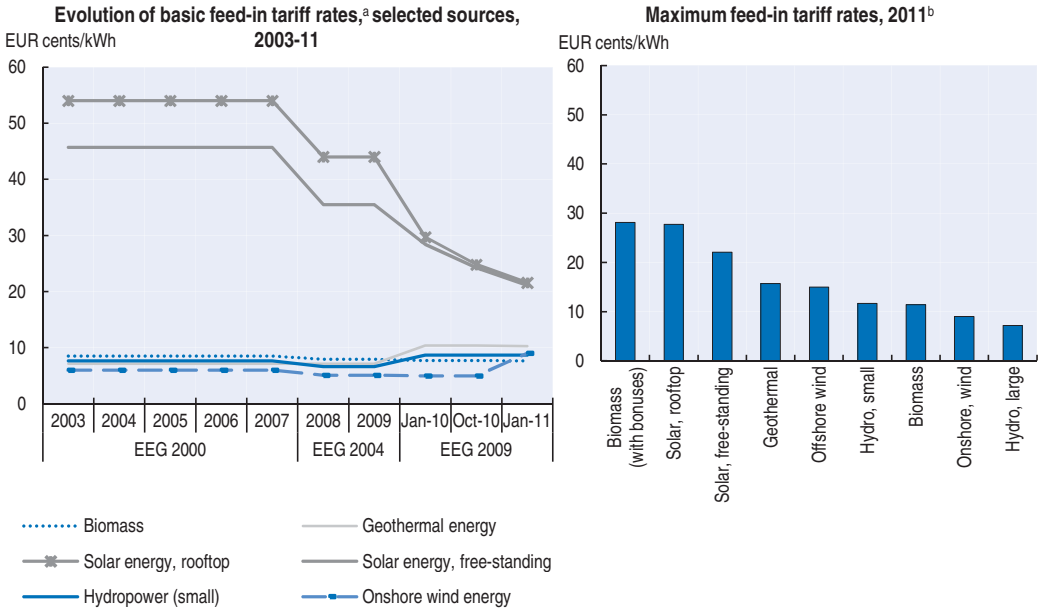
Consequently, designing the tariff structure poses high information requirements on the regulator. In the past, tariff rates were typically revised every four years. However, in 2010 they were exceptionally revised downward several times (Figure 4.2) because of a massive increase in solar photovoltaic (PV) installations in 2009, which was largely driven by cost decreases in the Chinese market. The tariffs offered at any given time are guaranteed for 20 years at a defined, decreasing rate. As a result, revised rates apply only to new installations commissioned after the revision. Implications are discussed later in this chapter.

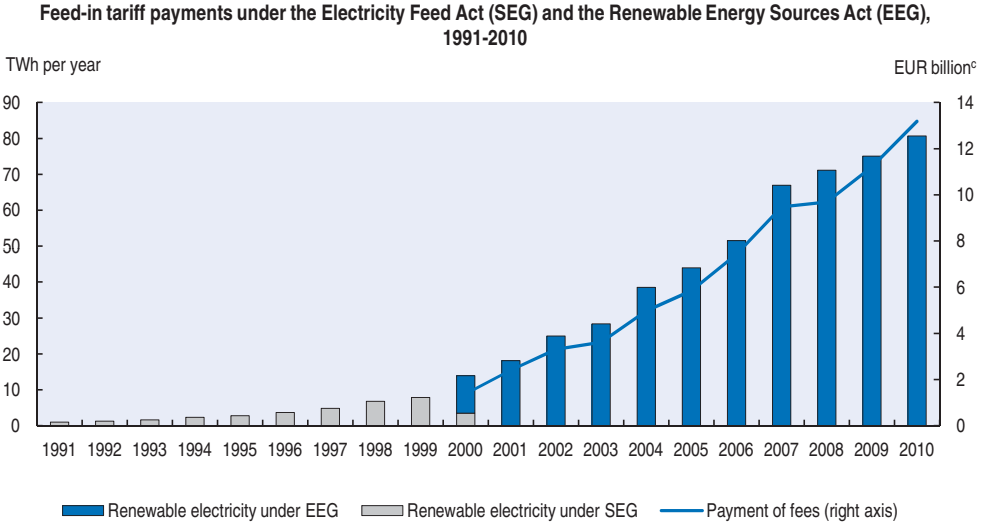
As an alternative to FITs, some countries have introduced portfolio obligations, also called renewable energy certificates (RECs) or renewable portfolio standards. Compared to RECs, the German-style FITs have both advantages and potential drawbacks. Some studies have suggested that FIT systems may be more efficient than other instruments. For example, Butler and Neuhoff (2008) and Mitchell *et al.* (2006) found Germany's FIT programme less costly and more likely to foster investment in renewables than the UK system of green certificates (UK Renewables Obligation).

Differentiation of the FIT rates by technology type allows maintaining a degree of diversity in generation sources and thus creating niche markets for technologies in early stages of diffusion. In contrast, REC programmes that do not distinguish between technology types let the regulated utility meet the quota using the least-cost option, such as wind power technology (see *e.g.* Johnstone *et al.*, 2010). RECs may thus provide insufficient incentives for early-stage technology development. However, setting the differentiated rates necessarily involves picking winners to a certain degree. There is indeed a fine balance between not picking winners and encouraging diversity in renewables penetration.[12]

However, the potentially most significant drawback of the German FITs is the inability of the regulator to directly control how much new capacity investors install in a given year.[13] This may introduce uncertainty because of the direct link between new installed capacity and FIT cost apportionment to the final electricity price. To a certain degree, the electricity price thus may become unpredictable. In countries where the cost was paid from public budgets, this unpredictability made such systems collapse. While the German programme may be more resistant to such shocks, rising costs and electricity prices could undermine public support of FITs.

Figure 4.2. **Feed-in tariffs for renewable sources**





a) Basic or minimal rates offered. The figure provides a highly simplified summary of the programme, based on information provided in Table A1. For a complete overview of applicable rates, see *www.erneuerbare-energien.de*.
b) Rates offered as of January 2011.
c) At 2010 prices.
Source: Adapted using data from BMU (2011), *Development of Renewable Energy Sources in Germany in 2010.*

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This was not an issue until recently, when rapid growth in solar PV installations started to increase the cost apportionment, known as the EEG surcharge. After a fast increase in solar PV capacity in 2007-09, the EEG surcharge increased from 1.3 EUR cents per kWh for 2009 to 2.3 EUR cents for 2010 and 3.53 EUR cents for 2011 (14% of the household electricity price). The German government reacted to these developments with

a swift revision of the FITs in 2009-10, which helped contain the speed of the increase. However, while regular evaluation and adjustment of the tariffs is important in keeping the costs in check, such a trial-and-error approach will be increasingly difficult to manage amid fast-developing technology markets and FIT commitments from previous years, which accumulate because the revised tariffs only apply to newly commissioned installations.

While it is important for governments not to add to market uncertainty, they need not try to predict the future better than markets. A predictable signal means putting in place a set of rules. The 2010 FIT revision goes in this direction by introducing the concept of dynamic degression for solar installations: instead of fixed degression rates to determine tariffs to be offered in future years, the degression rates are now linked to market developments. As a consequence, the FITs offered to installations commissioned in future years might increase or decrease by a predefined percentage depending on the volume of new capacity installed in the previous year (see Table 4.A2 in the Annex to this chapter).[14] Nevertheless, once an installation is commissioned the schedule of FIT payments remains fixed for 20 years.

In short, the German FIT programme has been a very effective policy instrument thanks to a set of incentives that create a well-protected market – a desirable characteristic for technologies in early stages of diffusion. However, this protection comes at a cost of high information requirements on the part of the regulator. And with the continuing rapid expansion of renewables in Germany and elsewhere in the world as the renewables market is scaled up, the risks involved are increasing. This may be a suitable moment to relieve the regulator of the increasingly complex task of FIT adjustments and introduce more flexibility into the system, at least for the more mature technologies.

There are several possible alternatives for introducing greater flexibility into the system:[15]

- Offer a schedule of price premiums; that is, a mark-up above the market price of electricity.
- Place a cap on annual growth in new capacity, an option sometimes viewed with scepticism on the grounds that it could undermine one of the basic virtues of the programme – the guaranteed market, which facilitates investors' access to investment financing (although the new dynamic degression approach implicitly creates such a cap).
- Introduce "reverse auctions", with potential investors bidding the lowest tariff at which they would be willing to feed renewably sourced electricity into the grid.

In addition, there may be alternatives for designing the cross-subsidy:

- Currently, the FIT cost apportionment (the EEG surcharge) effectively works as a tax on electricity, providing energy-saving incentives in electricity use. However, unless taxes on other energy carriers increase proportionally, the EEG surcharge will strengthen incentives to replace electricity with forms of energy that may be based on non-renewable fuels. This runs counter the initial objectives of the programme.
- Alternatively, the FIT cost apportionment could be spread over a basket of energy carriers, rather than only on the price of electricity; they could include automotive fuels, especially given the effort to encourage diffusion of electric vehicles.

The latest amendment of the Renewable Energy Sources Act (EEG 2012) includes new elements to strengthen the efficiency and flexibility of the system. The dynamic degression for solar installations has been further improved, and an optional market

premium and a flexibility premium for biogas have been introduced as supplementary, more market-based elements. These elements, as well as the Act in its entirety, will be closely and regularly monitored by the German government, which will also take into account ongoing scientific discussions on options for the further development and improvement of the FIT programme.

Moreover, EEG 2012 adds new incentives for grid integration of electricity from renewable sources: *i)* it introduces the concept of a "flexibility premium" for electricity generated from biomass (biogas) on a demand basis, thus providing an upstream incentive to facilitate integration of intermittent renewables into the grid; *ii)* it defines grid operators' liability in case of grid bottlenecks and an obligation to compensate renewable electricity producers for lost income, thus providing downstream incentives for grid integration; and *iii)* it extends the obligation to pay minimum FITs to electricity that is stored prior to being fed into the grid, thus providing incentives for the development of energy storage capacity.

Some studies have expressed concern over the fact that the FIT programme is being implemented in combination with the CO_2 emission cap of the EU ETS. Using multiple policy instruments to target the same environmental externality (greenhouse gas emissions, in this case) might shift abatement to more costly technologies without adding any climate mitigation benefits (OECD, 2011c). In practice, many governments have introduced such complementary policy instruments to facilitate achievement of more ambitious environmental objectives, or "dynamic efficiency" gains, in the longer run (Philibert, 2011). It should be also emphasised that such policies may target not only CO_2 mitigation but also other environmental objectives ("co-benefits"), such as reducing local air pollution. Moreover, markets for environmental innovation may suffer multiple failures and barriers, necessitating a mix of policy instruments. Still, while the debate remains, the potential interaction of these instruments should be carefully considered (see also discussion in Chapter 5).

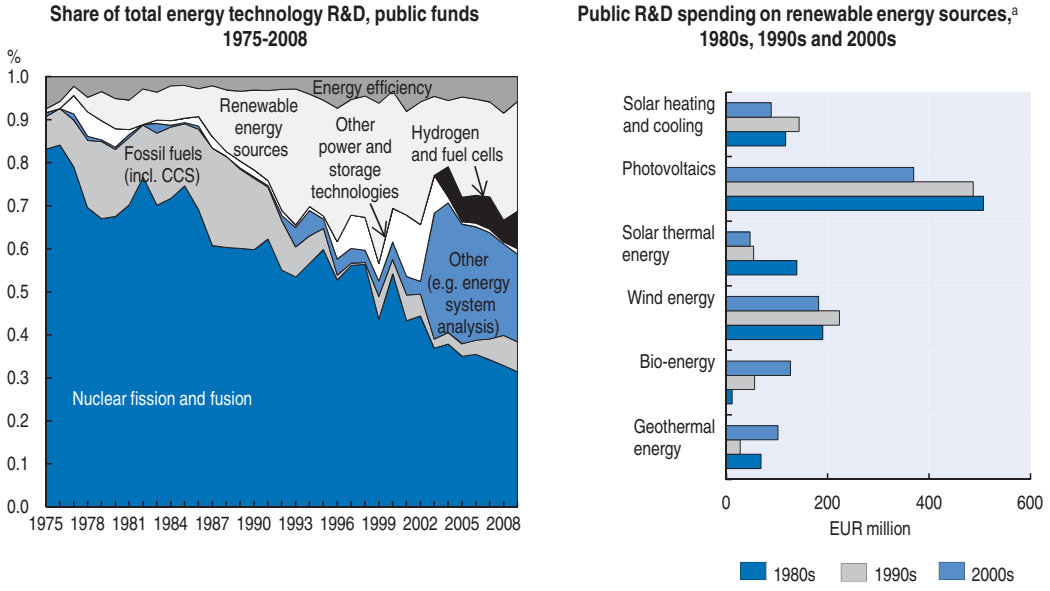
While differentiated FIT (or differentiated REC) systems help achieve diversity in energy generation from renewable sources, upstream measures, such as targeted differentiated support for technology development, present an alternative and are discussed in the next section.

2.3. Targeted R&D support

In an effort to develop domestic industry, the learning-by-doing benefits of FIT-supported diffusion of renewables have been complemented with targeted R&D support measures. Since the mid-1980s the share of public support for nuclear and fossil fuel R&D has decreased, with priorities gradually shifting to renewables, hydrogen and fuel cells, and other power and storage technologies (Figure 4.3). Interestingly, support for energy efficiency R&D has remained stable, although at relatively low levels, probably because of the introduction of a range of other instruments that aim to increase energy efficiency.

Within renewables, priorities seem to have shifted somewhat over time, with support for wind and solar energy decreasing and emphasis on biomass and geothermal energy increasing (Figure 4.3). As a consequence of direct support (R&D grants) and indirect support (learning-by-doing from diffusion), inventive activity in selected renewables technologies has increased sharply in Germany (especially as regards wind and solar) (Figure 4.4).

Figure 4.3. **Public R&D spending on energy technologies**



a) Cumulated spending over ten years (excluding negligible amounts on ocean energy and hydropower); 2009 prices.
Source: OECD (2011), *OECD Science, Technology and R&D Statistics Database.*

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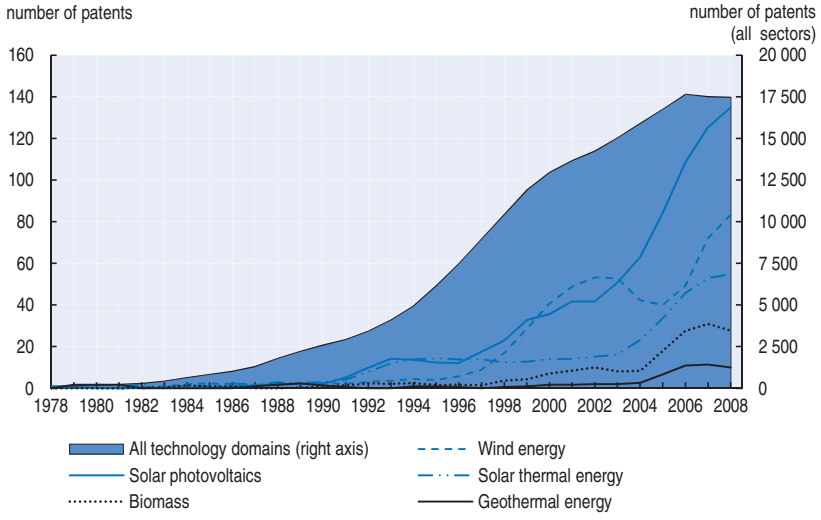
Figure 4.4. **Patenting activity in technologies for energy generation from renewable and non-fossil sources**[a, b]



a) Patent counts are based on patent applications filed under the Patent Co-operation Treaty (PCT) at international phase (EPO designations), using priority date and inventor's country of residence (fractional counts).
b) Three-year moving average data.
Source: OECD (2011), *OECD Patent Statistics Database.*

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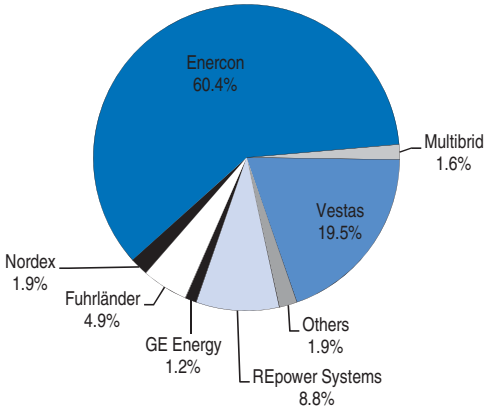
The large renewables market created by the FIT system allowed development of domestic R&D capacities and mobilised the domestic renewables industry. For example, in 2010 alone, investments in new renewables installations amounted to EUR 26.6 billion

(solar PV: EUR 19.5 billion, wind: EUR 2.5 billion, biomass: EUR 2.7 billion, solar thermal: EUR 0.95 billion and geothermal: EUR 0.85 billion, according to BMU [2011]).

In 2009, Germany became the world's primary market for solar PV installations, absorbing 53% of all new installed capacity worldwide. In wind energy, the German market ranks fourth (5% of all new capacity worldwide). German technology manufacturers have supplied large shares of these markets. Domestic wind equipment manufacturers (including Enercon, Nordex, Fuhrländer, REpower Systems and Multibrid) supplied over 77% of the German market alone in 2009 (Figure 4.5). They have also benefited from growing renewables markets internationally: as much as 80% of German-made wind power equipment is exported. German solar equipment manufacturers have thus far been less successful, supplying 30-35% of the domestic market, with the rest imported from China, Japan and Spain.

Figure 4.5. **Wind energy equipment suppliers**[a]



a) Share of new installed capacity in Germany up to end of 2009; provisional data.
Source: DEWI (2010), *Wind Energy Use in Germany*.

3. General innovation policy

Environmental policy is a key factor that can encourage development of innovative approaches to reducing negative environmental impacts of economic activity. What is also needed is an innovation policy that provides a suitable framework for such innovations.

3.1. Measures targeting positive information spillovers

The German innovation system is characterised by a generally high level of protection of intellectual property rights (IPR) – 4.5 out of 5 on the IPR index in Park and Lippoldt (2007). The Federal Ministry of Education and Research (BMBF) provides public funding for basic and applied research in a number of areas, including efficient energy generation and conversion, energy storage, energy transport and greenhouse gas (GHG) mitigation. The BMBF has established "innovation alliances" intended to co-ordinate and support joint research in companies, universities and extra-university research institutions (*e.g.* on development of prototypes of a new generation lithium-ion batteries).[16]

When it comes to environmental innovation, the funding of BMBF for applied research is very important. For example, a BMBF framework programme called Research for Sustainable Development is intended to intensify and enhance Germany's position as a technology and market leader in the fields of climate protection and adaptation to climate

change, sustainable resource management and innovative environmental technologies. Its central fields of action include global responsibility and international networking; earth system and geotechnologies; climate and energy; and sustainability and resources. The funding policy activities are concentrated on fields that develop future markets and further enhance the export orientation of Germany. The primary focus is on the challenges posed by climate change and scarcity of raw materials (BMBF, 2009).

Increasingly, international research collaboration also plays a role. Table 4.2 gives German co-invention rates for selected climate change mitigation technologies. As expected, the highest co-invention rates tend to occur in technologies where either the public-good aspect or network effects are most pertinent (*e.g.* GHG capture, grid management, CCS). Conversely, technologies with important private good aspects (and, therefore, high appropriability potential, such as renewables) tend to have below-average co-invention rates. Comparing the co-invention rates in the 2000s and the 1990s (not shown here), it appears that in the case of Germany, co-invention tends to be rare in the early stages of technology development but rises with increasing maturity of the technology. Indeed, the only case where co-invention did not increase between the two periods was conventional hydro, which has long been mature.

Table 4.2. **International research collaboration, selected climate change mitigation technologies, 2000-09**

Patent applications invented and co-invented by German residents

	Total inventions	Co-invention	Top five OECD partner countries[a]					Top five non-OECD partner countries[a]				
Greenhouse gas capture and disposal (non-CO_2)	152	24%	US	SE	CH	NL	GB	RU	ZA	BY	CN	
Grid management	224	21%	US	FR	SE	GB	DK	RU	VN	CN	AR	
CO_2 capture or storage	190	19%	US	GB	JP	CH	NL	CN	HK			
Biofuels	491	19%	US	GB	CH	NO	MX	CN	ZA	PE	SG	LI
Energy storage	2 699	16%	US	CH	GB	AT	FR	CN	UA	MT	RU	HK
Solar PV energy	2 076	15%	US	CH	AT	FR	GB	SG	LI	RU	IN	MY
All technology fields (total patents)	571 492	14%	US	CH	FR	GB	AT	CN	IN	RU	SG	BR
Hydrogen technology	463	13%	GB	US	CH	FR	AT	RU	CN	HR	IN	
Fuel cells	3 549	12%	US	CH	CA	GB	FR	CN	IN	RU	ZA	HK
Combustion technologies (CHP, IGCC, etc.)	565	12%	CH	NL	US	SE	FR	ZA				
Solar thermal energy	1 395	6%	US	CH	ES	AU	FR	LI	EG	TN	CN	HK
Wind energy	1 885	6%	US	NL	DK	ES	GB	TH	IN	RU	CN	BA
Hydro, conventional	308	5%	CH	US	MX	KR	IT	RU				
Marine energy	91	4%	GB	PL								
Hydro, tidal and stream	143	3%	DK	GB	IE	KR						
Geothermal energy	230	2%	AT	CH	IT							

a) The two-letter standard international codes refer to Argentina (AR), Austria (AT), Australia (AU), Bosnia and Herzegovina (BA), Brazil (BR), Belarus (BY), Canada (CA), Switzerland (CH), China (CN), Denmark (DK), Egypt (EG), Spain (ES), France (FR), the United Kingdom (GB), Hong Kong China (HK), Ireland (IE), India (IN), Italy (IT), Japan (JP), Korea (KR), Liechtenstein (LI), Malta (MT), Malaysia (MY), Mexico (MX), the Netherlands (NL), Norway (NO), Peru (PE), Poland (PL), Russia (RU), Sweden (SE), Singapore (SG), Thailand (TH), Tunisia (TN), Ukraine (UA), the United States (US), Vietnam (VN) and South Africa (ZA).

Source: OECD Project on Environmental Policy and Technological Innovation (*www.oecd.org/environment/innovation*), based on data extracted from the PATSTAT database.

3.2. Measures targeting availability of factors of production

Germany is facing potentially serious labour shortages. By some estimates, thousands of engineers are needed in the engineering sector alone, and the whole economy will be short of up to 2 million qualified workers by 2020 (*New York Times*, 2011). The German Chambers of Industry and Commerce found that "32% of companies viewed labour shortages as the single greatest risk to their future prosperity – double the 16% that expressed that concern a year ago" (Reuters, 2011). A similar conclusion was reached in a study reporting that "family-owned German companies see labour shortages as their greatest challenge in the recovery" (*Financial Times*, 2010).

These trends are likely to be aggravated against the backdrop of the demographic trends that Germany is facing. While this is a broader issue, and the shortages do not concern all sectors and professions equally, R&D personnel (especially in science and engineering) and high-skilled workers (manufacturing) are among the categories where the potential shortage is greatest. This is important for the capacity of the country to achieve its ambitious innovation objectives. Maintaining high quality in education, encouraging EU-wide labour mobility and facilitating immigration are some possible approaches.

3.3. Measures targeting market structure and barriers to firm entry/exit

In a recent Eurobarometer survey (EC, 2011), firms in EU countries were asked to assess the importance of various factors as "barriers to accelerated eco-innovation uptake and development". Figure 4.6 summarises the seriousness of these barriers as perceived by enterprises in Germany, compared with those in other EU countries. On the positive side, in all but two cases German firms were less apt to consider these factors barriers than firms elsewhere. The two exceptions were lack of qualified personnel and market dominated by established enterprises. The former confirms the labour market concerns. The latter points to the issue of market power and indicates that German industrial policy might be creating conditions that suit incumbents but are unfavourable to new entrants.

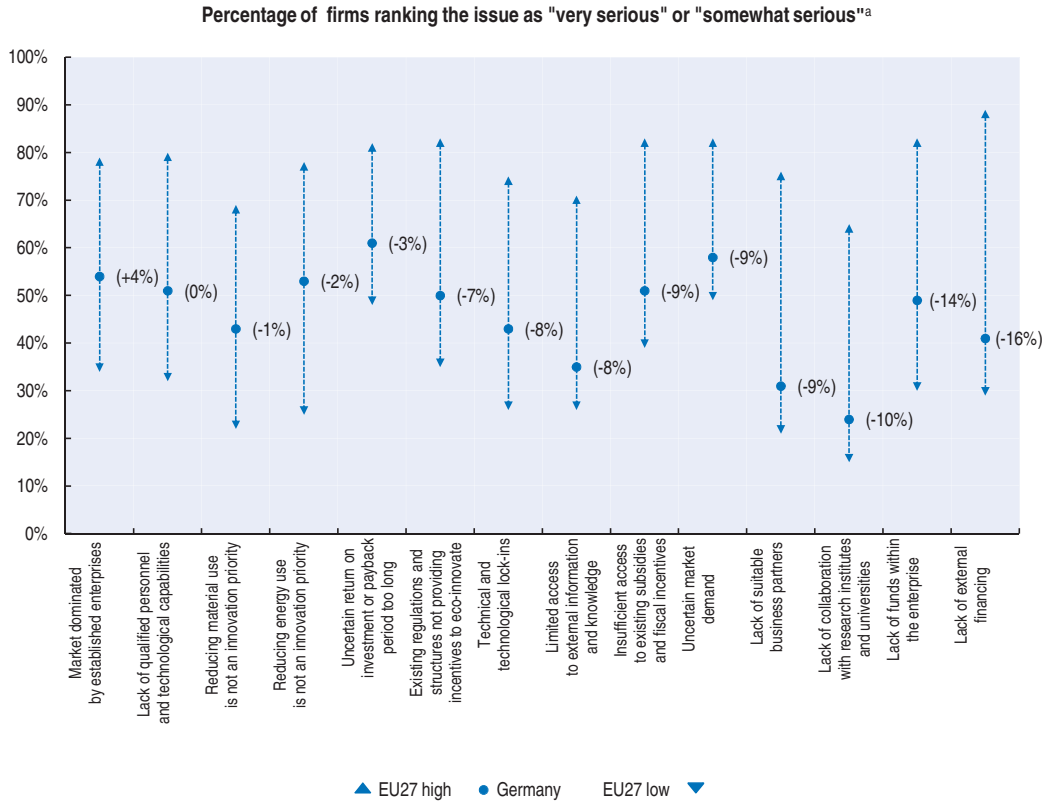
Reducing barriers to entry and exit is important because newly created firms can be very innovative. While they tend to account for a large share of patenting in OECD countries, their share is relatively low in Germany (Figure 4.7). One way of reducing barriers to entry is through simplifying and reducing start-up regulations and administrative burdens. Reducing barriers to exit is also important because firms planning to enter the market may have little idea of their chances of survival and costly exit can discourage them from entering (OECD, 2010).

3.4. Measures to support commercialisation and market introduction

Germany has a wide range of programmes that support market introduction, largely under the aegis of the Federal Ministry of Economics and Technology (BMWi) and the BMBF. These include the High-Tech Gründerfonds (foundation), the Business Angels network, spin-off activities of universities and support of new business models. KfW, a state owned development bank, also provides support. In addition, selected environmental priorities are supported specifically, for example through pilot projects backed by the BMU.

Public support of market introduction plays an important signalling role in the ability of private investors to raise further financing (*e.g.* in the form of venture capital). Hence, it is important for such signals to be provided rapidly and at low administrative costs. This is

Figure 4.6. **Barriers to companies for accelerated eco-innovation uptake and development**



a) Results of a Eurobarometer survey carried out over a sample of SMEs in the 27 EU Member States between January and February 2011. The figures in brackets indicate the different perception of eco-innovation barriers between Germany and the EU average.
Source: Adapted using data from EC (2011), *Attitudes of European Entrepreneurs towards Eco-innovation: Analytical Report.*

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particularly vital for survival of start-up companies and innovative small and medium-sized enterprises (SMEs) (Box 4.2).

3.5. *Financing R&D and technology adoption*

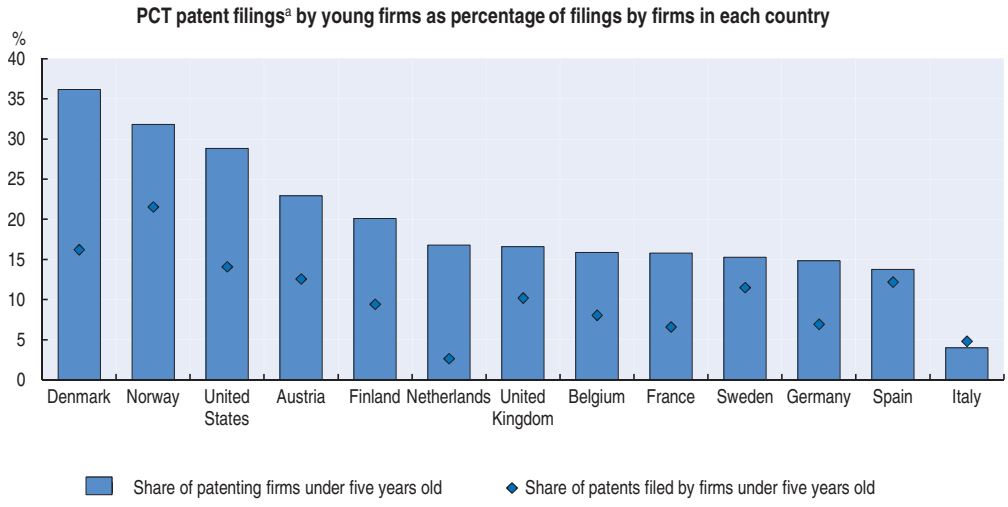
Germany's spending on R&D has been relatively stable: the share of gross domestic expenditure on R&D in GDP rose from 2.4% in 1981 to 2.8% in 2009. However, in 1981 Germany ranked first (together with the United Kingdom) among the OECD countries, but by 2009 it had been overtaken by Israel (4.3%), Finland (4.0%), Sweden (3.6%), Japan and Korea (3.4% each), and Denmark and Switzerland (3.0% each).

Achievement of the country's ambitious innovation objectives, for example as set out in the Energy Concept, will require massive investment in R&D as well as in technology adoption. However, the Energy Concept does not provide indications about ways to mobilise the necessary financing without crowding out private investment and without placing an excessive burden on public budgets.

3.6. *Improving supply-side co-ordination (innovation clusters, industrial networks)*

Markets for innovation frequently suffer co-ordination problems resulting in high transaction costs. This is particularly important for integrated technologies that cover

Figure 4.7. **Patenting activity of young firms, selected OECD countries**



a) Data refer to patent applications filed under the Patent Co-operation Treaty (PCT) by firms with a priority in 2005-07. Counts are based on a set of patent applicants successfully matched with business data. US firms account for 33.5% of overall PCT filings by firms, and 14% of these are applied for by firms under five years old.

Source: OECD (2010), *Measuring Innovation: A New Perspective.*

StatLink http://dx.doi.org/10.1787/888932591957

Box 4.2. **Zenergy Power**

Zenergy Power GmbH is an example of a highly innovative company that grew from a small start-up enterprise into a leader in the field. It specialises in transforming results of basic research on superconducting materials into commercial applications – high-temperature superconductor systems, components and wires. These products have a wide range of potential applications in the metal industry, power generation, power transmission and power distribution networks. According to the company, the benefits of these applications are in increased energy efficiency and performance. For example, a superconductor fault current limiter reduces the risk of blackouts, improves grid reliability and prepares the grid for integration of intermittent renewables; a superconductor generator for a hydropower plant allows a 30% increase in generator capacity; a superconductor generator for a wind energy turbine achieves a 50% reduction in generator losses and allows reductions in turbine size and weight, bringing down offshore wind power costs by 25%; and an industrial metal billet heater achieves a 50% reduction in energy consumption.

Zenergy Power is headquartered close to Bonn and has two other facilities, in the USA and Australia. It employs about 100 people, including 30 to 40 PhD-level researchers in science and engineering. Zenergy's development has been assisted by entrepreneurial managers, a local innovation cluster, support by local authorities and a solid network of potential suppliers, thanks to the broad industrial base in Germany (*e.g.* in metallurgy and metal products). Availability of skilled workers, whether graduates of local universities or staff found by facilitating international mobility, is essential. German and European R&D grants have been key in providing support for developing feasibility studies, scaling up prototypes and eventual pilot projects. In the process, speedy and transparent grant procedures have been helpful. Achieving improvement on this front is important because some form of public support (grants, risk guarantees, product purchase commitments) is essential as a signal in firms' efforts to raise private financing.

multiple domains (and hence require co-ordination between several ministries). The National E-Mobility Platform is an example of a measure intended to reduce these costs (Section 4).

In addition to the role of the federal government, many responsibilities for innovation support are decentralised to the state (*Land*) level. However, proximity is a double-edged sword, decreasing information asymmetry, on the one hand, but increasing the risk of rent seeking and vested interests of local industries on the other. There are some indications that these risks are present, although it is difficult to assess their significance.

4. Policy co-ordination

The importance of co-ordination – between different branches of government (ministries, agencies) or different levels of government (federal, state, local) – is important in order to achieve coherence of incentives provided by a package of policy instruments, along with development of the necessary infrastructure (Chapter 2).[17]

For example, the 2008 Master Plan on Environmental Technologies, a step towards implementing the High-Tech Strategy for Germany (EUR 2.5 billion of federal funding), was initiated jointly by the BMU and the BMBF. It was designed as a cross-sectoral environmental and innovation policy measure. Its aim is to speed up the innovation process from the research stage to the development of national and international markets in environmental technologies. It comprises a range of measures aimed at improving the framework conditions for innovation (promoting basic research and its conversion into applications, assisting market introduction, providing targeted support for SMEs and assisting diffusion of these technologies in national and international markets). The German Water Partnership is a component of the Master Plan on Environmental Technologies (Box 4.3).

Box 4.3. **The German Water Partnership**

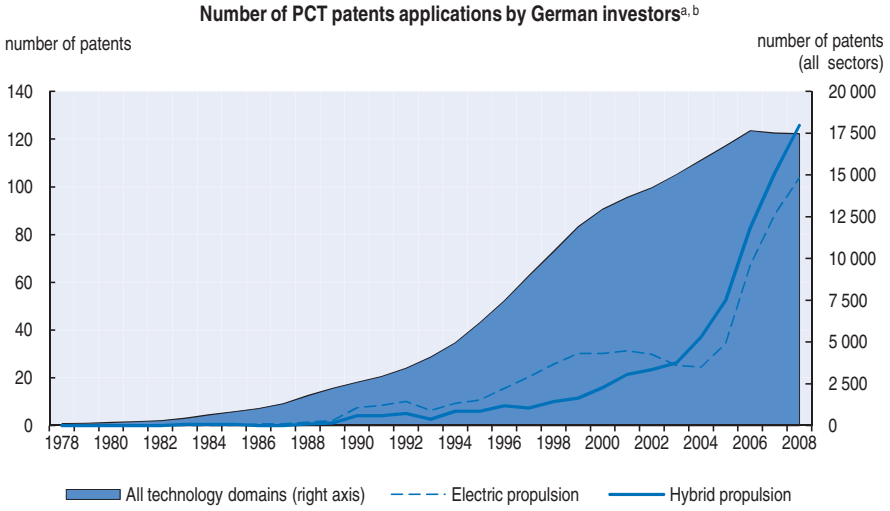
The German Water Partnership (GWP) is an innovation platform initiated by the German government in 2008. It brings together stakeholders from research, industry and civil society, pooling resources and activities. The GWP helps German businesses achieve a stronger long-term position in the export market for the water sector by allowing them to present themselves as a unified group. Benefiting from the contacts and networks of its more than 400 individual members by exchanging information and experiences, the GWP helps promote Germany's expertise in the water sector at a global level.

Source: German Water Partnership, *www.germanwaterpartnership.de*.

Another component of the Master Plan is the Electric Mobility Development Plan, a recent step in efforts to encourage development of alternative-fuel vehicle technologies in Germany (Box 4.4). E-mobility has attracted a great deal of attention, but it is important for the government to try to prevent technology lock-in by avoiding a focus on too narrow a set of options. As a large industrial country, Germany is experimenting with a wide range of transport-related technologies, including new fuels (biofuels), conversion technologies (fuel cells), storage (batteries), charging devices and propulsion technologies (electric car drive trains). Overall, the government has committed up to EUR 2 billion in public funding to support various research, development and demonstration programmes. However, it is difficult to assess the relative magnitudes of resources devoted to these areas, as few R&D

data on support directed at the automotive sector as a whole are publicly available. Nevertheless, there is evidence that inventive activity in electric and hybrid drives has picked up recently (Figure 4.8), though it remains modest compared to emission reduction efforts aimed at conventional drives (Figure 4.1).[18]

Figure 4.8. **Patenting activity in electric and hybrid motor vehicle technologies**



a) Patent counts are based on patent applications filed under the Patent Co-operation Treaty (PCT) at international phase (EPO designations), using priority date and inventor's country of residence (fractional counts).
b) Three-year moving average data.
Source: OECD (2011), *OECD Patent Statistics Database.*

StatLink http://dx.doi.org/10.1787/888932591976

Box 4.4. **National Platform for Electric Mobility**

The National E-Mobility Platform is a key element of the Electric Mobility Development Plan. It was established to facilitate inter-sectoral dialogue involving four federal ministries[1] and other stakeholders. Current priorities include major investment in battery R&D (EUR 4 billion by 2013, including EUR 500 million of public support), development of electric car drive trains, support for education and qualification (especially in electrochemistry and power electronics) and promotion of spillover through networks and demonstration.

A key objective is development of the necessary infrastructure for a large-scale introduction of electric vehicles in Germany. This includes a co-ordinated deployment of renewables-based power supply and intelligent charging of batteries to achieve twin objectives: the stabilisation of the electricity grid and the integration of intermittent renewable energy sources. The goal is to have 1 million electric vehicles on German roads by 2020 and 6 million by 2030.

In addition to environmental objectives, the e-mobility plan aims to achieve industrial policy objectives so as to keep a major part of the value added in Germany by using the key competences of German industry along the whole value-added chain (research, development and production).

Another important goal is international standardisation (in terms of legal and technical norms) of the charging infrastructure and associated vehicle components so as to reduce overall infrastructure investment costs and increase consumption spillover effects.[2]

1. The BMU, the BMWi and the ministries of transport and of building and urban development.
2. For more information, see NPE (2010) or *www.bmu.de/english/mobility/doc/44799.php*.

When it comes to supporting diffusion, no financial incentives for the purchase of electric vehicles (EVs) are currently in place. This most likely reflects the dominant role of foreign EV suppliers. Rather, non-financial incentives are being considered, such as free parking for EVs, dedicated lanes and free battery charging. Until recently, government procurement programmes were missing, even though a single big buyer is exactly what is needed given the important network effects involved (positive demand spillover) (OECD, 2003). Following the adoption of the Government Programme for Electric Mobility in May 2011, the German government set a procurement goal of 10% of EVs in government fleets. Nevertheless, the focus of the programme remains on R&D support, as the government believes this will help lower costs and improve technology more effectively in the current phase than fiscal incentives for consumers.

Overall, the transport policy mix appears rather incoherent. On the positive side, the vehicle ownership tax is now differentiated by vehicle CO_2 emissions,[19] and a preferential VAT rate on rail transport and road charging for heavy duty vehicles have been introduced. However, a number of issues remain unresolved and provide incentives that run counter to Germany's stated goals, including: the tax treatment of company cars (which account for a large share of the car fleet, especially in the high-emission bracket), which effectively amounts to a permanent subsidy for the car industry; a car allowance for commuters; the tax treatment of automotive fuels (a lower tax rate on diesel despite its higher carbon content); and insufficient use of measures targeting traffic volume (*e.g.* road tolls). In addition, the 2008 scrapping programme largely wasted EUR 5 billion by supporting undifferentiated car purchases (the only criterion was car age) (Chapters 3 and 5). Such policy incoherence is probably a result of the long history of industrial policy aimed at German car manufacturing, which has created powerful incumbents with vested interests in opposing change. This undermines the potential for effectiveness and efficiency of the sectoral policies implemented so far, as well as the environmental policy agenda more broadly.

In contrast, in the renewable energy sector a much more coherent package of policies has been put in place, although the question of efficiency remains to be answered. Some gaps still exist, notably inconsistencies in the energy tax, a lack of measures addressing the split landlord-tenant incentives in energy performance of buildings, a lack of measures to encourage efficiency improvements in electricity transmission, and barriers to expansion of the electricity grid and the related infrastructure.

Addressing this last issue requires co-ordination between energy policies, transport policies and local land use planning. The FIT programme, through its grid access mandate and the broad policy commitment to renewables expansion, already provides incentives for transmission system operators to invest in grid expansion and stability. The expected growth in renewables thus provides an incentive for transmission system operators to invest in infrastructure in order to prepare for very high shares of intermittent renewables (Box 4.5). Yet this is unlikely to be sufficient, given the important network effects in the energy sector and the monopolistic nature of electricity transmission. Therefore, consideration should be given to strengthening the role of the independent network regulator (the Federal Network Agency) so that it oversees grid extension and investments in grid stability, especially where co-ordination with local authorities is essential to deal with land use planning and "not in my backyard" issues.

Box 4.5. **Mini E-Berlin powered by Vattenfall**

Installed capacity of intermittent renewables (wind and solar) in Germany is expected to increase from 43 GW in 2010 to about 100 GW sometime after 2020. There are currently few alternatives for closing the growing gap in intermittency of renewables; the only realistic option is investment in pumped storage capacity at home and abroad (chiefly in Norway, Austria or Switzerland). Alternative energy storage facilities based on compressed air or flywheels are still under development. Without the appropriate technologies, a large-scale introduction of electric vehicles could pose a serious threat to grid stability. To avoid such complications, smart charging systems could turn threat into opportunity.

Vattenfall Europe AG has developed charging stations that allow intelligent charging to balance demand against electricity supply. A small fleet of electric Mini E-Berlin cars, a model developed by BMW, is being field tested in Berlin to determine the most suitable locations for the remotely operated charging stations, along with corresponding pricing options. According to Vattenfall, users will be able to buy a portable charger for charging at home or use public charging stations. In both cases, a user will specify the speed and duration of the charging procedure. Charging will be price-differentiated to provide incentives for charging during periods of excess supply (peak wind and off-peak load, also called "wind-to-vehicle") and for serving as a power source during periods of excess demand (off-peak wind and peak load, or "vehicle-to-grid"). Such a system allows optimising demand and supply by setting priority rules at spots with excess demand (local load management). However, obstacles remain, including municipal land use issues such as whether to have dedicating public parking space exclusively for EVs.

The charging stations can be used by e-vehicles of all kinds and by customers of different energy suppliers. Vattenfall intends to sell its charging equipment not only to individual car owners but also to electricity distributors as a means of improving grid stability by cutting peaks and shifting demand on hourly and daily fluctuations. A study at Humboldt University in Berlin calculates that the opportunity costs are high, estimating that, if all 45 million cars in Germany were electric, the maximum daily load would need to increase by a factor of 2.5.

4.1. Co-ordination between levels of government

In Germany, environmental policy making is centralised at the federal level while policy implementation and enforcement are delegated to state and local authorities (Chapter 2). This is a special case of the principal-agent problem: there are no direct incentives for the central government to design policies in a manner that allows cost-effective implementation (*i.e.* low administrative and monitoring costs), while the budget-constrained local authorities that are charged with implementation and enforcement have no direct influence over policy design. This has not only an array of fiscal implications, but also important innovation implications, as poor enforcement of a policy undermines its innovation incentives. It would seem that the two most likely solutions are to improve co-ordination between different levels of government with the aim of designing more cost-effective policies or to design self-funded programmes.

Notes

1. For more information, see *www.retech-germany.net* (in German).
2. After a long period of fuel tax increases, in 2004 the tax share of automotive fuel prices started to decline. The share of taxes in the final price of diesel went from 68% in 1998 to 51% in 2008. This general trend (common to most OECD countries except Korea) was linked to soaring oil prices in the 2000s. In the late 1970s, Germany's tax share was 58%, double the OECD average of 29%, but this spread narrowed as other countries increased their tax rates faster than Germany. As a consequence, by the late 2000s Germany's tax share in diesel price was about a third higher than the OECD average (56% *vs*. 44%).
3. In general, integrated approaches tend to be more cost-effective than end-of-pipe solutions and help keep environmental problems from occurring.
4. This expected effect has since been somewhat attenuated by a partial shut-down of the country's nuclear plants.
5. Given the higher carbon emissions from diesel combustion, the tax rate per litre of diesel ought to be higher than the tax rate per litre of petrol.
6. OECD (2011a) provides a discussion of environmentally motivated tax relief measures.
7. For more information see the Renewable Energy Sources Act, also known as the EEG after its name in German, Erneuerbare-Energien-Gesetz, see *www.erneuerbare-energien.de*.
8. The German electricity market has been deregulated. There are four large electricity utilities (E.ON, RWE, EnBW and Vattenfall) and four transmission system operators (EnBW Transportnetz, Tennet, Amprion and 50 Hertz).
9. Andor *et al*. (2010) have suggested that "priority grid access" could be removed under certain circumstances.
10. Barradale (2008) argues that uncertainty over annual renewal of the federal production tax credit discouraged investment in renewables in the United States, a position supported by anecdotal evidence in Wiser and Pickle (1998) on wind and solar power. In comparing wind power development in Denmark, Germany and Sweden, Söderholm *et al*. (2005) attribute the relatively slow pace of development in Sweden more to instability in the policy framework than to the level of support, several subsidy programmes having been implemented successively for short periods.
11. Moreover, introduction of Germany's FITs was based on a broad consensus of political parties. This too may have helped the system remain stable despite changes in government.
12. REC programmes can in principle be designed with multiple quotas differentiated by technology type (maturity), and possibly remunerated with varying amounts of credits. An example is California's zero-emission vehicle (ZEV) mandates (OECD, 2011b). Multiple-quota RECs would be, in many respects, equivalent to differentiated FITs. They would allow management of diversity in renewable sources but, like FITs, would suffer from high information requirements for the regulator. Recently, several countries, including Italy and the United Kingdom, have introduced differentiated REC schemes for solar power. The REC system introduced in Australia specifies "multipliers" to encourage deployment of selected technologies (solar PV, wind, micro-hydro). Insofar as such multipliers vary across technologies, the information requirements for the regulator are identical to those of a FIT.
13. Despite the lack of an explicit cap on new capacity, it is possible that the permitting process may itself allow for an indirect cap.
14. Traber *et al*. (2011) predict a significant moderating effect of dynamic degression on FIT cost apportionment.
15. For further suggestions on improving efficiency of the system see *e.g*. Frondel *et al*. (2010), Mennel (2010) and Andor *et al*. (2010).
16. Public funding of EUR 60 million is to be complemented with EUR 360 million in private research funding (BMBF, 2009).
17. In some countries, this is addressed by creating "superministries" in charge of a range of issues (economy, environment, research and technology). While such an approach can internalise co-ordination problems, it is not without risks. There is a trade-off between splitting responsibilities (and formal co-ordination) and merging responsibilities (and thus informal co-ordination). The big question is to what extent institutional division is a useful tool or a barrier to reconciling conflicting policy objectives.

18. The German government believes short- and mid-term GHG mitigation in motorised individual transport will heavily depend on advances in the conventional vehicle sector, as such vehicles are expected to dominate new car sales at least until 2030.

19. Nevertheless, the incentives it provides to choose diesel-driven vehicles are still too strong. The Israeli system, for example, also takes other emissions into account.

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ANNEX 4.A

Overview of tariffs under the Renewable Energy Sources Act (EEG)[1]

Table 4.A1. **Feed-in tariffs according to year of commissioning**

EUR cents per kilowatt-hour

	EEG 2000	EEG 2004	EEG 2009			EEG 2012
	Commissioned in 2003	Commissioned in 2008	Commissioned 1 January 2010	Commissioned 1 October 2010	Commissioned 1 January 2011	Commissioned 1 January 2012
Biomass (without bonuses)	8.5-10.0	7.91-10.83	7.71-11.55	7.71-11.55	7.63-11.43	6.0-14.3
Biomass (with bonuses)	–	9.91-25.01[a]	9.17-28.38[a]	9.17-28.38[a]	9.08-28.10	8.5-22.3
Geothermal energy	7.16-8.95	7.16-15.00	10.40-15.84	10.40-15.84	10.30-15.68	30.0 (25.0)[d]
Solar energy (rooftop)	54.0-57.4	43.99-46.75	29.70-39.57	24.79-33.03	21.56-27.74	18.33-24.43
Solar energy (free-standing)	45.71	35.49	28.43	24.26-25.37	21.11-22.07	17.94-18.76
Hydropower (large > 5 MW)	6.65	3.54-7.36	3.47-7.22	3.47-7.22	3.44-7.15	3.40-5.50
Hydropower (small < 5 MW)	7.67	6.65-9.67	8.65-11.67	8.65-11.67	8.65-11.67	6.30-12.70
Wind energy (onshore)[b]	8.80 (6.0)	8.03 (5.07)	9.11 (4.97)	9.11 (4.97)	9.20 (5.02)	8.93 (4.87)
Wind energy (offshore)[b]	–	8.92 (6.07)	15.0 (3.5)[c]	15.0 (3.5)[c]	15.0 (3.5)[c]	15.0 (3.5)

a) The upper limit of the interval takes account of all bonuses that are accumulable in principle. In practice, such tariffs are only paid in exceptional cases. Tariffs of up to EUR 0.25 per kWh for 2010 are realistic (small biogas installation with CHP, energy crops and manure use).

b) The basic tariff for wind energy is given in brackets. The increased initial tariff is paid for at least five years. This period may be extended depending on the reference yield.

c) Increased initial tariff (13.00) + quick-starter bonus (2.00). Increased initial tariff for offshore wind energy is paid in the first 12 years.

d) The basic tariff for geothermal energy is given in brackets. The increased tariff is paid for utilisation of petrothermal technology.

Source: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. For further details see *www.erneuerbare-energien.de*.

Table 4.A2. **Degression of feed-in tariffs**

% per year

	EEG 2000	EEG 2004	EEG 2009			EEG 2012
	Applicable in 2003	Applicable in 2008	Applicable on 1 January 2010	Applicable on 1 October 2010	Applicable on 1 January 2011	Applicable on 1 January 2012
Biomass (without bonuses)	1.0%	1.5%	1.0%	1.0%	1.0%	2.0%
Biomass (with bonuses)	–	1.5%	1.0%	1.0%	1.0%	2.0%
Geothermal energy	n.a.	1%	1%	1%	1%	5% (0%)[c]
Solar energy (rooftop)	5%	5%	8-10% (+1%)	16%	9% (+4%)[a]	9% (+6%)[d]
Solar energy (free-standing)	5%	5%	10% (+1%)	11%	9% (+4%)[a]	9% (+6%)[d]
Hydropower (large > 5 MW)	n.a.	10%	1.0%	1.0%	1.0%	1.0%
Hydropower (small < 5 MW)	n.a.	n.a.	n.a.	n.a.	0%	1.0%
Wind energy (onshore)	1.5%	2.0%	1.0%	1.0%	1.0%	1.5%
Wind energy (offshore)	–	2%	0%	0%	5% (0%)[b]	7% (0%)[c]

a) If the new capacity installed in the previous year exceeds 6 500 MW.
b) The 0% rate applies until 2014.
c) The 0% rate applies until 2017.
d) If the new capacity installed in the previous year exceeds 4 500 MW.
Source: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. For further details see *www.erneuerbare-energien.de*.

Note

1. Based on information available on 19 January 2012. Tariffs for electricity generated using landfill gas, sewage gas, mine gas and biowaste gas are also specified in the law but are not listed here.

PART II

Chapter 5

Climate change

Germany is a front-runner in developing solutions to address the challenge of climate change. It managed to considerably reduce domestic greenhouse gas emissions over the 2000s and will meet its target under the Kyoto Protocol exclusively through domestic measures. This chapter reviews the policy initiatives implemented over the decade to achieve these results, the institutional and strategic frameworks and the mechanisms in place to monitor implementation. It assesses progress in using market-based instruments such as energy taxes and emission trading; it analyses the effectiveness of measures implemented in the energy and transport sectors, including those to promote renewables, energy efficiency and improved vehicle technologies. The interactions between different policy instruments are also considered. Finally, Germany's ambitious emission reduction targets to 2020 and beyond are discussed.

Assessment and recommendations

Germany is among the few Annex 1 parties to the United Nations Framework Convention on Climate Change that will comply with its commitments under the Kyoto Protocol exclusively through domestic greenhouse gas (GHG) emission reductions. Domestic GHG emissions declined by 10% between 2000 and 2010, and in 2010 they were 24% below the Kyoto Protocol base year level. About 40% of this reduction occurred in 2008-10 and was partly due to the economic recession.

Progress in reducing emissions can be also attributed to a strong political commitment and to an effective climate policy cycle based on regular evaluation and adjustments. However, parliamentary oversight remains limited and the decision-making cycle has been criticised as not being fully transparent and not ensuring enough stakeholder participation. Addressing these issues could help provide a more balanced basis for decision making and maintain the widespread public support for the government's climate policy.

Germany is committed to continue its leadership role in climate policy and has pledged to reduce GHGs by 40% by 2020. This domestically agreed target goes beyond what would be required under current agreements at EU level. While this ambition is to be commended, and is in line with broader international goals, a number of related uncertainties remain to be resolved, not least how the target is to be achieved in the context of a transboundary emission trading system that covers a large part of German GHG emissions. Achieving the 2020 target will require accelerating the pace of emission reductions in the 2010s. GHG emissions are expected to grow in the early 2010s as a result of the expected economic recovery. In addition, the immediate closure of seven nuclear power plants in 2011, and the decision to phase out nuclear power by 2022, could initially lead to an increase in fossil fuel use and a related increase in GHG emissions.

Germany has increasingly used economic instruments as part of its climate mitigation policy. A reform of energy taxation (ecological tax reform) launched in 1999 helped reduce energy use and is estimated to have cut GHG emissions by about 2%. Germany participates in the EU Emissions Trading System (EU ETS), launched in 2005, which covers about 60% of its CO_2 emissions. However, as in most EU countries, emission permits were systematically over-allocated and resulted in the sectors involved benefitting from substantial windfall profits. These factors contributed to the volatile and persistently low allowance price, which, as a result, did not provide sufficient incentives for investing in lower-carbon technology and energy sources. While revision of the EU ETS is expected to address these issues to some extent from 2013, free allocations will continue for some sectors. Uncertainty remains about whether the market will lead to a sufficiently stable and high CO_2 allowance price.

As in other EU countries, energy taxation and the EU ETS should be adequately combined to provide an effective and consistent carbon price signal across the economy, in both ETS and non-ETS sectors. In a number of areas, however, double regulation is a

concern, and in others – including small combustion plants, export-oriented agriculture and manufacturing – neither instrument establishes a price on carbon. A flexible form of taxation could be applied at EU level to sectors participating in the ETS to supplement the anticipated (low) price of allowances and help control price volatility.

Germany's strategy for achieving climate- and energy-related goals relies heavily on increased use of renewable energy sources and energy efficiency. The share of renewables in electricity generation increased from 7% of in 2000 to 17% in 2010. Progress to date has relied heavily on a system of feed-in tariffs. This system has been better designed than in many other countries, and has helped the development and the diffusion of renewable energy technologies. This has contributed to increasing job opportunities and to reducing domestic CO_2 emissions and fossil fuel imports. However, the implicit CO_2 abatement cost is estimated to be well above the CO_2 allowance price. Continuous efforts are needed to control the relatively high costs of the feed-in tariffs, and their impact on electricity prices, and to shield them from unpredictable developments in the renewable energy market. The interactions between Germany's feed-in tariffs and the EU ETS should also be kept under review. The promotion of renewables in any EU country, especially a big player such as Germany, can lead to lower allowance prices and the displacement of emissions. For this reason, the expected development of renewables in EU countries was taken into account in setting the EU-wide cap for the third phase of the ETS. Achieving the targets outlined in the 2010 Energy Concept – at least 35% of gross electricity consumption from renewables by 2020 and at least 80% by 2050 – also implies additional costs due to the considerable investment to expand the electricity transmission and distribution network, as well as storage capacity, in order to ensure the security and reliability of the grid.

The Energy Concept provides for the establishment of a special energy and climate fund. This fund could be a positive development provided that it targets areas that present clearly identifiable market failures and projects that are justified environmentally and economically. The government launched a number of initiatives to overcome market barriers to investment in residential energy efficiency. However, to meet the ambitious target of doubling the annual number of thermal retrofits as outlined in the Energy Concept, barriers which prevent take-up among households, including in the private rental sector, need to be addressed.

Despite a significant increase in overall transport activity, especially in the freight sector, GHG emissions fell steadily throughout the review period. Germany is among the few OECD countries that managed to decrease transport-related GHG emissions in 2000-09. Several factors contributed to this, including significant progress in vehicle fuel efficiency, improvements in logistics, energy taxation and increasing world oil prices. As in most countries, diesel is taxed at a lower rate than petrol. This has led to a major shift towards diesel passenger cars, which are more fuel-efficient than petrol vehicles. However, diesel has a higher carbon content and generates more local pollutants than petrol. Low-emission zones in major cities and emission-based road tolls for heavy goods vehicles have also stimulated the uptake of more fuel-efficient freight and passenger vehicles. The new CO_2-based motor vehicle tax is expected to reinforce this trend. However, incentives that encourage private car use, thus contributing to increasing GHG emissions, remain in place. While GHG emissions from passenger road transport are expected to decrease further, efficiency improvements in freight haulage are needed to address the expected increase in related GHG emissions. Germany has supported biofuel use through mandatory blending quotas and tax reliefs. This has also helped reduce GHG emissions, although at high costs

and with potentially negative impacts on the environment. To address these impacts, in 2009 Germany introduced biofuel sustainability criteria.

Recommendations

- Strengthen mechanisms to identify policy adjustments needed to stay on track to achieve climate targets, *e.g.* by explicitly benchmarking progress, presenting an annual report to the Bundestag, and enhancing mechanisms for stakeholder and civil society participation in policy making.
- Contribute to discussion at EU level about possible measures to maintain an effective carbon price signal in the EU Emissions Trading System in line with overall medium- and long-term EU emission reduction targets.
- Use energy taxation to effectively complement the EU Emissions Trading System and to provide a consistent carbon price signal across the economy; gradually phase out energy tax exemptions that are not needed to avoid double taxation or pricing.
- Review the taxation of diesel and petrol with a view to internalising their environmental external costs.
- Continue to monitor the costs of feed-in tariffs; ensure that the mechanisms to control for the impact of unpredictable developments in the renewable energy market on these costs are effective and efficient.
- Ensure that the energy and climate fund targets projects that are justified environmentally and economically by: establishing appropriate criteria for eligible projects; applying instruments to provide targeted support and to leverage private resources; and establishing an independent mechanism to assess progress.
- Further improve the energy efficiency of buildings in the rental market, *e.g.* by introducing an energy-efficiency rental index.
- Further extend low-emission zones and use them to test the introduction of incentives (*e.g.* congestion and pollution charges) to reduce vehicle use in urban areas.
- Review support policies for biofuels in light of a comprehensive assessment of their costs and benefits, including their impact on land-use, biodiversity and water.

1. Introduction

Germany is a front-runner in developing solutions to address the challenge of climate change. Successive federal governments have agreed ambitious emission reduction targets and developed and deployed innovative policy measures and technologies to mitigate domestic greenhouse gas (GHG) emissions.

Under the EU burden sharing agreement, Germany committed to reduce its average GHG emissions by 21% below the 1990 level over the Kyoto Protocol commitment period, 2008-12.[1] Germany will be able to achieve this target through domestic measures alone (Section 2). After 2012, Germany's emission reduction targets go beyond what would be required under its EU commitments (Section 7). The federal government has set out medium- and long-term objectives for German climate policy in the Energy Concept, which was adopted in September 2010 (Bundesregierung, 2010). It commits Germany to, among other things, reduce GHGs by 40% by 2020.

In international forums, Germany has played a leadership role in promoting ambitious climate policy. This has been evident from the first Conference of the Parties to the United National Framework Convention on Climate Change (UNFCCC), which Berlin hosted in 1995, to the G8 Summit in Heiligendamm in 2008 (Weidner and Mez, 2008).

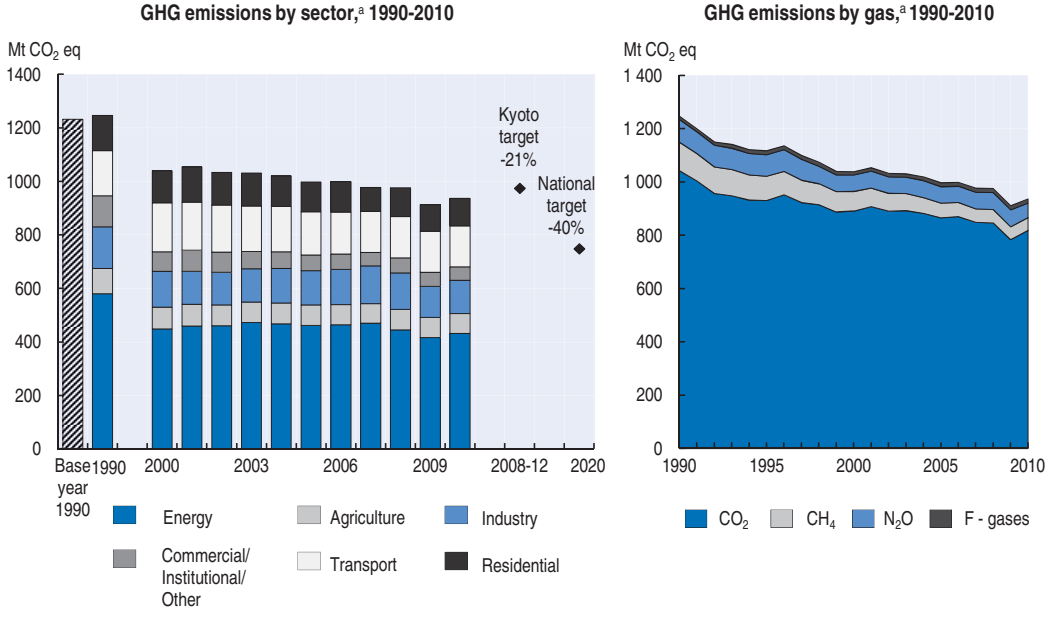
Germany's strong climate policy is built on public support. German citizens consider climate protection to be of high importance and express a willingness to accept ambitious reduction targets for GHG emissions. A large majority of citizens expect industry and energy utilities to take action on climate protection. While mitigation of GHGs is perceived as imposing costs, there is a widespread belief that the broader promotion of greener technologies also creates winners (UBA, 2010). This belief is attributed in part to Germany's positive experiences in dealing with air pollution in the 1970s and 1980s (Weidner and Mez, 2008).

2. GHG emission performance

In 2010, total GHG emissions (without emissions/removals from land use, land use change and forestry) amounted to 937 million tonnes of carbon dioxide equivalent (Mt CO_2 eq), which was 24% below the 1990 base year emissions for the Kyoto Protocol. On current trends Germany will more than meet its Kyoto target (–21%) through domestic emission reductions alone, without recourse to the Kyoto Protocol trading mechanisms (Figure 5.1).

German emissions declined rapidly in the decade following German reunification in 1990 despite sustained economic growth. The decrease was concentrated in the "new" (eastern) *Länder* and arose partly from restructuring of energy-intensive industries (mainly

Figure 5.1. **GHG emission trends by sector and by gas**



a) Excluding CO_2 emissions/removals from land use, land-use change and forestry.
Source: UBA.

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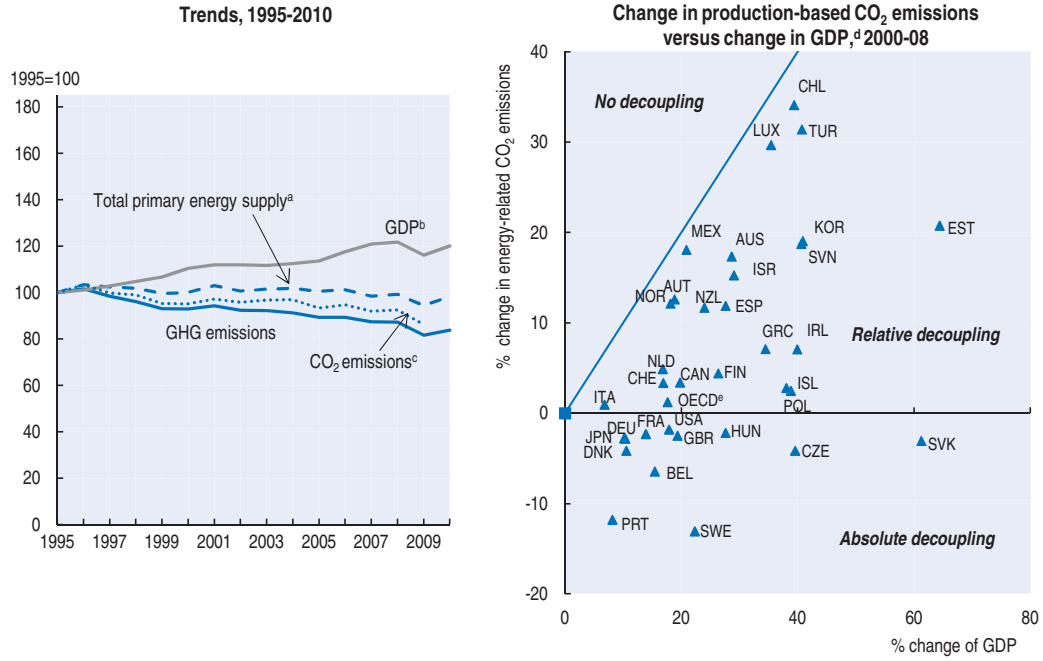
iron and steel), but also from a switch from lignite to gas in energy production and from improvement to energy efficiency in industry (OECD, 2001).[2]

Emissions continued to decline over the following decade (the review period), although at a slower pace. A 12% reduction was recorded between 2000 and 2009. Outsourcing of manufacturing to new EU member states and relatively low growth during most of the 2000s helped reduce emissions (OECD, 2012). However, slightly over half the reduction occurred between 2008 and 2009, and can be attributed to the global and domestic economic downturn. Emissions increased in 2010 as a result of economic recovery and cold weather (Figure 5.1).

Overall, Germany's GHG emission reduction since 2000 is among the largest in the OECD (see Reference I.C). Germany has succeeded in breaking the links between GDP growth, on the one hand, and GHG emissions and primary energy use on the other. Germany is one of the few OECD countries that absolutely decoupled GHG emissions from economic performance in the 2000s (Figure 5.2). Increased efficiency in energy use and electricity generation, as well as declining fuel use for transport, helped stabilise primary energy supply for most of the 2000s, a period of economic growth. Energy use plummeted in 2009 as a consequence of the recession (Section 5).[3] The primary energy intensity of the German economy (energy supply per unit of GDP) decreased over the decade and remained in line with the OECD Europe average (see Reference I.C).

Figure 5.2. **Decoupling GHG emissions from economic growth**



a) Excludes international marine and aviation bunkers.
b) GDP at 2005 prices and purchasing power parities.
c) CO_2 emissions from energy use. Excludes international marine and aviation bunkers. Sectoral approach.
d) GDP at 2000 prices and purchasing power parities.
e) The OECD area excludes Chile, Estonia, Israel and Slovenia.
Source: Adapted from OECD (2011), *Towards Green Growth: Monitoring Progress: OECD Indicators;* OECD-IEA (2011), *CO_2 Emissions from Fuel Combustion;* OECD (2010), *OECD Economic Outlook No. 88.*

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More importantly, the partial displacement of coal and lignite by natural gas and renewables has helped reduce the GHG intensity of electricity and heat production and of the overall economy, although increased electricity demand has partly offset the reduction in GHG emissions (Section 5). In addition, unlike many other OECD countries, Germany has reduced emissions in the transport sector, notably in road transport (Section 6), and made impressive progress in the waste sector. Emission trends by sector are described in more detail in Box 5.1 and the policy measures driving these trends are analysed in Sections 5 and 6.

Box 5.1. **GHG emissions by sector**

Emission reductions were recorded in all sectors of the German economy in the review period:

- Emissions from the energy sector amounted to 432 Mt CO_2 eq in 2010, some 46% of overall emissions (Figure 5.1). An overall decline of 7% was recorded from 2000 to 2009, when emissions were about 28% below 1990 levels. The sector includes emissions from energy industries,[1] which declined by almost 5% between 2008 and 2009, having risen slightly in previous years. It also includes emissions from energy use in manufacturing and construction (but not process combustion), which were stable from 2000 to 2008 before declining by roughly 13% in 2009 due to the recession (Section 5).
- Emissions from industry[2] totalled 124 Mt CO_2 eq in 2010, some 13% of overall emissions and down by about 20.5% since 1990, though over the review period emissions from this sector were stable until 2009, when they fell by 14%. The chemical industry recorded an increase between 2000 and 2009; emissions from metal production were relatively stable between 2000 and 2008 before declining significantly in 2009 due to the recession; and emissions from the mineral products sector were stable from 2001 to 2008 before declining in 2009.
- Emissions from transport amounted to 154 Mt CO_2 eq or 16.4% of 2010 emissions. Overall emissions from the sector fell 9% from 1990 and 15.8% from 2000. Emissions from road transport, the primary driver of transport emissions, rose until 2000 but declined in the review period (Section 6).
- Residential sector emissions, largely from fossil fuel use in space heating, amounted to 103 Mt CO_2 eq or 11% of total emissions in 2010. Residential sector emissions fell by 13.4% between 2000 and 2010 and by 24.4% between 1990 and 2010 (Section 5).
- Emissions from trade, commercial activities and services, again largely arising from fossil fuel use in space heating, totalled 37 Mt CO_2 eq or 4% of overall emissions in 2010. Emissions from this sector have fallen by 19.6% since 2000 and by 47% since 1990 (Section 5).
- Emissions associated with agriculture amounted to 74 Mt CO_2 eq or nearly 8% of overall emissions in 2010, down by 8.6% from 2000 and by over 20% from 1990. Emissions from enteric fermentation, agricultural soil and manure management have all declined consistently since 1990 due to reductions in livestock. Reductions were offset marginally by an increase in N_2O emissions from cropland due to land use change. The decline of emissions in the agricultural sector can largely be attributed to the EU Common Agricultural Policy reform and the Nitrates Directive.

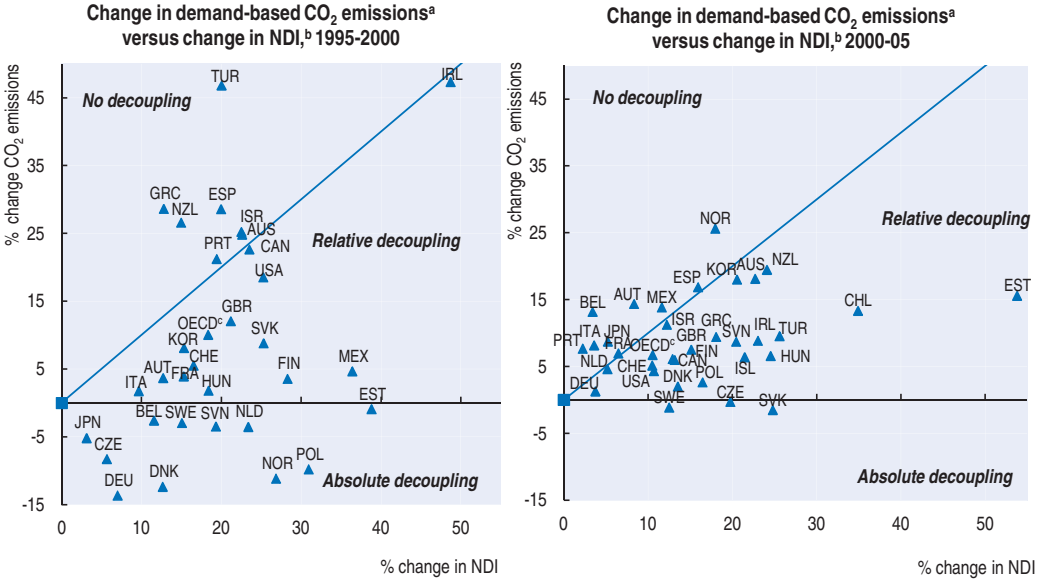
Box 5.1. **GHG emissions by sector** *(cont.)*

- Emissions from waste management totalled 13 Mt CO_2 eq or 1.4% of 2010 emissions, having fallen by 70% since 1990 and by 52% since 2000. The dramatic reduction in the review period was associated particularly with lower methane emissions from solid waste disposal in landfills, since landfilling of untreated waste has been prohibited by German law since 2005. Increased recycling and composting have helped reduce the quantity of waste landfilled and hence landfill emissions (Chapter 1). Emissions from wastewater handling have also fallen consistently since 1990.
- Net emissions from land use, land use change and forestry have changed only marginally since 2002 and amounted to 17 Mt CO_2 eq in 2010.

1. Public electricity and heat supply, refining, limestone flue gas cleaning of compressor stations for gas supply, and fugitive emissions from oil and gas (UBA, 2011a).
2. Iron and steel processing, blast furnace gases and limestone use, metal industries, chemicals, mineral products and process combustion in energy-intensive industries. It includes emissions of F-gases.

GHG emissions per capita, however, remain above the OECD Europe average, as do emissions per unit of GDP, albeit marginally (Reference I.C). This fact reflects the structure of the German economy, which is highly industrialised and remains dependent to some extent on energy-intensive manufacturing and processing, and of the energy supply, which still depends to a significant degree on hard coal and other solid fossil fuels (Section 5; Reference I.C). Furthermore, when overall GHG emissions generated in satisfying the country's domestic demand are considered (*i.e.* including those embedded in trade flows, not just those produced in the country), Germany appears to be less successful in decoupling emissions from economic growth (Box 5.2; Figure 5.3).

Figure 5.3. **Decoupling demand-based CO_2 emissions from economic growth**



a) CO_2 embodied emissions data estimated by the OECD.
b) Net disposable income at 2000 prices and purchasing power parities.
c) The OECD area excludes Chile up to 1996 and Luxembourg.
Source: Adapted from OECD (2011), *Towards Green Growth: Monitoring Progress: OECD Indicators.*

StatLink http://dx.doi.org/10.1787/888932592033

Box 5.2. **Demand-based and production-based GHG emissions**

Although international agreements to reduce GHG emissions consider territorial or production-based emissions only, it is interesting to compare OECD countries on demand-based (or consumption-based) emissions. Demand-based calculations include the emissions embodied (or embedded) in all imports consumed in a country, and exclude emissions embodied in exports.

Statistics on bilateral trade in goods and services, the IEA's energy statistics (*e.g.* fuel-combustion-based CO_2 emissions and international electricity transfer) and other industry statistics can be used to estimate the effects of international transfers of CO_2 emissions (OECD, 2011a).

Consumption-based CO_2 emissions of OECD countries were, on average, about 16% higher in 2005 than conventional measures of production-based emissions. The difference exceeded 30% in Austria, France, Luxembourg, Portugal, Sweden, Switzerland and the United Kingdom. In Germany, however, the difference between production and consumption measurements was relatively minor thanks to the country's status as a major exporter and its persistent balance of trade surplus, which includes a considerable proportion of consumer durables with high embodied emissions.

Nevertheless, Germany's performance in decoupling demand-based GHG emissions from economic growth appears less positive than that measured by production-based emissions in the 2000s: while Figure 5.2 shows that production-based emissions decreased while GDP increased (absolute decoupling), Figure 5.3 (right panel) indicates that demand-based emissions increased, although at a lower rate than national disposable income (relative decoupling). The decoupling performance worsened in the 2000s compared with the 1990s (Figure 5.3). This can be linked to the intensification of trade flows in the 2000s and the relocation and outsourcing of many manufacturing activities to the new EU member countries.

3. Policy-making framework

3.1. Institutional arrangements

The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) has the primary responsibility for climate change policy. It receives technical support from the Federal Environment Agency (UBA) and advice from independent statutory bodies such as the Council of Environmental Advisors and the Advisory Council on Global Change.[4] Co-operation across federal ministries is facilitated by the Inter-Ministerial Working Group on CO_2 reduction (IMA), established in 1990 (OECD, 2001). This group is responsible for drawing up guidelines for policy development, identifying policy requirements, exploring the potential of various instruments and technologies, and submitting comprehensive packages of measures for consideration by decision makers. It is assisted in these tasks by seven working groups.[5]

As in several policy areas, the federal government must interact both with EU institutions (the European Commission and the Parliament) and with subnational governments (those of the *Länder* and municipalities) when formulating and implementing climate policy.

Germany is required to implement packages of policy measures to reduce GHG emissions that have been developed at EU level, including the first and second European

Climate Change Programme and the more recent EU Climate and Energy Package to 2020. Like all EU member states, Germany has to put in place domestic actions that build on the EU measures or complement them. The interaction between the federal government and the EU is a two-way process whereby Germany, as the largest EU member state, is influential in promoting its policy preferences at EU level. Germany is also a climate policy taker within the European framework, as was to some extent the case with the EU ETS (Section 4.2) (Weidner and Mez, 2008).

Unlike in other areas of environmental policy, the 16 *Länder* (as well as the municipalities in each *Land*) have little responsibility with respect to climate change policies; this area of policy making is characterised by top-down governance (Weidner and Mez, 2008). This is because of the historically centralised nature of energy policy formulation in Germany, but also because of constitutional changes in September 2006. These modifications strengthened the federal government's hand by allocating to it exclusive competence for transposing EU environmental directives (Chapter 2). Somewhat surprisingly, the legally complicated system of multilevel governance seldom leads to serious stalemates in climate policy making. This fact has been attributed to institutionalised and long-standing co-operation networks among policy makers within Germany, as well as to shared goals in climate policy between the respective administrative levels in the federal government and the European Commission (Weidner and Mez, 2008).

3.2. The climate change policy cycle

Over the review period Germany introduced two major legislative packages in the area of climate change.[6] The first, the National Climate Protection Programme of 2000, was a direct response to emission projections which indicated that additional measures would be required if Germany's Kyoto target was to be achieved. It was made up of 64 proposals for emission reductions, translated into indicative targets for the main GHG-emitting sectors of the German economy. The IMA was given the task of submitting an annual assessment report to the cabinet outlining progress on meeting the targets. A review of the programme was conducted in 2005 and further measures were brought forward to meet sectoral targets.[7]

The Integrated Energy and Climate Programme (IEKP) superseded the National Climate Protection Programme in 2007. Its objective was to achieve a 40% reduction of GHG emissions by 2020 compared with 1990. It included 29 steps which were projected to achieve a 35% reduction by 2020. Another, smaller package containing further legislative proposals followed in May 2008.

The ministries involved in implementing the programme were required to submit a report to the cabinet in November 2010 (and every two years thereafter) on the overall impact of the IEKP, focusing on the effectiveness and efficiency of measures (Section 7.2). It was envisaged that inadequate or excessively costly measures would be supplemented or replaced (BMU, 2007). No interim targets have been set out against which progress might be benchmarked, however.

The 2010 Energy Concept builds on the previous two programmes by identifying additional measures to achieve the 40% reduction by 2020 (Box 5.3). It also takes a longer time horizon, considering the period to 2050. As a first step towards implementation of the Energy Concept, the government adopted an immediate action plan that was expected to be put into practice by the end of 2011. The BMU and the Federal Ministry of Economics and

Technology (BMWi), in consultation with other relevant ministries, are to present to the parliament an annual monitoring report on implementation of the Energy Concept. In addition, every three years, the government is to present a progress report.

Box 5.3. **The Energy Concept**

The Energy Concept was prepared jointly by the BMU and the BMWi and endorsed by the German government. It presents guidelines for an environmentally sound, reliable and affordable energy supply. It builds on the commitment to reduce GHG emissions by 40% by 2020 and by at least 80% by 2050. It indicates that reaching the 2050 target will imply a 55% reduction by 2030 and a 70% reduction by 2040. The intention of the concept is to set specific strategic goals to provide long-term orientation while preserving the flexibility required for new technical and economic developments. The key position of the concept is that renewable energy sources are to be a cornerstone of future energy supply in Germany. It envisages renewables contributing a major share to the energy mix of the future (60% of energy consumption by 2050), gradually replacing fossil fuels and nuclear energy.

All in all, the Energy Concept lists more than 100 measures for key sectors, including electricity supply, heat and transport. Some of the measures are intended to encourage technology diffusion; examples include considering life-cycle costs in awarding public contracts and further strengthening energy performance labelling of cars and buildings. The concept also proposes establishing an energy efficiency fund for purposes such as supporting market introduction of highly efficient cross-application technologies (*e.g.* engines, pumps, refrigeration), funding efficiency-enhancing pilot technologies to support their demonstration and assisting local authorities in developing model projects.

The Energy Concept proposed to extend the operating lifetime of the 17 German nuclear power plants by an average of 12 years, postponing the nuclear power phase-out agreed by the former government. To counteract any potential negative competition impacts in the energy sector, a nuclear fuel rod tax was levied for the six years to 2016 to raise EUR 2.3 billion a year in general budget revenue. In addition, a windfall profit tax was proposed. After the nuclear disaster in Fukushima Daiichi, Japan, in March 2011, however, it was decided once again to phase out nuclear power by 2022, a decision which appears to have widespread support in German society (Section 5.1).

The Energy Concept also envisages continuing to liberalise the electricity and gas markets. Further strengthening of competition should also be achieved by the establishment of a market transparency unit for wholesale trade in electricity and gas, located in the Federal Cartel Office, to uncover potential flaws in price formation more effectively.

The Energy Concept endorses the testing of carbon capture and storage (CCS) technology in the energy sector and industry. It views CCS as not only addressing climate change and hence giving the government a tool to push for closer international co-operation in CCS, but also as a way to create a potentially attractive export opportunity for German industry to countries that will continue to draw on coal for their energy supply.

In short, a virtuous policy process cycle has been created: major policy packages are introduced every three to five years; GHG inventory reports, which review emission performance, are systematically updated; the impact of policy interventions is evaluated; on this basis, and within the context of international obligations, options for further emission reductions are identified and assessed based on physical, technical and

economic considerations; obstacles to implementation are identified; the options are presented to the cabinet for selection and approval; and measures are then implemented and the review process begins again. This cycle, in combination with the political will to implement measures, has played a significant part in keeping Germany on track to meet its emission targets. German climate policy is exemplary in this regard.

This process operates through a network of senior officials from the relevant ministries and involves only the federal cabinet at a political level. Stakeholder and civil society organisations have not been formally integrated into the policy cycle. For example, while the Energy Concept was subject to extensive consultations, this consultation process has been criticised as taking place "behind closed doors".[8] There is a lack of transparency on how stakeholder input is managed. It is often unclear on what basis various options (which have economic and distributional consequences for society) were chosen. Moreover, committees in the Bundestag do not play any structured role in evaluating annual emission reports, and parliamentary oversight is limited. These factors, along with the lack of benchmarking against an indicative trajectory and the fact that the 40% target to 2020 is not legally binding, are the main weaknesses in the policy-making process.

As Section 7 explains, Germany's emission mitigation commitments in the period to 2020 are ambitious, and will be difficult to deliver. A strengthened annual review process, increased transparency in decision making and the inclusion of stakeholders and civil society into the policy development cycle may be required to ensure a full and balanced basis for decision making and continued public support for meeting these commitments.

4. Pricing carbon

4.1. *Energy taxation*

Germany carried out an ecological tax reform in 1999. From 1999 to 2003, taxes on petrol and diesel, electricity, heating oil and natural gas were increased in five stages (Table 3.1). However, standard tax rates have remained virtually unchanged since 2003. As a result, by the late 2000s, inflation and rising oil prices had reduced the effective share of taxation as a proportion of fuel prices per unit (Ludewig *et al.*, 2010).

The reform was introduced with the multiple policy objectives of mitigating CO_2 emissions, creating incentives for job creation and boosting innovation. The taxes are not set against the CO_2 content of fuels, but rather differentiated according to fuel type. When expressed per tonne of carbon, the levels of the taxes vary widely. While the multiple policy objectives which the Germany authorities had in mind when introducing the tax reform may partly explain the variation in carbon prices across fuels, the level of variance is difficult to justify from an environmental perspective in several cases. Overall, the eco-tax rates (*i.e.* the additional tax applied to the original excise duties) on diesel and petrol are much higher than the average emission allowance price under the EU ETS, while rates for natural gas, used either for transport or for heating, are in line with that price. On the other hand, the tax rates on other heating fuels have usually been below the ETS CO_2 average price, which had hovered around EUR 15-20 per tonne of CO_2 for most of the second trading period (since 2008), before plummeting to below EUR 10 in late 2011. Also, as the level of the eco-tax on diesel and petrol should reflect the carbon content of the fuels, it (as well as the total tax) should be higher for diesel (Table 5.1). The higher contribution of diesel-powered vehicles to local air pollution also argues for a higher tax on diesel than petrol.

Table 5.1. **Eco-tax rates expressed as EUR per tonne of CO_2**

	Total eco-tax	CO_2 emission factor (kg of CO_2/unit)	Tax (EUR/tonne CO_2)
Transport fuels (EUR cents/litre)			
Diesel	15.34	2.6413	58.1
Petrol	15.34	2.3018	66.7
Liquefied natural gas	2	1.2272	16.3
Liquefied petroleum gas	2	1.4902	13.4
Heating fuels			
Light heating oil (EUR cents/litre)	2.05	2.5299	8.1
Heavy heating oil (EUR cents/kg)	0.97	3.19	3.0
Natural gas (EUR cents/kWh)	0.37	0.20515	18.0

Sources: Ludewig *et al.* (2010); emission factors from UK Department for Environment, Food and Rural Affairs.

In the context of rising world oil prices, the eco-tax reform has achieved most of its objectives. An analysis by the German Institute for Economic Research (DIW) indicated that energy use considerably decreased as a result of the reform, especially in the transport sector (Section 6). The analysis estimated that reductions in emissions arising from the introduction of the tax would reach 2-3%, or 20-25 Mt CO_2, by 2010 (Ludewig *et al.*, 2010). Because of the reform, it is estimated that the economy was boosted by 0.5% over five years. The reform also promoted development and market penetration of energy-saving technological innovations (Knigge and Görlach, 2005).

The negative impact on energy-intensive sectors has been marginal mainly because of the structure of the tax. The bulk of the energy tax revenue was earmarked for transfer to the public pension system to lower the social security contributions paid by employers and employees, thereby to some extent offsetting the impact on businesses and households (Knigge and Görlach, 2005). A number of exemptions and partial derogations have also helped mitigate the impacts on energy-intensive sectors, although at the expense of the reform's effectiveness. Most significantly, brown coal, hard coal and fuels produced from them are excluded from the tax (coal used for heating is taxed, but at a reduced rate). Other exemptions have been granted to export-driven manufacturing and agriculture, which are potentially exposed to international competitiveness concerns. Until 2011, some 120 000 enterprises in these sectors paid 60% of the standard tax rate. According to a UBA report this group included some enterprises that were not exposed to strong international competition. The report estimated that, in addition, 20 000 enterprises in the manufacturing sector received a refund of 95% on eco-tax payments that exceed pension fund reductions under the so-called "peak equalisation" (UBA, 2011b). At the end of June 2007, this mechanism was renewed virtually unchanged until 2012, although the tax breaks were made less generous as form 2011 (Chapter 3).[9] Exemptions were also introduced to promote environment-friendly and energy-saving technologies. Exemptions or partial derogations apply for highly efficient combined heat and power (CHP), steam power plants, electricity from renewable sources not for grid, and local public transport and rail systems (Knigge and Görlach, 2005).

All these exemptions have distorted the price signal given by the eco-taxes. As a result, existing low-cost abatement options have not been sufficiently exploited (OECD, 2012). As technologies are available which allow for significant reductions in fuel consumption and carbon emissions in the most energy-intensive industries (*e.g.* cement and steel), a gradual reduction of exemptions from the energy tax seems feasible and

would not necessarily endanger the economic activities of these sectors, especially if combined with targeted technology investment programmes. From 2013, following an agreement with the European Commission, energy-intensive companies that are granted the eco-tax rebate under the peak equalisation regime will be required to operate an energy management system or other measures and to demonstrate energy savings (Bundesregierung, 2010). However, many of the exemptions remain unjustifiable on economic grounds and should be phased out rather than made conditional on the introduction of energy management systems. Reforms must be considered also in terms of the implications of the EU ETS for these sectors (Section 4.2).

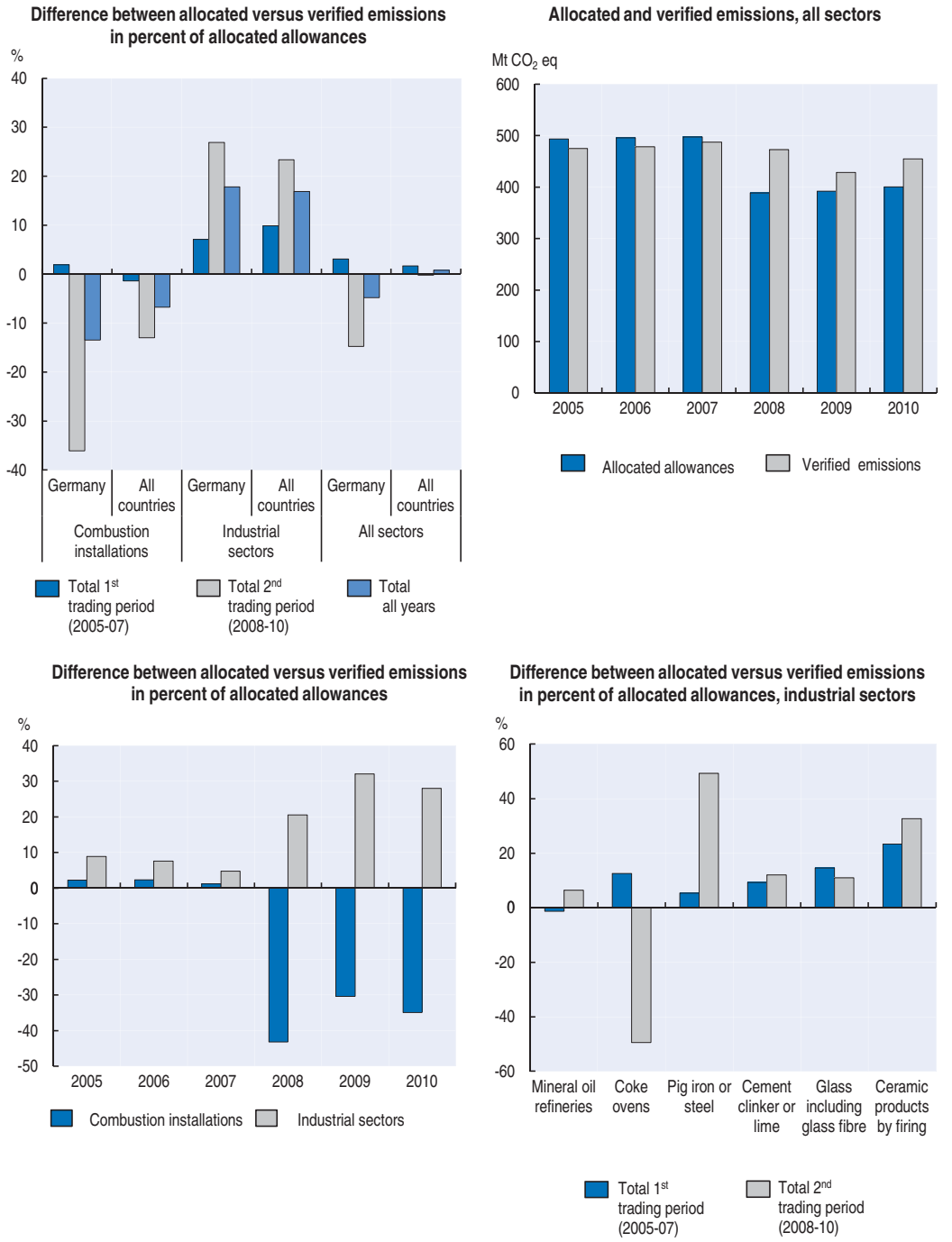
4.2. The EU Emissions Trading System

The EU ETS has become the most significant instrument in German climate policy, covering about 60% of total CO_2 emissions and over 2 000 industrial installations and large power plants. The participation of German industry in the EU ETS has its origins in voluntary agreements with the federal government to reduce emissions, announced at the Berlin Conference of the Parties in 1995. This initial declaration became a formal agreement to reduce emissions of CO_2 by 8% by 2005 and 35% by 2012 (OECD, 2001). International experience suggests that the cost-effectiveness of voluntary approaches in achieving environmental targets is limited (OECD, 2003). The German voluntary agreements failed to deliver reductions in emissions over the review period: industry declared it would cut CO_2 emissions by 20 Mt CO_2 by 2005 through the use of CHP, but instead emissions rose by 30 Mt CO_2 (Weidner and Mez, 2008).

The lack of initial progress on meeting voluntary targets resulted in a modification of the federal government's position on emission trading. Germany initially expressed scepticism about emission trading in both UN and EU negotiations. This position has been attributed to pressure from the energy industry and, in particular, the chemical sector (Skjærseth and Wettestad, 2008). The goals contained in the voluntary agreement formed the basis for negotiations with German industry around its participation in the ETS. The Emissions Trading Directive (2003/87/EC) required EU member states to assign an amount of allowances to companies operating under the ETS, and to share the overall reduction target between the sectors of the economy covered by the EU ETS and the remaining so-called "domestic" sector in National Allocation Plans (NAPs). The first NAP covered Phase I (2005-07) and the second covered Phase II (2008-12).

Germany, like most member states, over-allocated allowances to installations covered by the ETS in its first NAP (partly due to insufficiently comprehensive data), leading to a collapse in the allowance price in Phase I (EEA, 2008). As Figure 5.4 shows, in this period the over-allocation of permits was more serious in Germany than the average for all participating countries. In its second NAP the German government agreed an overall annual cap of 453 Mt CO_2 eq with the European Commission.[10] This cap was below Germany's verified emissions for 2008, 2009 and 2010. German companies had access to a further 20% (90.62 Mt CO_2 eq) per year in emission reduction credits from allowances under the Kyoto Protocol's Joint Implementation and Clean Development Mechanism provisions. Germany has been one of the few countries with an allocation below verified emissions in the second phase; allocation of allowances was far below verified emissions in Germany than on average in the market, and this corrected for the over-allocation of the first phase, albeit with a striking difference among sectors. Industrial sectors continued to receive considerable over-allocation of permits while combustion installations in the

Figure 5.4. **Allocated allowances and emissions under the EU ETS, 2005-10**



Source: EEA (2011), *EU ETS data viewer.*

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power generation sector, which is less exposed to international competition, had their allocations reduced far below verified emissions in 2008, 2009 and 2010 (Figure 5.4).

Allowances were largely allocated free of charge to German industries, including electricity generators. Since the allowance price is passed through to electricity consumers via price increases, electricity producers across Europe reaped substantial windfall profits in the first and second trading periods. Ellerman *et al.* (2010) concluded that the rents totalled about EUR 29 billion, using a modest carbon price estimate of EUR 12 per tonne of CO_2.[11] Another estimate put total windfall profits for German electricity generators alone at EUR 39 billion and argued that German companies in the chemical, refining, cement, and iron and steel sectors had also generated substantial windfall profits by selling significant surplus emission allowances (Figure 5.4) (Öko-institut, 2010).

As was the case in several EU countries, over-allocations, collapsed permit prices and windfall profits have meant that the externalities associated with GHG emissions have not been fully internalised by German companies operating under the EU ETS in the first and second trading periods. Nor has the allowance price been stable, certain or high enough to provide a signal to industry to invest in low-carbon technologies.[12]

Modifications to the EU ETS, particularly the progressive introduction of auctioning and tightening of the overall cap, should enhance its effectiveness in the next trading period. The wide range of price forecasts for allowances underlines the continuing market and regulatory uncertainty, however: the allowance price may continue to be too low or too volatile to provide sufficient incentives to invest in low-carbon technologies (HM Treasury, 2010). Furthermore, as most energy-intensive installations will receive freely allocated allowances even after 2013 to prevent their relocation outside the EU, windfall profits will likely continue to accrue to those sectors (De Bruyn *et al.*, 2010; Martin *et al.*, 2010). The extent to which the EU ETS will fully internalise the GHG externalities in the period to 2020 is therefore open to question. A key challenge for German climate policy is to use a combination of energy taxation and the EU ETS to fully internalise the environmental externalities associated with GHG emissions and to provide a consistent, equitable and clear price signal across the economy. To minimise the cost to society, the eco-tax on energy products and the EU ETS should be combined in a manner which avoids both gaps and double regulation (OECD, 2011b). Nevertheless, the current eco-tax has broader objectives than pricing CO_2 emissions, including redistributing the tax burden from labour (social contribution) to energy (Ludewig *et al.*, 2010). This may justify a certain degree of overlap.

The electricity sector and other energy-intensive industries are covered by the EU ETS, whereas households, small and medium-sized enterprises and the transport sector are covered by the eco-tax. In a number of areas, double regulation is a concern[13] and in others, neither instrument prices the environmental externality; the latter areas include small combustion plants (< 20 MW), export-oriented agriculture and manufacturing (Wartmann *et al.*, 2008).[14] However, direct overlaps between the eco-tax and the EU ETS are relatively limited. Perhaps more significantly, consumers may be subject to cumulative indirect effects via increased electricity prices (Ludewig *et al.*, 2010). While large industries get a reduced rate on the energy tax, private households and many small and medium-sized service companies are affected by both instruments, as well as by higher electricity prices due to the feed-in tariffs apportionment (Section 5.1).

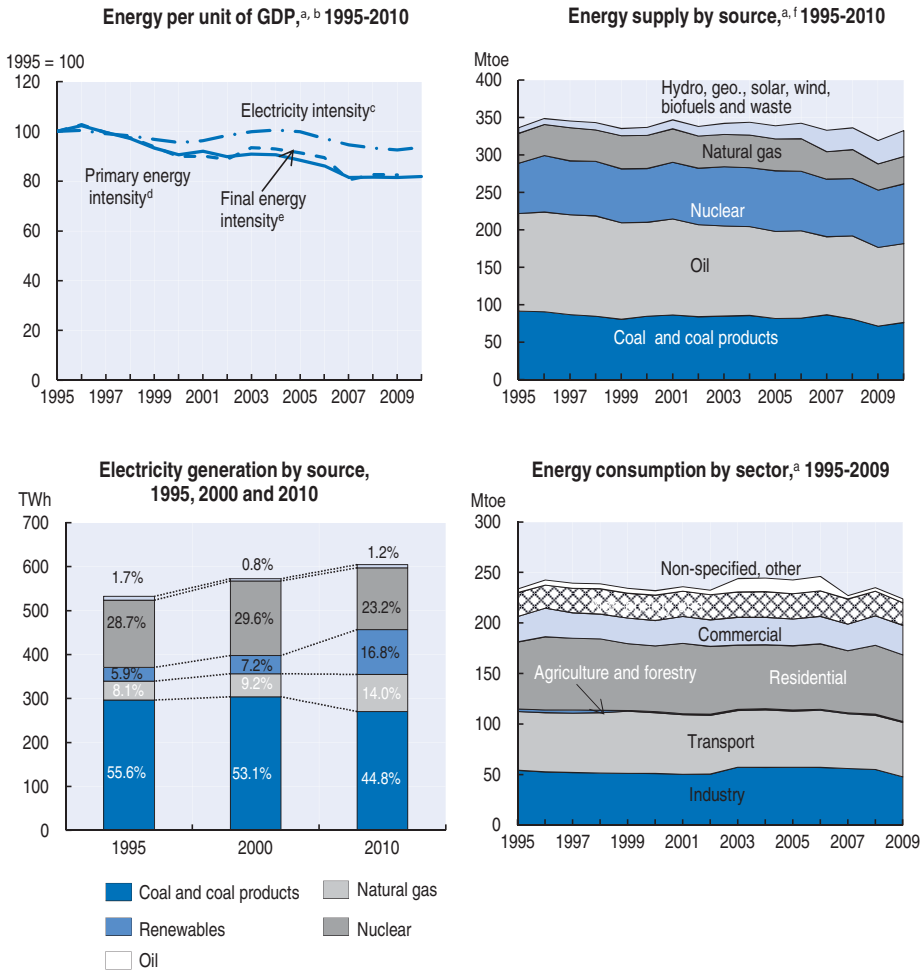
Given the volatility of the emission allowance price, some overlap of the two instruments might be justified to the extent that the tax is used to supplement the anticipated price of allowances under the EU ETS and establish a minimum, predictable carbon price. For example, when offshore oil and gas companies in Norway were included in the EU ETS in 2008, the Norwegian government reduced the CO_2 tax on them, but did not eliminate it as would have been required to avoid double carbon pricing. This was done to keep the CO_2 price constant for the sector, based on an anticipated EU ETS allowance of 160 Norwegian kroner (OECD, 2011c). A similar system is proposed in the UK, where the climate change levy or fuel duty would be extended to fossil fuels used in electricity generation, which is covered by the EU ETS. The so-called carbon price support rates will reflect the differential between the future market price of carbon and the floor price determined by the government (HM Treasury, 2010). Such combination of taxation and cap-and-trade systems can provide investors with greater certainty and stimulate investments in low-carbon technologies. However, to the extent that the overall emission cap remains unchanged, this would not lead to a reduction in EU-wide emissions, because emissions would be displaced to countries where the floor price is not in place (OECD, 2011b). To maintain the cost-effectiveness of the EU ETS, the floor price of carbon should be applied at EU level.

5. Policies and measures in the energy sector

The size and strategic position of Germany and the inter-connection of the German grid within Europe give the country great importance in the region (IEA, 2007a). Germany has a relatively diversified energy mix. Fossil fuels account for 79% of total primary energy supply, a share that is slightly below the OECD average but above that in many European countries (Reference I.A). Coal and other solid fuels account for 23% of energy supply (7% higher than the OECD Europe average) and nearly 45% of electricity generation. This makes Germany's fuel mix relatively carbon intensive, even though the use of renewable energy sources more than doubled in the last decade. In 2010, renewables accounted for 10% of primary energy supply and nearly 17% of electricity generation, up from 3% and 7%, respectively, in 2000 (Figures 5.5 and 5.6). With the exception of a decline in oil use, mainly due to reduced fuel consumption in the transport sector, the role of other fossil fuels in primary energy supply hardly changed during the decade, accounting for about 47% of the mix (Figure 5.5). A marked increase in electricity production occurred in response to increased domestic electricity demand and a growing export surplus in international electricity trade.

While Germany's economy grew in 2000-08, both primary energy supply and final energy consumption remained relatively stable. This resulted in a further decline in energy intensity, which is in line with the OECD average despite Germany's heavy industrial base. As Figure 5.5 shows, the largest share of consumption is in the residential sector, followed by transport and industry. Energy consumed in the industrial sector tended to mirror economic performance. Consumption in the transport sector declined by 10% over the last decade, in contrast to the trend in most OECD countries (Section 6).

Figure 5.5. **Energy structure and intensity**[a]



a) Excludes international marine and aviation bunkers.
b) GDP at 2005 prices and purchasing power parities.
c) Electricity consumption per unit of GDP.
d) Total primary energy supply per unit of GDP.
e) Total final consumption of energy per unit of GDP.
f) Breakdown excludes electricity trade.
Source: OECD-IEA (2011), *Energy Balances of OECD Countries*; OECD (2010), *OECD Economic Outlook No. 88.*

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5.1. *Reducing GHG emissions from electricity generation*

Renewable energy sources

Increasing the share of renewables was a priority of the federal government over the review period, and will continue to be so. According to the 2010 Energy Concept, renewable energy will account for at least 35% of gross electricity consumption in 2020, 50% in 2030, 65% in 2040 and 80% in 2050. Germany has implemented sector-specific measures to promote renewables. The Renewable Energy Sources Act (EEG) of February 2000, subsequently amended several times, introduced feed-in tariffs (FITs) for electricity generated from renewable sources. The FITs vary with the generation capacity of the installations and the type of source. They decline annually to take account of cost decreases for installations and parts, and to encourage technological advancements. Germany's feed-in structure for renewables promotion has been adopted by about

two-thirds of EU member countries as well as several non-EU countries (Chapter 4). Other measures to promote renewables development include capital grants and low-interest loans, reduced tax rates for renewable-generated electricity and heat, tax exemptions and quotas for biofuels and financial incentives for the use of renewables in buildings (Box 5.4).

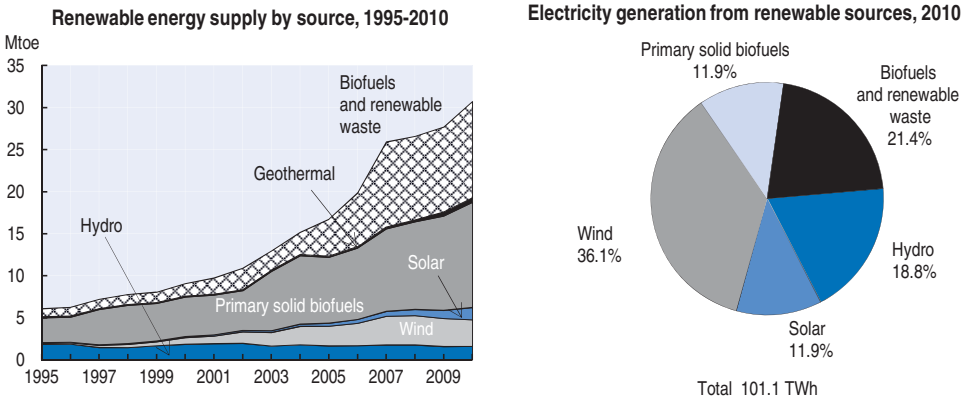
Box 5.4. **Promoting the use of renewable energy in residential buildings**

The Market Incentives Programme for Renewables, launched in 1999 and administered by KfW Bank, was designed to promote the use of small and large biomass systems, solar energy, geothermal energy and heat pumps (since 2008) in heat generation through grants and loans. By 2007, the programme had provided some EUR 1 billion of support and triggered investment amounting to EUR 8.2 billion. In 2008, total funding increased to EUR 350 million and in 2009 it reached EUR 500 million.

The federal government took a further step to promote renewables-based heating in the residential sector by introducing the Act on the Promotion of Renewable Energies in the Heat Sector, which came into force in 2009. The Act is aimed at increasing the renewables' share of final energy consumption for heating and air conditioning in buildings to 14% by 2020 from a 2009 level of 6%. Owners of new buildings, whether private individuals, the state or businesses, are obliged to use renewables for heating.

The use of FITs has been effective in promoting electricity generation from renewables and achieving the associated targets (Figure 5.6). The original policy objective outlined in the 2004 EEG of achieving a share of at least 12.5% for renewables in electricity generation by 2010 was achieved, and even exceeded, in 2007. In 2009, savings of 52 Mt CO_2 eq were attributed to the FITs. Investment in renewables has continued to increase dramatically, even during the recession: in 2009 investment in renewable energy installations increased by more than 30% over the previous year, while investment in most other sectors declined (BMU, 2010). Overall, the German FITs appear to be better designed and to have been more effective than those used in many other countries. There has also been a positive influence on innovation which has benefited the German economy (Chapter 4).

Figure 5.6. **Renewable energy**



Source: OECD-IEA (2011), *Energy Balances of OECD Countries.*

StatLink http://dx.doi.org/10.1787/888932592090

Nevertheless, the overall costs and economic efficiency of Germany's renewables policy has been the subject of considerable national and international debate. Contrary to similar FIT systems in other countries, the costs of the system are passed on to end-use consumers in the form of a surcharge on the electricity price, referred to as the EEG apportionment.[15] The costs increased nearly sevenfold over the review period, from EUR 1.4 billion in 2000 to EUR 9.8 billion in 2010 (in 2010 prices).[16] The EEG apportionment paid by residential electricity customers increased from EUR cent 0.2/kWh in 2000 to EUR cent 2.3/kWh in 2010. This represents about 10% of the total price per kWh paid by residential customers (BMU, 2011). While the increase in electricity prices could encourage energy savings, it could also encourage the displacement of electricity by more carbon-intensive fuels.[17]

As in most countries with FITs systems, the German tariffs are higher than electricity prices, varying from about 2 to 3 times the electricity price for biomass, biogas, wind and hydropower to 5 times for solar photovoltaics (PV). The cross-subsidies implied by the FIT (excluding hydropower) were estimated to account for some 0.2-0.33% of GDP in 2009, the highest share in OECD Europe countries after Spain (Égert, 2011). The largest shares go to wind and solar PV. Between 2000 and 2010, the total EEG cost amounted to EUR 46 billion (in 2010 prices). The overall cost has increased sharply in recent years, far above government expectations, mainly due to the strong development of photovoltaics. In response to increasingly rapid deployment of solar PV and the high costs entailed, the federal government announced an increase in the annual applied depreciation rate to solar PV in 2010 and 2011.

The subsidies provided to PV contribute to generating 9% of the electricity which falls under the EEG, but account for 40% of differential costs (Bundesregierung, 2010). Some estimates indicate that the FIT for PV was eight to ten times higher than the electricity price in 2009 and that, for some inefficient PV technologies, it translated into a cost of more than EUR 700 per tonne of CO_2 abated (Frondel *et al.*, 2010). That was more than 40 times the average EU ETS carbon price in 2009. Overall, the cost of abating one tonne of GHG emissions implied by the FITs is estimated to be quite high, well above the carbon price prevailing in the EU ETS, ranging from about EUR 65 per tonne of CO_2 eq for hydropower, biomass and biogas to EUR 655 for solar (Égert, 2011). High abatement costs are also due to the fact that, leaving aside considerations of energy security and industrial policy, FITs reflect the actual costs of investment in renewables. Still, GHG abatement costs implied by FITs are lower in Germany than in some countries because renewables displace energy produced from a more carbon-intensive fuel mix than in counties such as France or the Slovak Republic, where nuclear power plays a bigger role (Égert, 2011). While the level of subsidy, in particular for PV, has been criticised as being too high, it has brought renewables technologies closer to grid parity by driving technological innovation and widespread diffusion faster than would have otherwise occurred (Chapter 4).

Since renewables remain the core of German energy policy, controlling the cost of renewables support will be a key challenge. Despite further increases in electricity generated from renewable sources, it is estimated that the EEG apportionment will increase at a moderate rate in future years (BMU, 2010; Traber *et al.*, 2011). A study for the BMU (Wenzel and Nitsch, 2010), which assumed total renewables-based electricity production would rise from 16% in 2009 to 65% in 2030, found that the cost of renewables policy would rise until 2016, then fall until 2030. Such developments are uncertain, however, as the rising EEG costs associated with the PV boom showed.

The potentially most important drawback of a FIT is the inability of the regulator to directly control how much new capacity investors install in a given year, and the consequent inability to control costs. FITs need to be frequently reviewed to take account of decreased installation costs for renewables such as household PV systems, whose cost is dropping rapidly.[18] The experience gained in responding to market developments in solar PV must be applied to other areas, such as biomass support, in order to find a balance between assuring cost-effectiveness and providing an incentive for bringing innovative renewables technologies to market. This places a high information requirement on the regulatory authorities. Alternative mechanisms such as reverse auction tenders or caps on the annual permitted take-up of a particular tariff might also be considered (Chapter 4).

As in other EU countries, the interactions between Germany's renewables support policy and the EU ETS should be taken into account as well. In the context of an EU-wide emission allowance market, the promotion of renewable energy sources in one country, especially a big player such as Germany, can lead to lower allowance prices and the displacement of emissions, impairing the overall cost-effectiveness of the system.[19] For example, Traber and Kemfert (2009) estimated that the growth in renewables-based electricity generation stimulated by the German FITs would reduce the allowance prices by 15% (from EUR 23 to EUR 20 per tonne of CO_2). This would result in increased GHG emissions from electricity generation across the EU by 3.9% (Australian Government Productivity Commission, 2011). While expected development of renewables in EU countries has been taken into account in setting the EU cap for the third ETS phase (from 2013) to limit unintended price-lowering effects, uncertainty remains.

The EU ETS ensures that operators in the electricity market face a carbon price which provides an incentive to invest in renewables. OECD analysis shows that, when a carbon price exists, applying other policy tools can lead to overlap and undermine cost-effectiveness (OECD, 2009, 2011b). However, the price of CO_2 emissions in the EU ETS has been generally too low to stimulate such investment, as some technologies cannot compete with conventional energy sources even when the allowance price is taken into account. Technology-specific instruments such as FITs are being used to promote renewables beyond the incentives provided by the EU ETS, to the extent that such measures aim at encouraging innovation and long-term cost reductions rather than only short-term emission abatement. In addition, measures are needed to overcome other obstacles to the development of renewables, such as network effects, learning and demonstration effects, and limited access to finance (OECD, 2012). According to the German Advisory Council on the Environment (SRU), achieving 100% renewable power generation by 2050 is feasible without compromising security or grid reliability, and can be achieved in a way that enhances the outlook for Germany's economic future (SRU, 2010). However, the integration of renewables into the electricity system will require the expansion of the electricity transmission and distribution network because the current grid is not suited to transport electricity from decentralised sources which are often far-distant from urban centres. In addition, the network will need to be adapted to deal with the intermittent energy supply provided by renewables. The Energy Concept envisages evaluating all available sources of pumped storage for hydro, promoting biomass to counterbalance fluctuations in wind and solar and, in the long term, inter-connecting with Norway and the Alps, as well as supporting research into new storage technologies. According to estimates by the German Energy Agency, extending and adapting the overhead grid infrastructure to renewables development will require investment between

EUR 0.95 and EUR 1.6 billion per year to 2020. This in turn will increase electricity bills for households and businesses (Dena, 2010).

Combined heat and power

Highly efficient CHP systems, particularly those using gas, have been also promoted. Legislation to protect and modernise existing installations and provide incentives to build smaller CHP plants (up to 50kW) was introduced in 2002 (Combined Heat and Power Act). Under the Act, CHP generators receive payments for each kWh of electricity they feed into the grid, depending on the age of the plant, its size and its efficiency. The Act was amended in 2008 to extend support to large new power stations for industrial CHP and district heating, if commissioned by 2016. The cost of abating one tonne of GHG emissions implied by the CHP Act is estimated to be in the range of EUR 30/t CO_2 (Australian Government Productivity Commission, 2011). In July 2006 the law on taxation of fuel inputs for electricity production[20] was amended to exempt natural gas used for electricity generation in stationary CHP installations with a monthly or annual usage efficiency of at least 70%. The elimination of the natural gas tax for condensing power stations increases the attractiveness of natural-gas-based electricity production, with its relatively low emissions.

Nuclear power

It is envisaged that nuclear power will continue to play a part in German power generation portfolio for another decade. In 2000 the government and energy utilities agreed to phase out nuclear power by 2022. This decision was overturned in the Energy Concept in 2010, when it was agreed to extend the operating lives of nuclear power stations by 12 years, on average. After the nuclear disaster in Fukushima, Japan, in March 2011, however, the government decided to disconnect the seven oldest nuclear plants from the grid, in addition to the already disconnected Krümmel plant. Following a report by the Ethics Commission for a Safe Energy Supply it was decided to gradually phase out nuclear power by 2022, a decision which appears to have widespread support in German society.[21]

In principle, nuclear power could be phased out without increased emissions of carbon dioxide, thanks to a greater role for renewables along with energy efficiency gains. However, it is likely that the shut-downs will result in increased generation based on lignite, hard coal and gas, leading to higher overall GHG emissions in the short term. For example, Kemfert and Traber (2011) estimate that GHG emissions can increase by 9% due to the closure of the eight nuclear plants. It should be noted that these emissions would be offset by emission reductions elsewhere because of the overall EU-wide cap under the EU ETS. The required accelerated development of renewables is expected to further promote innovation. However, it requires anticipating investment in grid infrastructure, as noted above, and there is a risk of it deterring the development and use of more advanced technologies which would have taken more time to emerge (OECD, 2012). While the early nuclear phase-out is expected to have a limited effect on wholesale electricity prices, due to the use of cheaper fuels such as coal and imported electricity, additional near-term investments in new capacity are likely to be needed (IEA, 2007a). The Federal Network Agency estimated additional generation capacity needs of up to 17 GW by 2022.

While the early phase-out of nuclear power is expected to increase the costs of GHG mitigation, the SRU (2010) found that extending the operating life of nuclear power plants would have led to overcapacity in the system. Its analysis suggests that, in the long term, nuclear power is not compatible with renewable electricity supply because output cannot

be adjusted sufficiently quickly to match the fluctuations of wind and solar power generation. From this perspective, the phase-out of nuclear power would cause less difficulty than might at first seem apparent, and would prepare Germany for a pioneering transition to a decarbonised power generation system.

5.2. *Promoting energy efficiency and GHG emission savings in energy end-uses*

Industrial sector

Voluntary agreements, the EU ETS and energy taxation, discussed above, are the main instruments for regulating industrial sector emissions. In addition, advice, grants and low-interest loans are available to certain companies in the sector under programmes run by the German Energy Agency (Dena) and the KfW Bank.[22]

Germany has identified enhancing industrial energy efficiency as a key policy priority. According the Energy Concept, scientific analysis suggests that up to EUR 10 billion of savings are available annually to German industry through investment in energy efficiency (Bundesregierung, 2010). As agreed with the European Commission and to encourage energy savings, as from 2013, the eco-tax rebate under the peak equalisation regime will be available only to companies that "contribute to energy savings" and operate energy management systems (or equivalent measures). As Section 4.1 maintains, however, many of these exemptions are unjustifiable on economic grounds and should be phased out rather than made conditional on the introduction of energy management systems.

The Energy Concept provides for an energy efficiency fund to be established to support investment such as the introduction of highly efficient engines, pumps and other technologies. Resources from the fund will also be used to finance R&D projects on energy efficient technologies, to optimise energy-intensive manufacturing processes and to create business and industrial networks.

It may be beneficial to use supplementary energy efficiency measures to flank measures that establish a common carbon price across areas where market failures are found (OECD, 2009). If cost-effective energy efficiency opportunities are not exploited, a higher carbon price is needed to deliver the same level of emission reductions, increasing the cost to society. Supplementary support for energy efficiency investments should, however, target investments with a positive net present value when environmental benefits are included, and should target explicitly identified market failures. The establishment of an energy efficiency fund could be a positive development, provided that these conditions are met. On the other hand, a fund could lock in a spending commitment and thereby reduce government flexibility in responding to changing fiscal circumstances.

Residential building sector

The overall number of houses and the average private residence size (in terms of floor space per residence and per inhabitant) have increased continually since 1990, and the trend towards single-person households has continued. Nevertheless, policy interventions such as the eco-tax reform and the support of residential energy efficiency, as well as rising energy and electricity prices (in part due to the EEG apportionment), made it possible to keep energy consumption in the residential sector roughly constant in the 2000s and to shift the fuel mix used in households towards less carbon-intensive fuels (from oil to natural gas and renewables).[23] As a consequence, overall emissions from the residential sector declined by more than 13% over the 2000s.

The federal government launched a number of initiatives over the review period to reduce emissions from the residential building sector by promoting renewables-based heating systems (Box 5.4) and increasing the energy efficiency of buildings (Box 5.5). Evidence suggests that retrofit can be cost-effective and can result in a net benefit to householders and society. For example, a review of cost-benefit analyses found that energy savings exceeded the costs of deep retrofit in five out of seven cases (Neuhoff *et al.*, 2011)

Box 5.5. **Promoting energy efficiency in the residential, commercial and service sectors**

The KfW Bank implements a number of building energy efficiency programmes on behalf of the government. Under the CO_2-Building Rehabilitation Programme (energy-efficient rehabilitation and construction) a budget of EUR 8 billion was provided in 2006-11 for low-interest loans and grants to support energy-efficiency upgrades of more than 2.5 million residential units and more than 1 050 public buildings. The maximum value of a loan was EUR 75 000 for rehabilitation measures and EUR 50 000 for new constructions. To be eligible, a house's annual primary energy consumption must be approximately 30 to 60% lower than that required by regulations for new houses. The CO_2-Building Rehabilitation Programme will be expanded from 2012 to 2014, with an annual budget of about EUR 1.5 billion.

On-site consulting on efficient energy use in residential buildings is another important tool for outlining needed energy-related investment in the building sector. A programme called On-site Energy-related Consulting in Residential Buildings, overseen by BMWi, has grown considerably since 1998, when 1 034 consultations per year were carried out. The highest annual number of energy-related consultations to date was reached in 2006, when over 22 000 were carried out. In 2007, 20 400 consultations were done. In addition, consumers can seek energy advice from independent professionals in more than 600 locations throughout the country.

The federal government strengthened minimum energy standards for new buildings and existing buildings that undergo major renovations over the review period. The 2002 Energy Savings Ordinance increased the level of energy efficiency standards by on average 30% in comparison to previous regulations. In June 2007, the ordinance was amended to make energy certification for buildings mandatory, in compliance with the EU Energy Performance of Buildings Directive (2002/91/EC). A further amendment of the ordinance in 2009 increased the minimum energy efficiency standards for new buildings and existing buildings that undergo a major renovation by another 30%, on average.

The Special Fund for Energy Efficiency in SMEs was initiated by BMWi and KfW Bank in 2008 to provide incentives for investments in energy efficiency. Grants covering 60-80% of the cost of consultancy advice and low-interest loans for investment allowing at least 15-20% energy savings are made available. These initiatives providing low-interest loans and advice to SMEs are to be expanded under the Energy Concept.

Dena runs an energy efficiency initiative which provides consulting and information on options for enhancing energy efficiency in businesses, industry and the commerce-trade-service sector. The focus is on cross-cutting technology areas such as pump systems, compressed-air systems, refrigeration and ventilation.

The federal government introduced binding guidelines for procurement of energy-efficient products and services in 2007. The guidelines apply to all federal agencies that award public contracts; the *Länder* and municipalities have been asked to review the possibility of adopting similar regulations.

An amendment to the Energy Industry Act on liberalising metering was adopted in 2008 to facilitate and promote innovative metering, enabling consumers to reduce their energy costs; it is also expected to improve efficiency in power generation. A Federal Office for Energy Efficiency was established in 2009 to monitor the market for energy services and other energy efficiency improvement measures. The development of a market for energy services is a priority of German policy.

and the cost-benefit analysis of the Integrated Energy and Climate Programme suggests that most of the measures related to buildings have a positive cost profile. Yet a number of well-documented market failures and barriers to investment, such as lack of information, long payback period, credit constraints and split incentives between landlords and tenants (see below), prevent a socially optimal level of investment in home energy efficiency (Gillingham *et al.*, 2009; Ryan *et al.*, 2011).

Building renovation will continue to be a central focus of German climate policy. The Energy Concept envisages doubling renovations from about 1% of the building stock a year to 2%. A "climate neutral" building standard for new building will be introduced by 2020, and a roadmap for voluntary renovation initiatives will be introduced from 2020 for all buildings, the aim being to reach an overall goal of an 80% reduction in primary energy requirements by 2050 (Bundesregierung, 2010). Current programmes providing incentives for renewables in residential buildings and for upgrades to building materials will also be escalated.

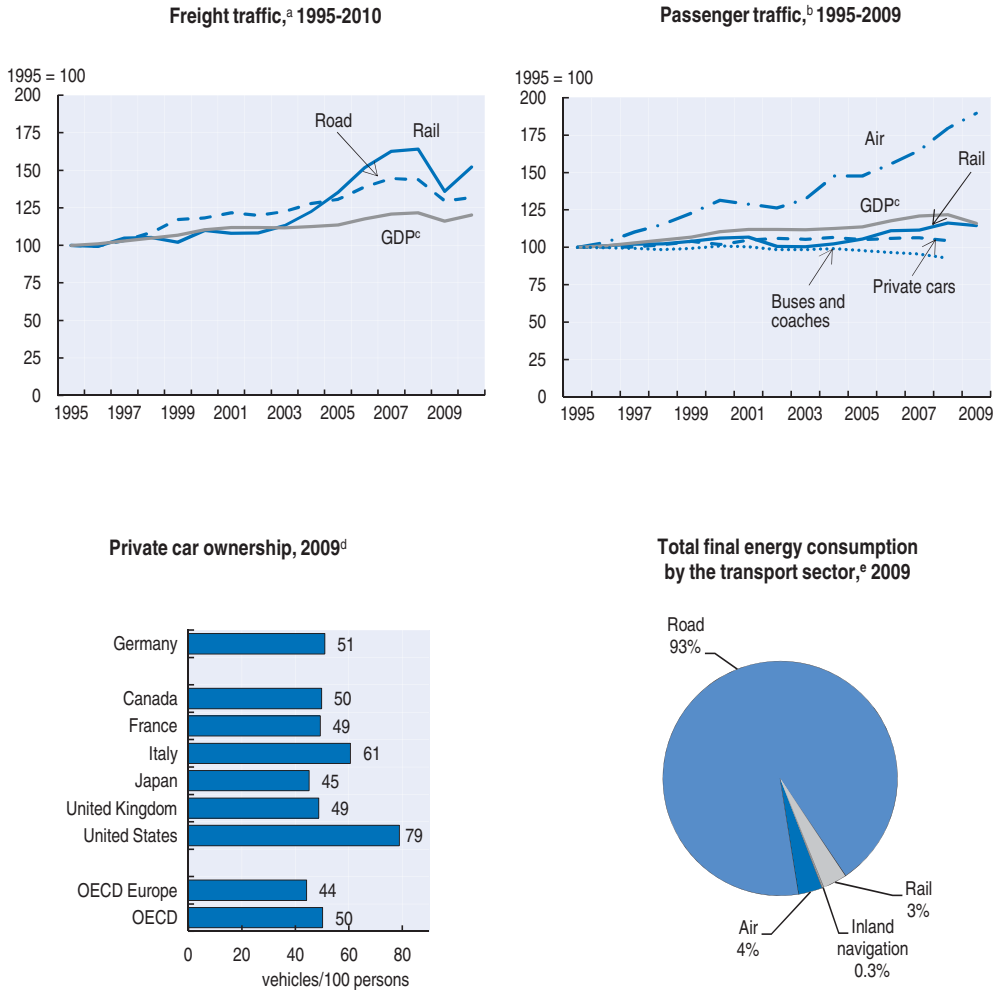
A key issue will be how to address the principal-agent problem concerning rented accommodation, which accounts for 55% of all German housing. This describes a situation where one party, such as a builder or landlord, decides the level of energy efficiency in a building, while another party, such as a purchaser or tenant, has to pay the energy bills (IEA, 2007b). Owners thus have little incentive to improve the energy performance of the buildings. While landlords are entitled to increasing rent by up to 11% following any refurbishment, in practice this can be difficult due to local market conditions. The Energy Concept promises that rent laws will be reviewed in light of the need to create incentives for building retrofit. The government could consider a gradual introduction of mandatory minimum energy performance standards for rented accommodation, and, as suggested by the OECD (2012), the introduction of an energy-efficiency rental index.

6. Policies and measures in the transport sector

Both passenger and freight transport volumes increased during most of the 2000s. Overall transport volumes declined at the end of the decade due to the recession. Between 1999 and 2008, freight transport volume (as measured by tonne-kilometres) grew considerably. This was largely a consequence of Germany's economic expansion, as well as of increased transit traffic after the 2004 EU enlargement. Freight transport increased by 35%, even more than GDP (+13.8%) (Federal Statistical Office, 2010). Road transport has continued to account for the largest share of freight haulage (Reference I.A). In contrast, passenger transport increased at a slower rate than GDP in the same period, by 3.4% (Federal Statistical Office, 2010). Air and rail accounted for most of this increase, whereas passenger transport by private vehicles was nearly unchanged (Figure 5.7), mainly because of the sharp rise in fuel prices. Vehicle stock continued to increase; Germany remains among the OECD countries with the highest private car ownership rates (Figure 5.7; Reference I.A).

Despite the increase in overall transport activity, energy use in transport fell by 10% between 2000 and 2009, leading to a steady decline of transport-related GHG emissions throughout the review period for the first time in German history. Higher fuel prices, due to rising world market prices and the introduction of the eco-tax (Section 4.1), helped mitigate the increase in passenger car use and provided incentives to shift towards

Figure 5.7. **Transport sector**



a) Index of relative change since 1995 based on values expressed in tonne-kilometre.
b) Index of relative change since 1995 based on values expressed in passenger-kilometre.
c) GDP at 2005 prices and purchasing power parities.
d) Or latest available year.
e) Excludes international marine and aviation bunkers.
Source: OECD, Environment Directorate; OECD-IEA (2011), *Energy Balances of OECD Countries.*

StatLink http://dx.doi.org/10.1787/888932592109

diesel-powered cars and more fuel-efficient vehicles for both passenger and freight transport.

The share of diesel vehicles in the total automobile fleet rose significantly, from 14.5% to 24.4%, between 2001 and 2008 (UBA, 2011b). While this is beneficial from a GHG mitigation perspective, it has negative local air pollution impacts. Diesel is taxed at a lower rate than petrol. This differentiation is not justified from an environmental point of view: diesel has a higher CO_2 content than petrol, and diesel vehicles generate more local pollutants than comparable petrol vehicles. Diesel's share of total fuel consumption in road transport has also increased sharply. In 1990, nearly two-thirds of all road traffic emissions were caused by petrol consumption. Today, the relationship is nearly reversed and diesel emissions predominate (UBA, 2011a).

Several sector-specific interventions have also played a role in the decline of transport-related GHG emissions. Increased biofuel use has likely helped reduce emissions. The share of biofuels in total fuel consumption rose from 1.8% in 2004 to 7.2% in 2007 before declining to around 5.8% in 2010 (though the consumption of bio-ethanol continued to grow). The rapid growth in the use of biofuels can be attributed to their favourable treatment in the tax system. As the cost-benefit analysis of the Integrated Energy and Climate Programme (IEKP) shows, this comes at a considerable cost: EUR 180 per tonne of CO_2 abated, much more than most of the other measures and certainly well above the allowance price in the EU ETS. The Biofuel Quota Act came into force in 2007, and it will require fuel suppliers to sell a statutory minimum share of biofuels. This quota system will replace the tax benefits for conventional biofuels by 2012. In 2009, the government, fearing competition between biofuel and food crop cultivation, froze the biofuel quota at 6.25% from 2010 to 2014. In addition, the 2009 Biofuels Sustainability Ordinance laid down minimum sustainability criteria for biofuels (in force since 2011). The 2010 Energy Concept reconfirms its intention to continue increasing the proportion of bio-components in fuels and to establish the GHG balance as the key criterion for any future biofuel support measure.

Measures have been brought forward to decrease emissions on a per-vehicle basis. In July 2009, the annual motor vehicle tax was restructured to include a CO_2 component. The base tax is EUR 2 per 100 cc on petrol and EUR 9.50 per 100 cc on diesel. The CO_2-tax component is linear at EUR 2 per g CO_2/km, but cars with CO_2 emissions below 120 g/km (falling to 110 g/km in 2012-13 and then to 95 g/km) are exempt.[24]

Low-emission zones have been progressively introduced in several municipalities with the aim of bringing down local air pollution. They have been successful in promoting renewal of the car fleet with vehicles that emit less air pollutants, which are also more fuel efficient and emit less CO_2 (Box 5.6).

Measures have also been taken to reduce emissions from freight transport. In January 2005, a new electronic toll collection system was introduced on the 12 000 km of German *Autobahn* for all heavy goods vehicles (HGVs) with a maximum weight of 12 tonnes and above. The GPS-based toll system, called LKW-MAUT, is a government toll based on distance driven, number of axles and the emission category of the truck (the average charge is EUR cents 16.3 per kilometre). The toll is levied for all trucks using the *Autobahn*, whether full or empty, foreign or domestic. Light-duty vehicles are not subject to the toll system. On 1 January 2009, the Toll Level Regulation was amended to raise the toll paid by HGVs with high emission levels.[25] As part of a programme to compensate hauliers for the higher toll rates, the federal government provides up to EUR 100 million a year in incentives to buy low-emission HGVs. This compensation should be temporary and withdrawn as soon as possible. While the toll system targets primarily emissions of local air pollutants from HGVs, it can help reduce related CO_2 emissions, not least by reducing freight transport volumes. The IEKP impact assessment suggests that, although the impact on GHG emissions will be relatively minor, this is a highly cost-effective method of mitigating emissions (Section 7).

To price the externalities associated with air transport and reverse the increasing emissions from this sector, as of 2011 passengers boarding flights in Germany are charged EUR 8 per short-haul flight, EUR 25 per medium-haul flight and EUR 45 per long-haul flight. This measure has to be considered in conjunction with the inclusion of aviation in

Box 5.6. **Low-emission zones**

To improve air quality, in 2008 the municipalities of Berlin, Cologne and Hanover launched a programme of low-emission zones. Only cars and trucks with emissions below certain thresholds, identified by a coloured sticker, can enter such a zone. At the same time, a national labelling system began classifying vehicles in four categories according to the installed emission reduction technology. Stickers are valid in low-emission zones nationwide. By 2011, 46 municipalities had introduced such zones and several more plan to do so.

The zone in Berlin covers the inner city (within the rail ring), a built-up, densely populated area of about 88 km^2 and 1 million residents. In the year after the introduction of the zone, the number of passenger cars in the highest emission category registered in Berlin dropped by about 70% and the number of commercial vehicles by more than 50% (Lutz, 2009). After the first year, emissions of diesel exhaust particulates were 24% lower than projected without the zone, and the corresponding drop in NO_x emissions was 14%. In 2010, the emission performance required to enter the zone was tightened and emissions declined further: by more than 50% for diesel exhaust particulates and 20% for NO_x, again compared to projections, after one year. Overall, since the introduction of the zone in 2008, traffic-related black carbon concentrations measured along heavily trafficked roads have been cut in half (Lutz and Rauterberg-Wulff, 2011). To maintain the incentive function of the zone, the emission thresholds need to be systematically reviewed and tightened to take into account vehicle technological development.

Passenger car traffic also decreased in the Berlin low-emission zone, with corresponding impact on air pollutant and GHG emissions. However, the decrease of car use in 2008 cannot be attributed to this programme, as it resulted from a more general trend largely linked to increasing fuel prices and the promotion of public transport (Lutz, 2009). The positive effects of the low-emission zones would be strengthened if demand-side measures to reduce car use were implemented. For example, charging systems as those in London and Milan would help reduce weekday traffic and curb particles generated by tyres and road use, as well as NO_2 emissions, and emissions of GHGs.

the EU ETS in 2012. The aviation emission cap will be set at 97% of the 2004-06 average aviation emissions, and between 2013 and 2020 will be reduced to 95%. However, 85% of aviation allowances will be allocated for free in 2012 (reduced to 82% in 2013-20).

The federal government plans a number of initiatives to promote electric mobility. It approved a national Electric Mobility Development Plan in August 2009 to promote R&D in this field and the market launch of electric and plug-in hybrid vehicles (Chapter 4). The plan sets a target of 1 million electric cars on roads by 2020, and the 2010 Energy Concept envisages 6 million by 2030. The Economic Stimulus Package II supports the e-mobility plan with funding of EUR 500 million. The 2011 Government Programme for Electric Mobility complements the e-mobility plan with additional funding of EUR 1 billion to 2013.

On the negative side of the balance sheet, perverse subsidies which encourage private car use and increase GHG emissions remain in place. Travel to and from work using private transport is tax deductible at a rate of EUR 0.30 per kilometre. The distance-based allowance encourages car use and longer commutes. It is estimated that abolition of this allowance could cut CO_2 emissions by more than 2 Mt CO_2 per year by 2015 and 2.6 Mt CO_2 per year by 2030 (UBA, 2011b). In addition, when company cars are used for

private purposes, the income tax due on this "payment in kind" is relatively low, being based on 1% per month of the vehicle's list price at the time of first registration. Moreover, company-paid operational costs, including fuels, are not considered taxable income. Hence, the cost to company car users of driving the car is virtually zero. This creates an incentive for companies to pay employees in the form of a company car. Some 30% of new registrations in Germany in 2008 were company cars, which tend to have higher emissions than private cars. Income tax on company car ownership should reflect the true value of the car. It could also be reduced for environment-friendly cars.

7. Climate policy after 2012

7.1. Targets

Germany has committed itself to ambitious GHG emission reduction targets to 2020 and beyond. The 2010 Energy Concept (Box 5.2) set a target of reducing emissions by 40% from 1990 levels by 2020. In addition, Germany is committed to achieve a number of targets set at EU level under the 2008 EU Climate and Energy Package. These include:

- a 14% reduction on 2005 emissions by 2020 for sectors not covered by the EU ETS (Decision No. 406/2009/EC);
- a requirement that the sectors covered by the EU ETS reduce emissions by at least 21% from 2005 levels by 2020 (Directive 2009/29/EC);
- an increase in the share of renewables in final energy consumption to 18% by 2020 (Directive 2009/28/EC);
- a rise in the share of renewables used for transport to 10% by 2020 (Directive 2009/28/EC).

In addition, like all EU countries, Germany is committed to achieving 20% energy savings by 2020, although this target is not legally binding.

The targets are based on an EU-wide GHG emission reduction commitment of 20% from 1990 levels by 2020. Together these commitments would imply a 30% emission reduction for Germany by 2020. Hence, the domestic target of 40% goes beyond EU requirements under current agreements. A *pro rata* application of Germany's 40% target between the EU ETS sector and the non-ETS sector would suggest that a more onerous reduction will be required of the non-ETS sector than is currently required by the EU.

Two closely related issues arise within this context. The first is how emissions under the EU ETS should be counted to meet Germany's economy-wide target. One option would be to attribute to the German ETS sectors a 21% reduction from 2005 emissions, the same as the aggregate EU-wide reduction. The problem with this approach is that there is no guarantee that the required reduction in emissions would occur in Germany, as it might be more cost-effective for German companies to purchase emission permits from abroad than to reduce their own emissions.

The second issue is where the additional efforts entailed in meeting Germany's domestic target will fall. Focusing them in the EU ETS sector would lead to the generation of additional allowances which could be purchased by companies in other countries. No overall reduction in emissions would occur at EU level. To avoid this, the authorities could buy and cancel a volume of allowances corresponding to the emissions they wished to cut over and above those determined by the EU allowance price, thus reducing the overall quantity of allowances available within the EU ETS. This would permit the authorities to claim that real emission reductions had arisen, as a result of their more onerous target, in

the most cost-effective manner. Alternatively, Germany could target its additional mitigation efforts outside the EU ETS, but this would greatly increase the cost of compliance because a higher mitigation burden would be focused on these sectors of the economy (transport, agriculture, residential and commercial fuel use, and waste).

Overall, defining domestic targets that go beyond those implied by the EU commitments may impair both the effectiveness and the efficiency of the system. However, they can be justified on the ground that climate and energy policies pursue objectives that go beyond GHG emission abatement, such as innovation in the energy sector (OECD, 2012). The implications of the measures put in place to reach a domestic emission reduction target within the context of a transboundary emission trading system that covers 60% of German emissions need further consideration. The EU committed to move from a 20% to a 30% emission reduction target provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and capabilities. This would result in a reduced cap in the ETS sector and a more ambitious target for Germany in the non-ETS sector. However, Germany's 40% reduction target is not made conditional on this development, which is by no means certain.

7.2. Cost and benefits of climate policy

Achieving Germany's ambitious GHG emission mitigation target is expected to require substantial public and private investment. The annual investment required to implement the measures outlined in the 2010 Energy Concept is about EUR 20 billion, or 0.8% of 2009 GDP. The Energy Concept expects revenue from auctioned EU ETS allowances to fund renewables, energy efficiency and research in these fields, as well as climate-related development assistance.

A number of analyses of the IEKP and the Energy Concept have been undertaken to assess what German's ambitious climate policy will cost taxpayers and the economy. A cost-benefit analysis of the IEKP, commissioned by UBA, found that overall annual investment of EUR 24 billion in climate protection would trigger energy savings of EUR 29 billion in 2020. These savings would be supported by programme costs (transfer costs) of EUR 2.5 billion annually, including surcharges for renewables and CHP, which would constitute the biggest share (Table 5.2). According to this study, investing in climate protection in Germany would yield net benefits (Doll *et al.*, 2007).

The IEKP-Makro study (Shade *et al.*, 2009) analyses the macroeconomic impact of the IEKP in Germany. All three policy packages assessed (energy efficiency improvement in industries and services, energy efficiency in buildings, and climate-efficient road transport) would lead to an increase of economic growth and employment in Germany. Energy-efficient buildings would induce the largest economic stimulus up to 2020, followed by climate-efficient road transport and energy efficiency in industry and services. The latter package would continue to improve economic performance until 2030. The basic conclusion is that the improvement in economic performance would be mainly driven by the economic stimulus of increased investment due to climate policy in the short and medium term, and by savings of energy and related expenditure in the long run.

However, the –40% target by 2020 remains challenging. It will require accelerating the pace of reductions in the 2010s: Germany is not expected to benefit from other one-off reductions in GHG emissions, as those occurred in the early 1990s (OECD, 2012).

Table 5.2. **Costs and benefits of selected measures in the Integrated Energy and Climate Programme in 2020**[a]

Programme measure	Title of the measure	Programme costs I[b] (EUR billion)	Programme costs II[b] (EUR billion)	Gross costs[c] (EUR billion)	Annually saved (fossil) energy (PJ)	Annually saved (fossil) energy[d] (EUR billion)	Specific net reduction costs[e] (EUR/t CO_2)
1	Combined Heat and Power Act[f]	0	0.26	–0.06	135	–0.24	9
2	Renewables in the power sector	0	1.4	5.5	255	4.2	27
6+7	Energy management systems; support programme for climate protection and energy efficiency (energy efficiency fund)[g]	0	0.3	2.9	128	3.2	–22
8	Energy-efficient products (in households and industry)	0.004	0	0.19	112	4.2	–266
10A	Energy-saving ordinance	. .	0	7.75	573	10.3	–63
	Excluding overlaps[h]	. .	0	2.66	225	5.4	–268
10B	Substitution of electric night storage heating in households	. .	. .	0.27	–5	0.9	–102
12	Modernisation programme to reduce CO_2 emissions from buildings	. .	0.62	2.30	189	3.2	–67
13	Energy-efficient modernisation of social infrastructure	. .	0.04	0.48	20	0.33	110
14	Renewable Energies Heat Act	0.01	0.00	3.21	210	1.1	121
15	Programme for the energy-efficient modernisation of federal buildings	. .	. .	0.06	6	0.10	–34
	Sum building measures 10A, 10B, 12, 13, 14, 15 (excluding overlap)	. .	0.65	9.00	643	11.1	–43
16	CO_2 strategy for passenger cars	0	0	6.45	275	8.7	–128
17	Expansion of biofuels[i]	0	0	0	323	–2.1	180
20	Improved steering effect of the toll on HGVs (variant 20a)	0	0	0.014	1.2	0.04	–275
	Sum (with overlaps for building measures)	**0.01**	**2.6**	**29.2**	**2 220**	**33.8**	**–23**
	Sum (excluding overlaps for building measures)	**0.01**	**2.6**	**24.1**	**1 872**	**29.0**	**–27**

a) Values in 2020 compared to the baseline case. Costs are given in 2000 prices (where necessary annualised but not discounted to the base year).
b) Programme Costs I are the additional administrative costs for the national budget incurred for implementing the measure. Programme Costs II contain funds which may lower the obstacles to investment (*e.g.* feed-in tariffs for CHP and renewables, direct investment subsidies), where necessary annualised but not discounted to the base year.
c) Additional costs of the measure without considering the energy saving.
d) Assumes a wholesale price of EUR 59/MWh for electricity and of EUR 60/MWh for heat.
e) Costs caused by a measure at a certain point in time. Profitable measures have negative specific reduction costs.
f) The gross costs of CHP are very low because, among other reasons, hard coal power stations were used as the reference system and these have high investment costs. The lower fuel costs of hard coal in comparison to the natural gas used in CHP plants are reflected in the negative energy cost savings.
g) Measures 6 (Energy management) and 7 (Support programmes climate/energy) complement each other and they are jointly evaluated.
h) The Energy Saving Ordinance has overlaps with the measures 10B, 12, 13, 14 and 15. According to the calculations the measures 12, 13 and 15 are entirely included, measure 10B is included to 50% and measure 14 to 65%.
i) The lower figures for biofuels refers to the introduction of second generation biofuels from 2015. The total was calculated using the highest costs (first generation biofuels).

Source: Doll *et al.* (2007).

GHG emissions increased by 2.7% in 2010 as the economy started to recover. The decision to phase out nuclear power by 2022 is also expected to lead to an additional increase in Germany's emissions in the short term. A highly cost-effective policy mix will, therefore, be needed to reduce the risks of negative impacts on the economy and the society.

8. Adaptation

In order to reduce vulnerability to the consequences of climate change, to maintain or improve the adaptability of natural, social and economic systems, and to take advantage of any opportunities that may arise, the federal government published the German Strategy for Adaptation to Climate Change in 2008 (BMU, 2008). The strategy was developed in co-operation with the *Länder* by a working group composed of representatives of most federal ministries, under the lead responsibility of the BMU. Support was provided by the Competence Centre on Climate Impacts and Adaptation, which was set up at the end of 2006 at the UBA.

In line with international best practice, this strategy lays the foundations for medium-term process in which risks will be identified, actions prioritised and adaptation measures implemented, in co-operation with the *Länder* and civil society groups. The key impacts identified, some of which are already being experienced, include illnesses caused by heat waves and other changes in climate patterns, impairment of agricultural yields due to more arid conditions, increased vulnerability of forests, increased heavy precipitation along with greater risk of flooding, threats to diversity of species, impairment of inland shipping, reduced snow reliability and consequent impacts on tourism, and more intensive and frequent coastal flooding.

In addition to giving a concrete description of possible consequences of climate change and outlining options in 15 fields of action and selected regions, the strategy provides an overview of the international context and Germany's contribution to adaptation in other parts of the world. It also describes forthcoming steps in its own continuing development.

An adaptation action plan to implement the strategy was drawn up with the 16 *Länder* and other stakeholders and was published in August 2011. It includes principles and criteria for prioritising action, derived specifications for federal measures, an overview of concrete measures by other stakeholders, information on financing of adaptation and proposals for progress review. The plan advocates action in four areas. The first is creating and disseminating a knowledge base about the consequences of climate change. It includes the elaboration of methods, models, data sets, prediction tools and indicators to monitor the consequences of climate change. The second area is setting frameworks and incentives. It proposes, *inter alia*, mainstreaming adaptation into relevant national policy areas, including legal and technical regulations and funding. Third, the plan lists actions under the direct responsibility of the federal government such as adaptation activities on federal assets (*e.g.* buildings, transport infrastructure and forests). Fourth, it proposes intensifying international co-operation and, in particular, making knowledge available to developing countries.

Notes

1. The burden sharing agreement was reached in 1998, after the EU15 collectively committed, in the 1997 Kyoto Protocol, to reduce emissions by 8% from 1990 levels by 2008-12. Germany had previously adopted a 25% national CO_2 emission reduction target (from 1987 levels) to be achieved by 2000. That target was modified in 1995 to be consistent with international targets using 1990 as the base year.
2. Due to the economic collapse in the new *Länder* after unification, their CO_2 emissions decreased by around 44% between 1990 and 1995 (OECD, 2001).
3. The year-on-year fluctuations shown in Figure 5.2 were largely due to climatic conditions, with increased energy use for heating in years characterised by colder winters (UBA, 2011a).
4. Several independent think tanks also have important indirect input to policy formulation, including the Wuppertal Institute for Climate, Environment and Energy, the Öko-institut and the Potsdam Institute for Climate Impact Research.
5. Dealing with energy supply, transport, the building sector, new technologies, agriculture and forestry, emission inventories, and project-specific mechanisms.
6. Prior to the review period the IMA reported on the national climate protection strategy in 1990, 1991, 1994 and 1997.
7. The residential sector was required to reduce emissions by 18-25 Mt CO_2 eq by 2005, transport by 15-20 Mt CO_2 eq, and the energy sector and industry by 20-25 Mt CO_2 eq, from a 1999 baseline.
8. This has led to a public perception that electric utilities obtained the postponement of the nuclear phase-out in exchange for agreement to use part of the resulting profits to subsidise renewables. It was partly as a consequence of this perception that, following the nuclear disaster in Fukushima Daiichi (Japan), there was new impetus to renegotiate the Energy Concept and speed up the transition to renewables.
9. From 2011, the tax reduction for industry and agriculture is reduced from 40% to 25%, and the peak equalisation is reduced from 95% to 90% of the eco-tax payment exceeding the relief of social contributions.
10. The federal government's initial proposed cap was 482 Mt CO_2, which was reduced by 6% in negotiations with the European Commission.
11. Despite the over-allocation of permits in Phase I, the price of permits remained at around EUR 12, allowing companies that had received allowances to make a profit by selling them.
12. Reduced industrial production and energy use during the economic crisis also contributed to the increased volatility of CO_2 allowance prices.
13. For example, a limited number of small energy generators over 20 MW in the commercial sector (*e.g.* heat generation at hospitals) are covered by both instruments. Also covered by both are industry installations not excluded from the energy tax, such as pulp, paper and cardboard, and crackers in the chemical industry. It should be noted that these companies (particularly labour-intensive ones) may experience net relief through reduced pension fund contributions.
14. Other gap areas include thermal waste, exhaust air treatment and ship transport, which may be covered under other regulations.
15. Over 500 electricity-intensive manufacturing companies and rail operators are largely exempt from the EEG apportionment, which leads to increased prices for all other electricity customers.
16. This cost is referred to as "differential cost", *i.e.* the difference between the fixed average tariffs paid to the electricity generated from renewable sources and the procurement prices for the conventionally generated electricity.
17. The impact on electricity prices would have been higher without the so-called merit order effect – the impact that priority feed-in of renewably generated electricity has on wholesale electricity prices. Because demand for conventionally generated electricity decreases as a result, under a merit-order system the most expensive of the power stations that would otherwise be used are no longer needed to meet demand. This exerts downward pressure on wholesale electricity prices on the spot market, with the reductions being passed on to some electricity consumers, mainly electricity-intensive companies, via lower electricity prices (BMU, 2010).
18. Over the last 20 years, PV has shown impressive price reductions, with the price of PV modules decreasing by over 20% every time the cumulative sold volume of PV modules has doubled. System

prices have declined accordingly: in the last five years a price decrease of 50% has been achieved in Europe (EPIA, 2011).

19. If the increase in electricity generation from renewables in one country replaces fossil fuel-generated power, demand for emission allowances from power plant operators decreases. If the EU-wide cap is not reduced, this results in lower prices and the displacement of GHG emissions to other sectors or countries.

20. Act for the Reorganisation of Taxation of Energy Products and for Amendment of the Electricity Tax Act, *Bundesgesetzblatt (Federal Law Gazette)*, Vol. I, No. 33, pp. 1534-61.

21. Ethics Commission for a Safe Energy Supply, "Germany's energy transition – A collective project for the future", 30 May 2011, Berlin, available at *www.bundesregierung.de*.

22. Measures have also been introduced to address specific emission categories. For example, methane emissions from hard coal mining will be eliminated when Germany ends hard-coal mining by 2018, as agreed by the federal government in 2007. The Chemicals Climate Protection Ordinance, included in the Integrated Energy and Climate Programme, was aimed at reducing emissions of fluorinated GHGs from mobile and stationary cooling installations. Savings are also expected to be achieved through provisions on leak-proofing, labelling of installations and recovery and return of refrigerants.

23. Consumption of oil products by households decreased by 28% between 2000 and 2009, from 30% of residential consumption to 21%, while the use of natural gas rose by 23%, renewables by 37% and electricity by 7%.

24. EU Directive 2009/33/EC requires average CO_2 emissions for new cars registered in the EU to be no more than 130 g/km by 2012.

25. The difference between the lowest and highest toll categories increased by around 50-100%.

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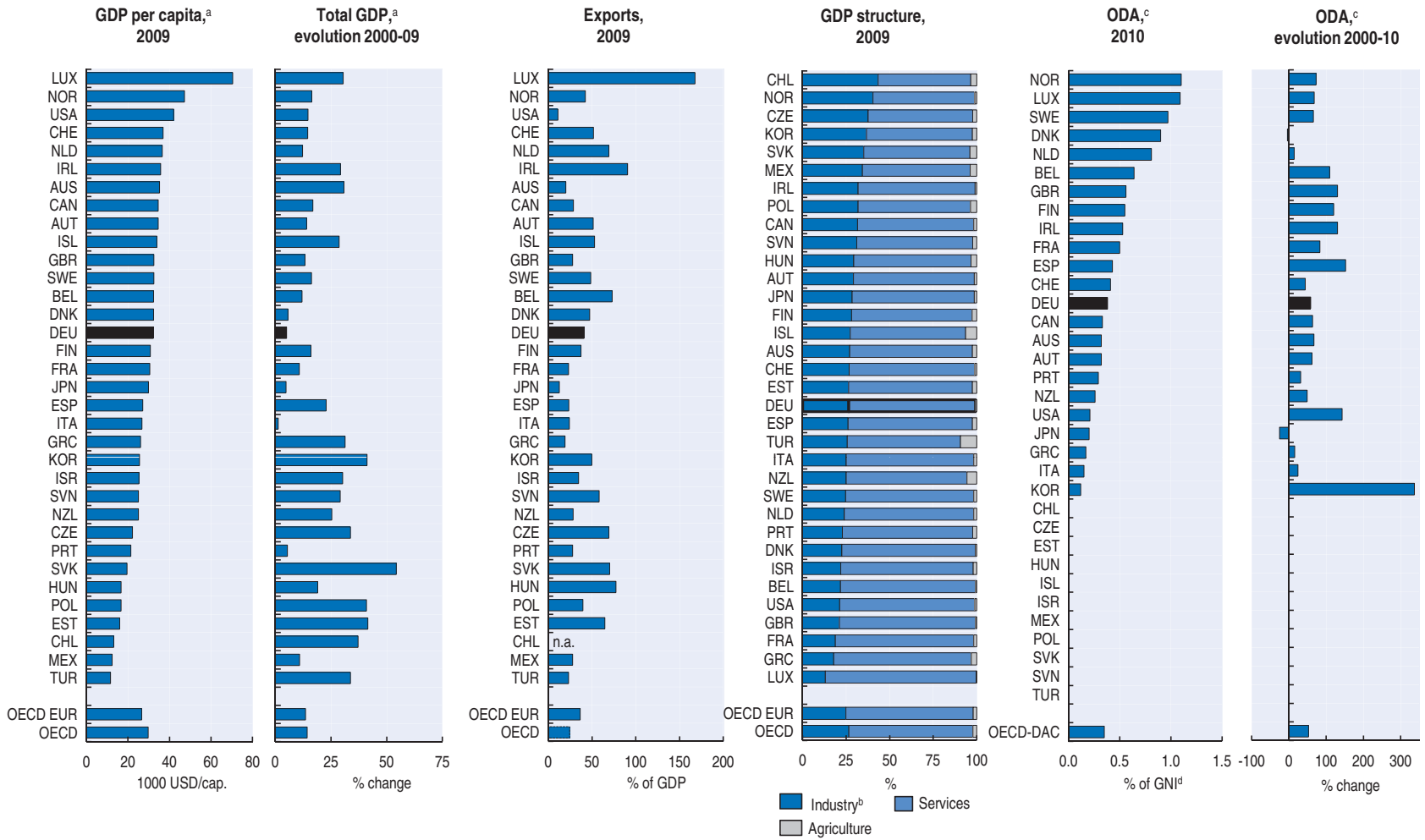

*) Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. Partial totals are indicated by dotted borders.
a) GDP at 2005 prices and purchasing power parities.
b) Including construction.
c) Official development assistance by member countries of the OECD Development Assistance Committee. Total net disbursements at constant 2009 USD.
d) Gross national income.
Source: OECD Environmental Data.

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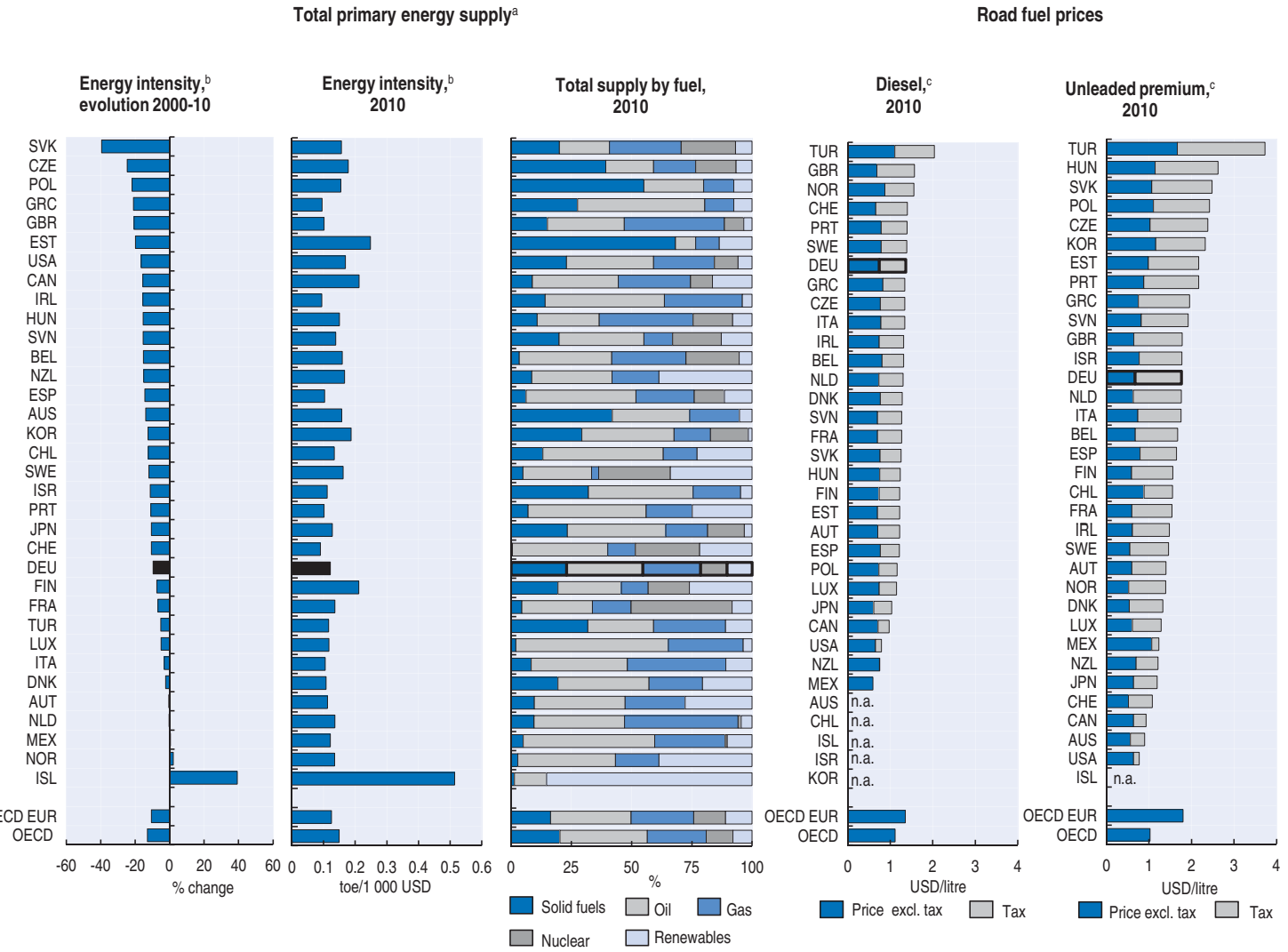


*) Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. Partial totals are indicated by dotted borders.

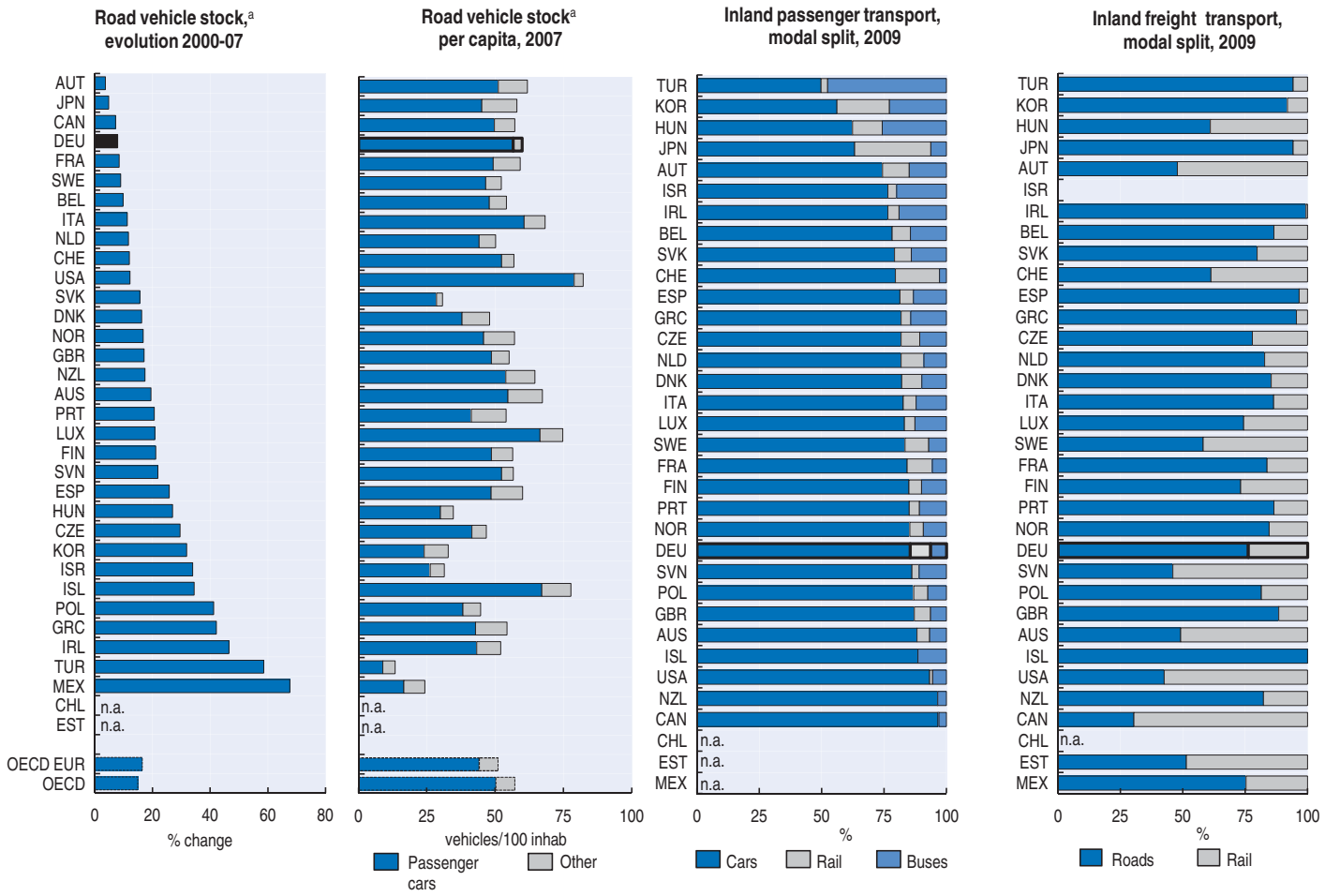
a) Excluding international marine and aviation bunkers.

b) Total primary energy supply per unit of GDP expressed at 2005 prices and purchasing power parities.

c) Diesel fuel: automotive diesel for commercial use, current USD; Unleaded petrol: Unleaded premium (RON 95): USD at current prices and purchasing power parities; JPN: regular unleaded.

Source: OECD Environmental Data.

Reference I.A. **Selected economic data* – Transport**

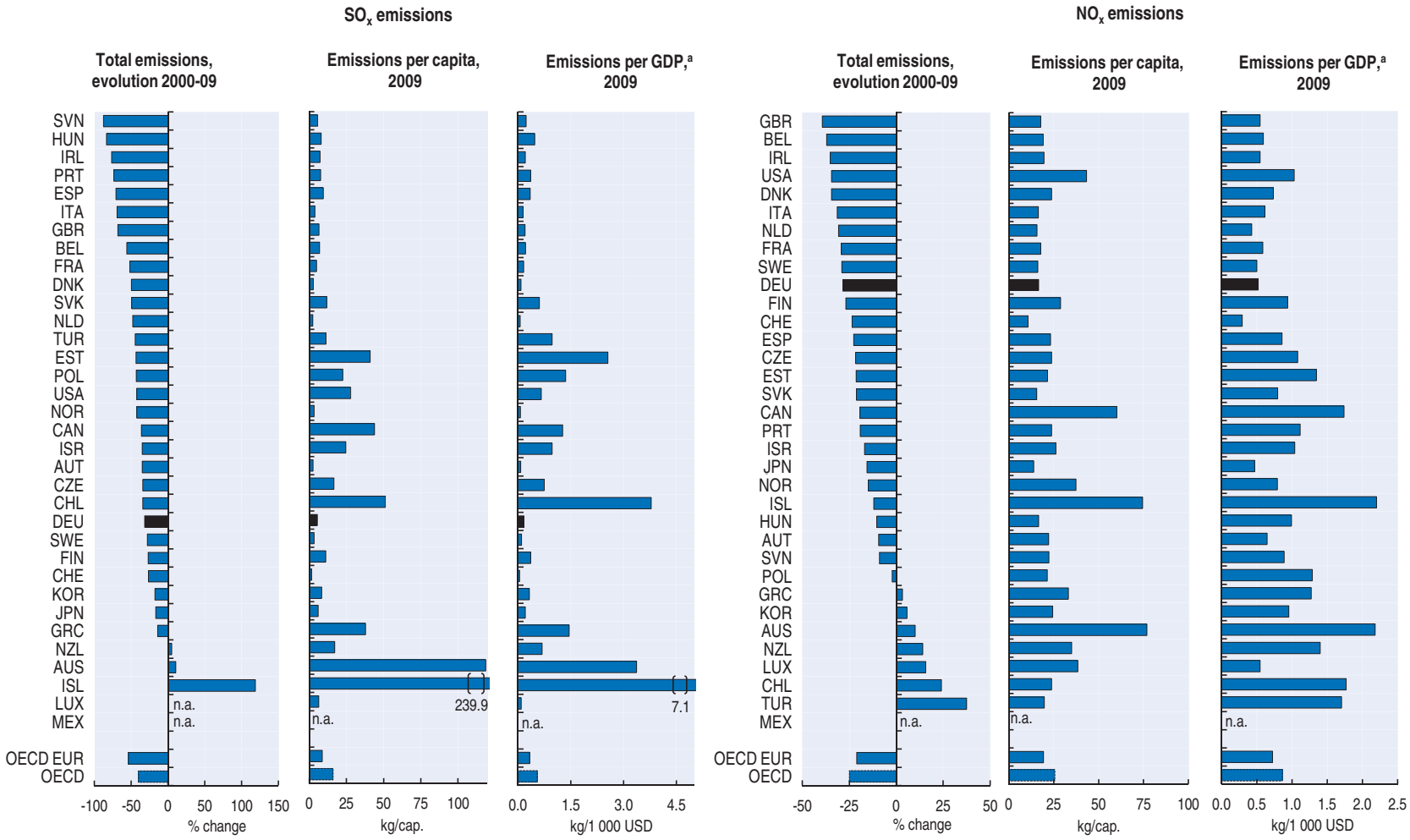


*) Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. Partial totals are indicated by dotted borders.
a) Motor vehicles with four or more wheels. ITA: includes three-wheeled goods vehicles.
Source: OECD Environmental Data.

Reference I.B. **Selected social data* – Social context**

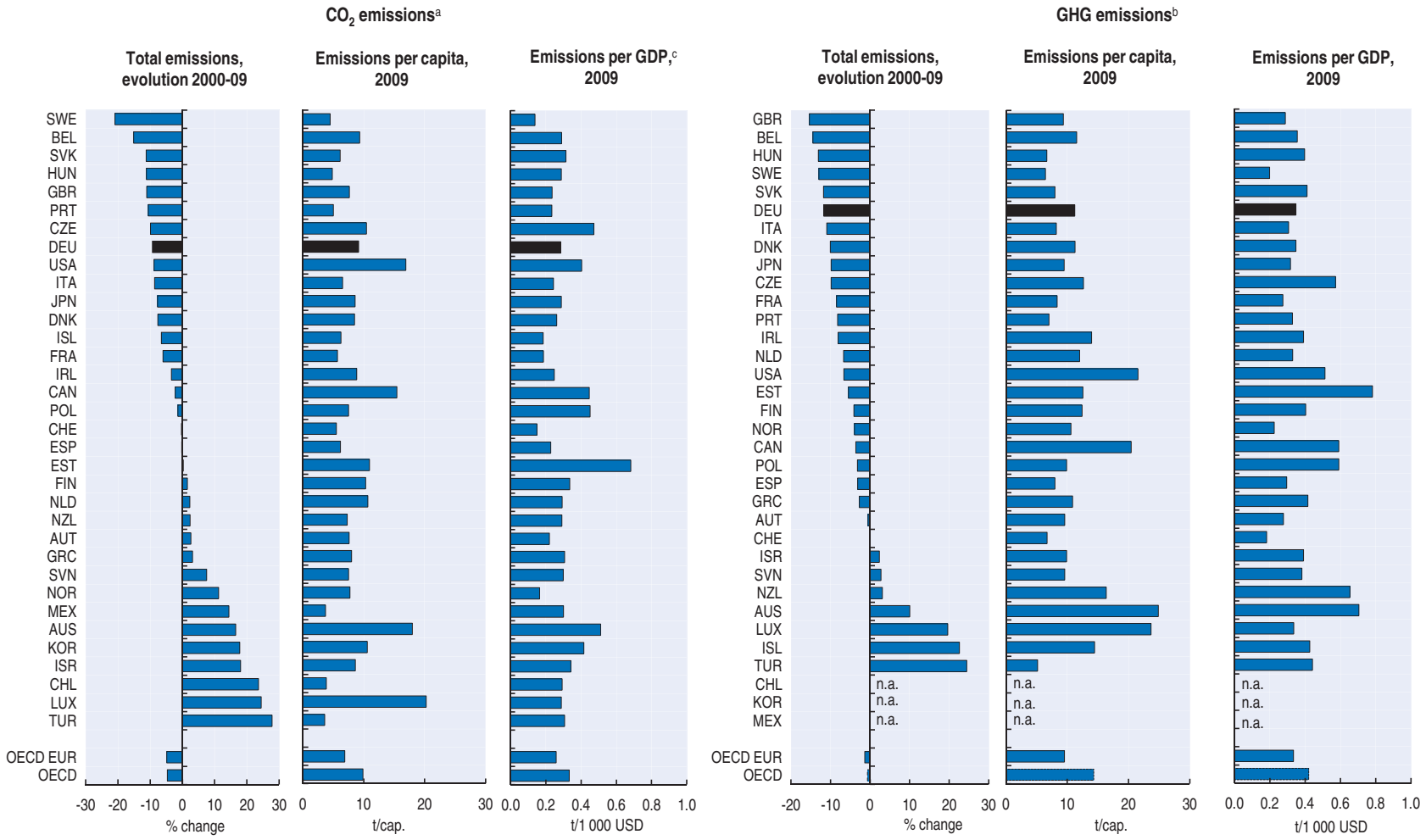
*) Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. Partial totals are indicated by dotted borders.
a) Share of population with an income under 50% of the median income.
b) Ranging from 0 (equal) to 100 (inequal) income distribution; figures relate to total disposable income (incl. all incomes, taxes and benefits) for the entire population.
c) Share of population aged 25-64 years with at least upper secondary education. OECD: average of rates.
d) Harmonised unemployment rates.
Source: OECD Environmental Data; OECD Factbook Statistics.

Reference I.C. **Selected environmental data* – Air**



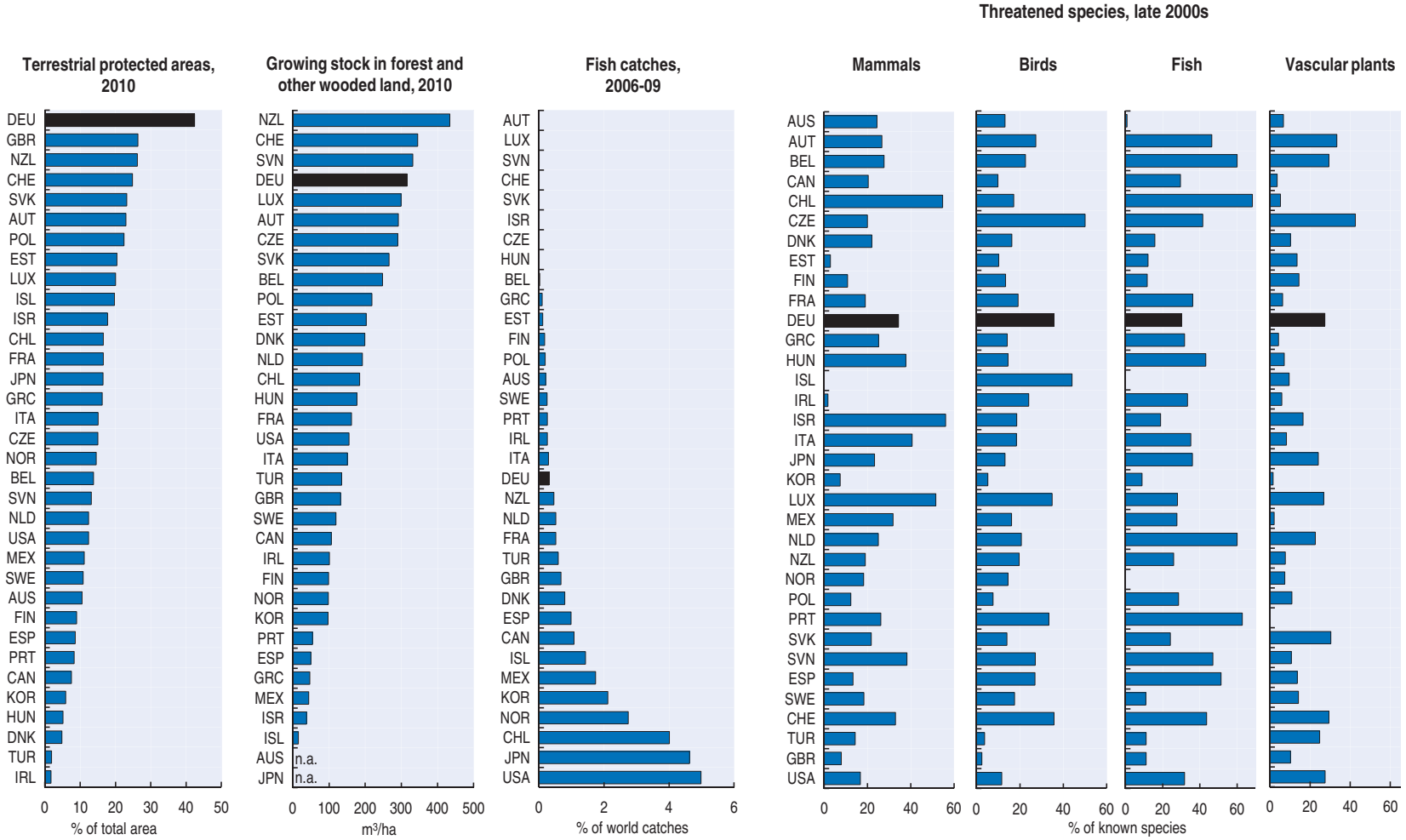
*) Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. Varying definitions can limit comparability across countries. Partial totals are indicated by dotted borders.
a) GDP at 2005 prices and PPP.
ISL: SO_x emissions include emissions from geothermal energy (190 kg per capita in 2009).
Source: OECD Environmental Data.

Reference I.C. **Selected environmental data* – Climate**



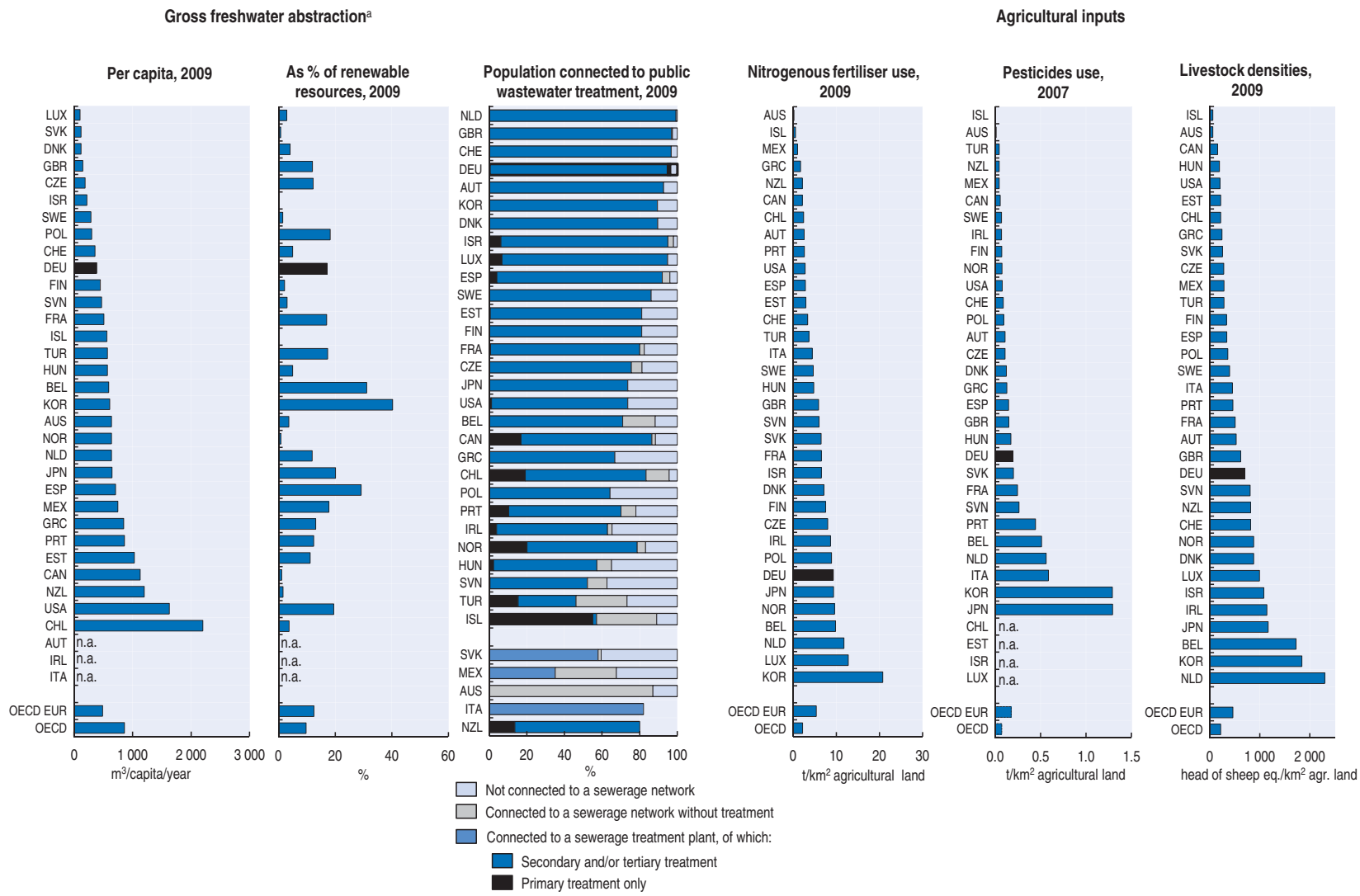
*) Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. Varying definitions can limit comparability across countries. Partial totals are indicated by dotted borders.
a) Emissions from energy use only; excluding international marine and aviation bunkers; sectoral approach.
b) Excluding emissions/removals of the land use, land use change and forestry sector. ISR: 2000 data exclude F-gases.
c) GDP at 2005 prices and PPP.
Source: OECD Environmental Data.

Reference I.C. **Selected environmental data* – Biodiversity conservation and sustainable use**



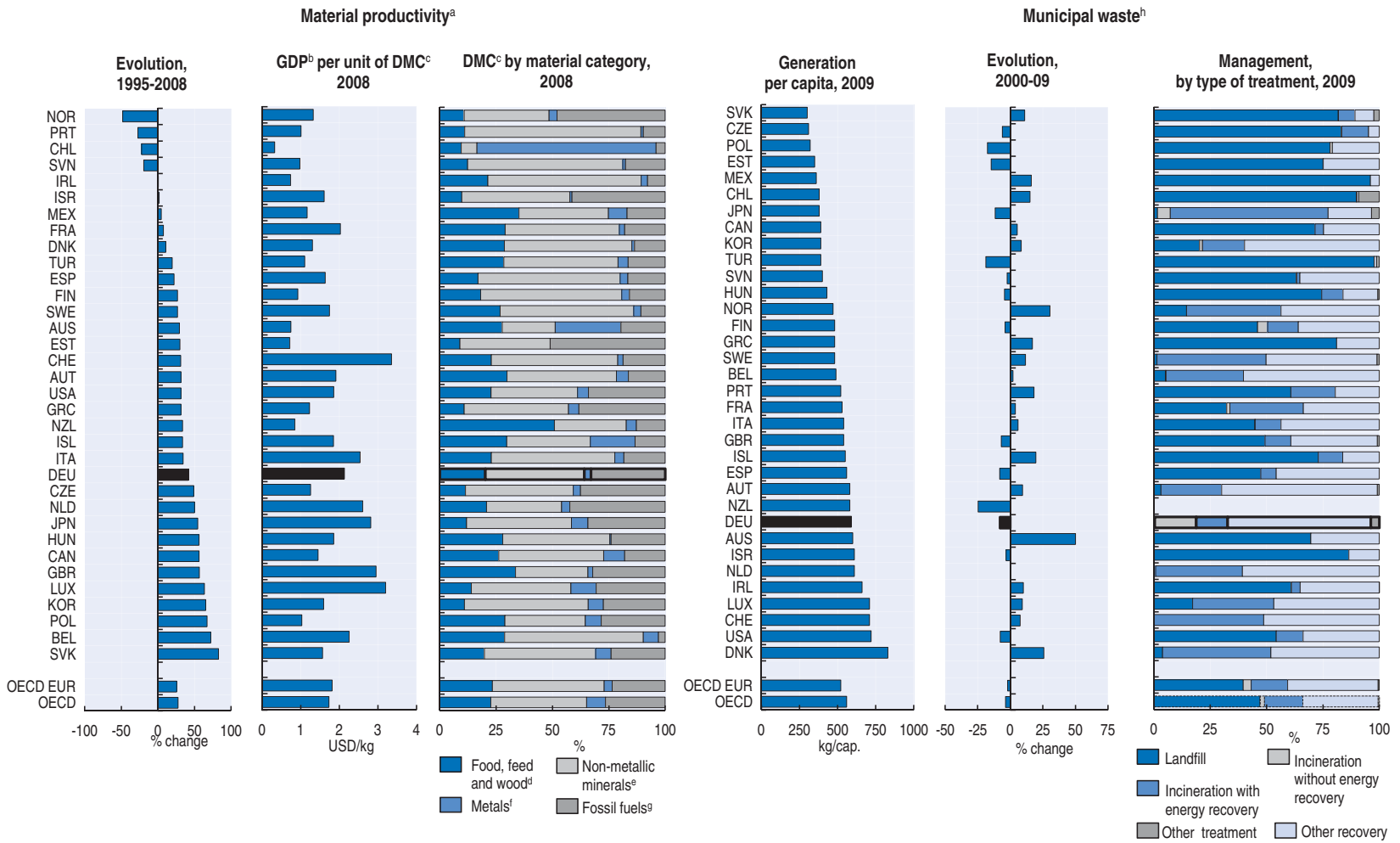
*) Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. Varying definitions can limit comparability across countries.
a) Designated terrestrial protected areas. Includes different level of protection ranging from IUCN categories I to VI. National classifications may differ.
GBR: Threatened species: Great Britain only.
Source: OECD Environmental Data.

Reference I.C. **Selected environmental data* – Water and land**



*) Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. Varying definitions can limit comparability across countries.
a) For some countries, data refer to water permits and not to actual abstractions.
GBR: Water abstraction and public wastewater treatment: England and Wales only; pesticides use: Great Britain only.
Source: OECD Environmental Data.

Reference I.C. **Selected environmental data* – Material productivity and waste**



*) Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. Varying definitions can limit comparability across countries. Partial totals are indicated by dotted borders.

a) Amount of GDP generated per unit of materials used, ratio of GDP to domestic material consumption (DMC).

b) GDP at 2005 prices and PPPs.

c) DMC equals the sum of domestic (raw materials) extraction used by an economy and its physical trade balance (imports minus exports of raw materials and manufactured products).

d) Domestic production from agriculture, forestry and fisheries, plus trade of raw and processed products from these sectors.

e) Domestic extraction and trade of minerals used in industry and construction, plus trade of derived processed products.

f) Domestic extraction of metal ores, plus trade of metal ores, metal concentrates, refined metals, products mainly made of metals, and scrap.

g) Coal, crude oil, natural gas, peat and traded derived products.

h) Waste collected by or for municipalities and includes household, bulky and commercial waste, and similar waste handled at the same facilities. CAN: household waste only and total incineration: NZL: lanfilled waste only.

Source: OECD Environmental Data.

REFERENCE II

Actions taken on the 2001 OECD Review Recommendations

RECOMMENDATIONS	ACTIONS TAKEN
Environmental management	
1. Implementation of environmental policy measures	
1.1. Further pursue efforts to decouple economic growth and employment creation from pollution pressures and energy and resource use.	The 2002 National Sustainable Development Strategy (NHS) explicitly pursues the objective of decoupling, in particular by: increasing the use of renewable sources; improving energy efficiency and increase material productivity. These specific objectives are pursued through a number of strategies, including: the 2007 Integrated Energy and Climate Package, the 2010 Energy Concept and the 2012 National Resource Efficiency Programme.
1.2. Extend environmental policy attention to unsolved or new challenges, including nature conservation and diffuse pollution from agriculture and transport.	Unsolved or new challenges which have been addressed in the past years include: biodiversity loss; energy and resource efficiency; air pollution from particulate matters; and new technological challenges such as nano-technology, mobile communications or medical appliances. See recommendations in Sections 2, 3, 5, and 9.
1.3. Continue efforts to harmonise, streamline and further develop environmental legislation within an integrated Environmental Code.	The 2006 amendment to the Basic Law strengthened the option of enacting a Federal Environmental Code. Several attempts were made to pass a Federal Environmental Code, including in 2009, but no agreement has been reached. The parts of the code concerning water and biodiversity were approved as separate federal acts in 2010, thereby consolidating legislation in these areas.
1.4. Strengthen and extend use of economic instruments to internalise external costs and to progress towards sustainable production and consumption.	Several economic instruments were introduced or reformed in the last decade, including: continuation of the eco-tax reform (1999-2003); the EU Emissions Trading System for CO_2 emissions (since 2005); the emission-based highway toll for heavy goods vehicles (since 2005); the CO_2-based annual motor vehicle tax (since 2009); the air travel tax, introduced in 2011; and the nuclear fuel tax, introduced in 2011. In addition, municipal waste charges, water charges for drinking water, wastewater charges and water abstraction fees have long been in place.
1.5. Improve the efficiency and transparency (*e.g.* Accounting practices) of water and waste related services provided at municipal level.	Waste charges reflect the costs of the waste management services. Municipal waste collection systems are organised and fully regulated by the municipalities, which provide the service either directly or through private and public-private companies. See also recommendations on waste (4.1, 4.2 and 4.6). Water prices reflect the actual costs incurred by water companies (water abstraction, treatment, storage and distribution, investments in maintenance and in water conservation). Environmental and resource costs are also partly covered, because licences for water abstraction are given under strict conditions concerning the quantitative effects on the groundwater level and the dependent ecosystems. Depending on whether the supply companies are publicly or privately organised, water charges are subject to local law or antitrust law. In the case of public water utilities, water prices are based on the principles of municipal fee legislation (cost coverage, equal treatment, equivalence). German water associations developed a tool (*Kundenbilanz*) for customers which allows comparing tariffs and underlying cost elements as well as structural differences that influence costs. Voluntary benchmarking of water utilities has been gradually applied.
1.6. Ensure that voluntary agreements become more effective and efficient (*e.g.* clear targets, reliable monitoring, improved transparency and third party participation).	A quality assurance system is in place for the Eco-Management and Audit Scheme (EMAS), under the supervision of the eco-audit committee (*Umweltgutachterausschuss*). Environmental auditors receive their license from the German society for the accreditation and licensing of environmental auditors, on the basis of public law, and are subject to state supervision. Systematic evaluations of selected voluntary agreements are in place.
1.7. Increase economic analyses of environmental policy measures, with the aim of achieving environmental objectives more cost-effectively.	Economic analysis was carried out to assess the costs and benefits of specific policies (*e.g.* the ecological tax reform and the feed-in tariffs to support renewable energy sources), but it is not systematically used.

RECOMMENDATIONS	ACTIONS TAKEN
	2. Air
2.1. Reduce or eliminate environmentally harmful subsidies in the energy and transport sectors.	The Act to Continue the Development of the Ecological Tax Reform (2003) reduced various tax exemptions for electricity tax and mineral oil tax, and increased the mineral oil tax rates on natural gas, liquid gas and heavy heating oil. As part of the fiscal consolidation programme 2011-14, the mineral oil tax reduction for industry and agriculture was reduced from 40% to 25% and the peak equalisation scheme was reduced from 95% to 90% of the eco-tax payment exceeding the relief from social contributions. The home ownership allowance for new buildings, which was previously granted over an eight-year period, was abolished in 2006. Subsidies for hard coal mining are to be discontinued at the end of 2018, as per the 2007 Agreement by the federal government, and the states of North Rhine-Westphalia and Saarland.
2.2. Reinforce measures to limit NO_x and CO_2 emissions from motor vehicle use and emissions of NMVOCs from solvent use.	The German government supported the legislation of EU-wide emission regulations for cars and light commercial vehicles (Euro 5/6), and for heavy goods vehicles (HGVs) and busses (Euro VI). It introduced financial incentives for the early diffusion of lower-emission vehicles. A subsidy for retrofitting in-use diesel cars with particulate filters was granted from 2006 to 2010, and relaunched in 2012. This incentive was extended to light commercial vehicles in 2010. The implementation of the EU Regulations on the reduction of CO_2 emissions from passenger cars and light commercial vehicles is expected to further contribute to curbing emissions from transport. The 2001 German Solvent Ordinance, which implemented the EC Solvents Directive, provided regulations to reduce VOC emissions from the use of organic solvents in specific installations. The other ordinance under the Chemical Act provided maximum limit value for VOCs used in coatings for vehicle refinishing from 2007.
2.3. Develop more rational transport pricing and taxation to further internalise associated environmental costs, and to encourage more fuel efficient and less polluting modes.	The emission-based highway toll has been applied to heavy goods vehicles (HGVs) since 2005. Low-emission HGVs and, since 2009, HGVs retrofitted with particulate filters pay lower tolls. EUR 100 million a year was provided to support the purchase of low-emission HGVs. The annual motor vehicle tax, which had been based on vehicles' emission categories and cylinder capacity, was restructured in 2009 to take into account CO_2 emission levels.
2.4. Develop mechanisms to evaluate the cost-effectiveness of control policy options, and make broader use of economic incentives for achieving air quality objectives.	Economic analysis was carried out to assess the costs and benefits of some policy options, but it is not systematically used. Economic incentives have been used to reduce emissions of air pollutants and greenhouse gases (GHGs) from the energy and transport sectors (see above and recommendations in Sections 6 and 9).
2.5. Take further measures to reduce total final energy consumption in the residential sector.	KfW, the state-owned development bank, launched a number of programmes that provide grants or soft loans for the construction of new energy-efficient homes and for the energy-efficient refurbishment of residential buildings (see Box 5.5).
	3. Water
3.1. Develop a comprehensive strategy to address diffuse pollution of surface and groundwater, including a mix of measures to further reduce nutrient surpluses from agriculture and to implement specific, more stringent requirements for farmers in vulnerable areas.	Beginning in 2005, the agriculture subsidy structure within the context of the EU Common Agricultural Policy (CAP) shifted from production to area-based subsidies; the payments have been linked to compliance with EU Directives on social and environmental standards under the Rural Development Regulation or Pillar 2. The 2007 amendment of the Fertiliser Act specified, *inter alia*, the minimum distance to water bodies for fertiliser application, limited the application of animal-based fertilisers (to 170 kg of nitrogen/ha/year), limited the maximum area nutrient surpluses and set requirements on black-out periods and application of fertilisers. The 2010 Federal Water Act introduced new provisions that specified further requirements for buffer zones at river banks.
3.2. Further reduce point source pollution of water through further investments in advanced treatment facilities, and through increasing the incentive function of water effluent charges.	The 2006 amendment to the German Federal Constitution allowed for application of uniform measures at the national level, including more stringent standards with emission limits and requirements for improving the hydromophological status of German rivers. The 2004 Wastewater Ordinance and a wide application of the requirements of the Integrated Pollution Prevention and Control Directive in the industrial sector led to a substantial investment in wastewater treatment capacity and reduction of urban wastewater discharges, including input of hazardous pollutants. A wastewater charge has been applied since 1981. It is paid by industries and households (through utilities) depending on the degree of pollution of the discharged treated wastewater.
3.3. Address diffuse water pollution by heavy metals in a comprehensive manner, through extension of charging for rainwater collection and treatment.	Around 30% of municipalities calculate their wastewater charges on the basis of a "split" tariff, *i.e.* the fees are calculated separately for wastewater and rainwater. The split wastewater tariff encourages land de-sealing and rainwater seepage. Rainwater seepage is not allowed if rainwater originates from roof surfaces containing specified levels of copper, lead or zinc which help to reduce pollution by heavy metals.

RECOMMENDATIONS	ACTIONS TAKEN
3.4. Enhance flood prevention in the main river basins by developing partnership approaches among stakeholders, and by including flood plain areas in regional land use planning and nature conservation.	The 2005 Flood Control Act set out binding regulations governing the designation of flood plains and areas at risk of flooding, banned new settlements and other uses in flood prone areas and specified flood prevention measures for the *Länder* legislation. An advanced flood emergency systems, based on advanced flood risk models and co-ordination of relevant civil defence, was also developed. International river basin commissions (for the protection of the Rhine, the Moselle and the Sarre, the Oder, the Elbe, the Meuse, the Ems and the Danube) co-ordinate river basin-related flood risk management measures across boundaries, including converting the existing flood action plans into flood risk management plans, and co-ordinating the aspects required for transboundary flood risk management. Joint measures for the targeted restoration of riverside revetments and embankments, the connection of bayous and the restoration of alluvial meadows, as well as eco-friendly flood alleviation and biodiversity conservation measures link large-scale nature conservation projects with flood prevention.
3.5. Pursue efforts to develop water quality monitoring, particularly for pesticides and nutrients in groundwater and lakes.	Surface and ground water monitoring has been redesigned to comply with the requirements of the EU Water Framework Directive. Surface water monitoring includes: surveillance (400), operational (7 855) and investigative monitoring sites (375). Surveillance and operational monitoring networks have also been established to assess the chemical and quantitative status of groundwater. Drawing on existing monitoring sites at the *Länder* level, two national networks have been created: *i)* a network providing an overview of groundwater quality throughout the whole of Germany (800 monitoring sites); and *ii)* a network of for monitoring nitrate from agricultural sources (180 sites) to fulfill the specific monitoring requirements of the EU 1991 Nitrate Directive.
3.6. Take further steps towards implementation of water resource management using a river basin approach.	Monitoring programmes were completed by 2006 for each of Germany's ten river basins, which take account of transboundary river flows. Programmes of measures and management plans for all river basins were adopted by the end of 2009. The 2010 Federal Water Act, which transposed the EC Directive on the assessment and management of flood risks (2007/60/EC), and the subsequent regulations, established new requirements for minimum water flows, fish passes and the use of hydropower in order to improve the hydromorphological status of surface water bodies.
4. Waste	
4.1. Improve efficiency of household waste management by opening the disposal market to competition, with monitoring and control by public authorities.	Three-quarters of household waste is recovered. All residues are treated thermally or by mechanical biological treatment. Landfilling of untreated waste is prohibited. About. 65% of household waste management is carried out by private companies. Public waste management authorities are subject to strict public procurement rules.
4.2. Conduct an analysis of the cost-effectiveness of the Duale System for recycling packaging material, and of material recycling schemes in general; assess their environmental benefits compared with other forms of treatment and disposal.	The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) has conducted an analysis of the Duale System. The packaging ordinance was amended in 2008 to promote competition. Since 2009, nine systems have been operating. Increased competition has led to a 50% reduction of packaging recycling costs.
4.3. Further develop implementation of the principle of extended producer responsibility in the industrial sector, possibly expanding the use of economic incentives.	The principle of extended producer responsibility has been broadened to waste electrical and electronic equipment in 2005.
4.4. Elaborate plans to ensure that treatment and disposal of waste (*e.g.* hazardous waste, household waste) which is unsuitable for recycling are organised efficiently, building on enhanced co-operation between federal and regional authorities and better identifying future infrastructure needs.	Waste management plans have been developed by all *Länder*.
4.5. Continue efforts aimed at upgrading landfill sites to meet legal requirements, and at remediating closed dump sites and contaminated sites, especially in the new *Länder*.	The number of landfills has been reduced. There are no polluted landfill sites. Out of 4 932 projects of contaminated sites reclamation, 4 730 were completed. Total costs incurred to date amount to EUR 2.56 billion, the bulk of which on large-scale ecological projects (chemical and metal industries). Out of 21 large-scale projects, 16 were completed.
4.6. Take measures to improve the availability and timeliness of data pertaining to waste generation, treatment and disposal at the national level.	Waste statistics were improved in line with European requirements. The time lap of statistical data (full set) was reduced to 1 year and 9 months.
5. Nature conservation and biodiversity	
5.1. Formally adopt a set of specific national objectives for nature conservation, and develop specific nature conservation plans at the level of the *Länder*.	A comprehensive National Strategy on Biological Diversity (NSBV) was adopted in 2007. It contains about 330 targets to be achieved between now and 2020, as well as 430 specific measures. Progress will be monitored using a set of 19 indicators divided into 5 topic areas; there are 7 indicators for biodiversity, 2 on settlements and transport, 8 on economic issues, one on climate change, and one on social awareness. An increasing number of *Länder* are adopting biodiversity strategies, action plans and programmes.

RECOMMENDATIONS	ACTIONS TAKEN
5.2. Increase understanding and awareness of nature conservation and biodiversity issues among decision-makers and the general public; in particular, develop and adopt a national biodiversity strategy.	In addition to the above, the BMU has launched a multi-year process to implement the NSBV that relies heavily on dialogue with stakeholders. Social awareness of biodiversity will also be monitored as part of reviewing implementation of the Strategy. A business initiative was also developed. Companies participating in this initiative undertake to include biodiversity targets in their business plans which should be reviewed and updated every 2-3 years.
5.3. Strengthen efforts and set targets for creating new protected areas (including Natura 2000 sites) and improve the representativeness of the network of protected areas.	The Natura 2000 network was completed in 2009. It includes 5 266 sites covering 15.4% of the land area and about 45% of the marine area. Its comprehensiveness and coherence has been approved by the EU. Two new National Parcs (Eifel and Kellerwald-Edersee) and three biosphere reserves (Karstlandschaft Südharz, Bliesgau, Schwäbische Alb) were designated.
5.4. Obtain agreement and transposition, at the *Länder* and local levels, of the federal objective of reducing the rate at which land is urbanised to 30 hectares per day by 2020.	The 2002 National Sustainable Development Strategy set the target of limiting the increase in the amount of land used for human settlements and transport infrastructure to 30 hectares per day by 2020. Various forms of co-operation with the *Länder* and local authorities were initiated. Important findings and ideas emerged from the research programme "REFINA – Research for the Reduction of Land Consumption and for Sustainable Land Management" funded by the Federal Ministry of Education and Research.
5.5. Establish a performance assessment system to increase the transparency and effectiveness of spatial and landscape planning decisions.	No action taken. The competence for landscape planning lies with the *Länder* and municipalities.
5.6. Extend the role of landscape protection groups in stakeholder mediation procedures concerning extension and management of protected areas.	See Recommendations 7.6 and 7.7.
5.7. Further improve the effectiveness of voluntary agri-environmental measures by ensuring that they are applied on an ecologically appropriate scale.	Under Natura 2000, the EU selectively co-finances nature conservation measures and compensation payments to farmers and foresters for activity restrictions in Natura 2000 areas. This area of funding was extended in 2005. The joint task "improvement of agricultural structure and coastal protection" is the main framework for co-ordinating structural change in the agricultural sector, and for implementation and national co-financing of EU policy for the development of rural areas. Such measures include the funding of agri-environmental measures. The *Länder* decide on the application of available funding in their development programmes. See Recommendation 3.1.
5.8. Encourage private landowners to conserve nature and biodiversity on their land, *e.g.* through a wider range of economic instruments.	Economic compensation is the main instrument used to minimise conflicts.
Towards sustainable development	
6. Integrating environmental and economic concerns	
6.1. Define and implement a national sustainable development strategy with targets, timelines, and commitments by the key actors.	In 2002, the federal government presented its National Sustainable Development Strategy (NHS) "Perspectives for Germany". The NHS outlines long-term priorities for sustainable development in 21 areas and sets quantified targets using a set of "key indicators for the 21st century". It is supported by 10 management rules. In 2008, the German government published its second progress report. An indicator report is published every two years, the last in September 2010. In 2010, the participation process for the next report 2012 was launched including broad online communication.
6.2. Better integrate environmental concerns in transport, agriculture, energy and regional policies.	Cross-sectoral integration has been strengthened in some areas and several cross-sectoral strategies were launched, especially in the area of climate and energy. See Recommendations 1.1, 6.1 and 9.6.
6.3. Further use the Environment Barometer and other tools to contribute to environmental and economic policy formulation, implementation, monitoring and assessment. In particular, extend its coverage to biodiversity.	The Environmental Barometer has not been developed further. The Federal Environment Agency developed a system of environmental core indicators, It includes more than 50 indicators showing cause and effect of environmental damages. The National Strategy on Biological Diversity established a system of monitoring indicators under the responsibility of the Federal Agency for Nature Conservation. State of Environment reports are systematically published, lately in 2009. The last comprehensive report on environmental challenges and policy responses "The Federal Environment Report 2010" was presented to Parliament in December 2010. Strategic Environmental Assessment was introduced in 2004-05 to implement the related EU directive. Since 2009, a sustainability check has been integrated in the general impact assessment procedure for draft legislation.
6.4. Continue to integrate environmental concerns in fiscal policies (*e.g.* ecological tax reform) and, in particular, review concessions leading to major distortions and disincentives.	The ecological tax reform was implemented from 1999 to 2003, with a gradual increase in energy tax rates. Other environmentally related taxes introduced during the review period include: the restructuring of the annual motor vehicle tax to include a CO_2 component (2009); the air travel tax and the nuclear fuel tax (2011). See Recommendation 2.1.

RECOMMENDATIONS	ACTIONS TAKEN
6.5. Review the environmental significance of subsidies (*e.g.* in the federal biannual subsidy report), in order to phase out those which are environmentally harmful, and provide incentives for sustainable development, environmental management and innovation.	The Federal Environment Agency (UBA) regularly publishes a report on environmentally harmful subsidies.
7. Integrating environmental and social concerns	
7.1. Further examine disparities in environmental quality and their impacts on health and living conditions in different parts of society.	The actions taken include: surveys and studies; conferences on the social distribution of environmental health bringing together representatives of federal and local authorities, research institutions and local stakeholders from different disciplines; contribution to the WHO-Project and WHO-Expert group "Towards Environmental Health Inequalities Reporting".
7.2. Further review the distributional implications of major environmental policy measures and ensure discussion of the results.	Questions regarding the acceptance of taxes imposed on environmental consumption and, more broadly, about justice in environmental protection have been addressed regularly in the Environmental Awareness Studies since 2006. The BMU contributes to the federal government's reports on poverty and wealth. BMU is leading a research project on "key elements of an ecologically sound welfare concept as a basis for environmental policy processes for innovation and transformation".
7.3. Further implement the joint action programme on environment and health.	The actions taken include: research projects on environmental health risks (main target group: children); an information campaign about the relationship between environment and health; workshops and conferences on environment and health (*e.g.* on climate change and health).
7.4. Build on successful local initiatives (*e.g.* Local Agenda 21) to foster environmental and sustainable development progress.	In 2007, the BMU launched the network and training conference for Local Agenda 21 – Initiatives. Local sustainability activities are being evaluated, especially in terms of their innovation potential for innovation (evaluation results expected in 2012). In 2010, the declaration on "Biodiversity in Communities" was published, signed by 187 cities and communities representing a total of about 15 million citizens. As part of the National Climate Initiative, funding is provided to local authorities for climate mitigation activities, such as the development of long-term climate protection concepts, the installation of high-efficiency lighting systems in public buildings, and the CO_2-neutral refurbishment of school buildings.
7.5. Improve the availability and timeliness of data and indicators on environmental quality, environmental pressures and related responses.	Research projects for indicator improvement and development are conducted to improve the availability of indicators in new policy issues (as new strategies and programmes). In 2011, projects were launched on indicators of resources and sustainable consumption. See Recommendation 6.3.
7.6. Improve public access to environmental information and access to justice for environmental stakeholders.	Environmental information is made available in various forms. See Recommendations 6.3 and 7.5. The Environmental Information Act was approved in 2004. Citizens can access administrative courts to defend their environmental interests. The 2006 Environmental Appeals Act recognises domestic and foreign environmental organisations the right to stand in administrative courts, under specific circumstances.
7.7. Strengthen public participation in the design, implementation and assessment of environmentally relevant projects and policies.	The BMU provides financial support to environmental non-governmental organisations (NGOs). Since 2000, there have been at least two meetings per year involving about 30 environmental NGOs and the BMU to discuss current policy topics. The BMU organises conferences with representatives of academia, NGOs, and *Länder* (*e.g.* the 2010 conference on the National Strategy on Biological Diversity). Strategic Environmental Assessment, which was introduced in Germany in 2004-05 (see Recommendation 6.3), includes public participation during the preparation of plans and programmes relating to the environment.
7.8. Broaden environmental education and encourage behavioural changes towards more sustainable consumption patterns.	Germany participates in the UN Decade "Education for Sustainable Development" (2005-14). The BMU educational service provides free educational material, up-to-date information, and financial support for environmental projects in schools and other educational establishments. Since 2009, the National Climate Initiative has provided funding for an action programme on climate protection in schools and other educational establishments. Numerous environmental awareness raising initiatives were launched. These included: the 2009-10 BMU pilot project Kopf an, Motor aus to encourage the use of transport modes other than cars; the "Energy Savings Club"; information campaign about the biofuel E-10; and a country-wide hiking day in natural areas in 2010.
International co-operation	
8. International commitments and co-operation	
8.1. Develop internal procedures further in order to speed up implementation of EU Directives requiring action by the *Länder*.	The reform of the federal system (amendment of the Basic Law) was meant to speed up German transposition and implementation of EU legislation. The reform introduced a provision regarding the liability of any German Land that does not fulfil its implementation obligations in cases of financial sanctions by the EU.
8.2. Further address international environmental issues related to the agricultural sector, such as releases of nitrates to rivers and ammonia to air.	Germany is party to the Gothenburg Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution. Germany also actively participates in the HELCOM and OSPAR Processes, which develop recommendations to reduce pollution (*e.g.* phosphorus and nitrogen) in the North and Baltic Seas.
8.3. Implement action plans to cope with flooding in international river basins.	See Recommendation 3.4.

RECOMMENDATIONS	ACTIONS TAKEN
8.4. Continue international environmental co-operation with central and eastern European countries, with a view to facilitating early accession of EU candidate countries.	Since 1992, under the BMU programme "pilot projects abroad", the German government has provided financial support of about EUR 68 million for 19 environmental pilot projects in the countries that entered the EU in 2004. These pilot projects addressed transboundary environmental problems and climate change. These projects involved capacity building and know-how transfer. Since 1998, the German government has supported 81 environmental twinning projects with a total volume of around EUR 84 million. The aim of this EU-financed programme is to support the new EU member states and accession candidates with the complete adoption and application of European law, and to develop the institutions required for this purpose. Experts from authorities in EU member states are seconded to partner authorities in the new member states and accession candidate countries for one or two years. Their work to date has focused mainly on waste management, air and water quality, avoiding industrial pollution, plant safety, and the financing of eco-investment projects. The German government also offers bilateral support with environmental projects to central and eastern European countries as well as to Russia and the states of the south Caucasus and central Asia, for which it provides funding of approximately EUR 2.2 million annually. The main focus is on: promoting transboundary co-operation; the development of model projects *e.g.* for decentralised wastewater disposal; and approximation to EU environmental standards. Since 2008, the German government has also been active in the region in the frame of its International Climate Initiative (ICI). The regional focus has been on Russia, Ukraine and central Asia. Examples include energy-efficiency loan programmes, the conservation of virgin forests in the Bikin region, or the support of energy-efficient building concepts in Ukraine.
8.5. Increase the level of official development aid, particularly so as to facilitate the solution of global environmental problems.	Over the previous decade, official development assistance increased from 0.27 to 0.38% of gross national income (GNI). Bilateral aid for the environment more than tripled in the same period, reaching nearly half of the (screened) sector-allocable aid in 2008-09. Germany was the second largest donor of both bilateral and multilateral climate-related assistance. This support will continue to increase following the pledge made at Copenhagen to provide fast-start climate financing. Germany has also consistently supported access to water and sanitation: since 2000, bilateral aid increased by 46% and Germany provided the largest imputed multilateral contribution to the Water and Sanitation sector in 2008-09.
9. Climate protection	
9.1. Implement agreed measures concerning climate change, taking into account the phase-out of nuclear energy, and specify related schedules.	Implementation of agreed measures continued (see below). More stringent national targets and additional measures were agreed as part of the 2007 Integrated Energy and Climate Programme and the 2010 Energy Concept (see Recommendation 9.6).
9.2. Speed up the ongoing gradual elimination of subsidies for domestic coal production.	Subsidies for hard coal mining are to be discontinued at the end of 2018, as per the 2007 agreement by the federal government, and the states of North Rhine-Westphalia and Saarland.
9.3. Further encourage development of renewable energy and greater energy savings.	Germany has supported renewable energy sources primarily by means of feed-in tariffs for electricity generation from renewables. Other measures include the Market Incentives Programme for Renewables, the Act on the Promotion of Renewable Energy in the Heat Sector (see Box 5.4), and the Biofuel Quota Act in the transport sector. In 2010, the German government agreed upon a national action plan for renewable energy expected to deliver an increase in renewable energy beyond Germany's binding target of 18% of gross energy use by 2020. Several measures have been implemented to promote energy efficiency in the residential, commercial and service sectors (see Box 5.5).
9.4. More vigorously address issues related to CO_2 emissions from the transport sector, going beyond voluntary agreements. Encourage use of public transport.	The actions taken in the transport sectors include: CO_2-targets for passenger cars and light commercial vehicles; restructuring of the annual motor vehicle tax to include a CO_2 component (2009); tyre pressure monitoring and tyre labelling; promotion of biofulel use; air travel tax. The federal government launched a National Development Plan for Electric Mobility, accompanied by an RD&D funding scheme of EUR 500 million until 2011. In 2011, the government adopted the Programme for Electric Mobility, which includes a procurement goal of 10% of electric vehicles in government fleets and adds EUR 1 billion of funding until 2013. A National Cycling Plan 2002-12 was also adopted.
9.5. Develop measures to enhance carbon sinks and to reduce emissions of non-CO_2 GHGs.	Additional measures to reduce emissions of non-CO_2 GHGs were included in the 2007 IEKP (see below).
9.6. Develop and implement additional policies and measures to enable national and international emissions targets to be met and energy efficiency to be increased.	In 2007, the government adopted the Integrated Energy and Climate Programme (IEKP), consisting of 29 key programmes which were followed up by legislative measures. The IEKP sets the target of reducing GHG emissions by 40% by 2020 relative to 1990 levels. Energy efficiency and renewables are at the core of the IEKP. In 2010, the government adopted the Energy Concept which sets out guidelines for an environmentally sound, reliable and affordable energy supply and includes a renewable energy roadmap. To implement the Energy Concept, the government adopted an action programme to be implemented from 2012. A monitoring progress has been also put in place.
9.7. Make greater use of cost-effectiveness analysis in determining the components of climate policies.	An economic analysis of the IEKP was conducted. The Energy Concept is based on a modelling exercise to explore economic impacts of different scenarios and choices.

Source: OECD, *Environmental Performance Reviews: Germany, 2001*; country submission.

REFERENCE III

Abbreviations

BMPF	Federal Ministry of Education and Research
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BMWi	Federal Ministry for Economy and Technology
BMZ	Federal Ministry for Economic Co-operation and Development
CCS	Carbon capture and storage
CHP	Combined heat and power
CO	Carbon monoxide
CO_2	Carbon dioxide
CSR	Corporate social responsibility
DAC	Development Assistance Committee, OECD
DIW	German Institute for Economic Research
ECJ	European Court of Justice
EEA	European Environment Agency
EEG	Renewable Energy Sources Act
EGS	Environmental goods and services
EIA	Environmental impact assessment
EMAS	EU Eco-Management and Audit Scheme
ETS	Emissions trading system
EU	European Union
EUR	Euro
EV	Electric vehicle
FDI	Foreign direct investment
FIT	Feed-in tariff
GDP	Gross domestic product
GHG	Greenhouse gas
GNI	Gross national income
GPS	Global Positioning System
HGVs	Heavy goods vehicles
IEA	International Energy Agency
IEKP	Integrated Energy and Climate Programme
IMA	Inter-Ministerial Working Group on CO_2 reduction
IPR	Intellectual property rights
ISO	International Organization for Standardization

ITF	International Transport Forum
ITR	Implicit tax rate
IUCN	World Conservation Union (International Union for Conservation of Nature)
KfW	German development bank
NCP	National contact point
NGO	Non-governmental organisation
NHS	National Sustainable Development Strategy
NMVOC	Non-methane volatile organic compounds
NO_x	Nitrogen oxides
N_2O	Nitrous oxide
NSBV	National Strategy on Biological Diversity
ODA	Official development assistance
PV	Solar photovoltaics
R&D	Research and development
REC	Renewable energy certificate
REDD	Reducing Emissions from Deforestation and Forest Degradation
RNE	German Council on Sustainable Development
SEA	Strategic Environmental Assessment
SMEs	Small and medium-sized enterprises
SRU	German Advisory Council on the Environment
UBA	Federal Environment Agency
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
USD	United States Dollar
VAT	Value added tax
VOC	Volatile organic compounds
WEEE	Waste electrical and electronic equipment
WHO	World Health Organization
WWF	World Wildlife Fund

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