Chapter 3
Cross-sectoral Interventions, Events and Processes

Abstract Renewable energies in Germany developed within an overall framework of cross-sectoral influencing factors and events. These issues essentially refer to the EU level and the German federal level. The energy and environmental crises, which triggered a change of mindset in society, were among the most important processes that affected the development of renewable energy in Germany. Also, the innovation process was – and still is – closely linked to international climate protection research and policy. The climate protection process and its institutionalization at international and EU level interacted with national problem awareness and respective processes. After the change of German government in 1998, climate protection – and from 2002 also renewable energy policy – was institutionalized with the Federal Environment Ministry. This significantly pushed the process at the national level. Specifications at EU level for the liberalization of the electricity market ultimately led to the energy sector opening up, national reforms being initiated in the energy sector and renewable energy being granted access to the electricity sector. In addition, the feed-in laws for renewable energies were accompanied by a large number of further legal adjustments.

Keywords Overall influencing • International climate protection policy • Energy policy • Energy crisis • Liberalization

3.1 Crises as Triggers for Social Rethinking Processes

Crises have significantly contributed to a stronger awareness of environmental and energy-related problems in politics and among the population. They caused institutionalized actors in particular to engage in comparatively complex activities

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designed to contribute to a solution. Problem awareness in public policy frequently emerged as the result of the initiative of innovative individuals (Hennicke et al. 1997). For them, the growing significance of environmental protection and sustainable energy supply as a common concern fueled the rethinking process. The goal of developing and expanding renewable energy was part of this process, and the crises described below triggered, accompanied or influenced this development.

3.1.1 *Environmental and Climate Crises*

Environmental crises significantly affected the deployment of renewable energies. There was a slowly growing awareness of environmental issues among certain groups of the German population even back in the early 1960s. This was reflected in publications, among the most important ones was the Meadows Report published by the Club of Rome. Its title was The Limits to Growth, and it raised considerable public attention in 1972 (Meadows et al. 1972). In "Ein Planet wird geplündert" (A planet being raided) Herbert Gruhl reveals the "horrors" of politics, admonishing the irresponsible way of dealing with natural resources that accompanies growth ideologies (Gruhl 1975). Numerous citizens and environmental initiatives[1] were founded around that time, the members of which – along with left-wing students – founded The Greens in 1980.

In his 1961 election campaign, and in view of considerable immission-related environmental problems, then Federal Chancellor Willy Brandt (SPD) promised a "blue sky above the river Ruhr" (Brüggemeier & Rommelspacher 1992). "To make a liveable environment the decisive guideline of their politics" was the declared objective of the social-liberal coalition of the time (Hofmann 1978). In 1971 the coalition adopted the Federal Government's first environmental program (BT-Drs. 6/2710), with environmental protection being defined for the first time as an important governmental task.

Doubts about the future viability of nuclear energy were part of the controversial discussions about the "risk society", a term coined by the German sociologist Ulrich Beck. His book of the same title appeared in 1986, the year of the Chernobyl reactor catastrophe, and was met with great enthusiasm both among experts and the general public. Beck's basic idea is that in the modern world, the social production of wealth also accompanies the systematic production of risk.

In 1987 the World Commission on Environment and Development, convened by the United Nations, published the Brundtland Report,[2] which mentions the guiding principle of sustainable development for the first time. The report significantly influenced the international debate about development policy and environmental

[1] A few years after its foundation in 1972, the Federal Association of Environmental Grassroots Action Groups (BBU) comprised already more than 600 groups (Roth 2009).

[2] Future report of the World Commission on Environment and Development "Our common future", chaired by Gro Harlem Brundtland.

policy, and ultimately prompted the 1992 Rio de Janeiro environmental conference.

At the same time, around 1987, the political arena paid more attention to the anthropogenic aspects of climate change. An important triggering factor in this process was an appeal prepared by the German Meteorological Society (Deutsche Meteorologische Gesellschaft – DMG) in cooperation with the German Physical Society (Deutschen Physikalische Gesellschaft – DPG). They forecast a global warming of 3°C over the next 100 years. The DMG drew on research data collected in its meteorological stations and illustrated changes based on weather data measured on Zugspitze, Germany's highest mountain, for example (Jaeger et al. 1994, 256 sqq.). The representatives of the DPG, who enjoy recognition across the fields of science, economy and politics, urged political decision-makers to include climate protection on their agenda. Representatives of the DPG also advocated that the use of nuclear power should be stepped up in this context.

At the end of the 1980s, the media were increasingly covering climate change,[3] too. Reports about the earth's atmosphere warming (green house effect), melting glaciers, and the expected rise in the sea level sparked a controversial public discussion about the causes and consequences of climate change.

Along with the reports of the IPCC, (see Section 3.2), the Stern Review[4] commissioned by the British government and published on 30 October 2006 was met with an outstanding media response. The Stern Review forecast serious consequences for the world economy if global warming was not stopped. The Review stated that 1% of the gross domestic product would need to be spent on immediate climate protection measures. If no action were taken, the costs of climate change would equal a loss of at least 5% of the global gross domestic product, according to Stern (2007). With regard to further risks and influences, the damage could amount to at least 20% of the gross national product. The massive international media response to the Stern report once again drew the public's attention to climate protection, the need for action and the consequences of not acting.

In addition, the growing number of natural disasters, such as hurricanes, floods and droughts, which can be attributed to man-made climate change, contributed to a stronger public awareness. The extent of possible effects of climate change became visible and created the pressure to act.

This was also reflected in the population's attitude toward new fossil-fuel power station projects. The construction of coal-fired power stations[5] is being

[3] E.g., GEO special issues on climate protection in the 1980s; Bild der Wissenschaft issues on hydrogen technology.

[4] The Stern Review: The Economics of Climate Change (Stern 2007).

[5] At the time of going to press, seven power station were under construction and 22 power stations were in the design phase (cf. http://www.duh.de/..., accessed August 25, 2009). Critical locations included Hamburg-Moorburg, Hamburg-Brunsbüttel, Berlin-Lichtenberg, Lubmin in Mecklenburg-Western Pomerania and Mainz-Wiesbaden (cf. Die Klima-Allianz: "Der Widerstand wächst – Proteste gegen neue Kohlekraftwerke." www.deutscheumweltstiftung.de/, accessed April 21, 2009).

increasingly questioned due to growing problems of acceptance within the German population.

3.1.2 Oil Price Crises

The 1970s were dominated by two oil supply and price crises[6] that entailed a noticeable shortage of coal and oil. Countries such as Germany, which, unlike Denmark or Great Britain, did not have their own gas or oil supply, were hit particularly hard by the crisis. Reliable supplies and independent energy imports became the guiding themes of energy policy. The supply crises of the 1970s were accompanied by soaring prices for oil and gas, which is why renewable energy, which was so far considered to be too expensive, was suddenly thought of as being able to contribute to the energy supply. Although there were different opinions about the extent to which this would be possible (see Section 3.6.2), the supply crises were the key to change.

The beginning of the second Gulf War saw the price of crude oil drop to just over $20 per barrel. In the second half of the year, the oil price briefly soared to a dramatic $35. This "historic coincidence" boosted the promotion of renewable energies as intended by the Electricity Feed-in Act. In the early 1990s the oil price temporarily dropped to just under $10 per barrel. This development was accompanied by a dwindling interest of many states, especially the USA, in renewable energy. Similarly, the year 1998 was characterized by an oil glut and a steep plunge in oil prices. The financial and economic crises in East Asia are considered to have contributed to the collapse of prices. The decline in demand there, or the anticipated decline in demand, caused the stock exchange prices to drop sharply. The low oil prices made it harder for renewable energy to remain competitive.

After 1999 the average crude oil price rose continually and reached a new all-time peak of more than $50 per barrel in 2004. This price development was caused by a global increase in consumption and to some extent by insufficient oil drilling capacities.[7] Another reason for rocketing prices was speculations in the oil market after the slump in the New Economy (Abdolvand & Liesener 2009).[8]

[6] The first oil price crisis was triggered in 1973 by the Yom Kippur War, in the wake of which the OPEC (Organization of the Petroleum Exporting Countries) drastically curbed oil production. The oil price rose by ca. 70% due to this "oil embargo". The second oil price crisis occurred in 1979, and was essentially caused by production losses and confusion after the revolution in Iran and the subsequent war between Iraq and Iran.

[7] See also the crude oil studies of the Energy Watch Group, which assume that maximum production ("peak-oil") had already been reached in 2006 (www.energywatchgroup.org/..., accessed December 10, 2009).

[8] The trading volume on the oil market is frequently 15 times that of the actual worldwide oil consumption of currently 86 million barrels per day (ibid.).

The historic mark of $100 per barrel was passed for the first time in March 2008. At the beginning of July there was talk of yet another oil crisis when the $140 mark was passed. While the USA associated the rise in prices in this phase with the low oil production rate, the oil producing countries attributed the development to speculations and the loss of the dollar's purchasing power (ibid.). Although the oil price again dropped markedly after this peak, the events show that this limited resource will become more expensive over time, or at least be subject to strong variation in the future.

3.1.3 Nuclear Energy Crisis

The successful squatting of the construction site of the planned nuclear power station in Whyl in February 1975 marked the beginning of a demonstration wave against nuclear power in Germany.[9] A supra-regional anti-nuclear power movement spread and grew rapidly, expanding increasingly to established institutions, parties and associations (Saretzki 2001, 206). Nuclear accidents such as on Three Mile Island, Harrisburg (US) in 1979[10] fueled doubts concerning the controllability of this technology. The discontinuation of the construction work on the controversial nuclear reprocessing plant in Wackersdorf encouraged the protest of the anti-nuclear power movement in Germany.

Acceptance of nuclear power experienced a massive setback as a result of the 1986 Chernobyl accident. This worst case scenario, brought about by a meltdown and an explosion in block IV of the Chernobyl plant, is viewed as one of the most serious environmental disasters of all times. Unlike with previous accidents (e.g., the one in Mayak in 1957[11]), the media reported about this disaster in great detail, clearly revealing the risks of nuclear energy production. So far dubbed "clean energy", nuclear power had now caused the largest environmental catastrophe ever. Time and again the reactor accident is stated as the key event to have marked a turn in the environmental and energy debate. This reflects in the institutionalization of environmental politics in the form of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety founded in 1986 (Jaeger et al. 1994, 256) (see Section 3.4.1).

[9] Demonstrations in Brokdorf in 1976, Grohnde in 1977, Kalkar in 1977, Gorleben in 1979 etc.

[10] On 28 March 1979 the reactor in block 2 experienced a partial meltdown, in the course of which about a third of the reactor core was fragmented or melted.

[11] In September 1957 a concrete tank containing a highly radioactive liquid exploded on the south-east side of the Ural mountain range (close to Ozyorsk) at the plutonium plant "Mayak". Significantly more radioactivity was released than during the Chernobyl accident. The disaster is regarded as the best kept secret of a maximum credible accident in history. See http://www.welt.de/wissenschaft/... (accessed August 25, 2009).

After the reactor accident the consensus about using nuclear energy, which was already being challenged by the anti-nuclear power movement, crumbled. Large percentages of the population advocated a nuclear phaseout, a concept pursued by the politics of The Greens, and also the SPD (then in the opposition). The SPD had decided in 1986 to commit itself to nuclear phaseout[12] (see Section 3.5).

As a result, the necessity of economically viable alternatives had become evident. The potential of regenerative energy was now taken more seriously in discussions about energy policy. Germany linked the nuclear phaseout process (see Section 3.5) with proactive activities in support of renewable energy and with the goal of reducing greenhouse gas emissions.[13] However, proponents of the continued utilization of nuclear energy revealed that the idea of a nuclear phaseout was contradictory to reducing greenhouse gas emissions: they claimed that nuclear power was indispensible since it was a technology low in CO_2 and because it was capable of meeting the electricity demand (see Section 3.1.4).

However, the hazardous incidents that occurred in German nuclear power stations in 2001 and 2007[14] strengthened the nuclear power opponents' position of continuing a phaseout and to switch off old power stations because they were regarded as entailing too much risk.

3.1.4 *Energy Supply Crises and Electricity Gap Debate*

Due to the gas dispute between Russia and the Ukraine, the Russian gas supplier Gazprom repeatedly discontinued gas supplies to the Ukraine between 2006 and 2008. Numerous European buyer countries, including Germany, were affected by these cuts as well. Despite the fact that Germany's population was at no point in time threatened by a supply bottleneck, the crisis still revealed to what extent an increase in the share of Russian gas in the German energy mix would involve supply risks. The aim of the Federal Government to lower import dependencies, among other things by using domestic renewable energy, met with approval once more. Biogas producers and gas grid operators also used supply uncertainty on the gas market as an argument for domestic renewable energy. They pointed to this uncertainty when arguing that the share of biogas in natural gas should be increased by feeding larger amounts into the grid.

Along with gas supply bottlenecks, shortages in the electricity sector are also a concern. According to statements made by the German Minister of Economics, Michael Glos, in 2008, Germany was threatened by an "electricity gap" if nuclear

[12] Press release of the SPD parliamentary group on 26 January 2000.

[13] Germany agreed within the context of the Kyoto Protocol to reduce six greenhouse gases by 21% between 2008 and 2012.

[14] Accidents in Brunsbüttel (2001) and Krümmel (2007).

power stations are switched off as planned and the construction of modern coal-fired and gas-fired power stations are postponed.[15] The Federal Minister was drawing on an analysis conducted by the federally owned energy agency for power station and grid planning in Germany, called "dena", according to which Germany will be faced with the threat of electricity undersupply from 2012 onward. According to dena (2008, 1), this electricity gap can only be prevented by extending the power stations' runtime and building additional fossil power stations, not, merely by implementing power saving potentials and expanding the use of renewable energy sources. Moreover, the increasing pressure to act with regard to climate protection (IPCC 2007) is used as an argument to maintain nuclear power. According to dena, its low CO_2 emissions make nuclear power less detrimental to the global climate than the conversion of coal into electricity.

The Federal Ministry for the Environment as well as members of renewable energy associations and The Greens rejected the electricity gap debate and labelled it as a "fear campaign". These critics were supported by several studies that refuted the claims of the dena report.

A study commissioned by Greenpeace (EUtech & Greenpeace 2008) opposed dena's findings. It concluded that there would be no electricity gap in the event of a nuclear phaseout, neither short-term nor long-term. According to this study, the premises implied by dena about the medium-term development of the power demand, the amount of output supplied by combined heat and power, as well as assumptions concerning the development of the future energy mix (ibid. 1) needed to be subjected to critical review.

Based on its own calculations of the existing power station capacity, the Federal Environmental Agency, too, proved that the planned nuclear phaseout would not endanger the electricity supply, if the goals of energy efficiency and expansion of renewables were consistently pursued (Loreck 2008, 12). The Federal Ministry of Economics came to similar conclusions, when it assumed in its 2008 Monitoring Report that the electricity supply would be secure in Germany despite nuclear phaseout by 2020 (BMWi 2008). In September 2008, the German Federal Network Agency also opposed dena's assessment, certifying that Germany had sufficient generation capacity to safely meet the demand until 2020.[16]

In spite of these studies' findings, the utility oligopolies RWE, E.ON, Vattenfall and EnBW maintain discussions about runtime extensions for nuclear power stations. Their interests are to preserve the structures they have been benefiting from over decades and to secure their economical power in the long run (DUH 2008, 8). The debate took place in the period of the Federal Government's preliminary negotiations about the "climate package" (see Section 3.7.3).

[15] http://www.bmwi.de/BMWi/... (accessed October 21, 2008). BDI president Jürgen Thurmann, too, opposed a nuclear phaseout based on the argument of climate protection (press release of 22 May 2007).

[16] http://www.verivox.de/nachrichten/... (accessed August 20, 2009).

3.1.5 *Food Crisis*

The food crisis is the result of a global supply and price crisis. After food prices had been stable for many years, they surged globally from 2006 onward. The high prices had been triggered by various factors, and they worsened the food shortage most of all in "Third World" countries.

The Food and Agriculture Organization of the United Nations (FAO) explained the rise in prices with a long-term increase in the demand for food and a simultaneous short-term decline in the supply (FAO 2008, 9). In addition to the steady decline in corn production experienced by major corn producers (China, EU, India, USA), draughts and floods in the years 2005–2007 caused further production losses. The high crude oil price affected corn supplies as well, since a rise in the crude oil price entails higher transport and fertilizer costs. According to the FAO, speculations at the commodities exchanges are responsible for the continually high food prices, which had increased by 30% in 2007 (FAO 2008, 11). Some countries responded to the expected losses by imposing export restrictions for corn, and in doing so aggravated the worldwide shortage.

Two factors in particular are deemed responsible for the increase in demand: economic growth in major industrializing nations such as China and India[17] and the newly emerging demand generated by the biofuel sector, which is partially subsidized and in part also increases as a result of the high crude oil price. The significance of demand-based greater energy recovery is regarded as an undisputed cause of the food crisis. This stimulated the debate about the "finite nature" or "limits to bioenergy utilization". Limited availability of acreage and usage competitions in the bioenergy sector clearly show that, unlike wind and sun as energy suppliers, bioenergy is not indefinitely available.

3.2 International Climate Protection Research and Politics

The growing pressure to act with regard to climate protection and renewable energy (RE) development is closely interlinked. Climate change and climate protection policies have reinforced the process of RE development by revealing that alternatives, especially to fossil energy sources, are urgently needed. This section deals with the milestones in international climate protection policy, with Germany frequently acting as a trailblazer (Weidner 2008). It is important to outline international activities revealing the entwinement and interplay between national and international politics at multiple levels, while national and international levels alternate between roles of "driving" and "being driven".

[17] Whether the changed consumption behavior in China and India has really contributed to the current price rise is doubted by the FAO. Their growing demand for grain, it argues, is met by their own production. China's and India's grain imports have dropped from 14 million tons at the beginning of 1980 to 6 million tons in the last 3 years, but the future influence on high food prices could be greater (FAO 2008, 11).

3.2.1 *International Climate Protection Pro*

3.2.1.1 World Climate Conference in Geneva

In the 1970s only a small number of scientists were
need for climate protection. It was not until the mi
protection began to attract more interest from t
Jaeger et al. 1994). The first World Climate Conferen
been organized by the World Meteorological Organization (WM
with the United Nations Environment Programme (UNEP), is considered the
of more recent climate (effects) research. After initially discussing a relatively broad range of anthropogenic climate influences and impacts, subsequent years focused on greenhouse gas issues.

At the World Climate Conference in Geneva, participants resolved to step up scientific research activities and international cooperation and adopted the first World Climate Research Programme (WCRP). The Geneva Conference provided crucial impetus, similar to the United Nations Conference on the Human Environment in Stockholm (1972)[18]: it inspired some countries to launch national climate protection programs (Jaeger et al. 1994, 256; Bechmann & Beck 1997, 122). International and national conferences followed soon after the first World Climate Conference. Similar to other areas of international environmental politics, international organizations took on a leading role in the case of climate issues, too. In this case the United Nations Environment Programme, which was brought into being in 1973, took over the role of a promoter, catalyst and organizer.[19]

3.2.1.2 Climate Conferences in Villach and Switzerland

In 1985 an international conference on the "Assessment of the Role of Carbon Dioxide and of Other Greenhouse Gases in Climate Variations and Associated Impacts" took place in Villach (Austria). After a number of smaller international meetings, this conference represented a turn in the discussion of increasing greenhouse gas emissions. There was a fundamental consensus concerning the size of the problem at hand, in conjunction with an appeal to scientists and political decision-makers to sound out possible counter-measures (Jaeger 1992). The final statement[20] indicated that the first half of the twenty-first century might be faced with a rise in temperature "which is greater than any in man's history". However, this declaration was the consensus of the experts invited and not that of the official representatives (Jaeger 1992). Two years later the conference "Developing Policies for Responding

[18] The United Nations Conference on the Human Environment (UNCHE), also known as the Stockholm Conference, took place in Stockholm from 5 to 16 June 1972. It was the first environmental conference convened by the United Nations.

[19] Strübel (1992, 18), cited in Bechmann & Beck (1997, 148).

[20] www.icsu-scope.org/downloadpubs/scope29/statement.html (accessed September 10, 2009).

to Climate Change", also held in Villach, focused on drawing up specific measures designed to reduce the greenhouse effect. Around 50 experts concentrated mainly on strategies of mitigation and adaptation. The conference marked the transition "from scientific stocktaking to a political discussion" (Matthes 2005, 26).[21]

The demand for an international regime designed to protect the climate was substantiated in particular by the "Brundtland Report" of 1987 (see Section 3.1.1). International political concern with the issue began with a conference held by the Canadian government in Toronto in 1988. The Toronto Conference was titled "The Changing Atmosphere: Implications for Global Security". The "Toronto target" was the first recommendation formulated in a specific political action plan for climate protection. CO_2 emissions and other climate gases were supposed to be reduced by 50% by 2050. As a first step the participants from science and politics recommended a 10% increase in energy efficiency between 1988 and 2005 and a 20% reduction of global CO_2 emissions compared to the emissions level of 1988 (Matthes 2005, 27). In addition, they expressed the necessity of adopting a comprehensive framework convention for the protection of the atmosphere.

3.2.1.3 The Intergovernmental Panel on Climate Change (IPCC)

Subsequently, in 1988 the WMO and the UNEP established the IPCC (Oberthür 1993, 24–25). As a kind of professional knowledge community (epistemic community), the IPCC adopts a special role in the discussion of the problem and in the political implementation process (Bechmann & Beck 1997, 138). Germany was represented at the first IPCC meeting by Hartmut Graßl,[22] who attended the event at his own expense, and who was also a committed member of the Commission of Inquiry "Provisions for the Protection of the Earth's Atmosphere".[23] The Ministry of Transport,[24] responsible for climate protection at the time, saw no need to delegate an official representative to the IPCC Conference.

[21] In November 1987 a conference of high-ranking political decision-makers was held in Bellagio (Italy). It drew on the results of the Villach conference (Matthes 2005, 26).

[22] Prof. Dr. Hartmut Graßl was the director of the Max Planck Institute for Meteorology, Hamburg, between 1989 and 2005. From 1994 he was in charge of the World Climate Research Program (WCRP) for several years, which is organized jointly by the WMO and the International Council of Scientific Unions.

[23] The Committee of Inquiry was appointed by the 11th German Bundestag and existed from 1987 to 1995. Its first report in 1988, presented at the researchers' convention on climate change in Hamburg, focused in particular on replacements for the greenhouse gas CFC and on measures for rational energy use (www.nachhaltigkeit.info/artikel/..., accessed November 10, 2009).

[24] The German Meteorological Service (Deutscher Wetterdienst) is still part of the Federal Ministry of Transport, Building and Urban Affairs today. It is no longer responsible for matters of climate protection, though. Climate issues were primarily associated with weather phenomena at the time.

The first IPCC report of 1990 emphasized the observability of climate change and linked its existence to greenhouse gas emissions[25] (the greenhouse effect). It ascertained that the anthropogenic greenhouse effect represented a dangerous threat to mankind (IPCC 1990). The report formulated some first targets for climate protection and for the reduction of CO_2 emissions.

3.2.1.4 UN Framework Convention on Climate Change

The presentation and adoption of the first IPCC report in 1990 and its reception at the second World Climate Conference in Geneva in the same year intensified the pressure on the international community of nations to take specific measures for climate protection. The World Climate Conference of 1990 and the IPCC report brought before this conference are regarded as the political breakthrough for climate issues (Fischer 1992, 5; Gehring 1990, 703). At this conference 650 scientists and top-level government representatives from 140 nations acknowledged that the need for action was urgent. It was agreed to begin negotiations toward the establishment of a binding agreement on climate protection under international law. In December 1990 the United Nations plenary meeting initiated the negotiations process on global climate change by founding the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change (INC/FCCC). The INC drew up the UN Framework Convention on Climate Change[26] under the participation of 150 states in a laborious process stretching over five meetings held between February 1991 and May 1992 (Coenen 1997, 163).

3.2.1.5 Rio Conference on Environment and Development

The Conference on Environment and Development (Sustainability Summit) in Rio de Janeiro in 1992[27] dealt with climate protection as its central issue. The Framework Convention on Climate Protection was signed in Rio by most of the conference participants. The signatories agreed to publish regular reports on current greenhouse gas emissions and related trends. Since the Convention stressed the requirements of global climate protection and with this the necessity of a transition to renewables, the potential of renewable energies was placed not only in the context of sustainable development but expressly in that of climate protection. Germany's environment minister at this time, Klaus Töpfer (1987–1994), significantly advanced the process of climate protection.

[25] The greenhouse gases addressed by the 1997 Kyoto Protocol are carbon dioxide, methane, nitrous oxide (laughing gas), perfluorocarbons, hydrofluorocarbons and sulfur hexafluoride.

[26] The United Nations Framework Convention on Climate Change (UNFCCC) aims to slow down man-made global warming and to mitigate its impact.

[27] The United Nations Conference on Environment and Development (UNCED) took place in Rio de Janeiro, Brazil, in 1992. It adopted the Agenda 21, an action program containing recommendations for sustainable development, and is regarded as a milestone in global environmental and development policy.

3.2.1.6 After the Framework Convention on Climate Change: The Climate Marathon

The annual Conferences of the Parties (COP) to the Framework Convention on Climate Change as the supreme and sole decision-making commission, mark important political stages in the implementation of targets set by the Framework Convention.

A significant milestone was the first Conference of the Parties to the Framework Convention in Berlin in March 1995, chaired by German Environment Minister Angela Merkel. At this conference, the fundamental decision to formulate binding greenhouse gas emission reductions for the industrial countries was adopted in the form of the so-called Berlin Mandate. It stipulated that a protocol of adequate measures against man-made climate change should be adopted within 2 years.

In the same year, the IPCC published its second Climate Report. Based on new findings on climate change, this report emphasized the man-made impact on global climate change and the necessity of taking political counter-measures. The report can be regarded as a well-founded reference for defining CO_2 reduction targets for climate protection.

Additional progress was achieved at the second Conference of the Parties in Geneva, which took place in July 1996. The Conference was regarded as an inspiring success, since a large majority of the delegations clearly supported the results of the second IPCC report and agreed that additional measures to significantly reduce greenhouse gases were urgently needed. The result of the second COP was a ministerial declaration according to which greenhouse emission reduction targets should be codified by law. It was considered remarkable that, contrary to their former statements, the USA now explicitly supported the IPCC and their findings. Sixteen parties, however, rejected the IPCC Report's conclusions, among them the OPEC states, Russia, Australia and New Zealand (Coenen 1997, 190), and objected to legally defined reduction targets and time schedules.

3.2.1.7 Kyoto Protocol

The third Conference of the Parties, which took place in Kyoto in 1997, is considered the most important milestone in international climate negotiations. In December 1997, the participating parties adopted a protocol specifying CO_2 reduction targets based on the second IPCC Report. The Kyoto Protocol[28] supplemented the Framework Convention on Climate Change (UNFCCC) with more stringent and in part legally binding measures. The signatories of the Kyoto Protocol defined individual emission reduction targets for six greenhouse gases that

[28] The Kyoto Protocol is an optional protocol linked to the United Nations Framework Convention on Climate Change (UNFCCC) and adopted on 11 December 1997. It sets binding targets for the reduction of greenhouse gas emissions.

affect the climate.[29] The European Union as a whole committed to greenhouse gas reductions of 8% (compared to 1990 levels) between 2008 and 2012. Based on their share within the EU, Germany pledged to reduce its greenhouse gas emissions by 21% compared to 1990. This target became binding for Germany in July 2001, when the German Federal Parliament and the Federal Council of the German Parliament unanimously ratified the Kyoto Protocol. Since then internationally binding reduction targets of 21% by 2010 form the declared basis of the Federal Government's climate protection policy.[30] After ratification by Russia on 18 November 2004, the Kyoto Protocol entered into force on 16 February 2005.

3.2.1.8 Third and Fourth IPCC Report

The IPCC continued its climate reports in 2001 and 2007: the third IPCC Climate Report in 2001 further raised the public's awareness of climate change. Surveys confirm that the use of renewable energy was highly accepted in the population.[31] In addition, the economic implications of climate change were now being discussed (for example in Kemfert 2004). The third IPCC Climate Report formed the technical basis for the Rio+10 summit in Johannesburg in 2002 and has since served as a reference for climate research and climate policy.

The fourth IPCC Climate Report (IPCC 2007) confirmed the correlations between CO_2 emissions and climate change. The Report again met a strong response both from politicians and the public.

3.2.1.9 Renewables Process

The 2002 "World Summit for Sustainable Development" (WSSD) in Johannesburg, also known as Rio+10, is considered the beginning of an international political process for the promotion of renewable energy. For the first time, renewable energy was a topic on the agenda of an international conference.

Gerhard Schröder, Germany's federal chancellor at the time, invited the participants in Johannesburg to come to Bonn for a first governmental conference on renewables ("renewables 2004"). This was the result of the realization that "specific initiatives for the expansion of RE and for the reduction of fossil energies and their subsidization were generally not attainable at multilateral UN conferences[32]"(Hirschl 2008, 577).

[29] Carbon dioxide, methane, nitrous oxide, perfluorocarbons (PFC), hydrofluorocarbons (HFC) and sulfur hexafluoride. Reduction of the individual gases were converted to "CO_2 equivalents", and then added up to a total value.

[30] www.bmu.de/klimaschutz/aktuell/... (accessed August 25, 2009).

[31] Cf. e.g., forsa (2005), BUND (2007), Agentur für erneuerbare Energien (2008). Mautz & Byzio (2004, 112) speak of "energy transition as a guiding principle of society".

[32] These targets failed as a result of the coalition of the US and the OPEC states known from the context of climate policy (ibid.).

The "renewables 2004" in Bonn was an intergovernmental conference of high-ranking politicians, which enjoyed extensive media coverage (ibid.).[33] The organizers hoped that the event would help publicize the issue on a large scale, and therefore not only involved representatives from the RE sector but also numerous social actors from the industrial and economic sectors. The main outcome of this conference was the International Action Program, which specified a large number of different actions and commitments toward the promotion of renewable energy. Germany's special contribution to the Action Program laid in federal chancellor Gerhard Schröder's announcement that the Federal Government would make available 500 million euros over a period of 5 years starting in 2005 from the Kreditanstalt für Wiederaufbau (Reconstruction Credit Institute) in order to expand the use of renewable energy (Mangels-Voegt 2004). The German hosts, i.e., the Federal Ministry for the Environment and the Federal Ministry for Economic Cooperation, had thus kicked off an international political process, with Germany's energy policy serving as a model.

Another important result of the Conference was the establishment of the Renewable Energy Policy Network for the 21st Century (REN 21) (Staiß 2007, 243), which was given the official go-ahead in Copenhagen in June 2005.[34] As a global political network of governments, international organizations and representatives of civil society (ibid.), it was intended to provide an international forum for leading initiatives in the field of renewable energy. REN 21 was supported by the International Energy Agency Network (Hirschl 2008, 578).

Further conferences were convened within the framework of the REN 21. The Beijing International Renewable Energy Conference in 2005 was significant due to the fact that it was held in an emerging country. China placed special emphasis on international cooperation with a view to establishing renewable energy in developing countries. The Washington International Renewable Energy Conference in 2008 with representatives from international (non-governmental) organizations and the private economy adopted 145 initiatives geared toward markedly increasing the share of renewables worldwide. The fourth conference in this series takes place in Delhi in 2010.

3.2.1.10 G8 Summit in Heiligendamm

In June 2007 the 33rd summit of the leaders of the Group of Eight[35] was held under German presidency in Heilgendamm. Its lead theme was "Growth and Responsibility", while the conference concentrated on the necessity of reducing greenhouse gases and expanding renewable energies.

Ultimately the G8 countries declared their support for the statements and targets of the IPCC Report and the results of the most recent UN climate report. For the first time the community agreed on the necessity of joint greenhouse gas reduction targets. In its final declaration it proclaimed a stronger recognition of climate change as a problem requiring a global and international solution. The announcement that the climate negotiations were to continue under the umbrella of the UN was considered quite remarkable, as it was contrary to the original attitude of US president George W. Bush. Implementation of the declared targets was, however, postponed to the negotiations of the Bali climate conference (Bals 2007, 4).

Participants had not been able to agree on fixed reduction targets or the two-degree mark.[36] A coalition of Japan, Canada and the EU advocated emissions reductions by at least 50% by 2050, hence acknowledging the necessary dimension of reductions, yet could not agree on a common base year. Moreover, Russia and the USA were not in favor of this declaration. Promoting renewable energy was recognized as a contribution to emissions reductions (Summit Declaration 2007, 35, 76), but did not play any significant role in the summit declaration.

At least the G8 decided to initiate the negotiation process for a post-Kyoto treaty at the World Climate Conference in Bali in December 2007 and to conclude this process by 2009 (Summit Declaration 2007, 52). With this, the UN was recognized as the central forum for international climate negotiations.

Environmental groups, non-governmental organizations and many more actors expressed their disappointment with the outcome of the summit. There had been great expectations concerning the German dual presidency of 2007 (EU presidency in the first half of 2007 and simultaneous presidency of the G8 summit), which from the perspective of environmental organizations could have been used to make climate change even more of a top priority in international politics (Bals 2008, 6).

3.2.1.11 World Climate Conference in Bali

A key target of the World Climate Conference in Bali[37] in December 2007 was to begin negotiations for a follow-up treaty to the Kyoto Protocol, which would expire in 2012, and to draw up a joint action plan and time schedule for the further negotiations process. In view of the resistances[38] this "Road Map" and the agreement on the main modules of a future treaty were regarded as a success.

[33] Hirschl (2008, 578) perceives an important positive effect of the conference in the fact that its voluntary context allowed the participating countries to "positively" deviate from their usual positions in climate and energy policy. The federal environment minister of the time termed the conference a milestone in the transition to an energy system that places climate protection and the real development potential of the world's poor countries at the center of attention.

[34] Cf. REN 21 Renewable Energy Policy Network. 2005. "Globaler Statusbericht 2005 Erneuerbare Energien". Washington, DC: Worldwatch Institute.

[35] The Group of Eight is comprised of the leading industrialized nations of Germany, the United States of America, Japan, Great Britain, Canada, France, Italy and Russia. The European Commission is also represented in the commission with observer status.

[36] This refers to the commitment to restrict the rise in temperature to below 2°C compared to the pre-industrial level.

[37] The Climate Conference on the Indonesian island of Bali was the 13th Conference of the Parties of the Framework Convention on Climate Change (cf. Löschel et al. 2008, 28 sqq.).

[38] Not all countries accepted the base line of the Kyoto Protocol, which prescribes and quantifies a reduction of carbon dioxide emissions. Nations with a strong economic development (USA, China) opposed for economic reasons. The developing countries, in turn, demanded greater support of the industrialized countries in dealing with the problems and costs incurred by climate change.

The participants aimed at successfully complete the negotiations by the 15th Conference of the Parties, which was to take place in Copenhagen in 2009 and to have this lead to a new climate treaty (Kyoto Protocol follow-up treaty) (Bali Action Plan 2007, 3).

The results of Bali fell short of what Germany and the EU had hoped for. Quantified target specifications for greenhouse gas emission reductions applied only to the Kyoto parties and not to the USA (Bals 2008, 23; AWG Report 2007, 5).[39] The parties attending the Bali Conference pledged to take additional climate protection measures that are measurable, reportable and verifiable, and that can be compared by taking into account specific national situations. It had not been possible to achieve international commitment to these targets, though. However, a positive result was that the so-called newly industrializing nations also pledged to take extensive measurable, reportable and verifiable action to lower greenhouse emissions. In turn they demanded technological and financial support from the industrialized countries. An Adaptation Fund, long demanded by the developing countries, was launched to finance measures designed to counter the adverse effects of climate change. It would be financed from the share of proceeds (2%) of Clean Development Mechanism (CDM) certificates.

All in all the Bali Road Map was also a signal to the financial market that emissions trading and the CDM should be continued and stepped up after 2012.

3.2.1.12 Fifteenth Conference of the Parties in Copenhagen

In December 2009 the 15th COP on the Framework Convention on Climate Change took place in Copenhagen (see Table 3.1). The Bali Road Map had stipulated that the parties sign a new, binding treaty to follow up the Kyoto Protocol before its expiry in 2012, and Copenhagen was viewed as the last opportunity to do so. In view of the many years of preparation, the meeting was frequently termed "possibly the most important conference in the history of mankind".[40] However, the UN Climate Conference is deemed to have failed. It led to the Copenhagen Accord,[41] a minimal consensus that was binding neither under international law nor politically. Its signatories "took note of" the fact that global warming should be limited to 2°C compared to the pre-industrial level. They did not, however, commit themselves to any generally binding, internationally verifiable mitigation targets for greenhouse gas emissions. Consequently several developing countries rejected the compromise.

[39] All of the G8 states (i.e. also the USA) declared their support for emission reductions by at least 50% by 2050 at the G8 Summit in Japan.

[40] Schellnhuber, J. in: http://www.epd.de/nachrichten/nachrichten_index_68662.html (accessed November 20, 2009).

[41] http://unfccc.int/resource/docs/2009/cop15/eng/l07.pdf (accessed December 23, 2009).

Table 3.1 Key milestones in the international climate protection process (Coenen 1997, 162; supplemented)

1979	First World Climate Conference (WMO) in Geneva
1985	Villach International Conference on the Assessment of the Role of Carbon Dioxide and of Other Greenhouse Gases in Climate Variations and Associated Impacts
1987	Villach Workshop Developing Policies for Responding to Climate Change
	Publication of the Brundtland Report "Our Common Future"
1988	Toronto Conference
	Establishment of the Intergovernmental Panel on Climate Change (IPCC)
1988	First Report of the Committee of Inquiry "Provisions for the Protection of the Earth's Atmosphere" at the International Conference of Researchers in Hamburg
1990	Adoption of the First IPCC Assessment Report
	Second World Climate Conference in Geneva
	Establishment of the Intergovernmental Negotiating Committee for a Framework Convention (INC/FCCC)
1991–1992	Five sessions of the INC to work out the Framework Convention on Climate Change between February 1991 and May 1992
1992	Adoption of the Framework Convention on Climate Change (UNFCCC) at the UN Conference on Environment and Development in Rio by approx. 150 states
1994	Entry into force of the Framework Convention on Climate Change
1995	First Conference of the Parties (COP) of the Framework Convention on Climate Change (UNFCCC) in Berlin
	Publication of the Second IPCC Assessment Report
1996	Second COP of the Framework Convention on Climate Change in Geneva
1997	Third COP of the Framework Convention on Climate Change in Kyoto
2001	Publication of the Third IPCC Assessment Report
2002	Rio+10 Summit in Johannesburg / World Summit on Sustainable Development – WSSD
2004	First Intergovernmental Conference on Renewables ("renewables 2004") in Bonn
	Establishment of the global policy network REN 21
2007	Publication of the Fourth IPCC Assessment Report
	G8 Summit in Heiligendamm
	Thirteenth COP in Bali
2009	Fifteenth Conference of the Parties (COP) in Copenhagen

After the failure to conclude a successor treaty to the Kyoto Protocol expiring in 2012, hopes are pinned on the 16th COP in Mexico City, which is to take place from 29 November to 10 December 2010.

3.2.2 Establishment of the International Renewable Energy Agency (IRENA)

The establishment of an International Renewable Energy Agency was proposed for the first time in 1981 (Bundesregierung 2008, 6), but was initially abandoned due

to a variety of resistances, for example, from the established energy industry. Supported by Spain and Denmark, Germany reverted to the idea of creating an international renewable energy agency as originally set out in the 2002 government coalition agreement. The founding process, which began in early 2007, culminated in the official Founding Conference in Bonn on 26 January 2009.[42] IRENA's head office is in Abu Dhabi, while Bonn hosts IRENA's Center of Innovation and Technology. A Liaison Office for cooperation with the UN and other international institutions in the field of energy was opened in Vienna.

IRENA is the first worldwide organization concerned exclusively with renewable energies. The Agency offers consulting services to industrialized, industrializing and developing countries (IRENA 2008a, 2; IRENA 2008b; BMU 2008b, 13 sqq.; Bundesregierung 2008, 8).[43] IRENA understands itself as a political counterbalance to the International Atomic Energy Agency (IAEA) founded in 1957 and to the International Energy Agency (IEA) founded in 1974.[44] Its studies and consulting services aim to reveal local potential and expansion options, and to make suggestions with regard to financing models and the necessary regulatory framework conditions. By June 2009 a total of 109 states had signed the founding treaty, among them a large share of European and African states. In mid-March 2009 India signed the founding treaty as the first of the five major industrializing nations (IRENA 2009a).

3.3 Incentives for Energy Policy at EU level

The challenges at hand can only be mastered if activities toward energy and climate policy are coordinated among EU member states. The provision of an environmentally friendly, safe and competitive supply of energy cannot be managed by individual nation states alone. In addition, energy and climate policies are regarded as issues that could help to promote the process of European integration. According to Geden & Fischer (2008, 113), this is not so much about a real shift of regulatory competence to the EU level but about gaining acceptance for the "European idea". At the EU level, energy and climate policies are currently thought of as matters that have the potential to demonstrate the EU's ability to act.

[42] Ultimately the efforts benefited from the simultaneous foundation of other partnerships, such as the REN 21 (Hirschl 2008, 484 and 532 sqq.) While REN 21 is a relatively open policy network with only a small secretariat that is operated by the GTZ and the UNEP, IRENA was devised as an independently acting agency right from the start (IRENA 2009a).

[43] The Agency provides its consulting services at the request of its member states only (Bundesregierung 2008a, 7).

[44] This Agency is accused of not taking a neutral stance toward the entirety of energy sources, but rather to heavily support conventional and nuclear energy supply (Scheer 2008a, 1; similar Gabriel 2009, 1). Gabriel therefore regards IRENA as an alternative to the lobby interests of the conventional energy industry (2009, 2).

3.3.1 Liberalization of the Energy Markets

The EU had been encouraging the liberalization of the energy markets since the late 1980s. The aim was (and is) to establish a functioning single European energy market.[45] The legal basis for resuming discussions about energy management structures within the EU was section 8 – a section that had been added to the EEC Treaty as part of the Single European Act of 1986. It stipulated the step-by-step implementation of a single market by 31 December 1992 (Matthes 2000, 178). In the light of this, the Council of Ministers adopted the "New Community Energy Policy Objectives" on 16 September 1986. It was not until 2 years later, on 2 May 1988, that the Commission presented the report "The Single European Energy Market" (COM 1988), in which the Commission takes stock of the situation concerning various energy sources and develops some first ideas about the creation of a single energy market. In 1989 the EU Commission published two draft directives on increasing the transparency of energy prices and on electricity transits. These drafts were significant in particular due to the announcement of further liberalization steps and due to the resulting breakup of closed supply areas (Matthes 2000, 178–179).

3.3.1.1 Single Market Directive 96/92/EC

After several years of controversial debate within the EU, Directive 96/92/EC concerning common rules for the internal market in electricity[46] was adopted on 19 December 1996. The directive had received a great deal of support from the conservative-liberal German government in power at the time, which saw itself faced with a national "veto coalition of the energy sector"[47] (Hirschl 2008, 568). It was hoped that this "change of levels" would remedy the situation and bring about new impulses for national liberalization.

The Directive entered into force on 19 February 1997 and obliged the member states to gradually liberalize the electricity sector by 1999. As a result, Germany was able to adopt a revision of its Energy Industry Act (see Section 3.9.3).

The aim of liberalization was to open up as many sections of the energy market's value chain[48] to competition. The competition was supposed to ensure that consumers

[45] The EU Commission had presented a first draft directive on the liberalization of the energy markets as early as 1992. Yet it was not adopted.

[46] The sources for the legal information used in this chapter are given in the Index of Legal Sources.

[47] This sector had successfully fought changes to the 60-year-old legal status quo, especially the abandonment of the protected regional monopolies.

[48] In the case of electricity it is made up of (1) generation, (2) (wholesale) trade, (3) electricity grids (high and extra high voltage), (4) sales and (5) distribution networks.

are supplied with electricity at the best possible prices based on the market situation. Unbundling is therefore an integral part of reforming the energy generation, transmission and distribution business (Monstadt 2004, 162).

Transport of electricity is tied to a costly grid infrastructure. Offering several, parallel power grids therefore did not seem to make economical sense. For this reason the grid operators' regional monopoly was maintained at this stage of the liberalization process. However, the power utilities were required to separate their transport networks and/or distribution networks from the other markets subject to competition both legally and operationally and in terms of information and accounting ("unbundling"). So-called vertical unbundling did lead to the formation of spin-offs, yet in Germany these were still owned by the parent company, so the process of unbundling initially remained incomplete. Along with unbundling, guaranteed third-party grid access to the transmission and distribution networks[49], as well as regulation of the system usage charges[50] and grid connection conditions count among the major requirements specified by the EU.

The actual wording of the directive allowed for various ways for implementation, depending on the respective national situations. In practice, however, this resulted in a deviation from the original goal of harmonization and integration of the energy markets (see Section 3.9.3.3).

3.3.1.2 Acceleration Directive 2003/54/EC

In order to lend weight to the objectives of the Single Market Directive and to accelerate its deficient implementation, the Commission adopted the so-called Acceleration Directive 2003/54/EC in 2003. This directive abandoned the choices concerning the organization of the market and called for the binding introduction of regulatory authorities in the member states. The responsibilities of these authorities were specified in detail. The German energy industry joined forces with the Federal Ministry of Economics to combat the introduction of a regulatory authority "imposed" by Brussels (Hirschl 2008, 569). Implementation in Germany was delayed until the German Energy Industry Act (see more in Section 3.9.3) was once again amended in 2005 and the "German Federal Network Agency" was founded.

[49] This grid access regulation is designed to permit non-discriminatory third-party access to the supply grids. Denying access to the grid is only possible if the grid does not have the required wheeling capacities.

[50] Grid operators must make available their grids at a certain fee, while grid usage charges may be government-regulated.

3.3.2 *Renewables and Climate Protection Policy at EU Level*

Supporting renewable energy, which forms one of the most distinctive interfaces between environmental policy and energy policy, has gained importance over the last years as a result of the climate objectives formulated by the EU (Geden & Fischer 2008, 95).

3.3.2.1 Support Programs for Non-nuclear Energy

Although the EU Parliament had resolved in 1991 that the amount of subsidies for renewable energy should be equal to the amount spent on nuclear fusion research, the Commission prevented the introduction of a separate legal section for this. The EU Parliament subsequently created collective programs for non-nuclear energy, which were also used for fossil energy. The programs "Joule", "Thermie" and "Altener" were available for projects involving renewables, while the latter was devised exclusively for renewables. Although the Green Paper "Energy for the Future" (COM 1996) propagated stronger promotion of renewable energy (see Section 3.3.2.2), the subsidies from the Altener program were on the verge of being cut.

In addition, application for EU subsidies – especially if the prospects of receiving support were questionable – presented a challenge for applicants. Applications were time and energy consuming because of stringent, extensive and complicated guidelines, the requirement to compile an international application consortium of three to five project partners, and lengthy approval procedures. Preparing a project draft could take a part-time employee several months. The subsidy practice in the EU therefore seriously disadvantaged smaller and medium-sized businesses (Kreutzmann 1997, 26–27).

3.3.2.2 Green Paper and White Paper of the European Commission[51]

The idea of subsidizing renewable energy was addressed at EU level in the mid-1990s, when Germany already had the Electricity Feed-in Act (StrEG), and the expansion especially of wind power was beginning to prove successful. As a precursor in the political process for expanding renewable energy, the EU presented the Green Paper "Energy for the Future: Renewable Energy Sources" (COM 1996).

In November 1997 the European Commission adopted the White Paper "Energy for the Future" (COM 1997) which sparked a lively political discussion. This White Paper had stated the necessity of decreasing the dependency on energy imports, complying with environmental and climate protection requirements, and creating

[51] The European Commission frequently introduces a legislative process (e.g. adoption of directives) with the so-called Green or White Papers. Green Papers are published with the purpose of initiating a consulting process at the European level. White Papers contain proposals for relevant measures and activities of the European Community.

jobs as the reasons for using, expanding and technically advancing renewable energy. A key but non-binding target at EU level was to double the share of renewable energy in the gross energy consumption of 6% in 1995 to 12% by 2010. According to the estimation in the White Paper, this target could be reached mainly by expanding biomass and secondly by expanding the use of wind power (Schmela 1998, 24–25)

A first step toward this target was made with the "Campaign for Take-off", which is described in the White Paper and was launched in 1999. The Community provided EUR 1 billion in subsidies for the implementation of the campaign. The Green Paper on a European strategy for energy supply security pointed to the important role of renewable energy as well (COM 2000).

3.3.2.3 European Strategy for Sustainable Development

The issue of sustainability had been added to the Treaty of the European Community as early as 1998, where it was defined as a fundamental goal of European politics. Three years later, in 2001, the EU Council adopted the European Strategy for Sustainable Development. It focuses on climate change, traffic, health, natural resources and global environmental protection.

New EU Sustainability Strategy and Lisbon Strategy

On 15 and 16 June 2006 the Brussels EU Council Summit updated the European Sustainability Strategy.[52] It was hoped that the modified "renewed strategy" would be more effective in tackling the challenges of sustainable development. It had also been necessary to modify the strategy because of additional accessions to the EU. Climate protection and the responsible management of resources remained key fields of activity within the strategy. The Commission has been submitting progress reports on the Sustainable Development Strategy since 2007.

The European sustainability strategy is complementarily correlated with the "Lisbon Strategy",[53] which was devised to make a significant contribution to the overall objective of sustainable development.

[52] http://www.bundesregierung.de/... (accessed September 1, 2009).

[53] The Lisbon Strategy was adopted at a special summit of the European heads of state in Lisbon in March 2000. It aims to assist political alignment in EU countries, which is intended to make the EU the most competitive and most dynamic knowledge-based economic area of the world by 2010. This strategy, which was simplified in 2005 after an evaluation of the half-time results, is supposed to make a significant contribution to the economic upswing in Europe. Cf. http://ec.europa.eu/growthandjobs/ index_de.htm (accessed September 1, 2009).

3.3.2.4 EU Directive 2001/77/EC on the Promotion of Renewable Energy

The EU aimed to double the share of renewable energy in overall national energy consumption. The Commission's drafts for the relevant EU directive initially envisaged rules concerning the promotion of market access for renewables that would be the same for all of the EU's members.[54] However, this concept was incompatible with regulations in various EU member states, and it was met with opposition from associations and the European Parliament. While the Commission exerted a great deal of pressure on the German government to change the Electricity Feed-in Act (StrEG) and to abolish the remuneration system, the majority of the members of the European Parliament favored the compensation system. In other words, the Parliament supported the German government, which in turn opposed a directive that would be incompatible with specific national subsidy schemes such as the StrEG or the Renewable Energy Sources Act (EEG) (see Section 3.7.2). In 2002 the proclamation of the advocate general of the European Court of Justice, stating that the StrEG did not represent impermissible aid, forced the Commission and the representatives of the energy utilities to give up their position. Finally the EU Commission presented a draft directive that did not prescribe a harmonized support scheme.[55]

On 27 September 2001 the European Parliament and the Council adopted the "directive on the promotion of electricity produced from renewable energy sources in the internal electricity market" (2001/77/EC). It provided the legal backing for the EEG 2000 and its remuneration system in terms of European law (Oschmann & Sösemann 2007, 2).

The main objective was to raise the share of electricity produced from renewables in the gross power consumption of the EU from an average 13.9% in 1997 to ca. 21% in 2010. The directive obliged the member states to create suitable instruments that would help attain concerted, yet non-binding national targets. For Germany this target was to generate 12.5% electricity from renewable energy sources by 2010.[56] The EU's original objective had been to define binding targets for the member states, but this had not been accepted.

3.3.2.5 EU Biofuels Directive 2003/30/EC

Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport, adopted in May 2003, defined a certain minimum share of these renewable fuels. For this purpose, various biofuels were first distinguished from other renewable energy sources (Art. 2). The EU-wide indicative target was to

[54] The Commission, or to be more precise, the competition commissioner and his directorate-general, preferred quota-based certificate schemes, and rejected feed-in models as being inefficient.

[55] This was favored by the advocates of the principle of subsidiarity, who had objected simplification as well and wanted to maintain the member states' scope for action (Hirschl 2008, 434).

[56] In 2001 Germany generated ca. 7% of its electricity from renewable energy sources.

attain a minimum share of 2% in the overall amount of gasoline and diesel fuels by the end of 2005, and to raise this share to at least 5.75% (Art. 3) by the end of 2010.[57] The directive stipulated that the member states submit mid-year reports on national measures taken and on their experience gathered in this context (Art. 4 (1)). The Commission's progress report of January 2007 found a biofuel market share of merely 1% in the overall fuel consumption for the first period until 2005 (COM 2006). Even this report conceded that the 2010 target would probably not be met, at the same time it viewed the use of biofuels as the "currently only viable way out of the traffic sector's almost complete dependence on mineral oil" (ibid.). It was recommended to revise the directive and to stipulate a minimum share of 10% for 2020.

As was the case with the 2001/77/EC electricity directive (see Section 3.3.2.4), the biofuel directive was not amended, but will be replaced on 1 January 2012 with the integrated directive 2009/28/EC (see Section 3.3.2.7) within the context of the climate and energy package (Art. 26 (3)). Furthermore, the target of 10% biofuels in the traffic sector's total final energy consumption by 2020 has become legally binding so as to benefit long-term security for investment. It applies equally to all of the member states, excluding partial national targets (Art. 3 (4)). An important integral part of the directive on the use of biofuels is the respective sustainability criteria specified in Articles 17–19 (Futterlieb & Mohns 2009, 23).

3.3.2.6 2007 Meeting of the EU Council – Reduction Targets for Greenhouse Gases

Climate protection targets were at the center of the debate at the EU Council meeting (on Environment) held in Brussels on 20 February 2007 (under German presidency). The participants reaffirmed the "ambitious" objective of preventing global warming by more than 2°C.

On 9 March 2007, and under German presidency, the EU's heads of state and government adopted a "historic resolution" on Europe's future climate policy. German Chancellor Angela Merkel was able to push through binding, raised CO_2 reduction targets at the EU summit. Although the climate protection regime was controversial among EU member states, the EU's heads of state and government resolved an "EU action plan for CO_2 reduction": the EU would commit to a 30% reduction of greenhouse gas emissions by 2020 compared to 1990, provided that other developed countries commit themselves to comparable emission reductions, and economically more advanced developing countries adequately contribute according to their responsibilities and respective capabilities. In a second step the industrialized countries would commit to reducing their emissions by 60–80% by

[57] The reference values for Germany were also 2% (2005) and 5.75% (2010). These targets do not necessarily require an admixture, but the respective percent share in the overall fuel demand to be covered by biofuels (cf. Art. 3 (2)).

2050 compared to 1990. In anticipation of international negotiations, the European Union agrees even at this point in time to lower its emissions by at least 20% by 2020. As one of the most important measures for implementing the targets, the Council stipulates that the share of renewable energies in the EU's overall primary energy consumption should be tripled to 20% by 2020 (so-called 20/20/20 target). These resolutions of the European Council point beyond the 2008–2012 commitment period of the Kyoto Climate Protection Protocol. It is agreed that implementation of these targets is to be based on EU internal-burden-sharing (BMU 2007a, b). The member states are asked to draw up national action plans setting out targets for the individual sectors. This provided renewable energy in Europe with a crucial stimulus.

3.3.2.7 EU Directive 2009/28/EC on the Promotion of Renewable Energy

About 5 years after the directive on the promotion of renewable energy had entered into force in 2001, it became apparent that the non-binding targets aimed at increasing the share of RE are not met by most of the EU member states within the defined period. In 2006, 21 member states had not even met half their targets. Due to this implementation deficit and worries about not being able to reach the climate protection goals, a target agreement for 2020 was adopted in 2007, according to which 20% of Europe's total final energy consumption was supposed to be covered by renewables. Unlike its 2001 predecessor, the draft directive presented in January 2008 suggested a legally binding stipulation of the target in EU law. Directive 2009/28/EC on the promotion of the use of energy from renewable sources came into force in June 2009.

In contrast to the old EU directives on power from renewable energy (2001/77/EC) and on biofuels (2003/30/EC, see Section 3.3.2.5), the new directive covered renewable energy in a comprehensive way: it included all of the renewable energy sources as well as the application areas of electricity, heating/cooling and transport.[58] The EU target of 20% is translated into national targets for the EU member states.[59] The national targets are binding, implying that infringement proceedings may be instituted in the event of non-compliance (Futterlieb & Mohns 2009, 90). Furthermore, the 20% target refers to the total final energy consumption and no longer to the electricity market only. This makes the target clearly more ambitious compared to the previously valid directive. Nitsch (2008, 13–14) worked out that the German national target of 18% in the total final energy consumption would necessitate a share of ca. 35% renewable energy in power consumption, provided

[58] http://www.euractiv.com/de/energie/... (accessed September 1, 2009).

[59] In addition, the directive specifies a non-binding indicative trajectory for each member state (interim targets). It also stipulates that 20% of the respective national targets shall be met in 2012, 30% in 2014, 45% in 2016, and 65% in 2018.

the target was mainly reached via the electricity market. But increasing support for renewable energy in the heating and cooling sector could reduce the share of renewables in the electricity sector accordingly. The directive requires the member states to submit national action plans to the Commission by 30 June 2010, and to present reports regularly thereafter.

A further key point of Directive 2009/28/EC is the extension of conditions concerning access to the electricity grid (see Section 3.9.3.3). Plants generating electricity from renewable energy sources shall be granted priority access to the grid. In Directive 2001/77/EC this type of access had still been optional. In addition, the directive stipulates accelerated and facilitated administrative procedures, certifications and permission to construct RE plants. Instead of a de facto harmonized system of subsidies, three flexible instruments were included in the directive, which are intended to allow for cost-efficient expansion of renewable energy based on the respective available potential. Member states that have already reached their respective national target may carry out "statistical transfers". Moreover, member states may run "joint projects" or projects with third-party countries. The new directive is the first to define sustainability requirements for the production of liquid biomass for energetic use (see Chapter 4). It was welcomed by the RE associations, especially the solar industry. After a draft directive, which had clearly accommodated the interests of the conventional energy industry, the final version largely assisted the interests of the RE sector (Futterlieb & Mohns 2009, 77–78).

3.3.3 *European Emissions Trading (Cap and Trade)*

In order to meet the climate protection targets set out in the Kyoto Protocol, the European Union introduced an emissions trading scheme. The Emissions Trading Directive 2003/87/EC entered into force in 2003. It created the legal basis for trading greenhouse gas emission certificates in Europe and required each member state to publish a national allocation plan at the beginning of each trading period (every 3 and then every 5 years) – i.e. an overview of the allocation of emission certificates.

Six years later the European emissions trading scheme was amended by the climate and energy package. In June 2009 the latter was adopted in the form of Directive 2009/29/EC. The lead principle of this resolution was the 20/20/20 target, which has formed a distinctive module within the European climate strategy since spring 2007 (see Section 3.3.2.6). From 2013 onward, the national action plans will be replaced by a European emissions trading budget – the European "cap" – which will be reduced each year by 1.74%, until in 2020 CO_2 emissions will have dropped by 21% compared to 2005 (Löschel & Moslener 2008, 249). The share of certificates to be auctioned off in the context of European emissions trading will rise from 20% to 70% between 2013 and 2020. The remaining certificates will be allocated free of charge, but in 2027 full auctioning will be implemented (Schafhausen 2009, 37).

Advocates of emissions trading consider this instrument as a key element in a long-term climate protection strategy. They see the advantages predominately in the scheme's simplicity of defining an international emissions mitigation target and leaving implementation up to the actors of the market. This they regard as a way of reaching the politically prescribed environmental target at minimal macroeconomic costs. Moreover, advocates argue that emissions trading provides an incentive to reduce emissions by adjusting the quantities and advancing the respective technology deployed, and to develop long-term strategies to reach these goals (SRU 2006).

Opponents mainly criticize the concrete legal specifications of emission allowance allocation in National Allocation Plans, claiming that insufficient CO_2 reduction targets are a political reality. It is assumed that the powerful German electricity industry cartel has been undertaking selective lobbying activities to systematically erode this instrument and to significantly weaken its effectiveness (Corbach 2007). The new emissions trading directive 2009/29/EC is being met with criticism as well, because of the large number of derogations which are regarded as watering down a generally positive approach (Futterlieb & Mohns 2009, 90; BWE 2008).

In the medium term, a conflict will also arise between emissions trading and the promotion of renewable energies. This so far largely hypothetical conflict is based on the fact that additional renewable energy sources could contribute to reducing the pricing pressure on fossil-based energies, implying that a rise in CO_2 certificate prices would matter less (Bode 2008, 244). From 2013 onward, operators of power plants will be committed to purchase all of their emission certificates by auction. Since Directive 2009/28/EC (see Section 3.3.2.7) also requires the expansion of renewables, the demand for emission certificates from the power industry will drop, which in turn will lead to a drop in certificate prices. As a result, other sectors will be able to buy emission certificates at more favorable prices, and the promotion of renewable energy will not effect greater climate protection (Bode 2009, 48).

Long-term synergies based on the coexistence of both systems as well as an additional climate protection effect would become possible, for instance, if the emissions saved as a result of renewable electricity use were directly deducted from the total budget of available emissions trading certificates. However, the critical point in this context is that emissions trading activities are decided at EU level, while decisions on the promotion of renewable energy are taken by the member states (Löschel & Moslener 2008, 251).

3.4 Emergence of National Problem Awareness and Process of Institutionalization

The institutionalization of renewable energy in national politics, administration and also in associations and interest groups forms a basic prerequisite for the innovation process of renewable energy in Germany. At the same time, the public perception of climate change, the need for climate protection and pollution control and the

benefits of using renewable energy sources are important aspects of the process. Key turning points in politics and public awareness originated in the 1980s.

3.4.1 *Institutionalization of Environmental Protection*

The institutionalization of climate protection and supporting renewable energy was preceded by the institutionalization of environmental protection.

3.4.1.1 The Greens in the German Bundestag

The German party Die Grünen (The Greens) was founded in 1980. The Greens were voted into the Bundestag as early as 1983, and soon after, in 1985, a member of The Greens (Joschka Fischer) was appointed minister for the environment. At the time The Greens were made up of left-wing students, members of environmental protection action groups and members of the anti-nuclear movement. Their strong concern with environmental issues forced the other parties in the Bundestag to deal with these issues. The Greens were instrumental in establishing environmental politics in the Bundestag during this phase.

3.4.1.2 Administrative Institutionalization of Environmental Protection

In the 1970s and 1980s energy policy and environmental policy were separate areas. It is true that in the course of the 1980s the energy debate was becoming increasingly entwined with environmental policy (SRU 1981), but it was only the Chernobyl accident in 1986 that ultimately provided the stimulus for establishing the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. Up until then the Federal Ministry of the Interior, the Ministry of Agriculture and the Health Ministry had been responsible for matters of environmental protection. The establishment of this Ministry under the Kohl government with Walter Wallmann as environment minister, followed in 1987 by Klaus Töpfer, was mainly a reaction to what was perceived as an insufficiently coordinated way of dealing with the environmental consequences of Chernobyl (e.g., radiation level in food).

Once the Ministry of the Environment had become a stand-alone department, environmental policy was visible and addressable within the German federal government (Gabriel 2006). In the 1980s climate protection and CO_2 reduction had mainly been part of the emissions mitigation policy to reduce smog and forest dieback.

3.4.2 *Climate Protection in Politics and Administration*

The following events and influencing factors were key to the national institutionalization of renewable energies.

3.4.2.1 Renewable Energy in the Former German Democratic Republic (GDR)

The territory of the former GDR has Germany's largest lignite resources. Consequently, large-scale lignite-fired power plants formed the backbone of east and central Germany's energy industry (Matthes 2000, 45–46). Moreover, the potential of renewable energy in the GDR was estimated to be extremely low due to the area's geological and climatic conditions. In 1988 the predicted combined share of all renewable energy sources in the primary energy demand was still at a mere 0.4% for the year 2000 (Friedrich-Ebert-Stiftung 1988, 51–52). Other forecasts assumed a maximum share of 1% in the primary energy balance by 2000 (Gruhn 1982, 105). Increasing this share would have been possible by promoting research and development, but this would have required higher investments.

In the GDR, environmental protection clearly ranked much lower than reliable energy supply, all the more so since less importance was attached to social acceptance than in the FRG (Weidenfeld & Korte 1992, 285–286). Avoiding the adverse environmental effects of processing lignite was no primary motive, even if environmental considerations did play a role in the promotion of using geothermal energy (Broßmann 2008, pers. comm.). While the GDR had launched a policy geared toward industrial energy efficiency in the 1970s, it had hardly created any incentives to save energy in private homes. This also reflected in the fact that the electricity price of 8 Pfennig/kWh in 1988 had not changed since 1948 (Friedrich-Ebert-Stiftung 1988, 55, 57).

The regenerative technologies that were used after 1980 were not primarily deployed to generate electricity. Biogas production was used mainly in fertilizer processing and to substitute mineral fertilizer, and heat was used as a waste product. Equally, geothermal energy was predominately, albeit only selectively, used as a means of heat supply. Wind energy was sometimes used to operate irrigation systems, but not for electricity generation (Friedrich-Ebert-Stiftung 1988, 51; Gruhn 1982, 105). A wind energy potential of 200–400 MW was forecast for the Baltic Sea coastal area, yet its economic utilization was viewed with skepticism (Gruhn 1982, 106). Hydropower, which according to Matthes (2000, 46) was scarce due to the topographical conditions, contributed to the overall power supply only to a small extent (1.8% in 1980). Similarly, solar energy was used in few, selected circumstances only (Friedrich-Ebert-Stiftung 1988, 52).

3.4.2.2 Committee of Inquiry "Protection of the Earth's Atmosphere"

Newly formed interfaces between science and politics played an important part in climate protection matters. The convening of the German Federal Parliament's Committee of Inquiry "Provisions for the Protection of the Earth's Atmosphere" in 1987 marked the emergence of anthropogenic climate change as an important political field of action. By this time parliamentary groups in the Bundestag were convinced that climate protection was an important issue that required attention.

The Bundestag appointed Bernd Schmidbauer, environmental spokesman for the CDU, head of the Committee of Inquiry. Together with Michael Müller (SPD), who partially acted as an adversary, and partially as an advocate within the Committee, he shaped the Committee's work. Wolfhart Dürrschmidt, today head of division in the Federal Ministry for the Environment, was in charge of climate and energy matters in the Committee's secretariat. During the 3 years of its existence, the Committee established close ties with the IPCC following extensive personnel and scientific exchanges.[60]

The convening of the Committee had been the result of applications of the CDU and The Greens. The CDU had once more wanted to advance nuclear power within the context of climate protection. The Greens, by contrast, were of the opinion that climate protection needed to be accomplished without nuclear power. The SPD ultimately agreed to the application for a Committee of Inquiry as well, and in the end it was supported by all of the parliamentary groups (Dürrschmidt 2007, pers. comm.). This constellation had a positive effect on the reception of the Committee's results in the Bundestag: despite the large number of differing opinions and interests[61] the reports of the Committee of Inquiry were unanimously adopted (Dürrschmidt 2007, pers. comm.).

World Congress on "Climate and Development" in Hamburg

In autumn of 1988 one of the first international congresses on "Climate and development"[62] took place in Hamburg. This Congress had been prepared and held by the German Ministry of Research in cooperation with the United Nations and the German Ministry for the Environment. The Committee of Inquiry (see above) presented its first interim report to the Congress. The Hamburg Congress provided a crucial impetus for advancing climate protection on the national level. It transported the issue of threatening climate change from the field of science to the field of politics (Dürrschmidt 2007, pers. comm.).

Final Report of the Committee of Inquiry

As a result of the Committee of Inquiry's work and its final report in 1990 (see Enquête-Kommission 1990), current scientific findings and the urgency of climate protection measures were directly transported into politics. Without the Committee of

[60] IPCC (Intergovernmental Panel on Climate Change) scientists were invited to attend the Committee of Inquiry. Not only the Committee of Inquiry benefited from this. The members of the IPCC, too, realized that there was great potential for scientific and political cooperation at the national level (Dürrschmidt 2007, pers. comm.).

[61] There were, for instance, considerable differences concerning the margin nuclear energy should have in view of climate protection.

[62] Cf. http://www.germanwatch.org/... (accessed August 25, 2009); cf. also Beisheim (2003, 225).

Inquiry, the climate protection process in Germany would certainly have been more sluggish. The Bundestag emerged as a driving force in this process. It set the German course for climate protection and development of renewable energy primarily by preparing draft bills and resolutions on restructuring departments.

The Federal Government's Climate Protection Program

A short version of the Committee of Inquiry's final report was issued in the form of the Federal Government's climate protection program in 1990. This task was assigned to the Environment Ministry (under Environment Minister Klaus Töpfer), because the Chancellery deemed this ministry better suited to promote climate protection than the Federal Ministry of Economics. Henceforth, the latter systematically opposed the Environment Ministry's climate protection activities, arguing that three quarters of the climate protection tasks concerned energy policy and that it was the Federal Ministry of Economics that was competent in that case (Dürrschmidt 2007, pers. comm.).

3.4.2.3 Establishment of Climate Protection in the Federal Ministry for the Environment

In 1990 climate protection was placed under the control of the Federal Ministry for the Environment. Until 1990, climate protection matters had been the responsibility of the Federal Ministry of Transport, which had not attached a great deal of importance to these issues. On 15 January 1990 the Federal Chancellery under Chancellor Helmut Kohl addressed a short letter to the Federal Environment Ministry, requesting it to submit a list of climate protection goals and suggestions for measures to be taken. The Environment Ministry made extensive use of this request. Neither the Ministry of Transport nor the Economics Ministry were overly interested in the topic at the time, and they obviously did not realize what implications the letter may have. At this time Bernd Schmidbauer, chairman of the Committee of Inquiry, found Environment Minister Klaus Töpfer to be a dedicated contact, which significantly contributed to the acceptance of the Environment Ministry's commitment.[63]

Initially there were two departments in the Federal Environment Ministry that dealt with climate protection: the Energy and Environment Department and the Department for Climate Protection and International Cooperation, established only in 1991. The latter was assigned the task of preparing the 1992 Earth Summit on sustainable development to be held in Rio de Janeiro and to coordinate international negotiations on the preparation of a climate convention.

Under the red-green government and Jürgen Trittin as environment minister, the Environment Ministry aimed to initiate an energy transition process[64] based on the

[63] The source for this section are personal reports from the Federal Ministry for the Environment.

[64] The term originates from the title of a study conducted by the Öko-Institut in 1980, which prepared a forecast about nuclear phaseout and energy generation from mineral oil.

success of the EEG. The conference "Energiewende – Atomausstieg und Klimaschutz" (energy transition – nuclear phaseout and climate protection) that took place in Berlin in February 2002 is regarded as the starting point for this energy transition policy.

With the environment minister Sigmar Gabriel assuming office in 2005, the process of energy transition was explicitly placed in the context of innovation policy. This clearly labeled the change in energy supply as an innovative technical accomplishment of great importance for the German economy. The promotion of renewable energy was now categorized as "innovation promotion". Minister Gabriel emphasized that development of renewable energies was a progressive and innovative move. He also highlighted the economic potential of renewable technologies. Linking renewable energy technologies to "innovation" enhanced the renewable energy sector's public image and made it an attractive field.

3.4.3 Institutionalization of Renewable Energy Policy

3.4.3.1 Administrative Establishment of Renewable Energy Policy

Establishment of this political field in the administrations of the federal and state governments is considered a key prerequisite for (political) allocation and (administrative) adoption of the corresponding portfolio responsibilities and for administrative governance. No appreciable administrative steps can be expected before portfolio responsibility has been defined and the portfolio's tasks have been outlined.

The 1998 change to a red-green government brought about a process of restructuring and reorganizing the ministerial administration. It broke up old routines and created the opportunity for the establishment of renewable energy competences within the federal administration (see Section 3.4.2.3).

From 2001 the Federal Environment Ministry, headed by environment minister Jürgen Trittin, had at its disposal research funds allocated by the Zukunftsinvestitionsprogramm (ZIP – Future Investment Program).[65] These funds were used among other things for the promotion and accompanying ecological research on renewable energy (Kaiser 2007, pers. comm.).

Along with the EEG (see Section 3.7.2), the German Government took additional measures to expedite implementation of its energy policy goals. On 18 October 2000, for instance, it adopted the climate protection program (see Section 3.5.3), and in that same year it co-founded the German Energy Agency[66] (dena).

[65] The future investment program was financed by interest savings that the federal government obtained from additional redemption payments on debts from UMTS allocation funds. Between 2001 and 2003 an annual 50 million euros from these savings were used mainly for research and development of projects in the field of renewable energy and fuel cells (BMU 2002, 19).

[66] The German Energy Agency (dena) was founded by the Federal Ministry of Economics and the Kreditanstalt für Wiederaufbau (KfW) on 29 September 2000. The federal ministry and the KfW each have a 50% share in dena. The objective was to establish a center of expertise for energy efficiency and renewable energy.

3.4.3.2 Transfer of Responsibilities/Continued Institutionalization

The responsibility for renewable energy research and development originally laid with the Federal Ministry of Research, which attended to the promotion of basic research and development, but not to the technologies' introduction on the market (Dürrschmidt 2007, pers. comm.). While the responsibility for basic research remained with the Ministry of Research, application-oriented research and development was initially transferred to the Federal Ministry of Economics in 1998. Commercial launch also fell within this ministry's sphere of competence. So between 1998 and 2002 the Ministry of Economics was temporarily responsible for all aspects of renewable energy, spanning research and development, market launch and energy efficiency. However, the Federal Ministry of Economics had not been able or not wanted to close the gap to market launch, since major assistance for the introduction of renewable energy on the market was viewed as subsidization.

Yet, under the red-green Federal Government, energy transition had advanced to one of the core environmental objectives since 1998 (Mautz & Byzio 2005, 113). After the federal elections in the fall of 2002, the responsibility for research and development in the field of renewable energy, as well as that for market launch and the EEG shifted from the Federal Economics Ministry to the Federal Environment Ministry. This had been the result of an organizational order of the Federal Chancellery agreed upon in the coalition agreement. The members of the Bundestag knew that the concern to expedite the development of the respective technologies was not only going to be competently and proactively dealt with at the Environment Ministry's executive level but also by its staff (Dürrschmidt 2007, pers. comm.). According to Mautz & Byzio (2005, 113) the shift in administrative responsibility indicates that the relevant protagonists viewed energy transition primarily as a project of environmental policy and less as one of economic policy. The economic relevance of renewable energy had not fully been recognized at that point in time, neither by economic stakeholders nor economic policy-makers.

In 2002, even before it was officially commissioned, the Federal Environment Ministry had already drawn up an offshore wind power strategy. With the Chancellery then also transferring offshore issues to the Environment Ministry it was able to further extend its authority in the field of renewables.

3.4.4 Establishment of Associations

The institutionalization of interest groups is regarded as an indication of the renewables sector becoming increasingly established in the economy and in society, and of interest groups becoming professionalized.

The 1980s saw the formation of first RE associations, some of them at state level. The umbrella organization "German Renewable Energy Federation"

(Bundesverband Erneuerbare Energie e.V. – BEE), founded in December 1991, i.e., not even a year after the Act on feeding electricity generated from renewable energy into the grid (Stromeinspeisungsgesetz – StrEG) had entered into force, now pooled these interests at federal level. The objective had been to improve the coordination of the individual associations' activities with regard to policies and the public, to lend more weight to these associations, and to enhance the equality of opportunities concerning renewable energy as compared to conventional energy generation. The long-term goal is to switch energy consumption entirely to renewable energy.

The unanimous adoption of the StrEG indicated the establishment of the political field of renewable energy. In turn this was viewed as an occasion to establish means for a more effective protection of interests. Potential rivalry between the individual energy sectors was likely, as the wording of the StrEG did not provide for a quantitative allocation scheme, i.e. a quota system or competition between the technologies. This situation allowed for the establishment of a common organization for all of the renewable energy sectors (Suck 2008, 194).

The BEE describes its parliamentary advisory council as a particularly important connecting link between the BEE and politics. This advisory council is made up of members of parliament of all parties who regularly convene with members of the BEE. The BEE's representation of the sector's interests is also becoming increasingly important in Brussels (Lackmann 2006, 37), reflecting not least in the fact that the BEE is a member of the European Renewable Energies Federation (EREF), the European umbrella organization for renewable energy.

The EREF currently comprises 26 associations with more than 30,000 members, including over 5,000 businesses. The association representatives of all the sectors dealt with in this analysis are members of the BEE. Their role in the innovation process and their activities are investigated in more detail in the chapters on the respective energy sector.

Activities within the BEE are described as consensus-oriented. However, internal disputes about who should have how much influence on the BEE's policy have repeatedly become known.[67] These rivalries within the umbrella organization may be explained with a shift in power: while the initiative to establish the BEE originated from what was then the main RE interest group, namely the German Federal Association of Water Power Companies (BDW), the political weight increasingly shifted to the wind power associations (Suck 2008, 195)[68] in the course of wind power's expansion during the 1990s. Similarly, the bioenergy and solar energy associations gained in importance as well.

[67] In its issue of February 2007, for instance, the journal Erneuerbare Energien, reported on conflicts between wind power interest groups and hydropower interest groups (Baars 2007, 6).

[68] The most important ones were the interest group "Windkraft Binnenland (IWB)" and the "Deutsche Gesellschaft für Windenergie (DGW)" which merged with the German WindEnergy Association (BWE) in 1996.

3.5 Energy and Climate Policy Strategies and Objectives at National Level

3.5.1 *Guidelines on Energy Policy Issued by the Federal Government in 1991*

On 11 December 1991 the Federal Government presented a set of guidelines for the "Energy Policy for the United Germany". According to these guidelines the priorities of energy policy – supply safety, economic efficiency, environmental soundness, and sustainable resource management – needed to be rearranged. Environmental aspects and the integration of the national energy policy in the European common market became increasingly important.

3.5.2 *Change of Government to Red-Green in 1998*

The Federal Government's priorities in energy policy clearly shifted toward environmental policies in the fall of 1998. The red-green government's coalition agreement of 20 October 1998 stipulated a forced turnaround in energy sources and announced changes in energy legislation. "The Federal Government will eliminate the obstacles that are still impeding an increased use of regenerative energies [...]" (SPD, Bündnis90/Die Grünen 1998, 20–21).

On the occasion of the 5th COP to the Framework Convention on Climate Change[69] held between 25 October and 5 November 1999, a year after the change of government to red-green, Federal Chancellor Gerhard Schröder expressed his intention to "double the German share of renewable energies by 2010". In doing so, Germany had adopted the European doubling target specified in the EU White Paper (see Section 3.3.2.1) of 1997 as early as 1999.

3.5.3 *National Climate Protection Programs*

3.5.3.1 National Climate Protection Program 2000

Following the suggestion of Federal Environment Minister Jürgen Trittin, the federal cabinet adopted a national climate protection program on 18 October 2000, which was intended to reduce Germany's carbon dioxide emissions (CO_2) by up to 70 million tons by 2005.[70] This extent of CO_2 emission reduction was necessary for

[69] United Nations Framework Convention on Climate Change (UNFCCC).

[70] http://www.bmu.de/klimaschutz/nationale_klimapolitik/... (accessed September 1, 2009).

Germany to fulfill its international climate protection commitments. At the Berlin Climate Summit in 1995 Germany had agreed to reduce its CO_2 emissions by 25% by 2005, compared to the 1990 level. In 1998 the new Federal Government reaffirmed this target. The internationally binding climate protection target at EU level, i.e. within the context of the Kyoto Protocol, specified reductions of only 21% between 1990 and the period between 2008 and 2012. The German government did not manage to meet its 25% target, but it got very close. In 2004 greenhouse gas emissions had dropped 19% below the balance of 1990. In part this reduction in emissions had been the result of industrial plants in former East Germany being closed down. Still, this achievement made Germany an internationally recognized pacesetter in climate protection.

3.5.3.2 National Climate Protection Program 2005

The national climate protection program was revised and updated by the Federal Government's resolution of 13 July 2005 (BMU 2005). At the same time this revision and update served to take stock of the Federal Government's climate protection policy pursued so far. This showed that the success of Germany's climate protection efforts varied in the different sectors. Despite negotiated agreements, emissions in the industrial sector and in the energy industry had increased instead of decreasing over the past years. Also, environmental groups criticized the 2005 climate protection program for not being ambitious enough. It had mandated that greenhouse gas emissions in Germany be reduced by 21% between 2008 and 2012 (compared to 1990). This, it was argued, meant it referred only to the fulfillment of the Kyoto commitment up to 2012, but lacked a strategy to reduce carbon dioxide emissions by 40% by 2020 (compared to 1990).

3.5.4 Nuclear Phaseout Resolution of 2001

After lengthy "consensus talks" the German Bundestag adopted the amendment to the Atomic Energy Act, which entered into force on 27 April 2002. It implements the agreement (called "Nuclear Consensus")[71] of June 2000 between the Federal Government and the power utilities, about the continued operation of German nuclear power stations.[72]

A major issue of this agreement is to define the nuclear power stations' remaining operating time. It is calculated on the amount of residual electricity. The volume of residual electricity is the amount of electricity a plant is permitted to produce before its operating entitlement lapses. According to these calculations, the last nuclear power would be switched off around 2021. In addition, regulations were defined concerning the storage and nuclear power processing of fuel elements in German interim storage facilities. The construction of new nuclear power stations was prohibited, while research, especially into safety issues, was agreed to be continued.

[71] "Vereinbarung zwischen der Bundesregierung und den Energieversorgungsunternehmen über die künftige Nutzung der Kernenergie" (Agreement between the German federal government and the power utilities about the future use of nuclar power) of 14 June 2000.

[72] In 2007, 17 nuclear power stations were still being operated.

3.5.5 Sustainability Strategy 2002

Around the time of the World Summit on Sustainable Development in Johannesburg, and after widespread public debate in Germany, the German government presented a strategy for sustainable development titled "Perspektiven für Deutschland" (Perspectives for Germany) in April 2002, which formulates concrete sustainability targets for all of the political fields.[73] The strategy has since been the benchmark of government action in Germany, its implementation and revisions being documented in progress reports.[74]

The "Strategy for the expansion of wind energy at sea" ("Offshore Strategy", see Chapter 7) of January 2002 is part of the national sustainability strategy adopted in April 2002 (Bundesregierung 2002b).[75] The strategy, for which the Federal Ministry for the Environment took over leadership, shows that the German government sees the main share of future wind energy use at sea. The goal of the expansion phase scheduled to take place between 2007 and 2010 was to install a wind power capacity of 2,000–3,000 MW, and up to 25,000 MW in further expansion phases (Bundesregierung 2002a). However, the expansion goals specified in the strategy have so far not been met. Obviously the challenges and risks of implementing offshore wind parks and connecting them to the grid were underestimated.

3.6 Government Aid for Renewable Energy

The Electricity Feed-in Act and later the Renewable Energy Sources Act were accompanied by a number of supplementary funding instruments. Apart from research promotion at the federal level (see Section 3.6.2) the states participated in funding schemes as well (see Section 3.6.3).

[73] Cf. Bundesregierung (2002a): The German national sustainability strategy "Perspectives for Germany" is very similar to the EU strategy of 2001.

[74] Bundesregierung (2004): "Fortschrittsbericht. Perspektiven für Deutschland"; Bundesregierung (2005): "Bilanz und Perspektiven".

[75] The utilization of offshore wind energy was viewed as necessary by the German government in order to meet the statutory climate protection commitments and substitution targets.

3.6.1 Market Incentive Program

The Federal Government's market incentive program (Marktanreizprogramm – MAP) of 1994 initially promoted only a restricted spectrum of renewables. In the domain of heat it supported the construction of solar heat plants and the reconstruction of geothermal heat facilities. In the field of electricity, the program subsidized the construction of small hydropower plants (up to 500 KW) and wind power plants (450–1,000 kW). The electricity generating technologies benefited from this in particular because these investment subsidies supplemented the compensation as per the StrEG (see Section 3.7).

Although renewables technologies for the heat sector were largely known already, comparably high investment costs hampered a pronounced market penetration. From September 1999, the Federal Ministry of Economics massively extended the scope and budget of the MAP (Staiß 2007, 212).[76] The goal was to strengthen the market launch primarily of the heat-generating technologies and to contribute to the improvement of their profitability so that they would develop in a free market (see-Hoffmann 2002, 53). Along with solar collector plants, hydropower plants, the utilization of deep geothermal energy, and photovoltaic arrays for schools, biomass combustion plants and individual biogas facilities have been funded as well. The authority responsible for implementation is the Federal Office of Economics and Export Control (BAFA). The MAP is viewed today as the key instrument for the launch of renewable energy in the heat market.

According to IfnE (2010, 5) more than 95% of all renewable energy plants built in Germany were subsidized by the MAP in the last 2 years. Since 2000 the MAP provided significant impetuses for the increased use of biomass heating systems and solar heat, and contributed to the fact that the amount of heat available from renewable energy has more than doubled since 1999.

3.6.2 Federal Research Funding

During the 1970s, energy research and research funding were dealt with by several portfolios. Parts of support came under innovation funding, which was essentially granted by the Federal Ministry of Education and Research during the 1970s. In 1972 the ministerial tasks were restructured. The newly formed Federal Ministry of Research and Technology under minister Horst Ehmke was assigned a number of key tasks in various fields including technology, development and innovation, nuclear technology and nuclear research, and space and aviation research. This ministry promoted the research and development of renewable energy to a notable extent (Nitsch 2007, pers. comm.).

[76] The funding volume was increased tenfold due to the green electricity taxation.

3.6.2.1 Energy Research and Energy Technologies Program (1977–1980)

While there had been several nuclear research programs since 1956 that promoted nuclear energy research, "public research specifically into non-nuclear energy" was promoted for the first time by the Research Ministry[77] within the context of its "Energy research framework program" (1974–1977) (BMFT 1978, 26). This novelty had been triggered among other things by the effects of the oil price crisis and worries about a shortage of imported energy sources, such as oil and gas (Semke 1996, 919). Between 1977 and 1980 this framework program was further pursued as the "First energy research program" (BT-Drs. 8/2039, 28–29). The objective had been to speed up the process of substituting crude oil with other sources of energy (Neu 2000, 4). The four focus areas included the rational use of energy, coal and other fossil-based primary sources of energy, "new sources of energy" (nuclear fusion, but also renewable energies) and the expansion of nuclear energy (BMFT 1978, 12), with the major share of funding (4.53 billion German marks) going to the promotion of nuclear energy, though (Nitsch 2007, pers. comm.).[78]

Major research institutes were involved in the research program, e.g., the Jülich Nuclear Research Center (KFA Jülich), the Fraunhofer Institute for Systems and Innovation Research (ISI) in Karlsruhe, and the German Center for Aeronautics and Space (DLR).[79] The DLR prepared a comprehensive analysis of the entire range of possibilities in connection with renewables (Nitsch 2007, pers. comm.). The study on the potentials of renewable energy was characterized by a great deal of optimism on the one hand, but it was also biased toward the energy world of the time (Bohn & Oesterwind 1976). Early studies concentrated mainly on furnishing proof of the technical feasibility and on the structural terms of an energy industry that is based on renewable energies, with hydrogen being assigned an important role.[80] Large-scale technologies, such as solar heat power plants or major photovoltaic plants, were of interest here. One had become used to thinking in terms of megawatts and gigawatts (Nitsch 2007, pers. comm.) instead of thinking about small-scale solutions.

[77] Under Hans Matthöfer, Federal Minister of Research and Technology from 1974 to 1978.

[78] The total budget had been 6.53 billion german marks. Nuclear energy was allotted 4.53 billion marks, coal (especially its conversion into liquid and gaseous energy sources) received a total of 940 million german marks, rational energy use 490 million marks, and new energy sources 570 million marks. When deducting nuclear fusion, the promotion of those energy sources that are defined today as "renewable" was merely 191 million marks (BMFT 1978, 160).

[79] At the time the DLR was going through a crisis during which aeronautics activities were curbed. Since the DLR had concerned itself with the conversion of energy with respect to aerospace technology, it now began to deal with questions of terrestrial energy supply as well.

[80] Cf. Program survey "Sekundärenergiesysteme. Strom, Kohleveredelungsprodukte, Wasserstoff, nukleare Fernenergie, Fernwärme. Kurzfassung." Report by the KFA Jülich No. 1148, Programmgruppe Systemforschung und technologische Entwicklung. Commissioned by the BMFT in 1974.

Now a vision of a "hydrogen world" evolved from a special group of people at the DLR with know-how concerning the exploitability of hydrogen, and the simultaneous initiatives of Ludwig Bölkow[81] in Munich. Several studies[82] mapped detailed energy systems of the future with hydrogen playing a more or less significant role in them. However, the role of hydrogen was overestimated at the time (Nitsch 2007, pers. comm.). The advantage, though, was that renewable energies attracted a great deal of attention from the public and particularly from the print media.[83] It had become possible to show that renewable energies do in fact have the potential to supply the world with energy. Hence, the first hurdle had been taken. Prior to the studies, there had been doubts about whether the physical potential of renewable energy sources would at all be sufficient (Nitsch 2007, pers. comm.).

3.6.2.2 Paradigm Shift in Research Policy

Until the late 1970s research had been based on the assumption that renewables, too, would need to meet constantly growing energy demands. Environmentally aware experts, however, advocated a paradigm shift: "Renewable energies and efficiency go together, they need to be conceived and planned as one" (Nitsch 2007, pers. comm.). The publication of the study on transition to renewables[84] triggered a change of perspective of the energy supply industry and associated scholars. The energy transition was expected to bring about increased energy efficiency, a reduction in the share of fossil fuels and an increase in the share of renewable energies in the overall energy supply.

But there were other developments going on as well: the trend toward "small is beautiful", for instance, i.e., the idea of a decentral system of energy supply consisting of numerous small plants. It was in this context that engineers began to realize that energy supply must go beyond the design of large-scale systems. In the mid-1980s experts had come to the conclusion that energy systems and the respective technologies

[81] Ludwig Bölkow founded the Ludwig Bölkow Foundation (Ludwig-Bölkow-Stiftung) in Ottobrunn in 1983. The objective of the Foundation was to make technology more ecological. Studies were performed on solar installations in the desert and on a more efficient storage of hydrogen as an energy source.

[82] Cf. Winter & Nitsch (1989); Nitsch & Luther (1990); DLR et al. (1990); Bradke et al. (1991); Traube (1991); Nitsch & Wendt (1992); Langniß (1994); Enquête-Komission (1995).

[83] Several titles of German news magazins like Der Spiegel show that energy from sun and water were of public interest: In 1976 it published an article titled "Energie aus Sonne und Wasser für die Welt" (Energy from sun and water for the world). It also published articles on the potentials of hydrogen in 1972, 1976 and 1977. In 1987 the magazine's cover story was: "Wasserstoff und Sonne. Energie für die Zukunft" (Hydrogen and sun: energy of the future) (Spiegel 1987, No 34, Issue 41, 17 August 1987).

[84] The idea of an energy transition was for the first time elaborated in a survey presented by the Öko-Institut Freiburg in 1980. It had the title "Energiewende" (energy transition) (Krause et al. 1980).

must be developed step-by-step and "from the bottom up" (Nitsch 2007, pers. comm.), not least because past experience had shown that energy systems could not simply be imposed on society.

3.6.2.3 Second Energy Research Program (1980–1990)

In addition to supply safety, which had been the main objective in the first energy research program, this new edition also included boosting the economy as well as protecting the environment (Semke 1996, 920). Depending on the individual sector's stages of development, the government funded basic research, materials research, prototyping of plants and the analysis of environmental impacts. Unlike its subsequent program, which promoted some first pilot plants, this program was chiefly about "industrial laboratory facilities" (Sandtner et al. 1997, 258–259).

From the end of the 1980s, special programs launched by the Federal Research Ministry ("Technologies for the utilization of solar power") and the Federal Ministry of Economics ("Biological-technical systems for the generation of energy and the production of raw materials")[85] promoted research on renewable energy.

3.6.2.4 Third Energy Research and Energy Technologies Program (1990–1996)

The third program focused on the further development of existing energies into long-term solutions for the future, the development of CO_2-free energy sources (renewable energies and nuclear fusion), and the efficient use of energy and explicitly the steady reduction of CO_2 (BMFT 1993, 7). It also placed significantly more emphasis on the reduction of greenhouse gases (Semke 1996, 920). In the mid-term the program stipulated further cost reductions and increased capacities for the technologies already developed. To this end, funding was also granted to various large-scale demonstration projects (Sandtner et al. 1997, 259). The use of renewable energies for heat generation from solar energy was considered to some extent as well. A funding concept for alternative biomass use and energy crops was launched in order to examine alternative uses in view of the agricultural surplus. In 1993 the partial program "Nachwachsende Rohstoffe" (renewable biomaterials), which had been issued as early as 1990, became the responsibility of what was then the Federal Ministry of Agriculture (BML) (BMFT 1993, 18). The aim of this market launch program, which is still being pursued today, is the efficient use of renewable biomaterials as an industrial raw material or for energy generation.

German institutes and companies managed to work their way up to the top of the world thanks to the promotion of renewable energies research. Yet there remained a gap between the excellent R&D work and market entry. The Research Ministry assumed that the results would immediately find their way onto the market or that

[85] Cf. BT-Drs. 8/3144 of 31 August 1979, p. 21.

the Ministry of Economics would close the gap by offering more application-oriented R&D support and taking suitable large-scale measures for market launch. Yet the Federal Ministry of Economics did not undertake any such measures since it thought that the new technologies should not need state subsidies to succeed in the market. It saw no reason to support medium-sized businesses in asserting themselves in an oligopoly (Dürrschmidt 2007, pers. comm.).

3.6.2.5 Fourth Energy Research and Energy Technologies Framework Program (1996–2005)

Published in 1996 by what was then the Federal Ministry of Education, Science, Research and Technology, the fourth energy research and energy technologies framework program defined the context for German energy research from 1996 to 2005 (Prognos et al. 2007, 14). In 2002 application-based R&D promotion was transferred to the Federal Environment Ministry, including measures for market introduction and shaping the overall conditions for expanding renewable energies. At a total of 537 million euros, renewable energies constituted the largest funding item in this framework program (excluding biomass). The Federal Environment Ministry devised an overall concept designed to close the above-mentioned gap between research and market introduction in a way that was in line with the legal framework conditions, targets and outlooks. The key motor in terms of the fourth energy research program was Germany's and its industry's negotiated agreement to reduce CO_2 emissions. The program therefore concentrated especially on technological options that promised appreciable contributions to climate protection and sustainable resource management (Prognos et al. 2007, 14).

The successful 100,000 Solar Roofs Program conducted between 1999 and 2003 (see Section 5.3.5.5) and the market incentive program for renewable energies (mainly in the heat sector) coincided with the period of the fourth framework program (Prognos et al. 2007, 35). Thus, the direct promotion and remuneration payments on the federal level became significantly important during this period. "As a result of increasing federal promotion, other funding programs, such as from the states, municipalities or power utilities, lost their relevance" (ibid., 42).

3.6.2.6 Fifth Energy Research Program "Innovation and New Energy Technologies" (2005–2008)

The fifth energy research program was drawn up by the Federal Ministry of Economics (then the Federal Ministry of Economics and Labor). Other ministries, including the Federal Environment Ministry, contributed within the scope of their responsibilities. The program forms part of the Integrated Energy and Climate Program of the Federal Government (IEKP, see Section 3.7.3). As with its predecessor, the objective of the program is to expedite innovation processes in order to launch technologies onto the market more quickly. Based on the evaluation results of the fourth framework program, the program defines primary and secondary funding domains, with the latter receiving a smaller share of funding (BMWA 2005, 23–24).

While the Federal Ministry of Economics was responsible for the branch of efficient energy conversion research, e.g., fuel cells, hydrogen and system analysis, the Federal Environment Ministry was in charge of renewable energies research. Basic research concerning renewable energy was transferred to the Federal Research Ministry, while the Federal Ministry of Agriculture was assigned the field of bioenergy research. The research program stipulated a clear shift in funding in support of energy efficiency and renewable energies (BMWA 2005, 10).

3.6.3 Funding on State Level

State funding of renewable energies contributed significantly to energy research. These contributions had amounted to 80 million euros in 2003, which corresponded to a third of the Federal Government's total research spending. It varied a lot throughout the country, with North Rhine-Westphalia topping the list of states with up to 15.7 million euros spent on the REN Program (program on the rational use of energy and use of inexhaustible energy sources).[86] This program was adopted by the North Rhine-Westphalia state government in October 1989 and has since undergone revisions and updates on an annual basis. The program was the result of an initiative launched by a group of committed and influential members of the administration (Hennicke et al. 1997). In 2002 the terms of funding were revised in favor of renewable energy taking into account the 100,000 Solar Roofs Program and the market incentive program. In 2007 the state of North-Rhine Westphalia provided REN broad-based funding to support solar collector arrays, photovoltaic systems, hydropower plants, apartment ventilation systems using heat recovery as well as biomass and biogas plants. The states of Brandenburg[87] and Bremen launched similar REN programs for the promotion of energy efficiency and renewable energies.

3.7 StrEG and EEG as Key Policy Measures

It was still under the conservative-liberal government that the Electricity Feed-in Act of 1991 created an important stimulus for the introduction of renewable energy on the market. In 1998, when after his 16-year tenure chancellor Helmut Kohl was unseated by the first red-green government consisting of SPD and Bündnis90/Die GRÜNEN, this change of government opened up a political time slot for fundamental changes in energy policy, part of which was the adoption of the Renewable Energy Sources Act.

[86] The program promotes investment in energy saving and the use of renewable energy sources. It differentiates between demonstration promotion (focus on feasibility) and widespread promotion (focus on marketability).

[87] Guideline of the Ministry of Economics in Brandenburg for the promotion of energy efficiency and for the use of renewable energies (REN Program) of 18 July 2007.

3.7.1 The Electricity Feed-In Act (StrEG)

Until the late 1980s the necessity of statutory remuneration were denied. Within the political arena, existing voluntary association agreements[88] under private law were considered to be sufficient to compensate for renewable energy feed-in.

Nevertheless, in 1989, after the German reunification, a draft law for an electricity feed-in act (Stromeinspeisungsgesetz – StrEG) was presented. The increasingly significant wind power lobby of the north-western states and hydropower plant operators from Bavaria and Baden-Württemberg influenced the agenda setting process and advocated guaranteed minimum feed-in payments. The draft had originated from an initiative launched by a group of members from various Bundestag fractions.[89] It had been drawn up largely by members of the Bundestag itself, which was considered an uncommon way to introduce new legislation. The relevant ministries, usually responsible for drafting laws, had only been consulted concerning specific passages.

The bill drew on the reports of the Committee of Inquiry "Vorsorge und Schutz der Erdatmosphäre" (Provisions for the Protection of the Earth's Atmosphere). An important historic predecessor of this Act was the 250 MW large-scale wind power testing program launched by the Research Ministry in the late 1980s. This program simulated a feed-in tariff in the form of fixed subsidies per kilowatt hour of wind power fed in, thus encouraging trust in renewable energies, and served as the basis for the feed-in act initiative.

The bill was fervently supported by members of the Bundestag like Dr. Wolfgang Daniels from The Greens, and Michael Müller and Hermann Scheer from the SPD. The StrEG was also advocated by members of the CDU/CSU (e.g., Bernd Schmidbauer and Matthias Engelsberger[90]), especially due to its significance as a means for securing the energy supply and as an incentive to modernize hydropower plants in the small-scale capacity range.

During tumultuous times, not even 2 months before the first all-German Bundestag election in December 1990, it was almost crowded off the agenda (Berchem 2006). Finally, the Bundestag unanimously adopted the bill on 7 December 1990, and it entered into force on 1 January 1991. According to Scheer (2004, 16 in Suck 2008, 171) the adoption of the StrEG did not receive much attention. This is owed to the circumstance that the electricity industry was simultaneously absorbed with negotiations on taking over the East German electricity market. It is also presumed that the power utilities seriously underestimated the effect of the StrEG at the time of its adoption in 1990 (Tacke 2004, 206–207; Berchem 2006).

[88] Association agreements ("Verbändevereinbarungen") have been a peculiar German way of corporate self-regulation.

[89] For the history of the Electricity Feed-in Act, see Kords (1993), Berchem (2006).

[90] Bernd Schmidbauer was the CDU/CSU's environment spokesperson in the Bundestag and member of the Committee of Inquiry "Vorsorge und Schutz der Erdatmosphäre" (Provisions for the Protection of the Earth's Atmosphere). Matthias Engelsberger, a member of the CSU and also of the Bundestag, represented the interests of medium-sized businesses (wood processing, hydropower) in Bavaria.

The electricity market, which had so far been dominated by the transmission and supply monopoly of the electricity market's companies, was now opening up to private renewable electricity generators as a result of the StrEG – this was a significant improvement compared to the previous situation. The Act defined the terms of purchasing electricity from renewable energy sources and access of this electricity to the grid. Within the Federal Government, the Economics Ministry, responsible at the time for matters relating to energy, played the main part in the preparation of the StrEG. However, it hardly identified with the Act's contents and objectives. "The Federal Ministry of Economics believed that an act that stipulated subsidies did not at all fit into the political landscape" (Dürrschmidt 2007, pers. comm.). The attempts at discrediting the StrEG and to repeal an amendment expected for 1994 showed how little the Economics Ministry was really prepared to tread new paths in energy policy.

3.7.1.1 First Revision of the StrEG in 1994

The first revision of the StrEG in 1994 aimed at adjusting the compensation rates. Yet the efforts to amend the Act were met with strong objections from the Federal Economics Ministry. On the other hand, Angela Merkel, environmental minister from 1994 to 1998, and the parliamentary state secretary Walter Hirche (FDP) strongly supported the Act's further development. Many members of the Bundestag and of the Chancellery supported its continuation as well (Dürrschmidt 2007, pers. comm.). So ultimately, due to the massive pressure, the Federal Ministry of Economics had to accommodate the amendment. The Federal Environment Ministry contributed the relevant technical information.

Meanwhile the electricity industry had become aware of the StrEG's effects and began to fight the Act with great determination. Between 1995 and 1997 the Act threatened to be overturned. The core of resistance came from the power utilities united in the Association of German Electric Power Utilities (VDEW). These associations argued that the StrEG did not comply with the rules of the market economy and doubted that the Act conformed to the German Constitution. They tried to file a model lawsuit with the Federal Constitutional Court under civil law and by doing so questioned the legality of the StrEG. Upon the recommendation of the VDEW, some of the power supply companies cut the statutorily defined compensation for power from renewable energies for one of their customers.[91] This cut back was met with massive criticism from the public. Members of the Bundestag across all parties expressed their disapproval of the power utilities' activities and demanded that they respect the feed-in act as adopted by the Bundestag.[92] From the district court, the lawsuit went to the

[91] Badenwerk AG in Karlsruhe, Kraftübertragungswerke Rheinfelden and Stadtwerke Geesthacht each paid only the rates declared in association agreements to one of their customers (Tacke 2004, 207).

[92] Der Spiegel, 8 May 1995; cf. Deutscher Bundestag, minutes of plenary proceedings 13/39 of 19 May 1995.

Federal Constitutional Court, before the cartel chamber of the Federal Court of Justice finally judged that the StrEG did not violate the Constitution.

3.7.1.2 Second Revision of the StrEG in 1998

An important novelty of the StrEG amendment in 1998 was the introduction of what was called the 5% cap.[93] It was intended to restrict the strain on grid operators who fed in large shares of wind power. Apart from that, the so-called "small amendment" did not lead to a rise in compensation, but introduced some clarifications and additions. For instance, the amendment broadened the spectrum of organic material that fell under the remuneration. Besides products, organic waste and residual material from agriculture and forestry the StrEG now also covered "biomass" in general (in other words, energy crops). In addition, the amendment specified that offshore plants fell under the compensation regulations as well.

3.7.1.3 Ruling of the European Court of Justice

With its ruling of 13 March 2001, the European Court of Justice ultimately stated that feed-in and minimum payment regulations generally comply with European Community Law (Oschmann & Sösemann 2007, 2). The judgment referred to a dispute between PreussenElektra and Schleswag. It specified that the German Electricity Feed-in Act does not represent state subsidies in the sense of Article 87 (1) of the EC Treaty. It also ruled that the Act does not infringe free movement of goods within the EU.[94] Consequently, any legal concerns regarding higher compensation for electricity from renewable energy sources had been ruled out. The Electricity Feed-in Act was no longer viewed as encouraging impermissible state subsidies (Schmela 2000, 18). Despite their defeat before the European Court of Justice, the power utilities managed to create an atmosphere of uncertainty especially within the still unstable wind power sector. Having involved the European Court of Justice in the German feed-in compensation dispute shifted the political process to the European level (Hirschl 2008, 135–136). At the time the European Commission too was dealing with the modalities of a feed-in compensation when drafting a directive on the promotion of renewable energy (see Section 3.3.2.4).

[93] This rule specifies that the upstream grid operator has to refund the additional costs incurred by exceeding the 5% share as soon as the share of renewable energies exceeds 5% of the kilowatt hours sold by the power utility.

[94] Cf. comments in Natur und Recht 2002, p. 148.

3.7.2 The Renewable Energy Sources Act (EEG)

3.7.2.1 The Renewable Energy Sources Act of 2000

The governing coalition believed that the amount of compensation defined in the StrEG no longer sufficed neither to achieve the German and European target of doubling the share of renewable energies in the electricity mix nor to introduce renewable energies on the market on a broad scale.[95] In addition, some regions were expecting to reach the "second 5% cap".[96] The new red-green coalition therefore planned to enact a new regulation on the feeding in of "green" electricity for 1 January 2000.

Preparations for the new law – the Renewable Energy Sources Act (EEG) – began in 1998. The Federal Ministry for the Environment was the key driving force behind it, with the Renewable Energies Department contributing the relevant technical information. In the context of research done by the department, studies on the potentials of renewable energies were commissioned in order to qualify further discussion about revising the StrEG.[97]

Still, the Federal Ministry of Economics did not manage to get any relevant legislative proposal off the ground at the end of the 1990s. Finally it was once more the Bundestag that took the initiative and drafted a bill for the EEG (Kaiser 2007, pers. comm.). In this case, members of The Greens acted as the drivers. They were supported by members of the SPD faction that wanted to prevent the newly establishing sectors from being weakened. The bill was finally adopted by the Bundestag on 25 February 2000, and it entered into force on 1 April 2000.

Important changes in the EEG compared to the StrEG (as at 1998):

- Coupling the remuneration to the average price was abandoned. Specified compensation rates per kilowatt hour were fixed, which aimed to create security for investment – independently of the development of the electricity price.
- Remuneration was guaranteed not only for the period of the Act's validity, but for 20 years.
- The amount of compensation differed according to sectors and plant size.

After extensive debates the Ministry of Economics and the Environment Ministry[98] agreed on a joint bill for the "law that gives priority to renewable energies", later

[95] The remuneration specified in the StrEG was coupled to the average power price, which dropped in the course of the continuing liberalization of the energy market.

[96] Cf. Green faction in the Bundestag (1999, 23).

[97] For example, see the pilot study by Nitsch (2000). The results of these examinations were presented at the Bundestag's expert sittings and were drawn on for the decision-making process.

[98] There was dissent on the compensation rates, on rotor surface model versus reference yield model, distribution of the grid connection costs and grid reinforcement costs.

referred to as the "Renewable Energy Sources Act".[99] The long-term compensation guarantee increased the banks' willingness to invest. This started off a dynamic development which mobilized investment capital and – in the case of wind power – made it possible to begin serial production.

What was new was that the power supply companies, which so far had been excluded from the feed-in regulations, were now, from 2000 onward, to benefit from these compensations as well. This circumstance gave rise to worries about small plant operators being threatened. If the large power utilities were to branch out into renewable energies, small-plant operators would not be able to compete. Yet the power utilities did not go into renewables – possibly because they expected profits that were even higher those that could be made with the guaranteed feed-in rates.

Section 16 of the EEG of 2000 allowed electricity-intensive businesses to benefit from a compensation regulation which exempted them from paying higher prices for electricity generated from renewable energy (Oschmann & Sösemann 2007, 2). This regulation can be viewed as a concession to the (power-intensive) economy.

3.7.2.2 Revision of the Renewable Energy Sources Act in 2004

Revision of the EEG 2004 was assigned to the Federal Ministry for the Environment. The Ministry began with the elaboration of a draft immediately after the Bundestag elections (Suck 2008, 422). The opposition's response was surprisingly positive. Due to the draft's focus on promoting crop energies, the agriculture portfolio cooperated as well. Yet the industrial sector had been exerting increasing pressure on the EGG. The industrial associations BDI (Federation of German Industries) and DIHT (German Association of Chambers of Commerce and Industry), the traditional energy industry (VDEW) and the economics portfolio fiercely attacked the draft. The energy-intensive industrial enterprises[100] feared higher energy prices would threaten their competitiveness and demanded an exemption clause (Suck 2008, 423).[101] All in all, the traditional energy sector was interested in restraining the promotion of electricity generation from renewable energy sources. In various contexts, members of the Federal Economics Ministry argued against the far-reaching objectives aimed to expand renewable energies as advocated by the Federal Environment Ministry. The Federal Economics Ministry tried to water down the Federal Environment Ministry's draft for an EEG revision by proposing lower targets and modified regulations (Hinrichs-Rahlwes 2007, pers. comm.). In a "major effort of the portfolios and the innovative sections of the economy"

[99] Draft of a law on the promotion of power generation from renewable energy sources (EEG) and on changing the oil taxation law of November 29, 1999. The EEG entered into force on April 01, 2000.

[100] Especially metal processing businesses and the aluminum industry.

[101] In view of the threat of job losses, the Federal Ministry for the Environment ultimately felt pressured to permit such a hardship provision for the energy-intensive industry.

(Dürrschmidt 2007, pers. comm.) and thanks to cross-party political support in the Bundestag, the EEG was adopted despite fierce attacks and various modifications to the government's draft. The Act that was finally adopted reflected the ideas of the Federal Environment Ministry much more than those of the Federal Economics Ministry.

As a result of the sector-specific and case-specific regulations, the EEG's scope and complexity had once again increased considerably compared to the 2000 version. In the proponents' view the success of the Act can be ascribed precisely to this differentiated and selective promotion. Critics, on the other hand, fear a danger of excessive governance and inadequate interference of public policy right down to executive levels.

On 1 August 2004 the law amending the Renewable Energy Sources Act (EEG 2004) entered into force. With this amendment, ca. 330 (particularly) electricity-intensive enterprises and railroad companies were relieved to an even greater extent from additional costs arising from green electricity.[102] According to Hirschl (2008, 563), the hardship provision is regarded as reciprocal deals with the economic sector that serves to eliminate blockades and to support concerns that would otherwise have little prospects for implementation (ibid.). In this case the introduction of an EEG hardship provision was coupled to the promise of creating a regulating authority in the energy market (cf. EnWG amendment 2005; Section 3.9.3.3).

3.7.2.3 Revision of the Renewable Energy Sources Act in 2009

Revision of the EEG 2009 was also assigned to the Federal Ministry for the Environment. Preparation of the EEG revision was closely linked to the adoption of the IEKP (see Section 3.7.3.2). The sector-specific monitoring studies on the EEG 2004[103] had been completed as early as summer 2007. They provided an extensive field report about the effects achieved with the EEG 2004,[104] which formed the basis of the amendment draft for the EEG 2008/09 presented in October 2007. After portfolio agreement in October and November 2007, the Federal Cabinet adopted the bill in conjunction with further accompanying laws and ordinances on energy efficiency (IEKP) on 5 December 2007. The government's draft of the EEG had been discussed in the commissions of the Federal Council as early as January 2008. The first reading in the Bundestag took place on 21 February 2008, and on 5 May 2008 a hearing

[102] The so-called "Härtefallregelung" (hardship provision). Doubts were raised about whether this increasing advantage of the electricity-intensive companies was still in accordance with the Constitution (Oschmann & Sösemann 2007, 3).

[103] Cf. BMU (2006) and the studies of ARGE Monitoring PV-Anlagen (2006) on photovoltaics and of IE Leipzig (2007) on biomass.

[104] The EEG field report (BMU 2007c) had been presented to the German Bundestag by the Federal Environment Ministry in consultation with the Federal Ministry of Agriculture and the Federal Ministry of Economics, and was resolved by the Federal Cabinet on 7 November 2007. In it the portfolios had already agreed on recommendations for shaping the system of promotion based on minimum remuneration and bonuses for the individual sectors.

proceeded in the Bundestag's environmental commission. After the commission had finally agreed on a motion for an amendment of the EEG, the coalition parties found solutions to the controversial issues[105] on 30 May 2008, enabling the newly composed EEG to be adopted in the Bundestag as early as 6 June 2008.

There was continued consensus on further forcing the expansion of electricity generated from renewable energies. In order to accelerate the dynamic, the remuneration rates in the EEG 2009 were adjusted upwards in almost all of the sectors, most of all for offshore wind and geothermal energy, since no appreciable expansion had set in this field. The compensation rates for solar power generation, by contrast, were heavily cut, since so far the annual cost reductions of 10% had exceeded expectations (reductions of 5% had been assumed). The new degression rates in the range of 8–10% do justice to this development.

3.7.2.4 Further Development of the EEG Equalization Scheme

The ordinance on the EEG Equalization Scheme (AusglMechV), which was enforced in 2010, aims primarily to reduce costs for grid operators, distributors and consumers and also to raise the transparency of the Equalization Scheme. Unlike so far, the transmission system operators shall now sell EEG electricity directly at the electricity stock exchange. The difference between the sales revenue and the remuneration paid to the RE plant operators as per the EEG, is allocated to the power distributors. Due to this regulation electricity generated from RE no longer needs to be physically passed on from the transmission operators to the distributors, which was frequently associated with risks and additional expenses due to inaccurate forecasts. However, critics expressed doubts about whether this new regulation would ultimately have a positive effect on the development of renewable energies (Jarras & Voigt 2009).

3.7.3 Integrated Energy and Climate Program of the Federal Government

The promotion of renewable energies has been codified in a package of acts and ordinances since 2007. This revealed that attaining the climate protection targets was an integrated task. It was no longer only the electricity industry, but also the mobility sector, the heat market and energy efficiency that gained in significance as fields of activity.

3.7.3.1 Meseberg Resolutions in Preparation for the IEKP

During its closed meeting in Meseberg in August 2007, the federal cabinet adopted the "Integrated energy and climate program (IEKP)" presented by the Federal

[105] Matters of dispute included the compensation rates for solar power, for instance, which the CDU and the CSU would have preferred to be much lower.

Ministry of Economics and the Federal Environment Ministry. This cabinet decision sparked off the compilation and coordination of a package of measures in which the EEG now formed part of a number of related acts. The IEKP reflected the awareness that several energy sectors relevant for climate protection required stimuli in order to reach the ambitious CO_2 reduction targets. The objective of the program is to reduce CO_2 emissions by 40% by 2020 compared to 1990. This reduction target, which is extremely ambitious by international standards, clearly assigned Germany the role of a pacesetter within the EU.

In view of the forthcoming world climate summit in Bali (2007), the cabinet hastily adopted the IEKP as a legislative package and presented it in the Bundestag. Never before had climate protection been the focus of the political agenda to this extent.

The Meseberg resolutions included the following key items:

- Expansion of the share of renewable energy: in the case of electricity from renewable energy, the cabinet agreed on an expansion target of 25–30% by 2020. Expansion of renewable energy in the electricity sector is expected to reduce CO_2 emissions by 55 million tons each year.
- Expansion of electricity and heat generation in cogeneration power plants: an amendment to the heat-power cogeneration act was expected to double the share of heat-power cogeneration in electricity generation by 2020, i.e. raising its share to 25%. An average funding volume of 750 million euros per year was allocated to this task. An investment grant of up to 20% and a volume of 150 million euros is provided for the expansion of local and district heat.
- Increased demands on the energy efficiency of buildings: in a first step the Resolutions specified that energy efficiencies of buildings should be raised by 30% in 2008, and by another 30% by 2012. Minimum energy standards were to be defined for old houses, specifying more concrete maintenance obligations for owners.
- Increased means for climate protection: for the budget year of 2008 a total of 2.6 billion euros (including up to 400 million euros from selling emission permits) was provided for climate protection. This corresponded to an increase of ca. 200% compared to 2005.[106]

3.7.3.2 Integrated Energy and Climate Program (IEKP)

The first package of measures for the "Integrated energy and climate program (IEKP)" was adopted on 5 December 2007, and included the approval of initially 14 legislative projects and legislative amendment projects, among them also the revision of the EEG (see Section 3.7.2.3). A second package focusing on improved energy efficiency was launched in June 2008. With all of the measures implemented, it is estimated that CO_2 emissions will be reduced down to around 34% by 2020 (BMU 2008a, 18). Critics from the opposition parties and environmental

[106] http://www.bmu.de/pressemitteilungen/... (accessed September 3, 2009).

groups claim that the IEKP measures designed to reach the 40% target do not suffice and point to a number of relevant expert reports (e.g. Kleßmann 2008; EUTech 2007) to substantiate their opinion. In their view the IEKP measures are half-hearted and do not fully exhaust the climate protection potentials in various areas. Critics therefore call for additional measures, e.g. increasing incentives for heat insulation in old buildings, enhancing energy effectiveness and reducing power consumption, especially by replacing night storage heaters. They also propose improved monitoring of the Energy Saving Ordinance (EnEV), an upgrade of the heat-power cogeneration act, the expansion of the Renewable Energy Sources Act to cover housing stock as well, and ambitious measures in the traffic sector.

3.8 Environmental and Planning Law for Renewable Energy Projects

Facilities generating energy from renewable sources have to undergo a licensing procedure, just like any other physical building. In the early 1990s the existing legal framework was not sufficient to meet the challenge of adequately dealing with the new types of facilities and their effects on the environment. In particular, wind turbines were still unfamiliar in terms of appearance and dimension.

The remuneration after StrEG and EEG caused a large expansion in the number of installed renewable facilities, especially of wind turbines. To meet the challenges of a strong and uncontrolled growth, the legal regulation had to be adapted.

The objective was to minimize possible conflicts between wind power generation and other uses sensitive toward the effects of wind turbines by carefully choosing suitable sites. It was also hoped that planning law and other relevant regulations would bring about special provisions designed to create specific facilitation and incentives for RE and thus effectively support the set of eco-economic instruments (Klinski 2005, 7).

The sector-specific approval requirements and their role in a technology's expansion as part of the innovation process are outlined in the relevant chapters. At this point we will only discuss the amendments to the most important and cross-sectoral legal framework which supported the implementation of renewable energy.

3.8.1 Amendment of Regional Planning Law

Regional planning law serves the development, structuring and safeguarding of supra-local plans. Up to the 1990s, it was only large power generation units that were subject to regional or state planning. From the mid-1990s, the regional planning authorities became concerned with coordinating the expansion of wind power use. Finally, the 1998 amendment of the building law also contained an amendment on regional planning legislation.

A new zoning category, the "appropriate area" (Eignungsgebiet)[107] was introduced for wind power. This created the basis for controlling wind power use by determining areas eligible for the sitting of wind farms. After corresponding amendments to the state regional planning acts[108] at the end of the 1990s, areas suitable for wind power use started to be formally designated. At the regional planning level it seemed possible to control plant locations and minimize undesirable effects by concentrating turbines in the appropriate areas. Restricting wind farm areas on the regional planning level compensated to some extent for the licensing privileges (Privilegierung)[109] at the municipal level (see Section 3.8.2).[110]

However, the preparation of regional plans including zones for large-scale wind use turned out to be excessively time-consuming due to rising protests against wind farms. The first regional plans, which supported the installation of wind farms by disentangling incompatible usages, were finished in 2003.

Regional planning was up to that time only to be performed on land and within the 12-seamile-zone offshore. In 2004 it was extended to the Exclusive Economic Zone (EEZ). Being recognized as a promising concept, it was established in order to coordinate competition between offshore wind power use and other marine utilization claims,[111] and in order to define priorities. The first EEZ land-use plan was adopted in 2009.

3.8.2 Zoning Law/Planning Permission Law

3.8.2.1 Amendment of the BauGB 1996/1997

In 1997 the German Federal Building Code (BauGB) was amended. The amendment had been preceded by a long and controversial discussion on the extent to which licensing privileges for projects in non-urbanized areas should also be

[107] The zoning category of "appropriate areas" was introduced by the BauROG 1998 (cf. Index of Legal Sources). The appropriate wind use areas were identified by overlaying criteria indicating high wind yield with minimal clearance criteria. The latter were meant to avoid conflicts with other land uses (like settlement, recreation) and protection needs (e.g. bird protection, cultural heritage, visual landscape).

[108] This opportunity was grasped in particular by the northern German federal states.

[109] Projects with a licensing privilege in non-urbanized areas have to be given approval, unless they are not compatible with public interests (see Section 35 of the Federal Building Act).

[110] In Brandenburg and Mecklenburg-Western Pomerania, the regional plans became more important as a means of regulation than in the old federal states due to the lack of local land use plans in the new federal states.

[111] E.g., shipping, construction of storage sites (sand and gravel quarrying), fishing, aquacultures, military use, communications (subsea cabling), tourism.

applied to wind turbines. Efforts to grant privileges to wind turbines had already failed twice before. Opponents feared that the granting of privileges would almost create a "license to disfigure the countryside". On the other hand, the wind power sector declared the introduction of a privileged status for wind turbines, implying simplified permission procedures, as indispensable for the sector's survival. In spite of considerable opposition among its own ranks[112] the Federal Environment Ministry ultimately made a strong case for simplified permit requirements, especially for wind turbines, which spurred the amendment process.[113]

The amendment of the relevant section (Section 35 BauGB) was finally enacted in 1996, which was half a year earlier than the amendment of the BauGB. The revision entered into force as early as 1 January 1997. Among the renewable energies, hydropower and wind power benefited from the stipulated privilege.

The privileged status of wind turbines was simultaneously flanked by what was defined as "planning reservations", which gave municipalities a right to reserve areas eligible for wind turbines in their local development plans. Thus the construction of wind turbines was permitted in specifically designated areas[114] only. This regulation was expected to bring about spatial concentration of the turbines. The aim was to integrate wind turbines into the existing land-use paradigm in an environmentally and socially sustainable manner. The privilege regulation significantly contributed to clearing the permit backlog that had built up by this time.

Ground-mounted photovoltaic systems are not affected by this privilege regulation. Similarly, biogas plants did not yet benefit from the permission privilege in 1996/1997.

3.8.2.2 EAG-Bau 2004

The adoption of the European Law Adaptation Act for the Construction Sector (EAG-Bau) in 2004 sparked the discussion about extending privileges for plants generating renewable energy in non-urbanized areas anew. An omnibus bill adapting the Federal Building Code to European law extended existing privileges to biogas plants with a capacity of up to 500 kW. From that time on, biogas plants were no longer only permitted as secondary systems for farming businesses.

In addition, planning principles were introduced into the BauGB which were intended to further promote the use of renewable energy within the scope of local responsibility. Ground-mounted photovoltaic systems had once again not been considered in these revisions.

[112] Supported by the Federal Agency for Nature Conservation, the Federal Environment Ministry's department for nature conservation initially rejected the privileged status for landscape protection reasons.

[113] The Federal Environment Ministry prepared a draft formulation for the privileged status for the Bundestag's Environment Committee (Dürrschmidt 2007, pers. comm.).

[114] At the level of regional planning: "Eignungsgebiete" (appropriate areas); at the level of local development planning: "Konzentrationszonen" (concentration zones).

3.8.3 *Legal Basis for Grid Connection and Grid Expansion*

The Act for the Acceleration of Infrastructural Planning and the Energy Line Extension Act were accompanying legal foundations that were intended to improve the grid integration for offshore plants, eliminate grid bottlenecks and guarantee the improved integration of a growing share of renewable energy.

3.8.3.1 Act for the Acceleration of Infrastructural Planning 2006

The Acts for the Acceleration of Infrastructural Planning (EnWG, EnLAG and ARegV) committed grid operators to bear the costs of offshore facilities grid connection.[115] This regulation implied considerable financial relief for future offshore wind park operators and was intended to reduce the obstacles for offshore implementation.

3.8.3.2 Energy Line Extension Act 2008

The power grid represents a technical and financial bottleneck especially for electricity to be generated offshore. In 2008 the federal cabinet initiated the draft bill of the Federal Economics Ministry for the acceleration of the expansion of extra-high voltage transmission networks. Article 1 of this Act contains the Energy Line Extension Act, as well as amendments to the Energy Industry Act (EnWG), the Rules of the Administrative Courts (VwGO) and the Incentive Regulation Ordinance (AregV). On 7 May 2009 the Bundestag enacted the Energy Line Extension Act (EnLAG). The Act is designed to accelerate permission procedures among other things, by ascertaining the economic necessity of implementing currently 24 urgent power-line construction projects. The planning and approval authorities are now legally required to see to the planning and permission of projects on the regional planning level (determination of power lines) and subsequent planning approvals (approval of singular line sections).[116]

Priority is placed on six line sections for 380 kV lines determined within the context of the dena Grid Study (dena 2005), the extension of which is expected to eliminate bottlenecks and provide for supply reliability and power grid stability. Moreover, projects of European interest are regarded as having priority since they are of paramount importance for the functioning of the European common market or have considerable impact on cross-border transmission capacities and on long-distance capacities.

[115] Article 7 of the Act for the Acceleration of Infrastructural Planning amended the German Energy Industry Act (EnWG) by inserting § 17a, which commits transmission system operators, in whose supply area offshore wind turbines are operated, to establish and maintain a connection to the grid at their own expense.

[116] Article 2 of the Energy Line Extension Act effects changes to the German Energy Industry Act. A planning approval procedure with a concentrating effect is introduced for grid connection of offshore turbines. It replaces the previously necessary time-consuming individual approvals.

Environmental organizations and affected citizens frequently demand underground cabling of extra-high voltage lines so as to reduce burdens on the environment. On the other hand, the energy industry argues that underground construction work has a considerable impact on the environment, too, and that cabling causes significant cost and line losses. The Act defined four pilot routes for cabling amounting to a total length of 500 km. The intention was to gather and evaluate experience with this line technology along these sections.

3.9 Overall Parameters of the Electricity Sector

The energy sector in Germany is firmly embedded in the European electricity industry, especially since the liberalization of its electricity market (Section 3.9.1). It is characterized by a close-knit, centralized structure of power generation and distribution. The market situation is dominated by an oligopolistic structure of a few energy providers. To this date the traditional path of conventional electricity generation has been maintained[117] despite a number of crises and debates (see Section 3.1). It features centralized structures of generation and transmission as well as the predominant use of fossil fuels and nuclear energy as a cornerstone of energy supply (see Section 3.9.2).

3.9.1 Integration of the Electricity Industry in Europe – Actors and Influencing Factors

3.9.1.1 Effects of Liberalization

The liberalization of the German electricity market is the result of the EU Committee's efforts to create a common European energy market. The opening up of the German energy market in the last decade followed a number of European directives (see Section 3.3.1) that leave the actual implementation up to the member states. Implementation of this liberalization, however, proved to be very difficult at the national level, since the European specifications were met with massive resistance from the dominant actors of the German power supply system.

As a result of domestic market liberalization, there is now a range of numerous power suppliers on the German market as well as on the electricity markets of other member states. Unlike private electricity clients, about half of the industrial enterprises and small businesses make use of this choice (Winje 2008b, 19, also Krisp 2007, 169). The rate of changing the supplier differs a lot between member states, with Germany ranging among the top quarter of all of its European neighbors

[117] Hirschl (2008) ascribes the German electricity sector a great deal of inertia in view of attempts at liberalizing and restructuring the supply structures.

(Winje 2008b, 20). Along with creating a free choice of power suppliers, the liberalization of the European electricity market also affected grid access and the conditions of grid expansion. However, so far this has not had the desired effects of greater competition in the electricity market and lower electricity prices (see Section 3.9.3).

3.9.1.2 Businesses in the Conventional Energy Sector

The German electricity market is oligopolistic in nature: ca. 80% of its generating capacities are owned by the "big four" (see Section 3.9.2). It was only recently that an association of municipal energy suppliers emerged as a potential fifth pillar.[118]

The European market is more diversified, yet large-scale enterprises are found here as well. Eight major suppliers transact 53% of Europe's electricity trade, while the remaining 47% is covered by small power generators (Winje 2008b, 17; 2008a, 13). Within the EU's electricity generating market, which records an annual trading volume of around 3,000 TWh, Germany's power utilities rank among the ten largest electricity generating enterprises.[119] These figures indicate that it is still the large power utilities that dominate the market.

3.9.1.3 Electricity Stock Exchanges in the European Electricity Market

Electricity stock exchanges are taking on an important role in commercial transactions in the electricity market. The Leipzig European Energy Exchange (EEX) has considerable impact on pricing in the European market. With its 218 market participants from 19 countries, the EEX is the largest electricity exchange in continental Europe. On the spot market alone, where business is transacted immediately (as opposed to the derivatives market), the amount of electricity traded (154 TWh) corresponds to 25% of Germany's net electricity generation. This suffices to provide clear price signals even outside of the EEX (Winje 2008b, 6–7; EEX 2009). The EEX is also trying to become established on the gas market and on the emissions trading market (Winje 2008b, 13).

3.9.1.4 Structures of the Integrated Grid System

Over the years, formerly local or national electricity grids have evolved to form a European integrated grid featuring an overall synchronous AC voltage of 50 Hz.

[118] In August 2009 E.on and a municipal buying pool agreed to purchase Thüga. Thüga is the core of Germany's largest network of local and regional energy suppliers (http://www.thuega.de/... accessed September 2, 2009). When carried out, the transaction will found Germany's fifth-largest independent energy and water supplier. The association of municipal businesses (VKU) hopes that the sale will create greater competition within the electricity market (Süddeutsche Zeitung of 12 August 2009).

[119] The largest power generating company is Electricité de France (EdF), with sales figures amounting to 633 TWh per year. E.ON is second, selling 435 TWh per year, and REW comes third. EnBW ranks tenth, selling 140 TWh per year.

Europe's largest integrated network is the Union for the Co-ordination of Transmission of Electricity (UCTE), which unites the networks of a total of 23 European countries. The members of the UCTE network have agreed on common standards and rules, which are set out in the "Operation Handbook" and also contractually codified in a multilateral agreement between the participating grid operators. The association allows for greater supply safety, as blackouts are mitigated and compensated for collectively by all of Europe's power stations. The significance of network associations and their compensating function increases as the share of volatile renewable energy generation rises. In 1999 ETSO (European Transmission System Operators) was founded as a merger of the four existing grid operator organizations (UCTE, NORDEL, ATSOI and UKTSOA) in Europe. It was intended to help meet the new challenges that had arisen in the context of cross-border cooperation after the market had opened up. Irrespective of this, the UCTE, founded in 1951, remains the main contact for all general technical matters of coordination.

3.9.1.5 Expansion of the European Network Association

An important cornerstone of the electricity industry's integration in Europe is the expansion of European electricity markets in terms of grids – an aspect necessitated by the increase in electricity trade and the need for a more sweeping counterbalancing of regionally fluctuating renewable energy feed-in rates. Yet, an integrated grid is still in its beginnings, with the capacity of existing inter-state coupling points being far too low. In the case of Germany, as little as just under 3% of the domestic power demand can be transmitted through these couplings, as up until now these points have served predominantly to stabilize grid operation.

The expansion of these coupling points' capacity would enable the operation of a European network, but this would initially also be linked to high investment costs. The advantages of such as system would include compensation for regional peak demands and avoiding blackouts in the event of power plant failures, implying greater supply safety and reduced generating costs (Winje 2008a, 30.)

3.9.2 Structure of the German Electricity Supply Sector

Germany's electricity industry is a historically grown system with federal structures existing alongside private and public utilities (Saretzki 2001, 198). It has developed into a three-tier electricity supply system consisting of supra-regional associations, regional utilities and municipal power suppliers (Schiffer 1999, 159 sqq.).

The electric utilities concluded demarcation agreements among each other, which defined their respective supply areas (Mez 1997, 433 sqq.). Within these they signed concession agreements with the municipalities. The tremendous power of these regional monopolies also impacted the price of electricity and gas.

The strongly centralized structure of energy supply was claimed to be indispensable for safety, efficiency and supply reliability: in the context of nuclear power it was argued that reactor safety could only be guaranteed for centralized, large power stations. With regard to coal-fired power plants it was argued that modern, economical pollution control was only possible with large-scale power stations. High capital expenditures and the infrastructural nature of the technology were also used as justifications for monopolization. The main arguments in favor of centralized energy technologies, however, were the inescapable increase in the energy demand and the lack of an economical decentralized alternative. The arguments of growing energy demand and lower costs as a result of the power plant's size were regarded as undisputed trends that were hardly challenged (von Weizsäcker 2001, 77; Nitsch 2007, pers. comm.).

The structures that had emerged proved to be rigid to the extent that the German energy market remained almost entirely shielded from the competition before the EU Committee launched its initiative in the 1980s. German politics reinforced the rigidity of those structures and so did the fact that all the parties involved silently accepted the reasons for monopolization.

Liberalization of the energy markets as demanded by the EU (see Section 3.3.1) effected the revision of the German Energy Industry Act in 1998 (EnWG) (see Section 3.9.3). The purpose of this revision was to open up the electricity market to the competition and in doing so to meet the declared objective of lowering the electricity and gas prices that were perceived as inflated. The energy industry had become expensive and inefficient as a result of its protection, and greater competition was viewed as a means of correcting this development (von Weizsäcker 2001, 78).

In the wake of liberalization, from 1998 onward, the energy market went through consolidation processes (see Section 3.9.3) that led to the emergence of four large power utilities – RWE, E.ON, EnBW and Vattenfall – which created an oligopolistic market situation.

3.9.3 Liberalization of the Energy Market – The German Energy Industry Act

3.9.3.1 The Amended German Energy Industry Act of 1998

The German Energy Industry Act (EnWG) is regarded as the energy industry's "Constitution" (Hirschl 2008, 197). With no changes since 1935, its revision was long overdue. So far a strong coalition of actors from the conventional energy industry[120] had persistently protected their interests in a monopolized energy market. The Federal Economics Ministry, which was in charge of the revision, thwarted attempts at modernizing and liberalizing the German energy law.

[120] Even at the time of adopting the EU directive in 1995, it aimed to save German utilities from being subjected to a regulating authority.

It was only the EU common market directive, which exerted the necessary pressure for member states to take action. Under the protest of the energy industry and related associations, a broad pro-regulation coalition was formed (Hirschl 2008, 571).[121] After lengthy struggles, the Federal Economics Ministry finally came up with a bill for the liberalization of line-bound energy supply (EnWG amendment) as specified by the 96/92/EC single market directive for the electricity market (see Section 3.3.1). The Act was adopted in 1998 and entered into force in the same year.

The new EnWG committed transmission and distribution network operators to grant access to their grids (Monstadt 2004, 164) (see Section 3.9.3.3). This also implied clearly improved prospects for grid access for renewable energy providers. According to the new regulations, denying access to the grid was only possible if the grid lacked the required transmission capacities. Supervision of compliance with the competition regulations was assigned to the Federal Cartel Authority.

Furthermore, the EnWG entitled electricity and gas customers to freely choose their power suppliers. This resulted in the formation of a market of electricity and gas suppliers as well as a market for "green electricity", which is based on customers voluntarily paying surcharges for environmentally friendly electricity. Yet despite the market of suppliers having developed considerably as a result of this, the demand lagged far behind expectations.

The first EnWG amendment was followed only by a brief phase of competition and price drops. Electricity costs declined temporarily, especially for clients with special contracts (industry and trade). Households in fact experienced a rise in electricity prices. For renewable energy, the initially lower prices brought about a decrease in the minimum remuneration, which, as per the StrEG, was coupled to the electricity price.

Fears of economic risks in a liberalized market increased the tendency toward concentration of the utility industry, which ultimately paralyzed the burgeoning competition. Four large energy companies emerged in the electricity market, which controlled 80% of the generating capacities, all of the transmission networks, and the majority of the distribution networks (see Section 3.9.2).

3.9.3.2 Amendment of the German Energy Industry Act in 2005

Since the competition had not developed as intended, the Energy Industry Act was amended a second time in 2005. This, too, was only accomplished after lengthy negotiations and a great deal of pressure from the European Committee,[122] and as a consequence of the Acceleration Directive 2003/54/EC.

In spite of being unpopular with the economics portfolio in charge, the amendment process was expedited by a number of factors at the national level[123]; the Federal Environment Ministry, for instance, had gained a great deal of negotiating power due to its growing expertise and the increasingly important role it played in the process of shaping Germany's energy policy. However, the EnWG amendment of 2005 was again strongly influenced by the established power supply sector, i.e. its associations, while representatives of the renewable energy sector had difficulties in asserting their interests.

The EnWG 2005 stipulated that grid access, which hitherto had been negotiated (via association agreements), should be replaced with the principle of regulated grid access. The EnWG 2005 therefore specified the establishment of the Federal Network Agency as a regulating authority (see Section 3.9.3.3), despite resistance from the Federal Economics Ministry under Wolfgang Clement.

However, even after this latest amendment of the EnWG, the renewable energy sector did not benefit from its liberalization regulations to any appreciable extent, since the utility's market dominance had remained unchanged. The representatives of renewable energy had managed to protect the EEG from being eroded by the EnWG, but they had not managed to encourage decentralized structures, such as energy management systems, storage or integrated generation, through the EnWG, which would, however, have been necessary in order to promote decentralized energy generation (Hirschl 2008, 433, 571). The development on the electricity market still suggests that there have been no great changes to the competitive situation or the price development even after the adoption of the second EnWG amendment.

3.9.3.3 Grid Access Requirements

The EnWG of 1998 stipulated that a statutory order would regulate the design of grid conditions and payments. Germany thereby became the only EU member state to have chosen to implement the EU common market directive using "negotiated grid access" (see Section 3.3.1), thereby initially doing without the adoption of a regulatory authority with the power to determine tariffs and conditions for grid access. It was hence left to the businesses which were feeding power into the grid – some of which were new arrivals on the market – to negotiate access rights and fees with grid operators. The negotiation of tariffs and conditions for grid use took place in the context of association agreements for the electricity and gas sectors.

Protection of the status quo for regional, closed supply monopolies was abandoned. Now, independent grid operator associations needed to be established whose task it was to guarantee reliable grid operation, allow for interregional cooperation of the grids and permit grid access for third parties. Operators of the transmission and distribution networks were committed to granting access to their grids.

This improved the market access opportunities for providers of electricity generated from renewable energy – the overall prospects of grid access were now good (Ziesing et al. 2001, 147). Existing transmission networks, however, remained in the possession of the power utilities. In practical terms, therefore, access to the power grid or transmission of electricity was not always entirely uncomplicated. Electricity providers were rarely discriminated explicitly when it came to grid access,[124] yet access was

[121] This coalition was made up of proponents of renewable energy, consumer associations, and even the conservative opposition or states under conservative governments and industrial energy consumers. The EnBW played a special role in that it stepped out of the otherwise closed ranks of the conventional power supply industry and spoke up in favor of regulation.

[122] Threatening infringement proceedings.

[123] See Hirschl (2008, 242).

[124] If a grid operator violates the order demanding discrimination-free access to the grid and fair remuneration, the state's competition authority (antitrust authority) can act retroactively.

and is in part impeded by extremely restrictive transmission regulations and fees which rank among the highest in Europe (Monstadt 2004, 170).

The 2005 amendment of the EnWG (see Section 3.9.3) finally stipulated the necessity of establishing a regulating authority, which led to the founding of the German Federal Network Agency. This agency is designed to ensure fair access and use of the energy supply grid for all users.[125] It is under supervision of the Federal Economics Ministry.[126] Whether the agency can fulfill its tasks independently while under the influence of the energy industry and that of the Federal Economics Ministry remains questionable, though. According to Leprich (2004, 198) in (Hirschl 2008, 271), the Federal Network Agency is threatening to become a "subcontractor to the Ministry of Economics".

The Federal Network Agency is entrusted with the unbundling and regulation of the electricity and gas supply networks, so as to separate the grid's monopolistic section from its competitive sections within the energy industry (Leprich et al. 2007). By the time of going to press, however, unbundling of the power utilities was still incomplete. All of the participants in upstream and downstream markets continue to be dependent on the grids. Operators of transport and distribution networks are still benefiting from their monopolistic position by demanding excessive prices and discriminating against network users outside of the utility by delaying grid connection. Complete ownership unbundling is heavily disputed in the energy industry, since this would imply a complete separation of the generation and transport network.

Currently, however, changes in the field of grid ownership are beginning to come up. E.ON and Vattenfall surprisingly announced they would sell their electricity networks, EnBW and RWE, however, are still insisting on keeping theirs. The decision to sell the networks was the result of massive pressure from the EU Competition Authority.[127] It is still open whether or when the electricity network should pass into the ownership of the state or an investor who is subject to state control.

3.9.4 Current Courses Set in the Energy Sector

The current objectives and strategies of the Federal Environment Ministry are based on the results of in-house pilot studies (Nitsch 2007, 2008): the stipulation of both the pilot scenarios developed in the context of these studies is to achieve the Federal

[125] Its tasks also include granting approval for grid remuneration for transmission of electricity and gas, preventing or eliminating obstacles blocking access to the energy supply grid for suppliers and consumers, standardizing supplier change processes, and improving grid connection conditions for new power stations. Cf. http://www.bundesnetzagentur.de/... (accessed September 9, 2009).

[126] Only in individual cases can the Consumer Protection Ministry and the Federal Environment Ministry be consulted (on general prices for private clients and on renewable energies, respectively).

[127] The accusation of having violated competition law and the threat of a possible penalty by the European Commission.

Government's medium- and long-term CO_2 reduction targets[128] while at the same time continuing nuclear phaseout. According to Nitsch (2007, 3 and 2008, 3) the following three partial strategies need to be embarked on in order to meet the emission reduction targets:

- Raised efficiency in all of the sectors
- Expansion of heat-power cogeneration
- Pronounced expansion of renewable energies

These three points reaffirm the political course taken by the Federal Environment Ministry. Furthermore, a study on renewable energy integration in the domain of electricity (BMU 2008c) suggested a variety of factors to be crucial to achieving a large share of renewables in the energy mix: the ability to regulate the generating facilities, the possibility of temporary energy storage, and an active demand-side approach (load management). The study also points to the indispensability of an optimized use of existing grid capacities in conjunction with a demand-based expansion of the power networks (BMU 2008c).

3.9.4.1 Reconstruction of the Power Generation Systems

So far the growth of renewable energies had been spurred mainly by the EEG's incentive scheme, which focuses on the generation technologies. With the share of renewable energy rising, however, fluctuating energy sources in particular, such as wind and photovoltaics, come up against increasing limitations of system compatibility if the power station structure, which is designed to cover base load, is maintained. This incompatibility is due to the fact that production of electricity in large power stations is variable only to a certain extent and characterized by an inability to adjust to varying amounts of power generated and by an inability to adjust to varying demands.[129] The Federal Government is in the process of making some fundamental decisions on whether to maintain power stations as they are or whether to retrofit them. The task of the years to come, which is to "renew the power station fleet", is gradually turning into the general question of which system to use.

Generation Management

The integration of large shares of renewable energy requires enhanced power management on the part of the generating companies. One prerequisite for this is

[128] With the adoption of the Meseberg resolutions in August 2007, the Federal Government reiterated the decision to reduce greenhouse gas emissions by 40% by 2020 compared to 1990. Moreover, the Federal Government advocates a commitment of the international community of nations (developed countries) to reduce greenhouse gas emissions by 80% by 2050.

[129] In technical and economic terms, nuclear and lignite-fired power plants are designed to generate a steady amount of electricity to cover the base load.

the use of conventional power stations that can be regulated.[130] Another prerequisite for the integration of large shares of RE would be to amalgamate the energy quantities generated in semi- or decentralized power generating plants. This would necessitate linking various power plants to form what is referred to as combined power plants.[131] This in turn would require the power suppliers to communicate with each other as well as enhanced communication between the power utilities and the consumers.

Power Station Structure

The power utilities aim to prolong the power stations' run times and also to speed up modernization of the coal-fired power station fleet. They argue that the energy supply would not be safe if the share of nuclear and coal-fired power plants were cut (see Section 3.9.2). If, by contrast, the current power station structure were maintained and reinforced in the long run, the share of renewable energy sources would, according to the energy industry, need to be restricted, otherwise operating the base-load power stations[132] would no longer make economic sense.[133]

Modernization of the power station structure based on lignite-fired power stations is designed to be accompanied by the concept of CO_2-capture (CCS)[134]. This technology is propagated by power station operators as an effective concept for CO_2 reduction.[135] It conflicts directly with the expansion of renewable energy though, as the continued use of coal and base-load power stations, which are relatively inflexible, is incompatible with a large share of renewable energy. Moreover, the captured CO_2 must be stored in underground sites. The application of CCS and the resulting storage of CO_2 would imply blocking the limited number of underground storage sites permanently. In future, however, these sites will also be needed to store gas in the context of renewable

[130] Nuclear power stations and CCS coal-fired power plants are regarded as inflexible, i.e., not capable of being regulated – it takes more than 20 h to start up a power station.

[131] These are "virtual" power plants with a regional focus which use control technologies to combine decentralized power conversion plants for solar power, wind, biogas and water located in various regions, in a way that allows for continual on-demand power supply. The linking of the power plants permits controlling the decentralized plants in the same way as a conventional large power plant.

[132] New large coal-fired power stations can only be operated economically if their capacity utilization is high. This holds true in particular for lignite-fired power plants that require a very high number of operating hours in order to be economical. The electricity produced must be sold on a continuous basis, even in times of low demand (at night or at weekends). The production rate of other generators must be decreased during this phase.

[133] In addition, the electricity stock exchange frequently saw situations that led to zero or negative prices, which result from the fact that there is an excess amount of base load while the distribution of electricity generated from renewable sources must be prioritized.

[134] CCS = carbon (dioxide) capture and storage.

[135] Arguments for the development and application of the CO_2 capture technology include the possibility of exporting it to countries such as China or India, where coal will remain an important source of energy for some time.

energy expansion (SRU 2009). Similarly, the use of underground storage sites may also conflict with the harnessing of geothermal energy (see Section 6.3.3). The securing of these underground storage sites still requires extensive exploration as well as measures for legal protection.[136] At this stage, the potential and limits of the CCS technology are still in the trial phase.

Critics have warned of hurriedly setting the course by erecting new power stations. Expanding base-load power plants, they argued, was only possible when dispensing with a substantial further expansion of renewable wind and solar power, since large shares of wind power and solar energy could not be sensibly combined with base-load power generation. The decision to build a considerable number of new base-load power plants, as is being discussed, would therefore imply rejecting the idea of further expanding the use of renewable energies. Among the public, the construction of new power stations is controversial. According to an opinion poll (forsa 2007) 67% of the interviewees voiced opposition against the construction of new lignite-fired or coal-burning power stations.

The limits of integration become apparent with an increasing share of renewable energies in the power supply. The issue is increasingly one of transforming the energy supply systems – a project that is proving to be much more expensive and ambitious than the question of integration dealt with so far.

3.9.4.2 Modernization and Expansion of the Transmission Infrastructure

Another prerequisite for the integration of larger shares of RE is that the capacity of the electricity grids meets higher technical demands. Grid capacities, mostly those in certain northern German regions with large proportions of wind power, are already coming up against limitations. Existing grid capacities must therefore be utilized as efficiently as possible, and electricity grids should be expanded according to the market's demand.

Along with expanding capacities, the concept of "smart grids", i.e. modernizing existing grids, is being discussed. "Smart grids" are characterized by power generation management, intelligently designed routes, effective load management (demand-side management) and transmission line temperature monitoring, which would improve grid load control, and by the ability to adjust their output in accordance with demand, which would significantly improve the existing power grid's capacity. It is largely unclear, however, to what extent the capacity could be improved as a result of such activities and to what extent this would render additional expansion of the transmission networks superfluous.

Looking beyond national borders, the creation of a European "super grid" based on high voltage direct current transmission (HVDC) is being discussed.

[136] At the time of going to press, a controversially debated bill on CO_2 storage was in the course of being legislated to explore this (see SRU 2009).

The benefit of such a network would be low-loss, long-distance transmission of electricity, which is not possible with alternating current. It is hoped that temporarily and regionally high renewable power generation, e.g. from offshore wind farms or solar thermal power stations in southern Europe and northern Africa, would be more evenly distributed within Europe. The high costs of expanding a future-capable network infrastructure are regarded as the greatest obstacle in this context, one that has so far been avoided by grid operators as well. This type of network requires a new European cooperation of grid operators that would plan and construct the relevant lines. The linking of international energy markets is still in its early stages, but the process is making dynamic progress.

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