



# OUTLOOK FOR NEW COAL-FIRED POWER STATIONS IN GERMANY, THE NETHERLANDS AND SPAIN

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A report to DECC

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## 1. EXECUTIVE SUMMARY

Decarbonisation is one of the cornerstones of European energy policy. Several EU Directives are now in place to implement international law (in the case of the Kyoto Protocol) and to ensure Member States contribute towards the overall decarbonisation, environmental standards and sustainability of the European energy system. Many Member States have added their own initiatives to further these policies – for example in the UK setting a legally-binding target for carbon emissions.

Collectively, these European policies drive the new build of low carbon generation; however, they also challenge the future role of emissions-intensive coal-fired generation. While the UK Government has implemented various policies that affect and guide the new build of coal-fired power stations (most notably a policy of no new coal without carbon capture and storage), other countries, like Germany, have no specific decarbonisation strategy for the power sector as such and several new coal and lignite stations are currently under construction.

This report for DECC examines the position of coal and lignite capacity in Germany's generation portfolio and investigates the reasons for the apparent surge in new build coal and lignite plants in recent years.

Germany is the largest electricity market in Europe, with peak demand over 85GW. In 2011, fossil-fuel generation accounted for more than half (58%) of Germany's electricity production, with nuclear contributing 18% and renewables 20%. Recent years have seen considerable growth in renewable generation; its dispatch priority is increasingly displacing fossil-fuel generation and placing pressure on coal and lignite plants to redefine their role within the system.

As of 2011, installed coal and lignite capacity in Germany amounted to 27.6GW and 20GW respectively. Just under 60% of this capacity was commissioned between 1970 and 1990, making the fleet relatively young. Most plants still have 10 years remaining technical lifetime and there is no specific policy for maintaining or phasing-out coal and lignite generation.

In addition to 2.7GW of lignite capacity that became operational in 2012, a further 8GW of new coal capacity is currently under construction and expected to commission by 2015. This apparent surge in coal and lignite is not a recent development, and needs to be understood as being due to highly unusual historical reasons:

- favourable market environment in 2007/8;
- temporary presumption of free carbon allowances for new build plants in Phase III of the EU ETS; and
- inability or reluctance of developers to cancel projects when the circumstances changed and when technical problems delayed their build.

Steeply rising capital costs, fierce local and environmental opposition, the priority dispatch for renewables, the economic downturn, falling demand, low wholesale electricity prices and the expectation of high carbon prices in the future make the short- and long-term investment cases for new thermal plants in Germany unattractive. While there are reportedly 2.7GW of coal or lignite projects in development stage, most of them have not advanced for some years, suggesting likely cancellation. Since 2007, four coal and lignite projects have been postponed and a further 22 abandoned as a result of a combination of the reasons stated above.

It is our opinion, that there will be no major new unabated coal or lignite projects in Germany for the foreseeable future beyond those currently under construction. Our view appears to be endorsed by the German companies: three majors have very publicly announced that they have no intention of building additional coal-fired power stations in Germany until at least the end of the decade.

The Netherlands has many parallels to Germany in that legacy circumstances are responsible for a wave of new coal-fired power stations, but that these conditions are highly unlikely to be repeated.

In Spain coal plant has prevailed in part because of subsidies for indigenous coal production, but the main investment in the sector has been in renewables, and while the difficult economic conditions do not encourage any new build of coal plant, there are no immediate reasons for closure of the existing fleet either.

We conclude that further new projects to build coal-fired generation in Germany, the Netherlands, and Spain are all very unlikely.

Prospects for Coal-fired Carbon Capture and Storage projects appear to be most likely in the UK, where clear policies and programmes to build demonstration projects are in progress.

## 2. GERMANY

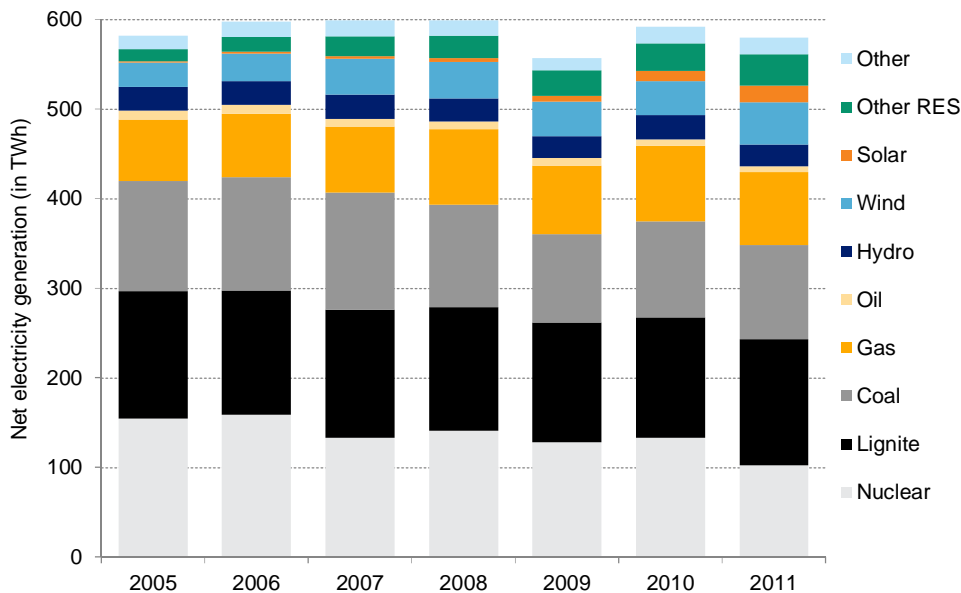
### 2.1 Overview of generation and capacity

Germany is not just largest electricity market in Europe; it also has high traffic across its interconnectors to nine surrounding countries. In gross terms Germany is the biggest importer of electricity (just ahead of Italy) and the second largest exporter (behind France) in Europe<sup>1</sup>. Peak demand in 2010 was 87.5GW<sup>2</sup>.

In 2011 fossil fuel generation accounted for more than half (58%) of Germany’s electricity production, with nuclear (18%) also contributing a sizeable share. Unlike most other Western European countries, fossil fuel generation capacity includes lignite (‘brown coal’). Germany is the largest lignite producer in the world with annual production of 176.5Mt in 2011, roughly 17% of total world production<sup>3</sup>. A growing share of renewables generation (125TWh or 20% in 2011) is putting coal and lignite plants increasingly under pressure to redefine their role within the system. Lignite plants have held their 25% generation share in recent years because their variable cost of production is so low; hard coal-fired generation, which sits slightly higher in the merit order has reduced its share from 21% in 2005 to 18% in 2011 (compare Annex B, Table 7). Due to the more favourable coal-to-gas price relativity and low carbon prices, generation in 2012 from coal and lignite plants was 0.6% and 1% respectively higher.

In contrast, the UK has no lignite-fired generation and coal accounts for about a third of electricity generation from a fleet of plant largely built in the 1960s and 70s. Recent upward trends in output are due to very similar commodity price drivers as Germany.

**Figure 1 – Net electricity generation by fuel type (TWh)**



Source: BDEW Bundesverband der Energie- und Wasserwirtschaft e.V.

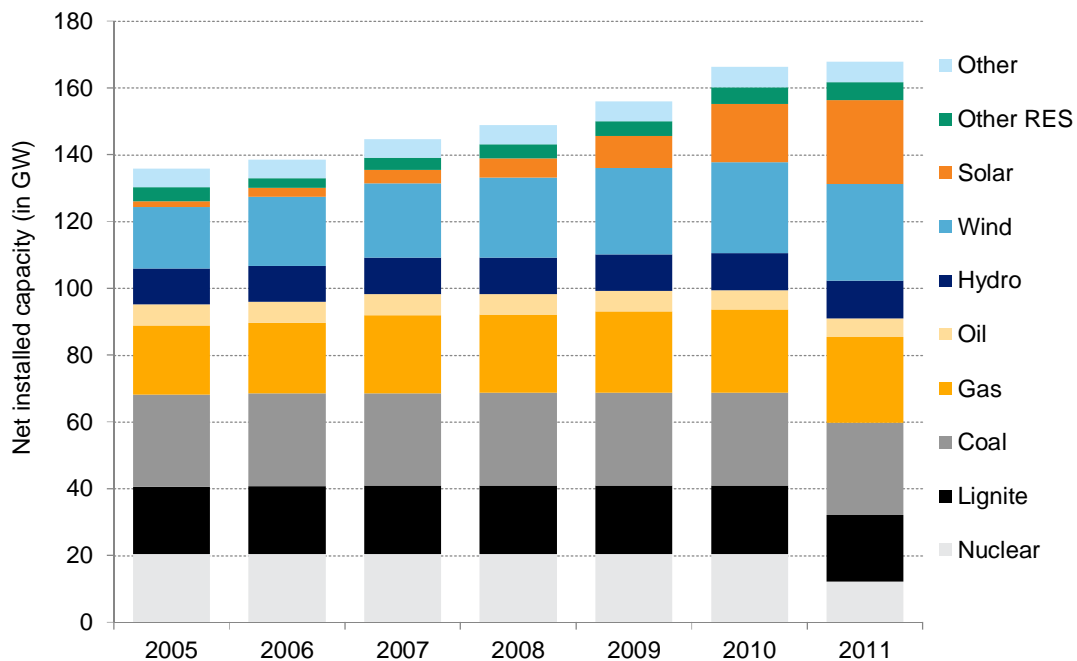
<sup>1</sup> 'ENTSO-E Memo 2011', European Network of Transmission System Operators for Electricity (ENTSO-E)

<sup>2</sup> Estimate, according to the grid development plan, 'Netzentwicklungsplan Strom 2012'

<sup>3</sup> 'IEA Statistics: Coal Information 2012', IEA: lignite also includes oil shale (but not shale oil)

In 2011 total net installed generation capacity in Germany was 168GW<sup>4</sup> and, as shown in Figure 2, the largest shares were wind (17%), coal (17%), gas (15%), solar<sup>5</sup> (15%) and lignite (12%). Thermal capacity has remained fairly constant since 2005, apart from the decommissioning of eight nuclear reactors in 2011. Installed wind and solar capacity grew rapidly over the last decade to reach 29GW and 25GW respectively in 2011. Germany has the largest installed capacity of wind and solar within the EU – accounting for approximately half of EU wind capacity and one third of EU solar capacity<sup>6</sup>. Due to their low load factors, generation from wind and solar remains much smaller than that from lignite, nuclear, coal and gas (see Figure 1).

**Figure 2 – Installed capacity by fuel type (GW)**



Source: BDEW Bundesverband der Energie- und Wasserwirtschaft e.V.

## 2.2 Energy policy and regulation

This section provides a short overview of Germany’s ‘Energiewende’ and its decarbonisation strategy before describing policies directed at thermal power plants such as the LCDP / IED, a potential market design change to support thermal power stations and the future framework for German CCS plants. Other major energy policies driving the German in the last couple of years, such as the 13th Amendment to the Atomic Energy Act (AtomG) leading to the closure of eight nuclear plants and the Renewables Energy Sources Act (EEG) successfully increasing the countries renewables generation, are detailed in Annex A.

<sup>4</sup> Data provided by BDEW Bundesverband der Energie- und Wasserwirtschaft e.V.

<sup>5</sup> Throughout this document, the term ‘solar’ will always refer to solar photovoltaic as there are no plans to use concentrated solar power in Germany.

<sup>6</sup> ‘Wind in power. 2011 European statistics’, The European wind energy association (EWEA), February 2012 and ‘Photovoltaic Barometer’, Euroobserver, April 2012



### 2.2.1 The 'Energiewende'

In 2011, the German Government changed the direction of its energy policy and introduced the 'Energiewende' – a new political programme for a transformation of the German energy system. It aims to move away from nuclear and fossil fuels towards a system dominated by renewables generation and efficient use of energy. The cornerstones of the Energiewende are the exit from nuclear power by 2022 and speeding up the implementation of the Energy Concept (see Annex A.1).

Implementing the Energiewende requires significant investment in networks and storage technologies, a regulatory framework providing sufficient incentives for investment, and a continued political will to implement the new programme.

With the first steps of the Energiewende implemented in 2011/12, the transmission network has increasingly come under stress because of:

- nuclear plants being shut-down in the south of the country;
- significant build of renewables generation in the north; and
- local protests delaying required new power lines.

Recently the regulator Bundesnetzagentur (BNetzA) stated that “..the situation in the grid is 'tense'..” and frequent interventions by TSOs have been necessary to maintain a high security of supply level<sup>7</sup>. To alleviate the situation over the winter 2012/13, TSOs were required to contract 2.6GW of cold reserve plants. The regulator is now facilitating planning procedures for network investments with a new Network Development Plan and the first proposals for a new Renewables Energy Act (EEG) are also being discussed with an aim to slow down the rapid growth of the few last years.

### 2.2.2 Decarbonisation targets

The Energy Concept in 2010 also set a target of 40% emissions reduction (compared to 1990) by 2020. Further into the future Germany is aiming to reduce emissions by 55 % in 2030, 70% in 2040 and 80-95 % in 2050. Unlike the UK, these targets are not legally binding (i.e. they are not part of any legislative document), however they are considered as 'politically binding', in that they appear in a range of official documents<sup>8</sup>. The Energiewende and the subsequent closure of low carbon nuclear plant have not altered the above ambitions; the decarbonisation targets have been confirmed within the Energiewende.

The Government has not adopted any specific roadmaps or strategies to meet its abatement targets and the Energy Concept does not specifically lay out measures to achieve them. There is, therefore, no specific regulation as to how much reduction the energy industry has to achieve and what role emission-intense generation should take in a future low carbon Germany. With the EU ETS in place, the Government has chosen to let the markets to decide on the cheapest emission reduction implementation, i.e. which plants will not cover their long run marginal cost and drop out of the market under the total CO<sub>2</sub> limits set by EU ETS. The Renewables Energy Sources Act (EEG) has been

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<sup>7</sup> Bundesnetzagentur, Bericht zum Zustand der leitungsgebundenen Energieversorgung im Winter 2011/12, May 2012

<sup>8</sup> The Federal State of North Rhine-Westphalia has recently adopted legally binding emissions reduction targets.

adopted amongst other things to subsidise emission-free generation, but is not a decarbonisation strategy of the German Government.

The clearest indication of a potential decarbonisation path for the country is in a scenario study commissioned by the German Government and conducted by EWI, GWS and Prognos<sup>9</sup> to accompany the Energy Concept in 2010. Different scenarios indicate potential paths towards Germany’s emissions goal in 2050 however all of them assume a nuclear plant lifetime extension<sup>10</sup>. In scenario IA the services sector is decarbonised rapidly (65% below 1990 levels in 2020), followed by the industrial sector (55% by 2020) and energy and residential sectors (both 40% in 2020) (see Table 1). In the ‘Leitstudie 2010’ by DLR, IWES and IFNE<sup>11</sup>, the electricity sector decarbonises more slowly because of the nuclear phase-out (in line with the 2002 version of the Atomic Energy Act<sup>12</sup>), so that comparable more reduction is achieved in the heat sector.

**Table 1 – Emissions targets in Scenario IA – EWI, GWS & Prognos study**

Sector	2020	2030	2040	2050
Residential	-40%	-60%	-75%	-85%
Services	-65%	-80%	-90%	-90%
Industry	-55%	-60%	-65%	-70%
Transport	-20%	-45%	-70%	-90%
Energy	-40%	-60%	-80%	-90%

Source: ‘Energieszenarien für ein Energiekonzept der Bundesregierung’, EWI Köln, GWS, Prognos AG, August 2010, rounded values

The results of both studies depended heavily on the assumptions made on the German nuclear plant lifetime, i.e. longer nuclear plant lifetime leads to a quicker and more steady reduction of emissions from the energy sector, while nuclear plant shutdown results in a fast reduction of a higher emission level after 2020.

Germany has been successful so far in decreasing its emissions within the Kyoto Protocol framework without a detailed and binding decarbonisation strategy (see Annex A.2.1). Annex A.2.2 and Annex A.2.3 also cover Germany’s allocation of carbon allowances under the National Allocation Plan in Phase I and Phase II of the EU ETS.

This approach contrasts strongly to the UK where a 2050 decarbonisation target is legally binding and the currently proposals for EMR include an EPS which would effectively prevent any new build of unabated coal-fired plant.

<sup>9</sup> ‘Energieszenarien für ein Energiekonzept der Bundesregierung’, EWI Köln, GWS, Prognos AG, August 2010

<sup>10</sup> It should be noted that this study was conducted before the 13th amendment to the Atomic Energy Act and the confirmation of the nuclear phase-out, so that scenario IA assumes a life-time expansion of all 17 nuclear plants by 4 years.

<sup>11</sup> ‘Leitstudie 2010. Langfristszenarien für den Ausbau der erneuerbaren Energien in Deutschland bei Berücksichtigung der Entwicklung in Europa und global’, DLR, Fraunhofer IWES and LFNW, December 2010

<sup>12</sup> German: ‘Gesetz über die friedliche Verwendung der Kernenergie und den Schutz gegen ihre Gefahren’ (Act on the Peaceful Utilization of Atomic Energy and the Protection against its Hazards, Atomic Energy Act), April 2002 (newest version was adopted February 2012)

### 2.2.3 Large Combustion Plant Directive and Industrial Emissions Directive

The Large Combustion Plant Directive (LCPD) regulating emissions of sulphur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>) and particulates from industrial sites, led to the closure of some older coal and lignite plants in 2012 (see Section 0). The Directive was implemented into German law by the 13<sup>th</sup> Federal Emissions Control Ordinance (BImSchV)<sup>13</sup> in July 2004. Plant operators who had chosen to opt-out of the law needed to declare their decision by 2006 and close their site by 31<sup>st</sup> December 2012. This shifted the original LCPD deadline three years forward.

From 1<sup>st</sup> January 2015, the LCPD will be replaced by the Industrial Emissions Directive (IED). For the power sector, the IED means further tightening of the emissions limits (for NO<sub>x</sub> in particular the limits will be significantly lower). The IED will replace the LCPD for opted-in sites; opted-out plants under the LCPD still have to close in line with their national deadline. The German Federal Parliament adopted legislation to comply with the regulation in November 2012, amending the Energy Act (EnWG) and the Electricity Tax Act (StromStG); however the exact emission limits – to be determined by the respective Member States for certain emission types independently – are only expected to be adopted in 2013. The current Government's draft for the amendment of the Federal Emissions Control Ordinance (BImSchV) would tighten the minimum requirements of the IED. For large hard coal plants (>300MW), for example, NO<sub>x</sub> limits would be reduced from 200mg/m<sup>3</sup> to 150mg/m<sup>3</sup> and dust limits from 20mg/m<sup>3</sup> to 10mg/m<sup>3</sup>. The German Association of Energy and Water Industries (BDEW) has criticised the tightening of several limits, however, more so for gas plants than for coal plants. The closure deadline for opted-out plants was not changed from the original IED (2023). The IED affects 52,000 installations in Europe; 9,000 are in Germany.

This approach is very similar to the UK, which has implemented the LCPD and IED, although adhering to the 2016 timetable of the LCPD. However, the impact has been far more widespread, because the age of so many coal stations meant that the additional investment required to meet the LCPD could not be justified. The IED will further challenge the UK coal fleet and apart from a few notable exceptions, particularly those that plan to convert to co-firing biomass, the majority will close in the early 2020s.

### 2.2.4 Ban on plant closures and discussions on future market design

Operating existing thermal plants has become increasingly difficult in the German market. Renewables priority feed-in is reducing output of all thermal plants and depressing wholesale electricity prices. From a network perspective, the nuclear plant shutdown in 2011 particularly affected the grid in the south, where 5GW of nuclear capacity has closed, and transmission constraints to the North limit the balancing services that Northern generation can provide.

Announcements of closures of low-efficiency gas-fired plant in the south due to negative spark spreads in 2011 and 2012 have initiated a lively debate of security of supply among the industry and now led to the German Government adopting legislation preventing plant shutdowns. The November 2012 amendment to the Energy Act (EnWG)<sup>14</sup> stipulated that plants greater than 10 MW cannot be shut down without informing the responsible transmission operator and the regulator BNetzA at least twelve months prior to a

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<sup>13</sup> German: 'Dreizehnte Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes (Verordnung über Großfeuerungs- und Gasturbinenanlagen)', 17 August 2012

<sup>14</sup> German: 'Gesetz über die Elektrizitäts- und Gasversorgung (Energiewirtschaftsgesetz - EnWG)', 20. December 2012

preliminary or permanent closure of the plant (at least for a transition period until 2017). Permanent shutdown of plants larger than 50 MW is also prohibited after this period if the responsible TSO declares them “system-relevant”. Any assessment has to be approved by the BNetzA and further operation has to be both technically and legally possible. An adequate remuneration has to be paid if a plant is prevented from being shut down: an availability payment which will only cover the spent costs to keep the plant able to produce and an energy payment for actual running costs. Plants are then restricted from participating in the wholesale market for 5 years, so there is little incentive for old plants to enter these agreements as they are only paid on a cost basis, i.e. opportunity costs are excluded from the remuneration. The Government is authorised to draft ordinances to specify the details and available funds for this payment, but has yet to do so.

The German Association of Energy and Water Industries (BDEW) and the association of municipal companies (VKU) have heavily criticised the proposed legislation because it “..constitutes a strong interference in the market, intervenes with plant owner property rights and leads to greater legal uncertainty, hindering investment in the German energy industry..”. They also remark that financial compensation for such forced operation has not been resolved. There have not been any public statements from the big electricity generators regarding this legislation.

The ban on plant closures will probably only effect coal and lignite plants indirectly, because so far none have been identified as system-relevant by the BNetzA. There is little coal and no lignite capacity in Southern Germany and gas-fired plants are better suited to provide the back-up generation needed.

A bigger impact on thermal plants' cashflow can be expected from Germany's plans to change its electricity market design as even high-efficient gas plants have only run very little in 2012 due to highly negative spark spreads. The Federal States, the Government, and the BNetzA are working together in the so-called ‘power station forum’ (Kraftwerksforum) to draft a regulatory framework which should provide a market-oriented solution for securing sufficient reserve capacity in the medium- to long-term. It is unlikely however that the German Government will introduce a new market design before the elections in Autumn 2013.

### **2.2.5 Polices for coal and lignite**

While the German Government has repeatedly intervened in the past in the energy sector to secure political aims, e.g. the closure of nuclear plants or the expansion of renewables, there is no specific policy for maintaining or phasing-out coal and lignite generation at large or any provisions for those plants out of a (non-existing) decarbonisation strategy. It is, however, increasingly concerned about security of supply and has taken action with the ban on plant closures and a potential new market design as laid out above. In the Energy Concept, they also acknowledge coal and lignite generation as necessary technologies to provide back-up electricity when renewables generation is low.

To prevent German coal mine closures, the Government has subsidised the coal mining industry for the last 40 years, effectively offsetting the difference between world coal prices and the high costs of the German industry. However, the subsidy will stop in 2018, and the last two of three remaining ones will be closed as they cannot survive without subsidies. In 2011, 26% of coal burned came from domestic mines enabling them to benefit from lower transport costs and take no exchange rate risk.

In contrast there are no explicit subsidies for lignite production in Germany. In 2010, 91% of produced lignite was used for electricity and heat generation, with the other 9% being

used in synthetic fuel plants and production. For more information on the subsidies for hard coal mining and lignite reserves, please see Annex A.5 and Annex 0.

In the UK any indirect support for deep-mined coal rapidly disappeared after the electricity industry was privatised in the early 1990s and since then the number of deep mines has reduced dramatically, with coal being increasingly sourced from abroad.

### 2.2.6 Carbon Capture and Storage regulation

Although the EU required its member countries to transpose the CCS regulations of the Directive on the geological storage of carbon dioxide (Directive 2009/31/EC) into national laws by June 2011, Germany passed its Act on the demonstration of the permanent storage of carbon dioxide (KSpG)<sup>15</sup> in August 2012 after several years' debate. The legislation only covers demonstration plants in Germany with very low CO<sub>2</sub> storage limits: a maximum annual storage limit of 1.3Mt CO<sub>2</sub> per site and 4Mt CO<sub>2</sub> for the entire country. Operators of CCS sites are allowed to transfer the responsibility for closed CO<sub>2</sub> storage facilities to state authorities after 40 years of operation. One of the most debated clauses in the new KSpG was the 'state clause', that allows Federal States to determine areas where CCS testing and demonstration would be allowed and areas where it would not be permitted. So far, both Federal States with realistic storage potential have now opted out, already severely reducing the impact of the KSpG.

Vattenfall cancelled its 250MW planned oxyfuel lignite plant (Jänschwalde) in December 2011 due to this protracted legislative uncertainty. It had been selected by the European Commission to receive funding under the EU Economic Recovery Programme for CCS demonstration projects in 2009 and 2010. It was supposed to start operation in 2016/17 as the first full-scale non-demonstration CCS plant. While Vattenfall did not rule out building such a plant at the Jänschwalde site in the 2020s, the cancellation of the project and the lack of any clear intent of other energy companies signals that, for the moment, CCS plant development in Germany is effectively dormant.

In contrast to Germany, the UK has been putting in place the many legal and regulatory frameworks necessary to underpin development of a CCS industry. Furthermore, there is a commitment to support development of at least one demonstration project with clear allocation of c £1bn funding. At the time of writing two projects have been selected for funding of FEED studies.

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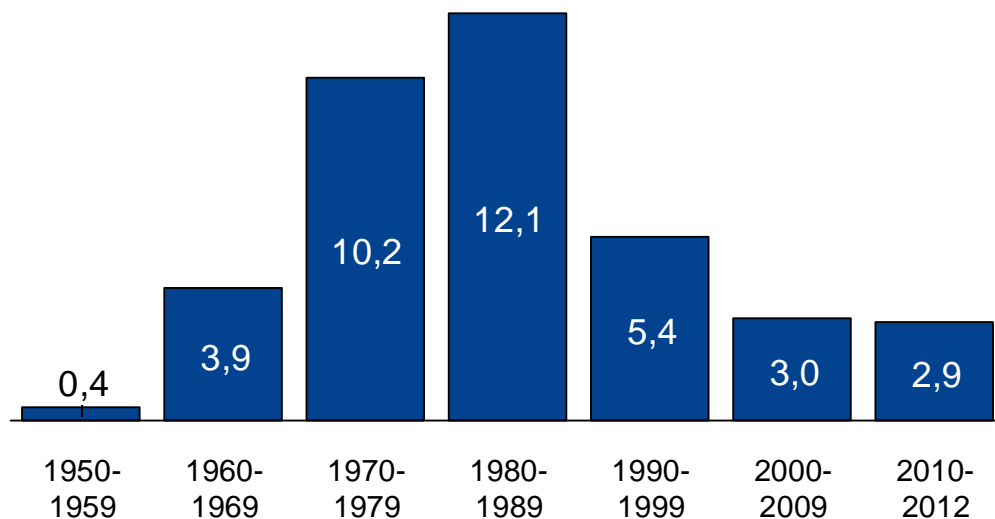
<sup>15</sup> German: 'Gesetz zur Demonstration der dauerhaften Speicherung von Kohlendioxid', 17 August 2012

### 2.3 Current coal and lignite fleet

Lignite accounts for a much larger share of the generation mix in Germany compared to other North West European country. The country is the largest lignite producer in the world, with mines concentrated in North-Rhine Westphalia and the former East Germany. It tends to be burned near the mines because of its relatively high transport costs. Long-term supply contracts between the mines and the power stations as well as very large reserves mean that its use in power generation is expected to continue for many years. With indigenous hard coal production expected to stop in 2018, the coal power stations will have to import all of their fuel supply, mostly via the North Sea ports (e.g. Amsterdam – Rotterdam – Antwerp, ARA)<sup>16</sup>.

As of 2011, coal installed capacity in Germany amounted to 27.6GW, while lignite plants capacity totalled 20.0GW. A small part of this capacity is in cold reserve (0.8GW lignite and 0.6GW coal plants). Figure 3 depicts the age structure of the existing coal and lignite plants in Germany. With just under 60% of plants commissioned between 1970 and 1990, the German fleet is young and most capacity has at least another 10 years' operational life. By 2030, plant retirements should reduce the fleet to below 20GW.

**Figure 3 – Age structure of the existing coal and lignite fleet in Germany (GW)**



Source: Bundesnetzagentur power plant list, 12 December 2012.

Note: This data does not include the category "several fuels" in the list, which explains the difference to the figures stated from BDEW in Section 2.1 and in the text above.

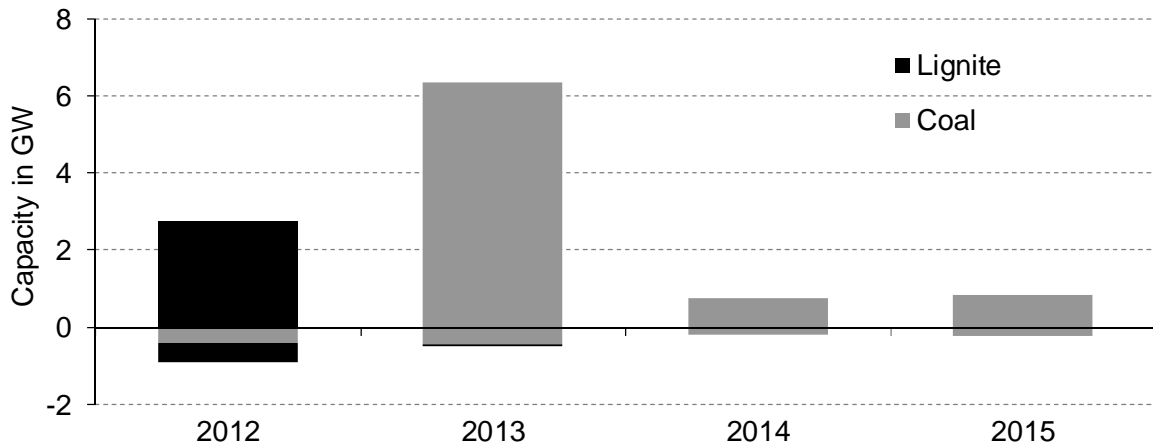
Around 0.6GW of lignite and 1.2GW of coal plant is due to retire in the period 2012 to 2015<sup>17</sup> as shown in Figure 4. This will be offset by 2.7GW of new lignite capacity due in 2012 and 8GW of coal plants under construction. By 2015, we expect a net increase of 8.9GW.

<sup>16</sup> Transport cost for hard coal from ARA ports to the German border are estimated by the German Federal Office of Economics and Export Control with €1.53/t.

<sup>17</sup> Bundesnetzagentur power plant list – new build and decommissioning 2012-2015, 12 December 2012



Figure 4 – Retirement and new build of plants (GW)



Source: Bundesnetzagentur power plant list – new build and decommissioning 2012 – 2015, 12 December 2012  
 Note: Not included are plants in cold reserve or reserve plants.

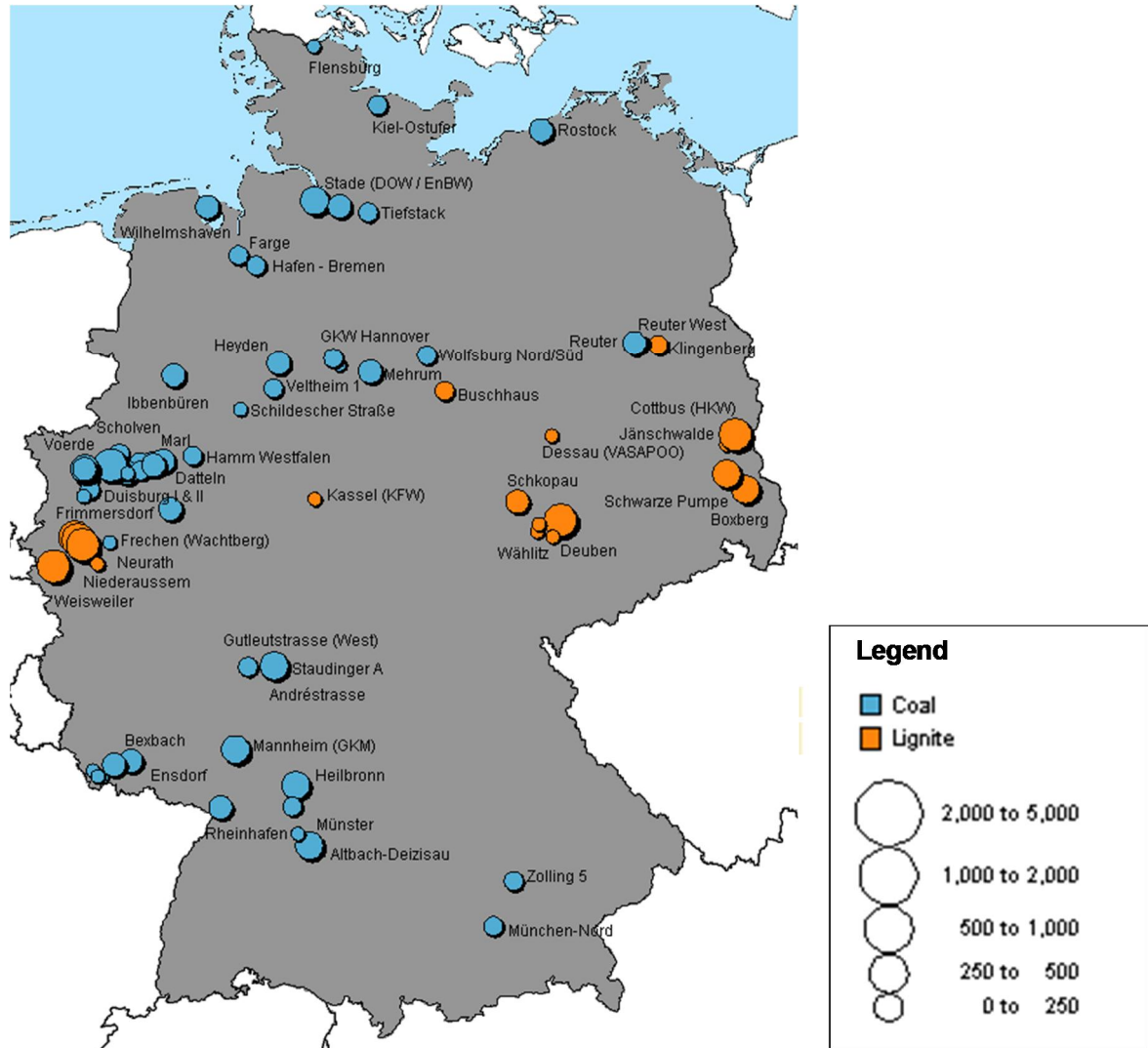
To comply with the LCPD, twelve plants closed in 2012: six 150MW units of the Frimmersdorf lignite plant, two 150MW units of the Niederaußem lignite plant, two units in Hesse, one in Schleswig-Holstein and one in Lower Saxony. Most of these plants had additional reasons for their closure: to receive permits for large new power stations (e.g. RWE Neurath or E.ON Datteln) the developers agreed to shut down older emission-intensive plants. All plants remaining on the system in 2013 meet the LCPD standards.

As the exact limits for certain emission types are only expected to be adopted in March 2013, the effect of the IED on the German coal and lignite fleet is for the moment uncertain. Since German environmental standards were strict (compared to other EU countries) even before the LCPD, Flue Gas Desulphurisation equipment and low NO<sub>x</sub> burners (or other secondary measures) are widespread. Any impact from the current regulatory uncertainty on any new build is therefore unlikely. The Federal Environment Agency expects only a few plants to be seriously affected by IED.

As previously described, the UK has already adopted the IED, but in its intentions to set an Emissions Performance Standard (EPS) will be also setting strict limits on carbon intensity and effectively limiting new coal plant to CCS ones only.

Most coal and lignite plants are located close to their mines or along one of the major rivers in Germany where coal is shipped via inland water transport as shown in Figure 5 below.

**Figure 5 – Location of coal and lignite plants in Germany**

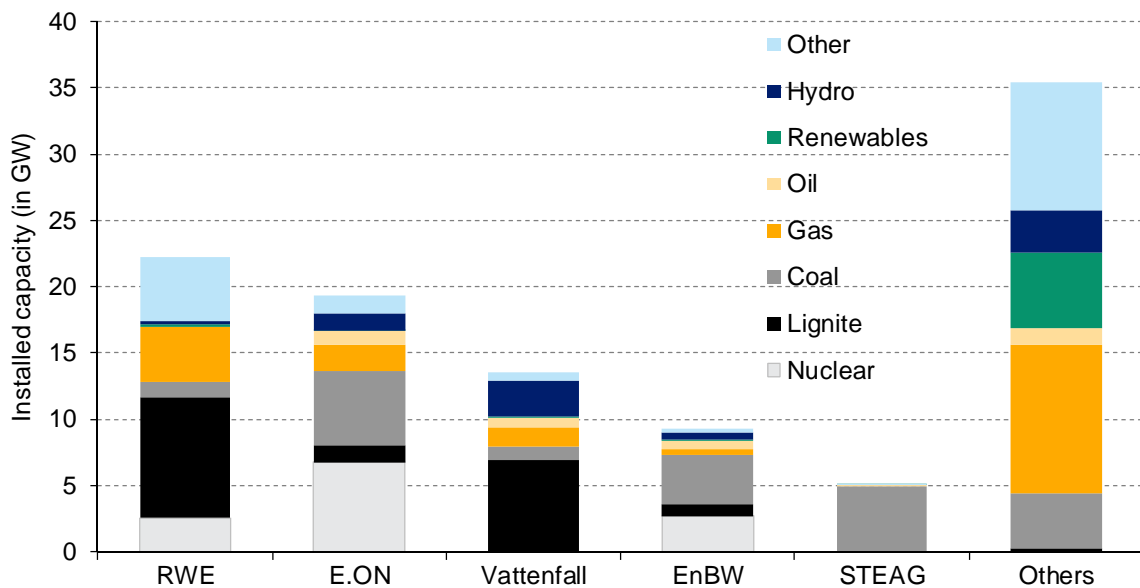


Source: Platts PowerVision, Q3 2009.

Figure 6 shows capacity ownership among the principal energy companies. Both RWE and Vattenfall Europe own significant of coal and lignite fired capacity in their portfolio, whereas E.ON’s mix also contains a significant amount of nuclear plants. EnBW has a fairly balanced portfolio. Owing to Steag’s direct legacy with the mining sector, the majority of its plants are coal-fired. Together these five companies determine the future of the current fleet in Germany and their business strategies provide a clear indication for its outlook.



**Figure 6 – Installed capacity in 2011 by owner (GW)**



Source: Bundesnetzagentur power plant list, 12 September 2012

Note: Net capacity ≥ 20MW. Power plants connected to the German power grid but not actually within German borders have been excluded.

Unlike the UK co-firing of biomass in coal and lignite plants is negligible in Germany. In 2010, only four lignite and five hard coal plants were co-firing small amounts of biomass (for most of them less than 1% by energy). Only two small lignite/coal plants have been fully converted to biomass. The future outlook for plant conversion in Germany remains poor as only plants below 20MW capacity are eligible for support under the Renewable Energy Sources Act (EEG), and to our knowledge no large-sized plants are currently planned to be converted. Future developers are more likely to build new small biomass plants to receive the EEG subsidy for their production. In 2012, dedicated biomass installed capacity increased by 519MW reaching 5.5GW.

This situation stands in comparison to the uptake of co-firing in the UK where extensive conversion to co-firing has been largely driven by eligibility for ROCs and the proposals for Feed-In Tariffs under EMR.

## 2.4 New coal plant construction

A significant amount of new coal and lignite-fired plant is coming on line in Germany. 2.7GW of lignite plant became operational in 2012 and 8GW of coal plant is currently under construction. However, they represent the end of a business cycle rather than being part of a longer term trend.

The financial investment decisions on all this new capacity were taken in the period 2006-2008 when the market environment was generally bullish and dark spreads were high.

At that time, specific German proposed legislation further fuelled the business case. In April 2006, the first draft version of the German National Allocation Plan 2008-12 allocated free carbon allowances to new power stations commissioned before the end of 2012 for a 14 year period. Free allowances would be calculated using load factors of 86% and 94% coal and lignite plants respectively and standard emission benchmarks. The Government’s intent was to incentivise substitution of old, inefficient plant with new ones

and to boost investments in modern technology plants. With this proposition and a general bullish environment for new power plants, at one time almost 30GW of new coal projects were being developed.

In November 2006, the European Commission dismissed the draft on the basis that it interfered with the period after Phase II of the EU ETS. The subsequent final NAP and the Allocation Act (ZuG 2012)<sup>18</sup> adopted in August 2007 did not contain a 14 year free allowances period for new build plants and reduced the allowances for new build in line with the allocation rules for existing plant.

The change led to the abandonment of many development projects, but some had been fast tracked (to achieve commissioning end of 2012) and were already so advanced that cancellation was prohibitively costly, e.g. major delivery contracts including significant penalties had already been signed. Some developers also considered portfolio reasons for further advancing their projects.

Despite the loss of the free carbon allowances, 2007 and 2008 were years of relatively high fuel and electricity prices as well as dark spreads, so that several developers took a view that the projects could still be economically viable. From a project developer's point of view after signing an EPC, it was most likely to be optimal to finish construction of a plant and benefit from future cash flows than cancelling the EPC at 30-50% of the projected costs.

So the present tranche of coal and lignite plants must be understood as a legacy of very peculiar circumstances that are very unlikely to be repeated.

Table 2 provides details of all the larger lignite and coal plants currently under construction.

Construction of most of this group of power stations has actually been far slower than normal for two reasons: firstly court cases with environmental lobbyists and secondly the highly unusual problem of cracks appearing in boiler casings caused by the use of T24 steel alloy<sup>19</sup>. RWE's Westfalen plant, originally due to commission in 2011, had only passed its steam boiler pressure test in August 2012 after T24 induced delays and is now expected to be online towards the end of 2013. Hitachi Power Europe, the company which patented T24, is based in Germany, and it seems only these German projects have used T24. No other North-West European plant has been affected to the best of our knowledge.

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<sup>18</sup> German: 'Gesetz über den nationalen Zuteilungsplan für Treibhausgas Emissionsberechtigungen in der Zuteilungsperiode 2008 bis 2012', December 2011

<sup>19</sup> The steel alloy is used in most coal and lignite plants under construction in Germany to increase steam temperature to around 700 °C and boost the plants efficiencies.

**Table 2 – Large thermal plants under construction**

Plant	Developer	Net capacity (MW)	Approx. FID	Original start year	Estimated start year <sup>1)</sup>	Type	Emission reduction technologies
Neurath F/G*	RWE Power AG	2 x 1050	09 2005	2010	2012	Lignite	ESP, FGD
Boxberg R*	Vattenfall Europe AG	640	10 2005	2011	2012	Lignite	30% less coal consumption than worldwide average plant
Lünen	Trianel GmbH	700	2005	2013	2013	Coal	SCR, FGD, ESP, anti-foaming agent station, <u>not affected by T24</u>
RDK Karlsruhe 8	EnBW Kraftwerke AG	842	10 2006	2011	2013	Coal CHP	SCR, FGD, ESP, CCS fit
Walsum 10	Evonik Steag GmbH, EVN	725	2006 -2007	2012	2013	Coal	SCR, FGD, ESP
Wilhelms-haven	GDF SUEZ Energie D. AG, BKW FMB Energie AG	731	06 2008	2012	2013	Coal	NO <sub>x</sub> , SO <sub>x</sub> and dust 60%, 65% and 50%, respectively, below set legal thresholds
Datteln 4	E.ON Kraftwerke GmbH	1055	2006	2011	2013	Coal CHP	SCR, FGD, ESP
Westfalen D+ E	RWE Power AG	2 x 765	2006	2011/ 12	2013	Coal	Not available
Moorburg A + B	Vattenfall Europe AG	2 x 760	2007	2012/ 13	2014	Coal	SCR, FGD, ESP
Mannheim 9	GKM	843	2007	2013	2015	Coal CHP	SCR, FGD, ESP

Sources: Bundesnetzagentur power plant list – new build and decommissioning 2012 – 2015, 12 December 2012, company websites.

1) Estimated start year according to the Bundesnetzagentur power plant list, not a Pöyry view.

\*Neurath F & G and Boxberg R already started operating in 2012

The near-complete €1bn Datteln 4 coal plant constructed by E.ON is still subject to an ongoing court case filed by environmental group BUND in 2008. The Constitutional Court of North Rhine-Westphalia quashed an environmental permit for the project in 2009; but E.ON still plans to commission in the plant in 2013. It was originally scheduled to start operation in early 2011. Until the new Datteln 4 plant is commissioned the three older Datteln units with a combined capacity of 303MW, and which were originally due to close by the end of 2012, are being allowed to stay operational to ensure a continuous power supply to the German railway Deutsche Bahn and the local district heating network.

Along similar lines, Trianel is reapplying for an operating permit for its 700MW coal-fired power project in Lünen as its original permit was annulled by the Higher Administrative Court in Münster in December 2011. This plant, which didn't use T24 steel, started trial operation in July 2012 was scheduled to come online in Q3 2013.

Vattenfall, having faced a number of challenges to its planned Moorburg 1.6GW coal-fired power station, managed to lay the first rounds of disputes to rest in September 2010. However, in January 2013, the Higher Administrative Court of Hamburg restricted a permit for using Elbe river water for cooling purposes. Not only will the thermal efficiency be impaired but having to construct a tower-based cooling system means that it will now not be commissioned until 2014.

Nearly all of the new power plants use the following technologies to reduce their emissions and comply with the IED:

- selective catalytic reduction (SCR) to reduce nitrogen emissions;
- flue gas desulphurisation (FGD) to remove sulphur dioxide emissions; and
- electrostatic precipitators (ESP) to mitigate particulate matter emissions.

Additionally, the RDK Karlsruhe 8 plant has been set up in a way that it could be equipped with a CCS facility, when the technology becomes commercially available.

## 2.5 No further coal or lignite plant investment in this decade

While 8GW of legacy coal projects are still under construction, there are hardly any new ones in developers' pipelines. Historically rising capital costs and fierce local and environmental opposition reduced developers' appetites but from 2009 onwards, falling demand, lower electricity prices and the economic downturn, have continued this trend.

Only 2.7GW of coal or lignite projects are reported as being in a development stage as shown in Table 3. Most of them have not advanced significantly in recent years and there is now good cause to doubt any proceeding further. The BoAplus project owned by RWE is partly a test project and so might not only be driven by commercial considerations (if built at all given E.ON's current plans not to build any new power stations until the end of the decade). DOW Chemical is currently considering converting their proposed coal plant into a CCGT project.

**Table 3 – Larger plants currently in the pipeline in Germany**

Plant	Developer	Net capacity (MW)	Start of development process	Start year (-)	Type	Status	Comment
Profen	MIBRAG	660	2006	2020	Lignite	In permitting	FID expected in 2015
BoAplus Nieder- außem	RWE Power	2 x 550	2011	n/a	Lignite	-	Unlikely to go ahead, ban on new build
Stade	Dow Chemical	900	2008	n/a	Coal	Awaiting permission	Potentially converted into a CCGT project

Source: Umwelthilfe, Projects of coal-fired power plants in Germany since 2007, November 2012; Greenpeace, Übersicht über neue Kohlekraftwerke in Deutschland: 17 Kohlekraftwerke in Bau oder Planung, 01/2013; company websites

In comparison to the short pipeline project list stands a long register of planned projects. A combined capacity of 25.5GW that have been put on hold or postponed (4 projects, 3.4GW) or abandoned (22 projects, 22.1GW) in the last 5 years is shown in Annex B, Table 8 and Annex B, Table 9. Most recently in July 2012, SüdWestStrom and around 100 municipal energy partners have abandoned their plans for a 1.8GW coal power plant at Brunsbüttel as it would not be able to operate economically and there was a lack of a market framework for thermal generation<sup>20</sup>.

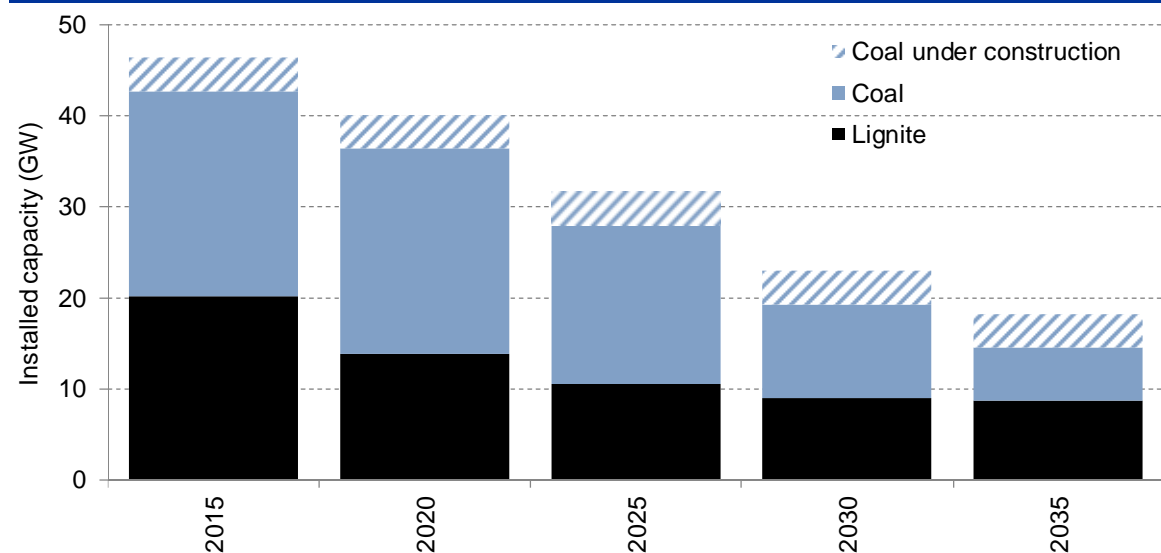
<sup>20</sup> 'SüdWestStrom baut kein Kohlekraftwerk in Brunsbüttel', SüdWestStrom Press Release, 19 July 2012

Kraftwerke Mainz-Wiesbaden announced abandonment of its planned 850MW coal development in Mainz in June 2012<sup>21</sup>. E.ON has abandoned plans for a 550MW plant in Wilhelmshaven, citing delays in new technology that would prevent them from building a plant with 50% efficiency. DONG Energy has withdrawn from a 1620MW project in Greifswald<sup>22</sup>. Local and environmental opposition has also caused suspension of a number of planned projects, e.g. Ensdorf, Berlin-Klingenberg, Germersheim and Krefeld-Uerdingen.

Most of the cancelled project are coal-fired but only two lignite-fired ones have been abandoned. However, each new open cast mine faces such heavy opposition from local population that greenfield lignite development has virtually stopped; only replacements for old lignite power stations, with already established mines are in the development pipeline.

Pöyry’s projections envisage the capacity of coal and lignite power stations to reduce to around 40GW in 2020 and around 23GW in 2030 as shown in Figure 7. Additional capacity only comes from plants currently under construction.

**Figure 7 – Capacity evolution of coal and lignite plant (GW)**

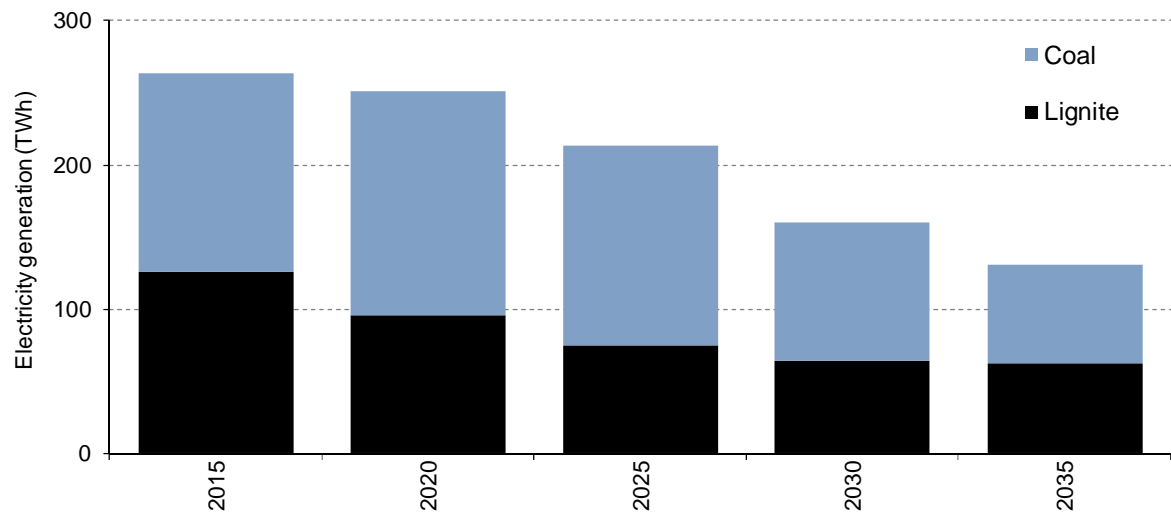


Source: Pöyry Management Consulting

<sup>21</sup> 'KMW setzt Bau des Kohlekraftwerk zeitlich aus', Kraftwerke Mainz-Wiesbaden Press Release, 29 September 2009

<sup>22</sup> 'DONG Energy withdraws from Greifswald project in Germany', DONG Press Release, 11 December 2009

**Figure 8 – Projected generation of coal and lignite plant (TWh)**



Source: Pöyry Management Consulting

Most coal plants had positive cashflows in 2012 due to low coal and carbon prices outweighing low electricity prices (compare Figure 9) and load factors being high.

However with the priority dispatch for renewables under the Renewable Energy Sources Act (EEG) and increasing amounts of them, existing coal and lignite plants will be increasingly forced to the margin in the next few years. Looking further out to 2020, rising renewables output and auctioning of carbon allowances (once unused Phase II allowances are used up) will make it more difficult for less efficient plants to earn a reasonable cash flow.

In our most recent analysis, generation from more modern coal and lignite plants could stay high beyond 2020 with typical load factors above 80% on average (compare Figure 8). Efficient plants recover their fixed costs when coal and carbon prices remain comparatively low (to gas prices) and Germany’s low-cost coal generation is replacing more expensive gas-fired generation in neighbouring countries.

We foresee no closure of coal or lignite plants due to economic reasons. In reality, given most plants will need a major overhaul after 30-40 operational years, some might decide not to undertake an expensive refurbishment and close their plant early, while others will invest in plant life extensions.

This situation contrasts dramatically to the UK where the costs of meeting the IED, combined with a generally far older fleet mean that apart from ones converting to biomass they will close over the next few years and generation from the current coal fleet should accordingly drop to lower levels than at present.

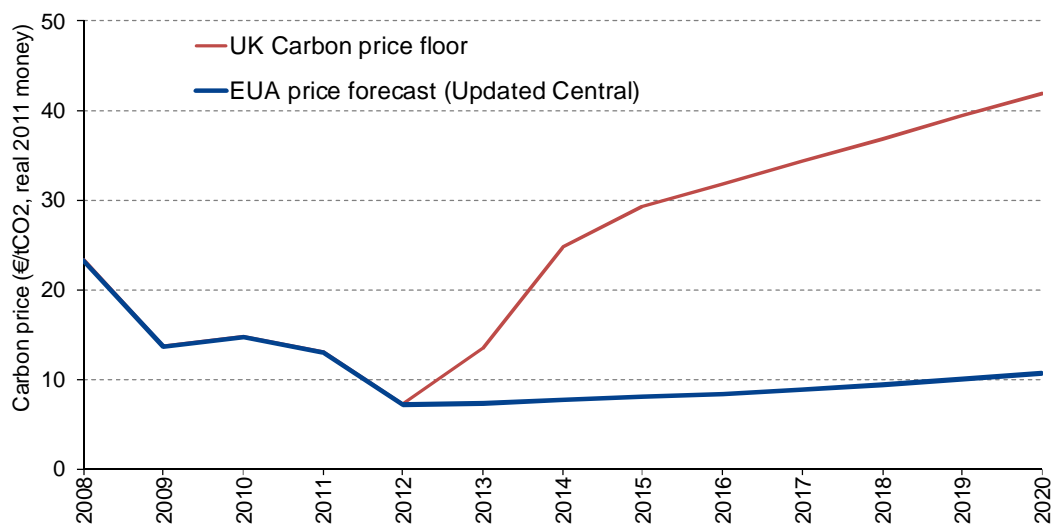
Any investment case for new thermal plants in Germany in the near future is poor: short-term electricity prices are low (due to low demand and an increasing amount of renewables sold via the exchange), the start of the emission allowance auctions this year will make coal and lignite expensive compared to other technologies in the long-term and investors regard coal and lignite plants as poorly suited to the load factors expected in a market with a high proportion of renewables. Our analysis of a central scenario suggest that the plant currently under construction will only earn returns in the range 0-7%.

Nevertheless, because of their very high efficiencies, they are likely to run at high load factors until 2030. Our analysis suggests that low wholesale electricity prices reduce their margins in the first operational years, and in the longer term rising costs of carbon make their business case less attractive<sup>23</sup>.

While the challenging economic drivers for new coal plant in Germany and the UK are similar, there is potential for coal-fired CCS projects in the UK have now qualified for FEED studies under the CCS competition.

Germany has no plans to introduce a carbon price floor like the UK's. Figure 9 shows the likely impact of the floor. If UK carbon price tracks were to be imposed in Germany we would expect to see far lower coal and lignite generation because of the increase in short run costs and the consequent changes in merit order position.

**Figure 9 – EU ETS carbon price projections and the UK carbon price floor**



Sources: DECC, Updated short-term traded carbon values used for UK public policy appraisal, October 2012; HM Treasury, Carbon price floor consultation: the Government response, March 2011.

In our opinion, it is unlikely that there will be any major new coal or lignite projects in Germany beyond the legacy projects already under construction. A few major German utilities have even officially announced their intentions to not build any new coal-fired generation until at least the end of the decade. The current market environment prompted RWE to announce that it will not build further coal-fired power stations beyond the two currently under construction<sup>24</sup>. E.ON announced in August 2012 that it has no plans to build any new coal- or gas-fired power plants until the end of the decade<sup>25</sup>, based on the view that there is sufficient capacity in Central Western Europe until 2020/22. Vattenfall has stated that the company does not intend to invest any further into new coal-fired generation capacity before CCS technology is used commercially<sup>26</sup>.

<sup>23</sup> The projected carbon price out of Pöyry's most recent modelling reaches around €30/tCO<sub>2</sub> in 2030.

<sup>24</sup> 'RWE not to build further new coal-fired power stations', Financial Times Deutschland, 16 June 2010

<sup>25</sup> 'E.ON baut keine neuen Kraftwerke', Handelsblatt, 23 August 2012

<sup>26</sup> Vattenfall.de company website: [www.vattenfall.de/de/energiemix.htm](http://www.vattenfall.de/de/energiemix.htm)

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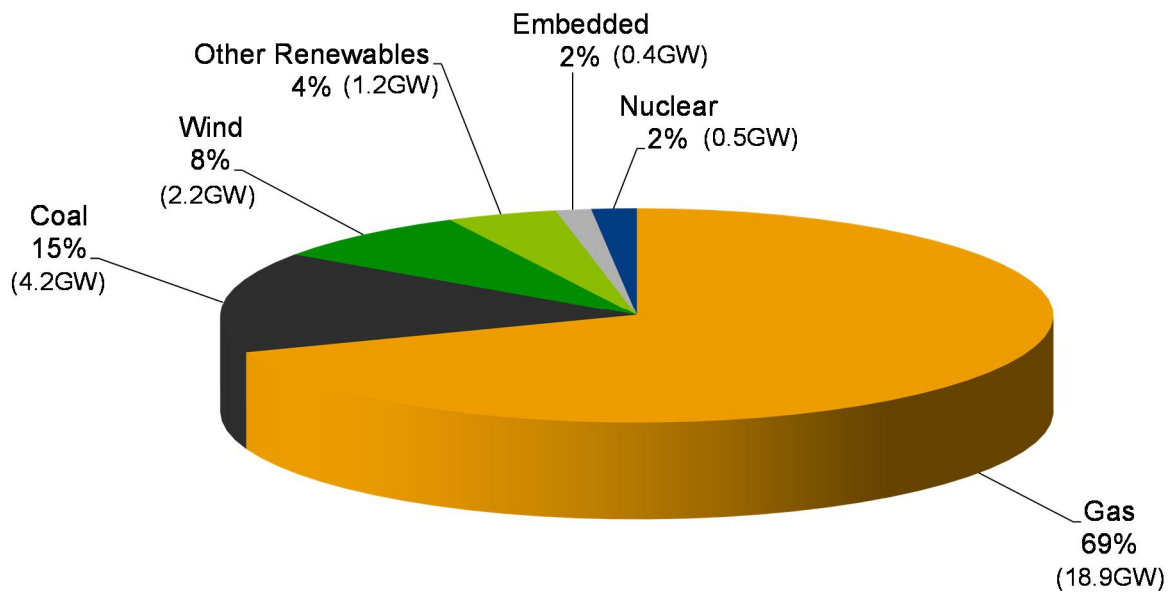


### 3. THE NETHERLANDS

#### 3.1 Existing coal-fired generation

There are eight large coal-fired power stations operating in the Netherlands, totalling around 4.2GW of installed capacity. One of these (Willem-Alexander Centrale, Buggenum) is an integrated gasification combined cycle (IGCC) plant – one of the few coal gasification plants in Europe. With the exception of the two oldest which are expected to close within the next 5-10 years<sup>27</sup>, they are LCPD and IED compliant, and not due to close until 2020-2030.

**Figure 10 – Dutch installed capacity by fuel type (2012)**



Despite the common perception of the country as a gas-dominated electricity market, coal-fired generation plays a significant role; both through domestic production and imports of coal/lignite-fired generation from (primarily) Germany. In particular, coal is an important wholesale electricity price-setting fuel. Our recent modelling of the Dutch wholesale electricity market indicates that coal/lignite-fired plants may be the marginal price-setter for up to 50% of the year in the short-term. For some of this time, the price will be set by a coal/lignite-fired generator across the interconnector with Germany.

#### 3.2 New coal build

There have been substantial additions of new capacity since 2008, leading to a significant capacity surplus. Despite this, a further wave of new capacity is currently in the later stages of construction.

Most under construction or recently commissioned are gas-fired CCGTs. However, as shown in Table 4, three large coal-fired stations are in the final stages of build, totalling

<sup>27</sup> Vattenfall have indicated that Willem-Alexander Centrale may close imminently, unless co-firing can be successfully expanded.

almost 3.5GW, and are expected to be completed in 2013-14. Once they have commissioned, coal as a percentage of total Dutch installed capacity will rise from around 15% (2012) to 22% (2014).

**Table 4 – Coal plant under construction in the Netherlands**

Plant	Developer	Capacity (MW)	Investment decision	Construction start date	Capex (€bn)
Maasvlakte 3	E.ON	1100	2007	April 2008	1.2
Eemshaven	RWE	1600	2008	Mid-2009	2.9
Maasvlakte 4	GDF Suez	800	2007	Mid-2009	1.2

Source: Platts, Energy Focus, RWE, Electrabel, E.ON

As we expect relatively few closures the overcapacity will be further exacerbated by this new build. With some parallels to recent history in Germany, the investment decisions were made for in the years before 2009, when capacity margins were tighter, and demand growth was forecast.

Even though there was a substantial drop in electricity demand in 2009 (-5.4%), the projects were not put on hold or cancelled. RWE CEO Peter Terium stated in February 2012 in the Dutch newspaper *Dagblad van het Noorden* that a coal-fired power station would no longer be built [in the Netherlands] based on current knowledge<sup>28</sup>.

In a number of further respects, the path of these projects has not been smooth. Environmental objections were raised by Greenpeace and the major Dutch environmental organisation Stichting Natuur en Milieu (SNM) against permits for all three. Objections centred on the view that the building of the three coal plants would lead to a de facto breach of the SO<sub>x</sub> and NO<sub>x</sub> emission limits set out in EU Directive 2001/81/EC. Following a long drawn out dispute, which saw the Council of State (RvS, the highest administrative court in the country) seeking the advice of the European Court of Justice in Luxembourg, the environmental permits were approved in November 2011.

### 3.3 Co-firing

The current situation for support of biomass co-firing is highly uncertain. Most existing Dutch coal-fired power stations secured funding for biomass co-firing (at a level around 10%<sup>29</sup>) in the early years of the legacy MEP subsidy scheme (which ran in the period 2003-2006). The support level was €67/MWh for co-firing wood and the duration of support ten years, so it will phase out over the period 2013-2016.

Biomass co-firing in coal-fired power stations is currently not supported under the SDE+ subsidy scheme<sup>30</sup>. Without support, co-firing is not economical. However, the Dutch

<sup>28</sup> Dagblad van het Noorden, 11 February 2012

<sup>29</sup> Most existing Dutch coal-fired plants would technically be capable of much higher co-firing rates, subject to additional capex spend and upgrades.

<sup>30</sup> SDE+ is the current scheme for support of sustainable energy production in the Netherlands. SDE+ is a premium top-up scheme, which operates along similar lines to a CfD FiT. Participants are paid the difference between the 'all-in' technology cost (i.e. a strike price)

Government has made clear its desire to make co-firing of biomass mandatory for all coal-fired power stations, including the three currently under construction. The Netherlands is strongly reliant on biomass co-firing to help meet 2020 renewable energy targets. Mandatory co-firing and/or a subsidy will be required in order to maintain and ramp up co-firing volumes to the required level for the targets to be met. However, no specific level of mandatory co-firing has so far been announced by the Dutch Government.

Following elections in September 2012, the new coalition Government stated that the SDE+ scheme will run until at least 2020. (Replacement with a green certificate scheme had been suggested by the previous Government, but this now seems unlikely before 2020.) An announcement is expected in H1 2013 on the future shape of SDE+ support which will clarify whether or not co-firing will be brought into the scheme.

All three of the new build coal plants should be technically capable of co-firing up to 50% biomass, although additional capex may be required. They will, however, not be able to co-fire biomass in the first three years of operation without invalidating the warranty on the new boilers.

### 3.4 Dutch coal-fired CCS

In October 2009, it was announced that an E.ON/Electrabel (GDF Suez) coal-fired CCS project at Maasvlakte (known as ROAD, a key part of the Rotterdam Climate Initiative) had been successful in gaining funding from the EPPR programme. The project has been earmarked to receive €180m of subsidy from the EU, with the Dutch Government providing an additional €150m. It was chosen in preference to the Magnum project being developed by Nuon (Vattenfall).

The Dutch Government has also awarded €10m to the CATO-2 CCS research project. Its primary focus is supporting two demonstration projects – the ROAD project and a Nuon project at Eemshaven.

However, the future of the ROAD project now seems in doubt, as neither E.ON or Electrabel believe the current carbon prices are sufficient to make the project viable, and the companies are requesting an additional €100m funding from the European Commission<sup>31</sup>. The business case for ROAD was made in 2009 based on a CO<sub>2</sub> price of €15/tCO<sub>2</sub> and the assumption that the price would quickly rise to €25-30/tCO<sub>2</sub>.

A number of other CCS demonstration projects elsewhere in Europe which had secured EC funding under EPPR have been delayed or abandoned, including projects in the UK, Italy, Spain and Germany. A final investment decision for the ROAD project was deferred in mid-2012.

There has been strong public opposition in the Netherlands to the onshore storage of CO<sub>2</sub>. Plans to store captured CO<sub>2</sub> from Shell's giant Pernis refinery in depleted gas fields under the town of Barendrecht were halted in November 2010 by the Dutch Government. This followed strong opposition and safety fears from the townspeople. In the Energy Report 2011, the Dutch Government confirmed that it would only fund CCS projects that stored carbon dioxide offshore.

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and a reference price based on the annual average day-ahead price (adjusted according to a technology-specific benchmark capture rate).

<sup>31</sup> 'ROAD project at risk due to low price of CO<sub>2</sub>', Energeia, 12 October 2012

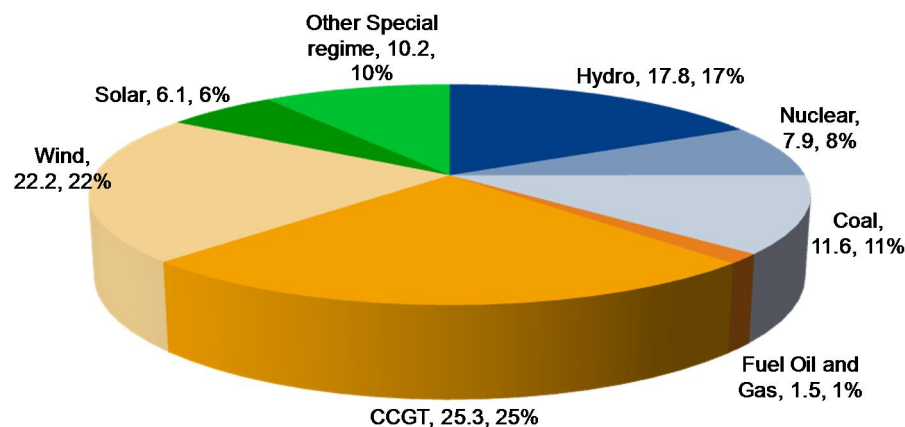
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## 4. SPAIN

### 4.1 Coal-fired capacity and generation

Spain has a significant coal fleet – some 11.6GW in a fleet of power stations whose construction started in the late 1960s with a considerable proportion of the capacity built in the late 1970s and early 1980s. The youngest unit was commissioned in 1997 and unit sizes range from 138-560MW with efficiencies 27-38%. No further coal-fired plants are under construction and to the best of our knowledge none of the market players have plans to add new ones. A considerable proportion of the fleet are located in the principal coal mining areas in the north of the country but a significant number run on imported coal. Figure 11 below illustrates the composition of the national generation capacity. Of note are the relatively high levels of hydro capacity (which historically requires thermal capacity to supply in dry years), and large amounts of wind and other renewables which has been incentivised in recent years.

**Figure 11 – Installed capacity in 2012 (GW)**



Source: REE, Annual Report & Monthly Bulletin

Note: The figures quoted after the fuel name correspond to the respective installed capacity in GW.

The majority of the plant has FGD equipment and only around 450MW of the fleet will retire as a result of the Large Combustion Plant Directive. A draft law to implement the Industrial Emissions Directive was approved for recommendation to Parliament in January 2013 and now awaiting issue of a Royal Decree. It is too early to draw any implications on the likely longevity of the coal-fired power stations, although it has been suggested that most of the imported coal-burning plant and some of the indigenous coal-burning plant, will make the relevant changes, provided that suitable arrangements are in place for coal procurement (see below for current situation).

In our opinion Carbon Capture and Storage does not feature in the plans of policymakers or energy companies, although it should be noted that there is an Integrated Gasification Combined Cycle plant at Puertollano.

## 4.2 Decarbonisation developments in Spain

The main focus of decarbonisation in Spain is through incentivising renewables.

Spain's target under the 2020 Directive is to deliver 20% of energy from renewable sources by 2020 and the country appears to be beating this challenge with 23% of electricity consumption from renewables in 2010, 40% including hydro generation.

Five yearly plans "Plan de Energías Renovables (PER)" issued by the Government lay out the intended mix of renewables generation by technology – both the 2005 and the 2010 PER showed the emphasis on onshore wind and solar technologies. Although altered many times due to the difficult economic circumstances and the greater than expected roll out of the renewables plant, the main policy instrument has been to incentivise the desired technology. In practice the widespread deployment of wind has eroded the output of both gas- and coal-fired plant, and as described below, has prompted additional support for power stations burning indigenous coal.

## 4.3 Support for indigenous coal-fired power stations

Since the start of the liberalisation process in 1994, indigenous coal production and use of coal in power generation has been subsidised in Spain. From 1998 to 2005, the use of Spanish coal was governed by the Mining Plan, which progressively reduced mining volumes from 17.5m tonnes in 1998 to 13m tonnes in 2005. A subsequent update to the Mining Plan in March 2006 set out a further reduction to 9.2m tonnes in 2012.

In 2009 the Spanish Government proposed further support to plants consuming Spanish coal to ensure their continued operation in the short-term. This proposal was driven by the tough economic conditions in the north of Spain where the majority of mines are located and possibly to ensure suitable capacity was available to back up the wind and solar plant. Royal Decrees 134/2010 and 1221/2010 took effect in 2011 and effectively guaranteed off-take of up to 23.4 TWh per year from the 10 coal units still burning national coal at a fixed price (equating to 9% of 2011 demand).

The subsidy expires at the end of 2014 and there is currently no indication of further support for coal plants. It may well cause closure for some of the 4.7GW of plants in the present scheme. There do not appear to be plans to cofire biomass at any of these stations or policies to incentivise such developments.

## 4.4 Outlook

Increasingly policy and regulation in the Spanish electricity market is being driven by the nation's finances. Reducing the burden of subsidising renewables has been at the root of many recent Royal Decrees.

In December 2012, the Spanish Government introduced a new tax on the value of electricity output (Law 15/2012). Among other measures, from January 2013 onwards, the production and feed-in of electricity into the Spanish electricity system would be taxed at a rate of 7% independent of the regime the plants are under (the ordinary or the special regime). The tax will impact different technologies equally as it increases all plants variable generation costs and should not distort the existing merit order.

It law also amended excise taxes for coal: In order to give an analogous treatment to the production of electricity using natural gas, the tax rate on coal is raised from €0.15/GJ to €0.65/GJ, and the exemption on coal consumption for production of electricity and cogeneration is eliminated.

There is even a reasonable chance of even more fundamental changes to the market structure in the next few years.

Against this background it would appear unlikely that the subsidies for indigenous coal plant will be renewed after 2014, but equally further erosion of coal generation by more renewables is also put in doubt as new investment in wind and solar plant seems less likely. Together these factors give an uncertain future for the Spanish coal fleet.

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## ANNEX A – GERMAN ENERGY POLICIES – EXTENDED

### A.1 The Energy Concept

On 28 September 2010, the German Government formally adopted Germany's 'National Energy Concept' to 2050, which provides guidelines for an environmentally-friendly, reliable, and affordable energy supply<sup>32</sup>. As a first step towards implementation of the Energy Concept by December 2011, the Government adopted ten measures including:

- the amendment to the Offshore Installations Ordinance;
- a €5bn offshore wind credit programme;
- improvements to the grid infrastructure;
- cluster connections of offshore wind farms in the North and Baltic Seas;
- exemption of pumped storage plants from grid charges;
- a public information campaign about grid expansion measures;
- nationwide grid expansion planning;
- heat contracting in tenant protection legislation;
- a legal basis for Carbon Capture and Storage testing; and
- the formation of a market transparency agency.

A report on the measures was made to the German Federal Parliament in March 2012 stating that some of the measures have already been implemented, e.g. the Offshore Installations Ordinance, the €5bn offshore wind credit programme, the start of upgrading of the grid infrastructure and construction of the cluster connections of offshore wind farms.

After the Fukushima Daiichi nuclear plant disaster in March 2011, the German Government reassessed the role of nuclear power in Germany. In June 2011 the Government decided to introduce a number of changes to the Energy Concept 2010. The two cornerstones of these changes were the exit from nuclear power by 2022 as well as changes to speed up the implementation of the Energy Concept.

Following the changes decided in June 2011, the following laws were signed into force in August 2011 by the German Federal President:

- 13th Amendment to the Atomic Energy Act (AtG);
- Amendment to the Renewable Energy Sources Act (EEG);
- Amendment to the Energy Act (EnWGÄndG);
- Grid Expansion Acceleration Act (NABEG);
- Amendment to Act on the foundation of special assets for Energy and Climate<sup>33</sup>; and
- Law to strengthen the climate friendly development in cities and municipalities<sup>34</sup>.

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<sup>32</sup> 'Das Energiekonzept der Bundesregierung 2010 und die Energiewende 2011', BMU, October 2011

<sup>33</sup> German: 'Gesetz zur Änderung des Gesetzes zur Errichtung eines Sondervermögens 'Energie- und Klimafonds'', July 2011

## A.2 Germany's decarbonisation targets (Kyoto Protocol and EU ETS)

### A.2.1 Kyoto Protocol

In the Kyoto Protocol of December 1997 the European Union committed to reducing greenhouse gas (GHG) emissions of the then 15 member block by 8% compared to 1990 levels for the period 2008-2012. Under the burden-sharing agreement between EU Member States, Germany's national target is a 21% reduction from 1990 levels for the period 2008-12 (target: 974Mt CO<sub>2</sub>e). In 2008, Germany fulfilled its obligations by achieving a 23% reduction in greenhouse gas emissions, in 2009 this grew to 26%<sup>35</sup>. Emissions increased slightly (to 937 Mt CO<sub>2</sub>e) in 2010 due to economic recovery but still remained more than 25% below 1990 levels. Emissions then dropped again to 917 Mt CO<sub>2</sub>e in 2011, 26.4% lower than in 1990<sup>36</sup>. Part of this reduction must however be attributed to the mild weather conditions during 2011 and the on-going economic crisis which reduces industrial production and therefore lowers electricity consumption from the industry sector. Furthermore the full effect of the nuclear plant shut-down is not fully captured by the 2011 figure as the moratorium only began in March of that year. Counteracting this potential increase in emission was the rise of renewables generation in Germany.

Figure 12 shows greenhouse gas emissions in Germany since 1990. It illustrates the continuous decrease of emissions over the two decades, however some of the reductions in the years after 1990 are the result of old German Democratic Republic lignite plants being shut-down after reunification. Germany is on a reasonable path for further reductions in the future.

The UK's target under the Kyoto Protocol is a 12.5% emission reduction against 1990 levels. So far, emissions decreased far beyond this target, e.g. in 2011 they were 25.9% lower than in the base year 1990 – several factors contribute to this, not least the replacement of large tranches of coal-fired generation with gas-fired CCGTs.

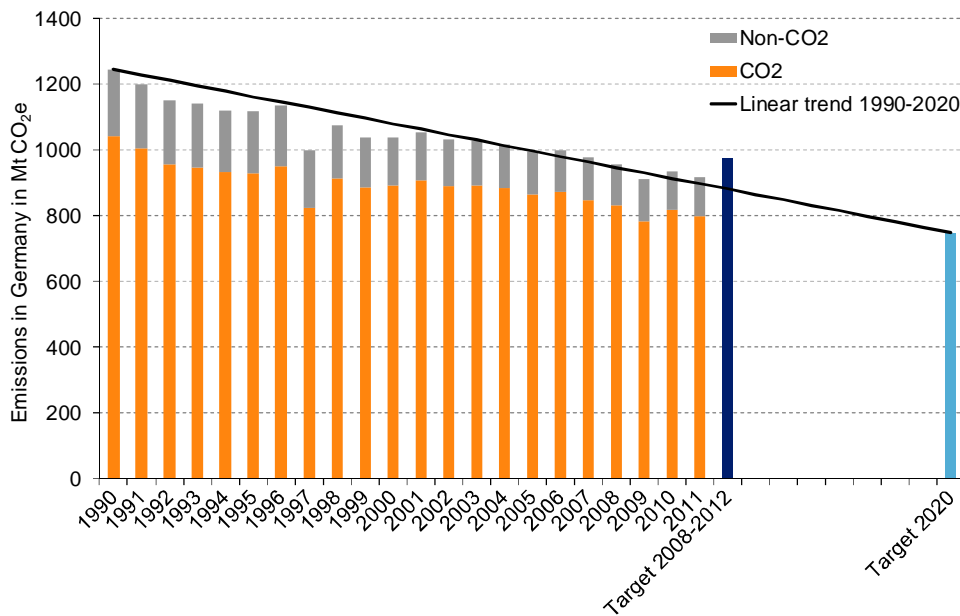
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<sup>34</sup> German: 'Gesetz zur Stärkung der klimagerechten Entwicklung in den Städten und Gemeinden', July 2011

<sup>35</sup> 'Climate protection: Greenhouse gas emissions in 2008 at their lowest since 1990', BMU, 29 March 2009

<sup>36</sup> 'Nationale Trendtabellen für die deutsche Emissionsberichterstattung atmosphärischer Emissionen seit 1990', Umweltbundesamt, 15 April 2012

**Figure 12 – Greenhouse gas emissions since Kyoto base year 1990 (Mt CO<sub>2</sub>e)**



Source: Umweltbundesamt, Nationale Trendtabellen für die deutsche Emissionsberichterstattung atmosphärischer Emissionen seit 1990 (Stand: 15. April 2012) inkl. Zeitznauschätzung für 2011, Presseinformation 2012

### A.2.2 EU ETS Phase I – 2005 to 2007

The EU ETS is a cap and trade scheme that covers CO<sub>2</sub> emissions from large stationary installations only (i.e. a sub-set of those emissions covered by the Kyoto protocol). During Phase I (2005-2007) and Phase II (2008-2012) Member States defined their own National Allocation Plans (NAPs) that:

- set the total number of allowances to be issued; and
- details how these allowances will be allocated to the installations the scheme covers.

The sum of total allowances of individual Member States is referred to as the cap. For Phase III (from 2013) NAPs will be replaced by an EU wide cap with a common method for allocating allowances.

The German National Allocation Plan for the period 2005-2007 had an emissions budget of 982MtCO<sub>2</sub>e per year. The 1,200 companies participating in emissions trading were allocated with 499MtCO<sub>2</sub>e of emissions per year<sup>37</sup>.

### A.2.3 EU ETS Phase II – 2008 to 2012

On 29 November 2006, the European Commission set Germany's annual allocation at 453.10MtCO<sub>2</sub>e per year plus an additional 3MtCO<sub>2</sub>e emitted by the steel industry per year for the second phase of the EU ETS<sup>38</sup>. This represented an 11.5% drop on a like-for-like

<sup>37</sup> Other sectors as trade, commerce, services, transport and households were allocated with 356MtCO<sub>2</sub> equivalents per year.

<sup>38</sup> 'Commission Decision concerning the national allocation plan for the allocation of greenhouse gas emission allowances', European Commission, 29 November 2006

basis from Phase I and was 29MtCO<sub>2</sub>e below the level in Germany's first draft of the NAP for Phase II in June 2006<sup>39</sup>.

The Allocation Act (ZuG 2012)<sup>40</sup>, assigning emission allowances to the covered sectors, came into effect in August 2007. Table 5 summarises the arrangements for different conventional thermal plant types. This includes the allowances that are available for new entrants, which are plants that are commissioned after the start of Phase II. The act specifies the number of yearly allowances allocated to power stations as the product of plant capacity (MW), standard load factor and standard emissions benchmark for the respective technology.

As Germany was required to reduce its total emissions, the act stipulates two separate reduction factors applied to the above mentioned calculation:

- According to §20, allowances for all power plants, existing and new built, were reduced by the 'realisation factor', which equalled the ratio of the annual emission reduction target for the electricity sector (38mn allowances) to the total allowances allocated to electricity generators per year, to achieve the desired overall emission reduction from the power sector.
- Most of the plants already in operation suffered a further pro-rata cut in their allocation of allowances, as stipulated in §4, No.3. These cuts were based on a separately stated emissions benchmark, so that the less efficient plants in any fuel category had their allowances reduced by more than more efficient plants.

Before the passing of the ZuG 2012, there was significant pressure placed on the Government by the lignite industry. The Government resisted this in setting the standard emissions benchmark for lignite plants at the same level as for coal, at 750gCO<sub>2</sub>/kWh. A number of measures though were incorporated to soften the effects on lignite plant, including more favourable treatment in the pro-rata cuts (990gCO<sub>2</sub>/kWh instead of 750gCO<sub>2</sub>/kWh) and an increase in the annual load factor assumed when calculating the allocation for a lignite plant.

The act also allows for companies to meet around a fifth of their requirements (up to 90MtCO<sub>2</sub>/year) with allowances derived from JI/CDM projects.

The ZuG 2012 also stipulated the Auctioning Ordinance<sup>41</sup> that entered into force on 23 July 2009. This decree sets out the conditions under which 40mn emission certificates allowances each year – almost 10% of the total – are auctioned on an exchange from 2010 onwards rather than sold directly to power producers and industrial companies as in 2008/2009. Each week 870,000 emission right certificates were auctioned at one of the existing emissions trading exchanges in form of spot and futures products (EEX). The ordinance was in force until 2012.

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<sup>39</sup> 'Nationaler Allokationsplan 2008-2012 für die Bundesrepublik Deutschland', BMU, 28 June 2006

<sup>40</sup> German: 'Gesetz über den nationalen Zuteilungsplan für Treibhausgas Emissionsberechtigungen in der Zuteilungsperiode 2008 bis 2012', December 2011

<sup>41</sup> Emissionshandels-Versteigerungsverordnung 2012 – EHVV 2012

**Table 5 – Allocations for thermal plant in EU ETS Phase II**

Plant commissioned	Fuel type	Annual allocation method: standard load factor (LF) and standard emissions benchmark	Pro-rata cut based on §4, No.3, (gCO <sub>2</sub> /kWh)
Before 2002	Coal	Multiplying the average annual output in the reference period 2000-2005 by the benchmark 750gCO <sub>2</sub> /kWh	750
	Lignite	Multiplying the average annual output in the reference period 2000-2005 by the benchmark 750gCO <sub>2</sub> /kWh	990
	Gas	Multiplying the average annual output in the reference period 2000-2005 by the benchmark 365gCO <sub>2</sub> /kWh	365
2003 – 2007	Coal	Multiplying the LF of 7,500 hrs/year by the benchmark 750gCO <sub>2</sub> /kWh	750
	Lignite	Multiplying the LF of 8,250 hrs/year by the benchmark 750gCO <sub>2</sub> /kWh	990
	Gas	Multiplying the LF of 7,500 hrs/year by the benchmark 365gCO <sub>2</sub> /kWh	365
Post 2008	Coal	Multiplying the LF of 7,500 hrs/year by the benchmark 750gCO <sub>2</sub> /kWh	Not subject to a pro-rata cut
	Lignite	Multiplying the LF of 8,250 hrs/year by the benchmark 750gCO <sub>2</sub> /kWh	Not subject to a pro-rata cut
	Gas	Multiplying the LF of 7,500 hrs/year by the benchmark 365gCO <sub>2</sub> /kWh	Not subject to a pro-rata cut

Source: Federal Ministry for the Environment, Nature Conservations and Nuclear Safety (BMU)

Note: All power plants' allocations were additionally reduced by the realisation factor, stipulated in §20.

### A.3 Nuclear phase-out

The details of the nuclear phase-out policy in Germany were originally laid out in the April 2002 Amendment to the Atomic Energy Act (AtomG)<sup>42</sup>, whereby the remaining operational period of an individual nuclear plant was characterised by its residual amount of electricity production, calculated from a nominal full-load equivalent operating time of 32 years.

This phase-out had been suspended by another amendment in 2010, allowing nuclear plant life-times to be extended past 32 years operating lifetime. However, the nuclear accident at the Fukushima Daiichi power station caused the German Government once again to change course. It prompted the immediate shut-down of eight of the oldest reactors and a phase-out of the whole nuclear capacity by 2022 in its June 2011 Amendment.

Alongside the October 2010 decision to prolong the lifetimes of the nuclear plants, the German Government also introduced a nuclear fuel tax (Kernbrennstoffsteuer), which was expected to generate €2.3bn per year. With the immediate shutdown of eight nuclear power stations, the tax is still expected to raise significant revenues with tax rates of

<sup>42</sup> German: 'Gesetz über die friedliche Verwendung der Kernenergie und den Schutz gegen ihre Gefahren' (Act on the Peaceful Utilization of Atomic Energy and the Protection against its Hazards, Atomic Energy Act), April 2002 (newest version was adopted February 2012)

€145/gram of newly inserted uranium fuel for the remaining nine plants. On top of this tax, plant operators have to donate some of their additional earnings (from longer operating lifetimes compared to the April 2002 amendment) into a foundation for research on renewable energies and energy storage technologies.

Given the changes made through the June 2011 Amendment to the Atomic Energy Act, RWE, E.ON and EnBW filed lawsuits against the German Government arguing that the tax was unlawful. In October 2011 E.ON and RWE were granted refunding of €96mn and €74mn, respectively, for taxes paid for two nuclear power plants in Bavaria<sup>43</sup>. However, in March 2012, the Federal Fiscal Court reversed this decision. EnBW also lost their lawsuit at first instance in January 2011. RWE, E.ON and Vattenfall are planning to claim for damages occurred because of the immediate shutdown of the eight nuclear power plants, amounting to a total of more than €15 bn. In July 2012, RWE filed a lawsuit against the closure of their Biblis plant (units A and B) during the 'Moratorium'<sup>44</sup>.

#### A.4 Renewable Energy Sources Act

The 'Act on Granting Priority to Renewable Energy Sources' (Renewable Energy Sources Act (EEG))<sup>45</sup> forms the core of the German promotion policy for various renewable electricity sources. It aims to increase the share of renewable electricity produced to 35% by 2020, 50% by 2030, 65% by 2040, and 80% by 2050.

The EEG first took effect on 1 April 2000 but has been amended several times since then. In the past two years the EEG has been adapted twice in order to respond to undesirable market developments and to implement the current political view on how to optimise the support mechanism. The renewable sources eligible under the EEG include hydro, wind, solar, geothermal, biomass (including biogas, landfill gas and sewage treatment plant gas) as well as the biodegradable fraction of municipal and industrial waste. The law places a legal obligation on TSOs to immediately connect renewable plants within defined technological parameters to the most suitable grid connection point and take up electricity produced from the various renewable technologies in their respective territories.

The current EEG considers the following four marketing mechanisms for renewable energy which were introduced with the June 2011 amendment of the EEG (effective from 1<sup>st</sup> January 2012):

- classic marketing of renewable energy employing feed-in tariffs;
- direct marketing claiming a market premium;
- direct marketing under the 'Grünstromprivileg'; and
- other direct marketing.

The different support mechanism either provide renewable electricity generators with an investment environment exempt from any risks related to price and volume or integrate them into the electricity market making them responsible for their output and balancing.

So far, the EEG has been a major success, as Germany is currently the leader in both installed renewable capacity and renewable electricity generation within Europe. Renewables showed a record performance in 2012 providing 22% of total electricity

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<sup>43</sup> 'E.ON, RWE refunded nuclear fuel tax', Handelsblatt, 25 October 2011

<sup>44</sup> 'RWE darf wegen Stopps von Atomkraftwerk Biblis klagen', Frankfurter Allgemeine Zeitung, 4 July 2012

<sup>45</sup> 'Gesetz für den Vorrang Erneuerbarer Energien', March 2000



generation. With continuously and significantly rising costs to consumers but little incentives for cost reduction and market integration, however, all political parties in Germany have called for a fundamental reformation of the EEG.

### A.5 Subsidies for hard coal mining

The costs of mining (hard) coal in Germany have exceeded international coal prices for more than half a century. To prevent the coal mines from early closures, leading to import dependency and the loss of jobs, the German Government adopted a subsidy for coal mining in 1966 which covers the difference between international market prices and the costs of mining<sup>46</sup>. This is subject to the conditions that the subsidised coal is used to supply power stations with fuel, steel production facilities with raw material or to cover the expenses of permanent decommissioning, including a socially acceptable process for older employees in coal mining. The coal subsidy mechanism quickly became a widely used benchmark for heat and fuel cost. BAFA coal<sup>47</sup> was a widely used reference index for long-term gas contract cost. In addition to the federal subsidy, the state of North Rhine-Westphalia also specifically supports its coal mines.

Coal production has been in decline in line with reducing reserves since the 1950s. As of 2011, Germany’s hard coal reserves were 48Mt, with resources totalling 82,961Mt<sup>48</sup>. Under the Coal Financing Act (SteinkohleFinG)<sup>49</sup>, the coal mining subsidy will come to an end in 2018, when the last two of three remaining coal mines are to be closed (the first one will already close in 2015) as they would not be competitive against world coal prices without the state subsidy. In 2011, 26% of coal burned in German power stations came from domestic mines enabling them to resource their coal locally with reduced transport costs and no exchange rate risk.

**Table 6 – Maximum\* of federal and state subsidies granted to coal mining (€bn)**

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Federal	1.55	1.51	1.36	1.72	1.28	1.33	1.05	1.02	0.94	0.79
North Rhine-Westphalia	0.47	0.44	0.42	0.39	0.36	0.17	0.17	0.16	0.15	0.22

Note: These are the maximum payments allowed under the SteinkohleFinG. As the subsidy also covers expenses of permanent decommissioning, some payments continue after 2018. Source: SteinkohleFinG.

While production has been decreasing, imports of coal have increased significantly over the last 20 years (see Figure 13). In 2011, coal imports amounted to 45Mt, most of which coming from Columbia (24%), Russia (24%) and the USA (18%)<sup>50</sup>. By far the biggest share of total consumed hard coal in Germany is used for electricity and heat generation (74% in 2010)<sup>51</sup>.

<sup>46</sup> Act for Securing the use of hard coal in the electricity sector, German: Gesetz zur Sicherung des Steinkohleneinsatzes in der Elektrizitätswirtschaft

<sup>47</sup> The Federal Office of Economics and Export Control publish monthly prices of imported steam, coking and PCI-coal.

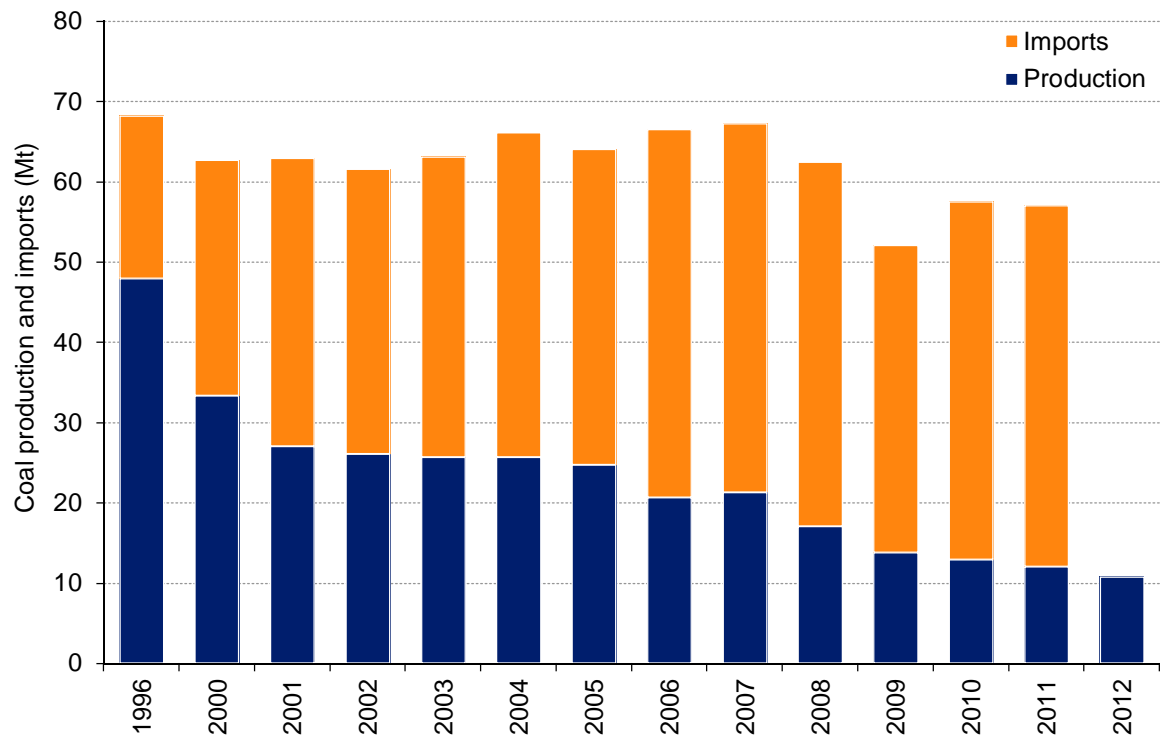
<sup>48</sup> ‘DERA Rohstoffinformationen, Energistudie 2012’, Deutsche Rohstoffagentur

<sup>49</sup> German: ‘Gesetz zur Finanzierung der Beendigung des subventionierten Steinkohlenbergbaus zum Jahr 2018’

<sup>50</sup> ‘DERA Rohstoffinformationen, Energistudie 2012’, Deutsche Rohstoffagentur

<sup>51</sup> IEA Coal information 2012

Figure 13 – Coal mining production and imports for Germany (Mt)



Source: kohlestatistik.de.  
 Note: import data for 2012 not yet available

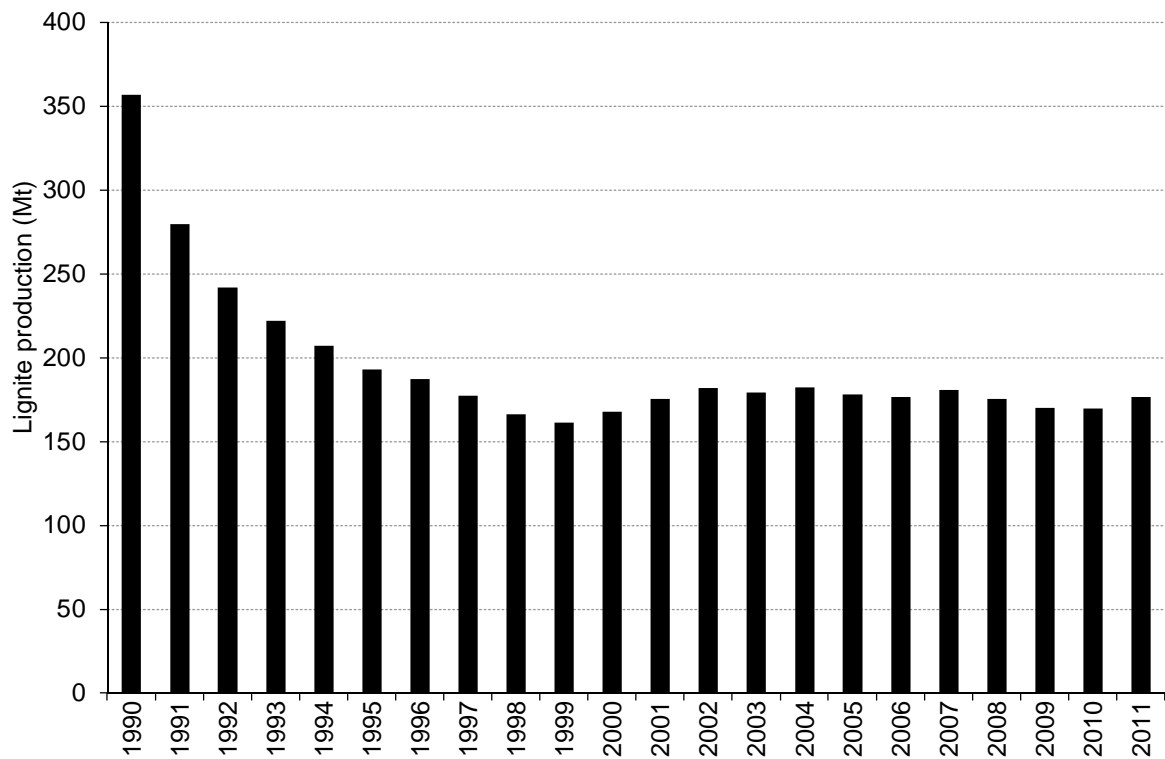


### A.6 Lignite reserves

There are no explicit subsidies for lignite production in Germany, such as the subsidy for hard coal mining. Some special provisions, however, apply to the mining of lignite, e.g. exemptions from the mining charge (10% of the market price) and water consumption charges.

Lignite is usually used for electricity generation at or near the production site. In 2010, 91% of produced lignite was used for electricity and heat generation, with the other 9% being used in patent fuel plants and production. German lignite production dropped from 357.5Mt in 1980 to 176.5Mt in 2011, a decrease of more than 50%<sup>52</sup> (compare Figure 14). However, the country remains the world's leading lignite producer. As of 2011, lignite reserves in Germany were 40,500Mt, resources amounted to 36,500Mt<sup>48</sup>.

**Figure 14 – Lignite production in Germany (Mt)**



Source: kohlestatistik.de

<sup>52</sup> IEA Coal information 2012

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## ANNEX B – ADDITIONAL TABLES AND FIGURES

**Table 7 – Net electricity generation (TWh)**

TWh	2005	2006	2007	2008	2009*	2010*	2011*
Nuclear	154.6	158.7	133.2	140.7	127.7	133.0	102.2
Lignite	141.6	138.5	142.3	138.1	133.7	134.2	140.7
Coal	123.1	126.8	130.8	114.4	98.8	107.4	105.1
Gas	68.4	70.8	73.4	84.0	76.2	84.1	81.4
Oil	10.6	9.5	8.6	8.3	8.7	7.5	6.3
Hydro	26.3	26.4	27.6	26.1	24.3	27.0	24.8
Wind	27.2	30.7	39.7	40.6	38.6	37.8	46.5
Solar	1.3	2.2	3.1	4.4	6.6	11.7	19.0
Other RES	13.8	17.0	22.1	25.4	28.2	30.6	35.1
Other	14.6	16.8	17.7	16.8	14.0	18.1	18.2

Source: BDEW Bundesverband der Energie- und Wasserwirtschaft e.V.  
Note: \*= estimated.

**Table 8 – Large coal plant currently on hold or postponed in Germany**

Plant	Developer	Net capacity (MW)	Put on hold	Source and status
Brunsbüttel	GETEC	800	12 2007	Newspaper <sup>53</sup> ; only initial application activities
Lünen, Moltkestraße	Evonik Steag	900	10 2007	Bund (environmental group); economic reasons
Herne 5	Steag	750	01 2008	Press release <sup>54</sup> ; delayed due to economic reasons, CO <sub>2</sub> auctions
Marl, Chemiepark	Infracor	900	11 2011	Environmental group websites; public development plan altered

Source: Umwelthilfe, Projects of coal-fired power plants in Germany since 2007, November 2012; Greenpeace, Übersicht über neue Kohlekraftwerke in Deutschland: 17 Kohlekraftwerke in Bau oder Planung, 01/2013; company websites

<sup>53</sup> <http://www.shz.de/nachrichten/schleswig-holstein/panorama/artikeldetail/artikel/kohlekraft-im-land-vor-dem-ende.html>

<sup>54</sup> <http://corporate.evonik.com/de/presse/suche/pages/news-details.aspx?newsid=4953>

**Table 9 – Large coal plant developments cancelled since 2007**

Plant	Developer	Capacity (MW)	Cancelled	Source and reason
Staudinger	E.ON	1,100	11 2012	Newspaper <sup>55</sup> , economic situation
Stade	E.ON	1,100	09 2012	Newspaper <sup>56</sup> , economic situation
Krefeld-Uerdingen	Trianel	810	07 2011	Newspaper <sup>57</sup> , local resistance and economic reasons, CCGT planned
Jänschwalde	Vattenfall	500	12 2011	<u>Lignite plant</u> ; newspaper <sup>58</sup> ; no legal basis for CCS
Arneburg	RWE	1,600	07 2010	Newspaper <sup>59</sup> , local and political resistance
Brunsbüttel	SüdWestStrom	1,800	07 2012	Press release <sup>60</sup> ; new state Government, not competitive
Hürth	RWE	450	01 2011	<u>Lignite plant</u> ; website <sup>61</sup> ; no legal basis for CCS
Wilhelmshaven	E.ON	500	03 2010	Website <sup>62</sup> : plant not feasible
Stade	GDF Suez	800	02 2010	Newspaper <sup>63</sup> ; noise/water concerns, economic situation
Dörpen	EnBW Kraftwerke, BKW FMB Energie	900	12 2009	Press release <sup>64</sup> ; heat buyer decided to build own plant, not economic without heat off-take
Mainz-Wiesbaden 5	KMW Kraftwerke Mainz/Wiesbaden	850	12 2009	Press release <sup>65</sup> ; financial crisis, process abandoned 06 2012
Greifswald	Dong Energy	1,620	12 2009	Press release <sup>66</sup> ; lost backing by state Government
Kiel	Stadtwerke Kiel, E.ON Kraftwerke	800	09 2009	Press release <sup>67</sup> ; political resistance, Stadtwerke now plan a gas plant

<sup>55</sup> <http://www.faz.net/aktuell/rhein-main/kohlekraftwerk-eon-baut-staudinger-nicht-aus-11959310.html>

<sup>56</sup> <http://www.abendblatt.de/region/stade/article2406281/E-on-verzichtet-auf-Kohlekraftwerk.html>

<sup>57</sup> <http://www.derwesten.de/unresolved/aus-fuer-kohlekraftwerk-in-krefeld-trianel-will-auf-gas-setzen-id4848081.html>

<sup>58</sup> <http://www.germanenergyblog.de/?p=8070>

<sup>59</sup> <http://www.az-online.de/lokales/landkreis-stendal/osterburg/rwe-keine-neuen-kohlekraftwerke-806114.html>

<sup>60</sup> [http://www.suedweststrom.de/index.php?eID=tx\\_nawsecured1&u=0&file=fileadmin/sws/pdf/Pressemitteilungen/20120719\\_PM\\_SuedWestStrom\\_baut\\_kein\\_Kohlekraftwerk\\_in\\_Brunsbuettel.pdf&t=1360662140&hash=9edb14ad4e1df322100afd937f116a93057c44549](http://www.suedweststrom.de/index.php?eID=tx_nawsecured1&u=0&file=fileadmin/sws/pdf/Pressemitteilungen/20120719_PM_SuedWestStrom_baut_kein_Kohlekraftwerk_in_Brunsbuettel.pdf&t=1360662140&hash=9edb14ad4e1df322100afd937f116a93057c44549)

<sup>61</sup> <http://www.steag.com/walsum.html>

<sup>62</sup> [http://www.kraftwerk-wilhelmshaven.com/pages/ekw\\_de/Kraftwerk\\_Wilhelmshaven/Portraet/index.htm](http://www.kraftwerk-wilhelmshaven.com/pages/ekw_de/Kraftwerk_Wilhelmshaven/Portraet/index.htm)

<sup>63</sup> <http://www.handelsblatt.com/unternehmen/industrie/energiebranche-gdf-suez-kommt-mit-kohlekraftwerk-nicht-durch/3359502.html>

<sup>64</sup> [http://www.enbw.com/content/de/presse/pressemitteilungen/2009/12/PM\\_20091209\\_d\\_\\_rpen\\_mw01/index.jsp](http://www.enbw.com/content/de/presse/pressemitteilungen/2009/12/PM_20091209_d__rpen_mw01/index.jsp)

<sup>65</sup> <http://www.kmw-ag.de/download/mitteilungen/pm-kmw-setzt-bau-aus.pdf>

<sup>66</sup> <http://www.dongenergy.com/EN/Investor/releases/Pages/omx%20feed%20list%20details.aspx?omxid=451981>

<sup>67</sup> [http://www.stadtwerke-kiel.de/index.php?id=unternehmen\\_\\_presse\\_\\_presse2009\\_\\_14\\_07\\_2009](http://www.stadtwerke-kiel.de/index.php?id=unternehmen__presse__presse2009__14_07_2009)

Berlin Klingenberg	Vattenfall Europe	800	03 2009	Newspaper <sup>68</sup> ; public & political resistance, now converted into a planned gas project
Germersheim	EnBW Kraftwerke	800	09 2008	Press release <sup>69</sup> ; public concerns, cooling water, grid connection, logistics, costs
Bremen- Mittelsbüren	SWB Stadtwerke Bremen	1,600	08 2007	Press release <sup>70</sup> ; investment decision: economic reasons
Ensdorf	RWE Power	1,600	11 2007	Newspaper <sup>71</sup> ; 70% of the town opposed the plant in consultation
Quierschied- Weiher	Evonik Steag	800	08 2007	Newspaper <sup>72</sup> ; company pursued other locations further
Köln-Niehl	RheinEnergie	800	07 2007	Newspaper <sup>73</sup> ; costs increased by 30%, CO <sub>2</sub> auctions, converted into a CCGT project
Brunsbüttel	GDF Suez	830	02 2010	Newspaper <sup>74</sup> ; noise prevention issues
Düsseldorf	SW Düsseldorf	400	04 2010	Press release <sup>75</sup> ; converted into a CCGT project
Emden	Dong Energy	1,600	10 2009	News article <sup>76</sup> ; financial crisis, different company strategy

Sources: Umwelthilfe, Projects of coal-fired power plants in Germany since 2007, November 2012; Greenpeace, Übersicht über neue Kohlekraftwerke in Deutschland: 17 Kohlekraftwerke in Bau oder Planung, 01/2013; company websites, newspaper websites

68 <http://www.stromvergleich-strompreisvergleich.com/news/vattenfall-neue-plane-fur-berlin-lichtenberg/>  
69 [http://www.enbw.com/content/de/presse/pressemitteilungen/2008/09/PM\\_20080926\\_cu\\_mw01/index.jsp](http://www.enbw.com/content/de/presse/pressemitteilungen/2008/09/PM_20080926_cu_mw01/index.jsp)  
70 <http://www.lifep.r.de/pressemitteilung/handelskammer-bremen/Handelskammer-bedauert-Entscheidung-der-swb-AG-gegen-den-Neubau-des-Kohlekraftwerks-Mittelsbueren/boxid/11022>  
71 <http://www.faz.net/aktuell/wirtschaft/unternehmen/rwe-scheitert-mit-kraftwerksbau-kleiner-ort-verhindert-grosses-kraftwerk-1485866.html>  
72 [http://www.strom-magazin.de/strommarkt/rag-kein-kraftwerksneubau-in-quierschied\\_20625.html](http://www.strom-magazin.de/strommarkt/rag-kein-kraftwerksneubau-in-quierschied_20625.html)  
73 <http://www.ksta.de/wirtschaft/kohlekraftwerk-auf-eis,15187248,13420910.html>  
74 [http://www.stromseite.de/strom-nachrichten/gdf-suez-gibt-kraftwerksprojekt-in-brunsbuettel-auf\\_29658.html](http://www.stromseite.de/strom-nachrichten/gdf-suez-gibt-kraftwerksprojekt-in-brunsbuettel-auf_29658.html)  
75 [http://www.swd-ag.de/unternehmen/presse/pressemitteilungen/pressemitteilungen\\_2010.php](http://www.swd-ag.de/unternehmen/presse/pressemitteilungen/pressemitteilungen_2010.php)  
76 <http://www.ndr.de/regional/dossiers/kohlekraft/kohlekraft102.html>

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