IV Policies and measures

IV.1 General and political framework and greenhouse-gas reduction targets

The Federal Government was early in developing a comprehensive climate-protection strategy. The Federal Government's climate-protection programme includes measures for reducing emissions of CO_2 and other greenhouse gases such as CH_4, N_2O, HFCs, PFCs and SF_6, as well as measures for maintaining and expanding CO_2 storage in forests and wood products. The Federal Government's climate-protection programme is also being refined at regular intervals and implemented on an ongoing basis.

The 5th report on climate-protection strategy, which was published in October 2000, again emphasises that the Federal Government's national climate-protection policy is oriented to the following aims:

IV.1.1 Reduction of carbon-dioxide emissions

The Federal Government continues to uphold its aim of reducing CO_2 emissions by 25 %, by 2005, with respect to their level in 1990. The aim formulated for 2005 is an important intermediate step within the meaning of the "demonstrable progress" called for by the Kyoto Protocol.

IV.1.2 Reduction of emissions of so-called "Kyoto gases" (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6)

Within the framework of the burden-sharing agreed on in 1998 by the Member States of the European Union, the Federal Government has committed itself to reducing, during the period 2008 to 2012, emissions of the six so-called "Kyoto gases" (calculated as CO_2 equivalents pursuant to IPCC) by 21 % with respect to their levels in 1990/95. With this commitment, Germany is contributing very significantly to fulfillment of the European Union's commitment, as entered into in Kyoto, to reduce the European Union's greenhouse-gas emissions by a total of 8 %, with respect to the relevant level in 1990, during the first commitment period, 2008/ 2012.

Medium-to-long-term aims

National and international climate-protection policy must not end in 2005 or 2012. The Federal Government considers it absolutely necessary to give all players a long-term perspective – and, thus, a reliable framework for investment decisions. Both nationally and internationally, further drastic reductions of greenhouse-gas emissions will be required after the Kyoto 2008/2012 target zone. The Federal Government plans to discuss long-term aims with the relevant groups, and it expects other industrialised countries to commit themselves to similarly ambitious aims, so that the German economy does not suffer any disadvantage in international competition.

The Federal Government maintains that the industrialised countries' commitments, as set forth by the Kyoto Protocol for the first commitment period, 2008 – 2012, will have to be significantly expanded in subsequent commitment periods, and that developing countries (non-Annex B countries), in addition to the industrialised countries (Annex B countries), will have to assume reduction commitments. Within this framework, the Federal Government also plans to continue developing – ambitiously – the commitments it has made to date.

IV.2 Measures and instruments for climate protection since 1990

Since 1990, the Federal Government has been implementing a comprehensive and co-ordinated package of measures within the framework of its climate-protection strategy. This package comprises a broad spectrum of regulatory provisions, economic instruments and supporting measures (such as research, training and education, provision of information and advising).

The following sections describe the measures that the Federal Government has taken, or will take, in order to achieve its greenhouse-gas-reduction targets. The measures are arranged in accordance with the following sectors: energy, transport, industry, private households, agriculture, waste-management and intersectoral measures.

This section does not include measures to reduce emissions of gases regulated by the Montreal Protocol.

The section also describes additional specific measures of the Federal Länder and of municipalities in order to reduce emissions of CO_2 and other greenhouse gases.

The abbreviations in the tables have the following meanings:

Type of measure:

E Economic instrument

R Regulation, law, guideline

V Voluntary agreement

I Information

ET Education and training

D Research and development

The following is important to note with regard to the column "expected effect":

The "expected effect" refers to the forecast reductions in millions of tonnes of CO_2 equivalents pursuant to IPCC, with respect to the relevant forecast year. The forecast years selected are 2005 and 2008/2012, which are important for Germany.

In assessing the effects, it must be remembered that political action normally consists not of structural changes – for example, "expansion of heat/power cogeneration" – but of measures to promote such changes. Such measures create extremely demanding requirements in the area of effects analysis, since the reactions of the parties directly affected, and the secondary effects of such reactions, are very difficult to predict. The less that political instruments restrict the relevant freedoms of the concerned parties, the more difficult it is to predict the effects of such measures. An added difficulty is that political instruments often function in combination, with the result that effects of individual instruments cannot be precisely stated. Finally, numerous measures (information, advising, even certain regulatiory measures) are qualitative in nature.

The effects analysis integrates purely qualitative information, individual predictions of experts and integrated model analyses. Qualitative estimates are unavoidable especially when measures cannot be sufficiently well quantified, when little empirical data is available regarding the paths by which measures function or when significant interactions occur that preclude clear allocation of effects. Quantitative assessments by experts take account of primary effects (effects on parties directly concerned), secondary effects (influences, "wake" effects, etc.), assessments of catalysed technical measures (for example, construction of facilities), calculations of impacts on the energy sector (for example, substitution effects) and calculations of impacts on emissions. Integrated global analyses must be carried out to illuminate interdependencies between measures and developments within the energy system.

IV.2.1 Intersectoral measures

The following section lists measures that cannot be assigned to specific sectors, since they function intersectorally.

The Ecological Tax Reform is part of the Federal Government's climate-protection policy. Applicable relevant laws call for energy prices to increase, in a total of five phases, from 1999 to 2003. The basic concept calls for energy to become more expensive, through taxation, and for "work" to become less expensive. In particular, ecologically oriented trends are to be encouraged by providing incentives for energy efficiency, for use of advanced technologies and, thus, for avoidance of greenhouse-gas emissions. The Federal Government plans to review the possibility of exempting renewable energies from taxation and of enhancing the ecological precision of the Ecological Tax Reform.

The Federal Government considers contracting and operator models to be an important, yet still insufficiently used, way of optimising energy use in the industrial, residential and institutional areas. In the main, it is up to the commercial sector to introduce such financing and operator concepts to the market. Nonetheless, the Federal Government plans to review options for supporting current developments in this area.

In order to provide a clear signal, the Federal Government has committed itself to reducing CO_2 emissions in its sphere of responsibility by 25 % by 2005 and by 30 % by 2010, with respect to their 1990 level. As part of this commitment, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) has made a commitment to reduce its own energy-related CO_2 emissions by 30 % by 2005 (base year 1990). The BMU has been commissioned to develop a coordinated concept that government ministries can use as a guide in reaching relevant targets, under their own responsibility in each case. The concept is expected to emphasise measures involving little or no cost. One relevant example consists of "fuel-saving training" events for motorists – events in which motorists learn effective techniques, especially changes in driving habits, that can very quickly reduce fuel consumption and generate significant savings. It is being left up to the ministries themselves to select measures for achieving the main aims within their own spheres of responsibility.

Name	Description / aim	GHG	Type	Implementation status	Institution carrying out measure	Expected effect in millions of t of CO_2 equivalents	
Intersectoral measures						2005	2008 to 2012
Ecological Tax Reform	Integration of ecological steering mechanisms within the tax system Aim: to change production and consumption patterns that have negative ecological effects	**CO_2**	R	In force; several phases through 2003	Federal Government	-10	-20
Promotion of contracting	Support for development of financing and operator concepts Aim: to enhance energy efficiency	**CO_2**	D	Review	Federal Government; commercial sector	NE	NE
Voluntary commitment by the Federal Government	In order to provide a clear signal for the public, the Federal Government plans to reduce CO_2 emissions, within its sphere of responsibility, by 25% by 2005 and by 30% by 2010. Aim: to enhance energy efficiency in buildings and structures, in equipment and devices and in transports	**CO_2**	V	Resolution of the Federal Government	Federal Government	NE	NE

IV.2.2. Measures in the energy sector

Germany's energy supply

A suitable energy supply represents a key basis for prosperity – and, thus, for a high standard of living. Whether in production processes, in the transport sector in or in heating buildings – energy is required virtually everywhere.

The Federal Government has made key decisions relative to its future energy-supply structures. These include decisions on an orderly termination of use of nuclear power, expansion of use of renewable energies, development of new energy technologies (such as fuel cells), and careful use of price signals, via the Ecological Tax Reform, aimed at conserving resources via increasing internalisation of previously external costs. At the same time, it is aware that the energy supply, throughout the foreseeable future, must be based on a balanced mix of energy sources in which fossil fuels continue to play a significant role.

Germany has completely liberalised its electricity and gas markets, in a single step. This has led to lower electricity prices, especially for the industrial sector, as well as to the development and provision of new energy products (for example, "green electricity"), efficiency improvements on the part of energy suppliers – to protect competitiveness – and to market-oriented trading arrangements such as electricity bourses and purchasing associations.

A reliable energy supply is a central concern of modern societies. To function properly, and to maintain a high standard of living – such as that attained in Germany – societies require adequate energy services (heating, cooling, lighting, power, communications, mobility). In addition to emphasising environmental compatibility (including both resources conservation and climate protection), sustainable energy policy thus focuses on ensuring that the energy supply is cost-effective and reliable.

One way of ensuring a reliable energy supply is to avoid strong dependencies on certain energy sources or supplier countries. Efficient, careful use of energy can help avoid such dependencies. Another key way of protecting reliabily is to structure the energy supply properly. For example, Germany would be ill-advised to limit its energy supply to a very few imported fuels and energy sources. Similar principles apply in the electricity market.

For this reason, Germany's energy policy will continue to emphasise a balanced energy mix comprising petroleum, natural gas, hard coal and lignite and renewable energies. Such an energy mix, including use of Germany's own coal reserves, can keep additional supply and price risks within acceptable limits.

In a competition-based energy sector, individual energy sources' various shares of the overall energy supply cannot, and should not, be permanently fixed. On the other hand, the country's energy-source mix is influenced by the prevailing political framework – for example, in the areas of climate protection, industry, the energy sector and tax policy. It is also affected by external circumstances such as developments in world energy markets and energy shortages (whether real or politically induced).

Cost-effectiveness

Along with its reliability, the energy supply's cost-effectiveness is centrally important. For both economic and social reasons, a sustainable energy policy must aim to keep energy as affordable as possible. For example, energy prices are an important competitive factor – at least for energy-intensive industries that face international competition; investments in energy-supply facilities must remain attractive.

Structure of the energy supply

Germany depends on fossil and nuclear energy sources to meet over 97 % of its energy requirements. With a primary energy consumption totalling about 14,500 PJ, Germany's per-capita consumption in 2001 was about 176 GJ (equivalent to about 6

t of hard coal per year). With respect to its gross domestic product, Germany's consumption amounted to 7.3 GJ/1000 €.

Within the foreseeable future, the market shares of Germany's various energy sources will change in Germany. The importance of nuclear power will gradually decline, as a result of an agreement reached with the energy sector, and legally enshrined, to phase out use of nuclear power. The "winners" of this agreement will include natural gas, which is increasingly having to be imported from outside the EU and transported over large distances.

The German economy is less sensitive now to energy-price fluctuations than it was in the 1970s and early 1980s. This development is due to a diversified energy mix that has reduced the country's strong dependence on oil. In electricity generation, use of Germany's own coal reserves has contributed to this result. In addition, use of renewable energies, which has increased sharply in recent years, and continual improvements in energy efficiency, have helped slow growth in dependence on imports and in relevant risks.

Final energy consumption

In the 1990s, final energy consumption developed in a number of very different ways, in the various consumption sectors: whereas consumption in the energy sector and in industry continually decreased, thanks to continuing efficiency improvements and structural changes away from energy-intensive products and toward services, the respective energy-consumption shares of private households and the transport sectors increased considerably, until recently. In the transport sector, this development was due to growth in numbers of vehicles and in transport mileage.

Tab. IV.2.2.1 Energy-consumption indexes

Energy-consumption indexes	**1991**	**2000**[*)]
Primary energy consumption per capita (GJ)	183	173
Gross electricity consumption per capita (kWh)	6,736	6,758
Primary energy consumption per 1,000 € of gross domestic product (MJ)	8,540	7,253
Gross electricity consumption per 1,000 € of gross domestic product (kWh)	315	283
Final energy consumption in industry per 1,000 € gross value added (MJ)	5902	5.363
Electricity consumption in industry per 1,000 € gross value added (kWh)	509	529**[)]
Average automobile fuel consumption (l per 100 km)	9.4	8.5

Sources: Federal Statistical Office, AG Energiebilanzen, VDEW, Calculations of Federal Ministry of Economics and Technology (BMWi):

*) In part, provisional data, **) Figure for 1999

Electricity and gas market

The prices commanded by German electricity and gas suppliers are within the EU's middle range. This statement must be seen in light of the fact that such comparisons depend strongly on what specific types of sales are being considered, however. For manufacturing companies, market liberalisation has brought electricity-price reductions of 30 % and more, providing palpable cost reductions and enhancing companies' competitiveness. On the other hand, the importance of energy costs for German industry has declined considerably over the past two decades: whereas in the 1980s energy costs accounted for an average of 3 % of production costs, their share today is only 1.7 %. Nonetheless, for energy-intensive industries such as basic chemicals, iron and steel and non-ferrous metals, energy costs remain an important factor in location selection.

In the electricity sector, liberalisation has also prompted utilities to improve their own efficiency, and it has led to decreases in electricity prices – especially for the industrial sector. Furthermore, new energy products (such as "green electricity") and market-oriented trading arrangements, such as electricity bourses and purchasing associations, have emerged.

Development of CO_2 emissions

CO_2 emissions developed in very different ways in different energy-consuming sectors, including industry, the energy sector, transports, residential consumers, institutional consumers (trade, commerce, services). Whereas in the 1990s emissions decreased considerably in industry and the energy sector, they increased in the residential and transport sectors. Very recently, however, this trend has reversed: in 2000, CO_2 emissions in industry and the energy sector increased by about 2 %, while the transport sector showed a decrease for the first time. The residential sector is also now among the sectors that have considerably reduced their emissions from 1990 levels.

Tab. IV.2.2.2 Total CO_2 emissions, by emitter groups

Sectors	Share of CO_2 emissions in 2000, in %	Sectoral change, 1990-2000, in %	Sectoral change, 1999-2000, in %
Energy sector	42.2	-17.7	2.4
Industry [1)]	16.8	-26.8	1.8
Transport	20.8	12.8	-1.9
Residential	13.2	-11.5	-4.9
Institutional [2)]	7,0	-33.8	-3.7

[1)] Including industrial processes

[2)] Trade, commerce, services; includes military agencies

Source: Federal Environmental Agency, Arbeitsgemeinschaft Energiebilanzen, Calculations of the DIW

Phasing out of nuclear power

On 14 June 2000, the Federal Government and electric power utilities reached an agreement to phase out nuclear-based electricity generation in an orderly manner. Existing nuclear power stations are to be decommissioned as soon as they have generated a specified amount of electricity (amounts has been specified for all stations; the remaining electricity-generation allowance is calculated as of 1 January 2000). Transfer of remaining electricity-generation allowances to other stations is permitted. Operation of nuclear power stations is subject to high safety standards as required by law. Safety reviews are to be carried out at specified dates, for all nuclear power stations, and are to be repeated every 10 years.

The orderly phase-out of nuclear power presents new challenges for climate-protection and energy policy. On the other hand, it offers the opportunity for a completely new approach to energy policy and for the introduction of a viable energy supply oriented to the concept of sustainability and to reliability, cost-effectiveness and environmental compatibility (including such aspects as resources conservation and climate protection).

By 2005, nuclear power stations now generating some 8 billion kWh/a of electricity must be replaced. Depending on what types of power stations replace these nuclear power stations – natural-gas-fired gas-and-steam power stations, hard-coal-fired stations or lignite-fired stations – an additional 3 to 7 million t of CO_2 will be generated. From 2006 to 2010, nuclear power stations now generating some 19 billion kWh/a (an additional 7 to 17 million t of CO_2) must be replaced; from 2011 to 2020, an additional 87 billion kWh/a (an additional 33 to 74 million t of CO_2) of capacity must be replaced.

Considerable efficiency improvements in energy conversion – for example, through expansion of heat-power cogeneration, highly efficient gas-and-steam power stations and state-of-the-art coal-fired power stations – and in energy use (including careful use of energy in all relevant sectors), and expansion of use of renewable energies, will all play important roles in meeting this challenge. With its climate-protection pro-

gramme of 18 October 2000, the Federal Government has taken the necessary decisions for making use of these options.

Energy efficiency

Enhancement of energy efficiency plays a key role in any modernisation strategy aimed at achieving a sustainable energy supply. By helping to protect the climate and the environment, and to conserve finite energy resources, energy efficiency thus promotes equitability between generations. In addition, it is an industry-policy and energy-policy key to sustainable, viable development. Improvements in energy efficiency reduce dependence on energy imports and reduce pertinent price risks. They also reduce companies' energy costs, thereby potentially helping to enhance companies' competitiveness. Significantly, consumers are paying more and more attention to their energy consumption.

Germany already leads all industrialised countries in energy efficiency. In areas such as electricity generation, industrial processes, motor-vehicle engines, household appliances and buildings and structures, Germany has continually enhanced its energy efficiency over the past ten years. Overall, Germany's per-capita energy consumption has decreased by 5.5% since the early 1990s. Energy input per unit of value added – i.e. energy intensity – decreased a full 15.5% between 1991 and 2000. Whereas annual energy efficiency improvements in Germany amounted to some 1.9% between 1991 and 2000, for the EU overall they were only 1.1% p.a. (1991 - 1998). As these figures show, Germany has been severing the links between energy consumption and economic growth – a process that must be continued.

Electricity generation plays an important role in this area, and significant progress has been made in recent years. For example, while state-of-the-art lignite-fired power stations have efficiencies of 41 %, older lignite-fired power stations have efficiencies below 35 %. Modern gas-and-steam power stations fired with natural gas, which can reach efficiencies of over 57 %, also hold great promise.

Cogeneration systems (heat-power cogeneration), which can reach efficiencies over 90 %, make especially efficient use of fuels. Above and beyond its existing, success-

ful agreement on climate protection, German industry has committed itself to retaining, modernising and expanding the cogeneration sector. This effort is expected to prevent up to 23 million t of CO_2 emissions through 2010. Germany's new Act on maintaining, modernising and expanding heat-power cogeneration (Kraft-Wärme-Kopplungsgesetz), which came into force on 1 April 2002, will support this commitment.

Further significant improvements can be made in energy efficiency. Household applicances are an important area in this regard, for example. After energy efficiency classes were introduced for such appliances and relevant labeling requirements were imposed, sales of appliances in the higher "A" and "B" efficiency classes rapidly increased. Appliances in the lower efficiency classes largely disappeared from the market. And yet persisting discrepancies in energy consumption show that the potential for further improvements is far from exhausted. A recent study reached the conclusion, for example, that (highly cost-effective) optimization of electric motors in household appliances could, by itself, save 8 billion kWh of electricity annually.

The potential for efficiency improvements in the buildings and structures sector is especially great. The Ordinance on Energy Saving (Energieeinsparverordnung) will considerably decrease energy consumption in new buildings. While "zero energy" and "passive" houses are still the exceptions, they provide an idea of the possibilities in energy efficiency. The key, however, is to improve efficiency of existing buildings. Optimised insulation and modernised heating systems can drastically reduce energy consumption. And in many cases, such measures amortise themselves within reasonable periods of time, via reduced energy bills. Progress in this area will depend centrally on proper enforcement, by Federal Länder, of legal provisions on energy efficiency.

CO_2-oriented building-modernisation programme:

Experts agree that enormous reductions in CO_2 emissions can be made via technical improvements in existing buildings. A CO_2-oriented building-modernisation programme has been established with the aim of reducing CO_2 emissions by at least 40 kg per square metre and year. The programme comprises a number of measures

packages and provides economic incentives to modernise heating systems in combination with insulation improvements or window replacements in buildings built in 1978 or earlier. This programme is expected to spark modernisation in some 330,000 residences in the next few years.

Campaign for "climate protection in the residential and institutional sectors"

One important element of the Federal Government's new climate-protection programme, in the buildings and structures sector, is a multi-year campaign – being carried out via a public-private partnership – aimed at tapping potential for reducing CO_2 emissions in the residential and institutional sectors. Within the framework of the relevant public-private partnership, the BMU is working with German industry – especially with manufacturers and providers of energy-saving systems and devices for buildings and structures. The campaign is aimed especially at providing effective information and advising in all relevant areas of action.

Expansion of use of renewable energies

One important way of achieving a sustainable energy supply in Germany is to considerably expand renewable energy systems' role in meeting Germany's energy needs. The Federal Government has thus established a comprehensive range of measures aimed at supporting expansion of renewable-energy use. The aim behind Germany's Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz) is to at least double renewable energies' share in meeting Germany's energy requirements. Specifically, renewable energies' share in meeting electricity needs is to be increased from 6.25% in 2000 (about 7% in 2001) to 12.5% by 2010. For comparison: in 1990, it was only 3.8%. And the expansion is to continue vigourously after 2010. Plans call for renewable energies to meet about half of the country's energy requirements by the middle of the century. This aim yields additional orientational levels for the period between 2010 and 2050.

The Federal Government's efforts in this area are proving successful: growth of renewable energies has accelerated considerably, and annual growth rates in some sub-sectors have reached two-place percentages. The aim is to make renewable

energies competitive within the single market for electricity, in the medium-to-long term. This is necessary, since renewable energies will be able to play a lasting, major role in the energy market only if they can thrive without subsidies. A continuing aim in this context is for prices of conventional and renewable energies to reflect their different external costs (especially long-term environmental and climate damage), although this must develop in an economically compatible way.

Breakthrough for renewable energies: the EEG

The Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz - EEG)* of 29 March 2000 represents a decisive step toward a sustainable energy supply. It obligates operators of electrical power networks to accept electricity generated with solar-power, hydroelectric, wind-energy, geothermal and biomass systems and to pay certain minimum rates. The EEG has proven to be a highly effective instrument for promoting expansion of renewable energies.

According to the electric power industry, in 2001 some 16 TWh of electricity were fed into the grid on the basis of the EEG, with network operators paying some 1.4 billion euros for this power. For the first time, the EEG now divides relevant burdens evenly among the nation's electricity consumers, and thus end consumers' resulting average additional costs per kilowatt-hour remain within reasonable limits.

The EEG will promote further expansion of Germany's already booming wind-energy sector and, in combination with the Biomass Ordinance, is likely to spark similarly dynamic development in biomass use. In addition, it has provided impetus for use of photovoltaic systems, and it is expected to help launch use of geothermal energy.

In 2001, Germany's wind-energy systems alone contributed some 12 TWh, or over 2 %, of Germany's electric power production – a figure equivalent to over one-third of all wind-based electricity generated worldwide. As of the end of 2001, over 8,700 megawatts of wind-energy capacity were installed. In 2002, wind-energy systems are expected to meet some 3 % of Germany's electricity requirements.

Since the limits to land-based wind-energy use are now being reached in Germany, the Federal Government, within the framework of Germany's National Sustainability Strategy, has developed a strategy for sea-based wind-energy systems. In an initial phase through 2006, and under current conditions in areas now expected to be available, the strategy would enable installation of a total of at least 500 megawatts (MW) of wind-energy systems; in the medium term – through 2010 – it would enable installation of 2,000 to 3,000 MW of generating capacity. In the long term – i.e. by 2025 or 2030 – and once true cost-effectiveness is achieved, some 20,000 to 25,000 MW of generating capacity could be installed.

Investments in the future – support programmes for renewable energies

The Federal Government's support programmes for energy generation with wind-energy, solar-energy, biomass and geothermal systems have sparked an unprecedented boom in renewable energies. From 1998 through 2002, the Federal Government, via various programmes, is making well over a billion euros available for such programmes. These programmes include:

- *100,000-roofs photovoltaic programme** (provision of low-interest loans for installation and expansion of photovoltaic systems with installed peak capacities of at least one kilowatt peak (kWp). Aim: by 2003, installation of about 300 megawatt-peak (MWp) of photovoltaic generating capacity)
- *Market-incentives programme for renewable energy sources** (promotion of greater use of solar-collecting systems, photovoltaic systems for schools, systems for burning solid biomass, small biogas systems, small hydroelectric systems and systems for using deep-subterranean geothermal energy)
- *Programme for Investment in the Future (Zukunfts-Investitions-Programm - ZIP)** (Runs from 2001 to 2003; promotes research into sustainable forms of energy, with funding from UMTS interest income; emphasis: renewable energies and fuel-cell technology)
- *Eco-subsidy for homeowners* (for example, incentives for installing solar systems, as part of energy-saving measures completed in 2002 or for energy-saving homes (Niedrigenergiehaus) completed in 2002, and where the rele-

vant application for, or notification of, construction was submitted before 1 February 2002)

In 2000, use of renewable energies in Germany prevented some 35 million t of CO_2 emissions. Doubling renewable energies' share in Germany's energy supply by the year 2010 will thus mean CO_2-emissions reductions of about 70 million t in 2010. What is more, it will also prevent emissions of other greenhouse gases – especially methane – on a scale of about 10 million t of CO_2 equivalents.

Resources conservation and climate protection

The world's current energy-consumption patterns are not in keeping with sustainable development principles. In particular, rapid exploitation of scarce fossil energy reserves, along with the greenhouse-gas emissions their use generates, are limiting options for future generations and violating the principle of equitability between generations. What is more, many people are forced to use renewable resources unsustainably in order to meet their basic needs. For example, overly rapid consumption of firewood degrades and destroys forests, especially in the tropics, thereby contributing to greenhouse-gas emissions and exacerbating other problems such as poverty, erosion and desertification. The possible consequences of climate change, which is caused primarily by industrialised countries' greenhouse-gas emissions, will have to be borne by future generations. Such consequences include shifting of climate zones and rainfall regions, extinction of many animal and plant species, increased hurricane and storm frequency and spreading of tropical diseases.

This means that industrialised countries, with their large share of worldwide energy consumption, are not meeting their international responsibility. Energy policies oriented to sustainability must seek to reduce consumption of fossil fuels, especially in industrialised countries. This is the only way to provide latitude for the standard-of-living improvements that developing countries need, without overtaxing the environment in the long run. Apart from the CO_2 reductions required in industrialised countries, the necessary ingredients for global climate protection include greater energy efficiency and greater use of renewable energies in developing countries and countries undergoing economic transition.

The central aim is that established by the Framework Convention on Climate Change (which has been ratified by over 180 countries): to stablise greenhouse-gas concentrations in the atmosphere at a level that will prevent dangerous disruption of the climate system. This can be achieved only via a drastic reduction of current emissions.

Furthermore, if it is to be achieved, the world cannot continue to depend almost exclusively on fossil and nuclear energy sources. In keeping with the principle of equitability between generations, a system must be developed and implemented that in the long run does not deplete the environment's resources faster than they can be restored to the environment, externally, and that does not overtax the earth's ecological carrying capacity.

Achieving this aim is an ongoing, long-term task. Within the framework of EU-burden-sharing under the Kyoto Protocol, Germany has committed itself to reducing its greenhouse-gas emissions by 21 %, by 2012, compared to their 1990 levels. Furthermore, the Federal Government has set itself the aim of reducing Germany's CO_2 emissions by 25 % by 2005, compared to their 1990 level. And yet national and international climate-protection policy cannot end in 2012 – it must continue long after that year: additional national and international efforts must be made if the consequences of climate change are to be effectively limited. Clear long-term perspectives are needed, to give all players a reliable long-term framework for investment decisions. This applies especially to the energy sector, which characteristically has long investment cycles.

In this context, the Federal Government reiterates its intention to continue to provide leadership in developing and implementing ambitious climate-protection policies. At the same time, the Federal Government is aware that this problem, in light of its global dimension, cannot be solved by one country acting alone. An EU-wide strategy, co-ordinated internationally as effectively as possible, is required.

From the Federal Government's perspective, industrialised countries' commitments, as mandated in the Kyoto Protocol for the first commitment period, 2008 to 2012,

must be considerably enlarged in subsequent commitment periods. Other key aims include bringing the U.S. back into the Kyoto process and reaching agreements with developing countries on limiting their emissions.

In this framework, the Federal Government plans to upgrade its existing commitments ambitiously and to continue to discuss necessary long-term aims with the relevant groups. The Federal Government also expects other industrialised countries to commit themselves to similarly ambitious aims, so that German industry will not be at a disadvantage in international competition.

Name	Description/aim	GHG	Type	Implementation status	Institution carrying out	Expected effect in millions of t of CO_2 equivalents	
Energy sector						2005	2008 to 2012
Renewable-Energies Act, Biomass Ordinance, market-incentives programmes to promote renewable energies, R&D, demonstration	Promotion of use of renewable energies in generation of electricity and heat Aim: substitution of fossil fuels	**CO_2**	R	In force	Federal Government	- - 20	- 40
Renewable-Energies Act, Biomass Ordinance, market-incentives programmes to promote renewable energies	Promotion of use of renewable energies; substitution of fossil fuels and prevention of methane emissions, especially via use of biomass, landfill gas, sewage gas and pit gas pursuant to Renewable Energy Sources Act	**CH_4**	R	In force	Federal Government	-5	-10

Maintenance, modernisation and expansion of heat-power cogeneration (including small cogeneration systems), and introduction of fuel cells on the market	Agreement between the Federal Government and German industry on reduction of CO_2 emissions and promotion of heat-power cogeneration, as a supplement to the climate-protection agreement of 9 November 2000 and the Act on heat-power cogeneration (Kraft-Wärme-Kopplungsgesetz)	**CO_2**	R	In force since 1 April 2002	Federal Government	-10	-23
Use of pit gas	Intensified use of pit gas, an unavoidable by-product of hard-coal mining; this will involve increasing percentages of pit-gas methane used for energy generation: from 70% to 78% Aim: avoidance of CH_4 emissions, substitution of fossil fuels	**CH_4**	V	Effective since 1993	Industry	-8.0	-8.0

Biomass Ordinance	Provisions on biomass specifications within the meaning of the Renewable Energy Sources Act (EEG), on technical processes for generating electricity from biomass, within the meaning of the EEG, and on environmental requirements in generation of electricity from biomass Aim: to use clean fuels as substitutes for fossil fuels	**CH_4**	E	In force since 2001	Federal Government		
Construction of additional natural-gas-fired gas-and-steam power stations	Modernisation of power stations Aim: to increase efficiency of power stations; to use fuels with lower carbon content as substitutes for carbon-intensive fuels	**CO_2**	V	Ongoing project	Industry	-8	-15 to -20
Reduction of methane losses in production and transport of natural gas	Optimisation of technical processes in production and transport of natural gas	**CH_4**	D	Ongoing project	Industry	NE	NE

IV.2.3 Measures in the transport sector

In comparison with other sectors, the transport sector exhibits the most unfavourable trends in energy consumption, in terms of climate protection. Because total mileage figures for all modes of transport increased between 1990 and 1999, CO_2 emissions the transport sector as a whole grew by 11 %[4]. Nonetheless, transport-related CO_2 emissions in recent years have not increased to the extent predicted by various studies. And recently the tide seems to be turning also in the transport sector. In 2000, carbon-dioxide emissions in the transport sector decreased for the first time. This positive development continued in 2001.

In light of the settlement, industry and transport structures that have grown over the past decades – and in light of these structures' ecological consequences – transport policy will have to deal with greater and greater challenges. It must chart the course for the future and ensure that the transport system remains effective – and remains a positive factor that helps make Germany an attractive location for industry and commerce. The public's demand for individual mobility must also be respected. Needless to say, this also applies to those who do not own their own vehicles. At the same time, environmental concerns must be taken into account, and transport-related pollution must be further reduced.

The Federal Government is carrying out a broadly diversified package of measures in order to reshape the transport system in keeping with principles of environmental protection and resources conservation.

Environmentally friendly, intermodal solutions are to be promoted, via an approach involving greater market orientation. Prices should have a guiding function also in the transport sector; the calculatory bases of relevant state taxation systems should be more strongly oriented to environmental criteria.

The example of introduction of emissions-based motor-vehicle taxation for automobiles provides proof of the effectiveness of such measures. From 1997 to 2001, the

overall number of heavily polluting vehicles was reduced by two-thirds. One fourth of all automobiles newly registered in 2001 already conform to the "Euro 4" emissions standard, which will apply as of 2005/2006, and the emissions-based motor-vehicle tax has contributed to this progress. And motor-vehicle-tax breaks have provided incentives for market introduction of automobiles with especially low CO_2 emissions *(*so-called "3-litre autos"). The Federal Government thus considers broader incentives for use of low-emissions vehiclies, within the framework of motor-vehicle tax, to be an effective instrument.

In 2003, time-based truck fees will be replaced with distance-based electronic fees for heavy trucks, in order to make assignment of road-use costs more equitable. The distance-based autobahn-use fee for trucks, with emissions-based fee categories, will support transport-policy and environmental-policy aims. With its flexible fee schedule, it will provide incentives to shift goods transports from roads to railways and waterways. It should also reduce percentages of "no-load" trips. The measure is expected to reduce CO_2 emissions by 5 million t.

Per-kilometer tax deductions for commuters, and for trips that employees make to rejoin their families (for example, in cases where an employee works in a city other than his or her city of residence), are now the same for all modes of ground transportation. This change is in keeping with both environmental and sensible transport-policy criteria. Standardised distance-categories that cover all modes of transportation in the same way create a level playing field, in terms of taxation, between competing modes of transportation and improve the basis for local public transportation.

Continuing development of low-emissions vehicles must be encouraged. The voluntary commitment made by the German Association of the Automotive Industry (Verband der Deutschen Automobilindustrie - VDA) to reduce average fuel consumption of automobiles made by German manufacturers by 25%, by 2005, with respect to relevant 1990 levels, is an important and successful contribution to the Federal Government's efforts to reduce CO_2 emissions absolutely for all road transports. The

[4] The last available figure, and not including international transports. CO_2 emissions of international air transports increased by 43% between 1990 and 1999.

Federal Government calls on the German automobile industry to update its voluntary commitment in order to achieve reductions of over one-third. In discussions with the German automobile industry, the Federal Government is also seeking to convince German automakers to join the agreement with German industry on climate protection (climate agreement). Further reductions can be achieved by intensifying optimisation and use of environmentally friendly fuels. As of 1 November 2001, tax breaks are being given for early introduction of fuels meeting sulphur standards, as mandated for 2005 by the EU Fuels Directive (98/70/EC), of 50 mg/kg ("low-sulphur"). This is being accomplished by making mineral-oil taxes on gasoline and diesel fuel dependent on sulphur content. When the sulphur content of such fuels is greater than 50 mg/kg, they are subject to an additional 1.53 cents per litre, a measure which favours low-sulphur fuels. As of 1 January 2003, the relevant tax exemption will apply only to fuels with sulphur content of up to 10 mg/kg ("sulphur-free"). Oil companies had already begun selling only low-sulphur fuels by the time this tax incentive came into force. As a result, consumers have not suffered any relevant price increases.

Sulphur-free fuels make it possible to use engine technologies with up to 15 % lower fuel consumption than conventional engine technologies. Another advantage is that sulphur-free fuels can help reduce emissions and soot formation even in older engines.

The Federal Government is planning to engage the VDA in discussions aimed at introducing broad use, in new vehicles, of low-viscosity oils and tyres with low roll resistance. According to estimates, each of the aforementioned measures can reduce fuel consumption from 3 to 6 %. The Federal Highway Research Institute (Bundesanstalt für Straßenwesen) estimates that the measures can provide CO_2 reductions of 3 to 5.5 million t by 2005.

The Federal Government is also supporting the transport-sector energy strategy of German automobile and energy companies. The aim of the transport-sector energy strategy is to concentrate on one – or no more than two – alternative motor-vehicle fuels (for both passenger and utility vehicles) that meet technical, economic and ecological criteria for suitability. This will then provide a basis for developing a common

strategy for broad, nationwide commercial introduction and for developing criteria for the necessary framework. For example, if hydrogen, under a long-term option, were implemented as a fuel in fuel cells or internal combustion engines, zero-emissions vehicles and drastic CO_2 reductions throughout the entire energy chain could be achieved – if hydrogen were produced via solar energy. Use of natural gas in the transport sector, an application that has already passed the pilot-scale phase, now provides an effective strategy for long-term transition to hydrogen via an environmentally friendly fuel. Certain other fuels, such as methanol, are also being considered as alternative-fuel candidates within the framework of the transport-sector energy strategy.

The EC Regulation "on substances that deplete the ozone layer", which will soon be adopted, will mandate annual inspections for stationary and mobile refrigeration systems filled with more than 3 kg of HCFC (and CFC) refrigerants. The required inspections are expected to reduce rates of leakage from such systems. Expansion of inspection commitments to cover refrigeration and air-conditioning systems with HFC refrigerants could reduce HFC emissions from such systems. The necessary basis for introducing such inspection commitments would include a national ordinance or an EU-wide regulation.

A legally defined prohibition on use of the main emissions sources of SF_6 is proposed. In automobile tyres, SF_6 can be replaced – with no sacrifice in quality – with a continually available substitute (air). Alternative window technologies can be used instead of SF_6 in order to meet soundproofing requirements as required by building codes. Relevant studies and experience in other European countries clearly prove the feasibility of this approach. In light of the risk for the earth's climate, a prohibition on use seems reasonable.

By promoting greater use of telematics systems in the transport sector, the Federal Government is pursuing an intermodal approach aimed especially at creating an efficient overall transport system integrating all modes of transport, at enhancing the efficiency of transport-infrastructure use and at reducing environmental burdens by optimising transport processes in passenger and goods transports. Even though

telematics can lead to additional transports, it still holds the potential for reducing CO_2 emissions by 2005. In the next section, the potential reductions are included with the potential reductions that can be achieved by fleet-management systems.

The railway-structure reform has equipped railways for managing a higher percentage of the transport growth expected within the European framework. For this potential to be realised, the decreasing trend in the railway sector's share of total transports must be stopped and then, following such an initial phase, the trend must be reversed, within the framework of a medium-to-long-term strategy. Expansion of combined road-rail transports will play an important role in this connection. In addition, expansion of the high-speed-railway network is expected to help reduce short-distance air travel. The Federal Government's investment policies in the railway sector are also oriented to such potential shifts. To finance information measures, the Federal Government, within the framework of the Programme for Investment in the Future (Zukunftsinvestitionsprogramm - ZIP), is providing Deutschen Bahn (German Railways) with some 3.1 billion € from 2001 to 2003[5].

The Federal Government is carefully watching the dynamically growing air-transport sector. It holds that internalisation of external costs must also be introduced in this sector, via use of economic instruments, as a result of both environmental and economic needs. Use of economic instruments can enhance cost-effectiveness in development of technical reduction potential, while ensuring that concerned parties largely retain their entrepreneurial flexibility. The Federal Government plans to pursue this approach actively, on three levels:

International: Within the responsible ICAO bodies, the Federal Government is supporting introduction, as soon as possible and on an international basis, of a kerosine tax or a more environmentally effective emissions-based tax on greenhouse-gas emissions or an emissions-trading system that is at least as environmentally effective as an emissions-based tax[6]. Before air transports can be integrated within any emis-

[5] Funding from interest savings generated through use of proceeds from the UMTS-license auction.
[6] Such emissions-trading systems are currently being discussed, but none have yet been defined.

sions-trading system, maximum emissions levels ("caps") must be defined, and international air transports must be included within the Kyoto Protocol.

European Union: Within the EU framework, the Federal Government is supporting introduction of an emissions-based tax. To this end, it strongly supports – in keeping with resolutions of the Council of Ministers of Transport, the Council of Environment Ministers and the ECOFIN Council – the Commission's action plan on "Air transport and the environment", and it encourages the Commission to present relevant proposals in 2002.

National: On the national level, the Federal Government plans to introduce emissions-differentiated take-off and landing fees[7]. This fees will be adjusted if there is overlapping with any EU-wide or global emissions tax.

One of the Federal Government's particularly important aims is for use of local public transportation to be intensified. Although this is an area in which the Länder have executive and financial responsibility, the Federal Government is focusing on it in an effort to lower road-traffic emissions. The Federal Government is thus providing the Länder with financial assistance for investments aimed at improving municipal transport systems, pursuant to the Act on financing of municipal transports (Gemeindeverkehrsfinanzierungsgesetz – GVFG), and it is financing relevant research projects. The Länder are also receiving federal funding under the Regionalisation Act (Regionalisierungsgesetz), which provides the Länder with funding for assuming responsibility for local public rail transportation within the context of local public rail reform. In 2002, the Länder will receive for this purpose the amount of € 6.745 billion from federal mineral-oil tax funds; from 2003 to 2007, the funding will then increase by 1.5 % annually. Together, the federal GVFG and regionalisation funding will reach a volume of over € 8.4 billion annually; as a result, the Länder will have enough funding, and a reliable enough planning framework, in order to provide adequate local public transportation services.

[7] Similar models, without a CO_2-reduction component, have already been introduced in Sweden and Switzerland.

The Federal Government considers promotion of bicycle use to be an effective way of considerably reducing short-distance automobile travel. Over half of all automobile trips made in Germany are shorter than 5 kilometres. This shows that considerable potential remains for increasing the numbers of short trips made by bicycle or on foot. In 1998, the Federal Government issued a first report on the situation in the "bicycle-transport sector". Accounting for 12 % of all trips made, in terms of numbers, bicycle transports play a relative significant role in Germany. The Federal Government is promoting cycling especially by means of its federal bicycle-path programme. As of the end of 2000, a total of some 15,000 km of bicycle paths were in place along federal roads. In its report of 23 May 2000 on measures to promote bicycle transports[8], the Federal Government laid out a national strategy for promoting bicycle use in a manner taking account of all concerned parties. It plans to continue developing this concept systematically, especially in co-operation with the Länder and municipalities and with the associations responsible for such issues.

On 24 April 2002, the Federal Cabinet approved a national plan for promoting use of bicycles.

[8] Report of the Federal Government on measures to promote use of bicycles, BT DS 14/3445 of 23 May 2000

Name	Description/aim	GHG	Type	Implementation status	Institution carrying out	Expected effect in millions of t of CO_2 equivalents	
Transport						2005	2008 to 2012
Promotion of use of sulphur-free fuel	Promotion of low-sulphur and sulphur-free fuels to provide a basis for high-mileage, low-emissions engines; this is to be achieved by raising mineral-oil tax on fuels that do not meet the sulphur standards of 50 ppm, as of 1 November 2001, and 10 ppm, as of 1 January 2003 Aim: to reduce fuel consumption in transports	**CO_2**	E	In force as of 1 November 2001 and 1 January 2003	Federal Government	-2 to -5	
Railway-structure reform	Expansion of the railway network, expansion of combined road-rail transports Aim: for railways to transport goods now transported on roads	**CO_2**	E	Resolution of the Federal Government	Federal Government		
Autobahn toll for trucks	Distance-based autobahn toll for trucks, with emissions-based structure Aim: for railways and waterways to transport goods now transported on roads	**CO_2**	E	Resolution of the Federal Government; implementation no later than 2003	Federal Government	-5	

Emissions-based motor-vehicle tax for automobiles	Broader incentives for low-emissions automobiles, within the framework of motor-vehicle tax. Aim: to enhance energy efficiency of automobiles	**CO_2**	E	Resolution of the Federal Government	Federal Government	-1	
Reduction of the average fuel consumption of new automobiles	Upgrading of the German automobile industry's voluntary commitment on further reduction of average fuel consumption in new automobiles, as of 2005: a reduction of 30%, instead of 25%, compared to relevant levels in 1990 Aim: to enhance energy efficiency of automobiles	**CO_2**	V	Request directed at industry	Industry	-4 to -7	-10
Improved integration and links between different modes of transport	Telematics, logistics management and fleet management, anti-traffic-jam programme Aim: to reduce use of energy services	**CO_2**	I, E	Planned as of 2003	Industry	-3.5	

Campaign for climate protection in the transport sector	Campaign for climate protection in the transport sector, with the following emphases: fuel-saving driving habits, maintenance, low-viscosity oils and low-roll-resistance tyres, combination of modes of transport (bicycle, automobile, local public transportation, railway, air), "3-litre auto" Aim: to enhance efficiency and reduce use of energy services	**CO_2**	ET	Resolution of the Federal Government	Federal Government, industry	-5	NE
Emissions-based landing fees	Introduction of emissions-based take-off and landing fees at German airports Aim: to enhance energy efficiency in air transports	**CO_2**	E	Resolution of the Federal Government	Federal Government	-1	
Vehicle air conditioners	As of 2007, motor-vehicle HFC air conditioners are to be supplanted by CO_2 systems Aim: to use a gas with lower impacts on climate	**HFC**		Proposed	Federal Government, industry	< 0	-1
Prohibition on use of SF_6 for filling automobile tyres	A prohibition on filling automobile tyres with SF_6 would eliminate this source of SF_6 emissions. Aim: prevention of use of SF_6	**SF_6**	R	Proposed	Federal Government	-0.3	-0.7

Distance-based tax deduction that does not vary by mode of transport	Tax deductions for commuter travel. A tax deduction that does not vary by mode of transport will help to place all competing modes of transport on an equal footing for tax purposes. Aim: to improve the attractiveness of local public transportation	**CO_2**	R E	Adopted; came into force on 01 January 2001	Federal Government	NE	NE
Use of low-viscosity oils and low-roll-resistance tyres	Use of low-viscosity oils and low-roll-resistance tyres in new vehicles, in order to reduce fuel consumption Aim: to reduce fuel consumption in road transports	**CO_2**	V	Planned	Industry	-3 to -5	NE
Energy strategy for the transport sector	Agreement between automobile and energy companies regarding a maximum of 2 different alternative fuels for motor vehicles (automobiles and trucks) Aim: to reduce CO_2 emissions through use of alternative fuels such as hydrogen and natural gas	**CO_2**	V	Planned	Industry	NE	-1 to -2

Integrated transport planning	Development of an overall transport-sector concept that makes use of traffic-reducing settlement structures and strengthens regional structures Aim: to reduce transports by reversing the trend toward sprawl	**CO_2**	D R	Planned	Federal Government, Federal Länder	NE	NE
Anti-traffic-jam programme	Provision of needed transport-management capacities that can keep traffic running smoothly Aim: to reduce traffic-jam-related CO_2 emissions	**CO_2**	D R	Planned as of 2003	Federal Government, Federal Länder	-0.5	NE
Promotion of bicycle use	Implementation of the Federal Government's report on promotion of bicycle use Aim: to reduce automobile use, especially for short trips	**CO_2**	D	Planned	Federal Government	NE	NE

IV.2.4 Measures in the residential sector

Experts agree that the residential-buildings sector holds the greatest potential for CO_2 reductions. And the need to protect the climate is not the only reason why the greatest possible use should be made of this potential. In light of the difficult situation in the construction industry, and of the construction industry's impacts, as a "multiplier", on income and employment, measures in this sector could help stabilise employment – especially in small and medium-sized enterprises on the local level. This combination of factors makes this topic especially important: in it, climate protection and the agreement on employment (Beschäftigungspakt) complement each other in a highly useful way. The various relevant concerns in this area can thus be balanced only via an integrated approach that takes account of the planning sector, modern technologies and effective concepts and that incorporates both investors and users.

The Act on Energy Saving (Energieeinsparungsgesetz - EnEG), which provides the legal basis for the Ordinance on Energy Saving (Energieeinsparverordnung), was passed in 1976, under the pressures imposed by the first oil-price crisis. At that time, its primary purpose was to reduce Germany's dependence on oil imports. In light of the changed political framework, the Federal Government plans to review the extent to which the EnEG meets current criteria for climate-protection-oriented energy efficiency and whether it can be improved.

The Ordinance on Energy Saving (Energieeinsparverordnung - EnEV), which came into force on 01 February 2002, combines and tightens existing requirements, as set forth by the Thermal Insulation Ordinance (Wärmeschutzverordnung) and the Heating-Systems Ordinance (Heizungsanlagen-Verordnung). It is aimed at reducing the energy requirements of new buildings by an average of 30%, and at developing potential for improving energy efficiency in existing buildings by cost-effective, economically reasonable means. In the residential sector, the Ordinance on Energy Saving will reduce CO_2 emissions by up to 4 million t, by 2005. And it will lead to further CO_2 reductions in the industrial and institutional sectors.

The amendment takes special account of the following aspects:

- Optional introduction of energy-consumption indexes for existing buildings – for buildings in which commitments to carry out formal accounting of heating costs apply. In addition, the Federal Government is reviewing whether use of energy-consumption indexes could be made binding within the foreseeable future,
    - conditional requirements for existing buildings (externally applied thermal insulation),
    - retrofit requirements for insulation of buildings' top-storey ceilings,
    - Replacement of obsolete heating systems (boilers) and, possibly, insulation of piping systems,
- Orientation primarily to energy efficiency criteria,
- Implementation of advanced technical and ecological standards.

Due to constitutional protection for existing assets, only a small fraction of the potential CO_2 reductions in existing buildings (nearly 80 % of existing buildings were built before the Thermal Insulation Ordinance (Wärmeschutzverordnung) came into force in 1983; over two million heating systems are more than 20 years old) can be achieved via regulatory means. Experience has shown that economic incentives can provide effective impetus for modernisation, thereby significantly accelerating the pace with which planned investments are actually made (shorter investment cycles) and increasing modernisation rates significantly. In early 2001, the Federal Government launched a support programme for modernisation of old buildings – the CO_2-oriented building-modernisation programme of the Kreditanstalt für Wiederaufbau (KfW) promotional bank. This programme is aimed at meeting needs for climate protection, at providing impetus for employment and growth and at improving housing quality without imposing undue burdens on renters and owners. Wtih a total loan volume of over 5 billion €, the programme will enable more than 350,000 additional residences to be modernised in keeping with energy-efficiency criteria in the next few years. To finance the programme, the Federal Government plans to provide a total of over 1 billion € through 2005. In connection with other support measures oriented to existing buildings, this programme will reduce CO_2 emissions by 5-7 million t, compared to their 1990 level, by 2005.

Measures in the residential sector must not be confined to indoor-heating systems. They must also focus on households' electricity consumption. Today's households not only have appliances such as refrigerators, washing machines, dryers, freezers, etc.; they also have increasing numbers of office and communications equipment (such as PCs, answering machines, telefax machines, cell phones) and home entertainment systems (such as TV sets, VCRs, stereo equipment). As the numbers of such devices increase, so does the significance of this sector's electricity consumption.

The Federal Government thus plans to considerably intensify its efforts to improve the energy efficiency of household appliances, office and communications equipment and home-entertainment systems. Planned measures include product-specific labeling, energy labels, information and advising, R&D, agreements with makers of electrical appliances and with the electronics industry, energy standards and regulatory measures.

Name	Description/aim	GHG	Type	Implementation status	Institution carrying out	Expected effect in millions of t of CO_2 equivalents	
Private residential						2005	2008 to 2012
Ordinance on Energy Saving (in the residential sector)	Combines and tightens existing requirements from the Thermal Insulation Ordinance (Wärmeschutzverordnung) and the Heating-Systems Ordinance (Heizungsanlagenverordnung). Aim: to reduce energy requirements in new buildings by 30%, and to develop economically reasonable potential for improving energy efficiency of existing buildings	**CO_2**	R	In force since 1 February 2002	Federal Government	-4	NE
CO_2 –oriented building-modernisation programme of KfW	Economic incentives to modernise buildings – for example, to replace obsolete heating systems, add thermal insulation, replace windows Aim: ti enhance efficiency in production and use of indoor heat	**CO_2**	E	In force since February 2001	Federal Government	-5 to -7	NE

Improvement of the energy efficiency of household appliances	Measures in the area of electricity consumption – especially in the area of stand-by consumption of household electrical and electronic devices; voluntary commitments and tightening and expanding of the Act on labelling to show energy consumption (Energieverbrauchskennzeichnungsgesetz) Aim: to enhance efficiency of electricity use	**CO_2**	ET, V, R	Expand existing activities	Federal Government, industry	-5	NE
Promotion of use of natural gas	Greater use of natural gas in home heating and hot-water systems Aim: to increase use of a fuel with relatively low carbon content, and use of more efficient technologies	**CO_2**	V	Ongoing project	Industry	-3.1	NE

Eco-subsidies in incentives for home ownership	Review of eco-subsidies in incentives for home ownership. Under the Act on subsidies for homeowners (Eigenheimzulagengesetz), additional support is provided for installation of modern energy-saving technologies such as heat pumps, solar heating systems and thermal collection systems Aim: to conserve resources through use of energy-efficient technology	**CO_2**	E	Ongoing project	Federal Government	NE	NE
Promotion of "green" electricity	Expansion of the availability of "green electricity", i.e. electricity generated from renewable energies Aim: to increase renewable energies' share of the energy mix	**CO_2**	V	Ongoing project	Industry	NE	NE
Campaign for climate protection in private households	Information about possibilities for saving energy in private households Aim: to tap potential for saving energy in the residential sector	**CO_2**	I ET	Planned	Federal Government, industry	NE	NE

Intensified introduction of state-of-the-art systems for buildings	Creation of incentive for intensified use of state-of-the-art systems such as condensing boilers, small heat-power cogeneration systems, fuel cells, connection to district heating networks, modern measurement and control systems, etc.. Aim: to reduce energy consumption, through efficient technology	**CO_2**	I D	Ongoing project	Industry, crafts sector	NE	NE
Intensification of research, development and demonstration	Further optimisation of products and systems Aim: to increase energy efficiency of products and systems	**CO_2**	D	Ongoing project	Federal Government, industry, science sector	NE	NE

IV.2.5 Measures in the area of industry and commerce

Over the past ten years, greenhouse-gas emissions from industry and commerce have been considerably reduced. Nonetheless, this sector still holds many possibilities for improving efficiency of energy use and for reducing greenhouse-gas emissions still further.

German industry's declaration on climate protection is a key element of a package of industrial-sector measures with which German industry is contributing to climate protection.

From the outset, "German industry's declaration on climate protection" has been implemented via a step-by-step, ongoing process and has been continually refined. This process is based on the annual monitoring reports of the Rhine-Westphalia Institute for Economic Research (Rheinisch-Westfälisches Institut für Wirtschaftsforschung Essen – RWI). These reports analyse developments in the various economic sectors, validate data from official statistics and industry association statistics, identify deficits and make proposals for further development. Since 1996, this process has been used to establish and refine a controlling system that is unprecedented in form. This system continually provides companies in the relevant branches with new information about ways to save energy and to optimise energy use (benchmarking). Since 1995, a number of industry sectors, within their systematic efforts to optimise their energy use, have implemented energy audits, developed energy-saving concepts, carried out relevant investment projects earlier than originally planned, developed new concepts for ensuring a reliable energy supply, intensified their training and further training efforts and entered into inter-company co-operation arrangements. To date, the Rhine-Westphalia Institute for Economic Research has presented its third monitoring report, covering the period 1990-1999.

Since February 2000, the Federal Government and the industry associations participating in the voluntary commitment have engaged in intensive negotiations, on the basis of the monitoring reports, regarding further development of commitments announced on 10 March 1995 and updated on 27 March 1996. These negotiations re-

sulted in an agreement of 9 November 2000, between the government of the Federal Republic of Germany and German industry, on climate protection.

German industry's current declaration on climate protection develops this agreement further in the following regards:

- Adaptation of the previous time frame (base year 1990 / target year 2005) to the time frame specified by the Kyoto Protocol (base years 1990/1995; target corridor 2008 / 2012);
- Inclusion of the other Kyoto gases (CH_4, N_2O, SF_6, HFCs and PFCs);
- Upgrading of targets: reduction of emissions of CO_2. CH_4, N_2O, SF_6, HFCs and PFCs by 35%, by 2012, compared to 1990 levels. Reduction of emissions of the greenhouse gas CO_2 by 28%, by 2005, compared to the 1990 level.
- General inclusion of possibilities for linking "German industry's declaration on climate protection" with the project-based Kyoto mechanisms "Joint Implementation" and "Clean Development Mechanism", as well as with trading in emissions certificates (emission trading).

Implementation of the "Agreement between the government of the Federal Republic of Germany and German industry on climate protection" will continue to be reviewed, as agreed, by an independent economic institute ("climate-protection monitoring"). The Federal Government, represented by the Federal Ministry of Economics and Technology (BMWi) and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), will continue to contribute 50 % of the financing for climate-protection monitoring. German industry will bear the other 50% of the relevant costs. To date, a number of additional associations have joined the declaration.

The contributions that can result from improved training and further training, and from more intensive information provision and advising, should not be underestimated. As an initiative on advising carried out by the association of the energy and electrical power industry (Verband der Industriellen Energie- und Kraftwerkswirtschaft - VIK) and numerous scientific studies have shown, many industrial and commercial enterprises need to improve – and can improve – their understand-

ing of relevant energy relationships. For this reason, the Federal Government attaches great importance to energy-efficiency advising and energy diagnoses, especially for small and medium-sized enterprises. It also expects industry's self-administration institutions to contribute substantially to efforts in this area.

In order to make greater use of potential for reducing greenhouse-gas emissions in the industrial and institutional sectors, the Federal Government plans to review possibilities for considerably expanding economic incentives within existing relevant programmes of the Federal Government, the Länder, municipalities, industry and federal banks (DtA and KfW), and within the ERP Special Fund.

The EC regulation on "substances that deplete the ozone layer", which will soon be adopted, mandates annual inspections for stationary and mobile refrigeration systems filled with more than 3 kg of HCFCs (and CFCs) refrigerants. The required inspections are expected to reduce rates of leakage from such systems. Expansion of inspection commitments to cover refrigeration and air-conditioning systems with HFC refrigerants could reduce HFC emissions from such systems. The necessary basis for introducing such inspection commitments would include a national ordinance or an EU-wide regulation.

Policies for reducing emissions from relevant foams could be based on any of several different approaches. The spectrum of such approaches includes legal provisions (for example, prohibitions on use of HFC as propellants in certain applications, and prohibitions on placing certain HFC-containing foams on the market), economic instruments (taxation of HFC emissions, financial support/incentives for alternatives and/or emissions-reduction measures) and voluntary commitments by industry.
In propellants for PU insulation foams, propane/butane, in combination with dimethyl ether (DME), can substitute for HFC in most applications – this is already current practice in Scandinavia, for example. But since propane/butane and DME are flammable, continued use of HFC, in small amounts, may be necessary in areas in which flammable propellants must be prohibited (for example, in mines).

Name	Description/aim	GHG	Type	Implementation status	Institution carrying out	Expected effect in million t CO_2 equivalents	
Industry and trade, commerce, services					2005	2008 to 2012	
German industry's declaration on protection	Updates and upgrades German industry's voluntary commitment of 1996 on emissions reductions Aim: to reduce CO_2 emissions by 28%, by 2005; to reduce emissions of so-called "Kyoto gases" (CO_2, CH_4, N_2O, SF_6, HFCs and PFCs) by 35% by 2012	**CO_2**	V	Agreement reached on 09 November 2000	Federal Government, industry	-10	-10
Training and further training	Advising initiatives covering energy interrelationships, energy saving and energy diagnoses, especially for small and medium-sized enterprises Aim: to enhance energy efficiency	**CO_2**	ET	Request directed at industry associations	Industry, crafts	NE	NE
Improvement of loan programmes of ERP, DtA, and KfW	Expands economic incentives, within the framework of existing programmes Aim: to enhance energy efficiency	**CO_2**	E	Review	Federal Government	NE	NE

Ordinance on Energy Saving (in the industrial and institutional sectors)	Combines and tightens existing requirements from the Thermal Insulation Ordinance (Wärmeschutzverordnung) and the Heating-Systems Ordinance (Heizungsanlagenverordnung). Aim: to reduce energy requirements in new buildings by 30%, and to develop of economically reasonable potential for improving energy efficiency of existing buildings	**CO_2**	R	Resolution of the Federal Government in fall 2000	Federal Government	-6	NE
Improvement of efficiency of electric motors	Provides for replacement, with more efficient units, of electric devices such as electrical drive units, pumps, ventilators, compressors, etc.. Aim: to enhance efficiency of manufacturing processes, in order to reduce electricity consumption	**CO_2**	V D	Ongoing project	Industry	-2	NE
Use of "green" electricity	Increases use of "green electricity", i.e. electricity generated from renewable energies Aim: to increase renewable energies' share of the energy mix	**CO_2**	V	Ongoing project	Industry	-1 to -1.5	NE

Technical measures in adipic-acid production	Provides for thermal or catalytic decomposition, in order to achieve a 95% reduction of N_2O emissions in manufacture of adipic acid, a product needed for manufacture of artificial fibres Aim: to prevent N_2O emissions	**N_2O**	V	Voluntary measures implemented	Industry	-28	-28
XPS hard foams	Provides for use of CO_2 and ethanol as substitutes for HFCs in about half of all production, as at 2000 Aim: In replacement of ozone-depleting gas, to use gases with smaller impacts on climate	**HFCs**	V	In effect	Industry	-1	-1.3
Stationary refrigeration equipment	As of 2003, mandates maintenance requirements for systems with fill amounts of at least 1 kg Aim: to reduce leak rates	**HFCs**	R	Proposed	Federal Government	-1.6	-3.6
PU insulation foams	Provides for extensive use of propane, butane or DME as substitutes for HFCs; continued use of (small amounts) of HFCs in applications requiring fire-proofness Aim: Substitution	**HFCs**	R, E, V	Proposed	Federal Government, industry	-1.2	-2.6

PU foam products	Cancels plans to introduce HFCs as propellants; instead, use of pentane, cyclopentane or water (CO_2) Aim: In replacement of ozone-depleting gas, to use gases with smaller impacts on climate	**HFCs**	V	Proposed	Industry	-0.1	-0.2
XPS hard foams	Provides for convincing as many manufacturers as possible to use CO_2 and ethanol as HFC substitutes Aim: to use gases with smaller impacts on climate	**HFCs**	V	Proposed	Industry	-0.8	-1
Medical aerosol sprays	Provides for enlarging the market share of powder inhalers in asthma therapy Aim: to reduce use of gas with impacts on climate	**HFCs**	V	Proposed	Industry	-0.3	-0.5
Semiconductor manufacture	Provides for highly efficient waste-gas scrubbing for new etching chambres as of 2000. As of 2009, replacement of old systems	**HFCs**		Proposed	Industry	< 0	-0.1
Voluntary commitment of the German primary aluminium industry	Voluntary commitment, as agreed	**PFCs**	V	Approved in 1997	Industry	-0.8 (-107 t CF_4) (-11 t C_2F_6)	-0.85 (-114 t CF_4) (-11 t C_2F_6)

Aluminium production	Provides for additional modernisation measures and process optimisation	**PFCs**	V	Proposed	Industry	-0.1 (-18 t CF_4) (-2 t C_2F_6)	-0.1 (-18 t CF_4) (-2 t C_2F_6)
Semiconductor manufacture	Provides for use of a new process for cleaning plasma chambres; Use of NF_3 as a substitute for PFCs in etching	**PFCs**	V	Proposed	Industry	-0.5 (-23 t CF_4) (-34 t C_2F_6)	-1.3 (-66 t CF_4) (-90 t C_2F_6)
Precautions in scrapping of electrical equipment	Voluntary commitment of the VDEW and ZVEI operator and manufacturer associations: the recycling concept will ensure, in the large-scale scrapping of systems that is to begin in 2010, that SF_6 fill gas, amounting to over 50 t annually, is recollected as completely as possible and then recycled and disposed of properly. Aim: to prevent emissions and recycle SF_6	**SF_6**	V	Approved in 1996	Industry	NE	-1.2
Avoidance of use of SF_6 in filling automobile tyres	Automobile tyre manufacturers will stop recommending use of SF_6 for filling automobile tyres Aim: to use air as a substitute for SF_6	**SF_6**	I	In effect	Industry	-2.3	-2.3

Prohibition on use of SF_6 for filling soundproof windows	By 2005, SF_6 is to be phased out in new soundproof windows. In light of the gas' strong impact on climate, and of the available alternatives, a prohibition on use does not seem unreasonable. Aim: to use alternative window technologies that do not require SF_6	**SF_6**	R	Proposed	Federal Government	-0.9	-1.0

IV.2.6 Measures in the area of agriculture and forestry

Some 45% of methane emissions, and some 52.5% of laughing-gas emissions, come from agriculture. In addition, agriculture is responsible for about 90% of ammonia emissions (NH_3), which have an indirect impact on climate via processes in the atmosphere and the soil that convert them to N_2O. The agriculture sector's share of energy-related CO_2 emissions, on the other hand, is relatively small (about 3%).

Agriculture can contribute to climate protection by increasing the percentage of agricultural land used for organic farming and by using other extensive agricultural production processes. Organic farming is especially effective in conserving resources and protecting the environment, and it contributes significantly to protection of water and soil resources and of rare plants and animals. For this reason, it meets criteria for sustainable agriculture to a very high degree. Organic farming typically features diverse crop rotation; low-intensity animal husbandry, with livestock herd sizes tied to farm area; and maximally closed nutrient cycles emphasing organic fertilisers and feeds that farms produce themselves. Significantly, because it refrains from using chemical and synthetic pesticides and chemical nitrogen fertilisers, organic farming generates considerably lower CO_2 emissions, per unit of area, than predominant, conventional farming methods. Organic farming also produces lower methane and laughing-gas emissions, per unit area, since organic farms' livestock-herd sizes are tied to the feeds that farms can produce themselves. The Federal Government is seeking to expand Germany's total area under organic cultivation significantly.

By managing and protecting existing forests, and by carrying out initial afforestation, the forestry sector already contributes to long-term binding of carbon in biomass. This "sink" function corresponds to a CO_2-emissions volume totaling over 30 million t per year. German forests' function as a CO_2 sink is listed separately in greenhouse-gas inventories and is not balanced with emissions.

By providing raw materials and fuels that are largely CO_2-neutral, agriculture and forestry also prevent CO_2 emissions to an extent corresponding to the amounts of fossil-based fuels, raw materials and basic production materials that such environmentally friendly materials and fuels replace.

Sustainably managed forests bind atmospheric carbon over periods ranging from decades (thinning) to centuries (end uses). Wood products can lengthen this sink function by periods ranging from several months (for example, paper used as newsprint, including recycling) to several hundred years (for example, wooden buildings). In Germany, it is estimated that wood products currently in use are storing at least 340 million t of carbon (corresponds to about 1.2 billion t of CO_2). Current wood uses are increasing this amount by about 4 to 5 million t of carbon annually. The average duration of carbon storage, for all relevant products, is about 33 years. Additional wood use – especially in the construction sector – can further increase carbon storage in wood (a wooden house with 240 m^2 of living space stores about 22 t of carbon, or about 80 t of CO_2). As such examples show, wood products can extend forests' function as a "carbon sink" and thus represent an important part of the climate-protection strategy. And wood use not only adds to carbon storage, it reduces CO_2 emissions when it involves wood substituted for fossil raw materials and energies.

Biomass, when burned in modern firing systems, not only releases substantially smaller amounts of pollutants into the air than fossil fuels do, it also releases CO_2 only in the amounts that the relevant plants removed from the atmosphere as they were growing. Such systems thus have virtually closed CO_2 cycles. Increased use of renewable, continually plentiful raw materials can reduce CO_2 emissions via substitution for fossil fuels such as coal, oil or natural gas. For years, the Federal Government, acting via the Agency of Renewable Resources (Fachagentur Nachwachsende Rohstoffe), has supported research, development and demonstration projects in this area. A relevant support programme, "Renewable raw materials", has been expanded to include animal products and waste products, including biogas. In addition, the Renewable Energy Sources Act now provides higher compensation rates that considerably strengthen biomass' position over that under the old Act on the Sale of Electricity to the Grid. These rates, in combination with the new Biomass Ordinance, can be expected to lead to considerably increased biomass use in electricity generation in coming years. Within the framework of a market-incentives programme for renewable energies that has been in effect since 1993, the Federal Government annually provides sums in the tens of millions for bio-energy systems for production of heat and electricity. Furthermore, a specifically aimed market-introduction programme of the Federal Ministry of Consumer Protection, Food and Agriculture

(BMVEL), "Biogenic fuels and lubricants", entered into force in 2000 and is now promoting introduction of such relevant products to the market. This programme, which has annual funding of some 10 million €, is currently being expanded to include additional products made from renewable raw materials. The various support measures in this area will help agriculture provide the largest possible amounts of raw materials for production of biogenic fuels that can substitute for fossil fuels. Via such materials, agriculture will be able to make an important contribution to CO_2-emissions reduction. What is more, the programme may also help protect jobs in agriculture.

Name	Description/aim	GHG	Type	Implementation status	Institution carrying out	Expected effect in millions of t of CO_2 equivalents	
Agriculture and forestry						2005	2008 to 2012
Fertiliser ordinance	Provides for biogas use in liquid-manure-treatment systems built primarily for manufacturing fertiliser products for precision nitrogen fertilisation Aim: to use substitutes for fossil fuels	**CH_4**	R	In force since 1996	Federal Government	NE	NE
Fertiliser ordinance	Provides for fertiliser use in keeping with proper practice; this is expected to reduce nitrogen input into the soil from 174 kg/ha in 1990 to 160 kg/ha in 2005 Aim: to prevent N_2O emissions	**N_2O**	R	In force since 1996	Federal Government	-2.1	-2.1
Expansion of organic farming	Promotes organic farming, a farming method that is especially effective in conserving resources and protecting the environment Aim: to reduce emissions of CO_2, CH_4 and N_2O	**CO_2** **CH_4** **N_2O**	E V	Ongoing project	Federal Government agriculture	NE	NE

Management and protection of existing forests / initial afforestation (CO_2 sink)	Afforestation and forest conservation Aim: Long-term binding of carbon in biomass	**CO_2**	E,RV	Ongoing project	Federal Government, Federal Länder, forestry sector	(-30 million t CO_2 storage)	(-30 million t CO_2 storage)
Use of biogas in agriculture	Reduces use of fossil fuels, through use of biogas Aim: to use fuels with lower carbon content, and to close CO_2 cycles	**CO_2**	EV	Ongoing project	Federal Government, agriculture	-0.7	-1.4

IV.2.7 Measures in the area of waste management

The waste management sector is also helping to reduce greenhouse gases. Ecologically oriented waste-management policies can contribute significantly to thrifty, environmentally oriented use of resources.

Considerations regarding climate protection in this sector begin with closed-substance-cycle waste management. Execution of the Technical Instructions on Waste from Human Settlements (TA-Siedlungsabfall) of 1993 was inadequate in a number of areas. As a result, new binding waste-storage requirements were imposed via the Ordinance on Environmentally Compatible Storage of Waste from Human Settlements (Verordnung über die umweltverträgliche Ablagerung von Siedlungsabfällen), which has been in force since 1 March 2001. This ordinance maintains high ecological standards throughout certification of mechanical and biological waste-treatment processes. As of 1 June 2005 at the latest, waste may be stored only if it does not endanger achievement of potential reductions in emissions of greenhouse gases. If this aim is to be achieved, relevant storage requirements for settlement waste (no storage of untreated household waste) must be implemented on time.

In addition, separate collection of biological waste in recent years, along with use of the relevant produced compost – as governed by the Ordinance on Bio-Wastes (Bioabfallverordnung), which has been in force since 1998 – has kept considerable amounts (in 2000, some 7 million t) of biologically degradable waste out of landfills and ensured that this waste is properly recycled. Furthermore, the Ordinance on the Management of Waste Wood (Altholzverordnung; scheduled to come into force at the beginning of 2003) will create a framework for old-wood recycling that, even before 2005, will keep large amounts of old wood out of landfills – where the wood would otherwise end up, leading to formation of landfill gas.

In the area of waste requiring special supervision, provisions of the 1991 Technical Instructions on Waste Management (TA-Abfall), in combination with specific support programmes, have led to considerable reductions of greenhouse-gas emissions over the past 10 years. These requirements were made legally binding in the Ordinance on Landfills (Deponieverordnung), which came into force on 1 August 2002.

Measures in the area of settlement-waste storage have the potential to achieve reductions of greenhouse-gas emissions totaling some 28 million t by 2005, and totaling some 31 million t by 2012 (potential reductions of emissions of CO_2 and other greenhouse gases, expressed in CO_2 equivalents pursuant to IPCC). In future, even greater use must be made of potential reduce greenhouse-gas emissions – especially via energy-oriented use of landfill gases (particularly methane); use of waste for energy generation, instead of fossil fuels; and increased waste recycling, leading to reduction of greenhouse-gas emissions in raw-materials production.

The concept of closed-substance-cycle waste management includes product-oriented responsibility whereby low-waste processes are used in production and products are designed to generate as little waste as possible. Two ordinances on product responsibility are relevant to climate protection. As a result of the Ordinance on Packaging (Verpackungsverordnung), which has been force since 1991, annual packaging consumption has decreased by 1.4 million tonnes, and rates of packaging recycling have increased. The End-of-life Vehicle Ordinance (Altautoverordnung), which has been in force since 1998, has increased the percentages of old-automobile waste that are recycled. Furthermore, the recycling rate for graphic papers has been increased to over 80 %, thanks to a voluntary commitment that has been in place since 1994 and was updated in 2001.

The Commercial Wastes Ordinance (Gewerbeabfallverordnung), which comes into force on 1 January 2003, establishes requirements for improved waste separation and more effective pre-treatment. As a result, it will lead to higher recycling rates for commercial waste from settlements, and for certain types of construction and demolition waste, thereby providing energy savings.

The amended version of the Ordinance on Management of Waste Oil (Altölverordnung), which has been in force since 1 May 2002, creates binding priorities for reprocessing (i.e. recycling for material recovery) in management of some 450,000 t of waste oil produced annually.

Name	Description/aim	GHG	Type	Implementation status	Institution carrying out	Expected effect in millions of t of CO_2 equivalents	
Abfall						2005	2008 to 2012
Technical Instructions on Waste from Human Settlements (TA-Siedlungsabfall) and Ordinance on Environmentally Compatible Storage of Waste (Ablagerungsverordnung)	Provides for prevention of landfill-gas generation in new facilities; extensive collection of landfill gas and use of gas for energy production in old landfills Aim: to prevent CH_4 emissions and use substitutes for fossil fuels	**CH_4**	R	In force since 1993 / In force since 1 March 2001	Federal Government, Federal Länder	-28	-31
Technical Instructions on Waste Management (TA-Abfall), Part 1, and Ordinance on Landfills (Deponieverordnung)	Provides for prevention of biological decomposition of organic components in waste requiring special supervision Aim: to prevent CH_4 emissions	**CH_4**	R	In force since 1991 / In force since 1 August 2002	Federal Government, Federal Länder	-0.3	-0.3

IV.2.8 Measures of the Länder

In keeping with the distribution of responsibilities between the Federal Government, the Länder and local authorities, the Länder have a very important role to play in developing and implementing Germany's climate-protection strategy. Many Länder are assuming special responsibility for climate protection. For example, on 31 March 1995 the Länder approved a resolution in the Bundesrat that underscored the need to develop and implement measures for achieving the reduction target established for Germany. Pursuant to the resolution, the Länder support the Federal Government's relevant objectives.

In this area, it is important to understand the different situations in the various Länder. CO_2 emissions differ as a result of difference in population, energy sources used, infrastructure, etc.. A few figures easily illustrate how the Federal Länder differ in this regard. The state of North Rhine-Westphalia (with a population of about 18 million, making it the most populous of all the Länder), for example, has annual CO_2 emissions of about 200,000 Gg, about the same as the annual CO_2 emissions of Spain or the Netherlands. The state of Berlin (with a population of about 3.5 million) annually emits about 25,000 Gg CO_2, or about half as much CO_2 as Denmark emits. The relatively sparsely populated state of Mecklenburg-West Pomerania, which has an area of 23,559 m² and population of about 2 million, has annual CO_2 emissions of 30,000 Gg.

Many Länder have established **new institutions** – such as Baden-Württemberg, with its new climate-protection and energy agency, and Bremen, with its new energy advisory board and interdisciplinary working groups concerned with climate protection. Schleswig-Holstein has created a number of new institutions. Many of the Länder institutions in question were involved in preparing the first climate-protection programmes and concepts of the Länder in which they are located. And many Länder have given their environment ministries responsibility for their energy sectors.

Many Länder began developing their climate-protection policies by preparing (or commissioning preparation of) **climate-protection programmes**, concepts and reports and relevant studies.

The Länder have focused their climate-protection policies especially on the energy sector. In keeping with this focus, all Länder are carrying out priority measures for improv-

ing energy efficiency in existing buildings (private residences, municipal properties and state properties), in companies and in public-sector facilities, since this is the area in which the largest CO_2 reductions can be achieved. All Länder are also promoting renewable energies, in order to support their commercial establishment. In general, biomass systems are seen to hold the largest growth potential. In addition, the Länder support expansion of heat-power cogeneration and district heating. Some also support increases in natural gas' share of the energy mix (Thuringia, Saxony, Lower Saxony, Bavaria and Baden-Württemberg). Development of new, low-emissions energy technologies such as hydrogen-based systems is also being considered (Bavaria, Mecklenburg-West Pomerania and Saxony-Anhalt).

IV.2.9 Measures of municipalities

Municipalities – cities and communities, i.e. the local level – continue to be an area that holds considerable potential for reducing emissions of CO_2 and other greenhouse gases.

This considerable potential results from the various functions and tasks of local authorities:

- They are the administrative level that carries out federal and Länder laws,
- They establish standards for their local communities,
- They function entrepreneurially in cases where the power supply is provided by a municipal power company,
- They own municipal properties such as administrative buildings, schools, kindergartens and swimming pools,
- They provide relevant support through municipal support programmes for CO_2 reduction, especially programmes to save energy and use renewable energies.

Important areas for municipal action in support of climate protection:

Sector	Measures
Ecologically oriented urban-development planning and regional planning	• Integration of climate-protection and energy-efficiency criteria in urban-development planning, construction planning and building permits • Emphasising of urban structures that tend to reduce CO_2 emissions (multi-functional structures, the "city of short distances", etc.) • Increasing the amounts of green and open areas in cities / unsealing of paved areas (carbon binding; CO_2 sinks); use of additional potential green areas (rooftops, facades)
Information, advising and public awareness	• Establishment of local and regional centres for energy advising • Inclusion of climate-relevant information in environmental advising
Energy-saving in consumption sectors	• Improvement of energy efficiency in municipal buildings, by means of structural improvements in thermal insulation, measures to enhance efficiency of heating, measurement and control systems, establishment of municipal energy management structures and use of other suitable measures to reduce heat and electricity consumption • Promotion of efficient use of heat and electricity in other consumption sectors: residential, institutional (commerce, crafts, services), manufacturing/industry and other public institutions/authorities (by means of information, planning and other supporting measures)
Environmentally compatible energy infrastructure	• Expansion of the line-based energy infrastructure (including that for providing energy for heating buildings: gas networks, small-scale / large-scale district heating networks) • Fuel conversions (for example, from coal to natural gas) • Conversion of the energy infrastructure to allow greater use of combined heat/power (CHP) generation / small-scale CHP systems • Use of renewable and local energy sources (wind power, hydroelectric power, solar energy, biomass, waste heat, etc.)
Environmentally compatible development of the transport sector	• Reduced use of private automobiles, coupled with greater use of local public transportation and environmentally compatible, low-emissions modes of transport • Improvement of the quality of the public transportation infrastructure, especially of local public transportation and other, less energy-intensive modes of transportation (bicycle paths/lanes, pedestrian zones, etc.) • Environmentally compatible development of goods transports (expansion of regional supply networks, etc.)
Municipal waste management and wastewater treatment	• Waste avoidance, waste separation for collection, re-use and recycling of materials in waste • Waste treatment (as part of a systematic policy of waste avoidance, re-use and recycling): use of waste and landfill gas for generation of heat and power; use of biogas systems fed with biomass waste, use of composting systems • Wastewater treatment: use of sewage gas, reduction of energy consumption in processes

IV.3 Other players in climate-protection policy

IV.3.1 Deutsche Bundesstiftung Umwelt

The Deutsche Bundesstiftung Umwelt (DBU; German Federal Environment Foundation) in Osnabrück was established as an independent private-law foundation by resolution

of the German Bundestag and at the initiative of the Federal Government. In began functioning in 1991 and is now one of Europe's largest foundations.

Its support guidelines, which were modified in September 1998, cover a total of 12 support areas, within main sections:

Environmental technology

Support area 1: Environmentally friendly and healthy processes and products
Support area 2: Energy technology
Support area 3: Architecture and construction
Support area 4: Closed-cycle systems and emissions reduction

Environmental research/environmental protection

Support area 5: Applied environmental research
Support area 6: Environmentally compatible land use
Support area 7: Grant programme
Support area 8: Environmental management in medium-sized companies

Environmental communication

Support area 9: Environmental communication for small and medium-sized companies
Support area 10: Provision of environmental information
Support area 11: Environmental education
Support area 12: Environment and cultural assets

The grant programme listed as support area 7 is used to support young scientists, on a nationwide basis, working in the area of environmental protection. It also promotes the establishment of, and endows, academic chairs for environmentally oriented research and teaching.

Each year, the foundation awards an environmental prize of 500,000 € to honour commitments and services that have played a decisive, exemplary role in protecting and conserving the environment or that in future will significantly help to reduce environmental stresses.

Since its inception, Deutsche Bundesstiftung Umwelt (DBU) has supported a total of over 3,900 projects, with total funding of more than 818 million €.

IV.3.2 Deutsche Energie-Agentur (dena)

The **Deutsche Energie-Agentur (dena; German Energy Agency)** was founded on 29 September 2000 as a national competence and information centre for energy efficiency and renewable energies. dena is not a subordinate authority of any ministry; instead it is a limited-liability company (GmbH). Its present shareholders, each of which has a 50 % stake, are the Kreditanstalt für Wiederaufbau (KfW) promotional bank and the Federal Republic of Germany, represented by the Federal Ministry of Economics and Technology (BMWi), the Federal Ministry of Transport, Building and Housing (BMV) and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

dena is charged with carrying out flexibly designed projects that support certain types of Federal Government activities in the areas of efficient energy use, renewable energy sources and climate protection. It also provides information to municipal and regional energy agencies and consumer-advocacy centres. Furthermore, it assists interested parties, whether in private households, companies, associations or government authorities, in obtaining information. Finally, the agency also has the important task of trading experience and carrying out projects with international partners and advising the Federal Government in connection with such international activities.

IV.3.3 Deutsche Bahn AG

Deutsche Bahn (German Railways), taking into account

- national and international developments in the area of environmental protection,
- relevant entrepreneurial interests and possibilities and
- society's expectations,

has established the following strategic aims:

- Reduction of specific primary energy consumption for traction by 25% by 2005, based on the 1990 level;

- Further reductions of absolute primary energy consumption in stationary processes,
- Reduction of emissions, especially carbon-dioxide emissions, by 25% to 30%.

V Emissions scenarios and projections, and assessment of the effects of measures

V.1 Reliability of forecasts, scenarios, projections

Forecasts and scenarios play an indispensable role, in connection with climate-protection strategy, in forecasting potential future developments and potential impacts of measures under consideration. They are subject to considerable uncertainties, as is also explained in Chapter V.

Participants in political discussion often forget that the future cannot be predicted with certainty and that scenarios cannot be more than "if-then" statements. Forecasts are always closely tied to identified "probable" trends, and conclusions derived from scenarios always depend on the relevant underlying premises. In other words, descriptions of future developments depend on assumptions regarding key economic, demographic and political trends, and on assessment of interrelationships relevant to energy consumption, and thus different, consistent and contradition-free descriptions of the future are always possible at any given time. Target-oriented forecasts are referred to as "projections". In each instance of a projection, careful studies will provide the best possible determination of whether the projection is realistic – i.e. of whether its targets can be achieved.

As to methods, emissions projections are based on impacts analyses, combining assessment of individual measures with integrated views of the overall effects of measures and policies. The longer the time periods covered by projections, the greater the need for numerical models – which by their nature can only provide a limited view of reality. As the time axis lengthens, framework conditions become increasingly blurred, and impacts analyses covering only individual measures produce increasingly unreliable conclusions. The projections presented below do not take into account the resolutions of 14 July 2000 on phasing out nuclear energy. Furthermore, the Federal Government has not officially endorsed the following projections and scenarios.