ALICE Electricity Sector Country Study:

Germany

- preliminary version -

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1. Basic Data

The nature of electricity production in Germany has not changed very much over the last 15 years (see Figure 1.1). With nuclear, lignite and coal as the major sources of generation, gas and renewables play only a minor, but nevertheless increasing, role.

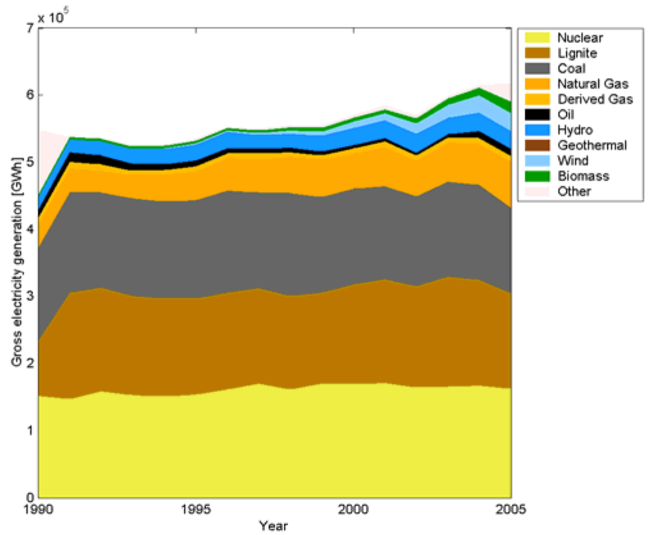

Figure 1.1

Accordingly, the installed net capacity gives an equal picture (see Figure 1.2). There is a nearly constant number of nuclear power plants that operate with high usage (2005: capacity factor ~91%). Compared to that and related to generation there is relatively more thermal capacity, comprising steam and gas turbines, combined cycle and internal combustion plants. Percentages of the various technologies are given only until 2000, so computing the usage for recent years is highly averaged over technologies (2005: capacity factor ~60%).

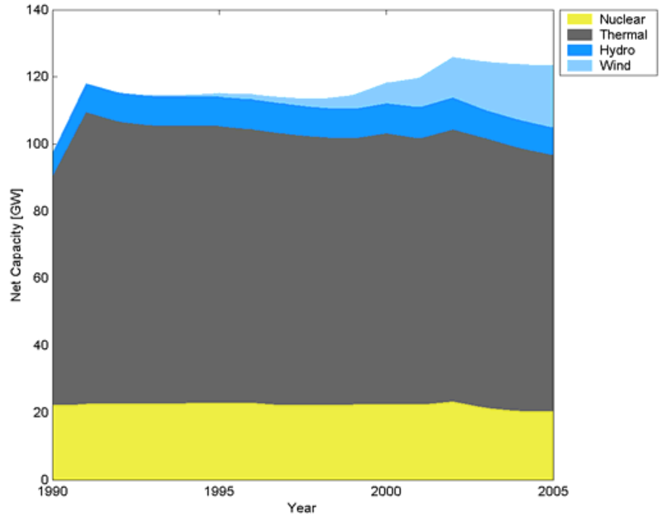

Figure 1.2

Besides this there is a comparably small amount of hydro capacity, roughly half of which (2005) is used for pump storage plants. Finally, a steadily growing number of wind capacity can be found (2005: ~18GW), that due to limited resource availability generates the lowest amount of electricity in comparison (2005: capacity factor ~17%).

A more detailed description of how different types of fuels are used is given by the daily load curve (see Figure 1.3), which shows the hourly production at every third Wednesday of a month, averaged for all months in 2006. First of all, it can be seen that generation through daytime is roughly 20% higher than the all-day minimum between 3-4am. Moreover, a constant amount (base-load) is provided by lignite fired und nuclear power plants. The daily deviations are nearly fully covered by switching gas and coal fired power plants on and off.

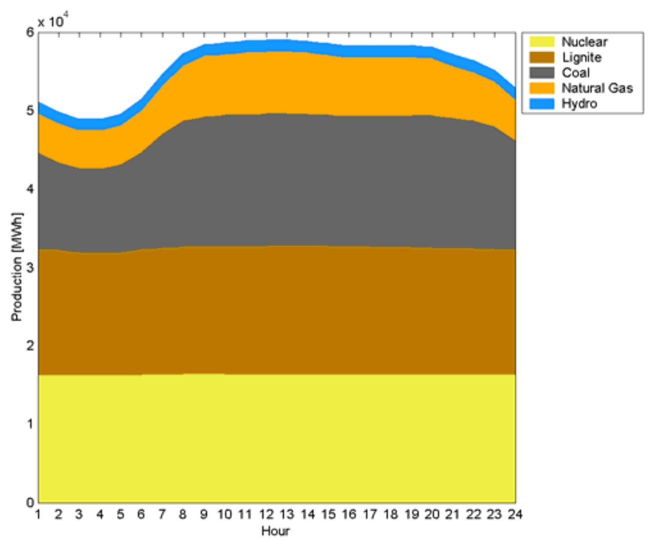

Figure 1.3

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- AG Energiebilanzen e.V.
- Map of German power plants (UBA?), geographical aspects

2. Resource Potentials

2.1 Fossil Resource Potentials

Apart from lignite Germany has a very high dependency on primary energy imports (see Figure 2.1). The national consumption of natural gas can still be covered in a small percentage by domestic production, but oil and uranium must nearly fully be imported from other countries.

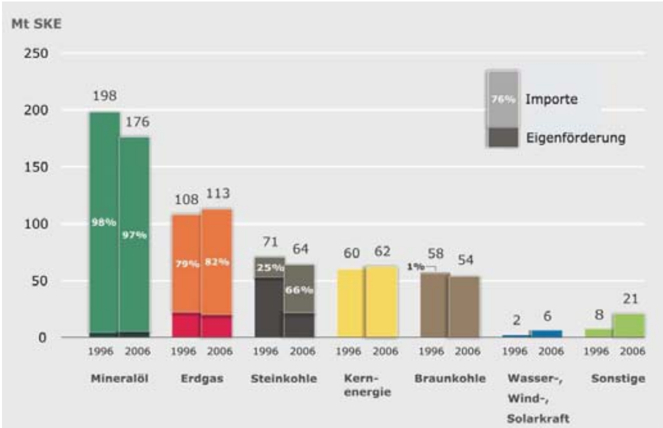

Figure 2.1: Import dependency and domestic production for various energy sources in Germany – Source: BGR (2007)

Even though both hard coal and lignite is available in large amounts with resources of 111.5 billion tons SKE (BMWi 2007), the mining of hard coal is not cost competitive compared to world market prices and – as subsidies are running out (see next section) – thus domestic production decreases steadily.

On the other side, lignite can be extracted in open cast mines and is much cheaper. Accordingly, there is a high annual production which covers demand to 100% (2006).

Figure 2.5: Annual extraction of lignite in Germany in million tons/year (2002) – Source: RWE (2007)

Resources are concentrated in four areas (see Figure 2.5), with the Rhine area (*Rheinisches Revier*) being the by far largest one. Of the total available resources of 77 billion tons (reserves of 41 billion tons), 55 billion tons are located there.
In 2002 178 million tons of lignite were burned to generate 138 TWh of electricity. So under equal conditions the above mentioned resources would last for another 128 years.

2.2 Renewable Resource Potentials

Producing electricity by **photovoltaic** devices is well known to be highly dependent on solar irradiation. The Photovoltaic Geographical Information System (PVGIS) provides data about solar irradiation in European countries, among them Germany (see Figure 2.1). Cumulated annual values found range from around 950 kWh/m² in the northwest to 1200 kWh/m² in the south and southwest.
In a recent study Suri et. al. (in press) have estimated the potential for all EU25 countries based on PVGIS data. Because photovoltaic devices are mainly installed on roofs and facades of buildings, they used additional land use databases in order to concentrate on urban residential areas only. They found that on average around 900 kWh of electricity could be produced each year by a typical 1 kW_p module mounted at an optimum angle. The somewhat lower gain than expected by mere irradiative power (see above) could be explained by system losses mainly due to operation at a suboptimal temperature.

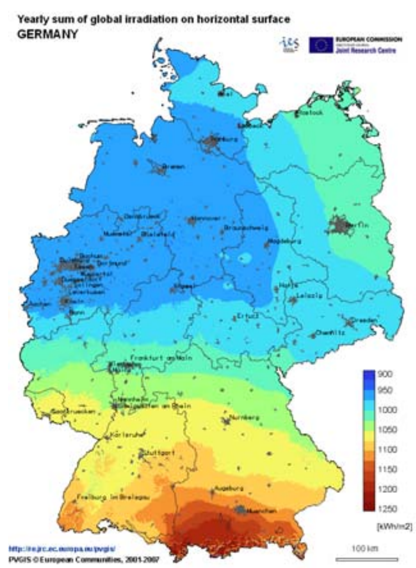

Figure 2. 2 – Source: EC JRC

Because the authors do not calculate the total potential available such a calculation has to be added here. Taken that solar modules are always installed on buildings of some type (see above), it is straight forward to restrict usage to residential and commercial areas. In 2004 6.7% of Germany's territory equaling around 24000 km² was covered by "Gebäude- und Freiflächen" (Destatis 2006). Assuming that 10% of this area could be used and that today a typical 1 kW_p module has a size of roughly 10m² gives a **total average annual potential of around 216 TWh**. However, this calculation is far from being sophisticated and many factors are subject to change or were completely omitted. So the results should only be seen as a first guess. Besides this there is considerable variation in generation throughout the seasons. With high gain in summer and low gain in winter the seasonal variation is between 50% and 60% of the annual average, or in other words: production in summer is 3 times higher than in winter. This, as is the case for wind power, clearly poses a hurdle for large scale integration into current day electricity networks.

In the case of **wind power** the relevant quantity for potential estimates is wind speed. However, compared with solar power the procedure is a little more complicated. Wind speed itself is only a proxy for the power finally gained, which is also determined by the particular device in use. Moreover, because wind speed also varies with the altitude it is important to measure at the correct height, i.e. at the height of the turbine. Modern turbines are operated at around 80m. Figure 2.2 shows wind speed class data for Germany and border regions taken from a recent study by Archer & Jacobson (2006).

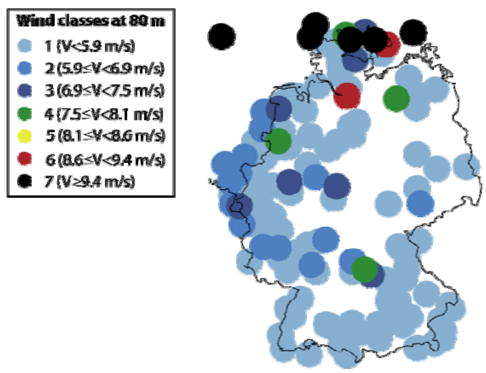

Figure 2.4 – Source: Archer & Jacobson (2005)

Here the situation is somewhat opposite to solar irradiation: winds are strongest at the northern coastal regions and weakest in the southern part.
There are several studies about the technical potential, both for offshore and onshore wind power. In the case of **onshore wind** numbers range from 24 TWh/a (van Wijk and Coelingh 1993), over 68 TWh/a (Nietsch 2006) up to 127 TWh/a (Kaltschmitt 1993). Cause two of these studies date back to the beginning of the 90ies, ceteris paribus the work by Nietsch seems to be a good candidate for being closest to the real potential. In this study there is also an additional limitation for reasons of public acceptance so that a total of 0.5% of Germany’s territory can be used for **up to 45-55 TWh/a**.
In comparison estimations for **offshore wind** indicate higher pontentials. Both BMU (2007a) and Nitsch (2004) give numbers of equal magnitude of around **80-100 TWh/a**.

Compared to wind and solar power **biomass** is even more difficult to assess. The main two reasons are (a) that there are many possible sources of energy (straw, wood, manure, energy crops, …) with different technologies and potentials for energy conversion and (b) that land used to grow biomass for electricity production could also be used to grow biomass for biofuel or food.
Taken this competitive nature one could certainly compute a technical maximal potential for biomass as in the solar case, but the result would certainly be artificial and hardly

plausible. Accordingly, in a study conducted by Fritsche et.al. (2004) the potential was computed based on various scenarios including life cycle analysis. They found, that in 3 pro-environmental scenarios electricity production from biomass reached **40-86 TWh/a in 2030**. Because their analysis is limited to 2030 it is not clear if the long-term potential is already reached at that time or not, but the considerable increase compared to 2020 (24-47 TWh/a) gives rise to the assumption that an even higher annual production might be possible and feasible.
Another study (EEA 2006) reports an environmentally-compatible bioenergy potential of around 1800 PJ in 2030. Assuming a conversion ratio of 0,1135 based on BMU (2007b) around 200 TWh/a could be generated (somewhat unrealistically) assuming that all biomass goes to electricity production.

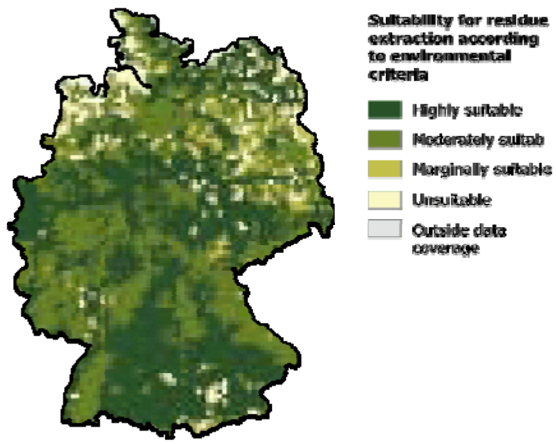

Figure 2.5 – Source: EEA (2006)

Seen under the criteria of continuous availability and concurrence of usage **hydrothermal energy** is certainly without concurrence. However, the absorption of underground heat is not renewable in the sense that there is an unlimited reservoir, except for the case of tectonic displacements or volcanic activities, where there is practically unrestricted “fuel” available.
Geothermal electricity generation has already been in commercial operation for more than 100 years, although its application had been limited to hydrothermal resources which directly delivered heated water from below ground like in Iceland, the USA or New Zealand . In 1974 the total worldwide capacity installed was only around 770 MW, none of it in Germany (WEC 2004). In recent years however more extensive use of hot water aquifers and so called enhanced geothermal systems (EGS), formerly called “hot dry rock”, opened up new opportunities and there has been considerable growth up to a total capacity of around 28.000 MW in 2005 (Lund et. al. 2005).
In Germany the most profitable sites are hot water aquifers, which consist of porous stone (aquifers) - capable of storing and conveying water - with relatively high temperature at relatively low depths. Appropriate sites for electricity generation require at least 100°C in typical depths and can be found in the northern part (Norddeutsches Becken) and two isolated regions (Oberrheingraben, Molassebecken) in the southern part of the country (see red areas in Figure 2.4). In a 2003 assessment (TAB 2003) the total

technical potential energy for these sites was reported around 2600 TWh, due to sustainability reasons to be used over a longer time scale (1000 years suggested). For comparison its interesting to know that Germany's latest geothermal power plant at Landau being in operation since November 2007 has 3 MW capacity.
Apart from this crystalline stones and geological fractures can also be used for geothermal electricity generation, though operation there is less economic. Nevertheless, because there is much broader availability of these sites, especially crystalline stones, the total potential energy available amounts to around 300.000 TWh - or roughly 600 times Germany's current annual electricity generation - according to the above cited study.

Figure 2.6 – Source: www.geotis.de

The Federal Ministry for the Environment (BMU 2007b) provides another estimation that comprises all of the sources of renewable electricity. A complete overview of all results can be found in the Table 2.1 below.

Photovoltaic	**Wind (onshore)**	**Wind (offshore)**	**Biomass**	**Geothermal**
216 TWh/a[1]				
	45-55 TWh/a[2]			
		80-100 TWh/a[2]		
		85-100 TWh/a[3]		
			40-86 TWh/a[4]	
			200 TWh/a[5]	
				300.000 TWh[6]
105 TWh/a[7]	68 TWh/a[7]	135 TWh/a[7]	50 TWh/a[7]	150 TWh/a[7]

[1] Own calc., based on Suri et.al. (in press) and Destatis (2006)
[2] Nitsch et.al. (2006)
[3] BMU (2007a)
[4] Fritsche et.al (2004)
[5] Own calc. for 2030, based on EEA (2006) p. 52 & BMU (2007b) p.11
[6] TAB (2003)
[7] BMU (2007b)

Table 2.1- Estimation for technical resource potential for renewable electricity

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3. Development of the Sector: Policies, Subsidies & Regulation

Compared to other European countries like France or the UK, where state owned companies served the whole country from the beginning on, the German electricity sector traditionally consisted of local companies operating within cities or smaller regions. Though ownership had a wide range from private and mixed to public in the beginning, due to mutual dependence (network structure and energy supply) municipalities became important investors strengthening the ties through mixed ownership structure (#71, p.6). Because of this regional focus and to avoid costly competition the industry agreed on so called demarcation treaties (*Demarkationsver-träge*) in the 1920ies that the home markets of each company shall be "off limits" for other potential competitors.
This situation, based on sector-wide but not legally binding agreements, became valid law in 1935 with the National Energy Act (*Energiewirtschaftsgesetz, EnWG*). However, the price to be paid for this was the obligation to supply electricity for everyone and everywhere in the respective territory, the requirement of a concession to distribute electricity, regulated allowances for building new power plants and regulated prices for households, small companies and the agricultural sector (#72, p.68). Before it was revised in 1998 in order to implement the European liberalization directive (see below) the EnWG shaped the German electricity sector (at least in the former FRG) for more than 60 years.

From the 1950ies on the by then emerged two states of West and East Germany followed, as their respective political system would suggest, completely different ways in energy policy and sector regulation. In the following only West Germany will be described in detail for the following reasons. First, in comparison capacity and production had been much smaller in the former GDR. Second, the use of technologies in the Eastern part was more restricted, mainly relying on the number one cheap and widely available fuel: lignite. Apart from one big nuclear power plant (Lubmin, 5x440 MW)[1] mainly hydro plants in the southern part and thermal power plants in the "lignite regions" in the eastern part of the country were operated. Finally third and most important, the political breakdown of the GDR in 1990 lead to a big discontinuity in the sector. The formerly state owned industry was privatized and a certain part of the old plants were either shut down for security (nuclear plants) or economic reasons. The remaining infrastructure was modernized with high investments. In the aftermath the industry was integrated, economically and legally, in the electricity sector of the former western part, in a certain sense rejoining the path of development that was left around 40 years earlier.

Western Germany , though lying in ruins at the end of WW2, found its electricity infrastructure in surprisingly good shape: RWE for example, at this time the country's biggest utility, had lost only a single power plant during the whole war (Schweer & Thiem 1998). Moreover, the by far largest amount of coal resources in western continental Europe were located in its territory; gaining access to these resources was one of the reasons for France, Italy and the Benelux countries to establish the European Coal

[1] Another, though much smaller one (70 MW), was located in Rheinsberg.

and Steel Community in 1951. However, only six years later in 1957/1958 the so called *coal crisis (Kohlekrise)* heralded the downfall of the German hard coal mining industry with the closing of many mines in the Ruhr region. High extraction costs, the increasing importance of oil as a substitute and comparatively cheap coal imports, mainly form the US, where the reasons for this crisis, the political remedies of which persist until today (Renz 2001, p.112, Storchmann 2005). At exactly the same time in 1957/1958 the new German government enacted an extensive antitrust law (*Gesetz gegen Wettbewerbsbeschränkungen, GWB*) which excluded energy supply companies, basically on the same basis as the EnWG of 1935. Together these two laws can be seen as the foundation of regulation for the network dependent energy supply industries till 1998.
In the following two decades regulation and legislation in the electricity sector was mainly about fostering technologies and resources. In 1960 a law about the non-military use of nuclear energy (*Atomgesetz, AtG*) was enacted, which set the foundations for the construction of nuclear power plants. A few years later in 1965 and 1966, the First and Second Electrification Act (*Verstromungsgesetze, VerstromG*) were decided in order to privilege domestic hard coal, namely by subsidizing it for power generation. These measures can be seen as reaction to the above mentioned coal crisis, which had become more and more distinct. However, especially the ongoing boom of oil based generation could not be prevented but at best be slowed down. Only after the first oil crisis in 1973/1974 did the German government decided on more rigorous and proactive actions by passing the Third Electrification Act. It entailed special permissions for building new oil fired power plants and the use of oil for electrification as such. Moreover investment subsidies were granted for the construction of new hard coal fired power plants within a period of 10 years till 1983. Finally, the industry was obliged to employ a certain amount of hard coal for electrification (between 33 and 47.5 million tons per year) for which it where entitled to raise a special levy (*Kohlepfennig*) form its customers. This levy started with a markup of around 3% on the retail price in 1975 and reached 8.25% in 1995 when it was raised for the last time. (Wolter & Reuter, p.216)

With the beginning of the 1980ies a new concern entered the agenda of energy politics: environmental protection. Increasingly high emissions of SO2, mainly from large power plants (~60%), had taken their toll in damaging the ecosystem, most visibly by impairing the national forests (*Waldsterben*). The German government reacted by putting the Ordinance on Large Combustion Plants (*Großfeuerungsanlagenverordnung*) into force in 1983. It required the retrofitting of all plants with flue gas desulphurization devices setting a maximum limit of 400mg/m³. It is interesting to note that this regulation was one of the driving forces of EU Directive 94/66/EC, which only after more than ten years later in 1994 required the members to reduce emissions in a similar way (Bültmann & Wätzold 2000).
It would be straight forward to assume that the 1991 Electricity Feed-In Law (*Stromeinspeisegesetz, StrG*), so to say mother of all feed-in laws for electricity from renewable sources in Europe, was the next step in policy making driven by environmental awareness. But even though one of the two persons behind it belonged to the Green party, its driving initiator was a member of the parliament for the Conservative party, working for the Association of Bavarian Hydropower Plants. Finding it intolerable that the big electricity companies (EVUs) bought hydroelectricity for a lower price than their own

generation cost, he drew up a draft that obliged the supply companies to buy all according electricity (hydro, wind, solar and so on) produced by plants of small size for a considerably higher price. Resulting additional costs for the EVUs would be covered by a markup on the retail price for consumers. Though there were some protests in the beginning, the total estimated costs of only 50 million DM and the tolerance of the consumers for electricity price markups testified on earlier occasion (Kohlepfennig) seemed to make this whole exercise a little side show during the time of Germany's reunification. In this sense the law sort of sneaked into action (Zeit Online 2006, Renz 2001 pp. 96-100).
In 1998 Germany experienced a political turning point: for the first time ever the environmentalist Green party became part of the coalition to rule the country. What followed was an unprecedented rush of actions and measures for the benefit of environment. Pertaining the electricity sector the two most important ones were certainly the Renewable Energy Sources Act (*Eneuerbares EnergienGesetz*, *EEG*) in 2000 - successor of the 1991 Electricity Feed-In Law - and the amendment of the1960 nuclear power law in 2002 by which the nuclear phase out was put into force[2]. Compared to the StrG the reasons and motivations for the EEG were much more straight forward. One part of the coalition (Green party) was inspired by earlier local feed-in laws for solar power and wanted to adopt this on a federal level. The other part (Socialists) feared that because of declining prices caused by the liberalization of the market (see below) the acquired comparative advantage of German wind mill producers could get lost. So the finally the EEG was enacted in 2000 granting fixed feed-in tariffs for all new facilities over a certified period (hydro plants 30 years, other 20 years). With this action the development of electricity generation based on renewable energy sources gained decisive momentum. (Jacobson & Lauber 2006, Agnolucci 2006).

Also in 1998, the year in which environmentalism got governmental force (see above), the sector as a whole entered a new era. Since the beginning of the 1980ies the concept of "liberalization" entered EU politics mainly advocated by the British government. What officially started with a "White Paper for the Internal Energy Market" in 1988 ended up with directive 99/92/EC constituting common rules for the internal market in electricity (Nylander 2001). In order to transpose this directive the 1935 National Energy Act was amended. The most important revisions it made were (a) the breaking up of regional monopolies by abandoning concessions and demarcations as formerly regulated by the Antitrust Law (GWB), (b) the abandoning of regulations for investment, (c) accounting unbundling between generation and transmission and (d) the regulation of network access by either "negotiated third party access" (nTPA) or alternatively a single buyer system until 2005 latest (Renz 2001). Especially by setting up a nTPA and not a "regulated third party access" (rTPA) Germany opted for an approach not shared by any of the other EU member states in this process.
However, five years later 2003/54/EC repealed the former directive and declared rTPA mandatory, which led to a second amendment of the National Energy Act in 2005. As required this revision put transmission under control of a national regulative authority

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[2] Another law pertaining the sector, the Electricity Tax Law (*Stromsteuergesetz*, *StromStG*), was enacted in 1999. Though it changed the prices of electricity to a small amount, it never had a considerable impact on the sector as such.

(*Bundesnetzagentur*). In addition, the level of unbundling was extended to legal unbundling (separate legal entity), which lead to the spin-off of the EVUs transmissions divisions in 2003 (Eickhof & Holzer 2006). The next step to follow will be an incentive regulation for network access to be put in force in 2008.

The following tables provides an overview on the most important milestones in energy policies and regulation since the beginning of liberalization:

Year	**Event**
1997	First mergers and acquisitions of large energy supply companies[1]

[1]Brandt 2006

(Brandt 2006, gute Übersicht 1998-2008)
(Bauknecht & Brunekreeft, gute Übersicht Eckdaten)

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4. Investments in and Decommissions of Plants and Installations

From what has been reported in the last section it is more or less clear that politics and policies in West Germany have stimulated and driven investments in generation capacities, at least to a certain degree. However, as Figure 4.1 shows the precise path of investments (until 1990) exhibits clearly distinguishable business cycles, each with a length of around ten years and centred in the mid-decade. The conclusion to draw is that despite of its highly regulated nature the sector had still followed the basic rules of investment economics.
Nevertheless, each of these cycles represents a period dominated by a certain technology that can be very well related to the above described policies. During the 60ies mainly hard coal and lignite fired power plants were build (Hilmes & Kuhnhenne 2006). The first deep regulatory impact certainly came from the First and Second Electrification Act (see section 2), which initiated the construction of approximately 10.000 MW hard coal fired capacity until 1971 (DSK AG 2007), and subsidies for investments prolonged for another 18 years until 1989. On the other hand, the Second Act prohibited the construction of new oil fired power plants, only the beginning of a series of constraining regulations (limitations in fuel type usage due to desulphurization, high taxation) that lead to the negligible share of oil in Germany's electricity generation today (MWV 02/2006). For later years Matthes (2000) reports that during the first half of the 70ies oil fired generation increased from 2.000 to 10.000 MW, only to be stopped by the first oil crisis. Natural gas fired power plants were extended from 1.000 MW in 1968 to around 11.000 MW within 10 years, but later on were operated only at lower utilization, presumably because the nuclear capacities pushed into the system with an additional capacity of 8.000 MW that was build between 1970-80.
The effect of policies and regulation on investments can also be underlined by the systematic R&D subsidies the government provided from 1974 on in direct reaction to the oil crisis by means of the Energy Research Support Schemes (*Energieforschungs-programme*). As part of these schemes investments subsidies were granted (*Zukunfts-investionsprogramme*). The first scheme (ZIP1, 1977-1981) for example was targeted at CHP and granted 730 million DM which induced 2.6 billion DM of investments (AFGW 2000).

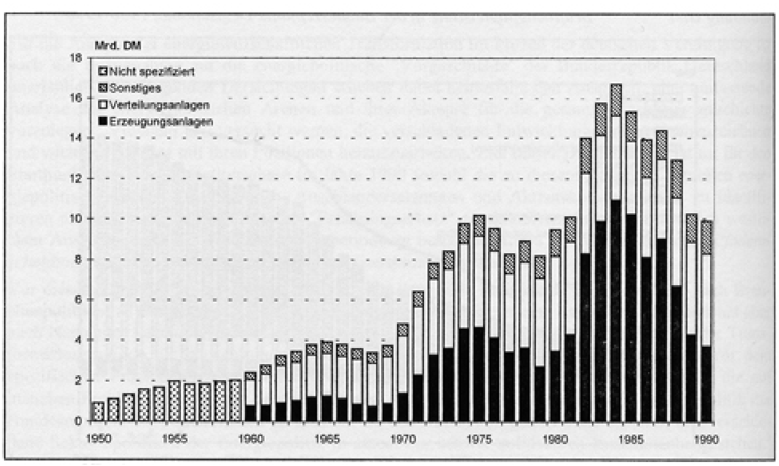


Figure 4.1: ESI Investment West Germany 1950-90 – Source: VDEW (1993)

During the 80ies even more capital intensive nuclear power plants were build, the last one 1989 in Neckarwestheim. Additionally, the 1983 Ordinance on Large Combustion Plants required technical adjustments that amounted to investments of around 7.3 billion EUR (Bültmann & Wätzold 2000).

In 1990 Germany was reunified, by coincidence exactly at the time when the industry was once again “ready to spend money”. In the years that followed large investments were made in the outdated electricity infrastructure in the former Eastern part (see Figure 4.2). This comprised both replacement of old lignite plants, mainly by the big western companies, and the entry of municipalities in the eastern part into the market because of temporary high prices. For the bigger part they relied on natural gas that had become more attractive after the political situation had changed and access to the Russian resources was available (Hilmes & Kuhnhenne 2006).

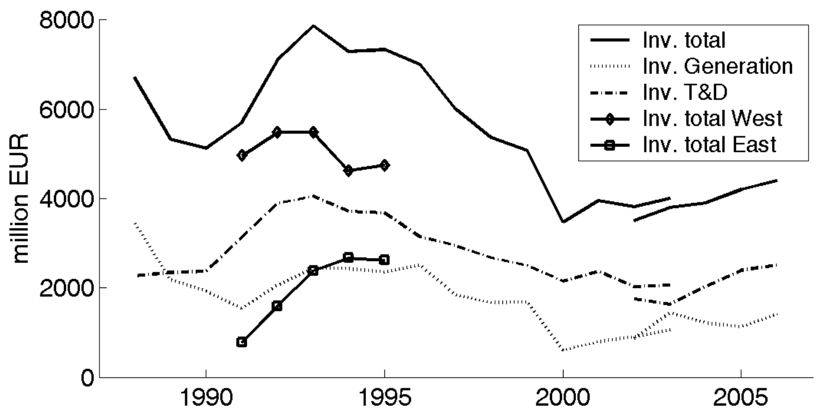


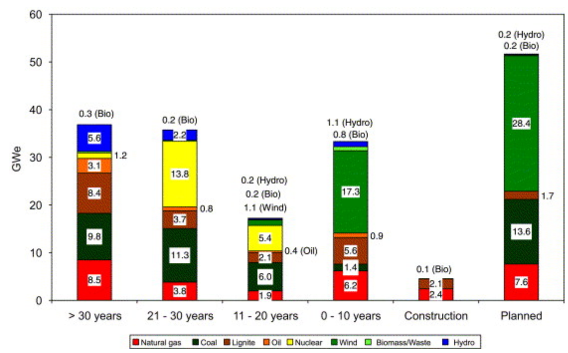
Figure 4.2: ESI Investment Germany 1988-2006 – Sources: Ifo Schnelldienst (1988-2003), VDEW (2008)

In 2000 then another turning point was reached: after continuously declining from 1993 on (7.3 Cent/kWh) electricity prices for industrial customers at last reached a low of 4.4 Cent/kWh (BMWi 2007) due to overcapacities. As Brunekreeft & Twelemann (2004) explain “[t]he combination of the traditional model of cost-based regulation, incentives to invest in new capital and an obligation to guarantee a reasonable supply security, created severe excess generation capacity in the German ESI.”. As they further describe RWE closed down a nuclear plant (Mühlheim-Kärlich, 1.2000 MW) and several old gas and coal plants, but at the same time had 3 GW new capacity (mainly coal) under construction. E.ON shut down 4.580 MW of old capacity, of which 1.330 MW was mothballed, but also had 800 MW new capacity in construction which summed up to 2.400 MW or around 8% of its total capacity by then (compare Süddeutsche Zeitung 23.08.2000). The total reduction of both companies amounted to 4.400 MW. It’s interesting to note that around the same time negotiations about the nuclear phase out had already reached a level of “precise numbers” (Welt 16.06.2000) and it was clear that within the next 20-25 years another big stack of capacity, namely the nuclear power plants, would be shut down.

From 2001 on investments once more started to increase, even though at a moderate rate. Apparently a new cycle had started - the first one ever under nearly fully liberalized conditions. Accordingly, the industry saw itself confronted with a number of challenges, summarized for example by Ziesing & Matthes (2003). They list (a) the upcoming European certificate System for CO_2 emissions (ETS), (b) the ongoing liberalization of the sector and particularly (c) the relatively old ages of German power plants combined with the enforced nuclear phase out of 2002. While (a) and (b) make decisions more difficult, (c) makes decisions for investments pressing. The above report estimates that until 2030 around 50.000 MW, 30.000 MW conventional thermal and 20.000 MW nuclear power plants, have to be replaced (roughly 40% of the total capacity). The authors assume that this would require 50-60 billion EUR of investments. The detailed structure of German power plants by age and fuel type is shown in Figures 4.3a and 4.3b below.

	Jahr der Inbetriebnahme			Insgesamt (Stand:
	bis 1974	1975 bis 1994	1995 bis 2000	31.12.2000)
Altersstruktur in MW				
Steinkohle	10 634,9	17 465,6	768,0	28 868,5
Braunkohle	9 570,5	6 207,0	5 465,0	21 242,5
Kernenergie	2 223,0	21 340,2	0,0	23 563,2
Erdgas	7 291,1	6 980,2	3 293,5	17 564,8
Heizöl	4 879,1	2 043,8	39,5	6 962,4
Sonstige	183,2	1 108,7	1 851,2	3 143,1
Insgesamt	34 781,8	55 145,5	11 417,2	101 344,5
Altersstruktur in %				
Steinkohle	36,8	60,5	2,7	100,0
Braunkohle	45,1	29,2	25,7	100,0
Kernenergie	9,4	90,6	0,0	100,0
Erdgas	41,5	39,7	18,8	100,0
Heizöl	70,1	29,4	0,6	100,0
Sonstige	5,8	35,3	58,9	100,0
Insgesamt	34,3	54,4	11,3	100,0

Quellen: Bundesministerium für Wirtschaft und Technologie, 2002;
Berechnungen des DIW Berlin.



Figures 4.3a, 4.3b: Age structure of German power plants – Sources: a) Matthes & Ziesing (2003), b) Kjärstad, J. & Johnsson. F. (2007)

A later report by RWE (2007) comes to a similar conclusion, albeit referring to 45.000 MW to be replaced between 2010 and 2020 assuming 40 years plant lifetime (see also Hilmes & Kuhnhenne 2006). Moreover, it poses the problem that - at the time of writing - there is no guarantee of grandfathering for replacements plants post 2012. Seeing it from the industry's point of view this is worth billions and thus a matter that needs to be agreed upon as soon possible, or in other words: the less free permits for the industry, the longer it takes for new investments to come up because only the (rising) electricity price will be act as the required trigger (Hilmes & Kuhnhenne 2006). However, this issue is only one part of the existing uncertainty about large scale EU climate policy, especially ETS, and thus of more general nature. According to recent news (Spiegel Online 10.01.2008) current plans of the EU are that there will be no grandfathering at all for the electricity industry beyond 2012.

The above cited RWE report also mentions volatile gas prices, supply constraints for power plant components, scarcity of consented sites and lengthy approval procedures for interconnector extensions as major drivers for capacity bottlenecks EU wide. In fact, the problem of over-aged capacities seems to exist even at the global European level.

Since political decision makers became aware of this problem it has turned up every now and then in the public debate. But the arguments put up in this discussion certainly had two rationales behind it: energy security, as part of it the above described age structure, on one side, on the other side the steadily increasing prices since 2000 (see Handelsblatt 08.11.2004). It seems that, at least as the public discussions reflects it, politicians were taken somewhat by surprise that liberalisation had not achieved what it was primarily supposed to do: making electricity cheaper. But it should be evident from the findings above that the industry had just entered a new business cycle were increasing prices would trigger investments. Moreover, at the end of 2004 the bargaining between the industry and the government for the final version of the Second Amendment of the National Energy Act in 2005 was at high level, so every party certainly played with heavy weapons. At the end of this game the industry had committed to invest around 20 billion EUR into generation and transmission until 2010 (Handelsblatt 31.03.2005). Looking on precise numbers from 2000 to 2007 around 7 billion EUR had been invested and 8.625 MW new capacity, most of it natural gas (~61%) and only ~17% coal fired, went in operation (VDEW 12.07.2007).

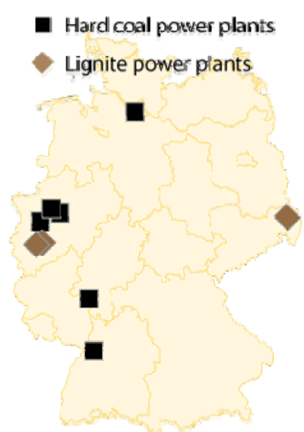


Figure 4.4: New coal power plants in Germany – Source: BMU, cited in Handelsblatt (27.12.2007)

So no matter which perspective one takes: the German electricity industry needs to fill a big gap in capacity within the next 10-20 years. But, as the problem has been known for several years and the logic of increasing prices requires it, the industry has not been idle for the last years. Currently, there is a large number of projects for new power plants in the various levels from planning to construction which will be described in more detail in the following.

Especially the fact there are a lot of coal fired power plants in preparation has attracted considerable attention recently, especially in the climate activist community. Yet finding out how many exactly there are is far from trivial. In a short survey compiled at the end of 2007 (Telepolis 19.12.2007) five different sources, each reporting different numbers, are listed: 9 until 2012 according to German Ministry of Environment (BMU, compare Figure 4.4.), 30 according to the magazine Spiegel, 24 according to the NGO BUND and 27 according to Greenpeace. An internal compilation of the Federal Network Agency (*Bundesnetzagentur*) is said to even list 46, around 50% of them to completed until 2012.

In October 2007 the Federal Environment Agency (UBA 2007) mentions 30 projects for new coal fire power plants, whereas the magazine Stern (04/2008) counts 22.
The German Association of the Electricity and Water Supply Industry (VDEW 16.04.2007), source for the Greenpeace numbers and also referenced by RWE (2007) and Hilmes & Kuhnhenne (2006), doesn't give details about technology, but only announces that 39.000 MW of new capacity will be build until 2012, 8.000 MW of which based on renewable energy. Older data though (VDEW 09.10.2006) lists 17 power plants with a total capacity of 16.605 MW, the last project to be completed in 2015. Overall 53 plants are planned with a total capacity of 31.400 MW for which 27.5 billion EUR are envisaged. One set of numbers, taken from RWE (2007) and based on data from VDEW and Platts UDI World Electric Power Plant Database, is shown in Figure 4.5.
A fifth source (Handelsblatt 27.12.2007) confirms the nine plants officially listed by the BMU, even though three times as much new capacity (30.000 MW) was under discussion during the energy summit in 2006.
But regardless of what the real numbers are, as mentioned earlier at least the non-industry statements claim that there is a big lack in investments. Just before the last energy summit in July 2007, the head of the Federal Network Agency, consumer associations and private consultants adhered to this statement, naming a decreasing reserve margin, from 20.000 MW in the past to now 6.000 MW (compare Brunekreeft & Twelemann 2004), as evidence and higher prices and thus profits due to lower capacities as motivation (Spiegel Online 30.06.2007).

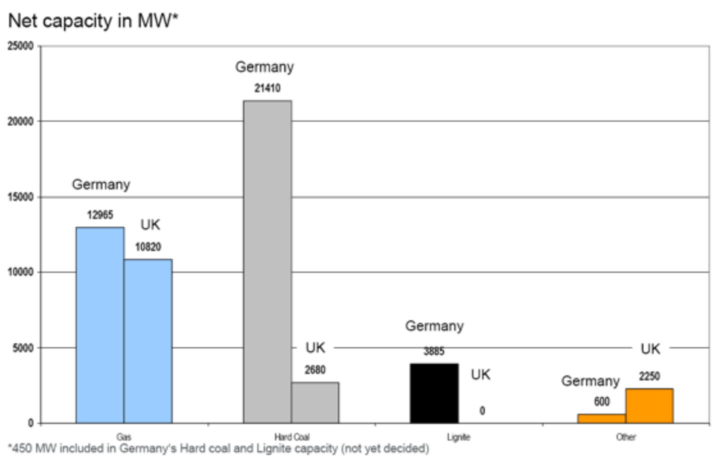


Figure 4.5: Planned power plant projects in Germany/UK by fuel type – Source: RWE (2007)

In any case the existing confusion about the number of projects on the way motivates to inspect possible hindrances in power plant development.
Referring to an external study the newspaper Handelsblatt (05.09.2007) reports that there has been a steep rise in installation costs for new power plants during the last year (compare Figure 4.6). This is due to increased demand, both by established big companies and by municipalities and other small companies trying to enter the market. In consequence, 22% of the 50 projects in preparation have already been cancelled, at least temporarily. Affected by this are foremost smaller companies, which placed their orders at later dates and in general are not entitled for quantity discounts.

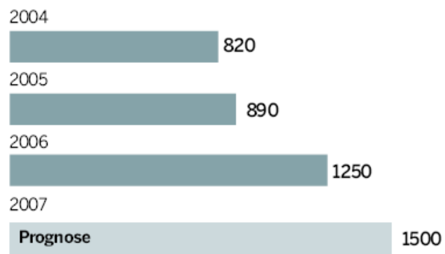


Figure 4.6: Installation costs for hard coal power plants (EUR/kWh) – Source: Handelsblatt (05.09.2007)

On the other side, representatives of the industry complain about a "poor atmosphere for investments" (Das Parlament 2007). Especially the European Trading Scheme and the allocation of CO_2 certificates are seen as factors of high economic risk for investments. The magazine further informs that low investments during the last years have caused developers to reduce capacities, leaving Siemens, Alstom and Babcock Hitachi as the only general developers available in the market. Moreover, higher prices for materials, especially steel, put another markup on installation costs. Ulrich Jobs, CEO of RWE Power, is quoted with the estimation, that of 130.000 MW planned capacity in Europe until 2012 only around 60% will be build. In Germany, in 2007 alone new projects with a total capacity of 6.500 MW were cancelled (Handelsblatt 22.01.208).
A lack of investment due to uncertainty in future emission allowances is also approved elsewhere (Handelsblatt 27.12.2007), which - following a RWE representative - could also lead to situations, "where the less efficient plants will continue to be operated".
A survey among municipalities and regional energy supply companies investigated chances and risks in more detail (Edelmann 2007). The most important risk turned out to be future trends for fuel prices, followed by credit ratings for customers and obligations and concessions for new plants (see Figure 4.7). The next ranks are held by future CO_2 and electricity prices. There is some reason to assume that for bigger companies the risk associated with fuel prices is several times higher than for future emission prices (personal communication with an RWE representative 2007). On the other hand, best opportunities come from support and subsidies for renewable energy, a possible renaissance of nuclear power and electricity prices.

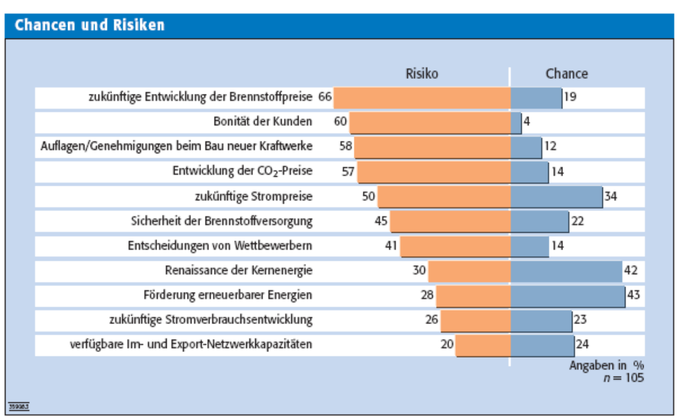


Figure 4.7: Chances and risks for new power plants – Source: Edelmann (2007)

But beside the list of risks above there is still another one, probably seen as the most annoying one by an investing company: residents. Because land-use plans have to be changed in order to accommodate new power plants or for modification of facilities there is always a public involved. Especially in the case of coal fired plants, which have non-charming connotations like “black”, “dirty” and “climate killing” in Germany, a big public resistance can be expected. And this resistance can be effective, as could be observed in Ensdorf, where 7.000 inhabitants stopped the construction of 1.600 MW power plant worth 2.3 billion EUR, at least temporarily (Energieverbraucher.de 26.11.2007). Similar protests delayed or stopped plans in Köln and Berlin (Stern 04/2008).

Altogether solving the problem of capacity replacement is more easily said as done. So another option, at least for the four big companies in the country operating respective capacity, is always desirable: stopping the nuclear phase out. On one side 21.000 MW nuclear capacity would not have to be replaced so early, on the other side most of the plants are already written off and thus are cash-cows by now (assumingly generating a profit of 1 million EUR/day). So it’s no wonder that some companies (RWE and Vattenfall) transfer operating credits in such a way that no plant has to be shut down in this election period, hoping the phase out will be cancelled in the next (Berliner Zeitung 07.12.2007). However, in the most recent case such a transfer was rejected by the responsible court (Handelsblatt 16.01.2008). Another supportive argument often referred to by the industry, especially in relation to development of new technology, is to defer nuclear phase out in order to win time for other technological options (see for example Handelsblatt 26.11.2007).

In the remaining part of this chapter current strategies and projects of the leading four companies in Germany, namely RWE, E.ON, Vattenfall and EnBW, will be described in more detail.

The third largest company in the German market, **EnBW**, will be the one to lose most under the nuclear phase out because of its high percentage of nuclear capacity (48%). Moreover, promising alternatives are limited because the company has no access to lignite resources and existing locations of older power plants are generally not connected to important rivers or channels, which means that hard coal is hardly an option for replacement. Hence there is a shift towards natural gas to supply flexible base load (*Mittellast*) and an ongoing cooperation with STEAG, a hard coal specialized utility (Hilmes & Kuhnhenne 2006). Concerning long-term goals the old CEO was replaced in October 2007 and a new company-wide strategy had to be developed by then (Handelsblatt 12.10.2007). Three months later the new CEO announced that 7.2 billion EUR would be invested until 2010, primarily in generation (Handelsblatt 21.01.2008). EnBW has two technologically notable projects ongoing: a cooperation with the University of Stuttgart for the development of a carbon capturing facility and a 150-600 MW Compressed Air Energy Storage (CAES) plant in Niedersachsen scheduled for 2014 (Technology Review 15.05.2006).

In comparison **Vattenfall Europe** has the smallest percentage of nuclear capacity among the four, and probably the widest strategic opportunities of all. It is a relatively new player in the German market, mainly operating in the former eastern part of country, where it had acquired and modernized the old lignite plants and open cast mines. Accordingly, its plants have a relatively small age on average. Besides, there are opportunities to build new hard coal power plants in the northern part where connection to the Baltic Sea is available, or natural gas fired plants elsewhere (Hilmes & Kuhnhenne 2006). Vattenfall Europe maintains a high corporate responsibility for climate and environment and will be the first commercial operator of a CCS enhanced pilot power plant from 2008 on (Vattenfall 2006).

Among the biggest two **E.ON**, like RWE (see below), has a high percentage of nuclear capacity and a number of hard coal and natural gas plants that were almost completely built at the end of the 70ies or earlier. Hence there is need for action to modernize. Like in the case of EnBW the locations of E.ON's nuclear plants are mainly in the south without suitable connection for hard coal delivery, so replacements are mainly limited to natural gas. Even though E.ON has access to lignite (*Mitteldeutsches Revier*), the available resources are clearly limited. So 70% of its planned projects are based on hard coal, all of them located in the northern part of Germany (Hilmes & Kuhnhenne 2006). After the failed acquisition of the Spanish utility Endesa E.ON reacted by announcing an investment program in mid 2007 worth 60 billion EUR, of which until 2010 Europe-wide a total of 10 billion EUR would be invested in new power plants and 3 billion EUR in renewable energy, foremost wind power (Eon.com 31.05.2007).

The company's direction concerning future technologies is somewhat different from its competitors: it does research and development on large-scale battery systems for balancing wind power (Handelsblatt 14.09.2007) and it will build a 8 MW tidal power plant off the Welsh coast scheduled for operation in 2010. Another considerable project is a planned supercritical hard coal power plant in Kingsnorth (UK), advertised to be "capture-ready" for post-combustion CCS. A joint project with Siemens to build a pilot plant in Germany for capturing CO2 from flues gases from 2010 on was announced in early 2008 (Eon.com 16.01.2008).

Moreover, the company has announced to build the "the most advanced hard coal power plant" with over 50% efficiency in Wilhelmshaven in 2010 (VGB 2007), which is a 12% improvement in comparison to the German average (compare BMWA 2003) and according to VDEW the highest worldwide (VDEW 16.04.2007). A study conducted by Ecofys (2007) though reports highest efficiencies for Japan (42%), ranking Germany only fourth behind the Nordic countries and France.

The last one, **RWE**, faces a similar situation like E.ON (old power plants, high nuclear share), except its extensive use of lignite in the Ruhr area (Hilmes & Kuhnhenne 2006). Besides this RWE can also revert to hard coal as an option because its main operating area is suitably pervaded by one of Germany's most important waterways, the river Rhine. Like it has been done be E.ON also RWE has announced a large-scale invest program of 25 billion in 2007, saying that renewables will play an important role (Wirtschaftswoche 42/2007).

Investments and research in new technologies is done in a broad range: the current generation of RWE lignite power plants (BoA) operates at around 43% efficiency, even higher efficiencies of 47% are envisaged for the future (Rwenews.com 18.04.2005). 2002 a first new BoA block was added to Niederaussem, a second and third will follow in Neurath in 2010. Additionally, RWE plans a CCS enhanced "emission-free" coal power plant for 2014 based in IGCC technology (Rwe.com 30.03.2006, VGB PowerTech

5/2005) and has made public only recently (Rwe.com 27.12.2007) that it will build a CAES demonstration power plant together with General Electric in 2012.

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5. Regulation, Manufacturing and Generation of RES electricity

5.1 Supporting policies for RES electricity

Taking current facts and figures, policies to support and foster the deployment of renewables in Germany have certainly been very effective so far: in 2005 Germany ranked first in installed capacity of wind power and grid-connected solar PV in the world (REN21 2005), it recently reclaimed the 2nd position in Ernst & Young's worldwide "Renewable Energy Country Attractiveness Indices" due to new ambitious renewable energy targets (2007b), and even presidential candidates in the US consider German renewable policy worth following[3] (Reuters.com 12.01.2008). Additionally, a recent report by the European Commission (2008) testified Germany very good results concerning effectivity and efficiency of its RES support schemes.

As has been pointed out above a systematic renewable energy policy comprising subsidies and investment aids for various technologies began right after the first oil crisis in 1974 and was notably expanded after the 1986 Tchernobyl incident (compare Wüstenhagen & Bilharz 2006).
The foundations of today's developments in the renewable sector were laid around 1990, but while the 1991 Electricity Feed-In Law was rather a stroke of luck in its consequences for renewable electricity (see above), the "250 MW Wind" support scheme of 1989 for constructing the respective capacity in wind power was a "straight plan". After the last windmill supported by this program was installed in 1996, the market was left to its own good and investments in new facilities reduced. However, at the latest with the enforcement of the Renewable Energy Act (*Erneuerbare Energien Gesetz, EEG*) new installed capacity per year reached an all-time high between 2001 and 2003, declining afterwards for various reasons (see below).

	Wasser-kraft [MW]	Wind-energie [MW]	Biomasse [MW]	Photovoltaik [MW_p]	Geothermie [MW]	Gesamte Leistung [MW]
1990	4.403	56	190	2	0	4.651
1991	4.403	98	k.A.	3	0	4.504
1992	4.374	167	227	6	0	4.774
1993	4.520	310	k.A.	9	0	4.839
1994	4.529	605	276	12	0	5.422
1995	4.521	1.094	k.A.	16	0	5.631
1996	4.563	1.547	358	24	0	6.492
1997	4.578	2.082	400	36	0	7.096
1998	4.601	2.875	409	45	0	7.930
1999	4.547	4.444	604	58	0	9.653
2000	4.572	6.112	664	100	0	11.448
2001	4.600	8.754	790	178	0	14.322
2002	4.620	11.965	952	258	0	17.795
2003	4.640	14.609	1.137	408	0	20.794
2004	4.660	16.629	1.550	1.018	0,2	23.857
2005	4.680	18.428	2.192	1.881	0,2	27.181
2006	4.700	20.622	2.740	2.831	0,2	30.893

Figure 5.1: Installed RES capacities – Source: BMU (2007b)

[3] Even though for effects on employment only.

In the case of solar electricity the breakthrough needed a little longer because generating costs at the beginning of the 90ies were much higher than for wind power. A first program named 1.000 roofs (*1000 Dächer*) was started in 1990 aiming at 10 MW_p capacity to be installed until 1992. A consecutive program (*100.000 Dächer*) followed from 1999 to 2003 implying additional capacity of around 300 MW_p (Agnolucci 2006). In between, mainly local support schemes initiated by specific states or even cities, foremost in Nordrhein-Westfalen, kept the market at pace (Lauber, V & Mez, L. 2006). From then on - with support of the first amendment of the EEG in 2004 in which the feed-in tariff compared to 2000 was increased (except for free standing installations) – the total capacity nearly exploded from 408 MW_p (2003) to 2831 MW_p (2006). Electricity generated from biomass also experienced a considerable growth during the last years, from 790 MW (2001) to 2740 MW (2006). A main driver for this development was the Ordinance on Generation of Electricity from Biomass (*Biomasseverordnung*) of 2001. Hydro power on the other side has not increased much over the last years, because appropriate location for power plants are very limited and in general have been utilized since decades.

5.2 The EEG in detail

The Priority for Renewable Energies Act or Renewable Energy Act is the single most important policy to foster the deployment of renewable energy in Germany. It represents an important part of the country's implementation of EU Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market. The first version was put into force in early 2000, its core elements are (see BMU 2007c):

- Privileged connection of RES plants and facilities to the power networks
- Privileged turnover and transmission of this electricity
- A generation cost oriented feed-in tariff for ever plant, constant over 20 years
- A nation wide balancing of this electricity ant the respective feed-in costs
- The shifting of feed-in and transmission costs to final consumers

A first amendment of the EEG took place in 2004, a second is due for 2008. In 2003 a special regulation to disburden electricity intensive customers was added, that has been revised two times since then.

In the following the most important mechanisms and regulations of the EEG will be described in some detail.

The obligation for **turnover and transmission** ensures that supported plants and facilities are connected to the power grid and that electricity they produce will be purchased by the network operator. However, due to congestions in the system, tedious network expansions and lacking system optimization for RES intermittency operator sometimes exclude EEG electricity for security reasons (*Erzeugungsmanagement*). In practice this procedure poses some problems though, namely that the network operator has to assure that congestion existed and a feed-in rejection was justified.

The precise value of the **feed-in tariff** is different for every technology, dependent on its generation costs and various parameters concerning the type and size of installation, for example roof-top solar panels gain less then and façade solar panels. Tariffs are paid up to 20 years or, in case of hydro power plants, between 15 to 30 years. To support wind power even in areas were wind speed and thus gains are low, there is a special regulation that pays wind in relation to a certain reference facility (lower gains, higher feed-in tariffs). To accommodate technical progress and learning by doing there is an **annual degression** of the initial tariff between 1% (geothermal) and 6.5% (open space solar). This percentage is subtract from the initial tariff for every year between the first year covered in the respective amendment of the EGG and the year of installation. The only exception are geothermal and offshore wind power plants. Figure 5.2 gives an exemplary overview of this scheme for solar power.

	Staffelung der Mindestvergütung für Inbetriebnahmejahr 2007 (Basiswerte für Inbetriebnahmejahr 2004 in Klammern)	Vergütungs-zeitraum	Degression für neu in Betrieb genommene Anlagen
Anlagen auf und an Gebäuden oder Lärmschutz-wänden	Leistungsanteil bis 30 kW_p: 49,21 ct/kWh (57,40 ct/kWh) Leistungsanteil ab 30 kW_p bis 100 kW_p: 46,82 ct/kWh (54,60 ct/kWh) Leistungsanteil ab 100 kW_p: 46,30 ct/kWh (54,00 ct/kWh)	20 Jahre zzgl. Inbetrieb-nahmejahr	5 % p.a. ab 1.1.2005
gebäudeinte-grierte Anlagen (Fassaden)	Bonus für Anlagen, die nicht auf Dächern oder als Dach errichtet werden: zusätzlich 5 ct/kWh		
Anlagen an oder auf baulichen Anlagen (z.B. Erdwälle) und sonstige Anlagen (z.B. versiegelte Flächen, Konversionsflächen)	37,96 ct/kWh (45,70 ct/kWh)	20 Jahre zzgl. Inbetrieb-nahmejahr	5 %. zum 1.1.2005 6,5 % p.a. ab 1.1.2006
Besondere Regelungen	• Der Bonus für Anlagen an Gebäuden unterliegt nicht der Degression. • Der Vergütungsanspruch für Anlagen, die nicht an oder auf baulichen Anlagen angebracht sind, die vorrangig zu anderen Zwecken als der Stromerzeugung aus solarer Strahlungsenergie errichtet wurden, ist an bestimmte Voraussetzungen geknüpft. • Der Vergütungsanspruch für Anlagen, die nicht an oder auf baulichen Anlagen angebracht sind, besteht nur, wenn die Anlagen vor dem 1. 1. 2015 in Betrieb genommen worden sind.		

Figure 5.2: Feed-in tariffs for solar power – Source: BMU (2007c)

Because the various RES plants are concentrated in certain parts the country, there is a **clearing mechanism**, through which the generated electricity is distributed and paid by equally among all network operators.

All EEG supported electricity purchased by the network operators must be resold by retailers in equal parts, i.e. all contracts with customers must include the average percentage of EEG generation at the respective feed-in prices. Hence this instrument is financed by a mark-up on consumer prices. The spread between feed-in prices and the regular contractual price for the total generation of EEG supported electricity is called difference costs (*Differenzkosten*). In 2006 they amounted to around 3,5 billion EUR, which resulted in a mark-up of 0,7 Cent/kWh (BMU 2007c).
To protect the electricity intensive industry an exception was put into force in 2003 (see above). It guarantees that consumers with a total demand of more than 10 GWh per year and a more than 15% ratio of electricity cost compared to net output must pay no or

reduced EEG mark-ups per year[4]. Accordingly, the they receive a lower percentage of EEG electricity which in turns a higher percentage for regular customers.

5.3 Wind power

5.4 Solar power

5.5 Other RES

5.6 Marketing of green electricity

Besides direct governmental measures there is another option to support the deployment of RES, namely consumers willingness to pay for green energy. In particular during 2007, the year of the 4th IPCC Report and the nuclear incidents in Krümmel and Brunsbüttel, the market experienced a change of contracts toward green energy retailers. The largest provider for example, Lichtblick, has doubled the number of consumer from summer 2006 to around 350.000 at the beginning of 2008 (Berliner Zeitung 21.01.2008).

Because EEG supported electricity must not be merchandised as green energy (EEG §18), retailers must provide the share of electricity beyond the EEG percentage by either non-supported domestic or by foreign green electricity. In most of the cases and to a very large extent they do this by importing hydro power from Austria and Norway.
The following shows the mix and the originating countries of the generated electricity for the largest green electricity retailers in Germany.

Retailer	Year	Electricity mix
Greenpeace Energy	2007	• EEG: 13,5% • PV: 1% (Austria) • Wind: 10 % (Denmark, Austria) • Hydro: 75% (Austria, Norway) • Biomass: 0,5% (Austria)
Lichtblick	2007	• EEG: 16% • Hydro: 74% (Austria, Norway) • Biomass: 10% (Germany)
Naturstrom	2006	• EEG: 13% • Hydro: 87% (Austria, Germany)
EW Schönau	2006	• EEG: 10,9% • Hydro: 77,1% (?) • CHP Natural Gas: 12% (?)

Table 5.x: Electricity mix of selected green energy retailers – Source: company websites

As this data shows, apart from some exceptions investments and contracts for delivery mainly go to Austria, Norway and Denmark for providing hydro and, to a much smaller percentage, wind energy. So the premium paid on green electricity does not directly trigger investments in renewable generation in Germany. However, by means of

[4] For a detailed description of this very complex regulation see BMU 2007c, pp. 147-148.

certifications, e.g. ok Power, or by self commitment retailer guarantee that a fixed percentage of their sales is invested in new RES plants and facilities.

Besides this, the European Commissions has established the prerequisites for a tradable certificate system for green electricity between member states (EECS) in its Directive 2001/77/EC. Basically, it prescribes that member states shall ensure until 2003 latest that the origin of RES electricity can be guaranteed by a national issuing body (IB). Based on this guarantees certified green electricity could be traded EU-wide.
In 2003 then, an association was founded to implement such a RECS system in Germany with the Öko Institut as IB and, among others, three of the four big energy companies (E.ON, RWE, Vattenfall) as constituting members.
Lately …

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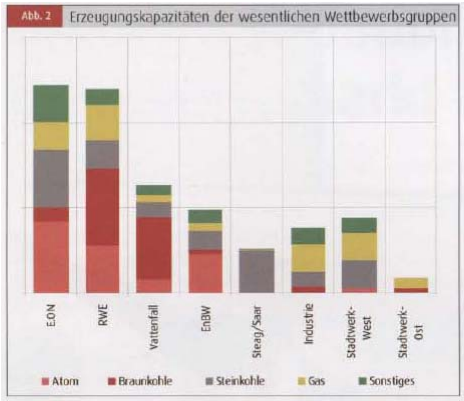
6. Market Structure

Germany as net exporter of elec. is the “swing” market in Europe, RWE factbook



Aus e|m|w 02/2006 (auch etwas zu den Preisen -> bestimmen sich aus Kohle und Gas Kapazitäten)

Rund die Hälfte der Kraftwerksprojekte planten neue Marktteilnehmer, die bisher noch gar nicht oder nur in geringem Umfang in der Stromproduktion aktiv sind. (#137)

Investitionsankündigungen RWE und E.ON

http://www.rwe.com/generator.aspx/rwe-trading/rwe-trading-microsite/mediencenter/property=Data/id=497994/12warum-der-wettbewerb-in-deutschland-funktioniertpdf.pdf

"Sehr harter Eingriff" #147

Energiechefs versprechen Glos mehr Transparenz. #149

- Structure and Performance of Six European Wholesale Electricity Markets in 2003, 2004 and 2005: Part II – Results for Germany and Spain
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7. Networks

Bericht zur Auswertung der Netzzustands- und Netzausbauberichte der deutschen Elektrizitätsübertragungsnetzbetreiber, #132

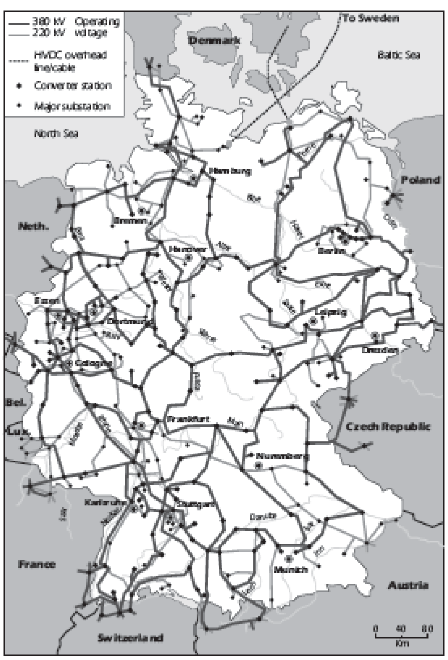
Trennung der Netzgesellschaften 2003

Charges for transmission
The Energy Management Act does not regulate the charges levied by operators for channelling electricity through third-party networks. Although it does provide a means for defining criteria for such charges by the Economics Ministry, the ministry has initially left the issue of charges to self-regulation by the industry itself.
This has been effected through the **Agreement on Criteria for Determining the Charges of Negotiated Third-Party Access** (*Verbändevereinbarung über Kriterien zur Bestimmung von Durchleitungsentgelten)* which was concluded by

- The Federation of German Industries (*Bundesverband der Deutschen Industrie*).
- The Federation of Industrial Energy Consumers and Self-Producers (*Verband der Industriellen Energie- und Kraftwirtschaft*).
- The Association of German Electricity Supply Companies (*Vereinigung Deutscher Elektrizitätswerke)*

in May 1998.
This Agreement describes the organisation of network access on a contractual basis regarding the injection of electrical energy at defined feeder points and the simultaneous removal of electrical energy at remote tapping points in the network (transmission pricing). In particular, it defines that the level of charges for transmission and distribution of third-party electricity can be determinded individually depending on the individual costs of transmission by the network operators. The network operators are ***not obliged to publish*** the calculated charges.

http://www.udo-leuschner.de/basiswissen/SB132-03.htm



IEA Germany 2007, #119

Transmission system operators report no congestion in their grid areas. Nonetheless, in the seven years between 1999 and 2005, they have spent over EUR 4.9 billion to upgrade and expand their high-voltage transmission networks, with investment in 2004 and 2005 being 32% above investment in 2002 and 2003. As part of this investment, 1 200 km of new transmission lines were added.

IEA Germany 2007, #119

VDN Jahresbericht 2006

Stromausfall 4.11.2006

Spannungen im Stromnetz. #145

Acht Netzbetreiber gründen gemeinsame Plattform. #152

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