INTERNATIONAL ENERGY AGENCY

Energy Policies of IEA Countries

GERMANY 2002 REVIEW

OECD

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INTERNATIONAL ENERGY AGENCY
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The International Energy Agency (IEA) is an autonomous body which was established in November 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an international energy programme.

It carries out a comprehensive programme of energy co-operation among twenty-six* of the OECD's thirty Member countries. The basic aims of the IEA are:

- to maintain and improve systems for coping with oil supply disruptions;
- to promote rational energy policies in a global context through co-operative relations with non-member countries, industry and international organisations;
- to operate a permanent information system on the international oil market;
- to improve the world's energy supply and demand structure by developing alternative energy sources and increasing the efficiency of energy use;
- to assist in the integration of environmental and energy policies.

** IEA Member countries: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, the Republic of Korea, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States. The European Commission also takes part in the work of the IEA.*

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
- to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original Member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became Members subsequently through accession at the dates indicated hereafter: Japan (28th April 1964), Finland (28th January 1969), Australia (7th June 1971), New Zealand (29th May 1973), Mexico (18th May 1994), the Czech Republic (21st December 1995), Hungary (7th May 1996), Poland (22nd November 1996), the Republic of Korea (12th December 1996) and Slovakia (28th September 2000). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

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SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

SUMMARY

The German government has a challenging energy policy agenda. It has decided to phase out nuclear power and it has established ambitious targets to reduce greenhouse gas emissions. While it is not yet clear how nuclear power will be replaced, it is likely that energy efficiency and conservation, co-generation and renewables, as well as fossil fuels, will play a significant role in Germany's energy supply. To ensure that these policies will be cost-effective, their development and effectiveness will need to be closely monitored.

Energy security is an important issue for Germany as the country has limited indigenous energy resources. Moreover, the decision to gradually phase out nuclear power by 2025 will increase Germany's reliance on imports of coal and natural gas, which currently represent 27% and 78% of demand for these fuels. Germany will also continue to depend heavily on imported oil, at about 40% of its total primary energy supply. To address these energy security issues, Germany is focusing on the development of domestic fuels and renewables, energy end-use efficiency, and on good relations with energy exporting countries.

For a long time Germany has managed to significantly **reduce the emissions of greenhouse gases** (GHG) and air pollutants. These reductions have resulted partly from the so-called "fall-wall effect"[1] in the New Laender where industrial restructuring has taken place, but environmental impacts were reduced by environmental investments and better environmental management throughout the country. In 1995 Germany established a demanding national target of reducing CO_2 emissions from 1990 levels by 25% by 2005. To reach this target, Germany needs to reduce CO_2 emissions by a further 9.6 percentage points from the 2000 levels. To reach its Kyoto target for 2008-2012, Germany needs to reduce its GHG emissions by a further 1.9 percentage points (excluding the impact of carbon sinks). While Germany seems to be on the right track to meet its Kyoto target, reaching the national target will be a challenge. The remaining emissions reductions may prove more difficult to achieve over the coming years than in the last decade, and the associated costs are also likely to be higher.

The federal government introduced the **National Climate Protection Programme** in October 2000 to help meet the national CO_2 reduction target. The eco-tax, promotion of co-generation and renewables, fuel switching, energy efficiency improvements in buildings, and industrial voluntary agreements have made

1. "Fall-wall effect" refers to the impacts of the restructuring and modernisation of the East German economy after reunification in 1990.

significant contributions to the programme. Cost-effectiveness was an important consideration when measures were chosen for the programme, and many of these are subject to continuous monitoring. However, the marginal cost of emissions reduction is likely to increase and the current mixture of very specific measures may be expensive. One of the key instruments developed to internalise external costs is the eco-tax. A key objective of the eco-tax is to reduce greenhouse gas emissions, yet the tax does not reflect the carbon contents of fuels and it does not affect energy users in an equitable manner. As the cost of domestic measures is likely to increase, the government should consider relying on the Kyoto Protocol's "flexible mechanisms" to achieve compliance.

Energy efficiency has improved because energy consumption in the New Laender decreased in the early 1990s after the restructuring of industry, and because specific energy consumption in different sectors declined throughout the country. The German Energy Agency (DENA) was established in 2000 to promote sustainable energy, mainly through energy efficiency and renewables. The DENA works in close co-operation with the energy agencies of the Laender or with other local contact points that are active in energy efficiency. It is also constantly seeking opportunities for closer co-operation with the industrial and financial sectors in order to be able to provide technical and financial support for projects. The agency's scope of work should be clearly defined and the main criterion for choosing its projects should be their cost-effectiveness. At present, Germany uses a wide range of measures to improve energy efficiency. In the industrial sector the emphasis is on voluntary measures, such as voluntary agreements and third-party financing. The housing sector relies mainly on regulatory measures. One of the key challenges in this sector is to reduce energy consumption in existing buildings. Also, the policies for different kinds of heating (*e.g.* district heating) should be clarified. Gasoline consumption in the transport sector has decreased in past years. Both government and industry expect a further decrease thanks to voluntary agreements by the car industries, a shift from gasoline to diesel in passenger transport, a modal shift to rail transport, and decreasing mileage.

Oil accounts for almost 39% of the primary energy supply in Germany. Almost all oil is imported, but from diversified sources. There has been some consolidation in the downstream oil market, but the Federal Cartel Office (FCO) has worked to maintain an oil market where effective competition can take place. In 2003, Germany will introduce product standards that clearly exceed the EU requirements for 2005. The refining industry has already adopted most of these norms.

The German government wishes to maintain a significant **coal**-based electricity generation capacity to avoid over-dependence, and associated supply and price risks, on imported energies. The policy for hard coal is also closely related to social, regional and employment policies. Because of its poor competitiveness, domestic hard coal receives a significant, but declining, amount of subsidies. The IEA considers that these indefinite subsidies are not justified because the international market in hard coal is well established and offers secure and reliable sources of fuel at prices – both now and in the future – that German national production cannot match.

Lignite production does not receive subsidies. Lignite power plants, however, are currently protected by legislation prohibiting new entries in the New Laender. In 2001, the Swedish power company Vattenfall agreed with the federal government to generate 50 TWh/year from lignite until 2011. Following this agreement, the government will phase out the restrictions for new entrants in 2002.

Germany is the second largest European **natural gas** market after the United Kingdom. These are the only European countries that have fully liberalised their gas markets. In 2000, gas consumption reached 88 bcm, representing a 21% share of primary energy supply. The supply base is diverse, with domestic production accounting for 22% of the supply, and preparations are under way to establish a gas-trading hub in Bunde, near the Dutch border. Currently there are about 750 companies operating in the German gas sector, but there is a trend of consolidation and mergers among gas companies, and between gas and electricity companies.

Gas-to-gas competition first arrived at the supra-regional transmission level when Wingas, one of Germany's largest supra-regional gas companies, installed its new pipeline system in the early 1990s. The EU Gas Directive of 1998 has been largely transposed to German legislation. A draft amendment to the Energy Industry Act was published by the Federal Ministry of Economics and Technology (BMWi) in December 2000, fully transposing the Gas Directive. This will be adopted in 2002. Germany has opted for negotiated third-party access. Industrial user and gas industry associations have signed the Associations Agreement of July 2000, and its amendments of March and September 2001 and May 2002, which are voluntary accords defining the framework for freely negotiated contracts and access conditions to gas networks and storage.

Only a small share of gas consumers have changed their suppliers, but larger consumers have managed to negotiate more favourable contracts. New entrants have experienced widespread access difficulties and consider the access process to be too complex, with rules being incomplete, access tariffs too high and tariff calculation methods non-transparent, making discriminatory behaviour possible. Also, the absence of a regulator has been criticised. Liquidity should be increased in the gas market as lower level operators are at present linked with suppliers through long-term take-or-pay contracts. The opening of the new trading hub may help in this respect. The user and supplier associations have negotiated a third amendment to their Agreement which addresses some of these issues; all parties, however, consider that the rules should be further clarified.

In 2000, the share of **renewables** (including hydro-power) in primary energy supply was 3.4% and in electricity generation 7.3%. The Renewable Energies Act of April 2000 aims to double the share of renewables in total energy supply by 2010 compared to 2000 levels. The national policy on renewable energy is embedded in a European framework, according to which Germany should generate 12.5% of its electricity from renewable energy by 2010. During the 1990s, wind power was greatly developed and Germany has become the world leader in this area, with almost 9 GW of installed capacity. As the sites suitable for hydro-power and onshore wind are becoming limited, Germany has announced ambitious targets for

developing offshore wind power. Renewables are supported by both direct subsidies and feed-in tariffs; the latter were introduced by the 2000 act, and are in effect indirect subsidies. The level of these indirect subsidies was approximately €1 billion in 2001, and this annual expenditure is likely to grow as more renewable energy capacity is installed.

Germany is the largest **electricity** market in Europe, with 490 TWh of final electricity consumption in 2000. In legal terms the market has been fully open to competition since 1998. As a consequence, electricity prices for both industrial and domestic consumers decreased significantly between 1998 and 2000. Germany has chosen negotiated third-party access (TPA) as the primary means of network access. As in the gas sector, there is no sectoral regulator for electricity and the rules for network access have been established by the electricity industry and network users in Associations Agreements within the legal framework of the Energy Industry Act and the Competition Law. Over the past year there has been significant progress – especially through the Associations Agreements – in addressing the problems that consumers and suppliers face in their efforts to gain access to electricity networks. Furthermore, recent work by the FCO and the Task Force for Network Access in the BMWi has demonstrated considerable will on the part of German authorities to address remaining network access problems.

Nevertheless, problems in the electricity market persist. The levels of TPA tariffs and their high variation are still matters of concern. Another concern is the lack of unbundling of the retailing and distribution functions of companies operating at the lower voltage networks as this can permit abusive behaviour. The government expects the monitoring mechanism, which was introduced by the latest amendment to the Associations Agreement (December 2001), to help in this respect. The amendment also simplified the conditions under which small consumers can have access to the market. However, there is still a need to make access easier and suppliers are developing further improvements under the moderation of the Task Force.

Electricity produced in **combined heat and power** plants (CHP) accounts for about 12% of total electricity supply. The Co-generation Act of May 2000 guaranteed a minimum feed-in price for electricity produced by CHP plants operated by public utilities. This act was replaced by the Co-generation Act that came into force in April 2001. It allows CHP operators, who are feeding electricity into the public transmission network, to receive bonus payments in addition to the revenue at market prices, provided that requirements for the power-to-heat ratio are fulfilled. No direct subsidies are given to CHP. Whatever financial support to CHP is needed should be on a declining rate and eventually phased out. Furthermore, possibilities for connecting more consumers to existing district heating networks should be explored to improve their competitiveness.

Germany will gradually phase out **nuclear power** by closing down plants when they reach an average of 32 years of operation. Nuclear power now covers 30% of electricity generation and 13% of total primary energy supply. The negotiated agreement between the government and nuclear utilities to phase out nuclear power entails no direct cost to the government and provides industry with some

level of certainty and flexibility in implementation. The national energy policy implications of the decision are significant. The magnitude of these implications makes it essential that necessary corrective action is taken and at the right time. The government thus needs to be well informed of developments in this area at all times, which will require a continuous assessment process. The nuclear phase-out policy will not relieve government and industry in the near future of the responsibilities they now carry for the ongoing nuclear programme. Competence in the nuclear sector will need to be maintained for decades. The ways and means for managing and disposing of radioactive materials will have to be maintained and developed, and nuclear power plants will need to be decommissioned safely.

The basic plan for **energy R&D** in Germany is set out in the 1996 "Fourth Programme on Energy Research and Energy Technologies", which runs until 2005. The primary objective of energy R&D is to support energy policy, and the secondary one is to support industrial development and economic growth. In most cases the two objectives can be achieved simultaneously, but a potential problem is that when many different policy objectives are sought at the same time, setting clear targets for projects may become obscured and consequently make it difficult to assess the performance of R&D programmes. R&D budgets have been declining over the past years. This is a concern as many different aspects of energy policy, such as the phase-out of nuclear power, large-scale use of renewables, continuing use of fossil fuels and ambitious climate goals, will demand technological innovation and create technology challenges.

RECOMMENDATIONS

The Government of Germany should:

General Energy Policy

- ☐ Evaluate the cost-effectiveness of the measures used to achieve all the energy and environment policy objectives simultaneously and publish the results. Monitor the consequences of the nuclear power phase-out, including the implications for the economy, the environment, security of supply and radioactive waste disposal.

- ☐ Put in place a long-term, stable energy policy framework, giving a higher priority to energy security, and implement as much of it as possible through the market mechanism. Encourage market participants to develop a strategy to substitute nuclear power with cost-effective alternatives that support energy security and climate change goals.

- ☐ Ensure that the federal and regional cartel authorities have enough resources to handle disputes and hand down decisions quickly.

Energy and the Environment

☐ Analyse further the various policy options and develop strategies for managing the evolution of GHG emissions beyond Kyoto target years.

☐ Pursue possibilities for supplementing domestic measures with Kyoto "flexible mechanisms".

☐ Develop and apply market-based instruments to give incentives for reducing emissions in cost-effective ways. Review and reform energy taxes and the eco-tax system to better reflect the externalities of each source of energy.

Energy Efficiency

☐ Ensure that energy intensity continues to decrease and energy efficiency to improve.

☐ Enhance measures to address energy efficiency in buildings, particularly in existing buildings.

☐ Develop a national energy efficiency strategy for the transport sector without delay and take into account the cost-effectiveness of measures.

☐ Ensure adequate funding for cost-effective DENA programmes, and support its co-operation with the private sector (industrial and financial sectors) and the Laender.

Coal and Lignite

☐ Continue to reduce coal subsidies with the aim of eliminating them, and set a clear deadline for this abolition. Compensate the loss of the subsidies and resulting decline of the coal industry with restructuring programmes to address social impacts.

Natural Gas

☐ Ensure that non-discriminatory, transparent and simple arrangements for access to gas transmission and distribution networks, and gas supply are put in place to speed up the development of competition in the gas market. Ensure that tariff calculation methods are transparent.

☐ Reinforce the resources and power of the Federal Cartel Office and the Task Force for Network Access in the Ministry of Economics and Technology to ensure that anti-competitive practices in the gas sector are abolished.

- ☐ Facilitate access to supply by promoting the liquidity of the gas market; in particular, encourage the development of spot markets and trading hubs.

- ☐ Continue to monitor concentration in the gas market to avoid further dominance of major players. In this regard, cross-shareholding between different network levels should be taken into account.

Renewable Energy Sources

- ☐ Take the economically feasible potential of renewables into account when promoting their use.

- ☐ Monitor closely the cost impact of policies that indirectly subsidise renewables through the feed-in mechanism; and take into account technological progress to reduce cost, and eventually phase out subsidies.

Electricity and Heat

- ☐ Reinforce efforts to make the rules for network access as fair, simple, rapidly applicable and widely usable as possible. Monitor the effectiveness of these procedures, including appeal mechanisms, and address remaining shortcomings.

- ☐ Consider options for separating network operation from other activities of vertically integrated companies at different network levels in order to ensure that system operation is effectively independent from generation and other activities.

- ☐ Monitor concentration in the electricity market and avoid dominance of market players. In this regard, cross-shareholding between different network levels should be taken into account.

- ☐ Put in place mechanisms to ensure that there will be no cross-subsidisation and discrimination between the distribution and retailing businesses of distribution network operators, and to demonstrate that access conditions are fair.

- ☐ Continue to monitor the prices, their components and the structural reasons for price differences for various groups of consumers, and compare these with those found in other countries.

- ☐ Encourage the development of adequate interconnection and transmission capacity to facilitate cross-border trade.

- ☐ Evaluate the cost-effectiveness of policy alternatives to promote combined heat and power (CHP) production – and aim to reduce unreasonable costs – by doing, for example, an analysis of the bonuses that are granted under the feed-in tariff

system. Evaluate the feasibility of expanding district heating systems to create an effective use for more heat from CHP plants; and compare this with the feasibility of using smaller CHP plants without expanding district heating networks.

☐ Incite market forces to develop other energy sources in a timely, economically and environmentally sound way to replace nuclear energy.

☐ Maintain national capability to assess future nuclear technology options.

☐ Assure the safety and operational performance of existing nuclear plants.

☐ Continue efforts to implement the planned interim and permanent arrangements for the management of radioactive materials.

Research and Development

☐ Ensure that there is a good balance between short-term and long-term R&D programmes. In particular, clarify the role of R&D in light of the nuclear power phase-out, and ensure that adequate resources are made available by the government and industry to support R&D in this area as needed.

☐ Given the importance of coal in the German fuel mix and the likely expansion of coal-fired power to replace existing nuclear capacity, give higher priority to R&D for clean coal technologies, including carbon sequestration.

2

ORGANISATION OF THE REVIEW

REVIEW TEAM

The International Energy Agency (IEA) 2002 in-depth review of the energy policies of Germany was undertaken by a team of energy policy specialists drawn from the Member countries of the IEA. The team visited Germany from 28 January to 1 February 2002 for discussions with representatives of government energy administrations and energy industries.

Members of the team were:

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Lea Gynther managed the review and drafted the report. Monica Petit and Bertrand Sadin prepared the figures.

The team consulted with the following organisations:

- Deutsche Steinkohle AG (DSK).
- E.ON AG (utility company).
- The Federal Cartel Office (FCO, *Bundeskartellamt/BKartA*).
- The Federal Ministry of Economics and Technology (BMWi).
- The Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU).
- The Federation of German Industries (BDI, *Bundesverband der Deutschen Industrie e.V.*).
- Friends of the Earth Germany (BUND, *Bund für Umwelt und Naturschutz Deutschland e.V.*).
- German Energy Agency (DENA, *Deutsche Energie Agentur*).
- German Hard Coal Association (*Gesamtverband des Deutschen Steinkohlenbergbaus*).
- Germanwatch.
- Government of North Rhine-Westphalia.
- RAG AG (coal company).
- Ruhrgas AG.
- RWE AG (utility company).
- VEAG AG (utility company, *Vereinigte Energiewerke).*

The assistance and co-operation of all participants in the review are gratefully acknowledged.

REVIEW CRITERIA

The Shared Goals of the IEA, which were adopted by IEA Ministers at their 4 June 1993 meeting held in Paris, provide the evaluation criteria for in-depth reviews conducted by the Agency. The *Shared Goals* are set out in Annex B.

3

ENERGY MARKET AND ENERGY POLICY

OVERVIEW

With a population of 82 million, the Federal Republic of Germany (hereafter Germany) is the most populated of the European OECD countries and also the largest European energy market. The country, with a land area of 357,000 km^2, is located in the middle of the European energy markets, making it an important transit country. Germany is also the third-largest economy among the OECD countries. In 2000, its GDP per capita, measured using current purchasing power parities, was US$ 24,900.[2] GDP growth was slow in the late 1990s, but reached 3% in 2000; in 2001, however, GDP growth dropped to 0.6% owing to the slowdown of the world economy. In the reunification of the country in 1990, five new Laender[3] acceded to the Federal Republic and Germany now consists of 16 Laender. Reunification was supported by massive efforts to restructure the economy of the New Laender, which brought many changes to the energy sector and led to a reduction of energy consumption in those Laender.

ENERGY MARKET

Primary Energy Supply

In 2000, total primary energy supply (TPES) in Germany was 339.6 Mtoe. TPES has decreased by 4.5% in the past decade, partly because of the reduction of energy demand in the New Laender that resulted from economic restructuring. The latest energy forecast[4] foresees an increase in energy demand of 3.2% between 1999 and 2010, with energy demand growing less than the economy. Germany's dependence on oil has declined from 47.9% in 1973 to 38.7% in 2000.

Final Energy Consumption

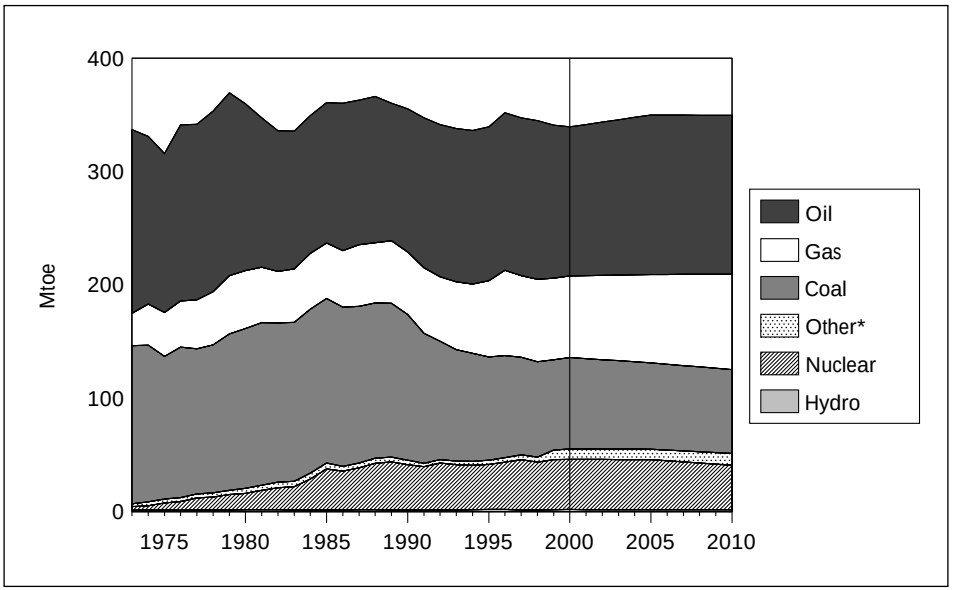
Total final energy consumption was 244.9 Mtoe in 2000, without significant change since 1990. The residential, services and other sectors (when combined) represent the largest energy-consuming sector (39%), followed by industry (33%) and transport (27%) (see Figure 4). In 2000, oil accounted for 50.2% of final consumption, natural gas 23.4%, electricity 17.2%, coal 4.2%, heat 2.8%, and combustible renewables and

2. On average in 2001, US$ 1 = DM 2.184 or €1.117. (€1 = DM 1.95583 which is the irrevocable conversion rate of 1 January 1999.)
3. German states are called Laender (singular – Land).
4. The latest energy forecast was prepared by PROGNOS/EWI by order of the Federal Ministry of Economics and Technology in 1999.

Figure 1
Map of Germany

* New Laender.

Figure 2
Total Primary Energy Supply, 1973 to 2010



* includes solar, wind, combustible renewables and waste, electricity and heat trade and ambient heat production.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

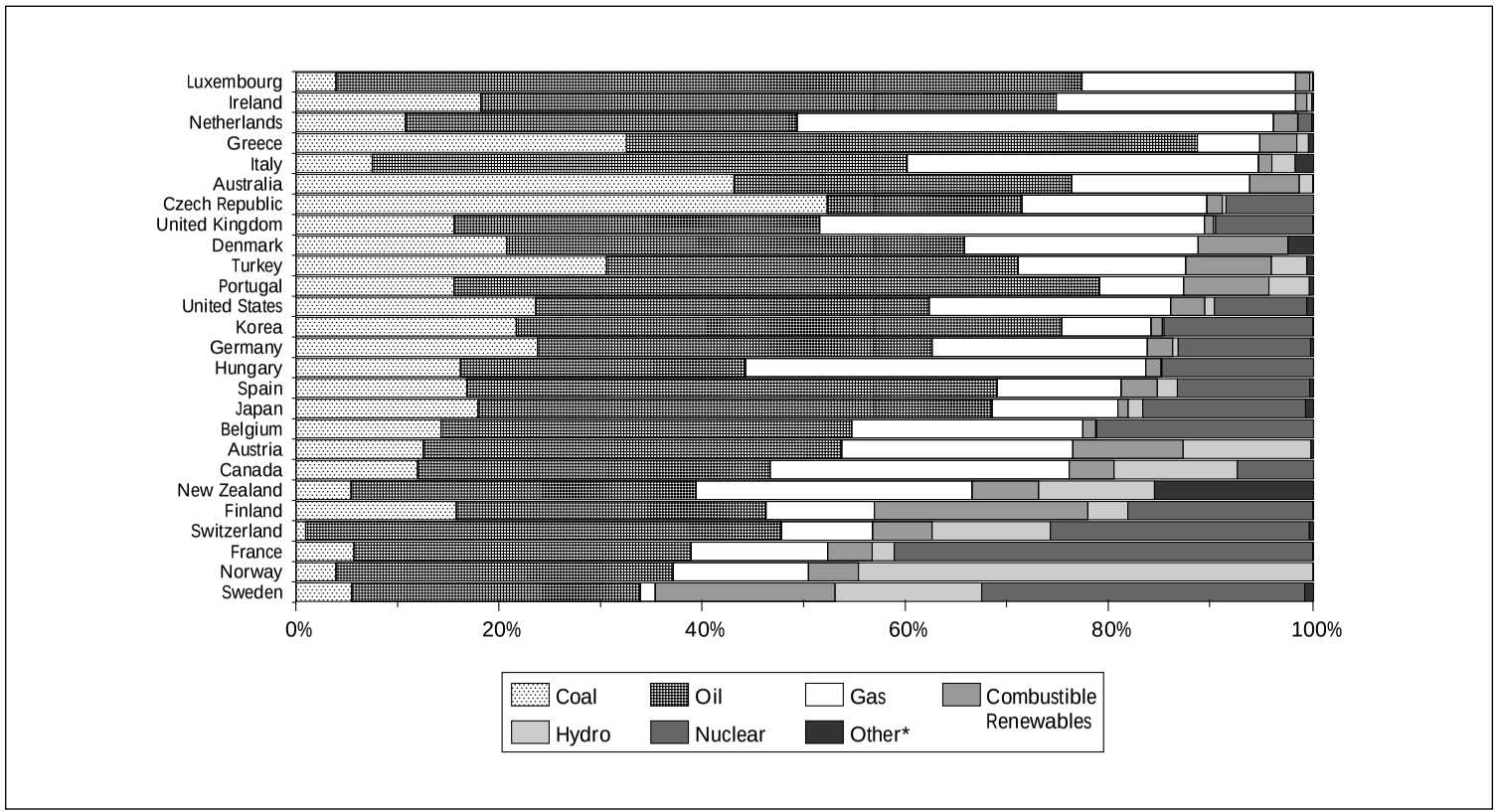
wastes 2.2% (see Figure 5). Changes in the proportions of different final energies in the 1990s were small, except for gas whose share increased from 16.6%, and coal whose share decreased from 15.1% in 1990.

ENERGY POLICY OBJECTIVES

The federal government in power during the late legislature (1998-2002) emphasised sustainable development in its energy policy. The Federal Ministry of Economics and Technology had outlined its new energy policy orientation in *Sustainable Energy Policy to Meet the Needs of the Future* (the Energy Report), which was published in November 2001. It defined three key objectives: supply security, economic efficiency and environmental compatibility. The energy report was based on the outcome of the "Energy Dialogue 2000", which was a year-long forum for exchanging thoughts and developing guidelines for energy policy. It had been jointly initiated and led by the Federal Minister of Economics and Technology and the Chairman of the Supervisory Board of the Forum for Future Energies (*Forum für Zukunftsenergien*). Participants in the forum included representatives from political parties, the Laender, companies, labour unions and environmental organisations. The conclusions of the Dialogue were published in *Guidelines on Energy Policy – Results of the Energy Dialogue 2000*. The key areas of action defined by the "Energy Dialogue 2000" are:

Figure 3

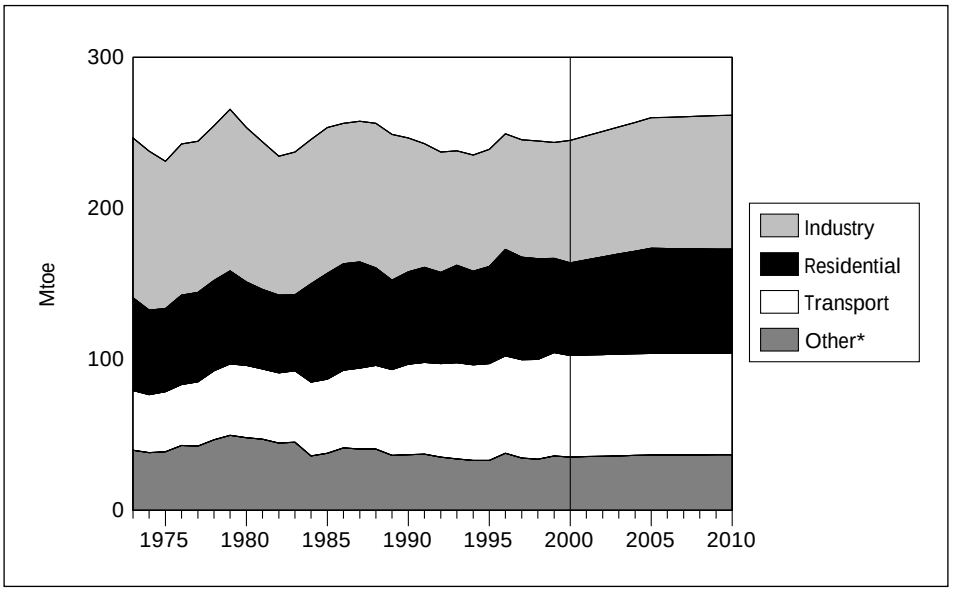
Total Primary Energy Supply in IEA Countries, 2000



* includes solar, wind and ambient heat production.

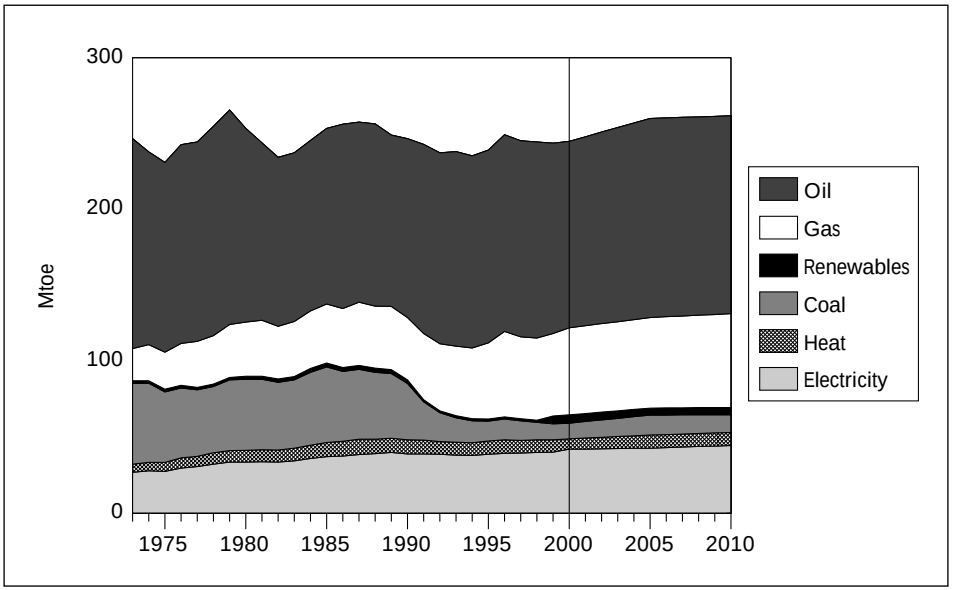
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001.

Figure 4
Total Final Consumption by Sector, 1973 to 2010



* includes commercial, public service and agricultural sectors.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

Figure 5
Total Final Consumption by Source, 1973 to 2010



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

- Climate change mitigation.
- Promoting energy efficiency.
- Continued use of domestic coal and lignite.
- Creating more competition in the liberalised energy markets.
- Promoting renewable energies.
- Creating a level playing field for energy companies throughout Europe.

Another important objective of the late government was to phase out nuclear power. Currently operating nuclear power plants will be shut down after 32 years of activity (see Chapter 10).

ENERGY POLICY INSTITUTIONS

As Germany is a federal country, the federal government and Land governments each have their roles in energy policy formulation and implementation. All energy legislation is planned and adopted at the federal level, but the Laender implement the federal laws. The Laender can, however, conceive their own programmes to promote, *e.g.*, renewables and energy conservation.

The Federal Ministry of Economics and Technology (BMWi) has the main responsibility for energy policy. It is also now responsible for energy research and development after these tasks were moved from the Federal Ministry of Education and Research to BMWi in 1998. The Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU) is in charge of environmental policies, including climate change mitigation, as well as the safety of nuclear facilities and the disposal of radioactive waste. Transport-related issues fall within the competence of the Federal Ministry of Transport, Building and Housing. The German Energy Agency (DENA) was created in 2000 to promote energy efficiency and renewables.

Germany has decided not to establish sectoral regulators and instead has given regulatory responsibilities in the energy sector to the Federal Cartel Office (FCO) or the local anti-trust agencies of the Laender. When energy issues concern more than one Land, then the FCO addresses these *ex post* within the regulatory framework for controlling abusive market positions. When the issues concern only one Land, they are dealt with by the local anti-trust agency of the Land. Recently, the FCO established a special department with ten employees to monitor the electricity market, give recommendations and handle complaints in the electricity market. A similar department is planned for dealing with gas market issues. Since the beginning of market liberalisation, federal and regional competition authorities have received more than 200 claims in the electricity sector. As a result, the FCO has initiated more than 20 preliminary investigations concerning network access charges, of which 11 cases have led to formal investigation procedures. No cases have been filed yet in the gas sector.

ENERGY FORECASTS

The BMWi regularly commissions national energy forecasts from independent scientific institutions. The forecasts are also made available to industry and consumers. The latest forecast, entitled "The Longer-Term Development of Energy Markets in Light of Competition and Environmental Factors" (*Die längerfristige Entwicklung der Energiemärkte im Zeichen von Wettbewerb und Umwelt*), was prepared by PROGNOS AG and the Energy Sector Institute (EWI) of Cologne University in 1999. Since the report was completed in 1999, its assumptions concerning the nuclear energy phase-out and new energy policy measures are not fully in line with actual recent policy decisions.

ANALYSES IN THE REPORT "SUSTAINABLE ENERGY POLICY TO MEET THE NEEDS OF THE FUTURE"

The report *Sustainable Energy Policy to Meet the Needs of the Future*, which was published by the BMWi in 2001, presents two scenarios for the long-term development of energy markets. Scenario I is based on the 1999 PROGNOS/EWI study and Scenario II on the study "Assessment of a 40% Reduction Scenario in Terms of Energy Policy and Overall Economic Impacts", which was prepared by PROGNOS, EWI, *Bremer Energieinstitut* (BEI) and the German Institute for Economic Research (DIW, *Deutsches Institut für Wirtschaftsforschung*) for the federal government in 2001.

Scenario I addresses the question: "How are energy markets most likely to develop in Germany?" The authors assume that the policies adopted by the current government at the beginning of its term will continue until 2020 and that some existing measures will be strengthened. They also assume that the liberalisation of European electricity and gas markets will progress and that environmental tax reform will be pursued until 2020, and the tax rate raised. Scenario II takes another approach and examines the following issue: "What has to be done to reduce CO_2 emissions in Germany by some 40% – relative to the 1990 level – by 2020?" This scenario considers the measures that would have to be taken, their implications and associated costs if Germany were to simultaneously phase out nuclear power, reduce CO_2 emissions beyond the "Kyoto target", and meet its more ambitious national target, which is to reduce CO_2 emissions by 25% by 2005 compared to the 1990 levels. Both scenarios track the development of energy markets between 1999 and 2020.

Scenario I estimates an initial slight increase in TPES but a decline of 3% by 2020 from the 1999 level. Electricity generation would grow by 8% and industrial energy use by 5%, but energy consumption for transport would decline by 4% and for space heating by 3%. Oil would account for 41% of TPES, followed by gas (28%), coal and lignite (22%), nuclear power (4%) and renewables (4%).

Dependence on energy imports would grow from 61% to 74%. Electricity consumption would grow by 14% over the period, while energy intensity (TPES per unit of GDP) is expected to decline by 2.1%/year compared to the average of 1.9%/year between 1991 and 2000. Under Scenario I, nuclear power would be replaced mainly by gas- and coal-fired power plants. The share of gas in power generation would grow to 20% from 10% in 1999, and the share of coal to 57% from 51%. The share of renewables would rise from 5% to 13%. As nuclear power would not be completely phased out by 2020, it would contribute 9%. The authors assume that the eco-tax on gasoline, diesel, fuel oil, gas and electricity will keep on being raised until 2020, and that world market energy prices will not change unexpectedly. Under these mainly business-as-usual assumptions, CO_2 emissions are estimated to decline by 15% by 2010 and by a total of 16% by 2020 from the 1990 level. However, the scenario does not take into account recent climate change mitigation policies. The study indicates that Scenario I would not lead to major structural changes or cause an increase in unemployment.

Scenario II estimates that by 2020 TPES will decrease by 18% relative to the 1999 level. Electricity generation would grow by 7%, but industrial energy use would decline (by 10%), and so would energy use for transport (by 18%) and for space heating (by 14%). Oil (36%) and gas (41%) would dominate TPES, followed by coal (11%), renewables (10%) and nuclear power (2%). Electricity consumption would grow by 11%, and dependence on energy imports would grow to 76%. Using these assumptions, energy intensity would have to decrease by 2.7% annually until 2020 if the target of a 40% reduction in emissions relative to the 1990 level is to be met by 2020. The authors consider this projection to be "extremely ambitious". Nuclear power would be replaced mainly by gas-fired power and renewables. The share of gas in power generation would grow to 54% and the share of renewables to 21%. The share of coal would decline to about 20% and the share of nuclear power to 4.5%. CO_2 emissions are expected to be reduced by 29% in 2010 relative to the 1990 level and reach the fixed 40% reduction target by 2020. The net cost (taking into account energy savings) of implementing the measures needed to meet the demands of this scenario is estimated at €11 billion annually in 2010 and €32 billion annually in 2020, with the total net accumulated costs for the period 2000 to 2020 estimated at €256 billion. The energy bill of households would increase by 60% compared to 2000, depending on the measures that are taken. The scenario is based on the assumption that world market prices for energy do not change significantly and that world gas prices do not continue to increase. The macroeconomic impacts under this scenario would be significant. The authors estimate that employment would be reduced, especially in coal mining and among energy-intensive industries, and that some industries would leave Germany. However, employment would increase in *e.g.* public and rail transport, construction and mechanical engineering. The impact on economic growth was not estimated. The authors conclude that achieving the desired emissions reduction target could be done at lower cost by non-national measures. On the basis of the findings of Scenario II, the government considers that isolated national targets for CO_2 reduction beyond the Kyoto targets would be neither economically feasible nor environmentally efficient.

ENERGY SECURITY

Security of Supply Policy

Energy security is an important element of German energy policy. "Energy Dialogue 2000" recognised energy security to be one of the three key objectives of German energy policy together with economic efficiency and environmental compatibility. The "Energy Dialogue 2000" draws the following conclusions regarding energy security:

- Germany's energy supplies are highly dependent on imports. Oil and gas are imported from only a few countries and these are of varying stability, entailing risks of disruption in supplies and price changes. Indigenous fossil fuel resources (*i.e.* gas, hard coal and lignite), renewables and energy conservation are the key means for reducing import dependency.
- Nuclear and fossil fuel resources are finite. Renewable energy sources pose other risks, such as the uncertainty of their availability.
- Market liberalisation facilitates diversification of supply sources, energy trade and expansion of energy services.
- Adequate energy infrastructure (networks) are necessary to ensure security of supply. There must be sufficient incentives to maintain and sustain the quality of the energy infrastructure.

Most of the above conclusions of the "Energy Dialogue 2000" are already reflected in German energy policies. For instance, domestic gas, coal and lignite account for a significant part of domestic energy supplies; energy markets have been fully liberalised; and considerable effort is put into improving energy efficiency and increasing the use of renewables.

The schedule for phasing out nuclear power has been planned jointly by the federal government and the nuclear industry (see Chapter 10). As the electricity markets have been liberalised, the government has entrusted decision-making on the amount of new capacity needed and the timing of investments to the energy industry. The government has initiated some analyses on the likely long-term impacts of the phase-out on the structure and cost of energy supply and on the environment.[5] Because most of the nuclear power stations will be decommissioned in the period between 2010 and 2020, the government has concluded that it does not need to rush into short-term energy policy measures now.

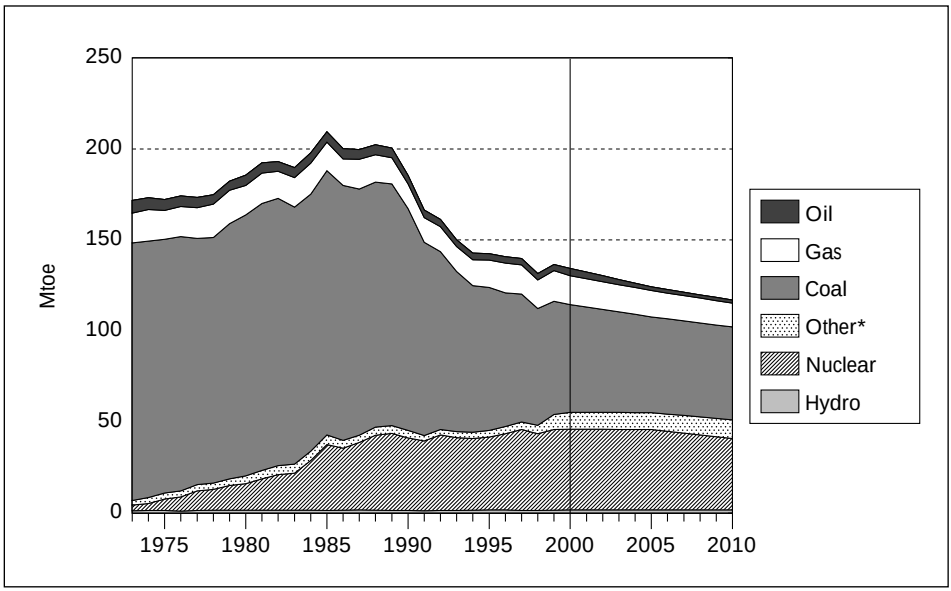
Energy Production

Domestic energy production accounted for 39.5% of TPES in 2000. This share is expected to fall to 33.3% by 2010. At present, half of domestic energy production

5. See above the Analyses in the Report "Sustainable Energy Policy to Meet the Needs of the Future".

comes from coal and lignite, and the rest from nuclear, gas and renewable energies. Over the last decade, coal production was halved. This was mainly because lignite production was reduced in the New Laender and because hard coal production was reduced in the Old Laender. Nevertheless, the government considers that domestic coal and lignite make a significant contribution to security of supply and so has applied policies to secure domestic production (see Chapter 7). Domestic gas production accounted for 22% of demand in 2000, but domestic oil production was negligible compared to demand. Nuclear power accounts for one-third of domestic energy production. The planned phase-out of nuclear power would significantly reduce the share of domestic production in the energy supply between 2010 and 2020, unless nuclear power is replaced by other domestic energy sources, such as coal and renewables.

Figure 6
Energy Production by Source, 1973 to 2010



* includes solar, wind, combustible renewables and waste, and ambient heat production.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

Electricity Supply

In the case of electricity, three aspects regarding energy security are essential: system security in terms of network infrastructure; supply security in terms of ensuring adequate generating capacity; and supply security in terms of primary energy sources for generation. Following the shutdown of nuclear power plants in the New Laender after reunification, there is some excess transmission capacity in the eastern part of the country, and the government considers that there are no significant bottlenecks in other parts of the country. (Interconnections are

discussed in more detail in the section on Transit below and in Chapter 10.) At the moment, there is also some excess generating capacity. Large power companies have recently merged, and they have reorganised their generation activities in the liberalised markets. Some of the generation units have become inefficient, and Germany now has about 10,000 MW of over-capacity. These power plants are either going to be closed or used mainly to provide middle and peak-load. For commercial reasons, power companies are importing some electricity to provide baseload. As for the availability of coal, gas and oil, the study made by PROGNOS and EWI does not see supply bottlenecks arising in the long term, which is in line with the analysis made by the IEA. Wind power is rapidly increasing its share in electricity generation and the government has announced ambitious plans to increase wind power generation (see Chapter 9).

Gas Supply

Security of gas supply can be divided into short-term security of supply (safeguarding against supply disruptions) and long-term security of supply (ensuring sufficient supply diversity and investments to meet increasing demand); the latter often involves long-term strategic and geopolitical planning. As there is little government regulation for gas markets in Germany, gas companies themselves are primarily responsible for ensuring security of gas supplies. So far the market has not had a supply security problem. In large part this can be attributed to the use of the following four instruments: long-term supply contracts (20 years and beyond); diversification of gas supply sources; adequate storage facilities; and interruptible contracts with some clients**.** According to a government estimate, the share of interruptible contracts covers about 10-20% of all gas consumption. Long-term import agreements (with a term longer than two years) must be reported to the Federal Office of Economics and Export Control (*Bundesamt für Wirtschaft und Ausfuhrkontrolle*, BAFA). This obligation helps to provide an overview of the extent and diversification of gas supply sources and of the supply periods covered by the agreements. It also helps in cases where importing companies want to make a claim against the government because of its interference.

The German government does not want to be highly dependent on natural gas in electricity generation. It considers the price risk of natural gas to be significant owing to the rapid increase of gas demand in Europe.

Refining Industry

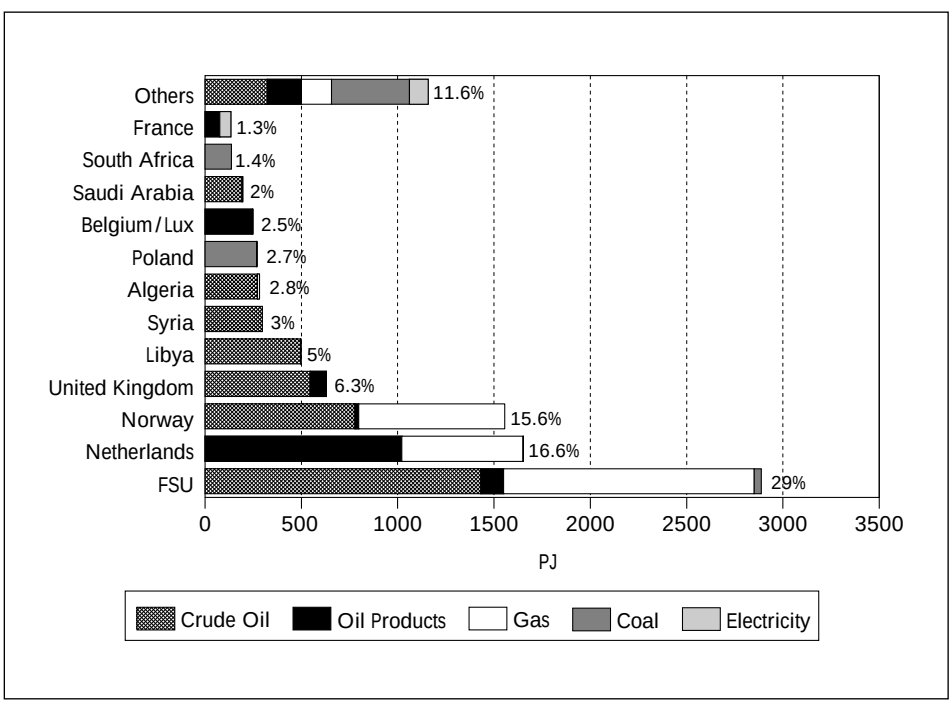
The government considers that a strong domestic refining industry is necessary to maintain security of energy supply, especially since the world market for crude oil is more reliable than that for petroleum products. There is a possibility that mergers in the oil sector – and the resulting reorganisation and rationalisation of

operations – together with the anticipated decrease in gasoline consumption, may lead to closures of refineries. Some large mergers that have taken place in world oil markets have affected the German market, and some domestic companies are also planning to merge.

Import and Export

About 60% of TPES is covered by imported energy (see Figure 7). The former Soviet Union (FSU) is the largest supplier of energy (29%), followed by the Netherlands (16.6%) and Norway (15.6%). These three countries are also the principal gas sources. Crude oil imports come from diverse sources, but Russia is the main provider, supplying 33% of imports. The Netherlands is by far the most important source of petroleum products, accounting for 59% of imports; the rest is imported from Belgium and other countries. Imports of electricity accounted for 7.9% of total electricity supply in 2000, with imports and exports almost offsetting each other. Germany's coal, gas and crude oil exports are negligible compared to imports. Export volume of oil products is about one-third of import volume.

Figure 7
Origin of Gross Energy Imports in Germany, 2000*



* provisional.
Source: BMWi.

Transit

Located in the middle of the European electricity and gas networks, Germany is an important transit country; this importance may even increase in the future when a unified European energy market emerges. The European Commission has defined Germany as belonging to the core area of the European electricity system that includes Austria, the Benelux countries, France and Switzerland. The current gas transit volume in Germany is some 30 bcm, which represents about 30% of domestic demand. Germany's role in European gas markets is likely to grow once the planned new trading hub in Bunde, near the Dutch border, will start operation. At present, there is some congestion in both the gas and electricity interconnections (see Chapters 8 and 10).

ENERGY TAXATION

Various types of taxes and fees are imposed on energy, including excise taxes, royalties, concession fees, the eco-tax and VAT (Table 1 shows the excise taxes applied in 2000). All fossil fuels but coal are subject to excise taxes. Royalties are paid to the relevant Laender for gas and oil production. The royalty rate for natural gas was 24% of the market value in 2001, up from 17% in 2000. Gas and power utilities pay concession fees to municipalities for the use of public roads when they are laying cables and pipelines. These concession fees are stipulated by the Regulation of Concession Fees for Gas and Electricity of 1992. Their level, however, depends on many factors, such as where the gas will be used, and on the municipalities. The general VAT of 16% is applied to all non-commercial use of energy.

The federal government introduced the eco-tax in 1999 to make energy use more efficient and to reduce labour costs (see Table 2). It is paid in addition to the taxes in Table 1. All the eco-tax revenues are used to lower the social security contributions of companies and their employees, and to promote renewables and co-generation. The government estimates that the resulting reduction in labour costs could help create 250,000 new jobs by 2003. The structure and level of the current eco-tax do not clearly reflect environmental externalities, such as the carbon content of fuels. The federal government will conduct a comprehensive study on the effectiveness of the eco-tax in 2003.

The eco-tax, which was introduced on 1 April 1999, has been raised in stages – at the beginning of 2000, 2001 and 2002 – with the last increase planned for 2003. The tax for liquid fuels has been increasing gradually by €0.0307 annually per litre and that for electricity by €0.0026 per kWh every year. However, there are a number of exemptions from the eco-tax. Manufacturing industries, forestry and agriculture get an 80% discount for eco-taxes on fuels and electricity, and energy-intensive industries get additional rebates (*Spitzenausgleich*); local public transport gets a 50% discount, and rail transport pays half of the standard eco-tax for electricity.

Table 1
Energy Taxes (Excluding the Eco-tax) in Germany, 2000
(in euros)

Sector/fuel	*Excise tax (excluding eco-tax) euro/unit*	*VAT %*
Households/electricity	-	16
Households/natural gas	21.42/toe	16
Households/heating oil	40.90/1,000 litres	16
Households/steam coal	..	16
Non-commercial use/unleaded gasoline	0.501/litre	16
Non-commercial use/diesel	0.317/litre	16
Industry/electricity	-	0
Industry/natural gas	21.42/toe	0
Industry/light fuel oil	40.90/1,000 litres	0
Industry/high and low-sulphur heavy fuel oil	15.34/tonne	0
Industry/steam coal	..	0
Industry and commercial use/diesel	0.317/litre	0

Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2001.

Table 2
The Eco-tax, 1999 and 2003
(in euros)

Energy	*April 1999*	*January 2003*
Electricity		
standard rate	1.02/100 kWh	2.05/100 kWh
night storage heaters[1]	0.51/100 kWh	1.02/100 kWh
manufacturing	0.20/100 kWh	0.41/100 kWh
Gasoline/diesel	0.031/litre	0.153/litre
Heating oil		
standard rate	20.45/1,000 litres	20.45/1,000 litres
manufacturing	4.09/1,000 litres	4.09/1,000 litres
Natural gas		
standard rate	19.03/toe	19.03/toe
manufacturing	3.81/toe	3.81/toe

1. The reduced rate applies only to night storage heaters installed before 1 April 1999.
Source: BMWi.

CRITIQUE

Significant changes have taken place in many parts of the energy sector since the last IEA in-depth review of Germany in 1998. The electricity and gas markets have been fully liberalised, energy efficiency has improved, and emissions of

greenhouse gases and pollutants have declined. The government continues to follow a challenging energy policy agenda. It has decided to phase out nuclear power and simultaneously it has set ambitious targets to reduce greenhouse gas emissions.

Germany is located in the centre of Europe and it is a large economy. It therefore plays an important role in many issues that concern European energy markets. It has been a leader in Europe in energy market liberalisation. The government is concerned over the slow pace of liberalisation in some other European energy markets because it believes that competition in Europe should be based on reciprocity. Issues related to cross-border electricity and gas transmission, such as congestion, reliability and cost, are also cause for concern. The government considers that these should be addressed on the European level. It is possible that, owing to political pressure at home and competitive pressure in Europe, Germany may need to proceed more synchronously with the rest of Europe in the future.

As the government considers renewables and co-generation to be key measures for reducing greenhouse gas emissions, it has adopted policies to considerably subsidise (directly and indirectly) these energy sources. The government also heavily subsidises domestic hard coal production because it considers this to be important for ensuring security of supply. Subsidies, and other measures such as the eco-tax, put a burden on consumers. The phasing-out of nuclear power could possibly add to this burden. So far, no comprehensive study has been done to estimate the impact of energy policies on economic growth in Germany. As the current energy policies are likely to entail significant costs and other impacts, the government should undertake a comprehensive study to examine these impacts and inform industry and the public of the findings.

A number of findings were presented during the political debate on the phase-out of nuclear power. It is clear that future energy policy in Germany should safeguard long-term supply and ensure that national and international environmental targets can be met. This will require sound analyses and projections. Although their results may significantly vary according to the assumptions that are used on the costs, benefits and constraints of alternatives to nuclear power, such studies are essential for policy-making. The government should make certain that these parameters are continuously assessed.

Germany has put much emphasis on conceiving guidelines for energy policy that are based on consensus involving all interested parties. The conclusions of discussions on energy issues (*i.e.* "Energy Dialogue 2000") have been taken into account in the BMWi's Energy Report *Sustainable Energy Policy to Meet the Needs of the Future*, which was published in November 2001. One of the leading ideas in German energy policy is sustainability, which is reflected, *inter alia*, in the National Strategy for Sustainable Development of April 2002, elaborated by the Committee for Sustainable Development (the "Green Cabinet" established by state secretaries). This policy paper sets objectives for energy efficiency and renewables, and excludes nuclear power from long-term electricity supply.

Measures that have been implemented under current energy, environmental and climate change policies represent the first steps in this far-reaching strategy, which in part looks as far ahead as 2050. Additional measures will be defined, taking into account future energy market trends. Every two years the government will present a progress report on the implementation of the strategy. These reports will also include new measures if necessary. In order to achieve energy policy objectives, Germany provides financial support to promote certain energy sources, including domestic coal, renewables and co-generation. The promotion of renewable energies and co-generation by feed-in tariffs has an impact on the market mechanism – even if the rate of feed-in tariffs for renewables is progressively reduced to take into account the maturity of these energy sources. The subsidies that are currently provided for co-generation and the eco-tax create an advantage for larger consumers in comparison to smaller consumers. The government needs to define how much it wants to rely on market mechanisms and how much on financial support in these policy areas.

Another issue that needs to be addressed is energy security. The phase-out of nuclear power is likely to cause substantial changes in the energy supply structure, and a balanced mix of different fuels should be sought in order to avoid excessive dependence on a few energy sources. Imports are likely to increase, which will require adequate transmission infrastructures.

Nuclear power should be replaced with a proven, commercially viable and low-cost technology – or mix of technologies – while not losing sight of the costs of addressing greenhouse gas emissions and security of supply. The alternatives for nuclear power need to be closely studied. This means conceiving a framework whereby the potential role of gas, coal and renewables – as well as of government R&D in energy – for the next 5-10 years can be defined**.**

Germany has not established sectoral regulators for the electricity and gas sectors and relies on *ex post* regulation carried out by the Federal Cartel Office (FCO) and the regional anti-trust authorities. The number of FCO staff dealing with complaints concerning the electricity market is small and no such staff has been allocated for the gas sector. This has caused delays in the handling of cases. While a plaintiff can also sue the incumbent directly, this may involve cost risks and be as time-consuming as FCO procedures. It usually takes four weeks (period of legal redress) before the decisions taken by the FCO and the regional authorities come into force, and an incumbent's appeal can cause further delays. In these cases, the dispute settlement process is very slow. This long process can distort the market because network monopolies may want to use the dispute settlement system to delay the access of new entrants. While appeal mechanisms are necessary, one approach to discourage companies from using the legal system to test limitations on their abusive behaviour would be to make FCO decisions enforceable on a provisional basis, even if they will be challenged in court. It is commendable that the proposed amendment to present energy legislation will introduce immediate enforcement of FCO decisions on network access.

RECOMMENDATIONS

The Government of Germany should:

- ☐ Evaluate the cost-effectiveness of the measures used to achieve all the energy and environment policy objectives simultaneously and publish the results. Monitor the consequences of the nuclear power phase-out, including the implications for the economy, the environment, security of supply and radioactive waste disposal.

- ☐ Put in place a long-term, stable energy policy framework, giving a higher priority to energy security, and implement as much of it as possible through the market mechanism. Encourage market participants to develop a strategy to substitute nuclear power with cost-effective alternatives that support energy security and climate change goals.

- ☐ Ensure that the federal and regional cartel authorities have enough resources to handle disputes and hand down decisions quickly.

4

ENERGY AND THE ENVIRONMENT

CLIMATE CHANGE

Greenhouse Gas Emissions

Energy-related CO_2 emissions have decreased in Germany since 1990, even though GDP has grown. In the Old Laender, CO_2 emissions increased by 2% between 1990 and 1995, whereas in the New Laender they decreased by 44%, mainly thanks to economic restructuring and significant energy efficiency improvements. Total CO_2 emissions fell by 12% between 1990 and 1995. By the end of 1995, per capita emissions in the New Laender were very close to those in the Old Laender. After 1995, CO_2 emissions reduction slowed down. In 2000, energy-related CO_2 emissions were 13.6% and total greenhouse gas (GHG)[6] emissions were 19.1%[7] lower than the 1990 level.

During the period 1990-2000, CO_2 emissions fell by 24.1% in industry, by 15.3% in the energy sector, and by 18.4% in the residential, services and other sectors. However, emissions from the transport sector increased by 8.8%. In 2000, energy industries accounted for 42% of total CO_2 emissions, followed by other industry (16.4%), transport (20.9%), residential (14.3%) and other sectors (6.4%).

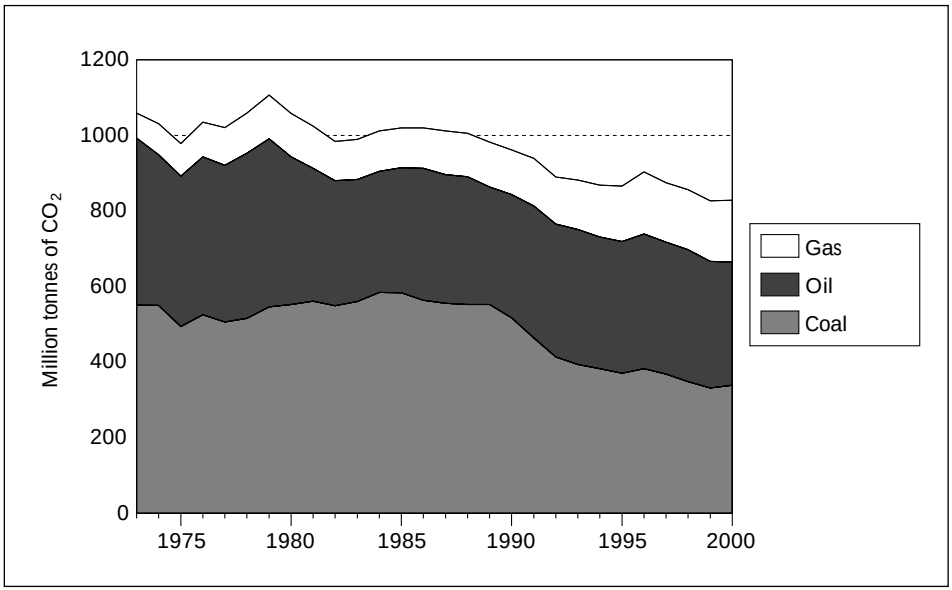
Germany plans to phase out nuclear power (see Chapter 10). The plan, which came into force by parliamentary decision in the spring of 2002, means that electricity generation from nuclear power plants will be reduced from about 160 TWh (net production) in 2000 to about 152 TWh in 2005 and 133 TWh in 2010. Generation will drop to about 46 TWh in 2020 and cease by 2025, at the latest. An analysis of the impacts of the phase-out on GHG emissions was included in the National Climate Protection Programme of October 2000. All things being equal, the nuclear phase-out would result in additional annual emissions of 3 to 7 Mt of CO_2 by 2005, another 7 to 17 Mt by 2010, plus 33 to 74 Mt by 2020, and up to 40 Mt more after 2020. These estimations were made with the unrealistic assumption that nuclear generation would be fully substituted by gas (lower estimates) or coal and lignite (higher estimates) installations.

Institutional Framework

It is the responsibility of the federal government to adopt national targets and measures to achieve environmental goals. The Laender can establish their own climate change mitigation programmes with a wider range of local measures, and all

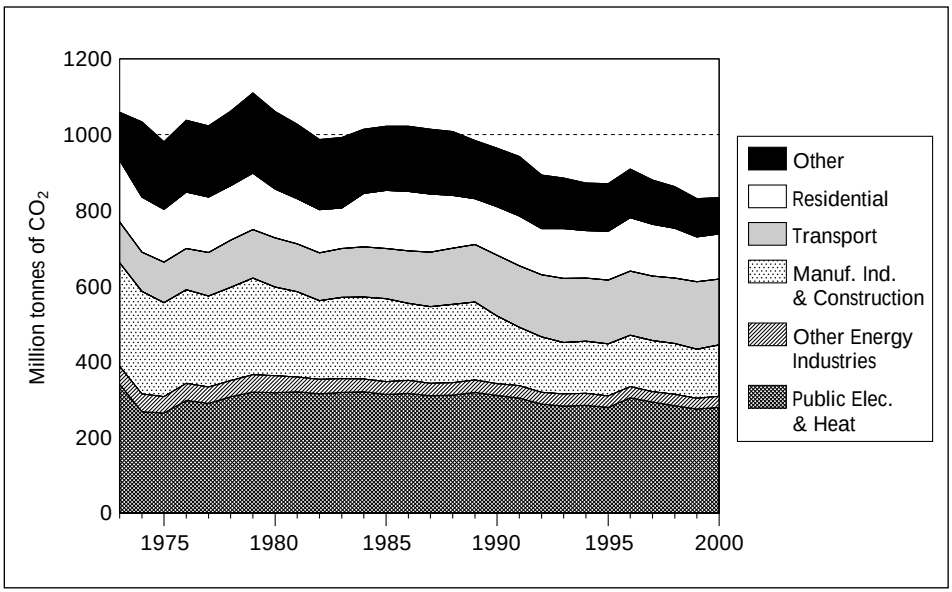
6. The EU Burden-Sharing Agreement under the Kyoto Protocol covers CO_2, CH_4, N_2O, PFCs, HFCs and SF_6.
7. This reduction is based on a comparison using 1995 as the base year for fluorinated greenhouse gases – an option stipulated by Article 3.8 of the Kyoto Protocol. If 1990 were used as the base year for all gases, the reduction would be –18.9%.

Figure 8
CO_2 Emissions by Fuel,* 1973 to 2000



* estimated using the IPCC Sectoral Approach.
Source: *CO_2 Emissions from Fuel Combustion*, IEA/OECD Paris, 2001.

Figure 9
CO_2 Emissions by Sector,* 1973 to 2000

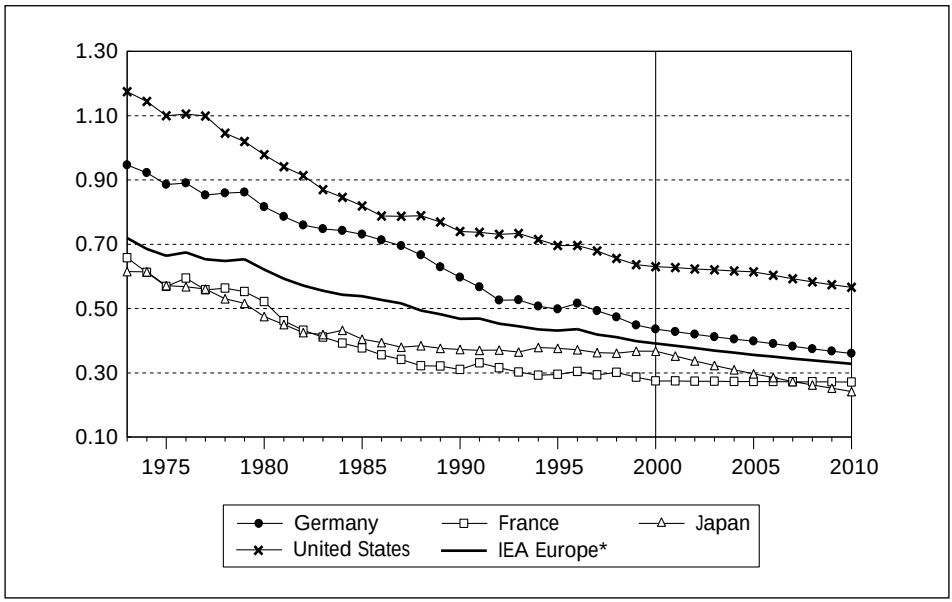


* estimated using the IPCC Sectoral Approach.
Source: *CO_2 Emissions from Fuel Combustion*, IEA/OECD Paris, 2001.

Figure 10

Energy-related CO_2 Emissions per GDP in Germany and in Other Selected IEA Countries, 1973 to 2010

(CO_2 emissions/GDP using 1995 prices and purchasing power parities)



* excluding Norway from 2001 to 2010.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001; *National Accounts of OECD Countries*, OECD Paris, 2001; and country submissions.

of them have chosen to do so. Local authorities have increasingly included climate change mitigation as one of their environmental policy goals. More than 400 cities, towns and rural districts have joined the Climate Alliance[8] and made a voluntary commitment to reducing carbon emissions in the energy and transport sectors. Citizens have also taken an active role in energy and environment-related policy-making through their participation in a number of important environmental NGOs.

The Committee for Sustainable Development ("Green Cabinet") was set up by the government in 2001 for formulating and implementing a strategy for sustainable development, which includes issues related to climate change and energy policy. In parallel, leading representatives from all relevant interest groups have been brought together in a Council of Sustainable Development (*Rat für nachhaltige Entwicklung*) to contribute to the National Strategy for Sustainable Development. The strategy was adopted by the government in April 2002.

8. The Climate Alliance (*Allianza del Clima*) was founded in 1990 as a partnership between European local authorities and indigenous rainforest peoples with the goal of protecting the atmosphere. Almost 1,000 European cities, municipalities and district authorities have joined the Climate Alliance. By joining, the members have committed themselves to certain goals, activities and measures. One of these is to halve CO_2 emissions by 2010 relative to 1987 levels.

Climate Change Policy

In 1995, the federal government adopted a national target to reduce CO_2 emissions by 25% in the 1990-2005 period. Germany's target within the EU Burden-Sharing Agreement under the Kyoto Protocol is to reduce its GHG emissions by 21% (compared to 1990 levels) for the first commitment period of 2008-2012. The parliament approved a bill on the ratification of the Kyoto Protocol on 26 April 2002. According to an estimate made by the federal government, Germany's GHG emissions reductions by 2001 represent 75% of total reductions achieved within the EU since the Burden-Sharing Agreement was adopted in 1998.

Germany has made progress towards the "Kyoto target"; in 2000, GHG emissions were only 1.9 percentage points above the target for 2008-2012. If carbon sinks are included, the difference between the target and present emissions is even smaller. The key measures that were introduced before the end of 2000 to reduce GHG emissions are:

- *Voluntary agreements with industry*
  In the 1996 Declaration by German Industry and Trade on Global Warming Prevention, industry made the commitment to lower its CO_2 emissions by 20% by 2005 compared to 1990 levels. Observed CO_2 emissions reductions amounted to 46.6 Mt in industry and 31 Mt in public electricity generation between 1990 and 1998. Also, the car industry has committed itself to reducing by 25% the fuel consumption of new cars built and sold in Germany between 1990 and 2005.

- *The eco-tax* (see Chapter 3)
  The German Institute for Economic Research (DIW) has estimated that the eco-tax will reduce CO_2 emissions by 2 to 3% (10 Mt) by 2005 compared with scenarios without the tax.

- *Promotion of renewables*
  Use of renewables has been promoted with the introduction of the Renewable Energies Act, the Market Incentives Programme and the 100,000 Rooftops Solar Electricity Programme; this last programme provides assistance for investments in photovoltaic systems (see Chapter 9). The promotion of renewables is estimated to reduce CO_2 emissions by 13 to 15 Mt by 2005.

- *Energy efficiency improvements*
  The Thermal Insulation Ordinances and Heating System Ordinances – together with advisory services to help implement these, and legislation on energy consumption labelling of consumer appliances – have reduced specific energy consumption in the residential sector. Before they were replaced by the Energy Conservation Ordinance in 2002, these ordinances are estimated to have reduced CO_2 emissions by 2.8 Mt. The labelling and energy consumption standards for appliances are estimated to have reduced CO_2 emissions by 0.3 Mt.

The federal government recognised that the above measures would not be sufficient to meet the national target in 2005, and therefore adopted a new National Climate Protection Programme in October 2000. This programme introduced new measures

in all economic sectors. Some of them, such as new voluntary agreements and new legislation for co-generation and energy conservation in buildings, have already been implemented.

- *New voluntary agreements with industry*
  In November 2000, industry agreed to a new voluntary agreement, the "Agreement on Global Warming Prevention", which aims to reduce CO_2 emissions per unit of output by 28% by 2005 and overall greenhouse gas emissions by 35% by 2012 (from 1990 levels). The new agreement is estimated to reduce GHG emissions by 10 Mt by 2005 and an additional 10 Mt by 2012, compared to 1998 levels.

- *Promotion of co-generation*
  A new Co-generation Act came into force in January 2002 (see Chapter 10). The estimated CO_2 emissions reductions are 20 to 23 Mt compared to 1990 levels.

- *Energy conservation in new buildings*
  The Energy Conservation Ordinance came into force in February 2002. Its objective is to reduce energy consumption, and related CO_2 emissions, in new buildings by 30% from the current level (see Chapter 5).

- *Energy conservation in existing buildings*
  The Climate Protection Programme for Existing Buildings aims to increase energy efficiency and reduce CO_2 emissions in existing buildings by providing low-interest loans for making improvements (see Chapter 5). The expected CO_2 emissions reductions are 5 to 7 Mt by 2005.

- *Measures to reduce other greenhouse gases*
  For example, measures have been adopted to reduce methane emissions from municipal waste representing the equivalent of 15 Mt of CO_2.

The only sector where CO_2 emissions increased in the 1990s is the transport sector, where emissions in 1999 were some 18 Mt higher than in 1990. A special package of new measures was introduced in 2000 in the National Climate Protection Programme to curb emissions growth in this sector. These measures are expected to reduce CO_2 emissions by 15 to 20 Mt by 2005 compared to 1990 levels. A key measure is the agreement between the federal government and the car industry to increase the fuel efficiency of cars by, *e.g.*, greater use of low-viscosity oils, low-friction tires and the installation of fuel consumption gauges. Cars that consume less than 3 litres and 5 litres of fuel per 100 km will benefit from lower motor vehicle taxes. Highway tolls for heavy trucks will be introduced in 2003. Information campaigns on energy-efficient driving are being jointly launched by the car industry, car users' associations and environmental associations. Moreover, within the framework of the "Investing in the Future Programme" (see Chapter 11) some €3 billion will be invested in rail infrastructure over the next three years.

The National Climate Protection Programme provides an estimate of reductions in CO_2 emissions that could be achieved in the different sectors by the measures described above. Table 3 illustrates this allocation and, at the same time, shows the

emissions reductions that can be expected from the use of cross-sectoral measures. It is envisaged that implementation of the programme would result in total CO_2 emissions reductions of 120 to 125 Mt by 2005, which corresponds to a reduction of some 10% relative to 1990 levels. Such a reduction would be sufficient for meeting the national reduction target.

Table 3
Sectoral Contributions to CO_2 Reduction in the National Climate Protection Programme

Area of action	*Total emissions reductions, in Mt of CO_2 by 2005*[1]
Ecological tax reform (eco-tax)	10 (impacts on different sectors)
Buildings (heating/water)	13-20
Private households, excluding buildings (electricity, *etc.*)	5
Industry	15-20
Transport	15-20
Energy industry	20
Renewable energy sources	13-15
Waste management	15[2]
Agriculture	Impossible to quantify
Total (with due regard for duplications)	**90-95**
+ forest sinks	30

1. Includes the impact of measures implemented in 1998-2000 and of additional measures adopted under the National Climate Protection Programme. Estimates on the impact of all measures adopted between 2005 and 2010 were not made.
2. Calculated in CO_2 equivalents on the basis of avoided CH_4 emissions.

Source: BMU, Germany's National Climate Protection Programme, Summary.

"Fall-wall Effect"

It is important to assess both the impact of the so-called "fall-wall effect"[9] on the development of GHG emissions and the impact of actual climate change policies, even if there are strong links between them. After 1995, statistics on the evolution of emissions in the Old and New Laender were no longer kept separately, and so it is possible to assess only the development of national total emissions after that year. The specific impact of measures on GHG emissions has been monitored as far as possible. The Fraunhofer Institute of Systems and Innovation Research (ISI) and the German Institute for Economic Research (DIW)[10] have made a joint attempt to

9. "Fall-wall effect" means the impacts of the restructuring and modernisation of the East German economy after reunification in 1990.
10. Source: Joachim Schleich, Wolfgang Eichhammer, Ulla Boede, Frank Gagelmann, Eberhard Jochem, Barbara Schlomann and Hans-Joachim Ziesing: "Greenhouse gas reductions in Germany – lucky strike or hard work?" in *Climate Policy*, Vol. 1 (Issue 3) (2001), pp. 363-380. 2001 Elsevier Science Ltd. PII: S1469-3062(01)00022-5.

examine the impact of the "fall-wall effect". They conclude that this effect accounts for almost 50% of the reduction of all six GHGs (but 60%, or 105 Mt, for energy-related CO_2) until 1995. Their analyses further imply that, without reunification effects, the reduction of GHGs would have been about 9% in 2000 compared to 1990 levels.

OTHER ENVIRONMENTAL ISSUES

Since 1990, Germany has achieved large reductions in emissions of many air pollutants, *e.g.* 84% for SO_x, 40% for NO_x, 49% for non-methane volatile organic compounds and 56% for carbon monoxide. The intensity of SO_x and NO_x emissions (kg per unit of GDP) is 65% and 50% below the OECD averages, respectively. Flue gas desulphurisation systems now cover more than 95% of the installed capacity of medium and large combustion facilities. The key factors affecting the evolution of emissions in the Old and New Laender have been different. In the Old Laender, reductions in emissions have mainly resulted from effective environmental management focusing on regulatory measures and their enforcement, pollution control techniques at stationary sources, and mandatory fuel quality and efficiency improvements in the transport sector. In the New Laender, emissions reductions have largely been driven by economic restructuring, energy supply switching from lignite to natural gas, and the upgrading of many polluting installations; state-of the art flue gas control equipment is now installed at the majority of large combustion facilities. Good progress has also been made in reducing ambient air pollution levels, but ground level ozone remains a problem in western and southern Germany.

Clean coal technologies are designed to enhance both the efficiency and the environmental acceptability of coal extraction, preparation and use. Germany is an active developer of clean coal technologies, including coal gasification (IGCC),

Table 4
Power Stations Using Clean Coal Technologies

Power plant	*Fuel*	*Type*	*Capacity*	*Efficiency*	*Status*
Cottbus	lignite	PFBC	..	40%	Commissioned in 1999
Frankfurt Oder	coal, gas	PFBC	49 MW	..	1997
Neckar	coal	USC	..	..	..
Staudinger	coal	SC	510 MW	42.5%	1992
Rostock	coal	SC (CHP)	508 MW	43%	1994
Schkopau	lignite	SC	790 MW	40%	1997
Schwarze Pumpe	lignite	SC (CHP)	1,500 MW	41%	1997/1998
Lippendorf	lignite	SC	1,730 MW	42.3%	1999/2000
Boxberg	lignite	SC	850 MW	41.5%	2000
Niederaussem	lignite	SC	965 MW	45%	Planned for 2002
Westfalen	coal	SC	350 MW	45%	Planned for 2003
Ensdorf	coal	SC	500 MW	47.5%	Planned for 2004

Source: *Coal Information 2000*, OECD/IEA Paris, 2001.

pressurised fluidised bed combustion (PFBC) and supercritical and ultra-supercritical pulverised combustion (SC and USC). Examples of power stations using these technologies are shown in Table 4. The annual R&D expenditure by the federal government on these technologies is significant – €17 million in 2000 – a budget exceeded only by Japan and the United States.

The EU directives on environmental impact assessment, integrated pollution prevention and control, and other directives on environmental protection were incorporated into German law in the summer of 2001.

CRITIQUE

Germany has managed to reduce the emissions of many pollutants and GHGs over the past decade. In 2000, total GHG emissions in Germany were only about two percentage points above Germany's Kyoto target (without considering carbon sinks). The intensity of CO_2 emissions decreased rapidly in the first half of the last decade and continued to decrease in the second half. The achievements in the reduction of other pollutants are remarkable. Though a fair part of the achievements can be attributed to environmental investment and management efforts, the single most significant factor until 1995 was the industrial restructuring process in the New Laender.

There are few and only rough estimates of the impact of the "fall-wall effect" on emissions. The "fall-wall effect" was a unique opportunity, which cannot be repeated. Therefore, it is unlikely that in the future Germany can continue to reduce emissions at the same pace as in the 1990s. In the Old Laender, further improvement will probably require greater expenditure than in the past. The PROGNOS Institute's long-term forecast indicates that energy demand is likely to continue to decrease – despite the recovery of industrial production and change in consumption patterns in the New Laender, such as increasing car use. Efforts to reduce emissions will need to be strengthened in both the New and Old Laender to bring about tangible progress in the future. Even if significant energy savings and emissions reductions are achieved in absolute terms, large improvements in relative terms will be more difficult to achieve in Germany than in a small country where, for example, the closure of a few factories can lead to large relative changes in energy consumption and emissions.

By 1995, per capita emissions in the New Laender had almost reached the same level as in the Old Laender. There was a one-year surge in 1996, but thereafter national CO_2 emissions have continued to decrease, albeit modestly, despite economic growth. Energy-related CO_2 emissions decreased by 13.6% between 1990 and 2000, whereas GDP grew by about 18% over the same period. Changes after 1995 are particularly significant for understanding if Germany has managed to decouple emissions trends from GDP. GDP growth between 1995 and 2000 was about 9%, whereas CO_2 emissions decreased by 7.5%. That seems to indicate that Germany has indeed managed to considerably decouple the evolution of emissions

from economic growth. Most of the reductions were observed in industry between 1995 and 2000, within the context of voluntary agreements with government. However, other reduction measures – including housing modernisation programmes, promotion of renewables, promotion of public transport and increasing fuel taxes – have also made a significant contribution. Industry has entered into voluntary agreements with the understanding that if these do not lead to adequate emissions reductions, then regulatory measures may be introduced.

Even though most voluntary agreements have achieved their targets, they have been subject to some criticism. Industry associations do not have adequate means to ensure compliance by different industrial branches or industrial firms, nor can they ensure that the burden is equitably shared among the different companies within a given industrial branch.

The German government considers the new measures that were introduced in the National Climate Protection Programme of 2000 to be sufficient for meeting the national emissions reduction target, as well as Germany's target within the EU Burden-Sharing Agreement under the Kyoto Protocol. In addition to voluntary measures, Germany also uses other tools, such as feed-in tariffs for electricity generated by co-generation and from renewables. Whenever possible, the cost and cost-effectiveness of the different measures should be carefully monitored, as these targets will not be easy to meet.

The impact of the planned phase-out of nuclear power will be significant, particularly after the first Kyoto commitment period (2008-2012). Germany has carried out an analysis of the economic and environmental impacts the phase-out would create. The National Climate Protection Programme estimates that this would lead to 43 to 98 Mt/year of additional CO_2 emissions by 2020, depending on the energy sources that are used to substitute for nuclear power. These estimates, however, were based on extreme assumptions whereby nuclear power would be replaced solely by gas or coal. In reality, nuclear power will be replaced by a mix of these and other energies.

The government does not exclude using the Kyoto "flexible mechanisms" as a potential means to achieve climate goals, but it prefers to a certain degree domestic measures, especially voluntary agreements by industry. Germany is actively participating in setting up a testing ground for the "flexible mechanisms", including emissions trading, in the Baltic Sea region. This approach is supported by industry, which also prefers voluntary measures to regulatory instruments. Emissions trading programmes on the company level require a prior allocation of permits (quotas) to trading entities. Both the federal government and industry consider that this initial allocation of burden for the establishment of emission quotas in "cap and trade" regimes for some branches, as the EU proposes, is difficult to achieve. They consider that this problem has not been solved at the European level or in Germany, where per unit goals under the voluntary agreements are established for industrial branches, rather than absolute caps for individual companies or plants. The energy industry claims that the implementation of European emissions trading could endanger the future of the present well-functioning voluntary agreements, and

would force generators to use only gas and renewables and give up the use of coal. The federal government is concerned that the proposed coverage of European emissions trading is not the same as that of the voluntary agreements, but it recognises, with reservations however, that these are technical details which could be resolved. The Ministry of the Environment, Nature Conservation and Nuclear Safety considers that in the long term, Germany should choose between voluntary agreements and emissions trading. The Ministry of Economics and Technology is of the opinion that it might be possible to combine voluntary agreements with a voluntary trading system. Germany has investigated the possibilities for establishing a national trading system, but the objective now is to operate within a European framework. Given that current energy policies already place a significant cost burden on consumers and taxpayers, the government should not exclude any possibilities to achieve the objectives that have been set with less cost. Actively seeking possibilities for using the "flexible mechanisms" should be part of such a strategy.

The current eco-tax does not adequately reflect the CO_2 emissions of each fuel. Mostly social aspects were considered in the design of the eco-tax leading to, for example, a lower tax rate for heating oil. Also, some fuels, such as coal and lignite, have been exempted from the eco-tax. Such a discretionary approach may significantly compromise the effectiveness of the eco-tax and create market distortions.

RECOMMENDATIONS

The Government of Germany should:

- ☐ Analyse further the various policy options and develop strategies for managing the evolution of GHG emissions beyond Kyoto target years.
- ☐ Pursue possibilities for supplementing domestic measures with Kyoto "flexible mechanisms".
- ☐ Develop and apply market-based instruments to give incentives for reducing emissions in cost-effective ways. Review and reform energy taxes and the eco-tax system to better reflect the externalities of each source of energy.

5

ENERGY DEMAND AND END-USE EFFICIENCY

TRENDS IN END-USE EFFICIENCY

Total final energy consumption (TFC) was 244.9 Mtoe in 2000, down by 0.7% from 1990. Industry[11] had the biggest share (33%), followed by transport (27.5%), the residential sector (25%) and other uses (16.5%).

In 2000, energy consumption by industry (81.0 Mtoe) was 8.7% lower than in 1990, mainly because of industrial restructuring in the New Laender and the voluntary agreements. Some growth (9.6%) in industrial energy consumption is forecast by 2010 owing to growing industrial production. The largest energy-consuming industries are chemical and petrochemical industries, which account for 43% of all industrial energy consumption; followed by iron and steel industries, with a 13% share; and non-metallic minerals industry, with a 9% share.

Transport is the only sector where energy consumption increased in the past decade. Energy consumption in the transport sector was 12% higher in 2000 than in 1990; it is forecast to grow slightly by 2005 and to decrease thereafter. The government and oil industries explain this trend by a greater number of diesel cars leading to reduced specific energy consumption (see Table 5), lower mileage in passenger transport, and the eco-tax. An increase in the transport of goods is not expected to reverse the decreasing trend in energy consumption that is forecast for the transport sector. Trends in the consumption of oil and oil products are discussed in Chapter 6.

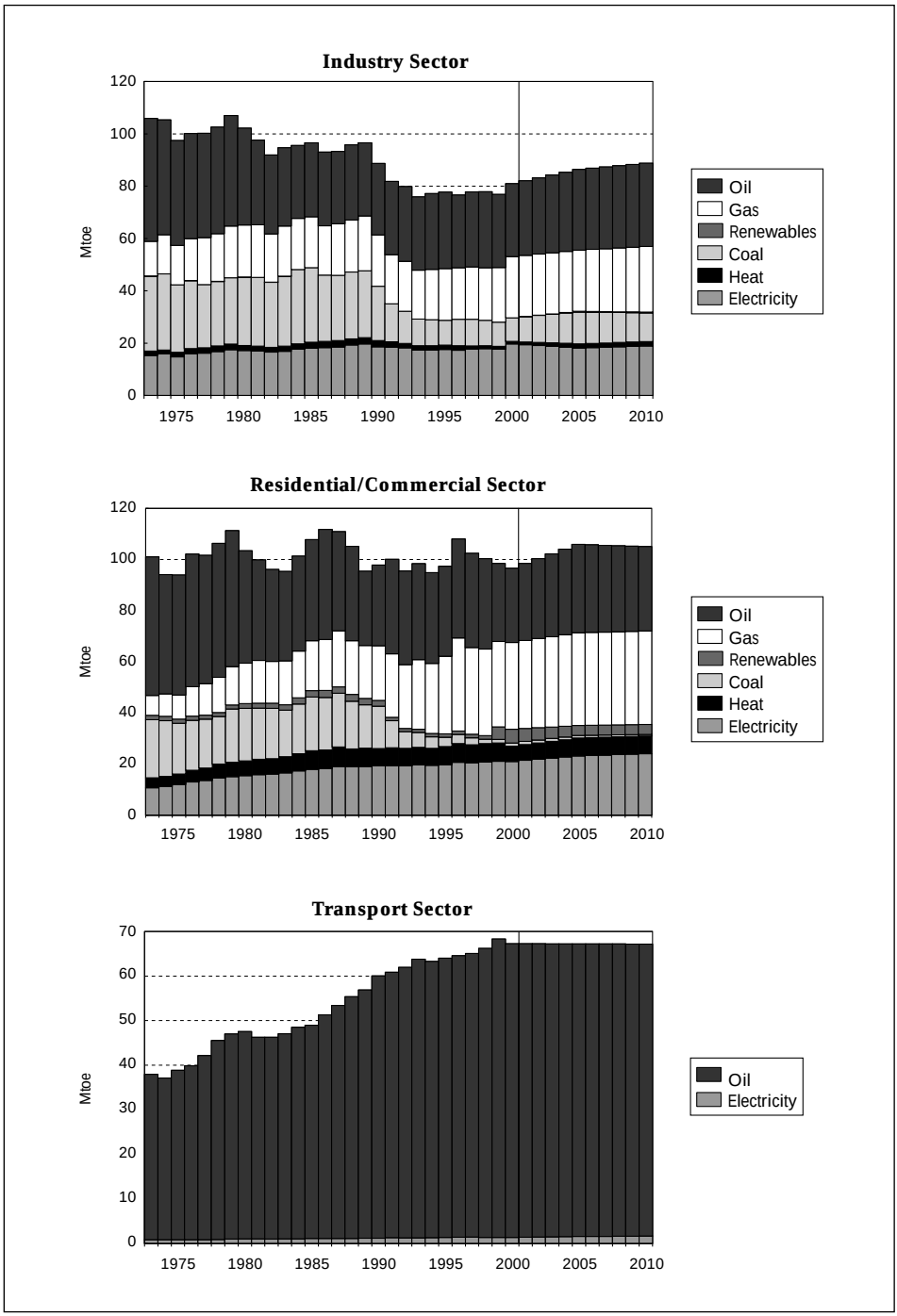
Energy consumption in the residential, services and other sectors decreased by 1.2% between 1990 and 2000. The latest forecast anticipates a 9.1% increase in consumption by 2010. The forecast does not take into account the impact of the new measures that were introduced in October 2000 in the building sector. Specific heat demand has continuously decreased since the mid-1990s (see Table 5).

Total primary energy supply (TPES) decreased by 4.5% from 1990 to 2000. Germany's energy intensity (TPES per unit of GDP) continued to decrease in the second half of the decade, after a sharp reduction in the early 1990s. In the past decade, energy intensity decreased faster in Germany than in IEA Europe, Canada, Japan and the United States. In 2000 for the first time, average energy intensity in Germany was below the average in IEA Europe. According to the latest German forecast, energy intensity will continue to decrease faster in Germany than the IEA Europe average.

11. Including non-energy use 5.2 Mtoe.

Figure 11

Total Final Consumption by Sector and by Source, 1973 to 2010

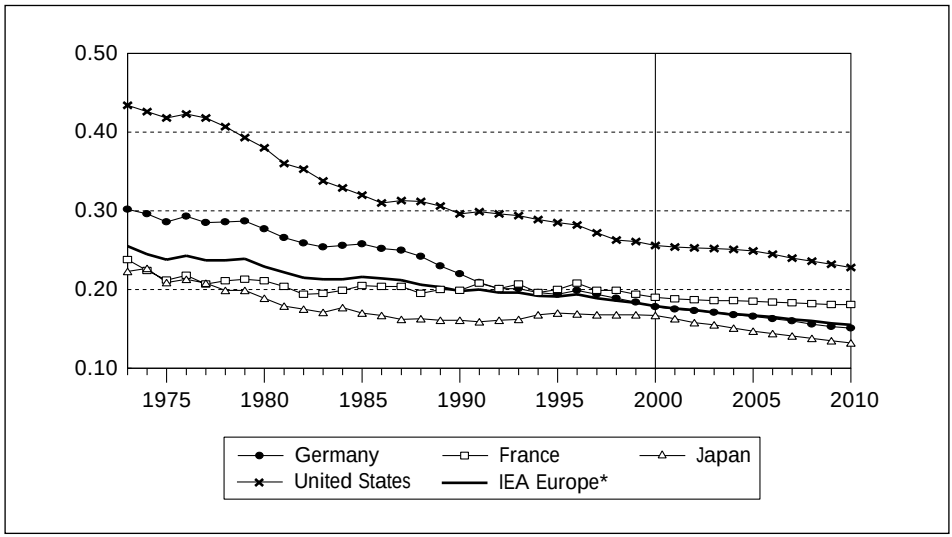


Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

Figure 12

Energy Intensity in Germany and in Other Selected IEA Countries, 1973 to 2010

(toe per thousand US$ at 1995 prices and purchasing power parities)



* excluding Norway from 2001 to 2010.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001; *National Accounts of OECD Countries*, OECD Paris, 2001; and country submissions.

Table 5

Energy Efficiency Indicators

	1995	*1996*	*1997*	*1998*	*1999*	*2000*
Specific energy consumption for passenger road transport, l/100 km [1]	8.9	8.8	8.8	8.7	8.6	..
Specific energy consumption in air transport, MJ per 10 passenger-km [1]	71.0	72.0	70.0	68.7	69.3	..
Specific energy consumption in railway transport, MJ per 1,000 freight and passenger-km [1]	847	871	825	779	745	..
Energy intensity in industry, MJ per DM 1,000 gross value added [2]	2,953	3,083	2,909	2,816	2,832	2,742
Energy intensity in the service sector, MJ per DM 1,000 gross value added (craft industry, commerce and services) [2]	624	684	599	592	551	518
Final energy consumption in the residential sector [2], MJ per m²	902	966	947	908	845	..
Final energy consumption for space heating in the residential sector [2], MJ per m²	..	791	723	723	666	..

1. Source: BMWi based on DIW's "Verkehr in Zahlen".
2. Source: BMWi based on "Arbeitsgemeinschaft Energiebilanzen" (Statistisches Bundesamt).

INSTITUTIONAL FRAMEWORK

The federal government is responsible for proposing legislation governing energy efficiency, but the Laender have an important role in implementing and enforcing it. They can also introduce their own measures to promote energy efficiency. The German Energy Agency (*Deutsche Energie Agentur*, DENA) was established to increase co-operation on the federal-Land level, inter-Land level and between the federal government, Land governments and industry (see box).

German Energy Agency (DENA)

The German government and the *Kreditanstalt für Wiederaufbau* (KfW), the reconstruction bank, established the German Energy Agency (DENA) in 2000. It aims to bring together the various players in the energy sector, help implement energy efficiency policy, and promote renewable energy sources, climate change mitigation and sustainable development. Typical activities of the DENA include working with industry on pilot projects that use new technologies and running information campaigns. The DENA *inter alia* organises these campaigns together with the 12 Land agencies for energy efficiency, but there are no formal organisational links between them. It also operates the "Energy Hotline", a toll-free telephone service for advising both companies and individuals on the rational use of energy in buildings, and on co-generation and renewable energy sources. At the beginning of 2001, the DENA had a staff of 26, but plans to increase this number to 45 by 2003. DENA's budget for 2002 is €19 million.

SECTORAL POLICIES

In the area of energy efficiency, the federal government prefers voluntary measures to regulatory ones in the industrial sector. It believes that industry will implement the most cost-effective measures, one reason being competitiveness. Voluntary agreements with industry were introduced in 1995 to reduce CO_2 emissions. The measures that industry took under these agreements have led to improvements in energy efficiency (see Chapter 4). At this point, the federal government considers that additional regulation to improve energy efficiency in the industrial sector is not needed.

Another non-regulatory measure for improving energy efficiency is energy conservation contracting (third-party financing), which has increased considerably in recent years. In 1999, about 480 companies ran a total of 39,000 projects with associated investments of €6.6 billion. The federal government supports this activity by exempting co-generation facilities established by the contracting companies from the eco-tax and by giving assistance for the installation of renewable energy applications in buildings under the Market Incentives Programme (see Chapter 9). Companies that provide energy conservation contracting can

receive financing from special programmes established by the *Kreditanstalt für Wiederaufbau* (KfW) and the *Deutsche Ausgleichsbank* (DtA).

The federal government also finances consulting and training activities to improve energy efficiency in small and medium-sized enterprises. In 1997, about €360,000 was spent on energy efficiency consulting and training for SMEs. Because of declining demand, this expenditure was reduced to €150,000 in 2001. The government will abolish this financial assistance in 2002.

Various measures are used in the transport sector to improve energy efficiency (see also Chapter 4). For example, the car industry has made a voluntary commitment to improve the fuel efficiency of vehicles. In 2002 Germany will implement the 1999 EU directive concerning consumer information on the energy consumption and CO_2 emissions of new passenger cars. The directive requires that a comprehensive inventory of the energy consumption and emissions of all new cars on the market be published annually and made available to consumers through car dealers. Another measure exempts cars with low specific fuel consumption and low emissions from the annual motor-vehicle tax. The federal government also supports a modal shift from roads to railways by providing financing for the development of rail transport; the budget for this activity is €125 billion for 1991 to 2012. The construction of new trans-shipment terminals to improve the interface between road haulage and railway transportation is a further step to promote rail transport.

Regulatory measures and information dissemination are used to reduce energy consumption in buildings. The federal government issued a Thermal Insulation Ordinance in 1977 and a Heating Installations Ordinance in 1978 and kept revising them until a new ordinance – the Energy Conservation Ordinance, which combines these two former ordinances – came into force in February 2002. As the new regulation stipulates only total specific energy consumption and does not give specific instructions on the choice of technology, designers and constructors can optimise the energy economy of buildings by using a wide range of technology options. The target of the new ordinance is to reduce energy consumption in new buildings from 100 kWh/m^2 per year to 70 kWh/m^2 per year. The federal government estimates that the additional costs of complying with the tighter energy efficiency requirements are offset by smaller energy bills. Another provision of the ordinance is that every new building must have an energy profile card that provides information on its energy consumption.

The Energy Conservation Ordinance also encourages energy efficiency improvements in existing buildings. The ordinance requires that all boilers installed before October 1978 – there were some 2 million such boilers in 2001 – be replaced with more energy-efficient boilers. Compared to the Thermal Insulation Ordinance of 1995, the new ordinance sets stricter energy requirements when modernisation or retrofitting measures are undertaken. In some cases, the ordinance requires that retroactive improvements be made, such as insulating floors, ceilings and piping.

The federal government recognises that energy efficiency improvements in existing buildings need to be supported by public financial aid and by advisory and information

services. "The Climate Protection Programme for Existing Buildings" was launched in January 2001 to provide such financial support. It is a modernisation programme for buildings that aims to improve energy efficiency and reduce CO_2 emissions. Over the next few years, measures for modernising heating installations, improving thermal insulation and replacing windows in more than 33,000 dwellings will be supported by low-interest loans from the KfW. The programme's budget is €1.02 billion for the next five years. In the first half of 2001, loans totalling €140 million were provided for energy conservation efforts in about 9,100 households. The DENA is conducting a series of information dissemination sessions for architects and engineers on the Energy Conservation Ordinance. The federal government also provides financial assistance for "on-site consulting". Building owners can receive a grant if they request that professional experts give them on-site advice on potential conservation measures. The government expects demand for this consulting service to increase because it helps to meet information needs created by the implementation of the new ordinance.

A number of other measures are in place to reduce energy consumption in buildings. Energy consumption labelling of domestic appliances has been mandatory since 1998. Voluntary labelling programmes are under way, such as the Group of Energy-Efficient Appliances (GEEA) labelling scheme for electrical appliances, and the Energy Star designation for office devices. Heat consumption metering for individual households became mandatory in the New Laender in 1996 and has been mandatory in the Old Laender since 1981. Individual metering in the New Laender is estimated to have led to 15% of energy savings in heating. In addition, various information campaigns on energy efficiency are run by the federal and Land governments and the DENA.

The federal government and the Laender have initiated third-party financing projects to improve energy efficiency in the public sector. The federal government has published a guide on third-party financing for improving energy efficiency in its own buildings, and building administrators have been instructed to use this guide when implementing new projects. The Land of Berlin has established the Energy Conservation Partnership Berlin, a project where energy management contracts have been placed with three private partners for a total of 120 public buildings. Several other Laender are looking into creating similar projects.

Responsibility for monitoring the efficiency of these different measures is assumed by various institutions to various degrees. Each institution – whether it is the BMWi, the BMU or the Land governments – monitors the effectiveness of its programmes and there is no single institution that is responsible for making a national assessment.

CRITIQUE

As the National Climate Protection Programme shows, Germany considers energy efficiency improvement to be crucial in climate change mitigation. The programme estimates that efficiency improvements in industry and in the buildings/residential sector could account for more than half of the CO_2 emissions reductions needed to

meet the national target for 2005. As Germany plans to phase out nuclear power, it needs to generate electricity otherwise or to reduce electricity demand. The government considers energy conservation to be one of the key measures to compensate for nuclear power. But the Energy Report assumes that under a business-as-usual scenario, electricity consumption will increase by 14% by 2020 as compared to 1999 levels. Saving enough energy through better energy efficiency to compensate for even a part of the electricity previously generated by nuclear power will be extremely challenging.

Germany has managed to reduce both its energy demand and energy intensity in the past decade. These changes came quickly during the first part of the decade, largely because of the "fall-wall effect". In the second part of the decade, total energy demand has levelled off and final energy consumption has continued to decrease, albeit more slowly. As separate statistics for the New and Old Laender were no longer kept after 1995, it is difficult to estimate exactly what part of the reduction in energy demand and improvement in energy efficiency over the decade resulted from the "fall-wall effect". Another reason the government gives to explain why reliable estimates cannot be made is that the overall effectiveness of all the measures that have been taken to improve energy efficiency has not been monitored.

Because of the lack of data, it is also difficult to estimate what the level of energy efficiency is in each part of the country and where the most cost-effective potential for improvement lies. However, it is widely considered that a significant part of the national energy efficiency improvements have come from improvements in the New Laender. To achieve a tangible and satisfactory outcome nationally, it is essential that all parts of the country strengthen their efforts to improve energy efficiency. Such potential can be found economically, especially in the household sector and in the building sector. According to the IEA Energy Indicator Database, temperature-corrected specific heat consumption in residential buildings is higher in Germany than in Denmark or in colder countries such as Finland and Sweden.[12]

In this respect, the introduction of new measures, such as the new Energy Conservation Ordinance and the Climate Protection Programme for Existing Buildings, is commendable. However, the ordinance focuses mainly on new buildings and does not have ambitious objectives for existing ones, with the exception of the boiler modernisation requirements. Significant areas remain (*i.e.* existing buildings) where the potential for energy savings has not been fully explored. Measures to improve energy efficiency in the existing building sector by retrofitting, improving insulation or installing modern energy-efficient facilities and equipment could bring significant results. Although the Climate Protection Programme for Existing Buildings does provide financial support for modernisation projects, the number of applications the programme can accept is very limited compared to the size of the existing housing stock.

12. According to the IEA Energy Indicators Database, final residential space heating energy consumption was 770 MJ/m^2 in Germany in 1997, 718 MJ/m^2 in Finland in 1994, and 477 MJ/m^2 in Denmark and 525 MJ/m^2 in Sweden in 1999. The data are weather-corrected *i.e.* the annual variation of heat consumption due to weather has been taken into account.

Transport is the only sector where energy consumption has increased in the 1990s. Energy efficiency in the sector has nonetheless improved with the decrease in specific fuel consumption of cars, which is partly due to the voluntary agreements that car industries have made. The National Climate Protection Programme of 2000 introduced a number of new measures to reduce energy consumption in the transport sector. One of them was to prepare an energy efficiency strategy for this sector. The choice of measures needed to implement such a strategy should be based on their cost-effectiveness.

The German Energy Agency (DENA) is likely to improve co-operation between the federal and regional governments on issues related to energy efficiency. DENA is constantly seeking partners in industry to participate in its projects. This is commendable because it reduces the need for public funding, widens the knowledge base of the projects and facilitates the adoption of new technologies. The projects that DENA implements are primarily chosen for their effectiveness. Insufficient financing possibilities may sometimes hamper implementation on that basis.

RECOMMENDATIONS

The Government of Germany should:

- ☐ Ensure that energy intensity continues to decrease and energy efficiency to improve.
- ☐ Enhance measures to address energy efficiency in buildings, particularly in existing buildings.
- ☐ Develop a national energy efficiency strategy for the transport sector without delay and take into account the cost-effectiveness of measures.
- ☐ Ensure adequate funding for cost-effective DENA programmes, and support its co-operation with the private sector (industrial and financial sectors) and the Laender.

6

OIL

INDUSTRY STRUCTURE

The German oil industry became fully privately-owned after the privatisation of the refining and distribution sector in the New Laender was completed in 1992. The German oil market is characterised by many operators and effective competition, even though there has been a trend towards concentration over the past few years. Two large mergers have already taken place and two more are about to be completed.

Many large oil companies with refining capacity operate in the German market.[13] No refineries have been commissioned or closed since 1998. Two major oil companies, Exxon and Mobil, merged in 1999 to create ExxonMobil. Total, Petrofina and Elf Aquitaine followed in 2000 to create TotalFinaElf. Two other mergers, *i.e.* those between BP and Veba Oel (a subsidiary of E.ON) and between Deutsche Shell and DEA Mineraloel (a subsidiary of RWE) have been approved by the Federal Cartel Office but with restrictions on market shares in refining and retail capacities.

The number of filling stations in Germany is decreasing modestly. In 2001 there were 16,324 compared to 16,617 in 1999. In 2000, the largest distributor was Aral, a subsidiary of Veba Oel, with 2,336 stations, followed by DEA with 1,630 stations and Shell with 1,348 stations.

SUPPLY, DEMAND AND TRADE

Oil supply grew only slightly between 1990 and 2000, from 126.5 Mtoe to 131.6 Mtoe. The share of oil in total primary energy supply decreased between 1973 and 1990, from 47.9% to 35.6%, but increased in the 1990s, reaching 38.7% in 2000. The increase of the share of oil in TPES in the 1990s was primarily due to the sharp reduction of coal supply in the New Laender. The latest forecast on oil demand was made by PROGNOS in 1999. According to this forecast, oil demand will increase by 7.5% by 2005 and stabilise thereafter. The forecast does not take into account the impact of the eco-tax (although it does take account of another, higher tax) since the eco-tax was introduced after the forecast was made.

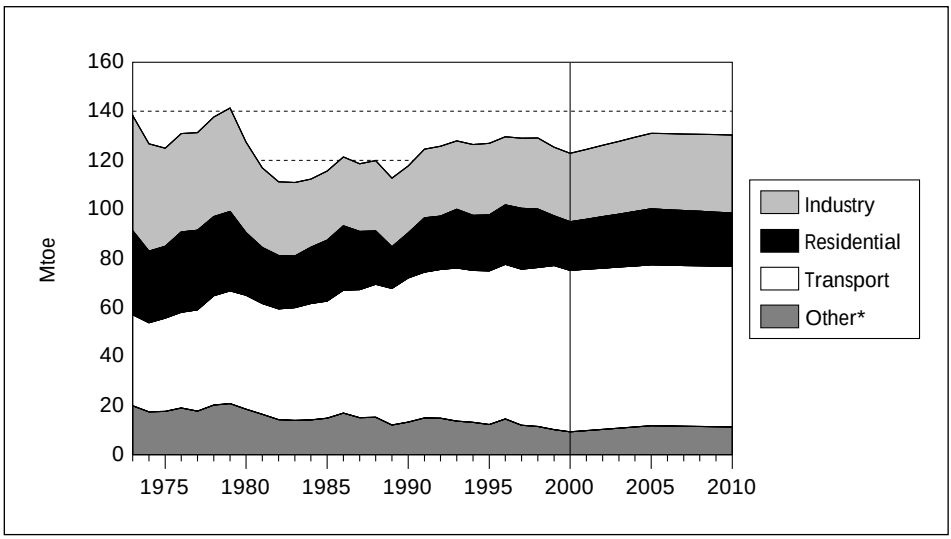
Similarly to the share of oil in TPES, the share of oil in total final energy consumption increased in the 1990s, from 47.7% in 1990 to 50.2% in 2000. Between 1990 and 2000, oil consumption increased by 2.3% in the industrial sector, but decreased by 8% in the residential, service and other sectors. Heating oil made up 23% of German

13. These include Agip Deutschland AG, Conoco Mineraloel GmbH, DEA Mineraloel AG, Deutsche BP AG, Deutsche Shell GmbH, ExxonMobil GmbH, Esso Deutschland GmbH, Holborn Europa Raffinerie GmbH, OMV Deutschland GmbH, TotalFinaElf Deutschland GmbH and Veba Oel AG.

oil product deliveries in 2000 compared to 28% in 1998. In the transport sector, oil consumption grew by 13.7% between 1990 and 1999, but decreased by 1.5% in 2000. The government explains the decrease mainly by the impact of the eco-tax; it recognises, however, that it is difficult to ascertain how much the change in demand was affected by the tax and how much by the general fluctuation of fuel prices.

The oil industry (represented by the association *Mineralölwirtschaftsverband*, MWV) provides its own forecasts. They are more recent and cover a different time span from the PROGNOS forecast. The latest forecast also takes into account the current level of the eco-tax, assumes decreasing specific energy consumption, a reduction in the average size of cars, a decline in driving distance per car and year, and substitution of gasoline use in cars by diesel. The oil industry forecasts that oil consumption will decline by 14% between 2000 and 2020. The forecast is quite different for diesel and gasoline. Diesel consumption is forecast to grow slightly until 2005, and then to decline by 4.7% by 2020 compared to 2000 levels. The consumption of gasoline is forecast to increase slightly up to 2005, but to fall thereafter to 17 Mt, *i.e.* 40% below the 2000 level by 2020. PROGNOS forecasts gasoline consumption to decline to 25 Mt by 2020.

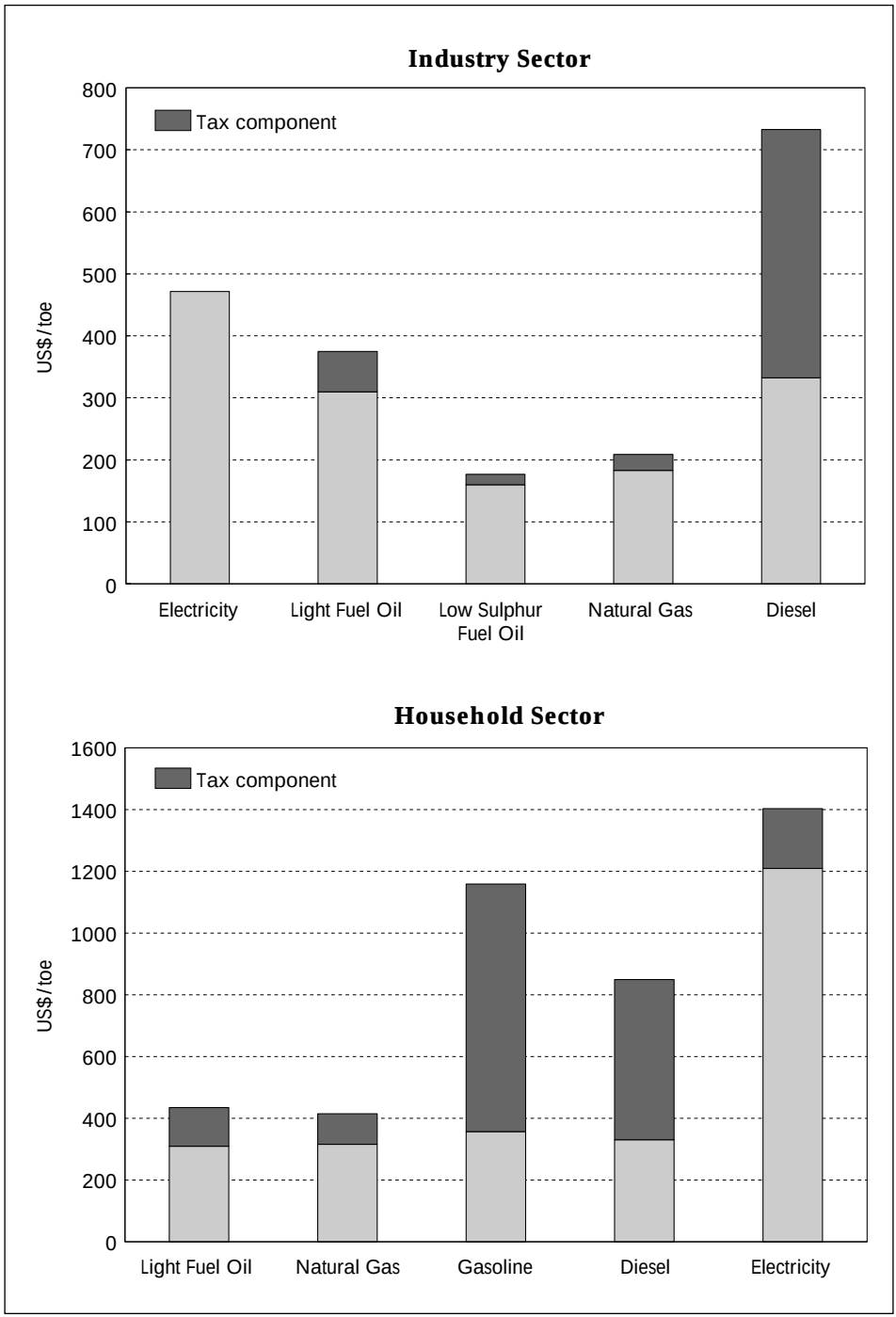
Figure 13
Final Consumption of Oil by Sector, 1973 to 2010



* includes commercial, public service and agricultural sectors.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

Almost all oil is imported. Indigenous oil production accounted for 3% of total oil supply in 2000. At the end of 2000, probable petroleum reserves in Germany were estimated to be 49.7 Mt. Crude oil production (4.4 Mt in 2000) is concentrated in the Laender of Lower Saxony (51%) and Schleswig-Holstein (44%).

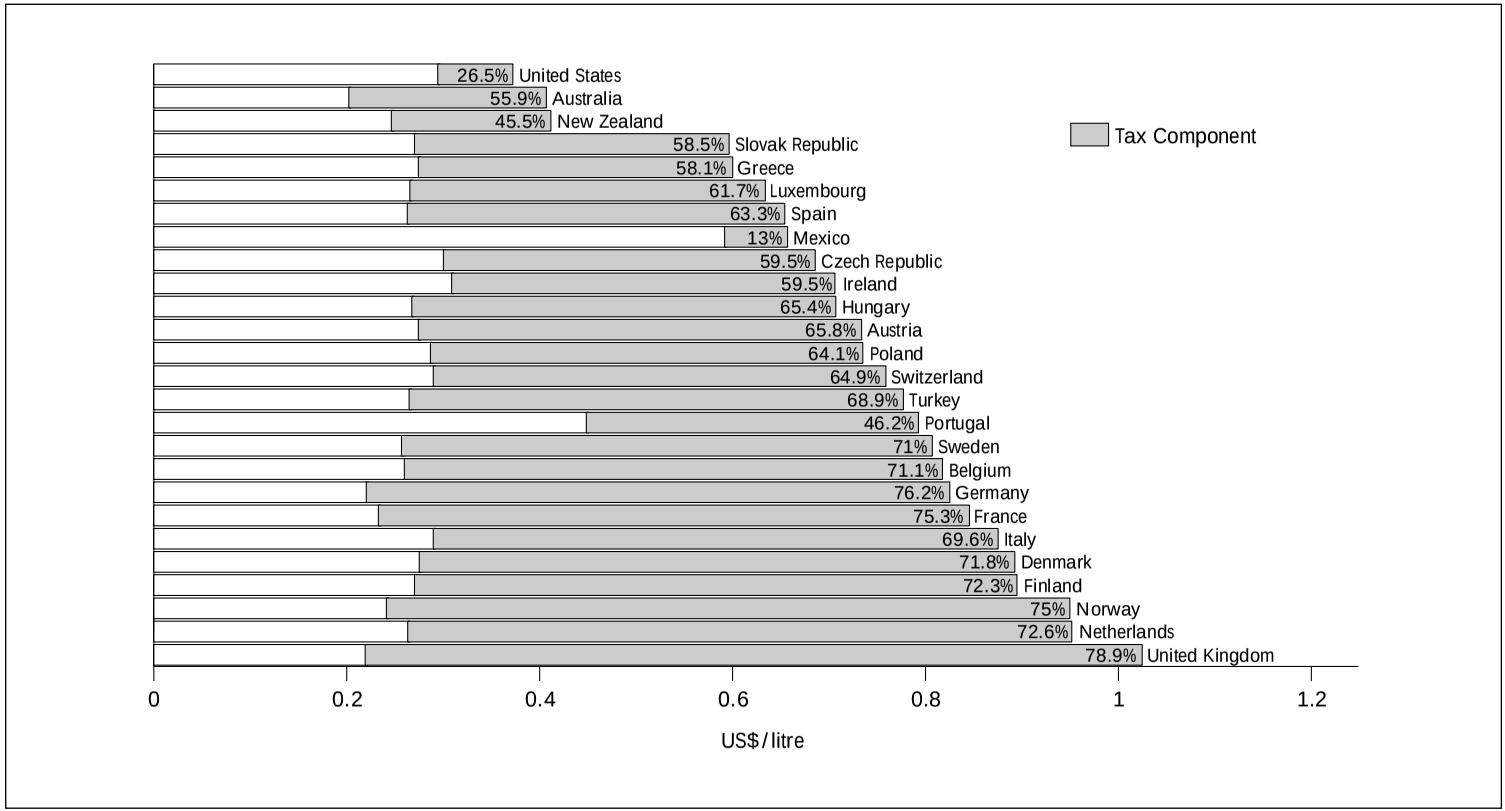
Figure 14
Fuel Prices, 2000



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2002.

Figure 15

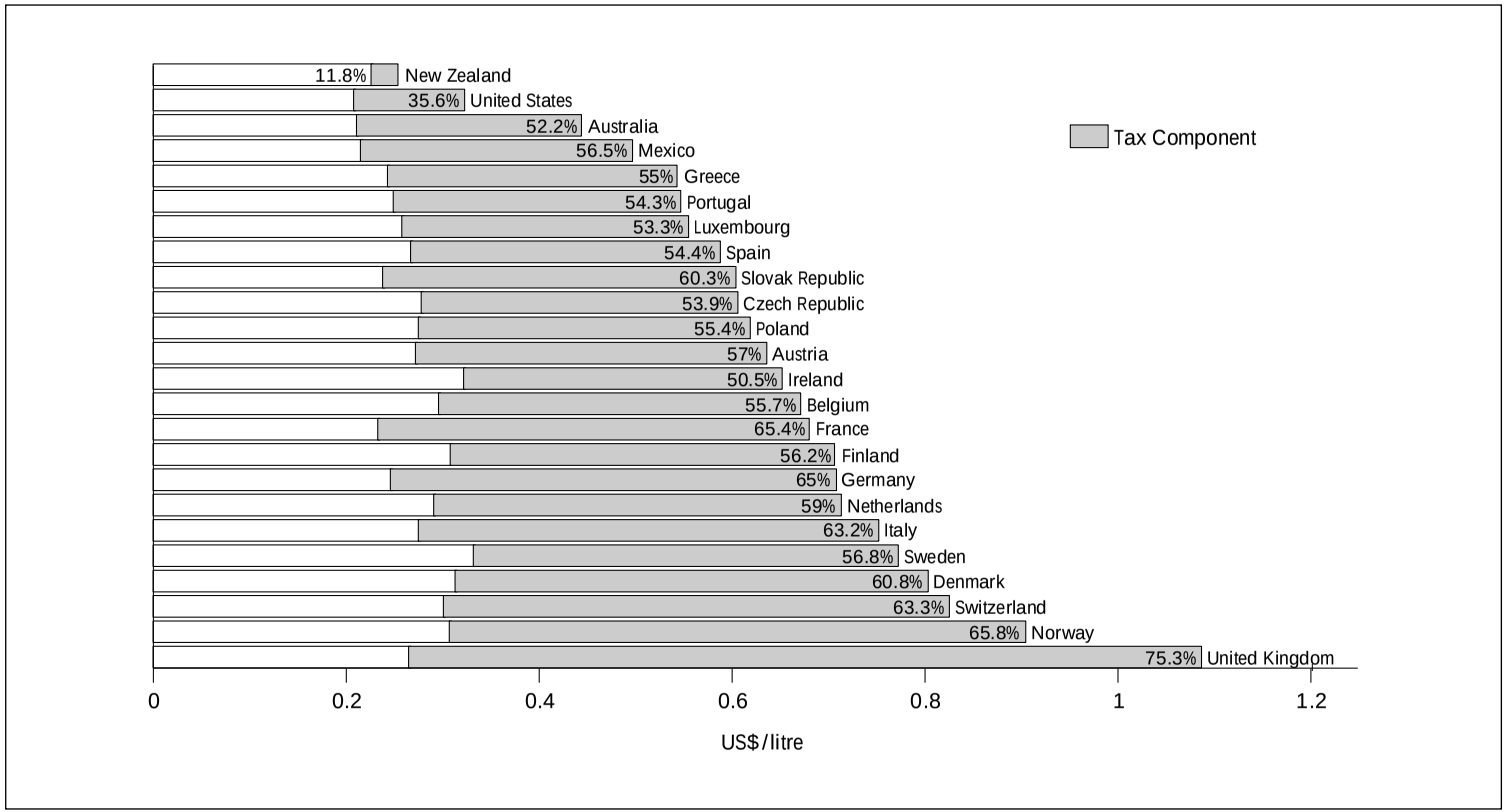
OECD Unleaded Gasoline Prices and Taxes, Fourth Quarter 2001



Note: Data not available for Canada, Japan and Korea.
Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2002.

Figure 16

OECD Automotive Diesel Prices and Taxes, Fourth Quarter 2001



Note: Data not available for Canada, Hungary, Japan, Korea and Turkey.
Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2002.

These Laender levy production charges on oil. Schleswig-Holstein imposes a 10% charge for the Mittelplate/Dieksand field. Lower Saxony introduced a 14% levy in 2001 on oil fields that produced at least 30,000 tonnes in 1999.

In 2000, crude oil imports were 103.7 Mt and re-exports 3.2 Mt. The main sources were Russia (33%), Norway (18%), the Middle East (13%), the United Kingdom (13%) and Libya (11%). Between 1998 and 2000, the share of crude oil imports from Russia into Germany increased by 7 percentage points, while the import share was stable for the Middle East and Africa, and declined by 2 percentage points for Norway and by 5 percentage points for the United Kingdom. Imports of oil products amounted to 42.1 Mt in 2001, and exports were 18.6 Mt. Over one-third of these imports were diesel (16.1 Mt), followed by gasoline (8.7 Mt) and naphtha (7.7 Mt). Diesel (5.5 Mt), gasoline (4.6 Mt) and fuel oil (4.4 Mt) dominate the exports. Germany both imports and exports some of these products for several reasons. One is commercial considerations of large oil companies operating worldwide. Other reasons include the market entrance of independent traders and seasonal variations in product demand (*e.g.* summer imports and winter exports of gasoline). Most oil product imports come from the Netherlands (59%), followed by Belgium (13%). Almost all oil product exports from Germany go to OECD countries.

PRICES

Gasoline and diesel prices in Germany are higher than the OECD average (see Figures 15 and 16), reflecting the higher taxes levied on oil products. Prices before taxes are among the lowest. At the end of 2001, taxes on unleaded gasoline were 76.2% and on diesel 65%, the second and third highest found within the OECD, respectively. Gasoline prices are higher in Germany than in neighbouring Austria, Czech Republic, Luxembourg and Switzerland, but almost the same as in Belgium and France, and lower than in the Netherlands. Diesel prices are higher in Germany than in neighbouring Austria, Czech Republic and Luxembourg, but almost the same as in Belgium, France and the Netherlands, and lower than in Switzerland. The pre-tax prices in Figures 14 to 16 include the concession fees, and the taxes include both the excise taxes and the eco-tax (see Chapter 3).

ENVIRONMENTAL ISSUES

The European (EU Directive 98/70/EC) and German standards for sulphur contents are 350 parts per million (ppm) for diesel and 150 ppm for gasoline. Stricter standards will be introduced at the beginning of 2005, when the limit for both diesel and gasoline will be set at 50 ppm. The level of the eco-tax on transport fuels depends on their sulphur contents (see Table 6). Since 1 November 2001, gasoline and diesel with sulphur contents lower than 50 ppm benefit from a €0.0153 per litre discount from the eco-tax, and at the beginning of 2003 the limit will be lowered to 10 ppm. The tax discount is intended as an incentive for refineries to

adapt their processes to meet with the tighter standards. By the beginning of 2002, all German refineries had adapted their processes to make oil products that meet the 2005 EU requirements. The government believes that the refineries had also made this effort in order to meet the domestic standards for 2003 and qualify for lower taxes. The government estimates that because of the tax incentive, practically all the gasoline and diesel sold in Germany already meets with the EU requirements for 2005, and that the sulphur contents of transport fuels will be reduced to under 10 ppm by 2003.

Table 6
EU Fuel Standards for Sulphur and the Estimated Impact of the Eco-tax on the Sulphur Contents of Fuels in Germany (ppm)

	Before 1 Nov 2001	*1 Nov 2001*	*1 Jan 2003*	*1 Jan 2005*
Diesel, EU standard	350	350	350	50
Diesel, German standard	350	50[1]	10[1]	10[1]
Gasoline, EU standard	150	150	150	50
Gasoline, German standard	150	50[1]	10[1]	10[1]

1. A discount of €0.0153 per litre from the eco-tax is given to fuels meeting the limit for sulphur contents.

Source: BMWi.

EMERGENCY RESPONSE MEASURES

Because Germany depends heavily on oil imports, ensuring oil supply security has always been a high priority and oil stockholding has been compulsory since as early as 1966. Germany has created efficient organisational units to ensure emergency response capability, both on a technical level concerning stocks and on a crisis management level. Germany's National Emergency Sharing Organisation is responsible for emergency management in crisis situations. Its board comprises representatives from the government, the stockholding agency (*Erdölbevorratungsverband*, EBV) and the oil industry.

In 1978, the Oil Stockholding Law (*Erdölbevorratungsgesetz*) established the stockholding agency EBV responsible for holding emergency oil stocks and assuring their availability in times of energy crisis (see box). Several subsequent amendments to the law made stockholding obligations for refiners generally lower and those of the EBV higher. After reunification in 1990, there was an 18-month transition period of considerable stock purchases. Then, in 1998, the law on stockholding was again amended, now fully abandoning stockholding obligations for producers and raising EBV's stockholding obligation from 80 to 90 days. Since then, EBV alone has been responsible for holding oil stocks equivalent to the IEA commitment of 90 days of net imports.

In the period 1974-2001 the federal government held so-called federal crude oil reserves. Some 7.3 Mt of crude oil were stored in salt caverns in north-west Germany (Wilhelmshaven) and financed by the federal government. In 1997, the government decided to sell these reserves, which was done in the period between August 1997 and September 2001. Even though these reserves represented approximately 16% of Germany's total stocks, the stocks that are held today by EBV and oil companies well exceed 90 days of net imports.

Erdölbevorratungsverband (EBV)

EBV holds oil stocks equivalent to Germany's international emergency reserves commitments. The agency guarantees the financing, building, maintenance and credibility of German emergency reserves. It is a public corporation to which all oil refining or importing companies active in the German market must belong. EBV is financed by membership fees based on product type and quantity. The membership fees are not collected directly by EBV but transferred to end-user product prices; for example, the cost impact for gasoline is approximately €0.005 per litre. EBV owns almost all of its stocks, which gives it stockholding credibility. In 2001, EBV owned 90% of the stocks it held, with the remainder being delegated by oil companies under leasing contracts.

Germany fully complies with its IEA commitments. Relatively large oil stocks – more than 110 days of net imports in 2001 – are paralleled with a stringent set of legal measures for demand restraint. In November 2001, EBV held 25.6 Mt of oil stocks, evenly distributed between crude oil and the three major oil product categories, namely gasoline, middle distillates and heavy fuel oils. In compliance with the law, much of the stocks is distributed over 5 logistic geographical regions in Germany, each storing at least 15 days of demand; a major part is also being held in salt caverns in northern Germany. Emergency transport arrangements between regions have been made, and processing agreements have been signed with every refinery in Germany.

CRITIQUE

Competition developed well in the German oil sector in the 1990s. However, during recent years, a consolidation trend got under way with many of the large players in the oil market merging or planning to merge. It is commendable that the Federal Cartel Office has set strict preconditions for granting approval of these mergers so as to ensure adequate competition. The government is encouraged to continue watching the market carefully and continue its efforts to ensure effective competition.

It is encouraging to see that German refineries are fully prepared to comply with the fuel standards that have been introduced by the respective EU directive for 2005. Actually, many of the refineries are already preparing to meet the much higher national standard set for 2003. This can be seen as an advantage for the German refining industry in its bid to compete successfully with international competitors in the long run. The oil products of some international competitors already meet standards that are stricter than those introduced by the EU for 2005, and discussions are already under way to make EU standards stricter still. However, if prices for oil products rise too much in Germany, refilling cars in neighbouring countries is likely to increase. The government thus needs to monitor this situation closely and determine whether additional measures become necessary.

The Review Team has no special recommendation to make to the Government of Germany.

7

COAL

SUPPLY AND DEMAND

Domestic Production

Hard coal and lignite are the most important domestic energy sources in Germany. In 2000, the share of domestic coal in TPES was 17% compared to 34% in 1990.

Germany is the largest hard coal producer in IEA Europe. In 2000, the production of hard coal was 37.4 Mt (34.5 Mtce). About half of the hard coal produced is coking and half is steam coal. As shown in Figure 17, hard coal is produced only in North Rhine-Westphalia and Saarland. Lignite is produced in Rhineland (North Rhine-Westphalia), Helmstedt (Lower Saxony), central Germany (Saxony-Anhalt and western Saxony) and Lausitz (Brandenburg and eastern Saxony). Also, small quantities are extracted in Hesse and Bavaria.

Germany is the largest lignite producer in the world. In 2000, the production of lignite was 167.7 Mt (50 Mtce). In the mines in the Old Laender, lignite extraction has been declining slightly since 1992, but the restructuring process in the New Laender led to a decline of 76% in lignite production there between 1989 and 2000. Now that the modernisation programme for power generation has been completed, lignite extraction in the New Laender has stabilised, with a 10.2% increase in production during 2000.

Imports

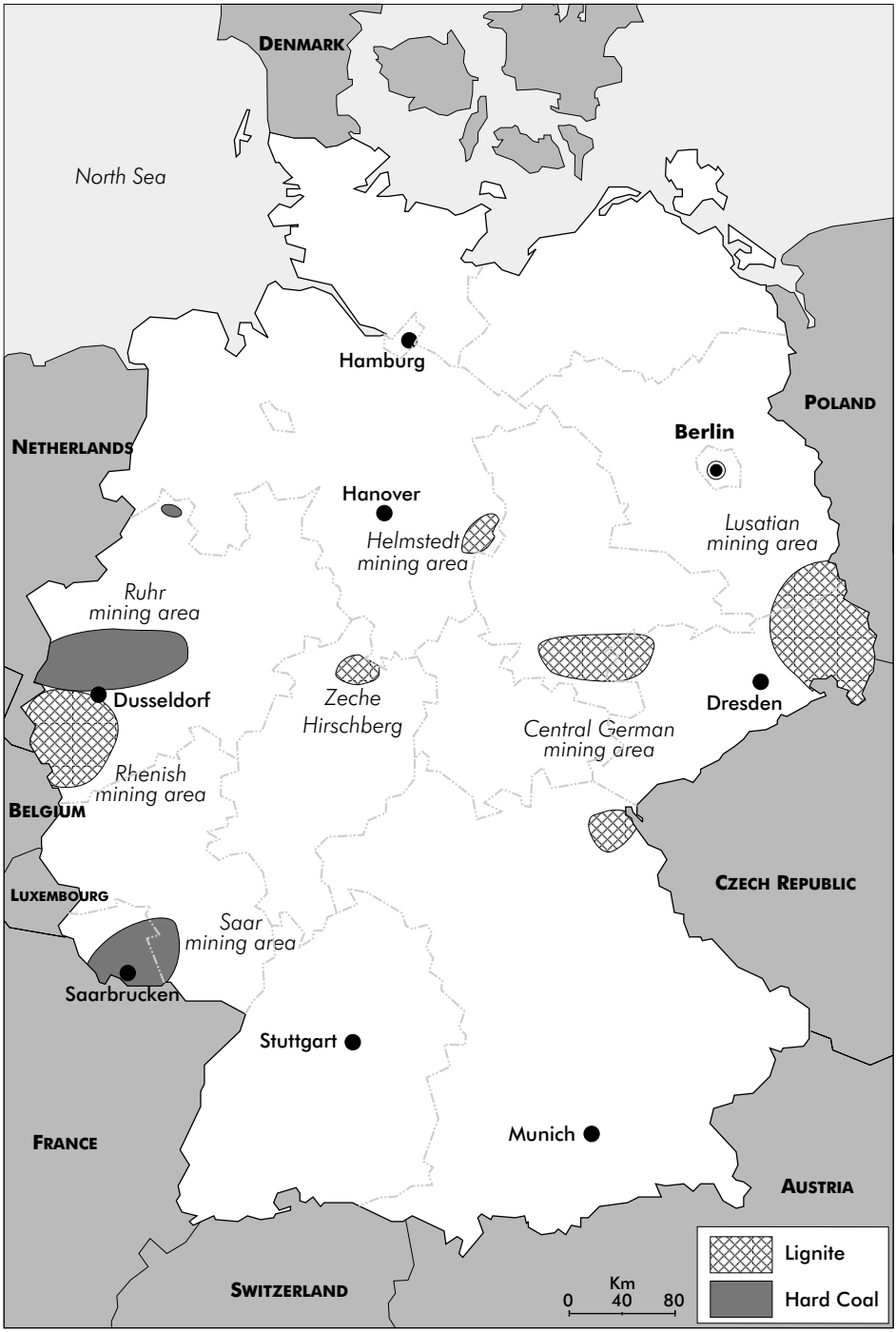
Coal is both imported and produced domestically (see Table 7). Even though coal imports have been growing constantly, they still cover only a quarter of supplies. Germany imports hard coal and coal products, and does not export significant amounts of any coal type.

Table 7
Total Coal Supply
(Mtce)

	1980	*1995*	*1999*	*2000*
Production	204.5	111.9	88.8	84.5
Imports	20.6	17.5	25.0	27.3
Exports	–22.5	–2.8	–0.6	–0.7
Stock changes	–1.1	3.5	0.2	2.2
Primary supply	**201.5**	**130.0**	**113.4**	**113.5**

Source: *Coal Information 2000*, OECD/IEA Paris, 2001.

Figure 17
German Coal Mines



Source: BMWi.

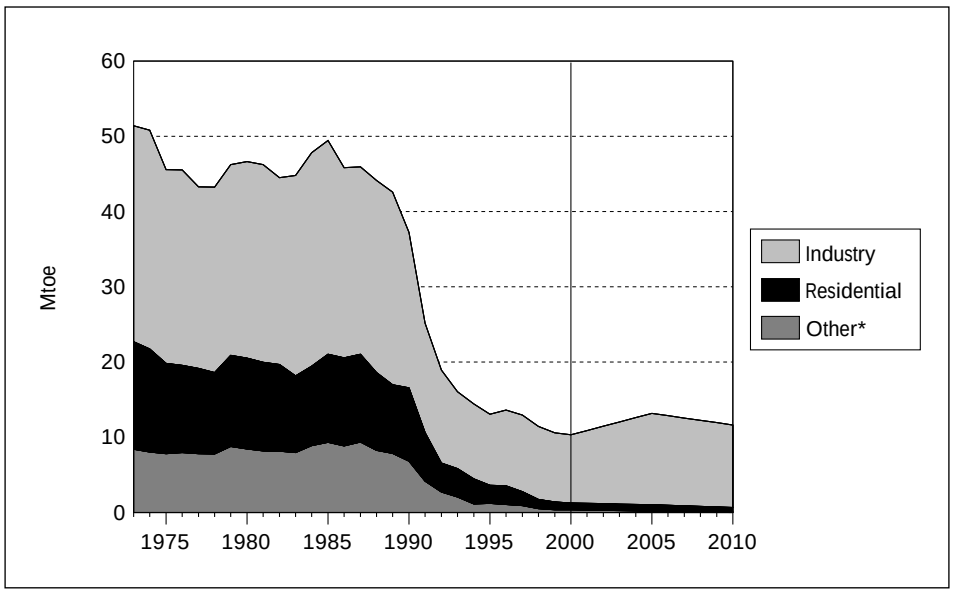
In 2000, the main exporters of coking coal to Germany were Australia (74%) and Canada (19%). For steam coal they were Poland (37%), South Africa (25%), Colombia (15%) and the Czech Republic (6%). All duties or quotas set for coal imports were lifted in January 1996.

Demand

Total coal demand decreased by 37% between 1990 and 2000 to 80.6 Mtoe. Great variation can be seen in the demand for different types of coal. Whereas the consumption of brown coal decreased by 55% between 1990 and 1999, and the consumption of coking coal decreased by 37%, the consumption of steam coal decreased by only 11%. Lignite is primarily used for power generation. About 75% of the domestic hard coal extracted in 2000 was used for power generation and most of the remainder was used by the steel industry. The final consumption of coal has decreased from 37.3 Mtoe in 1990 to 10.3 Mtoe in 2000 (see Figure 18).

Coal demand is expected to decrease by 12.7% between 2001 and 2010. The report "Sustainable Energy Policy to Meet the Needs of the Future" (see Chapter 3) forecasts that the share of hard coal in German TPES will change from 14% in 1997 to 11.7% in 2010 and 12.4% in 2020. The same study forecasts the proportion of lignite in TPES to decrease from 10.9% in 1997 to 9.5% in 2010 and 10.4% in 2020. In the forecast, nuclear power is expected to be replaced partly by coal.

Figure 18
Final Consumption of Coal by Sector, 1973 to 2010



* includes commercial, public service and agricultural sectors.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

Hard Coal

In 1990 hard coal was extracted in 27 mines, but by mid-2001 only 11 mines were in operation. Three mines were closed down in 2000, namely Ewald/Hugo and Westfalen in the Ruhr and Gottelborn/Reden in the Saar. In 2001, the Auguste Victoria and Blumenthal/Haard mines in the Ruhr mining area were combined to form the Auguste Victoria/Blumenthal mine.

The only hard coal mining company that currently operates in Germany is RAG AG. In 1998, RAG took over the other two German hard coal producers, Saarbergwerke AG from the federal government and the Saarland government, and Preussag Anthrazit GmbH from Preussag Aktiengesellschaft. RAG[14] operates internationally, and all its hard coal activities in Germany are concentrated in a subsidiary called Deutsche Steinkohle AG (DSK). The European Commission approved the merger of the three companies in 1998, and again in May 2002 after a British coal company had challenged the decision.

By 2000, the number of employees in German hard coal mining had declined from 130,300 in 1990 to 58,100. The average annual reduction in the workforce has been 7,000. This reduction was achieved through a halt in recruitment, early retirement and retraining. Increasingly, RAG employees are being transferred to activities other than mining.

Lignite

In Germany more companies operate in lignite mining than in hard coal mining. In the Old Laender, RWE Rheinbraun AG (a subsidiary of RWE) operates in the Rhenish mining area, and Braunschweigische Kohlen-Bergwerke AG (BKB, mainly owned by E.ON Kraftwerke AG) operates in the Helmstedt mining area. The coal that these companies produce is mainly used in their own power stations.

The restructuring of lignite mining has been completed in the New Laender. In the central German mining area, extraction of lignite takes place in two opencast mines by Mitteldeutsche Braunkohlengesellschaft mbH (MIBRAG, owned 50% by NRG Energy Inc. and 50% by Washington Group International) and in one opencast mine by ROMONTA GmbH (management buy-out). In the Lusatian mining area,

14. The shareholders of RAG AG are: E.ON AG, 37.1%; BGE Beteiligungsgesellschaft für Energieunternehmen (itself a subsidiary of RWE AG), 30.2%; Thyssen Stahl AG, 12.7%; Montan-Verwaltungsgesellschaft mbH, 10% (itself owned by Krupp Hoesch Stahl AG, 79% and E.ON AG, 21%); and Verwaltungsgesellschaft RAG-Beteiligung mbH, 10.0 % (itself owned by ARBED S.A., 65% and RAG AG indirectly via subsidiaries, 35%).

Lausitzer Braunkohlen AG (LAUBAG)[15] operates five opencast mines, in one of which extraction is currently suspended. Around 80% of the lignite produced by MIBRAG and LAUBAG is supplied to Vereinigte Energiewerke AG (VEAG), the largest power company in the New Laender, and 15% is used by the two companies in power generation. The number of employees in lignite mining in Germany declined from about 131,000 in 1990 to 21,300 in 2000.

HARD COAL POLICY

German hard coal is deposited deep underground and it is expensive to extract. For this reason, and because of low coal prices on the world market, German hard coal is not competitive and is supported by subsidies. As Germany does not have other significant domestic energy sources, the government wants to sustain domestic coal mining for energy supply security. It wants to ensure access to domestic hard coal deposits in the case of disruptions in international coal supply or world market price increases. It considers it therefore necessary to keep the infrastructure and equipment for hard coal mining well maintained and available, and the know-how up to date. So far, the government has not determined how much domestic hard coal should be produced. DSK has set a 26 Mt production target for 2005, which corresponds to about 5% of TPES in 2000.

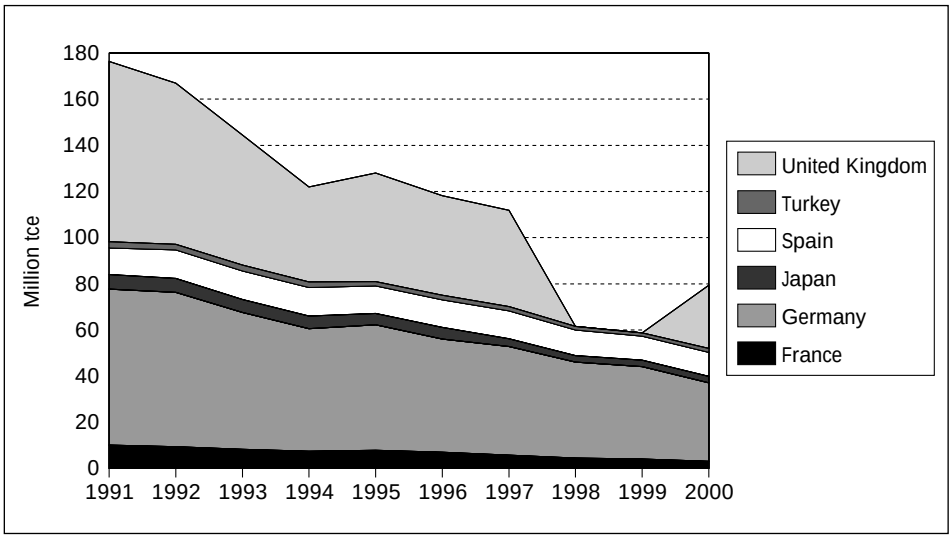
In 1999, domestic hard coal production costs averaged €137.47/tce whereas the price of imported steam coal was €34.36/tce and of imported coking coal €42.76/t. The difference between the average world market prices and domestic production costs is covered by subsidies. Germany has the largest subsidised hard coal production among IEA countries (see Figure 19), and the subsidies per unit of production are also high compared with other IEA countries. While these subsidies reached their peak in Germany in the mid-1990s, by 2000 they had decreased to approximately the same level as in the early 1990s (see Figure 20).

The federal government has implemented measures to limit coal subsidies and to make them more transparent. The first reform took place in 1994-1996, when the coal levy (*Kohlepfennig*)[16] was abolished, electricity companies became free to choose their coal suppliers and imports were fully liberalised. The second reform took place in 1997-1998. In March 1997, the federal government, the governments of mining Laender, the mining industry and IG Bergbau (the coal trade union), reached an agreement on future hard coal subsidies up to 2005. This agreement was implemented by a law which became effective on 1 January 1998. Since 1998, financial aid for coal production has

15. The merger of LAUBAG/VEAG, HEW and the Berlin power supplier BEWAG to form Vattenfall Europe AG took place at the beginning of 2002. LAUBAG's former main shareholders, RWE and E.ON, sold their shares to Hamburgische Electrizitäts-Werke AG (HEW) in December 2000.
16. Purchases of hard coal by electricity companies were in the past financed by a coal levy amounting to 8.5% of the price of electricity. This levy was paid by all electricity consumers in the Old Laender through payment of their electricity bills.

Figure 19

Assisted Hard Coal Production in IEA Countries,* 1991 to 2000

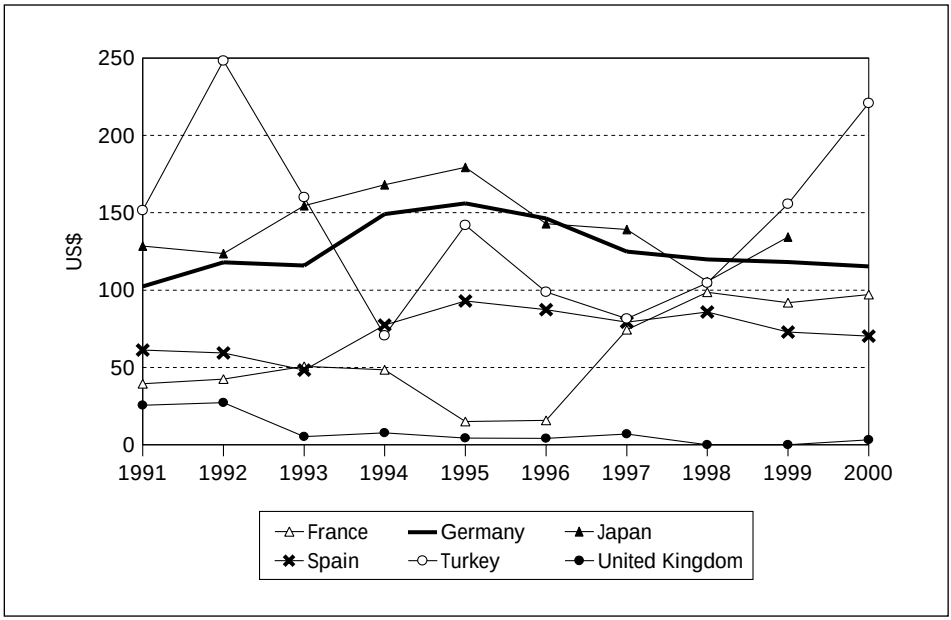


* assisted sub-bituminous production in Spain is included. Belgium (production halted in 1992) and Portugal (production halted in 1994) have not been included.

Source: *Coal Information 2001*, OECD/IEA Paris, 2001.

Figure 20

Aid per Tonne of Coal Equivalent, 1991 to 2000



Source: *Coal Information 2001*, OECD/IEA Paris, 2001.

been subject to a single ceiling, which covers steam and coking coal, as well as decommissioning assistance. Accordingly, the subsidies paid by the federal and Land governments are being reduced from €4.73 billion in 1998 to €2.81 billion in 2005 (see Table 8). Between 2001 and 2005, RAG AG itself will provide an additional €0.1 billion per year to support its coal mining activities in Germany (*i.e.* DSK). The production target established in the agreement for 2005 is 30 Mt per year (about 21 Mtoe). By then, the workforce is expected to have decreased to 36,000, which means an annual reduction of 4,400 workers from the 2000 level.

In December 2000 the EC authorised a total of €8.85 billion of government aid for coal production in Germany for 2000-2001. This authorisation entailed a decrease in aid for operation, and an increase in aid for reducing activity. In general, coal subsidies in EU countries were governed by the articles of the European Coal and Steel Community (ECSC) Treaty which expired on 23 July 2002. Government aid *per se* was prohibited under the treaty, but framework decisions enabled temporary financial assistance to the industry. The latest of these framework decisions was EC Decision

Table 8
Financial Aid for the German Coal Industry, 1997 to 2005
(billion euros)[1]

Assistance from	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
Federal government	4.12	3.96[5]	3.73[5]	3.58	3.22	2.91	2.56	2.25	1.94
Federal government for Saarland[2]	0	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Federal government[6]	0	0.15[6]	0.15[6]	0.15[6,7]	0.08[7]	0.08[7]	0.08[7]	0.08[7]	0.08[7]
Industry[3]	0	0	0	0	0.10	0.10	0.10	0.10	0.10
North Rhine-Westphalia	0.44	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
North Rhine-Westphalia (additional)	0	0	0	0	0.08[7]	0.08[7]	0.08[7]	0.08[7]	0.08[7]
Saarland[4]	0	0	0	0	0	0	0	0	0
Total	**4.56**	**4.73**	**4.50**	**4.35**	**4.09**	**3.78**	**3.43**	**3.12**	**2.81**

1. Converted from Deutsche Marks using the exchange rate €1 = DM 1.95583 which is the irrevocable conversion rate of 1 January 1999.
2. Commitment authorised on the precondition that Saarland transfers its 26% share in Saarbergwerke AG to Ruhrkohle AG.
3. On the basis of profits from non-coal activities of Ruhrkohle AG, guaranteed by the federal government and North Rhine-Westphalia.
4. Saarland's financial plan does not provide aid for sales and future closures.
5. Including surplus funds remaining from the ceiling set for coking coal aid, 1995-1997.
6. Commitment authorised on the precondition that Ruhrkohle AG acquires the federal government's 74% share in Saarbergwerke AG.
7. Interest bearing commitment authorisations, payable from 2006.

Source: Agreement between the German Federal Government, the mining industry and the Union of Mining and Energy Workers, after consultation with North Rhine-Westphalia and Saarland. Financial aid for coal-based power generation, coking coal and future closures between 1997 and 2005.

3632/93/ECSC, which entered into force in 1994 and expired together with the ECSC Treaty. On 7 June 2002, the EU Council Energy Ministers approved a Council Regulation on government aid to the coal industry. The intent of this regulation, which takes into account energy security considerations, is to ensure that some coal production capacity is maintained inside the EU after the expiration of the ECSC Treaty. The new regulation, which caps total aid at the 2001 level, will run until 2010. After that date, coal production in Germany will be subject to the normal rules for government aid of the EC.

LIGNITE POLICY

Lignite mining is not subsidised. However, lignite production currently enjoys beneficial treatment in the New Laender. Until 2003, the Energy Industry Act makes it possible to refuse network access if this endangers lignite-fired power generation in the New Laender. Recently, the federal government and Swedish Vattenfall Group finalised an agreement under which Vattenfall will produce 50 TWh/year from lignite extracted in the New Laender until 2011. Consequently, the federal government intends to delete the lignite protection clause in the Energy Industry Act.

CRITIQUE

German hard coal is not competitive in the international market and enjoys subsidies. The hard coal reforms of 1994-1996 and of 1997 have been successful in making the subsidy systems more transparent and reducing the level of subsidies. As a result, between 1990 and 2000, hard coal production was reduced by 51% and the number of employees in the sector declined by 55%. Both coal production and the number of employees are decreasing rapidly enough to meet the 2005 target. Since the 1997 agreement, reductions in domestic hard coal production have been compensated by a decline in total energy demand, and by an increase in coal imports and natural gas use.

The government intends to continue hard coal subsidies after 2005, albeit with a declining rate. It does not yet have a plan for implementing these subsidies as it is waiting for the European Commission to develop a framework for such aid. The federal government continues to argue that domestic coal production must be maintained for energy security reasons. The German Hard Coal Association supports this argument, but goes one step further by requiring that a long-term, coal-based and associated financing package be defined with a time frame of up to at least 2015.

A number of hard coal-producing countries give subsidies to their indigenous producers. The IEA, however, considers that markets work more efficiently when energy prices are not distorted (as is stated in the *Shared Goals*, see Annex B), and that the current coal market offers reasonable supply security. Member countries' views differ on the extent to which subsidies can be justified. Where IEA Member

countries evoke social and regional reasons for justifying aid to domestic coal producers, the IEA believes that there are other, more efficient, methods for distributing scarce financial resources to regions that are affected by the decline of the indigenous hard coal industry.

The German government wishes to maintain a significant coal-based electricity generating capacity in order to avoid over-dependence – and associated supply and price risks – on imported energies. The government considers the supply and price risks to be small at the moment, but thinks that these could possibly become more significant in the longer term. The government nonetheless stresses that government aid to coal has been decreasing for a long time, and that the agreement on coal production of 1997 will cut subsidies in half by 2005.

The Review Team considers that the argument the German government uses for continuing its support of domestic coal production – *i.e.* ensuring energy supply security – does not have a strong basis. Coal resources are abundant and geographically widespread across the world, with important, economically accessible reserves held by a number of IEA countries. International trade in hard coal is well established and highly competitive, with a large number of market players involved in moving sizeable quantities of hard coal, principally by sea. The risk of persistent interruption of supplies can therefore be regarded as minimal. As there is no compelling energy security reason for maintaining coal subsidies in Germany, and since they distort the international energy market, the government should continue to reduce such subsidies, and eventually abolish them.

The EU Commission has submitted proposals for a new aid scheme to maintain access to European coal deposits, the main objective being to increase security of supply. The use of subsidies to promote security of supply should be approached with caution. The choice between different means to enhance the level of security should be based on an assessment of their cost-effectiveness. Maintaining indigenous supplies of coal would be only one way of enhancing energy security in Germany. Without limiting the available options, other means would be to develop diverse sources of primary energy through trade, maintaining a diverse fuel mix and actively encouraging the development of European markets in electricity and gas. Each of these possibilities would be genuinely economic, and would achieve broader economic goals as well as energy policy goals.

The lignite industry has also undergone major restructuring, much of which has been completed in the New Laender. The industry has been supported by modernisation programmes for lignite-fired power plants to guarantee a certain demand for lignite. It is commendable that the protection that the Energy Industry Act provides for lignite-fired power generation will be abolished in the course of the coming revision of the act. This means that consumers in the New Laender also will soon have the possibility to choose their electricity supplier freely.

Germany has invested significantly to reduce sulphur emissions from coal-fired power plants, and it is active in developing clean coal technologies. These issues are discussed in more detail in Chapters 4 and 11, respectively.

RECOMMENDATION

The Government of Germany should:

- ☐ Continue to reduce coal subsidies with the aim of eliminating them, and set a clear deadline for this abolition. Compensate the loss of the subsidies and resulting decline of the coal industry with restructuring programmes to address social impacts.

8

NATURAL GAS

INDUSTRY STRUCTURE

The gas industry features a multi-tiered, decentralised structure with a number of privately and municipally owned gas utilities. There are more than 750 companies operating in the gas market in Germany. Depending on their market function and proximity to final consumers, gas companies can be classified into the following groups:

- Natural gas producers (16 companies).
- Supra-regional companies, also called long-distance gas suppliers or transmission companies (14 companies, of which 6 also import gas and some are involved in local distribution).
- Regional distribution companies (15 companies) and local distribution companies *i.e. Stadtwerke* (more than 700 companies, ranging from large utilities like GEW Koeln to many very small utilities).
- Gas dealers (11 companies), which have emerged in the market following market liberalisation.

By 2002, the number of supra-regional companies had declined from 18 in 1998 to 14. There are six big supra-regional companies, namely Ruhrgas, RWE/Thyssengas, Wingas, BEB, EWE and VNG (see box). None of these six, except for RWE in the area supplied formerly by VEW/WFG,[17] supplies gas directly to households. These companies transport imported gas through large-diameter gas pipelines over long distances mostly to regional gas suppliers, but also to local gas utilities and individual large consumers. Some of these pipelines run in parallel, and compete with each other. The numerous regional and local gas distribution companies operate distribution grids that do not extend beyond their respective regions, and supply smaller industrial consumers and residential consumers.

The 11 dealers who are now active in the natural gas market in Germany and who are not linked to gas network operators are: Aquila (USA), BP Gas (UK), Distrigas (Belgium), Duke Energy (USA), ENI (Italy), Essent (Netherlands), Gaz de France (France), Natgas (Germany), OMV (Austria), RAG (Austria) and Trianel (Germany). Enron was active in the German gas markets until it went bankrupt. In addition, all incumbent gas companies have developed their own trading branches.

Ownership structures vary by gas company type. Natural gas producers, supra-regional companies and dealers are under private ownership. The regional and local

17. RWE and VEW, which were primarily power companies, merged in July 2000. The regional gas distribution company WFG had earlier been merged with the gas operations of VEW.

distribution companies are mainly owned by Land governments and municipalities, or jointly owned by the private and public sectors. Several international companies own shares in the supra-regional companies (see box) and in regional or local suppliers (*e.g.* Gaz de France in Gasag in Berlin, and Vattenfall in HGW in Hamburg). Most of the local distribution companies, which are in large part owned by municipalities, are also involved in other network or public activities, such as electricity generation and distribution, heat and water supply, and public transport. It is generally recognised that the number of distribution companies will decrease in the near future as many local authorities sell shares of their distribution activities and municipalities co-operate or even merge with each other to form larger more economic units.

Supra-regional Gas Companies in Germany

- Ruhrgas AG is the largest supra-regional gas company in Germany. Ruhrgas supplied about 50.6 bcm (*i.e.* about 60% of the German gas market) in 2000 and owns the largest share of the high-pressure transmission system, about 10,750 km. Its 12 underground storage facilities have a working gas volume of just under 5 bcm. Ruhrgas is owned by Bergemann GmbH (59.76%), BEB Erdgas und Erdöl GmbH (25%), Schubert KG (15%), and others (0.24%).
- BEB Erdgas und Erdöl produces about half of the domestic gas in Germany and its supplies amount to about 16.4 bcm per year. BEB operates 3,439 km of high-pressure pipelines. Its owners are Esso, Shell and Mobil AG.
- Verbundnetz Gas AG (VNG) operates in the New Laender. Its supplies are about 15.8 bcm per year. VNG operates more than 7,300 km of high-pressure pipelines. At the end of 2000, its main shareholders were Ruhrgas (36.84%), Wintershall Erdgas Beteiligungs GmbH (15.79%), 14 cities and utilities (15.79%) and BEB Erdgas und Erdöl (10.53%).
- Wingas GmbH entered the German gas market by constructing its own gas transmission system. It now controls 1,836 km of high-pressure pipelines that can import gas from both East and West. Its supplies amount to about 11.8 bcm per year. Wingas accounts for nearly a quarter of the total gas storage capacity in Germany; its Rehden storage facility in Lower Saxony, with a working gas capacity of 4.2 bcm, is the biggest underground natural gas storage facility in Western Europe. Wingas was founded in 1993 as a joint venture of Wintershall AG (65%) and OAO Gazprom (35%).
- RWE AG is one of the two largest electricity companies in Germany and is becoming one of the largest German gas companies through its 75% ownership in Thyssengas GmbH. The remaining 25% are owned by Shell. Thyssengas operates 2,500 km of high-pressure pipelines and its supplies were about 6.7 bcm in 2000.
- EWE AG operates in the electricity, gas, water and telecommunications sectors. Its gas supplies are about 4 bcm per year. EWE's high-pressure network consists of 3,870 km of pipelines. EWE is owned by administrative districts and towns in the Weser-Ems region (59.4%), those in the Weser-Elbe region (13.2%) and by E.ON (27.4%).

Note: The gross supply data for each company are rough estimates.
Sources: Country submission 2001 and company Internet pages.

There are cross-shareholdings among the gas companies. Supra-regional companies also have shares in regional and local distribution companies. Ruhrgas, for instance, has minority interests in 8 regional and 15 local distribution companies. E.ON's subsidiary Thuegas has a significant number of minority interests in local distribution companies. Also, RWE owns a network of regional (VEW/WFG in particular) and local distribution companies, including parts of Rhenag and former VEW. New cross-shareholdings above 25% now fall under the merger control regime; this also applies to the acquisition of smaller shares that provide a significant competitive edge. In the past, larger cross-shareholdings had been permitted, partly due to a different legislative framework. For instance, Ruhrgas has a 37% stake in VNG and a 50% stake in Saar Ferngas. There is also a trend towards consolidation and mergers between gas and electricity companies (see section on "Market Reform and Competition" in this chapter).

DEMAND AND SUPPLY

Demand

Germany is the second largest European gas market after the United Kingdom. In 2000, total gas demand reached 71.8 Mtoe (91.4 bcm), representing 21.1% of TPES. Natural gas use for electricity generation and heat production accounted for 20% of total gas demand. The final consumption of gas was 57.3 Mtoe, of which 59% was used in the residential and services sectors and 41% in the industry sector (see Figure 21).

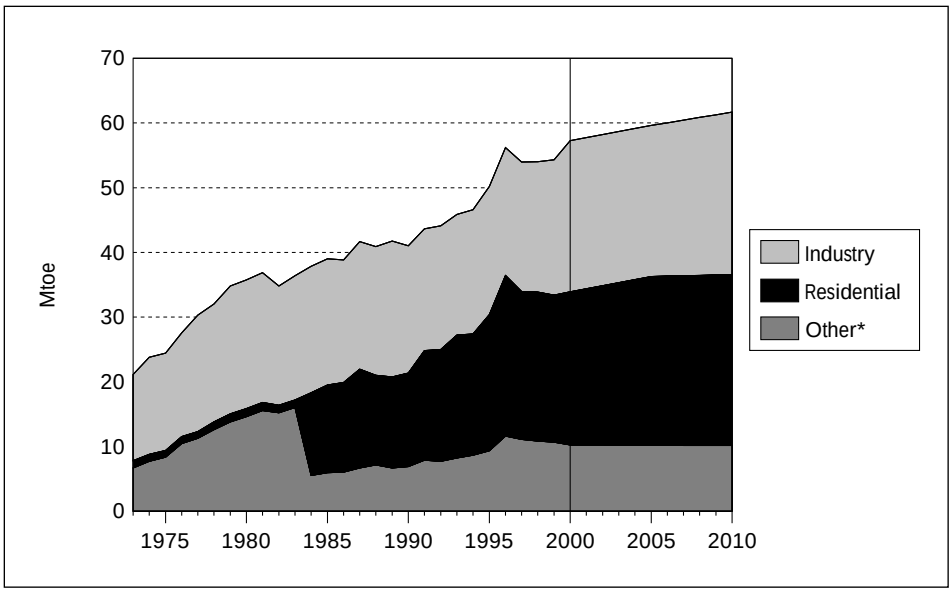
The former German Democratic Republic promoted district heating. As a result, co-generation and district heating are widespread in the New Laender. They accounted for 30% of overall gas use in Germany for electricity generation and heat production in 2000. In the New Laender, municipalities and industry have built new gas-fired co-generation plants for district heating, and natural gas is progressively replacing lignite in the district heating systems. A large part of electricity is still being generated by traditional condensing power plants with lower efficiency and not yet in combined cycle gas turbines (CCGT).[18] The surge of natural gas prices over the last few years has made it difficult for gas-fired electricity generation to compete with nuclear and coal power plants for baseload.

According to the latest forecast, gas demand in Germany will rise to 84.2 Mtoe by 2010. The share of gas in electricity generation and heat production is estimated to rise to 14.5%. The report *Sustainable Energy Policy to Meet the Needs of the Future* introduced two future scenarios (see Chapter 3). Under Scenario I, nuclear power will be replaced by gas- and coal-fired power plants, whereas under Scenario II,

18. The number of CCGTs is slowly increasing; two CCGTs (450 MW_e and 185 MW_e) were commissioned in 2000 and one (400 MW_e) in 2001, and another one is at the feasibility study stage. No other CCGT plants are under construction at the moment.

it will be replaced by gas-fired power plants and renewables. Both scenarios forecast a significant rise of natural gas in TPES; the share of gas in TPES would rise from 21% in 1999 to 28% by 2020 under Scenario I, and to 41% under Scenario II. The share of gas in power generation would increase from 10% in 1999 to 20% by 2020 under Scenario I, and to 54% under Scenario II.

Figure 21
Final Consumption of Natural Gas by Sector, 1973 to 2010



* includes commercial, public service and agricultural sectors. Prior to 1984 most of the Residential Sector was included in "Other" Sectors.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

Supply

Germany is a sizeable gas producer. In 2000, indigenous production amounted to 22 bcm and covered 22% of domestic gas demand. There are 16 exploration and production companies. Two of them are responsible for three-quarters of German production, namely BEB Erdgas und Erdöl (50%) and Mobil (25%). Germany has already been fully explored for gas deposits. Proven gas reserves are estimated at 264 bcm and probable reserves at 113 bcm; considering the current production volume, the proven reserves would be enough to cover 12 years of supply. Gas reserves have remained stable over the past few years as gas resources have been used more effectively.

Imports of natural gas amounted to 75.8 bcm in 2000. Germany has diverse supply sources. Russia provided 45% of imports in 2000, the Netherlands 22%, Norway 27%, and all others 5%. The Netherlands and domestic gas producers provide peak load gas, while Russia, Norway, Denmark and the United Kingdom deliver baseload

gas. The supplies from Norway are expected to increase to 30% of total gas imports by 2010. Most of the imports are based on long-term take-or-pay contracts. The contract with the Netherlands will be in force until the mid-2010s, and the contracts with Norway and Russia until the mid-2020s. In the future, spot sales will supplement long-term gas supply arrangements.

Most domestic gas, as well as the gas imported from the Netherlands, is low-calorific gas, with a calorific value of 10 kWh/Nm^3 and high nitrogen content of about 18%. High-calorific gas with a calorific value of more than 11 kWh/Nm^3 is imported from Russia, Norway, Denmark, the United Kingdom and, to a lesser extent, also from the Netherlands. Gas with low calorific value and gas with high calorific value are transported in separate networks.

Trade

Germany is an important transit country for gas. Over the last few years, transit gas amounted to some 30 bcm/year and went to Austria, Belgium, France, Italy, the Netherlands and Switzerland. Gas exports were 5.4 bcm in 2000.

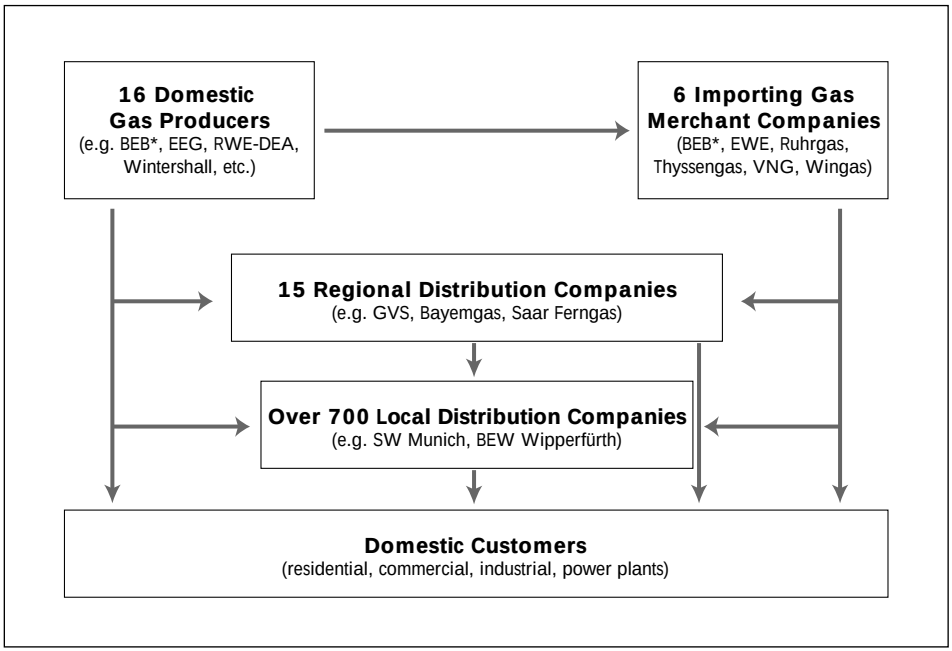
After the establishment of a gas-trading hub in Zeebrugge (Belgium), preparations are under way to establish another European gas-trading hub in Bunde (Germany). Bunde is close to the delivery points for Norwegian gas in Emden and Dornum, to the main supply point for Dutch gas in Oude Stadenzijl, to German domestic production areas and storage facilities (Etzel, Nuettermoor, Krummhoern and Rehden), and to the north/south and east/west pipelines. It is thus particularly well placed to become a major trading location. At present, gas transits through Bunde at 7 mcm/hour.

There is some congestion in the interconnections between Germany and neighbouring countries. The European Association of Gas Transmission Operators (GTE) classifies the 60 European cross-border nodal points into three categories according to their available transmission capacity. The most congested links to Germany are those from the Netherlands (3 out of 4), but congestion can be found at all the cross-border nodal points. Out of the three links used for exports from Germany, the one to Switzerland is considerably congested, whereas those to France and Luxembourg are satisfactory.

GAS INFRASTRUCTURE

The total length of the pipeline network is about 365,000 km. Approximately 27% are high-pressure pipelines (100 bar to 1 bar); roughly 38% are medium-pressure pipelines (1 bar to 100 mbar); and 35% are low-pressure pipelines (up to 100 mbar). The major pipelines for domestic transport, transit and import of gas are indicated in Table 9 and Figure 24. Currently, both Ruhrgas and Wingas are planning to build new pipelines mainly in the southern part of the country. Some €2.6 billion was invested in the networks in 1999. Of this total, €2 billion was used to build new infrastructure. In 2000, the number of gas storage facilities was 42, with a working capacity equal to 18.6 bcm. This capacity will be expanded to 23 bcm over the next few years.

Figure 22
German Gas Market Structure



* BEB is a gas producer and importer.
Sources: Ruhrgas and BMWi.

Table 9
Major Pipelines

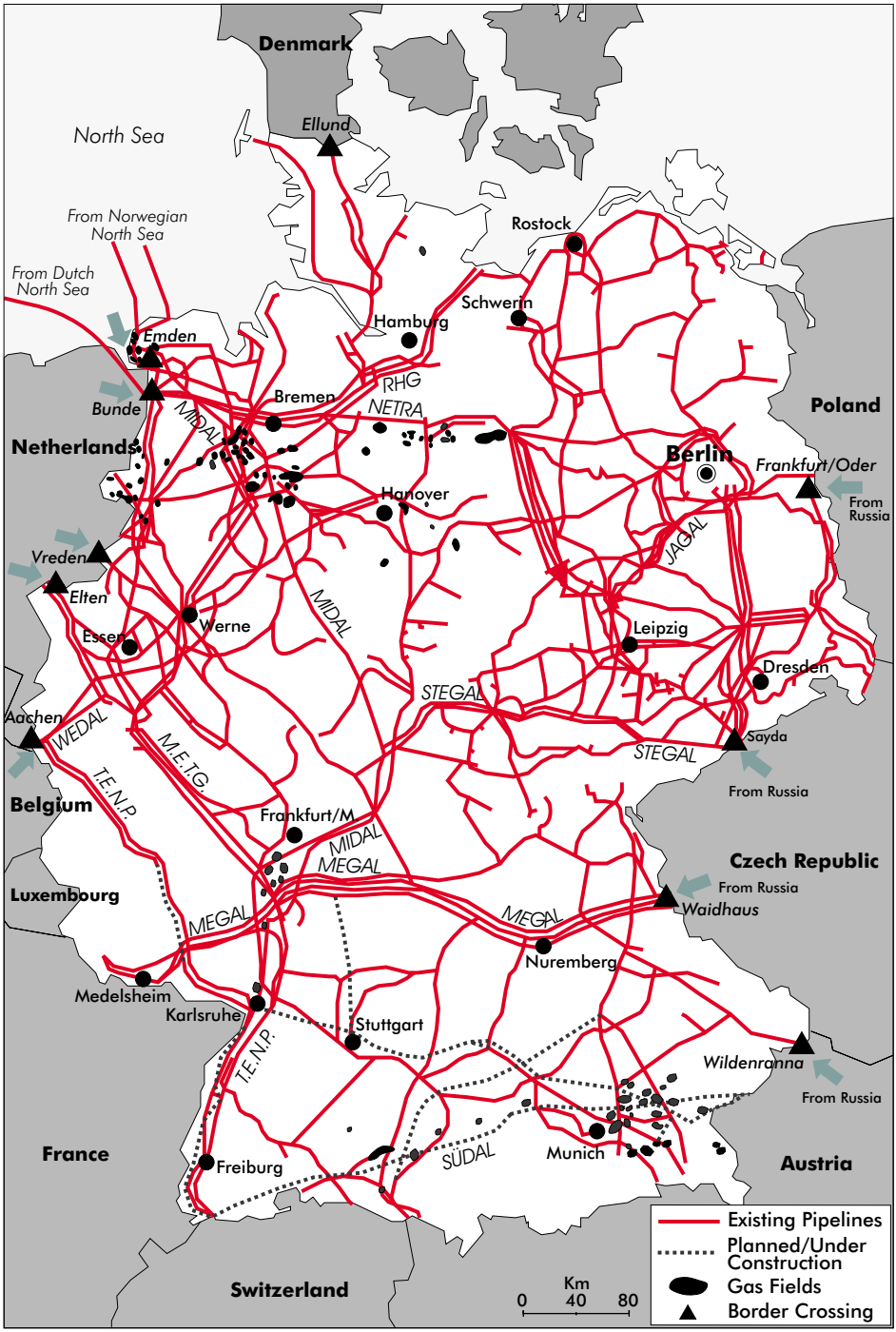
Pipeline	*Commissioned*	*Capacity*	*Ownership*
Megal (Czech Republic – France)	1980	22 bcm	Ruhrgas 50%, GDF 43%, ONV 5%, Stichting Megal 2%
Tenp (the Netherlands – Switzerland)	1974	14.4 bcm	Ruhrgas 51%, Snam International 49%
Netra (Etzel – Bernau)	1994	19.8 bcm	Ruhrgas 41.7%, BEB 29.6%, Statoil 21.5%, Norsk Hydro 7.2%
Midal (Emden – Ludwigshafen)	1993	13 bcm	Wingas 100%
Stegal (Saxony-Thuringia)	1992	10 bcm	Wingas 100%
Wedal (Belgium-Midal)	1998	10 bcm	Wingas 100%
Jagal I/II (Malnow-Stegal)	1996/1999	24 bcm	Wingas 100%

Source: BMWi.

Figure 23
Import and Export* of Gas, 2000
(million standard cubic metres)

* Does not include gas transit.
Source: *Natural Gas Information 2001*, IEA/OECD, Paris 2001.

Figure 24
Natural Gas Infrastructure



Source: *Natural Gas Information 2001*, IEA/OECD Paris, 2001.

Legislation and Regulatory Framework

In 1998, the gas market was fully liberalised with the adoption of the Energy Industry Act of 29 April 1998 (*Gesetz zur Neuregelung des Energiewirtschaftsrechts*). The act abolished demarcation agreements and exclusive concession contracts by municipalities, which formed the basis for regional monopoly markets. At the same time, the right to construct new energy supply networks without licences was introduced.[19] In 1999, the Competition Act (*Gesetz gegen Wettbewerbsbeschränkungen*) (article 19.4.4) was amended to include a special agreement that grants a legal right for third parties to access energy supply networks in Germany. With this amendment, the Federal Cartel Office and local cartel authorities became responsible for examining cases regarding access refusal to judge if a grid company was abusing of its power.

The two acts have already, in principle, implemented large parts of the EU Gas Directive of 1998. In December 2000 the BMWi proposed an amendment to the Energy Industry Act that would fully transpose the directive to German legislation. The amendment would explicitly establish non-discriminatory third-party access (TPA), require of grid companies to publish basic business and technical requirements for network access, and make separate accounting mandatory. The amendment stipulates that utilities must unbundle accounts for transmission, distribution and storage, but does not oblige utilities to publish these accounts. In reality, many gas utilities, particularly the supra-regional companies, have voluntarily chosen organisational unbundling. It is expected that the amendment will be adopted in 2002.

Germany has relied heavily on self-regulation of the gas market. It has, for instance, opted for negotiated TPA. Network access tariffs are privately negotiated between companies on a commercial basis within the framework of the Associations Agreement (*Verbändevereinbarung*), signed in July 2000 by two industrial user associations and two gas industry associations.[20] The agreement sets the framework for freely negotiated contracts for access to the transmission and distribution grid. It is a voluntary accord that contains recommendations by the associations to their respective members, but it does not legally bind them. As a general principle, the agreement states that TPA is to be granted on the basis of objective, transparent and non-discriminatory criteria in conformity with the EU Gas Directive. It also addresses a large range of other issues. For example, the first amendment to the Associations Agreement, published in March 2001, defines conditions for access to commercial storage facilities, management of bottlenecks, interruptible transport contracts and expansion of balancing regime. The second

19. Official submission of plans for approval and of an environmental impact assessment is necessary only for large-scale network construction projects.
20. The associations that signed the agreement were Bundesverband der deutschen Industrie e.V. (BDI), Verband der Industriellen Energie- und Kraftwirtschaft e.V. (VIK), Bundesverband der deutschen Gas- und Wasserwirtschaft e.V. (BGW) and Verband kommunaler Unternehmen e.V. (VKU).

amendment was published in September 2001. It clarifies some technical grid access conditions, defines reconciliation procedures, and allows small consumers to have access to the market through consumer profiling, which makes it possible for them to enter the market without having to invest in costly metering.

The associations had started to negotiate a new Associations Agreement to make the rules for network access and remuneration less complicated and more transparent. After the negotiations failed in April 2002, the Minister of Economics and Technology announced that preparations for establishing a regulator would begin. Following the signing of the new agreement – the Associations Agreement for Natural Gas II or AA II (*Verbändevereinbarung Erdgas II*) – on 3 May 2002, the plans to establish a regulator have not progressed. The major change that AA II will bring is to reduce the layers in the pricing schedule from three to two: a distance-related tariff for national and regional transmission and a "postage stamp tariff" for local distribution. The new agreement was to enter into force on 1 October 2002. The parties to the agreement have also recognised that further improvements in the access system are necessary and they have announced that they will continue their negotiations.

Along with Austria, Germany is the only country in the EU that has not established a sectoral regulator. The reason the government gives for this is that Germany has a significantly different market compared to other European countries. This difference arises essentially from the following: the country's federal structure; the complexity of its gas market with more than 700 companies operating in it; three levels of operation (supra-regional, regional and local); mostly private ownership of industry; and a light-handed approach to market regulation. The Federation of German Industries (BDI) and most supra-regional companies are in favour of self-regulation by industry, and wish to continue with such a system.

As Germany does not have a regulator for the gas market, the behaviour of market players is controlled by the *ex post* application of competition legislation by the Federal Cartel Office (FCO) for cases involving more than one Land. The Land competition agencies are responsible exclusively for cases within the boundaries of their respective Land. Appeals are brought to court.

Transmission tariffs are set separately for supra-regional and regional transmission and local distribution. Individual network operators determine the tariffs for each contract, and they also publish indicative tariffs in their commercial conditions. AA II is expected to make this information more transparent, and provide a uniform framework for supra-regional and regional transmission tariffs.

Competition

Pipeline-to-pipeline competition began at the supra-regional level with Wingas's new pipeline system in 1993. Wingas has a market share of about 13% and is the main supplier to 40 distribution companies and over 15 industrial customers.

Third-party access has attracted new players at the wholesale level. There are now 11 (both domestic and foreign) new trading companies active in the German gas market. In 2001, Trianel won supply contracts with Stadtwerke Viernheim and Stadtwerke Neubrandenburg. Natgas delivered gas to seven industrial customers in 2001. Ruhrgas reports that, between autumn 2000 and January 2002, it received 400 access requests from customers and traders for different transmission volumes and lengths, which finally led to 50 contracts.

The government estimates that only 2 to 5% of consumers have switched their suppliers. The European Commission estimates that proportion to be under 5%. The government assumes, however, that more consumers have been able to negotiate better conditions with their old suppliers.

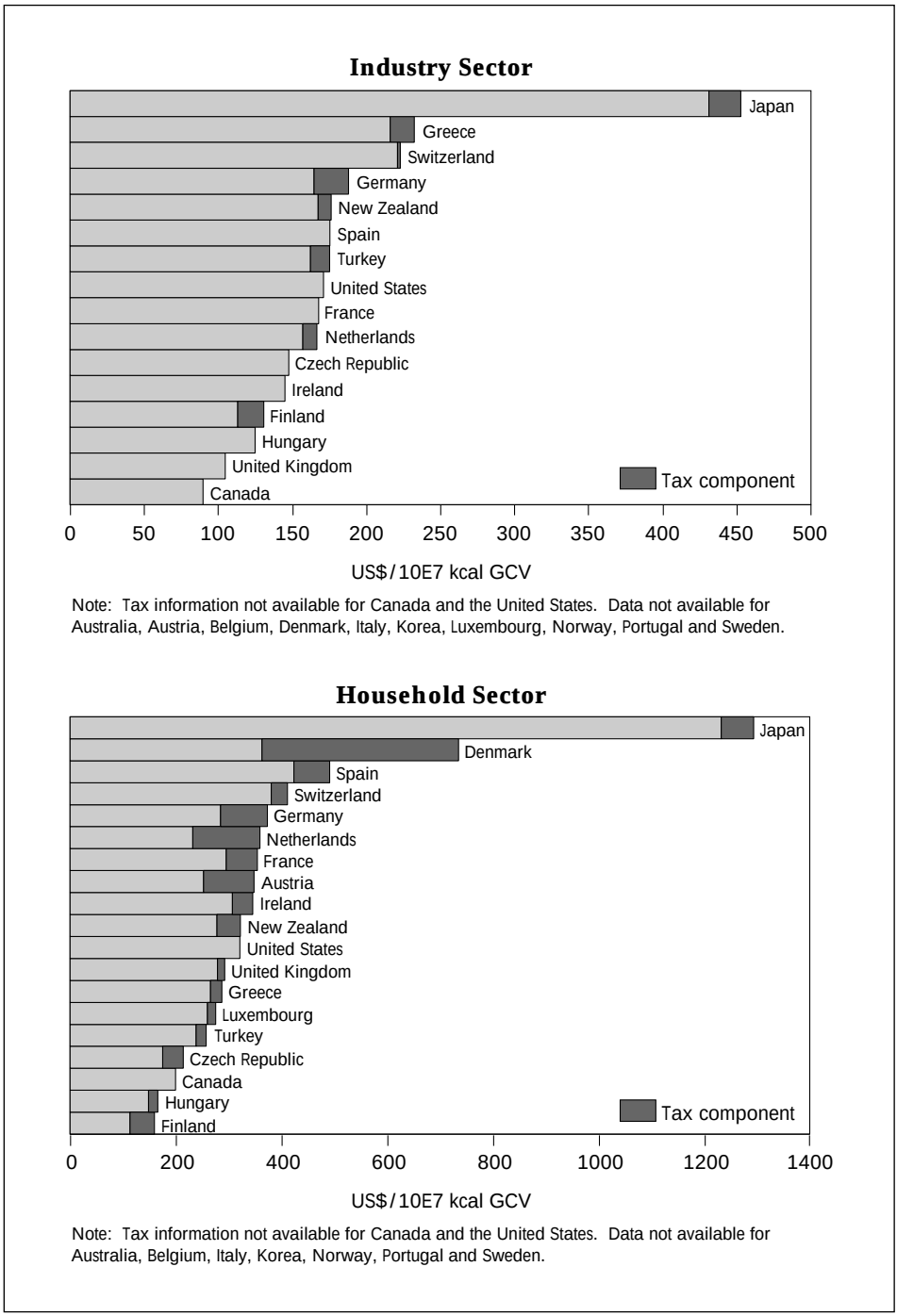
So far, the FCO has received no complaints regarding access to the gas network. It has focused on mergers and uses this work to foster competition. For instance, following the announcement of RWE to merge with VEW, the Federal Cartel Office obliged RWE to give up 20% of its gas sales to accept the merger. Another case was E.ON's plan to increase its minority stake in Ruhrgas to a majority holding. This was rejected by the FCO. E.ON nevertheless requested authorisation from the Minister of Economics and Technology who, under German law, permitted the merger on the grounds of public interest.

PRICING

Gas prices are set in the market without government restrictions. As part of their responsibilities, the FCO and regional cartel authorities perform regular checks on gas prices to ensure that there is no abuse. This means that they can take action against companies whom they suspect are abusing of their strong market position, or upon complaints on an *ex post* basis. The purchasing price the gas utilities pay to the producers and importers, and the prices the utilities charge for large-scale customers, are set on the basis of a sliding price scale linked to trends in fuel oil prices. By contrast, prices for households and small customers are not based on a predetermined and automatically adjusted scale; rather, utilities are free to change prices periodically so as to reflect fuel oil price trends. Fixed pricing, as well as pricing linked to the prices of other fuels, such as coal-based prices, have also been used in the wake of gas market liberalisation.

Gas prices in Germany are among the highest in IEA countries (see Figure 25), which is also the case for oil products. Gas is subject to excise taxes, the eco-tax, royalties, concession fees and VAT. The higher rate of these taxes for gas and the high level of royalties and concession fees largely explain the high gas prices. (Taxes and other fees on gas and other fuels are discussed in more detail in Chapter 3.) Over the last decade, gas prices for both household and industrial consumers have fluctuated (see Figure 26).

Figure 25
Gas Prices in IEA Countries, 2000



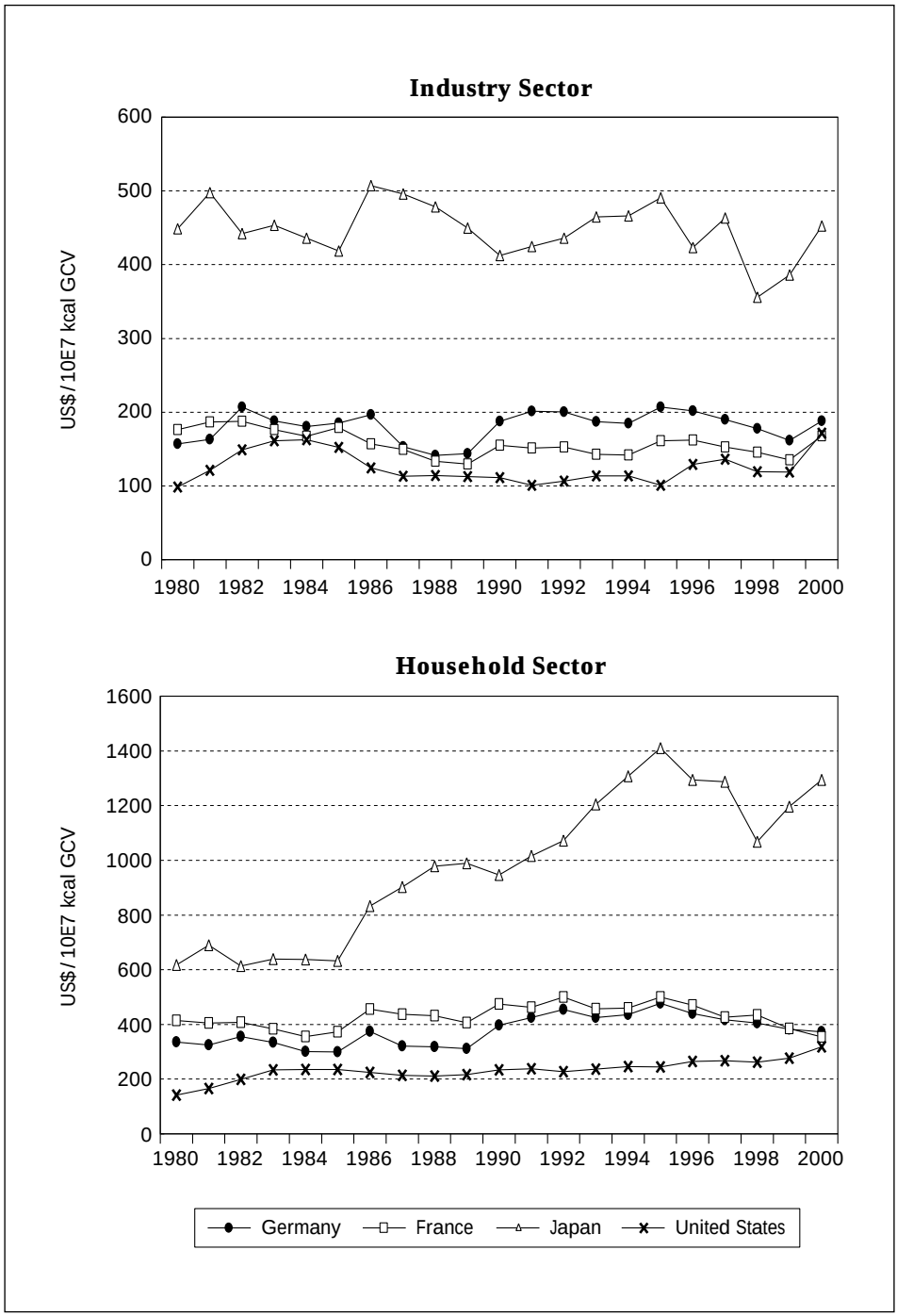
Note: Tax information not available for Canada and the United States. Data not available for Australia, Austria, Belgium, Denmark, Italy, Korea, Luxembourg, Norway, Portugal and Sweden.

Note: Tax information not available for Canada and the United States. Data not available for Australia, Belgium, Italy, Korea, Norway, Portugal and Sweden.

Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2001.

Figure 26

Gas Prices in Germany and in Other Selected IEA Countries, 1980 to 2000



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2001.

CRITIQUE

Germany has a fairly diverse supply base for gas, with significant domestic production; still, Russia alone accounts for 45% of gas imports. Compared to many other European countries, the increase of gas demand in the 1990s has been moderate in Germany. The government has decided to continue to pursue a policy of diversification of energy sources – including of imports, especially gas – because it feels that excessive dependency on a single, or few, energy sources can increase price risks and security of supply risks. However, the government has not formulated a clear policy on what the role of gas will be in the future if nuclear power is to be phased out. Germany is also an important gas transit country, and this role is likely to be strengthened in the future as European gas markets develop. In this respect, Germany should make an effort to reduce congestion in some of its gas links with neighbouring countries.

By 1998, Germany had fully opened up its gas retail market (in the legal sense). However, the EU Gas Directive has not yet been entirely transposed to German legislation, which has led to proceedings by the European Commission. The proposed new amendment to the Energy Industry Act will fulfil all the requirements of the directive, and hopefully clarify network access conditions and help settle disputes. Approval of the amendment has been delayed, and so development of competition in the market has also been delayed.

While competition is gradually growing at the wholesale level, it does not yet exist in the small consumer market segment. Only a few consumers, less than 5%, have changed their suppliers since market liberalisation, but some large industrial consumers have been able to negotiate better contracts with their current supplier. This can be seen in how gas prices in different market segments have evolved. During 2001, according to Gas Briefing International, prices decreased most for large industries (–12.5%), but also for smaller consumers (residential –1.8% and small industries –4.7%). These are national averages and the situation varies greatly by location. For example, according to Eurostat, between July 2000 and July 2001 gas prices for the largest industrial consumers (annual consumption of at least 1,163 GWh) increased by 12% in Düsseldorf compared to the 17 to 40% increase for small industrial and residential consumers, depending on the consumer group. In Munich the development is the reverse; prices for industrial consumers increased more than for residential consumers. Nevertheless, on the whole, it seems that larger consumers have been able to negotiate larger price rebates.

The government recognises that competition has not yet developed to a satisfactory degree, but argues that market opening is still at an early stage. One basic reason for this, it says, is a lack of liquidity in the gas market that has resulted from long-term take-or-pay contracts which link companies with their suppliers, both internal and external. According to a survey carried out by the consulting company DRI-WEFA for the European Commission, new entrants to the German gas market have experienced access difficulties. They consider the process to be too complex and access charges too high. They criticise not only the system of negotiated third-party access, but also the absence of a regulator.

Germany chose negotiated TPA over regulated TPA because of the structure of its gas market, and also because the government and industry prefer to set rules through negotiation rather than regulation. Given the complexity of the German gas market, with many companies operating in different parts of the market (supra-regional, regional and local levels), the government considered introducing regulated third-party access to be too complicated and the associated cost of regulation too high. While negotiated TPA is a market-oriented approach where access prices are determined through negotiation by the market players, the process is time-consuming and can be burdensome for small market players.

The details for network access have been defined in Associations Agreements. When the two amendments to the first agreement could not resolve access problems, it was agreed that the rules for third-party access should be clarified. A new agreement (AA II) was signed in May 2002. The new agreement was reached only after the Minister of Economics and Technology announced that preparations for the establishment of a regulator would start. The parties to the agreement believe that further changes are still necessary. While this process has been long and cumbersome, the results that have been obtained at this stage are encouraging.

Since the associations did finally manage to conclude their negotiations, it is possible that Germany may continue with its tradition of Associations Agreements and negotiated TPA, and not establish a regulator. If rules are set clearly, it may be possible to achieve competition in the gas market by maintaining negotiated TPA, but fundamental changes will nonetheless have to be made in the current approach. For example, the government could involve itself in the negotiation of the agreements. The agreements would then become legally binding statutes that could reduce the possibilities for abusive behaviour. A supervisory body could be established to monitor how the rules are being followed, or this task could be carried out by the FCO. A special body, composed of both industry and government representatives, could propose improvements to the rules in the agreements. In fact, the federal government has already established – within the BMWi – a body that would be suited for such a task, namely the Task Force for Network Access. A similar system is currently applied in Australia.[21]

The FCO has already established a special unit to deal with disputes in the electricity sector, and a similar unit is being planned for the gas market. In addition, the BMWi

21. The Australian government believes that it is in the interest of the industry to establish and maintain fair rules of the game and that a light-handed approach to regulation, including a certain degree of self-regulation, will be beneficial to competition. The initial grid access rules were established by the Gas Reform Implementation Group, which was composed of, *e.g.* representatives of the Commonwealth, industry and state and territory governments. The outcome of the work of the group was the Natural Gas Pipelines Access Inter-Governmental Agreement (IGA), which, after approval by the government, became a binding commitment to adopt legislation for open access. After the group completed its task, it was dissolved. The National Gas Pipeline Advisory Committee, a non-statutory multi-jurisdictionary body, with broad industry representation, was established under the IGA to administer the Australian grid access code and to propose changes when necessary. The committee meets on average four times a year. The Australian Competition and Consumer Commission (ACCC) is the national regulator for gas transmission pipelines, except in Western Australia which has established its own regulator whose primary task, however, is to enforce regulation.

has created the Task Force for Network Access to address practical issues that are posing a problem for market competition in the electricity and gas sectors. The electricity sector unit in the FCO and the Task Force in the BMWi appear to be working effectively in carrying out the tasks entrusted to them. If no regulator is established, the Task Force should take a more active role in gas sector issues. Given the experience gained from the electricity sector, these two bodies would be capable to help solve the problems associated with network access and to help settle disputes.

New entrants to the German gas market consider that the access tariffs are still too high; the government and the FCO admit that the methods used to calculate the tariffs still lack transparency, making discriminative behaviour possible. The new Associations Agreement is supposed to address this issue, but it is too early to determine whether it has effectively solved the problem.

Most of the contracts for gas imports and internal supplies are long-term take-or-pay contracts. Whereas these contracts may contribute towards increasing the security of supply, internal long-term supply contracts have also been used in some cases to refuse new entrants the use of transmission facilities. In a recent case, however, a German court overruled a decision that refused network access on the basis of such a contract. More liquidity – *i.e.* more possibilities and new mechanisms for consumers to have access to gas supplies – is needed in the gas market. An effective approach to increase liquidity would be to increase supplies from the spot markets. In this respect, the plan to open a new trading hub in Bunde is commendable as this will facilitate the development of the spot market.

As many as 750 companies currently operate in the German gas sector, but only six of them deal with imports and long-distance transmission. There has been a clear concentration trend in the gas market, both horizontally and vertically. It is encouraging that the FCO has been watching the gas market carefully to ensure that there is effective competition, and to intervene when necessary. This can be seen in its decisions to disapprove of the merger of E.ON and Ruhrgas, and in the limitations it has put on the market share that RWE and VEW can hold in gas operations after their merger. The gas market structure is complex, which forces new entrants to negotiate with many parties and makes entry difficult. Concentration at the supra-regional transmission level will persist in the near future and little competition is expected at this level because of the dominant position of a few large incumbents. However, competition could develop among local distribution companies, as it is much easier to enter at this level, for example through acquisitions.

RECOMMENDATIONS

The Government of Germany should:

- Ensure that non-discriminatory, transparent and simple arrangements for access to gas transmission and distribution networks, and gas supply are put in place to

speed up the development of competition in the gas market. Ensure that tariff calculation methods are transparent.

- ☐ Reinforce the resources and power of the Federal Cartel Office and the Task Force for Network Access in the Ministry of Economics and Technology to ensure that anti-competitive practices in the gas sector are abolished.

- ☐ Facilitate access to supply by promoting the liquidity of the gas market; in particular, encourage the development of spot markets and trading hubs.

- ☐ Continue to monitor concentration in the gas market to avoid further dominance of major players. In this regard, cross-shareholding between different network levels should be taken into account.

9

RENEWABLES

SUPPLY

In 2000, energy from renewable sources amounted to 11.2 Mtoe, of which 8.4 Mtoe came from combustible renewables and waste, 1.9 Mtoe from hydropower and 0.9 Mtoe from wind power. This is a sharp increase from 1990, when the energy supply from renewables totalled 5.6 Mtoe, with 1.5 Mtoe coming from hydropower. Much of this increase has resulted from significant growth in wind power use. The contribution of renewables to the total primary energy supply (TPES) was 3.4% in 2000. According to the latest forecast, the supply of renewables should grow by 1 Mtoe between 2000 and 2010 and their share of the energy supply should increase to 3.5%. These very conservative estimates were made with 1998 policies in mind, and do not reflect more recent and future policies (see the section on "Policy").

Generation from all renewables increased in the 1990s. In 2000, gross electricity generation from renewables and waste (without pumped storage) was 41 TWh, representing 7.3% of total electricity generation. According to IEA statistics, at the end of 2000 the installed capacity of hydropower in Germany was 8,980 MW (without pumped storage); wind power 6,100 MW; and combustible renewables and waste 1,940 MW.

The federal government has not published an official estimate of the technical and economic potential of renewables. It points out that all estimates are heavily dependent on the assumptions that are used, including those for wind power. One of the most recent estimates for different renewables was published in 2001 in the final report of the EU-financed project ElGreen.[22] The estimate indicates the technical potential for each renewable energy by 2010. It was made by taking into consideration the theoretical potential (energy flow), technical feasibility, social acceptance, planning aspects and growth rate of industry, but not the cost of the systems and their implementation. Photovoltaics were estimated to have the largest unused technical potential (49 TWh per annum), followed by biomass (39 TWh/a), onshore wind (19 TWh/a), biogas (9 TWh/a), municipal solid waste (9 TWh/a), and offshore wind (7 TWh/a). The unused technical potential for small- and large-scale hydropower was estimated at 3 TWh/a and 2 TWh/a, respectively. Cost estimates were also made for electricity generation. For photovoltaics, the most probable estimate for generation in new plants was €1.0721 per kWh (minimum €0.7829 and maximum €1.5375 per kWh); for biomass it was €0.0881 per kWh (€0.0420 and 0.1163); and for onshore wind power, €0.0667 per kWh (€0.0499 and 0.108).

22. Final Report of the Project ElGreen ("Organising a Joint European Green Electricity Market"). Prepared by the Energy Economics Group (EEG), the Institute of Power Systems and Energy Economics, and the Vienna University of Technology, with the support of the European Commission.

Wind power is the fastest growing renewable energy source in Germany. Germany is the world leader in wind power production, and it accounted for about half of all wind turbines built worldwide in 2001. Wind power represented 3.6% of total installed electricity capacity and 1.7% of total electricity generation in 2000. However, wind power capacity is estimated to have more than doubled since then, and wind power accounted for 3.5% of Germany's electricity supply in 2001. According to the German Wind Energy Association, by the end of 2001 installed wind power capacity reached 8,750 MW, there were 11,500 wind turbines in operation, and capacity had increased by 44% during the year. About 2,400 MW of wind power capacity is installed close to the North Sea, in the Land of Lower Saxony; wind power met almost 10% of the Land's total electricity demand in 2001. Installed capacity in Schleswig-Holstein is 1,555 MW, and in 2001 annual electricity generation from wind power was equivalent to 28% of electricity demand in the Land. Other Laender with significant wind capacities are Mecklenburg-West Pomerania, Saxony-Anhalt and Brandenburg.

Since the number of potential onshore wind power sites has become limited, and the wind is stronger at sea, the government is developing offshore wind power (see the section on "Policy"). Some of these turbines are planned to be operating in the open sea up to 45 km offshore, a feat never before attempted. Large wind turbines, double the size of conventional turbines, are being developed for offshore use. Some 16 companies have expressed interest in building offshore wind turbines and have submitted 28 applications. A pilot project, "Borkum West", is expected to be operational in 2003. The plan is to install 12 multi-megawatt wind turbines about 45 km north of the island of Borkum. Each turbine is expected to generate up to 20 GWh per year. This pilot project will help to evaluate problems for future offshore wind development. For example, it is not yet clear what the installation cost of such offshore wind power plants will be.

According to the German Electricity Association (VDEW), 38 waste incineration plants[23] were in operation in 1999 with a total capacity of 522 MW. In the future, the amount of waste generated is expected to decline as a result of recycling policies. There are some examples of biomass-based co-generation. Unlike wind, biomass could be used to generate baseload electricity. The government believes that the use of biomass for power generation will increase rapidly in coming years.

Germany has the highest installed solar electric capacity in Europe. At the end of 2000, total installed capacity was 80 MW, and it has more than doubled during 2001. About 90% of the installations are connected to the grid and the rest are stand-alone systems. The "100,000 Rooftops Solar Electricity Programme", launched by the federal government in 1999, aims to install 300 MW of photovoltaic capacity by 2003.

23. The German government and the EU do not consider waste, except from biodegradable sources, to be a renewable energy source.

POLICY

Germany has adopted policy measures to actively exploit the potential of renewable energy sources. The government considers renewables to be an important source of energy and anticipates that they will be vital for replacing phased-out nuclear power and contributing to climate change mitigation. It estimates that the 25 Mt of CO_2 savings that resulted from the use of renewables between 1990 and 2000 can be doubled by 2010.

In September 2001, the EU adopted a new directive (2001/77/EC) to promote electricity production from renewables. Following the directive, Germany agreed to an indicative target of generating 12.5% of its electricity from renewables, including large-scale hydro, by 2010. The federal government has also announced national targets. It intends to double the share of renewable energy sources in TPES by 2010, but it has not established a specific target for each renewable.

The Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU) published a study in January 2002 that examines which areas in the North Sea and the Baltic Sea could potentially be used for offshore wind parks. It takes into account the ecological aspects and diverging interests of this and alternative activities (*e.g.* shipping, fishery and military use) in these areas. From theoretical calculations it was derived that approximately 25 GW of offshore wind power capacity could be installed in these potentially available areas by 2030. The study clearly shows that the realisation of offshore wind power projects depends essentially on their economic viability and on the willingness of the electricity industry and potential investors to provide the necessary grid installations and connections to the coast.

The 1991 Electricity Feed Law (*Stromeinspeisungsgesetz*), and its 1994 amendment, obliged power companies to buy all the electricity that was generated from wind, hydropower, biomass (including commercial wood) and solar energy from renewable energy power plants situated in their distribution areas. The law established feed-in tariffs that were derived from a fixed percentage of the average end-use price for all consumers. The feed-in tariffs were set at 65 to 90% of these prices, depending on the renewable; for example, for wind power the feed-in tariff was 90% of the average end-use price. The greatest cost burden was borne by network operators in whose areas generation took place. In practice, this was principally in the northern part of the country where most of the wind power capacity was installed. To address the problem, the 1998 Energy Industry Act established a ceiling[24] for the quantity of electricity from renewables that the utilities were required to buy. Despite the ceiling, the system still placed a greater cost burden on network operators in the north than on others.

24. This ceiling, which was applied to the local utilities (*Stadtwerke*), was 5% of the total volume of electricity distributed. If the generation from renewables exceeded the 5% ceiling in the area of any given *Stadtwerk*, the remaining electricity was purchased by regional utilities and supra-regional power companies.

In April 2000 the Renewable Energy Act (*Gesetz für den Vorrang erneuerbarer Energien*) was introduced to promote the generation of electricity from renewables by providing feed-in tariffs based on the electricity generation cost of each technology and by providing long-term certainty (20 years) regarding feed-in tariffs for developers and users. Another objective of the act was to distribute the costs of the feed-in system evenly to all network operators, regardless of where the electricity was being generated. The act of 2000 replaces the provisions for renewables in the Electricity Feed Law and the Energy Industry Act.

Before the Renewable Energy Act was introduced, alternative means of promoting renewables had been discussed, including feed-in tariffs and portfolio standards using green certificates. A feed-in mechanism was chosen for the new law because the government – given the ambitious emissions reduction goals that have been set for 2005 – wanted to increase the use of renewables rapidly. Furthermore, as the feed-in mechanism introduced in the 1991 law was successful in increasing the capacity of renewables, the government decided to continue with an improved feed-in system. As the government also wanted to give developers of renewables some security for their investments, it has extended the time frame of the feed-in system for 20 years. The new system includes a degressive scheme for tariffs, and the act requires continuous monitoring of the system's cost-effectiveness.

The renewable energy sources covered by the Renewable Energy Act are: biomass with a maximum capacity of 20 MW; hydropower; gas from landfill and sewage treatment plants with a maximum capacity of 5 MW; solar power with a maximum capacity of 5 MW;[25] wind power; geothermal energy; and mine gas. Capacity limits for biomass and hydropower were established because the government considers that larger units using these energy sources will be competitive without financial support.

The transmission system operators are obliged to purchase and feed into their grids – on a priority basis – electricity that is generated from renewable sources. The minimum feed-in tariffs set by the Renewable Energy Act depend on the energy source and installation size,[26] and they are guaranteed for a period of 20 years.[27] Furthermore, the Renewable Energy Act stipulates that, starting from 2002, the minimum feed-in tariffs for electricity from biomass, wind and solar energy will depend on the year of commissioning; it also defines the tariff degression factors for each energy source. At present, the feed-in tariffs for each renewable are:

- €6.65 to 7.67 per 100 kWh for hydropower, and gas from landfill, mines and sewage treatment plants.

- €10.23 per 100 kWh for biomass with electric capacity of up to 500 kW; €9.21 per 100 kWh for up to 5 MW of capacity; and €8.7 per 100 kWh for up to

25. The limit for solar power is set at 0.1 MW for cases where solar power has been installed primarily, for example, to supply electricity to a building and not to feed electricity to the grid.
26. The minimum feed-in tariffs for wind power depend also on the site.
27. There is no 20-year limit for hydropower.

20 MW. These tariffs will be reduced by 1%/year for new installations, starting from 1 January 2002.

- €8.95 per 100 kWh for geothermal energy with electric capacity of up to 20 MW, and €7.16 per 100 kWh for installations with capacity of over 20 MW.

- €9.1 per 100 kWh for wind power for at least the first five years of operation after commissioning. Thereafter, depending on the quality of the site, the rate is reduced to €6.19 per 100 kWh. These rates are subject to a degression of 1.5% for new installations (starting from 1 January 2002).

- €50.62 per 100 kWh for photovoltaics and solar thermal electricity. This tariff is granted for new installations until their total installed capacity reaches 350 MW. After the 350 MW limit is reached, the government will review the feed-in scheme. This limit was raised to 1,000 MW in June 2002. The tariffs are reduced by 5%/year for new installations, starting from 1 January 2002.

During the nine months after the Renewable Energy Act came into force in 2000, about 9.9 TWh of electricity generated from renewables was eligible for these feed-in tariffs and received €0.8 billion of indirect subsidies. In 2000, the share of wind power in the total volume of feed-in tariffs was 57.7%, followed by hydropower (36.6%), biogas (5.4%) and solar power (0.3%). According to preliminary estimates made by the federal government for 2001, the total generation volume eligible for fixed feed-in tariffs reached 16 TWh (about 10 TWh from wind) and it was supported by approximately €1 billion of indirect subsidies. The federal government estimates that the weighted average of premiums given to eligible power generators was €2.2 to 2.6 per 100 kWh in 2001.

In June 2001, a special ordinance for biomass was adopted to supplement the provisions of the Renewable Energy Act. The objective of the decree was to provide a more specific definition of what types of biomass and what technological processes should be covered by the provisions of the Renewable Energy Act, and what environmental standards must be met. For example, electricity generation from a mixture of biomass and fossil fuels is not covered by the act.

The minimum feed-in tariff is the only incentive that the federal government provides for using wind power. Other renewable energies, however, benefit from additional financial support. In September 1999, the federal government introduced the "Market Incentives Programme for the Use of Renewable Energies". It provides direct subsidies – or, alternatively, low-interest loans – for installing power plants that use renewables to produce heat (solar thermal, biomass and biogas combustion, and geothermal energy) and for installing hydropower systems. The budget for the programme is approximately €540 million for 1999 to 2003.

For 1999-2003, there is also a federal government project to support photovoltaics. It provides low-interest loans for installing solar energy equipment under the "100,000 Rooftops Solar Electricity Programme". The key objectives of the project are developing the technological know-how that is necessary for mass-producing

photovoltaics (and, hence, reducing their cost), and building a domestic industrial base for photovoltaics. The target is to install 300 MW of photovoltaic capacity by 2003.

In addition to the federal programmes, all Laender, except Berlin, have their own programmes to promote renewables. They cover different renewable energies (hydro, wind, solar and biomass) and technologies (power generation, heat production and heat pumps). The scope of activities ranges from information dissemination and bringing together the scientific community with business to providing investment subsidies, which can cover up to 30% of the investment costs.

Many utilities have plans to build demonstration and pilot projects, or to provide advice and information for renewable energy users. About 60 utilities have given their clients the possibility to voluntarily buy electricity generated from renewables at a cost-reflective "green tariff". Some 280,000 consumers have chosen this option, and about 0.7 TWh of "green electricity" was sold in 2001. The BMU plans to develop criteria for labelling energy sources to ensure that electricity sold under these "green tariffs" is indeed from renewable sources.

Research and development (R&D) play an important role in the promotion of renewables, particularly photovoltaics. This is discussed in detail in Chapter 11.

CRITIQUE

Germany has given renewables an important role in its energy policy, and it recognises that government intervention is needed to accelerate their deployment. The government is therefore promoting renewables through a significant amount of financial support and active R&D. As a result, Germany has become the world leader in wind power installations and the European leader in photovoltaic installed capacity. Electricity production from renewables, particularly from wind, is increasing rapidly.

Even though, as a result of strong government policies, the introduction of renewables has been remarkable, the downside of the policies is that they have placed an additional burden on taxpayers and consumers. The cost of indirect subsidies through the feed-in mechanism alone was about €1 billion in 2001, and this does not include the cost of other financial support and R&D expenditures. The degression scheme for feed-in tariffs and continuous monitoring of the cost-effectiveness of measures to promote renewables are key elements for the future development of these energies.

Germany has adopted a policy to gradually reduce feed-in tariffs. These reductions are based on learning curves that include, for example, estimates for the pace at which capacity from renewables is being installed. As such, this is an innovative, market-oriented approach. However, the rate of reduction appears quite modest, particularly for onshore wind power, when the expected reduction in the cost of

this technology is taken into account. For instance, wind power installations have been growing much faster than the estimated 15% increase that was used in the design of the feed-in tariffs; on the other hand, the high capacity growth rates observed in 2000-2001 may be difficult to sustain in the future. The annual reductions in the feed-in tariffs – *e.g.* 1.5% for wind power – are consistent with the average observed growth rates before the Renewable Energy Act was introduced and the observed learning rates for wind turbines. However, one should not only consider the learning curves regarding investment cost for wind power (*i.e.* "technology learning"), but also the learning curves of utilities when they use wind power plants to produce electricity. The learning rates have been considerably higher for energy production than for wind turbines only. The government should therefore consider increasing the yearly reductions in feed-in tariffs for wind power.

The use of learning curves for policy setting and design should be embedded in a continuous process of policy analysis and evaluation. Recently, the BMWi completed a report on the cost and competitiveness of renewables for the Parliament, as is required by the Renewable Energy Act. This is an important step for enhancing the economic deployment of renewables. Also, the availability of good and up-to-date statistics is vital for monitoring the progress that is being made in the development of renewables.

Germany has been providing heavy support for the development of photovoltaics, both through the feed-in mechanism and R&D effort. Because of its climate and land-use constraints, Germany is not an ideal place for large-scale deployment of photovoltaics. In this case, justifying such support is more a matter of industrial policy than meeting energy policy objectives. The government needs to pay careful attention that such support will not incur disproportional cost burdens for German energy consumers and taxpayers.

RECOMMENDATIONS

The Government of Germany should:

- ☐ Take the economically feasible potential of renewables into account when promoting their use.

- ☐ Monitor closely the cost impact of policies that indirectly subsidise renewables through the feed-in mechanism; and take into account technological progress to reduce cost, and eventually phase out subsidies.

10

ELECTRICITY AND HEAT

INDUSTRY STRUCTURE

The structure of the electricity industry in Germany is very similar to that of gas. The electricity market has a decentralised structure with a number of privately and municipally owned utilities. About 900 companies operate in the electricity market, and they can be classified into the following groups:

- Integrated supra-regional companies (4 companies).
- Regional utilities (56 companies) and local utilities *i.e. Stadtwerke* (about 840 companies of different sizes).
- Electricity dealers (about 120 companies).

The integrated supra-regional utilities generate electricity, transmit electricity across regional boundaries and supply final consumers. As a result of the mergers that took place after 1998, there are now four such companies in Germany: namely E.ON Energy AG, EnBW AG, RWE AG and Vattenfall Europe AG.[28] The four supra-regional companies account for almost 80% of electricity generation in Germany. There are six transmission system operators (TSOs); RWE, E.ON and EnBW have each created their own TSO, and the TSOs of BEWAG, HEW and VEAG continue to operate under Vattenfall Europe. The shareholding structure of the supra-regional utilities is complex and varies from company to company (see box below). In general they are privately held enterprises, but Land governments and municipalities are often minority shareholders.

The principal task of the regional utilities is to distribute electricity over a defined area. To a small extent they also generate electricity, about 10% of the total electricity generated in Germany. Companies at the regional level provide electricity to both local utilities and final consumers. After market liberalisation was initiated, many mergers also took place among regional suppliers. The largest regional utility is E.ON Bayern, which operates in Bavaria and was formed after four regional utilities merged.

28. Until then, there were eight grid companies (Energie Baden Württemberg AG (EnBW), Bayernwerk AG, Berliner Kraft und Licht AG (BEWAG), Hamburgische Electrizitäts-Werke AG (HEW), PreussenElektra AG, RWE Energie AG, VEAG Vereinigte Energiewerke AG, and VEW Energie AG). RWE acquired VEW Energie AG in July 2000. VIAG (the owner of Bayernwerk) and VIBA (the owner of PreussenElektra) merged in June 2000, forming E.ON AG. The energy operations of E.ON AG are concentrated in its subsidiary E.ON Energy AG. Swedish state-owned Vattenfall has acquired majority ownership of VEAG, HEW and BEWAG (and the Lausitz brown coal mining company Laubag). These three companies are going to operate under the umbrella of a new holding company, called Vattenfall Europe, which will start its operation in Berlin on 1 January 2003. Each company will, however, retain its own name.

The local utilities distribute electricity to final consumers, but some of them also have their own generating capacities. Generation by local utilities accounts for about 10% of total electricity in Germany. Although most of these are municipal utilities, some are privately owned.

Supra-regional Electricity Companies

- RWE AG operates in the western part of Germany. In 2000, RWE's sales were 255 TWh, of which about 22% was sold to regional suppliers and local utilities. Half of RWE's total electricity supply came from its own power plants. Half of these use lignite for generating electricity. RWE has several interests in regional suppliers and local utilities. Municipalities also had shares with multiple voting rights in these companies until 1998 when the practice was abolished to attract private investors. The largest individual shareholders of RWE are Allianz Aktiengesellschaft (12%), RW Holding AG (11%), and Kommunale Energie-Beteiligungsgesellschaft mbH (10%).

- E.ON Energy AG operates in the central part of the country, in a narrow area extending from the Danish border to the Austrian border. In 2000, E.ON Energy supplied 211 TWh of electricity, of which 57% came from its own power plants and 43% from other sources. About 60% of the sales was to regional and local utilities. E.ON Energy is a subsidiary of E.ON AG, which is 70% owned by insurance companies, investment funds, and banks in and outside Germany. E.ON Energy itself holds significant shares in 12 regional utilities.

- Vattenfall Europe AG will form the third-largest power company in Germany beginning 1 January 2003. It will operate mainly in the New Laender, essentially in the area currently served by VEAG and BEWAG (Berlin), and in Hamburg, which is served by HEW. In 2000, VEAG generated 45 TWh of electricity, mainly from lignite-fired power stations. Over 90% of its sales goes to regional suppliers. VEAG was privatised in 1994, and is now owned by RWE (26%), PreussenElektra (26%), EBH Energie-Beteiligungsholding (25%) and Bayernwerk (23%). BEWAG's electricity generation totalled 11 TWh, its sales were 14 TWh and the volume of trading activities was 13 TWh in 2000. The sales of HEW were 33 TWh in 2000.

- Energie Baden-Württemberg Aktiengesellschaft AG (EnBW) operates in the south-western part of Germany. In 1999, EnBW's sales were 69 TWh, of which 30% went to industrial clients, 27% to network companies, 24% to local utilities and 19% to private customers. The two largest shareholders of EnBW are EDF (34.5%) and Zweckverband Oberschwäbische Elektrizitätswerke (34.5%).

Sources: Annual reports and company Internet sites.

A growing number of domestic and foreign electricity merchandising companies have entered the market. Currently they are engaged only in marketing activities and do not have any generating capacity of their own.

The two power exchanges in Germany – LPX Leipzig Power Exchange in Leipzig and EEX European Power Exchange in Frankfurt – have merged under the name EEX, and started operations in June 2002 in Leipzig. Before the merger, LPX operated on both futures and spot markets, whereas EEX operated only on spot markets. Every day about 300 traders gave their bids to the TSOs in the two exchanges. In April 2001, the estimated volume of electricity traded on these exchanges for 2001 was 288 TWh, which is equivalent to almost 60% of national consumption; the rest is covered by bilateral contracts. Some 8% of the traded electricity came from international markets. The volumes traded in these two exchanges have been increasing, and market players expect the merger to increase liquidity in the electricity market.

Germany is the largest European electricity market, and foreign companies have shown considerable interest in entering it. For instance, in addition to acquiring three grid companies, Swedish Vattenfall Group has acquired stakes in Vasa Energy and Hamburg's municipal utility, and developed a combined cycle gas turbine plant in the eastern part of the country. The French EDF Group has acquired a 34.5% stake in EnBW. TXU Europe, a subsidiary of the US-based company TXU Energy, acquired a 51% stake in Kiel Stadtwerke at the beginning of 2001. In 1997, the US-based Mirant Corporation, formerly known as Southern Energy, purchased an initial 26% interest in BEWAG, increased its ownership to 44.8% in 2001, but then at the end of the year sold its shares to Vattenfall. Enron was a significant trader on the German power exchanges until it went bankrupt.

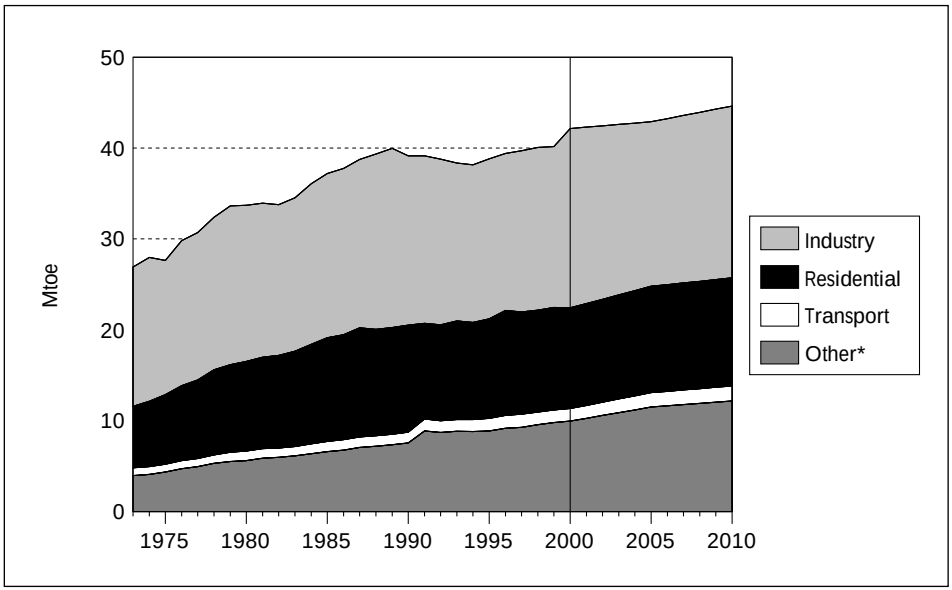
DEMAND, SUPPLY AND TRADE

Electricity consumption in Germany was 490 TWh in 2000. The industry sector was the largest user, consuming about 47% of electricity, followed by the residential sector (26%), service sector (22%), transport sector (3%) and agricultural sector (1.5%). Between 1990 and 2000, electricity consumption grew moderately by 7.7%, and the latest forecast puts growth in electricity consumption for this decade at about 6%. (See Figure 27).

Coal remains the main fuel for generating electricity, although its share in generation declined from 58.8% to 52.7% between 1990 and 2000. Hard coal accounted for 25.2% and lignite for 26.2% of total power generation in 2000. Nuclear power was the second most important source of electricity, making up 29.9% of generation in 2000. Natural gas has increased its share from 7.4% in 1990 to 9.3% in 2000. The shares of other fuels in 2000 were 3.8% for hydro, 1.8% for combustible renewables and waste, 1.7% for solar and wind energy, and 0.8% for oil.

At the end of 2000, total electricity generating capacity was 118 GW. Some 8.5% of this capacity has been installed by autoproducers. The government estimates that total generating capacity will increase to 130 GW by 2010. Coal-fired capacity will account for about two-thirds of the increase, and gas-fired capacity for one-third.

Figure 27
Final Consumption of Electricity by Sector, 1973 to 2010



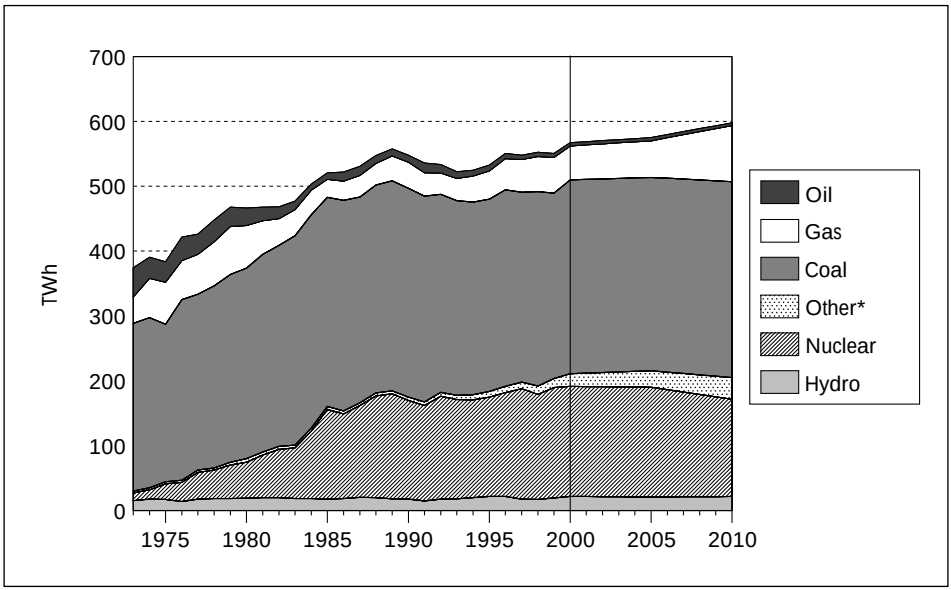
* includes commercial, public service and agricultural sectors.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

Germany has decided to phase out nuclear power over the next two decades (see section on nuclear power below). According to the plan, nuclear power stations with annual electricity generation of approximately 8 TWh will cease operation by 2005. An additional 19 TWh of annual electricity production will need to be replaced between 2006 and 2010, and an additional 87 TWh between 2011 to 2020. The remaining annual production of electricity from nuclear energy (46 TWh) will cease by 2025 at the latest. In 2001, PROGNOS AG, EWI, DIW and BEI in their Energy Report presented two scenarios for the replacement of nuclear power (see Chapter 3). In Scenario I, which describes a more likely evolution of energy needs and markets in the future than Scenario II, electricity consumption would grow by 14% between 1999 and 2020. Nuclear power would be replaced by gas, coal and renewables. Between 1999 and 2020, the share of natural gas in power generation would rise from 10% to 20%, that of coal from 51% to 57%, and of renewables from 5% to 13%.

The total volume of international electricity trade in Germany amounted to 87 TWh in 2000, with exports and imports almost offsetting each other (see Table 10). The imports essentially came from France (34%), the Czech Republic (20%), Norway (14%), Austria (13%) and Switzerland (12%), and exports went mostly to the Netherlands (40%), Switzerland (24%) and Austria (18%).

The German capacity of interconnections is about 10% of the capacity of its system. In comparison, one-third of the EU countries has interconnection capacity

Figure 28
Electricity Generation by Source, 1973 to 2010



* includes solar, wind, combustible renewables and waste, and electricity from heat pumps.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

accounting for 20% of total national capacity, and another third has interconnection capacity accounting for 3 to 7% of the national total. The European Commission considers that in all member countries interconnection capacity should be at least 10%, and higher in transit countries like Germany. The EC has made an inventory of the most significant electricity interconnector bottlenecks and identified one between Belgium and Germany and another between Denmark and Germany. The inventory indicates that in coming years Sweden, and perhaps also Norway, will import more electricity from Continental Europe, possibly leading to interconnection problems (*i.e.* congestion) between Germany and Denmark.

Table 10
Import and Export of Electricity, 1990 to 2000
(TWh)

	1990	*1995*	*1998*	*1999*	*2000*
Import	25.1	39.7	38.3	40.6	45.1
Export	26.0	34.9	39.0	39.6	42.1
Net import	**–0.9**	**4.8**	**0.6**	**1.0**	**3.1**

Source: *Electricity Information 2001*, IEA/OECD Paris, 2001.

Figure 29
Import and Export* of Electricity, 2000
(TWh)

* Does not include transit.
Source: *Electricity Information 2001*, IEA/OECD Paris, 2001.

PRICING AND TARIFFS

At the beginning of electricity market liberalisation in Germany, between 1998 and 2000, electricity prices decreased for both industrial and household consumers (see Figure 31). However, according to Eurostat, pre-tax prices of electricity increased slightly in the industrial sector between January 2000 and July 2001 for almost all consumer categories in almost all parts of the country. A similar trend can be seen in electricity prices for households, although in some parts of the country prices have decreased. Compared to other IEA countries, electricity prices for industry in Germany were about average in 1999 and those for households were at the higher end among IEA countries in 2000 (see Figure 30). The higher electricity prices for household consumers can be explained to some extent by a larger tax component, but even pre-tax electricity prices for households in Germany were among the highest within the IEA.

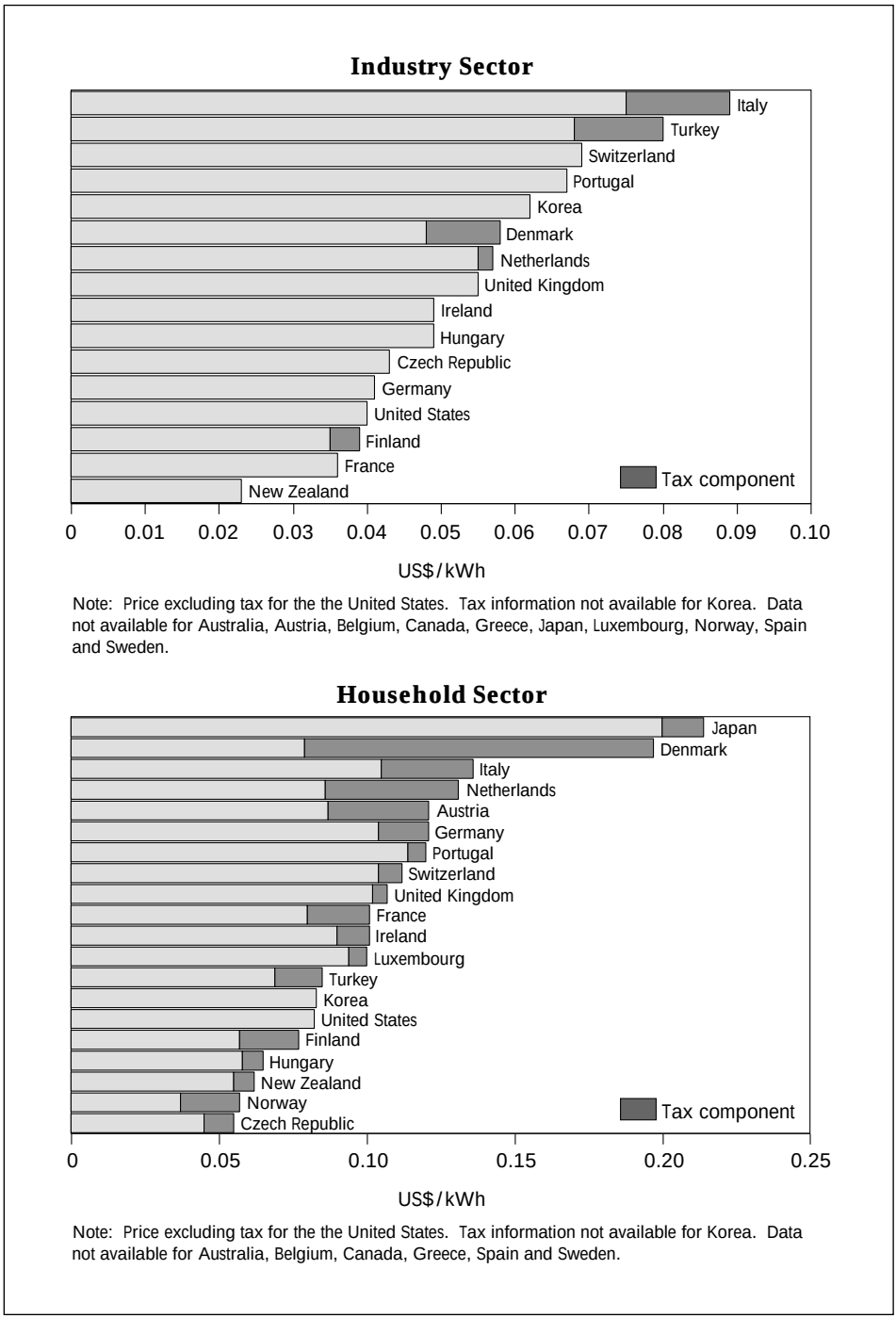
ELECTRICITY MARKET REFORM

The electricity market in Germany was fully liberalised in the spring of 1998 with the adoption of the Energy Industry Act of April 1998. The minimum requirement that had been set by the EU Electricity Directive for February 1999 was opening up the market by 26%. Furthermore, the Energy Industry Act lays down objective and non-discriminating principles for companies that wish to start energy supply activities, and for the construction of power plants and power lines. Access to German markets by foreign companies is subject to reciprocity.

Germany has no sectoral regulatory body for the electricity market. As in the gas sector, there is little regulation and the government has relied on self-regulation by market players. Currently, the behaviour of market players is controlled by the *ex post* application of competition legislation by the Federal Cartel Office (FCO) for cases involving more than one Land. The individual Land competition agencies are responsible for cases exclusively within the boundaries of their respective Land. Appeals are brought to the courts. The FCO has established a special unit for the electricity market to investigate cases regarding abusive and discriminatory practices, network access and unjustified access fees. The unit has a staff of seven specialists. The BMWi has created a special Task Force for Network Access that gives recommendations to market players on third-party access, dispute settlement processes and "best practices", and that negotiates the implementation of these recommendations with suppliers and users. The Task Force is composed of ten specialists from both the BMWi and industry. Its recommendations are not legally binding. The Task Force also handles consumer complaints and provides information to consumers on how to buy electricity from competitive markets.

For use of its electricity networks, Germany has opted for negotiated third-party access. With negotiated TPA, an electricity supplier will have to agree with the network company on the terms and conditions of network access (within the framework of the Associations Agreements) in order to reach the final customer.

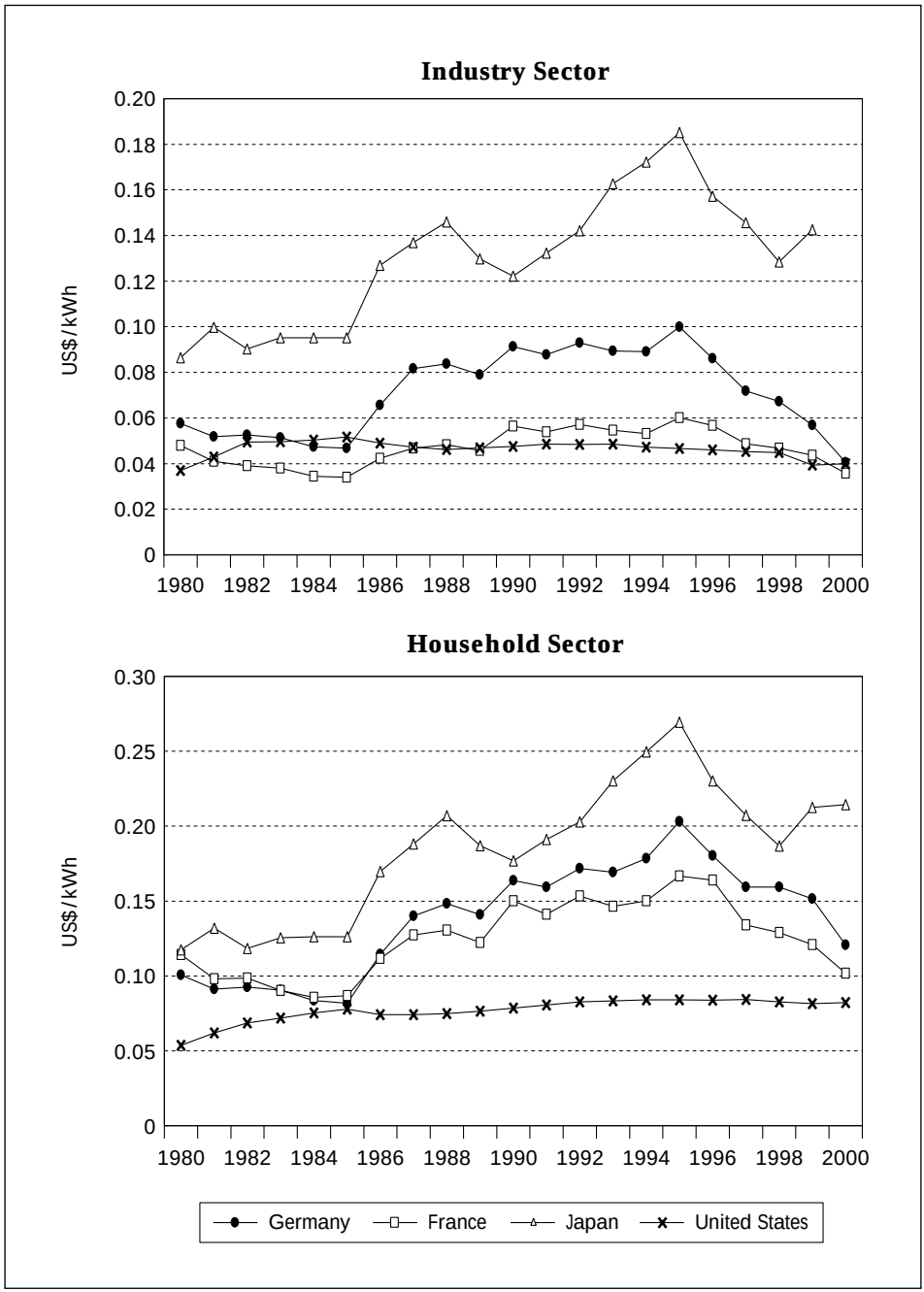
Figure 30
Electricity Prices in IEA Countries, 2000



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2001.

Figure 31

Electricity Prices in Germany and in Other Selected IEA Countries, 1980 to 2000



Note: Price excluding tax for the United States.
Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2001.

Nevertheless, electricity distribution companies can also apply for a "single buyer"[29] status instead of TPA. This option has been used only in very few cases. According to the Energy Industry Act, the rules for network access must be reviewed in 2003 and a decision must then be made on whether changes are needed to ensure effective competition. Unless otherwise recommended by the review, the single-buyer system will be abolished by the end of 2005. Germany's choice to adopt negotiated TPA for network access is a rare choice indeed, as is shown by Table 11.

Table 11
Electricity Network Access in IEA Countries

Regulated third-party access	*Negotiated third-party access*
Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, Norway, Netherlands, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States	Germany, New Zealand

Source: IEA.

The German Electricity Association (VDEW), the Federation of German Industries (BDI) and the Association of the Industrial Energy and Power Industry (VKI) have negotiated voluntary agreements, called Associations Agreements (*Verbändervereinbarung*), which are the basis for freely negotiated contracts for access to the transmission and distribution grids. The first Association Agreement (AA I) was signed on 22 May 1998, and the second (AA II) was signed on 13 December 1999. Associations Agreements are voluntary accords that contain specific standards for the electricity sector and guidelines for negotiating third-party access. The members of the associations participating in the AAs are not legally bound, nor are AA recommendations legally binding. AA I did not work well as it resulted in distance-related tariffs for network access that were considered discriminatory by the European Commission. The government and industry recognised these problems, and so a new Associations Agreement was drawn up (AA II) stipulating an access regime that was no longer transaction- and distance-based. Small consumer associations participated in the negotiations for AA II Plus, which brought further simplifications and facilitated switching suppliers for small customers. The AA II Plus also abolished specific fees for registration and administration of power balancing services and suspended switching fees. Furthermore, it introduced more flexibility into schedule management. However, suppliers still need to make switching procedures for small consumers easier, which could be achieved with the help of the Special Task Force for Network Access.

29. Under the single buyer system, consumers are free to conclude supply contracts with generators/suppliers both inside and outside the incumbent utility's territory. The single buyer (network company) purchases the electricity (contracted by the customer from a producer) at a price that is equal to the sale price offered by the producer to the customer minus the price of a tariff for grid services.

In addition to the Associations Agreements, other non-binding, non-governmental standards concerning third-party access have been elaborated. One is the Grid Code of October 1998, which contains regulations for feeding in electricity from power plants and for the transmission of electricity in transmission grids. Another is the Distribution Code of May 1999, which sets standards for the feeding in and transmission of electricity in distribution grids. The Metering Code of May 1999 regulates measuring procedures.

The levels of transmission access tariffs in Germany vary greatly among the different network operators. According to a recent report by the European Commission,[30] average TPA tariffs in Germany are among the four highest within the EU.[31] However, the average TPA tariff for using high-voltage networks in Germany is on par with the European average. This was confirmed by another recent EC study.[32] TPA tariffs for consumers connected to lower-voltage networks, on the other hand, seem to be higher in Germany than the European average, and those for household consumers are the highest among ten EU countries.

In the electricity sector, more than 200 cases have been brought before federal and local competition authorities. The FCO has initiated over 20 preliminary investigations concerning network access charges, of which 11 have led to formal investigation procedures. The proceedings, in some instances, have resulted in reduction of transmission fees by 15 to 20%. The FCO has thus far based its assessments on benchmarking with German companies, but it is planning to carry out international benchmarking as well. The FCO is also planning to publish "best practices" for grid companies on how they should define their TPA tariffs, and it anticipates that the criteria may differ from those defined by the Associations Agreements. The FCO is critical of the special low tariffs that power companies offer their old clients to keep them because these tariffs are making it very difficult for new entrants to compete. The FCO, however, does not consider that power companies are significantly cross-subsidising consumer groups with regard to TPA tariffs.

German legislation requires account unbundling for the generation, transmission and distribution/retailing of electricity. There is no obligation to unbundle distribution from retailing. These requirements are consistent with the EU Electricity Directive. In practice, some supra-regional companies and regional utilities have separated their transmission activities into independent companies. Most other IEA countries consider independent transmission system operators (*i.e.* by ownership or legal unbundling) to be a prerequisite for the development of competition.

30. European Commission Staff Working Paper: "First report on the implementation of the internal electricity and gas market", SEC(2002)1957, Brussels, 3 December 2001.
31. However, the methodological basis of these comparisons needs further clarification. Comparisons are difficult because tariff-setting methods, voltage levels and customer profiles vary among countries.
32. "Benchmark of Electricity Transmission Tariffs". Prepared by Comillas for the DG TREN/European Commission. Final report February 2002.

Table 12
Unbundling of Transmission System Operators in IEA Countries[1]

Ownership unbundling	*Legal unbundling*	*Management and account unbundling*
Australia, England, Finland, Norway, Sweden, Spain, Wales	Main parts of Austria, Belgium (TSO not nominated yet), Czech Republic, Denmark, Ireland, Italy, Korea, Netherlands, New Zealand, Portugal, Spain	Grid of Tiwag and Illwerke in Austria, France, Germany, Greece, Hungary, Japan, Northern Ireland and Scotland, Switzerland, Turkey

1. Varying methods of unbundling can be found in Canada and the United States, depending on state. Luxembourg does not have significant transmission networks.

Sources: IEA and the EC.

In Germany, the TSOs set the charges for the ancillary service of balancing power at a predetermined level, which may vary according to the time of day and degree of imbalance. The FCO suspected that these charges were not cost-reflective and started to take action against BEWAG, HEW, VEAG and EnBW on the lack of competition in balancing power supply. The case against EnBW was dropped in February 2002 because the company offered new and lower prices. As for RWE and E.ON, the FCO had already forced them to create a tendering system for balancing power supply as a prerequisite for approving their merger.

The EC estimates that about 10 to 20% of large users and under 5% of small users have changed their suppliers in Germany since 1998. The FCO estimates that 3.5% of households have changed their suppliers and 28% have negotiated better contracts with their old suppliers. At the beginning of market liberalisation, many suppliers imposed extra fees on small consumers who wanted to change. Following a decision by the FCO, such practices have now been abolished. Moreover, the Associations Agreements were changed to forbid charging for switching suppliers unless a specific court decision is taken to allow such charges. Some suppliers have asked small consumers to install meters. While the FCO does not approve of this requirement, there are small consumers who prefer metering to load profiling.

Many market players complain that, despite the fully opened market, it is difficult to compete effectively; some of the large incumbents, however, are content with the way the market is functioning at present. In 2002 the EC published a survey on the problems experienced by the market players in all the national markets. The most frequently raised problems in Germany (in order of importance) were: level of unbundling, insufficient regulation and delays in handling complaints, problems related to cross-border transmission, and the level of network access tariffs.

Nuclear Energy Production

Nineteen nuclear power plants (see Table 13) were operating in Germany in 2001, producing 170 TWh and meeting about 30% of total electricity demand. In 2001, the average availability of the power plants was 91.43%, the maximum ever achieved in Germany. All of them were built by KWU, a subsidiary of Siemens; 13 are pressurised water reactors (PWRs) and 6 are boiling water reactors (BWRs). They are all privately owned, and have been in use for an average of 20 years.

No new nuclear power plant has been built in Germany since Neckarwestheim-2 was commissioned in 1988. One plant – the 1,300 MW unit of Mülheim-Kärlich – has not been operational since 1988. It is owned by RWE Energie and has been the object of legal claims involving the Land of Rhineland-Palatinate.

Table 13
German Nuclear Power Generation, 2000 to 2001

NPp name	*First commercial operation date*	*Gross capacity [MW]*	*Gross production 2000 [MWh]*	*Gross production 2001 [MWh]*
Obrigheim	1968	357	2,803,373	2,950,313
Stade	1972	672	5,169,040	4,542,807
Biblis A	1974	1,225	6,274,800	10,093,284
Biblis B	1976	1,300	8,868,400	7,887,660
Neckarwestheim-1	1976	840	6,634,487	6,445,437
Neckarwestheim-2	1988	1,365	11,227,420	11,172,100
Brunsbüttel	1976	806	6,035,515	6,012,689
Isar-1	1977	912	6,926,699	6,142,898
Isar-2	1988	1,475	11,942,563	12,395,641
Unterwesser	1978	1,410	10,111,138	11,205,761
Philippsburg-1	1979	926	7,251,420	7,291,830
Philippsburg-2	1985	1,458	11,287,670	9,497,370
Grafenrheinfeld	1981	1,345	10,239,255	11,154,047
Krümmel	1983	1,316	9,430,460	8,485,573
Gundremmingen B	1984	1,344	9,797,120	10,784,441
Gundremmingen C	1984	1,344	10,697,907	10,319,635
Grohnde	1984	1,430	11,679,821	11,559,939
Brokdorf	1986	1,440	11,926,546	11,790,779
Emsland	1988	1,400	11,385,996	11,525,914
Total		**22,365**	**169,689,630**	**171,258,118**

Source: German Atomic Forum.

Institutional Framework

There is no single central nuclear authority in Germany. The Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU) has the primary responsibility for nuclear policy. It is also responsible for developing the general nuclear safety strategy and establishing the national policy on nuclear safety issues. Furthermore, the BMU is competent to co-ordinate and harmonise the requirements concerning nuclear safety and radiation protection. These are implemented by the Laender Committee for Nuclear Energy (LAA) where all Laender are represented.

The Atomic Energy Act (*Atomgesetz*), together with numerous ordinances, sets the legal basis for the use of nuclear energy in Germany. Essential parts of the act are implemented by the Laender; and the BMU supervises the competent authorities of the Laender. Committees composed of experts, the Reactor Safety Commission (RSK) and the Commission on Radiological Protection (SSK) advise the BMU. Each Land nominates its own authority responsible for licensing. The licensing authorities work with technical inspection agencies such as the *Technische Überwachungsvereine* (TÜV), and with nuclear safety institutions such as the *Gesellschaft für Anlagen und Reaktorsicherheit* (GRS).

Nuclear Energy Policy

Since the 1980s the German environmental movement has put much pressure on government policy that was in favour of nuclear power. Political opposition to nuclear power culminated in the 1998 election of a coalition government that has taken the policy decision to phase out the use of nuclear energy in Germany. The government initiated negotiations with utilities that own nuclear power plants to seek an agreement on how to implement its phase-out policy. A key issue in the negotiations was financial impacts. Government policy aims to phase out nuclear power without this entailing any costs for the government. Industry has consistently argued that the phase-out would deprive it of future revenues and create a need for new investment. Issues concerning reactor lifetimes, taxation, trade, the environment, electricity prices, and overall energy policy were raised in the negotiations. Finally, a compromise agreement was reached between industry and the federal government in June 2000 and signed in June 2001. The German nuclear industry recognises the validity of the democratic process used to reach the agreement and generally views it positively since it has brought a certain economic stability to the energy sector.

However, the agreement has also raised strong opposition. Parliamentary opposition leaders have said that they would reverse the decision as soon as they could. The Federation of German Industries (BDI), which represents large energy users, has said that the nuclear option should be kept open.

The federal government and the nuclear industry assume that the agreement and its implications will not give rise to any claims for damages from the participating

parties. The agreement secures continued operation of the existing nuclear power plants but forbids the construction of new ones. It puts a cap of 2,623 TWh on the total combined lifetime production of all 19 operating reactors. This is equivalent to an average operating life of 32 calendar years. The production quantity that has been allocated can be transferred among power plants, thus providing operators with some flexibility. (Table 14 shows the approximate remaining generating capacity for each power plant.) Other key elements of the agreement include:

- A government commitment not to introduce any "one-sided" economic or taxation measures.
- Recognition by the government of the high safety standards of German nuclear plants and a guarantee not to erode those standards.
- Resumption of spent fuel transports for reprocessing in France and the United Kingdom for five years or until contracts expire.
- Maintenance of two waste repository projects (at Konrad and Gorleben, albeit that the latter has been delayed).
- Introduction of the principle of on-site storage of spent fuel for up to 40 years.

Table 14
Net Remaining Generation for Individual Reactors as of 1 January 2000
(net TWh)

Reactor	*TWh*	*Reactor*	*TWh*
Obrigheim	8.70	Gundremmingen-B	160.92
Stade	23.18	Philippsburg-2	198.61
Biblis A	62.00	Grohnde	200.90
Neckarwestheim-1	57.35	Gundremmingen-C	168.35
Biblis B	81.46	Brokdorf	217.88
Brunsbüttel	46.67	Isar-2	231.21
Isar-1	78.35	Emsland	230.07
Unterwesser	117.98	Neckarwestheim-2	236.04
Philippsburg-1	87.14	**Subtotal**	**2,516.05**
Grafenrheinfeld	150.03	Mülheim-Kärlich	107.25
Krümmel	158.22	**Total**	**2,623.30**

Source: Agreement Between the Federal Government and Utility Companies

The Atomic Energy Act has been amended to take into account the agreement. Parliament approved these amendments in December 2001, and a final decision was taken by Parliament in April 2002.

As a consequence of the phase-out policy, the first nuclear power plant that is likely to be closed down will be Stade in 2003. The utilities will be responsible for decommissioning the nuclear power plants, and funds have been made available for this purpose. Nuclear regulators, however, will verify the process.

An agreement was also reached to resolve outstanding problems related to the costs of the Mülheim-Kärlich plant, which will be decommissioned as of 2003.

Nuclear Fuel Cycle and Radioactive Waste Management

Uranium is no longer mined in Germany. Uranium ore, hex conversion and enrichment services are purchased by German utilities on the world market. Urenco Group, a global enrichment services company, owns an enrichment plant in Gronau in Germany. All German utilities, however, purchase uranium fuel produced by KWU of Siemens in Hanau.

Part of the nuclear policy of the current government is to stop future reprocessing of German irradiated nuclear fuel in France and the United Kingdom. The transport of the fuel to the reprocessing plants will cease on 7 January 2005. Thereafter, options for managing radioactive fuel will be limited to direct disposal.

The utilities are building interim storage facilities adjacent to nuclear power plants to hold spent fuel after this date. Transporting this fuel within Germany will be restricted in general, but permitted between the power plants and interim regional storage facilities (at Gorleben and Ahaus) until local facilities for final disposal become available.

The Federal Office for Radiation Protection (BfS) is responsible for the construction and operation of federal facilities for the final disposal of nuclear waste. The salt dome at Gorleben is being considered as a possible final disposal site. However, the amended Atomic Energy Act has halted the exploration of this site for 3 to 10 years in order to clarify some conceptual, safety and technical issues this project has raised.

The amended Atomic Energy Act also supports the conclusion of the licensing process for making the Konrad mine shaft a disposal site for low and medium-level radioactive waste.

CO-GENERATION AND DISTRICT HEATING

Heat for district heating and industry is produced in both combined heat and power (CHP) plants and heat-only boilers. The government estimates that 12.5% of domestic electricity generation takes place in CHP plants. The German Association

of District Heating and CHP Producers (AGFW) estimates that in 1999 the installed electric capacity in CHP plants was 10,700 MW and electricity generated by CHP was 28 TWh.

District heating is widely used in East European countries, and also in the New Laender. According to Euroheat and Power,[33] district heating accounted for 28% of the total heat market in the New Laender in 1998, whereas in the Old Laender the share was about 8%, and the national average was12%. In 1998, district heating sales in Germany amounted to 84,000 GWh, with 621 CHP plants and 1,751 heat-only boilers supplying 250 district heating schemes. The total length of the district heating pipeline system is 18,500 km. About 75% of heat supplied to district heating systems is produced by CHP plants and the rest by heat-only-boilers. While coal is still the main energy source used in CHP plants and heat-only boilers (50%), it is being replaced to some extent by natural gas (42%), and by waste (5%), oil (2%) and other fuels (1%).

The price of heat is not regulated. Prices are negotiated between the supplier, usually the local *Stadtwerke,* and the consumer.

After market liberalisation, electricity prices decreased and gas prices increased. As a consequence, many municipal CHP plants lost competitiveness in the market. The Berlin Energy Agency estimates that about 2 GW of CHP capacity has been closed down since 1998. This has created a political issue. In May 2000, the Parliament adopted a law to guarantee temporary protection for existing co-generation units operated by public utilities. This law provides a guaranteed minimum remuneration for electricity produced by CHP plants, amounting to €4.6 per 100 kWh. This minimum remuneration will be lowered by €0.26 per 100 kWh per year. The feed-in tariff is applied to all public CHP plants. In principle, the cost of this scheme is transferred to consumers *via* the electricity price. Since this law was introduced, fewer CHP plants have effectively been shut down.

The difficulties faced by CHP plants in the last few years have triggered a broad debate on finding adequate policy instruments to make CHP sustainable. For example, CHP supporters have suggested introducing tradable certificates – which are similar to green certificates – for co-generated power, and the five largest electricity companies have proposed new voluntary agreements with fixed CO_2 reduction targets. The government has decided to include the new voluntary agreements with industry in the new National Climate Protection Programme of 2000, and to introduce a new CHP law, which would further support co-generation through attractive feed-in tariffs.

In August 2001, the government presented a new CHP law, which replaced the existing one. The old law's provisions on remuneration were also replaced, mainly to give new incentives for the continued operation and modernisation of existing

33. Euroheat and Power is a non-governmental international association for district heating, cooling and combined heat and power (CHP).

co-generation units. The 2002 law aims to lower CO_2 emissions in 2005 by about 10 Mt and in 2010 by 20 to 23 Mt compared to 1998 levels. The new law, which will remain effective until the end of 2010, allows CHP operators who feed electricity into the public transmission network to receive bonus payments on top of the revenue at market price. For the period 2002-2010, the estimated total cost of these bonus payments is €4.45 billion. The law requires that an interim assessment be made in 2004 to evaluate whether the climate targets are being met and the expenditures are within budget. To qualify for the bonus, CHP operators must meet requirements for the power-to-heat ratio in CHP plants that have been set down by the 2002 law. The bonus then varies according to the CHP plant type:

- Existing CHP plants receive initially (*i.e.* 2002-2003) a bonus of €0.0153 per kWh.
- After modernisation, existing CHP plants receive initially (*i.e.* 2002-2004) a bonus of €0.0174 per kWh.
- Existing and new small plants (up to 2 MW_e) receive initially €0.0256 per kWh.
- Fuel cell plants and new small plants (up to 50 kW_e) receive €0.0511 per kWh.

The above rates will be progressively reduced from 2004 onwards, except for fuel cells and new small plants (up to 50 kW_e). Payments will end in 2010 for small plants, and for CHP plants built before 1990 and modernised in 2002 or later. For non-modernised plants with more than 2 MW capacity and that went into operation before 1990, payments will end in 2006; for other CHP plants, the payments will end in 2009. In principle, the cost of the bonuses granted along with the feed-in tariffs can be transferred to electricity consumers through electricity prices. The cost is generally transferred in proportion to consumption, but for large consumers (those consuming more than 100 MWh/year or whose electricity bill is more than 4% of annual turnover), the price increase is limited for amounts exceeding 100 MWh/year.

In addition to the feed-in system, CHP is promoted by tax exemptions. Units with maximum 2 MW of electricity generating capacity are exempted from the tax that autoproducers pay on electricity they generate for their own use (article 9 of Electricity Tax Law). In addition, CHP units with minimum 70% fuel efficiency receive exemptions from the mineral oil tax (article 25 of Mineral Oil Tax Law).

CRITIQUE

Market Reform

Germany is one of the five EU countries that have fully opened their retail electricity markets. Full market opening (in the legal sense) was achieved as early as 1998. It has led to significant price reductions for industrial and – to a lesser degree – household consumers. Nevertheless, network access remains problematic, dispute

settlement processes are slow and can be costly, and the incumbents can abuse of their dominant market position, especially in distribution because of insufficient unbundling. There has been some progress over the past year in addressing these problems, especially with the Associations Agreements. Some market players consider the lack of a sector-specific regulator a key problem. Others, of whom many are domestic incumbents, favour the current light-handed regulatory approach. The trend in consolidation and mergers that has been observed in the markets, particularly at the supra-regional level, is another issue that needs to be closely monitored; this trend appears to be a reaction to new competition in the market.

Competition is gradually growing in the different sectors of the electricity market. The impact of cross-border trade is still small and most of the competition is internal; companies that have been acquired by foreign investors play an important role in this regard. The problems that new suppliers who enter the German market face still arise essentially from difficulties in competing on equal terms with incumbents, the underlying complexity of the German market and customer loyalty to their local utilities.

Since market liberalisation, some 10 to 20% of large consumers and less than 5% of small consumers have changed their suppliers. Furthermore, according to the German Electricity Association (VDEW), about 25% of the consumers have worked out better contracts with their current suppliers. This can be seen in the evolution of prices in the different market segments; particularly at the beginning of market liberalisation, electricity prices declined. After 2000, prices increased for various reasons, including the higher subsidies paid to promote renewables and co-generation, changes in fuel prices, and the end of low, promotional prices offered by market players at the beginning of market liberalisation.

Germany is the only EU country that has chosen negotiated TPA as the primary means for electricity grid access. The reasons the German government gives for choosing negotiated TPA include the complex market structure in Germany and a preference for negotiation – to regulation – for achieving consensus and voluntary measures. The government considers that even introducing one transmission tariff just at the transmission level would be difficult given that there were eight privately owned supra-regional companies in 1998. However, in most other IEA countries, including those with a complex industry structure, the number of TSOs has been reduced and regulated TPA has been successfully implemented.

While negotiated TPA reduces the need for regulatory intervention and regulatory cost because access prices are determined through negotiation by market players, the process can be time-consuming and burdensome for small market players, and it can result in discriminatory access conditions. Several problems associated with network access persist in Germany. The high level and dispersion of TPA tariffs are still a concern. Furthermore, the tariffs are difficult to challenge in court. Also, because of inadequate unbundling, abusive corporate behaviour is possible. While complaints can be handled by cartel offices or brought to court, these procedures can take considerable time. All parties agree that the rules of negotiated TPA can be

further improved. It is important, however, that all parties who participate in Associations Agreement negotiations do so on an equal basis. Small consumer associations did not participate until AA II Plus was negotiated. While AA II does provide a framework under which small consumers can have access to the market, practical details to make access simpler for them still need to be worked out. Authorities should both closely monitor developments and widen the scope of their activities in this area. The government has recognised these problems and has established a special Task Force in the BMWi to find practical solutions.

Germany has not established a sectoral regulator for the electricity sector for the same reasons it has chosen negotiated, instead of regulated, TPA: the complexity of its market structure and an energy policy that is based on minimal regulatory interference. Most major market players are in favour of self-regulation by industry and wish to continue with such a system. Although Germany has had open energy markets since 1998 and has implemented the Associations Agreements since then, there are still access problems and the level of access tariffs is still high.

Since negotiations in the gas sector have led to a new agreement, the government will probably not establish a regulator. However, given that problems have persisted, and that negotiating effective agreements is difficult, the government could consider changing the regulatory framework. One alternative would be to establish a regulator who could set the access rules. Another option, which is more in line with the light-handed regulatory approach preferred by the government, would be for the government to involve itself in the negotiation of Associations Agreements, and to eventually make these legally binding. A specific body composed of both industry and governmental representatives could then propose improvements to the rules. The federal government has already established a suitable body for such a task within the BMWi, namely the Task Force for Network Access.

If consumers or suppliers need to report abusive market behaviour, the steps for making a claim should be simple, inexpensive, clear and well defined. Even though the FCO has managed to solve some cases effectively, it has limited resources. On the other hand, suing incumbents directly is a slow process, and involves significant costs to all parties involved. Because court procedures can be so time-consuming and expensive, some players may not choose this option even if they have a strong case, especially if they believe that the cost of bringing the case to court may be higher than the losses they will incur by inefficiencies of the market.

Independent transmission system operators (TSOs) are widely considered to be necessary for facilitating competition. The OECD Council of Ministers made the following recommendation in their meeting of April 2001 "... separate potentially competitive activities from regulated utility networks, and otherwise restructure as needed to reduce the market power of the incumbents..." With vertical separation, for instance, there is no longer an economic benefit for the owner of a grid monopoly to favour its generating activity. Vertical separation can thus limit the ability and incentive of grid monopolies to distort competition. Germany does not require electricity TSOs to unbundle their operations, only their accounts; however,

three supra-regional companies have legally unbundled their network operations voluntarily. Many regional and local distribution companies in Germany also generate electricity. This low level of mandatory unbundling is found in only a few other IEA countries, and little competition has developed there. Most IEA countries have chosen to establish independent TSOs and require legal unbundling, and some countries apply ownership unbundling. Still others require that distribution and retailing activities be unbundled. German legislation does not require unbundling the retailing and distribution activities of power utilities. Yet retailing is a potentially competitive activity. The lack of unbundling also leaves room for cross-subsidisation and discrimination. According to an analysis made by the FCO, there seem to be no significant cross-subsidies with regard to TPA tariffs in Germany. However, when there is no effective unbundling, monitoring the practices of such a large number of companies is extremely difficult.

Fewer and larger TSOs would be better positioned to incorporate system-wide congestion costs into transmission prices and to plan for cost-effective transmission expansion. Furthermore, if Germany were to reduce the number of TSOs, this would simplify the market structure and increase efficiency. For example, Canada and the United States are trying to reduce the number of TSOs by creating larger regional TSOs because they consider that these will operate more efficiently and facilitate competition. In this respect, it is positive that the merger of three German TSOs will reduce the number of TSOs from six to four by the end of this year. However, the government argues that TSOs in Germany are private entities and that it cannot interfere with their company structure.

According to comparative studies made by the European Commission, the German TPA tariffs in the low and medium-voltage networks are among the highest in the EU, and their dispersion is also a matter of concern. While the new monitoring procedure of the AA II Plus and the new agreed calculation guidelines will help to lower tariffs to a certain degree, this will put little downward pressure on network access prices as a whole. Competition authorities, by handing down market abuse decisions in major cases, could also be helpful in this respect.

Electricity prices for small consumers are relatively high in Germany. Only part of this can be explained by higher taxes. Information provided by electricity companies suggests that a very large share – some 80% – of the total electricity price that large industrial customers pay is attributable to generation and supply costs (these costs vary by supplier), and hence is contestable by competitors. However, only 18% of the electricity price paid by household customers of local utilities is contestable. This low contestable element of household electricity prices creates yet another difficulty for suppliers to compete effectively. Even when the higher cost burden that renewable energy and CHP programmes place on small consumers is taken into account, this contestable share for household consumers still seems low by international comparison (*e.g.* 50% in the UK). This suggests that fixed costs, including for network access, are disproportionately high. The German government cites several reasons to explain the high transmission tariffs. One reason is the high quality of the transmission networks. Another is their over-capacity. The networks now no longer transmit the electricity of five nuclear

power plants that were shut down (for security purposes) in the eastern part of the country following reunification.

Germany is currently not a member of the Council of European Energy Regulators because it does not have a regulator who would have the necessary jurisdiction to adhere to the decisions taken within this framework. This forum does not consider anti-trust authorities to be comparable to regulators, and therefore does not invite them to participate. Given the size of the German electricity market and its central location in Europe, this creates concerns over the effectiveness of establishing rules for electricity transmission at the European level. More German participation in this area would benefit the country, as this would make it possible for Germany to be more actively involved in decisions that affect its companies and consumers.

Access to services for balancing power is particularly important for new entrants. They do not know in advance exactly what the demand and load characteristics of their customers will be and yet they need to ensure that demand is covered at every moment. This continuous power balance is necessary so that they can secure their contracts with final consumers. In Germany, the TSOs themselves set the prices for balancing power and, apart from the general competition law, there is no mechanism to ensure that these prices are cost-reflective. Given that having access to this service is very important, especially for new entrants, the FCO took the initiative to investigate access conditions and practices. In order to avoid case-by-case decisions by the FCO, access rules for balancing power were included in the AA II Plus. In addition, the four largest TSOs will establish a tendering procedure for the procurement of balancing energy services by the end of 2002.

Most of the German networks and interconnections are not seriously congested, but some bottlenecks can be found. Adequate transmission capacity is an important precondition for creating competition in the electricity market. In Germany, transmission network owners and operators are fully responsible for the development of the networks, without any government supervision. There are therefore no mechanisms to ensure that the transmission networks and interconnections are on par with transmission needs. Many countries have addressed this issue by obliging TSOs/network owners to provide the regulator and/or government with a plan on how they intend to reinforce the networks. These plans become binding after the regulator and/or government has approved them. Such a procedure might be slightly cumbersome for Germany where the power companies have been fairly successful in providing needed transmission capacity, despite a few bottlenecks. However, the government should continue monitoring the situation closely. To make this task easier, the government could oblige TSOs to regularly provide information on their plans to reinforce networks.

There are as many as 900 companies operating in the electricity sector in Germany. Yet only four of them, the supra-regional companies, account for 80% of all electricity generation, and most of the imports. Since market liberalisation, the number of companies operating at the supra-regional level was reduced by half with the creation of E.ON, Vattenfall Europe and the merger of REW and VEW. The government should try to avoid further concentration in the electricity sector and

avoid new cross-shareholdings between electricity and gas companies. It is encouraging to see that the FCO has been watching the market carefully to ensure effective competition; this is apparent in its decision to disapprove of the merger between E.ON and Ruhrgas (see Chapter 8).

Co-generation and District Heating

The new CHP Act removes subsidies for new large-scale CHP plants, sets clearly defined deadlines for phasing out most other subsidies for CHP, and requires that CHP plants meet certain efficiency standards to qualify for subsidies. This is a commendable move. Establishing clearly defined efficiency requirements for CHP will help meet the environmental objectives that have been set by the act. However, there are still concerns over whether the bonus payments are the least-cost policy instrument for promoting co-generation, and whether they will be effective enough in increasing the use of CHP so as to achieve the emissions reduction targets that the government has set. Furthermore, the cost of CHP bonus payments is not distributed in an equitable manner among the consumers, resulting in a disproportionately heavy cost burden for smaller consumers. Efficient CHP can be competitive and does not need to be subsidised. Bonuses are currently paid only to existing CHP plants and small new plants. Small CHP plants, however, are generally more costly than large ones and may not be very competitive. Relying heavily on small CHP units to meet emissions reduction targets through greater use of CHP may thus be difficult. A way to address this problem without distorting the market would be to internalise the costs of avoiding CO_2 emissions. In this regard, policy instruments other than feed-in tariffs should be studied.

There are some technical alternatives that could make CHP more economical. One possibility would be to expand district heating (DH) systems in order to use more heat from CHP plants. Another would be to choose the size of CHP units more carefully according to heat demand. Despite the milder climate, specific heat consumption in residential buildings is clearly higher in Germany than, for example, in Denmark, Finland and Sweden (see Chapter 5). Co-generation and district heating are competitive in Finland and Sweden without subsidies; the situation is less clear in Denmark, where households are required to join district heating systems in some areas. Furthermore, compared to these three countries, Germany has a much higher population density,[34] which ought to improve the competitiveness of district heating. Currently, the number of households connected to DH systems in the Old Laender is only 8% compared to 28% in the New Laender. In Denmark and Finland about 50%, and in Sweden about 40%, of the whole building stock is connected to district heating. These factors suggest that more buildings could be connected to district heating in Germany, thus improving the competitiveness of DH systems. On the other hand, Germany has introduced ambitious targets and

34. Average population density is 230/km^2 in Germany, 123/km^2 in Denmark, 15/km^2 in Finland and 20/km^2 in Sweden.

new measures that could, in the longer term, significantly reduce specific heat consumption in buildings, creating a considerable risk for DH developers. This suggests that the size of CHP units should be carefully considered so that CHP production can be matched with heat load.

Nuclear Power

Germany has chosen to phase out nuclear power. The negotiated agreement between the government and the nuclear utilities entails no direct cost to the government and provides industry with some level of certainty and flexibility in implementation. However, by closing down its nuclear power plants over the next 20 years, Germany will not be able to enjoy the potential economic benefits of extending the operational lives of fully depreciated units.

The national energy policy implications of the decision to phase out nuclear power are quite significant. Replacing nuclear energy – which now covers 30% of electricity generation and 13% of TPES – poses a challenge to the three fundamental premises of national energy policy, namely economic growth, security of energy supply and environmental protection. The scenarios presented in the report "Sustainable Energy Policy to Meet the Needs of the Future" take into account the nuclear phase-out. The "business-as-usual" scenario assumes that nuclear power will be replaced by coal, gas and renewables, and that energy efficiency improvement will also play an important role in this regard. However, the technical and economic potential of renewables and the potential to increase energy efficiency are limited. In addition, generation from renewables tends to be intermittent and not suitable for baseload. The cost-effective alternatives may be to increase the use of gas, which would increase GHG emissions and the dependence on energy imports, or increase use of coal, which would also increase emissions.

In the short term, the nuclear power phase-out policy does not relieve government and industry of the responsibilities they now have for the ongoing nuclear energy programme. For many years to come there will be the need to ensure the safe operation and good management of German nuclear power plants and their support services. The means that are necessary for managing and disposing of radioactive materials will also have to be maintained and developed so that the needs of stakeholders can be met. The power plants will have to be decommissioned safely. Consequently, competence in the nuclear sector will need to be maintained for decades.

It is essential for the government to have a reliable estimate and clear sense of the consequences – including real costs and benefits – of the nuclear power phase-out. (This issue is discussed in detail in Chapter 3 on Energy Policy). Furthermore, it is important for the government to continue monitoring the impacts of the phase-out of nuclear power as these impacts will be felt gradually. As time goes by, there will be a better understanding of the possible alternatives to nuclear power and also of the incremental cost associated with the phase-out.

RECOMMENDATIONS

The Government of Germany should:

- ☐ Reinforce efforts to make the rules for network access as fair, simple, rapidly applicable and widely usable as possible. Monitor the effectiveness of these procedures, including appeal mechanisms, and address remaining shortcomings.

- ☐ Consider options for separating network operation from other activities of vertically integrated companies at different network levels in order to ensure that system operation is effectively independent from generation and other activities.

- ☐ Monitor concentration in the electricity market and avoid dominance of market players. In this regard, cross-shareholding between different network levels should be taken into account.

- ☐ Put in place mechanisms to ensure that there will be no cross-subsidisation and discrimination between the distribution and retailing businesses of distribution network operators, and to demonstrate that access conditions are fair.

- ☐ Continue to monitor the prices, their components and the structural reasons for price differences for various groups of consumers, and compare these with those found in other countries.

- ☐ Encourage the development of adequate interconnection and transmission capacity to facilitate cross-border trade.

- ☐ Evaluate the cost-effectiveness of policy alternatives to promote combined heat and power (CHP) production – and aim to reduce unreasonable costs – by doing, for example, an analysis of the bonuses that are granted under the feed-in tariff system. Evaluate the feasibility of expanding district heating systems to create an effective use for more heat from CHP plants; and compare this with the feasibility of using smaller CHP plants without expanding district heating networks.

- ☐ Incite market forces to develop other energy sources in a timely, economically and environmentally sound way to replace nuclear energy.

- ☐ Maintain national capability to assess future nuclear technology options.

- ☐ Assure the safety and operational performance of existing nuclear plants.

- ☐ Continue efforts to implement the planned interim and permanent arrangements for the management of radioactive materials.

11

RESEARCH AND DEVELOPMENT

ENERGY R&D PRIORITIES AND FUNDING OF THE FEDERAL GOVERNMENT

The federal government's energy R&D objectives are defined in its "Fourth Energy Research Programme" of 1996. The primary objective is to ensure that the energy supply is secure, affordable and environmentally benign, and that it produces less greenhouse gas emissions. The secondary objective is to develop high technology that will help to create professional jobs and enhance the competitiveness of German industry.

The federal government is trying to meet both objectives by focusing energy R&D on the following priority areas: increasing energy efficiency to reduce energy consumption; making electricity and heat production from fossil fuels more efficient (*e.g.* clean coal technologies); and improving the economics of renewables so that they can become alternatives to fossil fuels and nuclear energy. In addition, the government supports nuclear fusion technology because it wants to keep options for new energy sources open, and it continues to support activities on nuclear fission to improve the operational safety of existing nuclear power plants and nuclear waste management.

The key R&D areas and the breakdown of federal expenditure are as follows:

- **Energy efficiency:** In 2000, €9 million (7% of the federal non-nuclear energy R&D budget) was allocated to R&D for energy conservation. One of the activities is developing more energy-efficient heat pumps for industry and households.

- **Clean coal technologies:** In 2000, €9 million (7% of the federal non-nuclear energy R&D budget) was allocated to R&D for coal technologies. Much of this effort is focused on clean coal technologies, especially on: designing new power station concepts;[35] control and monitoring technologies; combustion technologies, including gas and steam turbines; and research in materials. These new technologies are being developed in collaboration with universities, research institutes, and industry.

- **Renewables:** In 2000, some €73 million (59% of federal non-nuclear energy R&D budget) was allocated to renewables R&D. About 67% of this amount was

35. One example is electricity generation by high-pressure pulverised fuel combustion of hard coal, which can reach over 55% fuel efficiency. Another example is electricity generation by high-pressure fluidised-bed combustion of lignite with over 50% fuel efficiency. Some €2.7 million was spent on this technology in 2001.

used on solar technologies, 21% on wind power technologies and the remainder mainly on biomass. Federal R&D spending on renewables concentrates on photovoltaics, especially on materials and system development, and optimisation of manufacturing processes. This includes the development of more efficient solar cells (*e.g.* thin-layered solar cells), the use of new materials (*e.g.* amorphous silicon and copper-indium-selenid), and increasing automation in manufacturing processes. During 1974-2000, about €163 million was spent on developing wind power technologies. In the future, wind power R&D will concentrate on offshore technologies. The Federal Ministry of Consumer Protection and Food has supported biomass R&D with €14.5 million in 1998-2001. Most of this support has gone to developing the use of plant oils ("biodiesel") in combustion engines. A governmental agency specialised in energy crops and renewable raw materials supports R&D on solid biomass, and directs most of the funds to projects that have been implemented by manufacturers of furnace units. Germany co-operates with France and the EU in R&D on geothermal energy. At present, the main collaboration project is the hot dry rock geothermal project in Alsace.

- **Nuclear fission and fuel cycle:** The governmental budget for R&D for nuclear fission and fuel cycle was reduced from €78 million in 1993 to €23 million in 2000. At present, two-thirds of the funding goes to nuclear safety and the rest to radioactive waste disposal. In the future, R&D will concentrate on phasing out nuclear energy and finding a domestic location for the final storage of radioactive waste. As many of the nuclear power units will continue to operate for 20 years, efforts are being made to maintain their safety and to develop waste management solutions, including the construction and operation of intermediate storage facilities. In March 2000, the Federal Institute for Geo-sciences and Natural Resources, together with universities and research institutes specialised in nuclear technologies, established the "Network for Competence in Nuclear Technology" (*Kompetenzverbund Kerntechnik*) to keep German competence in nuclear technology up to date. Germany continues to co-operate closely on nuclear energy with other countries within the framework of the European Union and under bilateral co-operation programmes.

- **Nuclear fusion:** The federal government supports R&D in nuclear fusion with over €100 million each year. Additional financial support is provided by the European Union. At present, German research in nuclear fusion is mostly devoted to working on an international collaborative effort to develop and test two different plasma containment concepts, namely Tokomak and Stellarator. A large-scale test facility on the Tokomak process is currently in operation in England (JET – Joint European Torus), and the research partners are trying to develop a commercial reactor, ITER. A large-scale test model, W7x, is now being built in Greifswald in Germany to test Stellarator technology, and it may be commissioned in 2006.

In 2000, €21 million (17% of the federal non-nuclear energy R&D budget) was used for electric power conversion and/or energy storage, and €11 million (9%) for "other R&D activities". These include energy systems analysis, fuel cells, and the application

of results from other research areas (*e.g.* material research on super-conductivity) to energy R&D.

German non-nuclear energy R&D budgets have decreased significantly over the past decade (Table 15). In 2000, the non-nuclear energy R&D budget was €123 million. BMWi considers that the minimum sustainable expenditure level that will be needed in the future to achieve the objectives of non-nuclear energy R&D is €120 million/year. The R&D budget for nuclear fission technology has also declined in the 1990s. In 2000, total expenditure in nuclear R&D was €145 million. For 2001 the estimated budget for nuclear R&D was €126 million, and for 2002 it is €121 million.

The estimated federal budget for non-nuclear R&D for 2001 (€165 million) and the planned budget for 2002 (€150 million) are higher than the 2000 budget because new funds – in addition to those indicated in the Fourth Energy Research Programme – have been budgeted. In 2001 the federal government realised that the funding that had been provided over recent years was not adequate to meet energy R&D objectives, and so it launched the "Investing in the Future Programme" with a budget of €153 million for 2001-2003. These funds are matched with contributions from companies that do the R&D, which increases the total budget of the programme to over €250 million. This new government funding is allocated as follows:

- €63 million to fuel cells (stationary and mobile applications).
- €15 million to alternative vehicle propulsion (*e.g.* high-performance batteries) and regenerative fuel production (*e.g.* hydrogen and methanol).
- €15 million to geothermal energy projects.
- €15 million to offshore wind energy (3 research platforms for offshore wind parks).
- €15 million to improve energy efficiency in existing buildings.
- €30 million to energy R&D projects of the Federal Ministry of the Environment, Nature Protection and Nuclear Safety.

Table 15
Federal Government Energy R&D Budget
(million euros)

	1993	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001e*	*2002e*
Non-nuclear	170	130	105	135	114	122	106	123	165[1]	150[1]
Nuclear fission	78	66	66	52	37	36	20	23	16	8.5
Nuclear fusion	118	104	91	99	108	122	126	122	110	112
Total	**366**	**300**	**262**	**285**	**259**	**280**	**252**	**269**	**292**	**271**

e: estimate.

1. Includes financing from the "Investing in the Future Programme".

Source: Country submission.

The German energy R&D budget is among the highest of the IEA countries. During 1995-1999, German expenditure on energy R&D was fourth or fifth-highest after Japan, the United States, France, and Italy or Canada, depending on the year. In spite of this relatively high R&D budget, however, German R&D expenditure on energy is relatively low compared with GDP. In this regard, Germany ranked about 13th in 1999 among IEA Member countries,[36] both when nuclear R&D was taken into account and when it was not.

ENERGY R&D INSTITUTIONS

Until 1998, energy research and development was under the responsibility of the Federal Ministry of Education and Research. In 1998, most of the responsibility for energy R&D was transferred to the Federal Ministry of Economics and Technology. The Federal Ministry of Consumer Protection, Food and Agriculture is responsible for R&D in biomass. The Federal Ministry of the Environment, Nature Conservation and Nuclear Safety is responsible for R&D in radiation protection, and the Federal Ministry of Education and Research is responsible for nuclear fusion R&D.

In Germany, the private sector has primary responsibility for energy R&D, and the government provides support to areas where long-term efforts are required and risks are high. This government support can come from the federal government, the Laender governments or from various federal and Laender foundations that are financed with public funding.

Federal aid is offered to programmes that are of national interest and the Laender provide aid to programmes that concern a given Land. The federal government finances both R&D projects and the operation of certain R&D institutions. Projects are selected in specific priority areas and given fixed-term financial support. The government supports the operation of R&D institutions that conduct basic research which could provide a basis for applied research. The federal programmes are open to both scientific institutions and private companies, and projects that call for co-operation between academia and industry are encouraged. The federal government has established many joint projects with industry not only to share costs, but mainly also to help introduce new energy technologies to the market more quickly.

The Laender programmes, and programmes run by some municipalities, focus primarily on demonstration projects for new technologies. The principal objective of the Laender programmes often is to provide a link between academia and industry in order to facilitate the deployment of new technologies. Many of these programmes operate in the fields of building modernisation and renewable energy systems, especially photovoltaics and solar thermal systems. An exception is the

36. Information for both non-nuclear and nuclear R&D budget per GDP was not available for Australia, the Czech Republic, Greece, Ireland, Italy and Korea.

Bavarian hydrogen initiative, which is not a demonstration programme. It supports various hydrogen projects with the aim of improving the efficiency and economic viability of hydrogen technology.

In Germany, a number of universities are active in energy R&D, as are some large research facilities, such as the Fraunhofer-Gesellschaft and the Helmholtz Institutes. Contrary to the Max-Planck Institute, these research institutes are oriented more towards applied R&D than basic research.

INTERNATIONAL COLLABORATION

Germany participates in many of the IEA's Implementing Agreements.[37] It is particularly interested in the fields of end-use technologies, renewables and nuclear fusion. The federal government would like to increase German participation in the Implementing Agreements on fossil fuels, but so far has not managed to do so because of a lack of support by industry. Germany has also been collaborating with international partners on EU research programmes. Furthermore, Germany co-operates with non-OECD countries in technology transfer, particularly in the field of renewable energies.

CRITIQUE

In many cases, government support for energy R&D has other policy objectives than meeting energy policy goals. In Germany, government R&D support has emphasised industrial development and economic growth, along with meeting energy policy objectives. Often these objectives can be achieved simultaneously. A potential problem, however, is that when many different policy objectives are sought at the same time, clear targets for projects may become obscured. Consequently, it may become difficult to assess the performance of R&D programmes. Yet, in order to use resources efficiently, it is essential to set clear objectives and goals for R&D programmes, and regularly evaluate the programmes to see if they are meeting their goals. This is particularly true when programmes are designed to help pursue challenging energy policy objectives, such as meeting international and domestic environmental targets, or phasing out nuclear power.

37. Germany participates in the following IEA Implementing Agreements: Advanced Fuel Cells; Advanced Materials for Transportation; Buildings and Community Systems; Coal Combustion Science; District Heating and Cooling; Emission Reduction in Combustion; Energy Storage; Energy Technology Data Exchange (ETDE); Energy Technology Systems Analysis (ETSAP); Geothermal Energy; Heat Pumping Technologies; Photovoltaic Power Systems; Solar Heating and Cooling; SolarPACES; Superconductivity; and Wind Turbine Systems. Germany participates in all the Implementing Agreements on nuclear fusion through Euratom.

In 2000, the federal government spent 18% of its entire energy R&D budget on photovoltaics and 45% on nuclear fusion technology. In Germany, only a small part of the technical potential for photovoltaics has been exploited, but photovoltaics are not expected to gain competitiveness in Germany, even in the medium term (as compared to other energies or other renewables), despite substantial R&D efforts. It appears that the primary driver of government support for R&D on photovoltaics is industrial and trade policy rather than energy policy. As for R&D on nuclear fusion, it is understandable that a country with energy supply concerns for the long run and a strong technology base wants to explore fusion technology, which may prove to have enormous potential in several decades. However, the important policy issue here is how such long-term interests can be balanced with short- and medium-term interests, especially when allocating the limited federal funds that are available for energy R&D.

The phase-out of nuclear power poses many challenges, also with respect to technology. Nuclear waste disposal issues will remain, even after all plants have been shut down, and technology will play a very important role here. Maintaining adequate technological competence to safely operate the nuclear power plants throughout their life is also necessary. The government recognises the importance of keeping abreast of technological development in these areas. However, it should also determine if the current federal R&D programmes, together with R&D efforts by industry, are adequate to ensure that technological competence over coming decades will be able to support the phase-out of nuclear power. Such a review should consider the possibility of drawing expertise from other countries as an alternative to developing a domestic expertise base.

Clean coal technologies have been identified as one of the key areas for government R&D support, but received only 7% of the federal non-nuclear R&D budget in 2000. Given the need to develop alternatives for nuclear power while reducing GHG emissions, this share of government support for clean coal technologies appears too small.

The government has announced ambitious targets for increasing offshore wind power. This will create new technological challenges, yet many issues still have to be resolved regarding onshore wind power. Particularly in the long term, when wind may take up a greater share of the energy supply, the variable nature of the wind resource will need to be addressed through measures such as modified systems operation, hybrid systems with other technologies and energy storage. Other challenges are related to transmission technology for offshore wind power. While onshore wind power has become almost competitive under favourable wind conditions, the cost of offshore wind power is more uncertain. As there are plans to significantly increase wind power capacity, particularly offshore, the implications for R&D should be carefully assessed. Wind power technologies have reached relative maturity, and it does not necessarily follow that government expenditure should increase; however, industry could play a more significant role.

One of the key challenges posed by the phase-out of nuclear power is developing alternative energy sources that can replace nuclear power in electricity

production, that do not endanger security of supply nor increase the cost of electricity, and that have low emissions and environmental impacts. Today, alternatives with low or no emissions are either expensive, limited in supply, or have a problem of intermittence. Economic alternatives emit GHG and pollutants. The government emphasises energy efficiency improvements in its energy policy, but such improvements are in many cases partially offset by greater energy use for a better quality of life, or by driving bigger cars or driving more. While the challenges posed by the phase-out of nuclear power are very significant, they will happen over a fairly long time, and so technology can play an important role in developing effective alternatives. It would be useful to carry out a comprehensive assessment of technology options in order to identify how government R&D policy could best support such options. A careful selection process, including quantitative systems analysis methodology, was used to choose the main technologies for the "Fourth Energy Research Programme for 1996-2005". Given that new challenges have come to the forefront and that the Research Programme will expire in 2005, assessing the programme and bringing it up to date would be very helpful.

Germany is seeking to simultaneously phase out nuclear power, achieve an ambitious GHG reduction target and continue large-scale use of coal and lignite. Analyses presented in the Energy Report show that electricity demand is growing despite energy efficiency measures now in place. Germany will not only need to replace 171 TWh of electricity that is currently generated by nuclear power, but it will also have to develop new sources of baseload power.

Germany has not defined how nuclear power will be replaced. While possible alternatives to nuclear power include new energy efficiency measures, increasing use of renewables, gas and coal, and increasing electricity imports, it is not clear exactly which role each – or combination – of these energy sources could play. For example, Germany plans to develop renewable energy sources more, particularly wind power, to replace nuclear energy. However, wind power is only partially suited for baseload generation because of its limited reliability and consequent need for back-up power (*i.e.* gas). The share of gas in electricity generation is likely to grow, but the government policy is to diversify energy sources because of perceived supply and price risks. In any case, a greater use of natural gas would increase GHG emissions compared with nuclear power. Electricity imports could make a significant contribution, but the feasibility of relying on imports for the amount of electricity that would be required to replace nuclear power should be evaluated carefully before taking this course of action. Relying on imports from France would simply replace domestic nuclear power with imported nuclear power.

Regardless of the decision to phase out nuclear power, Germany intends to continue using domestic coal and lignite as it considers these energy sources to be essential for ensuring energy security (see Chapter 7). Also, coal imports have been increasing. Given the limitations of other alternatives, coal would be a cost-effective means of replacing nuclear capacity, but at the cost of significantly increasing GHG emissions above the level achievable with continued use of nuclear power.

The problem is to achieve compatibility with the environmental goal of reducing GHG emissions. Germany is looking closely at some available technologies that are considered to be a potentially competitive means of reducing GHG emissions from coal-fired power generation. Advanced combustion technologies, for example, can raise the thermal efficiency of coal and lignite use. Germany is active in this area of R&D. If the average thermal efficiency of 38.5% of coal and lignite use in 1999 could be increased to around 55%, some 121 TWh of nuclear generation could be replaced by coal without increasing GHG emissions. While at this level of efficiency emissions would still be high, in combination with carbon sequestration,[38] coal-fired power could reduce carbon emissions to the level required. A broad-based and aggressive approach to developing and deploying clean coal technologies along the whole coal chain, from mining to carbon disposal, would be necessary for coal to become a satisfactory replacement for nuclear power.

The cost-effectiveness of this approach would need to be considered alongside other options. For example, the US Department of Energy estimates that the cost of carbon sequestration using present technology is in the range of US$ 100 to 300/tonne of carbon emissions avoided, but opportunities for significant cost reduction may exist. Therefore, it has launched a research programme with an objective to reduce the cost of carbon sequestration to under US$ 10 per tonne by 2015.

RECOMMENDATIONS

The Government of Germany should:

- ☐ Ensure that there is a good balance between short-term and long-term R&D programmes. In particular, clarify the role of R&D in light of the nuclear power phase-out, and ensure that adequate resources are made available by the government and industry to support R&D in this area as needed.

- ☐ Given the importance of coal in the German fuel mix and the likely expansion of coal-fired power to replace existing nuclear capacity, give higher priority to R&D for clean coal technologies, including carbon sequestration.

38. Carbon sequestration means carbon capture, separation and storage or reuse. The technology can be used to reduce GHG emissions while allowing the continued use of fossil fuels.

A

ANNEX

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

	1973	1990	1999	2000	2005	2010	2020
TOTAL PRODUCTION	**171.7**	**185.5**	**136.5**	**134.3**	**124.3**	**116.9**	**..**
Coal [1]	141.4	121.8	62.2	59.2	52.6	51.0	..
Oil	6.8	4.7	3.4	3.9	2.0	1.6	..
Gas	16.4	13.5	16.7	15.8	14.4	13.1	..
Comb. Renewables & Wastes [2]	2.5	4.1	7.7	8.4	7.8	8.3	..
Nuclear	3.2	39.8	44.3	44.2	44.2	39.1	..
Hydro	1.3	1.5	1.7	1.9	1.8	1.9	..
Geothermal	–	0.0	0.0	0.0	–	–	..
Solar / Wind / Other	–	0.0	0.6	0.9	1.4	2.0	..
TOTAL NET IMPORTS [3]	**167.3**	**165.4**	**202.1**	**201.1**	**226.6**	**233.5**	**..**
Coal [1] Exports	18.3	8.2	0.4	0.4	0.2	0.1	..
Imports	15.2	11.5	17.8	19.2	23.7	23.1	..
Net Imports	–3.1	3.3	17.3	18.8	23.5	23.0	..
Oil Exports	9.9	10.2	18.7	22.2	14.8	14.6	..
Imports	171.1	132.9	148.1	149.6	155.4	154.7	..
Bunkers	4.1	2.5	2.1	2.2	1.9	1.8	..
Net Imports	157.1	120.2	127.4	125.2	138.7	138.4	..
Gas Exports	0.1	0.9	4.3	4.2	2.7	2.9	..
Imports	12.4	42.7	61.6	61.1	66.2	74.1	..
Net Imports	12.3	41.7	57.3	56.8	63.5	71.2	..
Electricity Exports	0.7	2.6	3.4	3.6	1.9	1.7	..
Imports	1.7	2.7	3.5	3.9	2.8	2.6	..
Net Imports	1.0	0.1	0.1	0.3	0.9	0.9	..
TOTAL STOCK CHANGES	**–1.1**	**4.7**	**2.4**	**4.3**	**–**	**–**	**..**
TOTAL SUPPLY (TPES)	**337.9**	**355.5**	**341.0**	**339.6**	**350.8**	**350.4**	**..**
Coal [1]	139.4	128.5	79.7	80.6	76.1	74.0	..
Oil	161.9	126.5	135.1	131.6	140.7	140.0	..
Gas	28.7	55.0	72.0	71.8	78.0	84.2	..
Comb. Renewables & Wastes [2]	2.5	4.1	7.7	8.4	7.8	8.3	..
Nuclear	3.2	39.8	44.3	44.2	44.2	39.1	..
Hydro	1.3	1.5	1.7	1.9	1.8	1.9	..
Geothermal	–	0.0	0.0	0.0	–	–	..
Solar / Wind / Other	–	0.0	0.6	0.9	1.4	2.0	..
Electricity Trade [4]	1.0	0.1	0.1	0.3	0.9	0.9	..
Shares (%)							
Coal	*41.2*	*36.2*	*23.4*	*23.7*	*21.7*	*21.1*	*..*
Oil	*47.9*	*35.6*	*39.6*	*38.7*	*40.1*	*39.9*	*..*
Gas	*8.5*	*15.5*	*21.1*	*21.1*	*22.2*	*24.0*	*..*
Comb. Renewables & Wastes	*0.7*	*1.2*	*2.2*	*2.5*	*2.2*	*2.4*	*..*
Nuclear	*0.9*	*11.2*	*13.0*	*13.0*	*12.6*	*11.2*	*..*
Hydro	*0.4*	*0.4*	*0.5*	*0.6*	*0.5*	*0.5*	*..*
Geothermal	–	–	–	–	–	–	*..*
Solar / Wind / Other	–	–	*0.2*	*0.3*	*0.4*	*0.6*	*..*
Electricity Trade	*0.3*	–	–	*0.1*	*0.3*	*0.3*	*..*

0 is negligible, – is nil, .. is not available.

Please note: All data include the new Laender of Germany. In the forecast data, gas works gas is included with coal instead of with gas. Statistical differences in both coal and gas are due to differences between production and consumption in the German "Energiebilanzen". Forecasts are based on the 1999 submission.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1999	2000	2005	2010	2020
TFC	**246.6**	**246.6**	**243.7**	**244.9**	**260.0**	**261.7**	**..**
Coal[1]	53.1	37.3	10.6	10.3	13.2	11.6	..
Oil	138.2	117.7	125.3	122.8	131.0	130.3	..
Gas	21.1	41.0	54.3	57.3	59.6	61.7	..
Comb. Renewables & Wastes[2]	1.7	2.3	5.0	5.4	4.3	4.3	..
Geothermal	–	0.0	0.0	0.0	–	–	..
Solar/Wind/Other	–	0.0	0.1	0.1	0.3	0.5	..
Electricity	26.9	39.1	40.2	42.2	42.9	44.6	..
Heat	5.5	9.1	8.2	6.8	8.6	8.6	..
Shares (%)							
Coal	*21.5*	*15.1*	*4.3*	*4.2*	*5.1*	*4.4*	..
Oil	*56.0*	*47.7*	*51.4*	*50.2*	*50.4*	*49.8*	..
Gas	*8.6*	*16.6*	*22.3*	*23.4*	*22.9*	*23.6*	..
Comb. Renewables & Wastes	*0.7*	*0.9*	*2.0*	*2.2*	*1.6*	*1.6*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	*0.1*	*0.2*	..
Electricity	*10.9*	*15.9*	*16.5*	*17.2*	*16.5*	*17.1*	..
Heat	*2.2*	*3.7*	*3.4*	*2.8*	*3.3*	*3.3*	..
TOTAL INDUSTRY[5]	**105.9**	**88.7**	**76.9**	**81.0**	**86.4**	**88.8**	**..**
Coal[1]	28.7	20.7	9.2	9.0	12.2	11.0	..
Oil	46.9	27.3	28.0	27.9	30.9	31.8	..
Gas	13.3	19.7	20.9	23.4	23.3	25.1	..
Comb. Renewables & Wastes[2]	0.0	–	–	–	0.3	0.3	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	15.3	18.6	17.7	19.7	18.1	18.9	..
Heat	1.6	2.4	1.1	0.9	1.6	1.7	..
Shares (%)							
Coal	*27.1*	*23.3*	*11.9*	*11.2*	*14.1*	*12.3*	..
Oil	*44.3*	*30.8*	*36.4*	*34.5*	*35.7*	*35.9*	..
Gas	*12.6*	*22.2*	*27.2*	*28.9*	*27.0*	*28.3*	..
Comb. Renewables & Wastes	–	–	–	–	*0.3*	*0.3*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*14.5*	*21.0*	*23.0*	*24.4*	*21.0*	*21.3*	..
Heat	*1.5*	*2.7*	*1.4*	*1.1*	*1.9*	*1.9*	..
TRANSPORT[6]	**39.7**	**60.0**	**68.3**	**67.2**	**67.3**	**67.4**	**..**
TOTAL OTHER SECTORS[7]	**101.0**	**97.9**	**98.5**	**96.7**	**106.2**	**105.5**	**..**
Coal[1]	22.7	16.6	1.4	1.3	1.0	0.7	..
Oil	54.2	31.6	30.4	29.1	34.5	33.0	..
Gas	7.8	21.3	33.4	33.9	36.3	36.6	..
Comb. Renewables & Wastes[2]	1.7	2.3	5.0	5.4	3.9	3.9	..
Geothermal	–	0.0	0.0	0.0	–	–	..
Solar/Wind/Other	–	0.0	0.1	0.1	0.3	0.5	..
Electricity	10.7	19.3	21.1	21.1	23.2	24.0	..
Heat	3.9	6.7	7.1	5.9	7.0	6.9	..
Shares (%)							
Coal	*22.5*	*16.9*	*1.4*	*1.3*	*1.0*	*0.6*	..
Oil	*53.6*	*32.3*	*30.9*	*30.0*	*32.5*	*31.3*	..
Gas	*7.7*	*21.8*	*33.9*	*35.1*	*34.2*	*34.6*	..
Comb. Renewables & Wastes	*1.7*	*2.3*	*5.1*	*5.6*	*3.7*	*3.7*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	*0.1*	*0.1*	*0.3*	*0.5*	..
Electricity	*10.6*	*19.8*	*21.4*	*21.8*	*21.8*	*22.8*	..
Heat	*3.9*	*6.9*	*7.2*	*6.1*	*6.6*	*6.5*	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1999	2000	2005	2010	2020
ELECTRICITY GENERATION[8]							
INPUT (Mtoe)	**98.6**	**141.2**	**132.0**	**132.4**	**129.3**	**128.8**	**..**
OUTPUT (Mtoe)	**32.2**	**47.1**	**47.3**	**48.8**	**49.4**	**51.4**	**..**
(TWh gross)	374.4	547.6	550.3	567.1	574.9	598.0	..
Output Shares (%)							
Coal	*69.0*	*58.8*	*52.0*	*52.7*	*51.9*	*50.5*	..
Oil	*12.0*	*1.9*	*1.1*	*0.8*	*0.8*	*0.8*	..
Gas	*10.9*	*7.4*	*10.0*	*9.3*	*9.8*	*14.5*	..
Comb. Renewables & Wastes	*0.8*	*0.9*	*1.5*	*1.8*	*2.2*	*2.7*	..
Nuclear	*3.2*	*27.8*	*30.9*	*29.9*	*29.5*	*25.1*	..
Hydro	*4.1*	*3.2*	*3.6*	*3.8*	*3.6*	*3.6*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	*0.0*	*1.0*	*1.7*	*2.2*	*2.9*	..
TOTAL LOSSES	**90.7**	**112.0**	**98.6**	**99.6**	**89.1**	**86.5**	**..**
of which:							
Electricity and Heat Generation[9]	60.0	83.4	75.6	76.1	71.4	69.3	..
Other Transformation	7.0	8.0	5.1	5.8	1.0	0.9	..
Own Use and Losses[10]	23.7	20.5	17.8	17.7	16.7	16.3	..
Statistical Differences	**0.5**	**–3.0**	**–1.2**	**–4.9**	**1.8**	**2.2**	**..**

INDICATORS

	1973	1990	1999	2000	2005	2010	2020
GDP (billion 1995 US$)	1574.08	2270.26	2608.14	2686.50	2966.11	3274.83	..
Population (millions)	78.96	79.36	82.09	82.17	79.70	78.60	..
TPES/GDP[11]	0.21	0.16	0.13	0.13	0.12	0.11	..
Energy Production/TPES	0.51	0.52	0.40	0.40	0.35	0.33	..
Per Capita TPES[12]	4.28	4.48	4.15	4.13	4.40	4.46	..
Oil Supply/GDP[11]	0.10	0.06	0.05	0.05	0.05	0.04	..
TFC/GDP[11]	0.16	0.11	0.09	0.09	0.09	0.08	..
Per Capita TFC[12]	3.12	3.11	2.97	2.98	3.26	3.33	..
Energy-related CO_2 Emissions (Mt CO_2)[13]	1058.7	964.1	830.7	833.0	838.6	838.5	..
CO_2 Emissions from Bunkers (Mt CO_2)	21.8	22.1	27.1	28.6	27.7	27.5	..

GROWTH RATES (% per year)

	73–79	79–90	90–99	99-00	00–05	05–10	10–20
TPES	1.5	–0.4	–0.5	–0.4	0.7	–0.0	..
Coal	–0.2	–0.6	–5.2	1.2	–1.1	–0.6	..
Oil	–0.1	–2.2	0.7	–2.6	1.4	–0.1	..
Gas	10.2	0.6	3.0	–0.2	1.6	1.6	..
Comb. Renewables & Wastes	6.2	1.2	7.2	9.9	–1.5	1.3	..
Nuclear	27.5	10.3	1.2	–0.2	–0.0	–2.4	..
Hydro	3.2	–0.5	1.3	10.6	–0.9	0.8	..
Geothermal	–	–	4.0	–	–	–	..
Solar/Wind/Other	–	–	49.3	62.7	9.5	6.9	..
TFC	1.2	–0.7	–0.1	0.5	1.2	0.1	..
Electricity Consumption	3.8	1.4	0.3	5.0	0.3	0.8	..
Energy Production	1.0	0.2	–3.3	–1.6	–1.5	–1.2	..
Net Oil Imports	0.2	–2.5	0.6	–1.7	2.1	–0.0	..
GDP	2.4	2.1	1.6	3.0	2.0	2.0	..
Growth in the TPES/GDP Ratio	–0.8	–2.4	–2.0	–3.3	–1.3	–2.0	..
Growth in the TFC/GDP Ratio	–1.1	–2.7	–1.7	–2.4	–0.8	–1.8	..

Please note: Rounding may cause totals to differ from the sum of the elements.

Footnotes to Energy Balances and Key Statistical Data

1. Includes lignite.
2. Comprises solid biomass, liquid biomass, biogas, industrial waste and municipal waste. Data are often based on partial surveys and may not be comparable between countries.
3. Total net imports include combustible renewables and waste.
4. Total supply of electricity represents net trade.
5. Includes non-energy use.
6. Includes less than 1% non-oil fuels.
7. Includes residential, commercial, public service and agricultural sectors.
8. Inputs to electricity generation include inputs to electricity, CHP and heat plants. Output refers only to electricity generation.
9. Losses arising in the production of electricity and heat at public utilities and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of 33% for nuclear and 100% for hydro.
10. Data on "losses" for forecast years often include large statistical differences covering differences between expected supply and demand and mostly do not reflect real expectations on transformation gains and losses.
11. Toe per thousand US dollars at 1995 prices and exchange rates.
12. Toe per person.
13. "Energy-related CO_2 emissions" have been estimated using the IPCC Tier I Sectoral Approach. In accordance with the IPCC methodology, emissions from international marine and aviation bunkers are not included in national totals. Projected emissions for oil and gas are derived by calculating the ratio of emissions to energy use for 2000 and applying this factor to forecast energy supply. Future coal emissions are based on product-specific supply projections and are calculated using the IPCC/OECD emission factors and methodology.

B

ANNEX

INTERNATIONAL ENERGY AGENCY
"SHARED GOALS"

The Member countries* of the International Energy Agency (IEA) seek to create the conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants.

In order to secure their objectives they therefore aim to create a policy framework consistent with the following goals:

1 **Diversity, efficiency and flexibility within the energy sector** are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2 Energy systems should have **the ability to respond promptly and flexibly to energy emergencies.** In some cases this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.

3 **The environmentally sustainable provision and use of energy** is central to the achievement of these shared goals. Decision-makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should where practicable have regard to the Polluter Pays Principle.

4 **More environmentally acceptable energy sources** need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of

* Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, the Republic of Korea, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.

IEA Members wish to retain and improve the nuclear option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

5 **Improved energy efficiency** can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6 **Continued research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

7 **Undistorted energy prices** enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8 **Free and open trade** and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9 **Co-operation among all energy market participants** helps to improve information and understanding, and encourage the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at their 4 June 1993 meeting in Paris.)

C

ANNEX

GLOSSARY AND LIST OF ABBREVIATIONS

In this report, abbreviations are substituted for a number of terms used in the International Energy Agency. While these terms generally have been written out on first mention and subsequently abbreviated, this glossary provides a quick and central reference for many of the abbreviations used.

AA	Associations Agreement.
bcm	billion cubic metres.
BAFA	Federal Office of Economics and Export Control.
BDI	Federation of German Industries.
BEI	Bremer Energieinstitut.
BEWAG	Berliner Kraft und Licht AG.
BMU	Federal Ministry of the Environment, Nature Conservation and Nuclear Safety.
BMWi	Federal Ministry of Economics and Technology.
CCGT	combined cycle gas turbine.
CHP	combined production of heat and power, or "co-generation".
CO_2	carbon dioxide.
DENA	German Energy Agency.
DH	district heating.
DIW	Deutsches Institut für Wirtschaftsforschung.
DSK	Deutsche Steinkohle AG.
EBV	Erdölbevorratungsverband (oil stockholding agency).
EC	European Commission.
ECSC	European Coal and Steel Community.
EEX	European Power Exchange.
EnBW	Energie Baden Württemberg AG.
EU	European Union.
EWI	Energy Sector Institute.
FCO	Federal Cartel Office.
GDP	gross domestic product.
GHG	greenhouse gas (see footnote 6).

GTE	European Association of Gas Transmission Operators.
GW	gigawatt, or one watt × 10^9.
GWh	gigawatt-hour = one gigawatt × one hour.
HEW	Hamburgische Electrizitäts-Werke AG.
IEA	International Energy Agency.
IGCC	integrated coal gasification combined cycle.
IPCC	Intergovernmental Panel on Climate Change
ISI	Fraunhofer Institute of Systems and Innovation Research
KfW	Kreditanstalt für Wiederaufbau.
kt	thousand tonnes.
kV	kilovolt, or one volt × 10^3.
kWh	kilowatt-hour = one kilowatt × one hour.
LAUPAG	Lausitzer Braunkohle AG.
LNG	liquefied natural gas.
LPX	Leipzig Power Exchange.
m^2	square metre.
m^3	cubic metre.
mbar	millibar, or one bar × 10^{-3}.
mcm	million cubic metres.
MIBRAG	Mitteldeutsche Braunkohlengesellschaft mbH.
Mt	million tonnes.
Mtce	million tonnes of coal equivalent (one Mtce = 0.7 Mtoe).
Mtoe	million tonnes of oil equivalent; see toe.
MW	megawatt, or one watt × 10^6.
MW_e	megawatt of electrical capacity.
MWh	megawatt-hour = one megawatt × one hour.
NGO	non-governmental organisation.
Nm^3	normal cubic metre.
OECD	Organisation for Economic Co-operation and Development.
PFBC	pressurised fluidised bed combustion.
ppm	parts per million.

R&D	research and development; may include the demonstration and dissemination phases as well.
SC	supercritical pulverised combustion.
TFC	total final consumption of energy.
TJ	terajoule, or one joule $\times 10^{12}$.
toe	tonne of oil equivalent, defined as 10^7 kcal.
TPA	third-party access.
TPES	total primary energy supply.
TSO	Transmission System Operator.
TW	terawatt, or one watt $\times 10^{12}$.
TWh	terawatt-hour = one terawatt $\times$ one hour.
USC	ultra-supercritical pulverised combustion.
VAT	value-added tax.
VEAG	Vereinigte Energiewerke AG.
VDEW	German Electricity Association.
VNG	Verbundnetz Gas AG.

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