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THEMATIC AREA "ENERGY"

I. Using energy efficiently - protecting the climate effectively

1. Initial situation

The Federal Government's Strategy for Sustainability aims to merge energy policy and climate protection policy in the interests of an integrated approach. Of equal ranking, the goals of this approach are:

- Energy supply that is competitive economically and internationally,
- Conservation of the environment and protection of resources as well as protection of the climate,
- Sustainable and safe energy supply.

In order to achieve these goals, the Federal Government has focussed on two points of reference in its Strategy for Sustainability.

On the one hand, it is concerned with using energy more efficiently in all areas. The need to replace power stations over the next few decades offers considerable potential. This current revision of the Strategy for Sustainability deals with this challenge comprehensively as a separate subject. The renovation of old buildings, more economical vehicles and – covering all sectors – the Ecological Tax Reform also make important contributions to increasing energy efficiency.

On the other hand, the expansion of renewable energies plays a crucial role. In the last few years exemplary achievements have been made in this area. Compared with other countries, Germany has taken on a pioneering role, and is generally recognised as doing so. The amendment of the Renewable Energy Sources Act in 2004, especially, should ensure that this trend continues.

Alongside economic (also in terms of the energy sector) and ecological goals, the Federal Government also attaches great importance to effects on employment policy and thus the "third pillar" of sustainable development when formulating its energy and climate protection policy. Measures to expand the use of renewable energies have safeguarded existing jobs and lead to the creation of new jobs in the relevant sectors. In the same way, investments to increase energy efficiency not only benefit climate protection, they also make sense in terms of employment policy. As with ever-growing demand for oil, gas and coal in the world markets, we have to expect ever-rising energy prices. Under these conditions, energy efficiency is becoming more and more important in terms of the competitiveness of power plant technologies, machines, vehicles and other industrial products.

2. Implementation of planned measures

a) Key indicators of energy and climate protection policy:

Energy use becomes more and more efficient

Over the last few years Germany has made considerable progress on the route towards efficient use of energy. Primary energy consumption was lower in 2003 than it was at the beginning of the 1990s. Also energy consumption per head dropped noticeably against the backdrop of rising prosperity. If one includes growth in gross domestic products, there is a clear decoupling of energy consumption and economic development. Energy productivity, i.e. economic output per unit of energy used, was more than 24% higher in 2003 than in 1990 and 7.3% higher than in 1998.

However, the speed at which energy efficiency is rising has slowed down over the last few years. In the 1990s energy productivity was still increasing by 2%[1] per year, on average. This was mainly attributable to substantial investments in the East German *Länder*. After this potential was to a large extent exhausted, energy productivity has increased on average by just under 1% each year for the last few years. The goal set out in the Strategy for Sustainability of doubling energy productivity by 2020 proves to be very ambitious against this backdrop and it requires greater efforts to be made in all areas.

As before, there is still enormous potential for increasing energy efficiency. For instance, in budgetary terms, an average household can significantly reduce its electricity consumption by using the best equipment on the market: for example, compared with standard appliances, energy-efficient fridge-freezer combinations use on average nearly 60% less electricity per year. The same applies to energy-efficient personal computers as opposed to standard ones. With the implementation of energy efficiency labelling programmes for electrical appliances, consumers will also be able to utilise this potential. In conjunction with other EU Member States, we are still looking for solutions to reduce energy loss when electrical equipment is in standby mode. The discussion on the introduction of additional efficiency standards is ongoing. There are various ways to proceed in this respect. One possible way is, for example, the top runner approach practised in Japan, according to which the standard of the most efficient equipment on the market is fixed as compulsory. Other approaches do without regulatory provisions and rely on more market transparency.

Despite the rise in energy prices, there is still considerable potential for efficiency in industry, too. Forecasts signal a further decline in specific energy consumption of around a quarter by 2020. Electrical motors alone are attributable for around 70% of electricity consumption in industry. For example, the use of electronic revolution controls could reduce consumption by around a quarter. Of this technological potential around 70% could be exploited in industry as economic potential. Often the problem is that industry offers pre-assembled appliances. The energy efficiency of built-in electrical motors is of secondary importance in the investment decision – if at all. An economic savings potential of 20% was proven in a project run by the

[1] The Federal Statistical Office has not yet calculated an official figure for GDP for the base year 1990. Data on the development of energy productivity compared with 1990 is thus based on the estimate by the German Institute for Economic Research (DIW) for GDP in 1990.

German Energy Agency (dena) in the field of compressed air supply. Projected to cover the entire manufacturing industry, this would mean savings of up to 2,800 million kWh of electricity per year. Compressed air is becoming more and more important in industry, because it is used, among other things, to operate robots.

In the political sphere there are proposals to encourage the market launch of such measures with the aid of an energy efficiency fund which are not supported by Germany. However, the success of a strategy for efficiency in industry depends crucially on arousing the interest of participants in business – the engineers and the sales people. This can be done using energy prices, in particular. Obligations that German trade and industry imposes on itself voluntarily are also a significant factor in improving energy efficiency. In addition to this, however, new directions need to be set, especially with regard to industrial electricity consumption. For example, energy suppliers could strengthen their commitment to efficient electricity use in industry and the rest of the business world, as has already been achieved in the private sector by means of public-private-partnerships under the campaign *"EnergieEffizienz"*. This would also make an important contribution to improving efficiency on the demand side. Here, the typical potential of the individual sectors for increasing efficiency could be identified and practical solutions developed for the companies. These results could be made accessible, especially to small and medium-sized companies, with the aid of qualified advisers.

Greenhouse gas emissions are falling

The rise in energy efficiency is also reflected in emissions of greenhouse gases. Between 1990 and 2003 emissions of the six most important greenhouse gases fell by 18.5%. Compared with 1998, they fell by 3.6%. CO2 emissions declined by 14,7% compared with 1990 and by 2.2% compared with 1998. There has been a significant drop in CO2 emissions also in relation to economic output and so a decoupling of these factors has been achieved. This is also true in relation to population.

Industry was the main contributor to the development, reducing its emissions by around a third in comparison with 1990. The energy industry also notched up considerable successes in the 1990s. Although the energy efficiency of power stations has risen markedly as a result of modernisation measures, the energy industry has reported a rise in emissions over the last few years through greater use of lignite in electricity production. In contrast, the steady rise in emissions from transport has been reversed.

On the whole, Germany is making good progress towards its goal of reducing emissions of the six most important greenhouse gases by 21% by 2008/2012. The Federal Government published the review of its national climate protection programme on July 13th 2005. The update sets out additional measures for private households and the traffic sector in addition to emissions trading. The National Climate Protection Programme 2005 ensures that Germany will meet its Kyoto-target

b) Development in important areas of action

aa) International climate protection policy

Global action is required

The fight against climate change is one of the key challenges for the 21st Century. International climate policy aims at limiting the rise in global concentrations of greenhouse gases in the atmosphere for the medium to long term to such an extent that people and nature remain able to endure the consequences of climate change. Our point of reference here is the scientific view that warming of the global climate by more than 2 °C on pre-industrial times must be prevented.

To date, despite intensive international efforts, it has not been possible to stop the rise in global emissions. From 1990 to 2002 CO2 emissions increased worldwide by approximately 13%. Two thirds of this increase were attributable to China and the USA alone.

By contrast, the EU was able to reduce its greenhouse gas emissions by 1.7% between 1990 and 2003. This decline is due almost exclusively to positive results in Germany and Great Britain. Some of the other Member States are far behind on their obligations under the Kyoto Protocol. Without the significant reductions in Germany, the EU would report a 3.8% increase. The situation is even more drastic when it comes to CO2 emissions: without Germany, the increase would be 8.6%.

All industrial countries are still especially responsible for climate protection. This is also expressed by a comparison of energy consumption. A US citizen uses almost nine times as much energy as a Chinese person – despite enormous growth in China in the last few years. In other industrial countries too, energy consumption is many times higher than it is in developing countries, even though it is still far below that of the USA. The USA uses twice as much energy per head as Germany.

However, developing countries also have to be incorporated gradually into international efforts on climate protection. Their share of global emissions is steadily increasing due to growth in trade and industry and population. Developing countries also have significantly better potential for increasing efficiency. For example, energy consumption per unit of gross domestic product in China is almost seven times as high as in Germany.

The Kyoto Protocol must be implemented

It is crucial for international climate protection that the Kyoto Protocol will be implemented effectively. Only then will the agreed targets for reduction be binding under international law. The Federal Government regards the development of the Kyoto targets beyond 2012 as necessary. This will require further significant obligations on industrial countries to reduce emissions, including the USA, the first effective climate protection obligations on major developing and emerging countries, as well as policies and measures in the area of cross-border air traffic and shipping, which have not yet been covered. It will also require a balanced spread of climate protection efforts among all participating countries. In this context, the Federal Government is proposing that the EU declares itself ready to reduce its greenhouse gas emissions by 30% by 2020 compared with the base year 1990.

The project-related mechanisms (Clean Development Mechanism (CDM) and Joint Implementation (JI)) agreed in the Kyoto Protocol are important elements of international climate protection policy. These offer industrial countries the opportunity to fulfil their obligations to reduce emissions in part by investing in developing countries as well as in Central and Eastern Europe. This can significantly cut costs of reducing emissions incurred by industrial countries. For their part, the developing countries can benefit from a stronger inflow of foreign capital and expertise.

The JI and CDM projects are particularly important in relation to emissions trading in the EU (see below). At the beginning of April 2004, the European Parliament, the European Council and the European Commission adopted a directive that enables JI and CDM projects to be recognised within the framework of trading in emissions. In this way, companies can implement the minimum targets set out in the national allocation plans more flexibly and more cost-effectively. To this end, the KfW-Förderbank is currently preparing a climate protection fund that will offer mainly private investors the opportunity to acquire credit notes for emissions.

bb) Emissions trading

The European Emissions Trading Scheme commenced at the beginning of the year 2005. The new instrument will play a key role in climate protection in the EU. The trading system is intended to contribute to cost-effective fulfilment of the EU's climate protection goals under the Kyoto Protocol. Emission trading combines an effective absolute restriction on greenhouse gas emissions with flexible enforcement of the necessary measures to reduce emissions. The basic principle is simple: plant operators will be allocated a certain level of emission rights free of charge. If the actual emissions produced by a plant are higher than the allocated level, the operator will have to acquire emission rights on the market, or if the reverse is true, the operator can sell its emission rights. It therefore puts in place incentives for saving energy and increasing energy efficiency.

According to the Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community (Emissions Trading Directive), all mediumsized and large plants operating in the fields of energy generation, refineries, coking plants, the steel, cement, ceramics and cellulose and paper industries will participate in the new scheme. Overall, trading in emissions in the first period 2005–2007 will cover around 58% of German CO2 emissions. For the next period 2008–2012 it will be decided within the framework of a European review whether other areas should be incorporated into the trading system.

Germany passed the National Allocation Plan 2005-2007 and two laws in order to implement the Emissions Trading Directive:

- Law on Greenhouse Gas Emission Allowance Trading (*Treibhausgas-Emissionshandelsgesetz- TEHG*),
- Law on the National Allocation Plan for Greenhouse Gas Emission Allowances in the Allocation Period 2005–2007 (*Zuteilungsgesetz 2007 –ZUG 2007*).

Essentially it depends on the Federal Government to ensure that emissions trading not only points the way forward in terms of climate protection policy, but that it is also economically sustainable. For this reason, the National Allocation Plan offers positive incentives for investing in the most modern and most efficient technology. Thus, emissions trading reinforces sustainable development in energy supply.

cc) Renewable energies

Growth continues

On the basis of a consistent strategy to increase efficiency, environmentally friendly expansion of renewable energies forms a second corner-stone of sustainable energy supply. The goal of the Federal Government is to double the proportion of renewable energies to 4.2% of primary energy consumption and to at least 12.5% of electricity consumption by 2010, as compared with the year 2000. By 2020 the proportion of electricity consumption attributed to renewable energies should be at least 20%. By the middle of the century, renewable energies should cover around half of energy consumption. To this end, the Federal Government is taking into consideration the various issues of environmental protection and nature conservation.

Germany has made significant progress towards achieving these goals over the last few years: in 2004 water, wind, sun, biomass and geothermics made up 3.6 % of primary energy consumption and 9,3 % of electricity consumption.:

Impacts of the Renewable Energy Sources Act

The Renewable Energy Sources Act *(Erneuerbare-Energien-Gesetz – EEG),* which replaced the Electricity Feed Act (*Stromeinspeisungsgesetz* – StrEG) on 1 April 2000, is crucial for the expansion of renewable energies in the electricity sector.

Under it, plant operators will be granted fixed compensation normally over 20 years, for electricity fed into the grid. The level of compensation will depend on the energy source as well as the year in which the plant started operation, as it is reduced each year for new plants (degression). This offers a continuous incentive to increase efficiency and reduce costs. The extra Compensation for electricity fed into the grid – around € 2,500 million in 2004 – can be shifted from the network operators onto the consumers. Since mid 2003 a hardship clause (special compensation rule) has ensured that costs incurred by electricity-intensive businesses are limited. This counteracts any restriction on the competitiveness of these companies.

The amendment of the Renewable Energy Sources Act came into force on 1 August 2004. The aim of the revised Renewable Energy Sources Act is, on the one hand, to guarantee the expansion of renewable energies in the next few years too. For this purpose, improvements were made to framework conditions and, in particular, to compensation rates in certain areas (e.g. offshore wind farms, biomass). As the 100,000 Roofs Programme (*100.000-Dächer-Programm*) came to an end in 2003, the Federal Government improved basic conditions for the promotion of solar-powered electricity with its interim law on the amendment of the Renewable Energy Sources Act, introduced as early as 1 January 2004.

On the other hand, the amendment of the Renewable Energy Sources Act aims to strengthen incentives for improving efficiency. This is why degression was reinforced in some areas. Compensation for onshore wind farms was reduced and for areas not exposed to much wind it was abolished. The amendment of the Renewable Energy Sources Act also aims to make renewable energies competitive in the medium to long term. In this way, they will be able to survive in the market without financial aid and guaranteed rates of compensation and in the long term, they will play a major role in the energy market.

Another innovation is the hardship rule. This was extended and simplified. In future, this will not only benefit major companies, but also energy-intensive medium-sized companies as well as the railways. The additional burden placed on other electricity consumers resulting from this extended regulation will be clearly limited.

Market Incentive Programme causes boom in solar panels

The second key element for the expansion of renewable energies is the Market Incentive Programme, which was set up in connection with the Ecological Tax Reform. It mainly promotes solar panels and biomass heating equipment. Last year, the Federal Government increased its funding rates for solar panels and, by doing so, caused the number of approved applications to more than double from approximately 46,000 in 2002 to more than 145,000 in 2003, in 2004 it were 113.000. The investment volume behind this increase alternated from around € 892 million (2002) to € 575 million (2003) and 807 million (2004). The new guideline for the Market Incentive Programme, came into force on 1 July 2005. It provides improved funding conditions for solar panels and modern wood firing systems and a wider circle of eligible applicants.

Positive ecological and economic conclusions

With their rapid growth, renewable energies are contributing to progress towards reaching the Kyoto target. From year to year, water, wind, sun, biomass and geothermics reduce CO emissions by a considerable extent. In 2004, renewable saved around 70 millions tonnes CO2

At the same time the number of jobs with manufacturers of wind farms, photovoltaic equipment, solar panels and other companies, has risen. Around 130,000 are now employed in this sector. In 2004 the renewable energies sector generated turnover of around € 11,600 million: These figures underline the fact that a remarkable industry has emerged here.

The Federal Government is continuing to push ahead with the expansion of renewable energies. The greatest potential for this over the next few years can be found in the areas of wind energy and biomass. In the medium to long term, however, renewable energies must become competitive, as only then, when they are able to survive in the market without financial aid and guaranteed rates of compensation, will they be able to play a major role in the energy market in the long term. Due to demand induced within the framework of the Renewable Energy Sources Act, significant technological progress has already been achieved, so that with modern, high performance plants, for example, in the area of wind power, it has been possible to more than halve the cost of electricity generation since the beginning of the 1990s.

This trend is expected to continue. The Federal Government's aim is for renewable energies to be competitive in the domestic energy market in the medium to long term. Some people hold funding of renewable energies responsible for the increase in electricity prices observed over the last few years. In reality, only around 2% of the price of electricity is currently attributable to the Renewable Energy Sources Act. After renewable energies have become profitable, electricity consumers will no longer be burdened by sharing the cost of compensation for electricity fed into the grid. Funding, which makes sense from an economic perspective too, is of crucial importance to the necessary social legitimation of the expansion of renewable energies: only when it is clear that electricity prices will not increase excessively as a result of funding, will this extremely important element of sustainable energy supply be accepted by private and commercial electricity users for the long term.

Research and development activities in this area are vital to the competitiveness of renewable energies. In connection with the Initiative for Innovation of the Chancellor, the Federal Government has increased by around a third funding for research in the area of renewable energies and renewable resources in its budget for 2005.

The position of renewable energies has also been strengthened considerably in the basic energy-related research of the major research institutes of the Helmholtz Association of National Research Centres (HGF). All of the additional funds earmarked for HGF's energy research in the years 2004 to 2008 will be concentrated on the areas of renewable energies and rational energy conversion. This means an increase of more than 15% in funds available to these areas of research.

Global expansion of renewable energies

It is important to open up the potential of renewable energies outside Germany, too. In many parts of the world, the natural conditions for using renewable energies (wind conditions, solar radiation) are considerably better than in Germany. This is why, with its renewable energy export initiative, the Federal Government supports the marketing of German technologies worldwide.

At the World Summit on Sustainable Development in Johannesburg in September 2002, Chancellor Gerhard Schröder invited the international community of states to the International Conference for Renewable Energies (www.renewables2004.de). The conference was held from 1 to 4 June 2004 in Bonn and underlined the fact that expansion of renewable energies worldwide can help combat poverty, aid economic development, safety of energy supply, and climate protection. In this sense, renewable energies, combined with increased energy efficiency, should become a most important and widely available energy source. The official results of the conference included, alongside a political declaration and recommendations on more effective political strategies, the concrete International Action Programme (IAP), which covers around 200 voluntary actions and commitments by govern- ments, international organisations, non-governmental organisations, trade and industry and science. Among these are ambitious targets for the expanded use of renewable energies of almost 30 states and financial commitments by, among others, Germany, the World Bank and the Global Environment Facility (GEF) and numerous concrete projects. According to recent analysis, full implementation of the IAP actions

and commitments will result in yearly CO2 reductions of 1.2 billion t by 2015. This corresponds to around 5% of the expected global CO2 emissions.

An international follow-up conference was hosted by the Chinese government from 7. to 8. November 2005 in Beijing, supported by the German government (German Federal Ministry for Economic Cooperation and Development, German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety). The "Beijing International Renewables Conference 2005" endorsed the importance of renewable energies, especially in developing countries. The “Beijing Declaration” suggests that the UN Commission on Sustainable Development (CSD) resolves upon a monitoring arrangement to review the commitments made in the Johannesburg Plan of Implementation and the International Action Programme of Bonn. The Chinese government was requested to introduce this proposal in the upcoming CSD 14/15 process.

Pilot project - Expansion of Offshore Wind Energy

One of the pilot projects included in the National Strategy for Sustainability is the strategy to expand the use of off-shore wind energy at sea. This could increase the proportion of electricity consumption attributable to offshore wind energy to 15% within the next three decades. By implementing the offshore strategy, the following has been achieved to date:

The procedure for determining suitable sites for offshore wind parks was launched. The first suitable sites for wind energy are to be demarcated by the end of 2005.

A proposal on demarcating NATURA 2000 sites in the North Sea and Baltic Sea was published. The sites are to be registered with the EU Commission in 2004.

With respect to the expansion of offshore wind use, the German Energy Agency (dena) had a report drawn up on network expansion and effects on the structure. The study has shown that a low cost integration of wind energy would be feasible with a moderate grid expansion.

Accompanying ecological research, research on measurement platforms as well as the further development of systems technology have been secured for the long term by research programmes on renewable energies. The first research platform began operating in the North Sea, approximately 45 km north of Borkum Island, in 2003.

With the amendment of the Renewable Energy Sources Act, compensation for electricity fed into the grid was brought into line with current technological developments and distinctions were made based on water depth and distance from the coast.

The approving authority, the Federal Maritime and Hydrographic Agency (BSH), has so far approved ten wind parks in the North Sea with an installed output of more than 3,000 MW.

dd) Electricity supply

The German electricity market was liberalised completely and at one go in 1998. This liberalisation had resulted in substantial changes for companies active in the industry, for employees and for customers.

The German electricity sector faces huge challenges in the future, too. In the next 20 years it will gradually withdraw from using nuclear energy altogether. At the same time a considerable

proportion of power stations run on coal, gas and oil are to be replaced, depending on their age. Together with the nuclear power stations to be shut down, the network is to lose power stations with an output of around 40,000 MW. This means that around a third of German power stations will need to be renovated.

The energy source structure of electricity generation will change considerably over the next few years as a result of this. In parallel to the gradual discontinuation of nuclear energy use, the proportion of renewable energies used is to be increased to 20% by 2020. The fossil energy sources lignite and hard coal, as well as natural gas, will then count for around 80% of electricity generation (currently around 60%).

Substantial investments are also required in the high voltage network. In view of the anticipated offshore wind development and the need to replace 40,000 megawatts of power plant output by 2020, the German Energy Agency (DENA) has co-ordinated an expert report on the impacts of renewable energy development on expansion of the grid and on power plant structure in Germany. The study has shown that a low cost integration of wind energy would be feasible with a moderate grid expansion. The study found that the total necessary expansion of the grid for extra high voltage will be not more than 850 km up to 2015. At a total grid length of 18,000 km in Germany, this is less than 5 per cent of the existing extra high voltage grid. In addition, the liberalisation of the European electricity markets will be accompanied by new demands on the high voltage networks.

The Federal Government has focussed on these challenges in its National Strategy for Sustainability (see Section E. II). It will formulate the basic conditions of energy policy in such a way that Germany remains a major centre for industry and energy. This is important for investments in energy supply and jobs associated with it.

Future energy supply must continue to guarantee the high level of supply safety and be available at prices that safeguard the profitability and international competitiveness of the German economy. At the same time, it must help ensure that Germany achieves its climate protection goals and, by doing so, fulfils its international responsibility.

Both from the perspective of climate protection as well as with regard to the competitiveness of electricity production in Germany, the forthcoming modernisation of power stations offers extensive opportunities that are worth taking. Efficient hard coal and lignite power stations will also play a major role in the future. So, for example, Germany’s oldest lignite power stations have a net efficiency level of around 30%. By contrast, today’s most modern lignite power station can achieve around 43%, while hard coal power stations can reach 46% and more. Considerable reductions in CO2 emissions can therefore be realised through the forthcoming modernisation of power stations.

Increasing use of natural gas, especially in combined heat and power (CHP), plants, as well as in modern gas and steam turbine plants with high efficiency levels contributes to this trend. With its CHP Act (*Kraft-Wärme-Kopplungsgesetz – KWKG*), the Federal Government has given important stimulus for the modernisation of CHP plants as well as the further expansion of combined heat and power generation. In addition, highly efficient gas and steam turbine plants are subsidized within the framework of the mineral oil tax.

An essential element of the energy policy of the Federal Government is the scheduled withdrawal from use of nuclear energy. With the amendment of the Nuclear Energy Act (*Atomgesetz*) of 22 April 2002, the relevant agreement with the energy sector was made legally binding on 11 June 2001. The nuclear power station at Stade was the first to be removed from the grid in November 2003. Next year the power station at Obrigheim will follow.

Domestic coal continues to make an important contribution to safe energy supply. This is mainly true of lignite, which was attributable for 27.4% of gross electricity generation in 2002. Hard coal made up 23.3%; half of this was from German hard coal. Mining of hard coal in Germany has steadily reduced over a considerable period of time. In 1990 around 66 million tonnes were mined, by 2002, just 26 million tonnes. In 2001 hard coal imports exceeded domestic mining for the first time. The decline in domestic mining will continue over the next few years. The Federal Government has been successful in its efforts to bring about a new regime of EU aid for hard coal. On this basis, the Federal Government has also adopted a follow-up regulation at national level. Accordingly, public aid will be reduced step by step over the coming years. At the same time, mining of hard coal is to be cut back from 26 million tonnes to 16 million tonnes. The staff cuts associated with this will be carried out in a socially responsible manner.

The Federal Government will further develop the framework of energy law and enforce under national law the new EU single market directive on electricity. The new framework must ensure stable basic conditions, but at the same time offer the flexibility required to react quickly to new market requirements. Maintenance and expansion of networks by companies must be guaranteed in the future, too.

On 28 July 2004, the Federal Government presented a draft amendment of the German Energy Industry Act (*Energiewirtschaftsgesetz*). This law will implement the EC directive concerning common rules for the internal market in electricity. Important market regulations on network access will be prescribed by law and the German Regulatory Authority for Telecommunications and Posts will be instructed to formulate the regulation. This authority must ensure non-discriminatory network access to facilitate effective and genuine competition.

ee) Energy consumption in the building sector

Around a third of all final energy used in Germany is required for heating buildings and providing hot water. Increases in efficiency and savings in this area therefore have an important part to play. The Federal Government has taken various steps over the last few years.

The German Energy Saving Regulation (*Energieeinsparverordnung*), which came into force on 1 February 2002, prescribes ambitious efficiency standards for new buildings, as well as some for modernisation measures. For new buildings, the requirement for maximum energy consumption was increased by around 30% on the previous standard.

Funding from the KfW-Förderbank building renovation programme to reduce CO2 emissions, which was launched in 2001, was nearly doubled in May 2003 within the framework of the Ecological Tax Reform. By 2005 € 360 million will be available each year.

At the same time the funding conditions were improved. So there is a partial debt relief of 20% for the renovation of old buildings as low energy houses. 3,000 house owners made use of this opportunity in 2003. This shows very ambitious consumption levels can be achieved in old buildings, too.

In addition, there is also funding for the construction of "Energiesparhäuser 40" (houses with an energy consumption of less than 40 kWh/m^2). This will help push forward the development and spread of energy-saving technologies in new buildings. As a result of the improved funding conditions, loan commitments rose by more than 50% in 2003. Overall, around 46,000 jobs were secured in 2003 as a result of the KfW-Förderbank programme to reduce CO2 emissions.

Considerable progress has been made in modernising existing buildings over the last few years. Between 1990 and 2001 specific energy consumption per m2 of living space dropped from 240 kWh to 190 kWh. This trend will continue. Over the next 10 years, a reduction to 150 kWh is expected. Associated with this is a corresponding reduction in CO2 emissions. This positive development is, however, countered by continuous growth in living space. From 1993 to 2002 living space per inhabitant rose from 36.2 to 41.6 m2.
Before the end of this year, within the framework of its climate protection programme, the Federal Government will review whether, in addition to the goals set out in the National Allocation Plan, further measures are required in the building sector and if so, which steps should be taken.

Pilot project: Low energy house in the housing stock

The project *"Niedrigenergiehaus in Bestand"* (Low energy house in the housing stock), which was proposed by the German Council for Sustainable Development (RNE), is designed to launch model projects on renovating buildings. By doing so, it is intended to show that the standard of a low energy house can be attained by old buildings as well.

The project is coordinated by dena. 26 residential construction firms from nearly all the German *Länder* are participating in it. They have undertaken to renovate a property of their choice over the course of 2004 so that its primary energy consumption is 60, 50 or 40 kWh/m2. For the purpose of comparison: primary energy consumption of old buildings is around 200 kWh/m2. The project is therefore aiming to achieve energy savings of up to 80%. The model project will renovate almost 1,500 residential units covering around 83,000 m2 of living space. The building projects will be supported financially by the KfW CO2 Building Renovation Programme.

Pilot project: Energy Efficiency Contracting for Government Properties

The pilot project *"Energieeffizienz-Contracting in Bundesliegenschaften"* (Energy Efficiency Contracting for Federal Government Properties), which was also proposed by the German Council for Sustainable Development (RNE), is coordinated by dena. The aim is to optimise energy consumption at as many federal properties as possible by means of contracting. In this process, energy-saving measures are financed by private energy service providers (contractors). The savings guarantee of the contractor ensures that energy costs are reduced by a certain amount. The contractor is financed by the savings in energy costs. In this way the Federal Government can finance energy-saving measures, reduce operating costs, and, not least, contribute to climate protection without the need for additional funds from the budget.

Within the framework of the project, handling of contracting for federal properties was first clarified from a budgetary point of view and a manual for contracting projects was drawn up (sample contracts, tender documents, calculation programmes, etc.). In addition, around 600 properties were examined for their suitability to participate in the project. The aim is to incorporate 40–50 properties into the project. Before the end of 2004 around 20 of the Federal Government's larger properties will be inviting tenders for contracting.

Dena wants to pass experiences gained from the project on to local authorities and districts. For this reason, it is planning consultations and information material to help overcome the obstacles currently in the way of decision-makers in politics and administration.

ff) Transport

Nearly 30% of German energy consumption is attributable to transport. As late as the 1990s, the transport sector was recording steadily rising energy consumption and CO2 emissions were increasing at a corresponding rate. CO2 emissions in the transport sector reached their highest point in 1999, when they were almost 15% higher than in 1990. This trend has been stopped. Since the year 2000 CO2 emissions from transport have gradually decreased. In 2003 they were just 8% higher than the level of 1990.

The Ecological Tax Reform has played an important part in this development. On the one hand, it has lead to more economical behaviour among drivers and, on the other hand, it ensures that petrol consumption is an important criterion in car buying. The tax cut on natural gas and liquid gas as fuels, which was extended to 2009 (liquid gas) and 2020 (natural gas respectively), also has positive impact. The number of environmentally friendly natural gas cars had increased to 20,000 by the beginning of 2004. The basic conditions for biofuels were also improved. Biofuels – also as admixtures – are fully exempt from mineral oil tax at present.

The commitment made by the European Automobile Manufacturers Association (ACEA) also provides important stimulus for reducing the CO2 emissions of road traffic. Accordingly, the average CO2 emissions of motor vehicles sold by ACEA members will be reduced to 140 g/km by 2008. This commitment is currently well on its way to being realised: whereas the specific CO2 emissions of a new motor vehicle were on average 185 g/km in 1995, they were 165 g/km in 2002. The EU Commission is currently holding negotiations with the automobile industry on revising the voluntary commitment (target: 120 g/km by 2010).

A new decree on labelling motor vehicles will make an important contribution to increasing energy efficiency in road traffic. It obliges manufacturers and dealers to provide standard labelling on the fuel consumption and CO2 emissions of new motor vehicles. There will be a handbook for consumers listing all motor vehicles for sale on the German market and their consumption and emission values available free of charge at the car dealers. Consumers will then be able to give greater consideration to climate protection and energy efficiency when buying a car.

Progress has also been made with the efficiency of freight transport. The proportion of empty kilometres of lorries has dropped noticeably (from 28.6% in 1995 to 24.7% in the year 2000).

Incentives for efficient freight transport will be reinforced further with the introduction of the lorry toll (*Lkw-Maut*).

For further information on this subject, please refer to the chapters ‘Sustainable mobility’ and ‘Alternative fuels and innovative drive systems’.

gg) Innovation

Innovation plays an outstanding role in efficient and climate-friendly use of energy. In addition to further developing technologies for using renewable energies, above all, we must further increase the efficiency of our power stations and work towards making emission-free power stations a reality.

Main themes of future research on power stations

A new research strategy of the Federal Ministry of Economics and Labour on the further development of power plant technology (COORETEC) is aimed at making coal and gas considerably more environmentally friendly. The strategy follows two paths: the first path is about further improvements in efficiency. Coal and gas power stations can boost their efficiency levels by around 7–9% within the next two decades, as compared with today. Alongside the savings effect on the resources of coal and gas, this will result in a 15–20% reduction in specific CO2 emissions.

The second path of COORETEC focusses on the separation of carbon dioxide at the power station in a cost-effective manner and with as little loss as possible and then to store it safely. The time needed for research and development to make these technologies ready for the market is estimated at 10–20 years. This would facilitate widely CO2-free electricity generation from coal and therefore solve the conflict between the goals of climate protection and safety of supply. The German Council for Sustainable Development (RNE) referred emphatically to the importance of CO2-free electricity production from coal in its “Guidelines for a Modern Coal Policy and the Promotion of Innovation” (*Leitlinien einer modernen Kohlepolitik and Innovationsförderung*). It sees this as prerequisite through which fossil energy sources can contribute to sustainable energy supply in the long term. The separation and storage of CO2 represents an important means by which use of fossil energies can be brought over into the age of regenerative energies. The German Council for Sustainable Development therefore welcomes the fact that CO2-free power stations are one of the main themes of COORETEC.

Development of fuel cells

Fuel cells represent a forward-looking and innovative technology. Due to their high level of efficiency in generating electrical energy, also in small units, they could take on a key position in sustainable energy supply in the future.

Before then, however, extensive development activities need to be carried out. Each year € 8–10 million in funds from the Energy Research Programme (*Energieforschungsprogramm*) are employed for this purpose. The main aim of the funded projects is to increase the life span of the fuel cells, to simplify the systems and thereby reduce costs. From 2001 to 2005, an additional €

40 million will be made available from the Future Investment Programme (*Zukunftsinvestitionsprogramm*) for the development of fuel cell technology. Funding will be provided, e.g. for coupled production of electricity and process heat at one plant, equipment to supply heat and electricity to homes, as well as for accompanying ecological research. Mobile applications will also be funded. In Berlin, Stuttgart, Hamburg and the town of Barth, use of fuel cells will be demonstrated in buses.

Photovoltaics – leading position in the world

Thanks to continuously high levels of funding for research within the framework of the Energy Research Programme of the Federal Government, Germany is in a leading position in global research on photovoltaics. Germany is pioneering in technologies based on crystalline silicon and thin layer technologies. With research funds of around € 25 million per year, cost reductions of around 25% in total have been achieved in photovoltaic solar electricity production since 1999. Thanks to these achievements in research, the German solar industry is well established in several lines of technology and over the entire value added chain – from silicon raw material production, through the manufacture of solar cells, to solar modules – and after Japan, it is one of the leading countries in technological development and export.

hh) Miscellaneous

Ecological Tax Reform

The first stage of the Ecological tax reform took effect on 1 April 1999. Thereby the mineral oil tax rates on motor and heating fuels were increased as well as the electricity tax was introduced. In four more stages mineral oil tax rates on motor fuels as well as electricity tax rates were increased on each 1st January of 2000 till 2003. In addition, a differentiation of the mineral oil taxes each on petrol and diesel dependent on the sulphur content was introduced at 1 November 2001, to reduce the sulphur output. Regarded as „low-sulphur“ is motor fuel with a sulphur content not exceeding 50 mg/kg. This limit was reduced to 10 mg/kg at 1 January 2003 („sulphur-free“).

Because of economic, environmental or social political reasons in the beginning mineral oil and electricity duty concessions were needed, which could be partly reduced in the last three years. The most important subsidies are concerning the economy, because the fiscal basic conditions for enterprises standing in the international competition are still insufficient. Other subsidies are concerning combined heat and power generation, gas as motor fuel, rail traffic and local public passenger transport traffic, electricity generated from renewable energy sources and biofuels.

The most outweighing share of ecotax revenue, which accrues to the Federation, is used for the discharge of the pension insurance. Without the ecotax the pension insurance contribution rate would have had to be more highly specified about 1.7 points.

The Ecological Tax Reform provides incentives for economical and efficient use of energy in all sectors and thus contributes crucially to reducing CO2 emissions. According to a study by the German Institute for Economic Research (DIW), the Ecological Tax Reform will cut CO2 emissions by 2–3% by 2005.

A breakthrough was achieved in the EU, after many years of negotiations, with the Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity which paved the way for greater harmonisation of energy management. Above all, this directive represents an important step in the direction of the Federal Government’s desired alignment of the various tax rates for mineral oil in the EU Member States. The minimum tax rates for fuels set out in the directive are already in force in Germany, while adjustments were required in other EU countries.

German Energy Agency (dena)

The German Energy Agency – dena was founded in the autumn of 2000 by the Federal Government and the KfW as a competence centre for energy efficiency. Its objective is to promote pioneering approaches to and achieve provable successes in increasing energy efficiency. Examples of dena's activities:

- With its initiative *EnergieEffizienz*, dena provides information on efficient electricity use. More than 5,800 sales offices of the retail trade and electrical trade nationwide are participating and offering consumers targeted advice on the energy consumption of their products.
- In the area of energy efficiency in the building sector, dena is the coordinator of two pilot projects (renovation of old buildings and contracting), which the Federal Government adopted on recommendation by the German Council for Sustainable Development (RNE) (see above).
- (see results of dena-study above)
- In order to support the expansion of renewable energies worldwide and the position of German manufacturers in the world market, dena has published a number of studies including the Reports on the Practical Experience with Solar Energy Markets (Praxisreport Solarmarkt) in Spain, France, Italy and – shortly – USA. Furthermore, dena provides an Renewable energy market overview of 33 countries (www.exportinitiative.de)..

Craft and trade – links to consumers

How do consumers make their purchase decisions? Where do they seek advice? These are important questions for the successful conveyance of information about energy efficient products to consumers. A consultation with the architect or fitter is more likely to convince many people of the benefits of certain solar equipment than an expensive advertisement in a magazine. Likewise a seller's indication of the energy consumption of household goods is an important factor in the real buying decision. For this reason, dena often targets its info-campaigns at the craft and specialist trades. It is these target groups that need to be mobilised on the subject of energy efficiency in order to reach as many consumers as possible.

3 . Summary and outlook

The Federal Government sees profitable, environmentally friendly and climate-friendly as well as safe energy supply as a key pre-condition of sustainable development in Germany and worldwide. This depends crucially on the intelligent linking of energy policy and climate protection policy. The integrated approach to 86 Progress:
energy policy and climate protection policy of the Federal Government focuses on increasing energy efficiency and expanding renewable energies and aims at strengthening Germany as a location for energy and industry.

Reducing greenhouse gas emissions, increasing energy productivity and rapid growth in renewable energies show that the Federal Government's strategy is a success. The Federal

Government's comprehensive set of measures is effective. The Ecological Tax Reform, the Renewable Energy Sources Act, the Market Incentive Programme for Renewable Energies, the Act on Combined Heat and Power Generation (*Kraft-Wärme-Kopplungs-Gesetz*), the Energy Saving Ordinance (*Energiesparverordnung*), energy research, the funding programmes and pilot projects on renovating old buildings, the successful voluntary commitment of the automobile industry, the founding of the German Energy Agency dena and many other measures are concrete steps on the path towards sustainable energy supply.

The Federal Government will continue on this path. With the International Conference for Renewable Energies in Bonn (renewables 2004) and the results of this conference, especially the International Action Programme (IAP), the Federal Government has created a strong momentum for sustainable energy supply worldwide. The ambitious follow-up process, namely the creation of the Renewable Energy Policy Network for the 21st century (REN 21), the follow-up conference in Beijing (BIREC2005, 7-8 November) and the implementation of the German contributions to the IAP will reinforce the momentum for renewable energies.

Within the framework programme *"Forschung für die Nachhaltigkeit"* (Research for Sustainability), the Federal Government has developed a new climate protection strategy: *"Forschung für Klimaschutz und Schutz vor Klimawirkungen"* (Research for Climate Protection and Protection against the Impact of Climate Change). In addition, the strategy is concerned with prevention of climate changes by people, although preventive adaptation strategies for unavoidable extreme weather events, like floods and droughts, are also included. This strategy is intended to reduce climate-related economic losses and open up new economic opportunities incorporating all social groups.

In the new National Climate Protection Programme 2005 the Federal Government presents a coordinated set of measures based on an evaluation of climate protection policy which will be the framework of the Federal Government's activities related to climate protection for the next few years.

II. Taking global responsibility

1. Sustainable energy for development

a) Current situation

Approximately 2,000 million people, a third of the world's population, have no or insufficient access to modern energy supplies. As such, for many countries an adequate energy supply represents an important key to economic and social development. In addition, global greenhouse gas emissions must be halved by the middle of this century if climate change and all its perilous effects, such as a rise in sea levels, a shift in climate zones and the increase of drought and flooding, are to be warded off. Consequently, sustainable energy supplies through the development of renewable energies, as well as increased energy efficiency and conservation, in both the industrial and developing nations is one of the foremost objectives of international environmental policy and development cooperation. The prime responsibility for developing efficient technologies and renewable energies as well as facilitating their market feasibility lies with the industrial nations.

Nonetheless, the support of developing countries – where the potential for exploiting renewable energies, efficient energy consumption and energy conservation is extremely high – can be gained to assist with this global task. Since energy systems minimise the threat of conflicts over limited fossil resources, they provide an important contribution to world peace and security.

b) Renewable energies in developing countries – a "win-win" strategy

Utilisation of renewable energies will play a key role in ensuring provision of the foreseeable, additional energy requirements of newly industrialised and developing countries. The increasing energy needs of these countries cannot be met solely by traditional energy sources, such as coal, gas or oil, which contribute considerably to climate change on account of their high CO2 emissions. By contrast, renewable energies are "climate neutral", that is, they do not emit CO2. Three points of consideration demonstrate that this represents a "win-win" strategy for developing countries:

- In many developing countries the natural potential for renewable energies is superior to that in industrialised nations – particularly solar radiation in dry zones, wind potential on the continental coasts and the geothermal potential of, for example, the East African Rift Valley.
- "Energy poverty" is typical in the remote villages and scattered settlements of developing countries. In areas where the construction of a power supply network or the operation of a diesel generator is uneconomical, utilisation of renewable energies can offer new perspectives for the rural population and, thus, provide an important contribution in the battle against poverty. This applies particularly to women and young girls who are traditionally burdened with the time-consuming task of gathering firewood, which, in turn, seriously limits their access to educational measures.
- Finally, increased use of renewable energies is in the economic interests of many developing countries owing to the fact that the technologies exploit local – in part freely available – domestic energy resources, such as wind and sun, thereby reinforcing the security of their energy supply. This reduces the dependence upon imports of fossil fuels and susceptibility to pressures resulting from often highly unstable world market prices, which can represent a serious barrier to effective development for developing countries in particular. Means allocated for energy source imports are then released and can be redirected to development measures.

Tapping this potential and using the opportunity to contribute to combating poverty and furthering development, while at the same time supporting global climate protection, is the task of the programme entitled "Sustainable Energy for Development".

c) Federal Government activities

At the World Summit on Sustainable Development (WSSD) in Johannesburg, Chancellor Gerhard Schröder, announced details of the "Sustainable Energy for Development" programme. Within the scope of development cooperation, a total of € 1,000 million has been allocated to the programme for the period 2003 to 2007: € 500 million for renewable energies and € 500 million to increase energy efficiency. The aim is to assist partner countries in gaining improved access to environmentally friendly energies, combating poverty, as well as replacing climate-damaging and ecologically harmful forms of power generation with environmentally friendly alternatives.

Within the scope of the programme, concrete pilot projects using various renewable sources of energy have been implemented in several partner countries (e.g. wind parks, solar thermal power plants in the "sun belt", photovoltaic energy supplies in decentralised plants, geothermal power plants as well as projects for the sustainable use of biomass energy and hydro-power). These projects should act as a "pilot" in terms of international support for renewable energies. The essential basic requirement within the respective developing country is that there is a willingness to create the suitable political and financial framework conditions for securing long-term utilisation of renewable energies in that country.

Over and above this, the Federal Government is calling for a significant expansion of the role of renewable energies in the portfolios of international financial institutions, such as the World Bank, and is also making efforts to strengthen support with respect to the allocation of export credit guarantees.

With the hosting of the International Conference on Renewable Energies in

Bonn in June 2004 – under the title "renewables 2004" – the drive for global expansion of renewable energies generated in Johannesburg was given additional impetus, and the need for comprehensive strategies for a global energy turnaround incorporating renewable energies highlighted. The official results of the conference encompass:

- The political declaration which details common goals and a vision for the greater role of renewable energies within a sustainable and efficient energy system, as well as agreements with respect to post-conference action. In particular agreement was reached to assess review arrangements for the implementation of the Johannesburg Plan of Implementation and the International Action Programme.In order to strengthen international dialogue and cooperation for the expansion of renewable energies it was decided to a global policy network, REN 21 made up of government representatives, international organisations, and private sector and civil society representatives including the environment, development and energy community..
- The international action programme which comprises around 200 voluntary activities and obligations by governments, international organisations, non-governmental organisations, industry and scientific institutions. These include ambitious renewable energy expansion targets from almost 30 states, partly up to the year 2020, and financing commitments on the part of the World Bank and the Global Environment Facility (GEF).Chancellor Gerhard Schröder announced the setting up of a special facility of € 500 million for renewable energy and energy efficiency projects (in addition to funding committed to in Johannesburg).

- The policy recommendations offer the decision-makers a choice of strategies and options to further expand renewable energies on the basis of available experience and knowledge.

Examples of projects in the energy sector

Geothermal: In a number of countries with favourable natural conditions, the use of geothermal energy is today already making a significant contribution to the supply of more cost-effective, clean energy. Consequently, by last year, the largest geothermal power plant in Africa, Olkaria II (64 MW), located in the Kenyan region of the East African Rift Valley and sponsored by the German development cooperation, had already commenced operations. This process involves transforming hot steam from the earth into electrical energy with the use of steam turbines and generators.

The German contribution to the total cost of € 145 million stood at € 13 million. The Federal Government also plans to participate in further geothermal energy plants in Kenya. Through the reliable, efficient and environmentally friendly provision of electrical energy, these power plants are an important prerequisite for the growth o trade and industry in Kenya.

In order to develop the use of geothermal energy and with the support of Germany and East African partners, the United Nations Environment Programme (UNEP) also initiated a regional geothermics development programme. The aim is to assist with financing instruments and consultation for the development of geothermal resources and, for example, minimise the risk of costly misdrilling. In the longterm, in addition to East Africa, the programme could also be extended to other regions with high geothermal potential (such as South and Middle America as well as volcanic islands in the Pacific and Caribbean). The "Geothermics for Development" initiative is sponsored by the Federal Government to the tune of € 10 million.

Solarthermal: According to recommendations by the German Advisory Council on Global Change (WBGU) solar thermal power plants, which utilise mirror systems to enable concentrated solar light to be used, for example, to power conventional steam turbines, should contribute significantly to future global energy supplies.

At the Kramer Junction solar power plant (California), the Federal Government sponsored a demonstration project to test and evaluate a European parabolic trough collector, a technology in which Germany is the world leader. This is an important milestone for the commercial application of these power plants, which – in line with the goal – should be brought into operation in many countries on the Earth's sun-belt through pilot projects initiated in the wake of the "renewables 2004" conference.

Wind energy: Within the scope of German-Chinese development cooperation, wind parks have been constructed at five locations in China and have been connected to the national grid. The capacity of these installations amounts to around 10% of China's overall wind power capacity with China placed orders with German companies totalling € 26.3 million for delivery of the wind power turbines. Particularly the southeast coastal area and northern China possess great potential for exploiting wind energy. In light of this, Chinese project partners are being supported in the drafting of a law to promote renewable energies: through the training of specialists, sector-policy consultancy and wind measurement, whereby positive experiences with respect to output devices gathered in Germany are able to be transferred. Another German supported project set up in China, the "Training and Research Centre for Wind Energy"; will also take up work during 2004.

III. New energy supply structure incorporating renewable energies

1. Current situation

In many areas, the supply of energy is experiencing a time of great upheaval, not least due to increasing oil prices and the requirements posed by climate change. In order to produce conclusions within a manageable sphere, the comments in this chapter are limited to the supply of electricity. As an important element of energy supply, a safe, cheap, consumer-friendly supply of electricity that is compatible with the climate and overall environment is of great significance for the sustainable development of our country. The investment decisions of many companies, and consequently a multitude of jobs, depend on it. Stimulating investment in sustainable energy supplies is a tremendously important objective for the Federal Government, and is also directly linked to the credible contribution that Germany is making to global climate protection.

Increases in efficiency in terms of electricity generation and consumption, combined with responsible ecological and economical development of renewable energies within the scope of a balanced energy mix, characterises the Federal Government's approach to sustainable energy supply.

2. The challenge

Demands presented by climate protection and the liberalisation of electricity and gas markets are the driving forces behind structural change in the supply of electricity. In accordance with the 1997 Kyoto Proticol to the UN Framework Convention on Climate Change and the European-wide sharing of the burden associated with it, Germany has committed itself to reducing greenhouse gas emissions until the period 2008-2012 by 21% in comparison with 1990 levels. In 1996 and 1998 the European directives on liberalisation of the electricity and gas markets were concluded.

Against this background, the Federal Government has introduced important steps to generate sustainable energy supplies, including the expansion of renewable energies that now account for around 10% of the electricity supply. At the same time, fossil fuel energy supplies are being replaced through the development of renewable energies, thereby also contributing to climate protection. However, modernisation and the development of combined heat and power generation also represent significant steps. Through such measures, energy is being generated more efficiently and greenhouse gas emissions are being reduced. The introduction of emission trading is also bringing about real change in the energy policy landscape. Emissions trading creates economic incentives to reduce carbon-dioxide emissions in facilities where this is associated with the lowest costs.

These important and necessary realignments are changing the overall framework of the energy industry. In the light of such newly introduced instruments and the multitude of changes, the question arises: what must be done for the stated individual measures to be more effectively incorporated into an integrated sustainable energy supply structure?

Overall, following the stated basic realignment, this concerns a phase of coordination in which the various elements required for a sustainable energy supply must be linked in such a manner as to ensure the best possible achievement of the following objectives, which form the Federal Government's central energy policy:

- safeguarding supply,
- environmental compatibility,
- efficiency.

The subject is one of optimally developing – both economically and ecologically – the energy industry in a liberalised European market. In this respect the Federal Government is standing by its fundamental energy policy decisions. Hence, the question is not one of whether renewable energies should be developed, but rather one of how they can be best integrated into the energy supply. Against the background of withdrawing from nuclear energy, the question for debate is how a practical mix of energy sources can subsequently be achieved.

Accordingly, in a market economy with statutory regulations and economic incentives, the state merely lays down the framework, but cannot determine the energy source mix or stipulate a specific generating plant. These decisions are a matter for the energy industry, which ultimately bears the associated entrepreneurial risk. Consequently, beyond the governmental framework conditions, the goal of optimal, economic and ecological development of the energy supply can only be attained in cooperation with energy industry protagonists (particularly energy supply companies, but also consumers). This is also in the interest of competitive energy suppliers, which contribute significantly to value added and safeguard employment.

The energy industry is also on the move internationally. Furthermore, the global demand for energy is increasing, particularly as a result of high economic growth in Asia and the increasing world population. Insecurity in the oil markets created by political instability (e.g. through terror attacks) has led to considerable price risks. These aspects affect both availability and primary energy source prices and, as such, are of importance to Germany in terms of the future structure of electricity supplies. The dry summer of 2003, which led to serious electricity supply problems in a number of European countries, clearly demonstrated the major importance of an efficient supply of electricity. Specifically, highly developed industrial nations such as Germany are dependent upon ensuring that supply is also secured in the future.

How the German energy industry comes to terms with this transitional situation will be decisive in determining the extent to which the above stated energy policy goals can be realised, how Germany will fare against future international competition as an energy supply location and what the prospects are for electricity-intensive sectors. In this respect, the optimisation of economic and ecological framework conditions is becoming an ever more pressing issue.

3. The task

The stated changes in the framework conditions and the resulting upheaval of the German energy industry, in addition to the illustrated need to optimise achievement of energy policy goals, generate a number of specific tasks which need to be addressed.

a) Ideal integration of renewable energies

The development of renewable energies presents the electricity industry with enormous challenges that require innovative solutions. Wind and solar energy are weather-dependent and are consequently subject to considerable fluctuations, which have to be balanced out by other power plants (additional balancing energy). By contrast, biomass, hydro and geothermal power provide a stable contribution and, comparable with other methods of power generation, can be utilised for the basic and medium energy supply load. Today, the lion's share of renewable energy already falls to wind power, which offers the greatest potential and, consequently, the Federal Government's development strategy envisages a considerable increase in the generation capacity of offshore wind power. Against this background, optimal economic integration of wind power into the energy supply is a significant focal point of current plans.

The second challenge to optimal integration of renewable energy into the energy supply lies in the different regional distribution of core generation and consumption. In Germany, the main areas of consumption are in the west and south of the country. The development of wind energy plants in coastal regions in the north of Germany and offshore wind parks in the North Sea and Baltic Sea will give rise to new, consumer-distant regional centres generating electricity capacity the national electricity grid (on the high tension level) consequently needs to be adapted to. Thus, development of wind power at these locations with particularly high wind levels creates an urgent requirement for expansion of the electricity supply network.

Deutsche Energie-Agentur GmbH (dena) commissioned a study (the so-called dena network study) which examined the technical and economic effects that further expansion of renewable energies – particularly the integration of wind power plants located at sea and on land – would have on the power grid and future power plant parks. The study was prepared by a consortium under the direction of the Institute of Energy Economics at the University of Cologne (EWI). Relevant protagonists (from the wind energy sector, grid operators, power plants and associated industries as well as the responsible federal ministry) were also contextually integrated into a project steering group that accompanied the study. A follow-up study is planned which will focus on the investigation of optimisation measures to better integrate renewable energy into the grid.

b) Power plant renewal

The upcoming renewal and restructuring of the German power plant network is of decisive importance for orientation towards an overall sustainable and, consequently, economically successful energy supply. Currently, around 115,000 MW of power plant capacity is installed in Germany. By the year 2020, it is predicted that more than 40,000 MW will be required from new power plant construction as a result of decommissioning nuclear and inefficient fossil fuel power stations.

With respect to the necessary construction of new power plant capacity, the share of individual primary energy sources in electricity generation is particularly important.

In 2003, the gross level of electricity generated in Germany stood at around 600 TWh of electricity, with 51% coming from lignite and coal-fuelled power stations, 28% from nuclear power stations and around 8% generated by renewable energies, in addition to 13% from other energy sources (e.g. gas, oil). Assuming a gross level of electricity consumption of up to 660 TWh in 2020, a contribution from renewable energy of around 140 TWh (20%) and a contribution from nuclear energy of around 40 TWh, leaves fossil-fueled power plants with a contribution to gross electricity generated of around 480 TWh (73%), thus, around 100TWh more than at present.

The requirement for additional power plants in Germany is decisively determined by the following factors:

- improvement with respect to electricity consumption, particularly in relation to economic growth, energy efficiency and consumption habits,
- the share of fluctuating power plant provision, particularly from electricity generation using wind energy and photovoltaic energy facilities, and the resulting need for balancing power and energy reserves,
- the development of new storage technologies,
- development of other lines of renewable energy, such as biomass, geothermal and hydro energy,
- expansion of decentralised capacities for electricity generation (particularly combined heat and power generation),
- measures to extend the operational life of available power plants,
- technical and economic conditions regarding the import and export of electricity,
- Germany’s competitiveness as a power plant location in an international context,
- the volume and structure of electricity trade.

In summary, it must not be forgotten that around a third of the existing power plant park must be renewed and/or replaced by 2020. Given the long life service of power plants, decisions on new power plant construction determine structural adjustments to the power supply for decades to come. Renovation and restructuring of the power plant park, as well as the integration of renewable energies, place new demands upon the electricity network.

c) Optimising the framework conditions

Today, the energy industry is governed by historically rooted and ever more compact regulations. Liberalisation of electricity and gas markets, environmental protection provisions, the development of renewable energies and the increasing significance of consumer protection have traditionally been and remain the driving forces, one inevitably leading to another. As such, the network of regulatory provisions has become more tightly interlinked and supplemented by ecological incentives.

Today, the question has to be asked as to whether all these regulations are necessary. Where are the provisions contradictory? In what areas can we forego regulatory provisions or do away with fiscal differentiations for the benefit of economic incentives (e.g. emissions trading)? Does this require the amendment of European directives?

Overall, the matter is one of determining how the existing statutory regulations and economic incentives can be optimised in order to allow energy policy goals to be achieved with greater efficiency and less bureaucratic effort. Therein lie the major opportunities for successful, economically and ecologically balanced sustainable development.

Such ideal framework conditions are important in order to maintain the international competitiveness of the German energy industry and to ensure that Germany remains an attractive location for power supply investment in the future. However, this task must also be addressed in order that industry, trade and households can be supplied with electricity that is cost-efficient and in line with internationally competitive prices.

4. Conception and approach

The starting point requires taking stock of legal, economic, ecological and technical framework conditions pertaining to the energy industry and their subsequent effects. Added to this, amongst other things, are the goals and agreements that the Federal Government has already resolved with the economy (e.g. agreement on the systematic phasing out of nuclear energy utilisation). National stocktaking is also supplemented by a stocktaking of European framework conditions. Hypotheses are concluded with respect to the progression in demand for electricity.

The objective of the overall process is to generate a proposal as to how energy policy framework conditions can be optimised through an intelligent linking of the economic and ecological issues.

To this end, the initial step is to evaluate the individual aspects ascertained in the stocktaking process in an integrated analysis. Forming the basis of this are currently available expert reports, in particular the dena network study that will shortly be reaching its conclusion.
Upon integration of the individual aspects, the next step is optimisation of the overall system. Drawing upon the experience gained through such optimisation, conclusions are then drawn with respect to the structuring of energy policy instruments. Results will be documented in the 2006 Progress Report.

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