Carbon Tracker Initiative

Coal:

Caught in the EU Utility Death Spiral

June 2015

About Carbon Tracker

The Carbon Tracker Initiative is a team of financial specialists making climate risk real in today's financial markets. Our research to date on unburnable carbon and stranded assets has started a new debate on how to align the financial system with the energy transition to a low carbon future.

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Mark Fulton has had 35 years experience in financial markets spanning three continents in London, New York and Sydney. As a recognised economist and market strategist at leading financial institutions including Citigroup, Salomon Bros and County NatWest, he has researched international economies, currencies, fixed income and equity markets. Mark was head of research at DB Climate Change Advisors at Deutsche Bank from 2007 to 2012. From 2010 to 2012 he was Co-chair of the UNEP FI Climate Change Working Group and in 2011 and 2012 was part of the technical committee of the UN Secretary General's Sustainable Energy for All.

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Executive Summary

Coal: caught in the EU utility death spiral.

Ever since Thomas Edison patented a system for electricity distribution in 1889, the electricity sector has grown and become essential to the social and economic development of every country worldwide. However, the electricity sector is changing. Nowhere has this change been more profound than in Europe. In this report we analyse the EU's largest 5 power generators: Électricité de France (EDF), GDF Suez, Enel, E.ON and RWE, who collectively represent nearly 60% of Europe's electricity generation, during the period between 2008 and 2013 to help understand: 1) why they lost so much value; and 2) the viability of new coal in Europe based on our assessment of future market conditions.

> On a market capitalization basis, the EU's largest 5 power generators have collectively lost over 100 billion euros (or 37% of their value) from 2008 to 2013.

EU electricity markets shifting

On a market capitalization basis, the EU's largest 5 power generators have collectively lost over 100 billion euros (or 37% of their value) from 2008 to 2013. In contrast, Germany's stock market increased 18% over the same period. The utility death spiral has called into question the old utility business models. Renewable energy technology, environmental and air quality concerns, and evolving customer needs are transforming the production and consumption of electricity. As a result we are seeing the restructuring of major European utilities to split fossil fuel and renewables businesses.

Electricity demand and GDP decoupling

EU electricity demand fell 3.3% from 2008 to 2013, whilst GDP grew 4.1%. This improved efficiency of economies demonstrates that continued economic growth is not necessarily dependent on parallel growth in energy. Not only is the overall level of demand falling, but the proportion being met by fossil fuels is declining. Yet utilities have been banking on business as usual which has led to oversupply and excess fossil fuel capacity. In the face of increased competition, EU coal-fired generation fell 4.2% over the 2008-2013 period. However, some of the largest utilities have maintained significant coal capacity, led by RWE which still had more than half of its generation based on coal as of 2013.

Risk of stranded assets increasing

We evaluated how developments in carbon pricing, energy efficiency and renewable energy will impact fossil generation in Europe in the future and found: (1) reform of the EU's Emission Trading System (EU ETS) could see carbon prices average 9.7 €/t over the next five years and 19.4 €/t from 2020 to 2030; (2) continued gains in energy efficiency will likely continue to dissipate demand for electricity; and (3) renewable energy generation will continue to increase beyond 2020, as onshore wind and solar PV compete with fossil and nuclear generation on an unsubsidised basis.

> EU electricity demand fell 3.3% from 2008 to 2013, whilst GDP grew 4.1%

New German coal plant economics don't add up. Moorburg plant case study.

To give an idea of the future prospects of new coal plants, we analysed the viability of one of the few recent additions. Our analysis of Vattenfall's newly built Moorburg plant shows capital costs of over €3 billion are unlikely to be recovered. Even if coal prices are low, carbon prices are low and the load factor is high, the new plant struggles to turn a profit. Under our optimistic and pessimistic modelling scenarios the Moorburg plant would be cash-flow negative throughout its project lifecycle, potentially generating a negative Net Present Value (NPV) range of €3.3 billion to €4.4 billion. This analysis should serve as a warning to shareholders in companies who are considering developing new coal plants in OECD countries.

1 Scope of Report

There is a growing consensus that new coal plants in most OECD countries do not make financial sense. To demonstrate this theory we review recent trends and future market conditions to help understand the future revenues of a new coal plant in Europe. To use a concrete example we apply two scenarios to one of the few recent capacity additions – the Moorburg plant in Germany.

In order to understand how new coal plants are going to be affected by changing market conditions, we analyse the performance of Europe's five largest publically-listed electricity utilities: EDF, GDF Suez, Enel, E.ON and RWE, who collectively represent nearly 60% of Europe's electricity generation, during the period between 2008 and 2013. We then look to the future by evaluating how strengthening carbon pricing, increased energy efficiency and continued growth of renewable energy will impact those utilities if they chose to continue to invest in conventional forms of electricity generation.

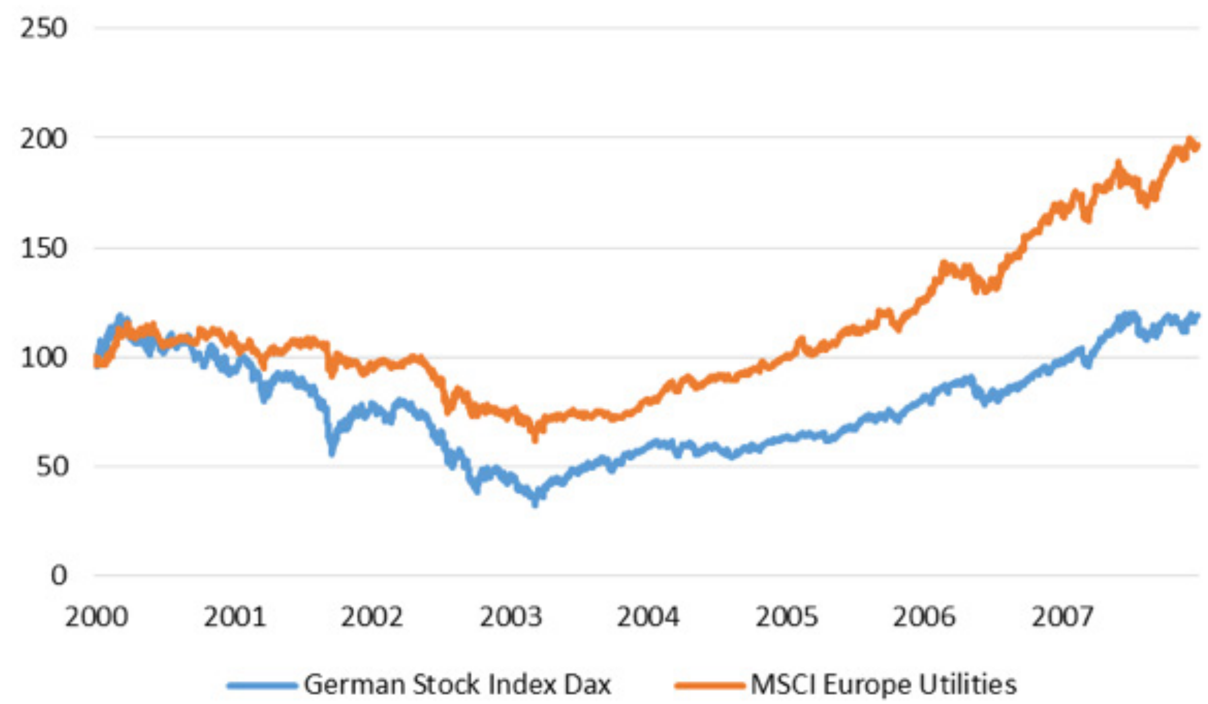
The electricity sector is complicated. The supply chain involves the generation, transmission and distribution of electricity, as well as grid balancing and customer management. A host of technological, regulatory, and economic considerations impact the economic viability of utilities on a daily basis. In Europe, the mix of utilities includes investor owned utilities, or IOUs, and municipal utilities who compete with each other, as well as state owned utilities that still dominate their respective markets. We do not seek to analyse how the sheer complexity of the sector, and the vast number of players involved across the supply chain, have created inertia towards changing market conditions; but rather focus on how the regulatory backdrop and structural changes have influenced company and asset valuations, with specific emphasis on those factors which relate to a low carbon transition.

Past and Present
what happened and why?

2

Investors have traditionally gravitated towards electricity utility stocks for stability and income. Utilities often operate with the protection of government regulations which can act as a barrier to market entry. Until more recently, utilities have also been resistant to economic cycles. With low-demand elasticity for electricity and resulting reliable revenue streams, utilities have traditionally been able to pay consistent and high dividends. For this reason, utility stocks have historically been treated like bonds by investors who often rely on their holdings for income generation. As shown in Figure 1, from 2000 to 2007, the stock prices of European utilities outperformed Germany's stock market (Deutscher Aktienindex or DAX) by 77%.

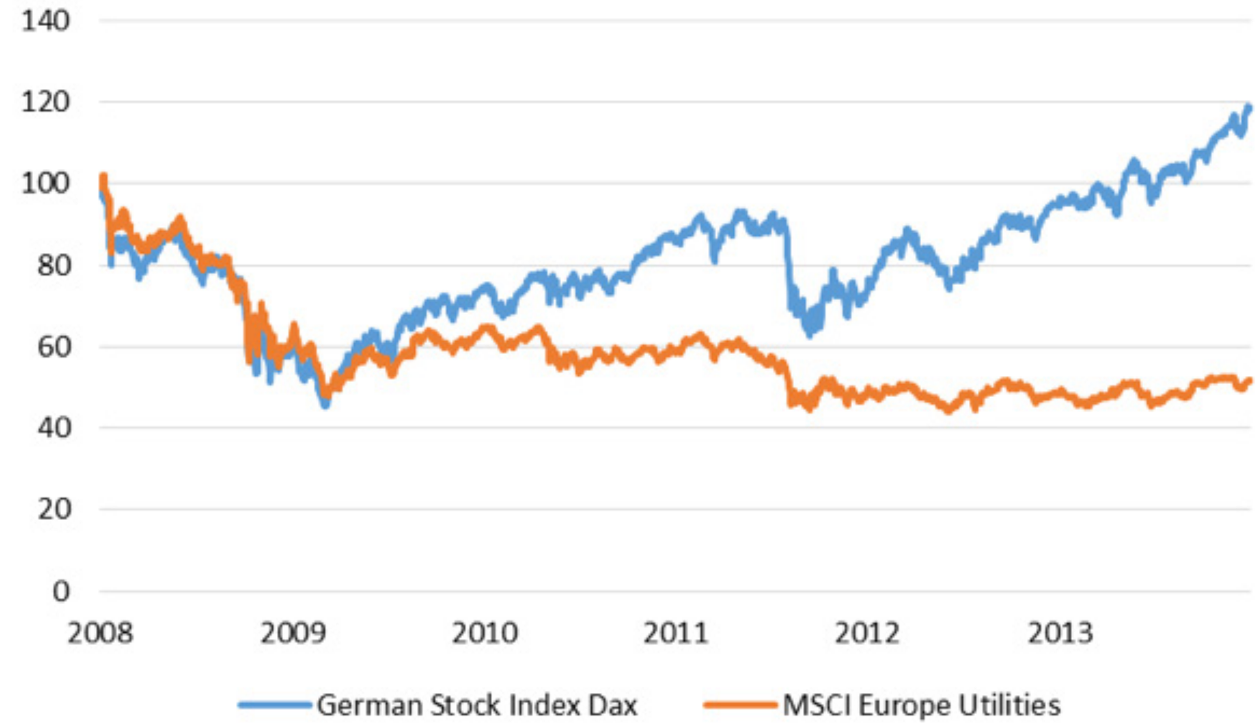
Figure 1. European utility share price performance versus DAX from 2000 to 2007 (2000 = 100)



Source: Bloomberg LP data

However, from 2008 to 2013 the trend over the previous eight years reversed as the stock prices of European utilities decreased 48%, while the DAX increased 18% over the same period.

Figure 2. European utility share price performance versus DAX from 2008 to 2013 (2008 = 100)

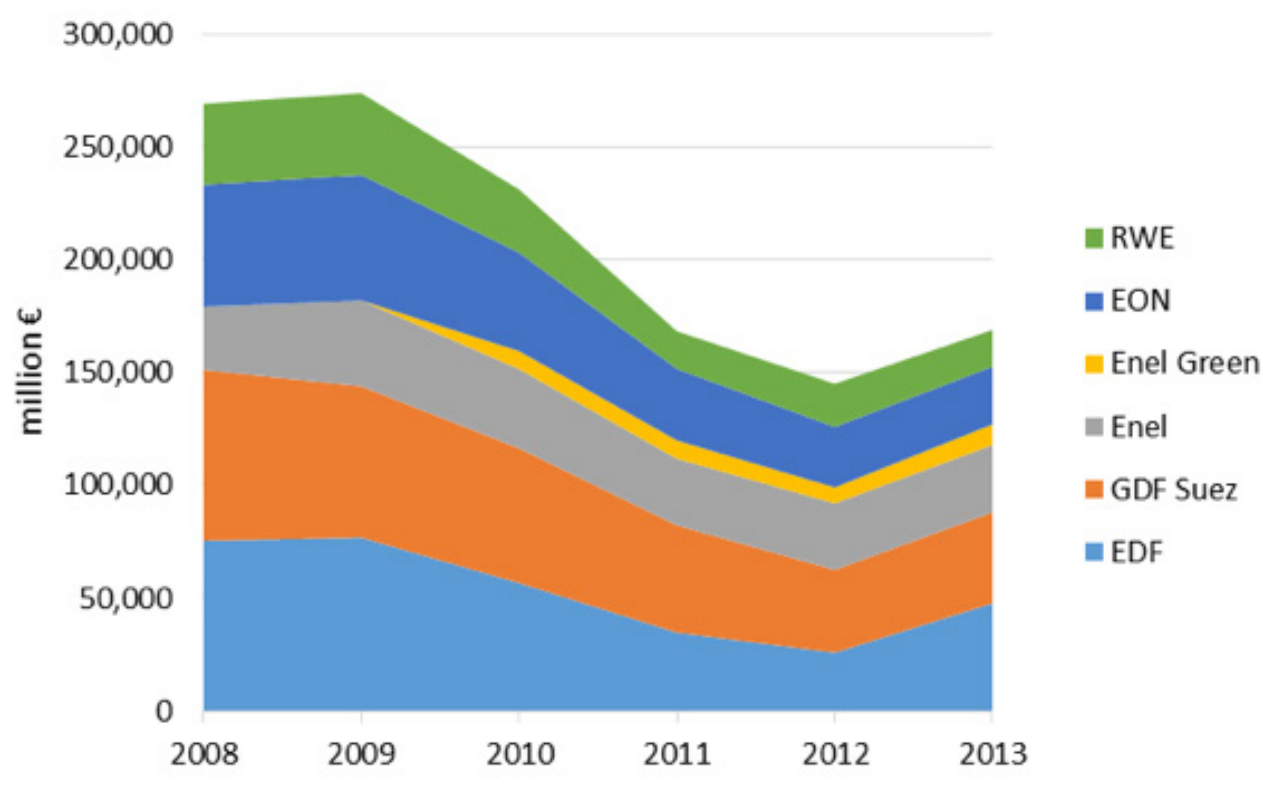


Source: Bloomberg LP data

On a market cap basis, the companies surveyed have collectively lost over 100 billion euros (or 37% of their value) from 2008 to 2013. A data set of 2008 to 2013 was chosen as at the time of writing company-level data before 2008 and beyond 2013 was unavailable in the granularity required to conduct this analysis. Enel was the strongest performing company, growing its market cap by 7% excluding Enel Green and 39% including Enel Green. RWE was the poorest performing with negative market cap growth of 55%. While the market cap of EDF, E.ON and GDF Suez declined 37%, 53% and 47% respectively. This loss of value is broadly consistent with devaluations experienced by larger electricity utilities across Europe. The Economist reckons that Europe's top 20 utilities lost roughly half their value, or around half a trillion euros, from September 2008 to October 2013.[1]

1 *The Economist, 2013; How to lose half a trillion euros: Europe's electricity providers face an existential threat; Available: http://www.economist.com/news/briefing/21587782-europes-electricity-providers-face-existential-threat-how-lose-half-trillion-euros*

Figure 3. Market capitalisation of surveyed utilities



Source: Bloomberg LP data

Throughout 2008 to 2013, EDF, GDF Suez, Enel, E.ON and RWE were all downgraded by Moody's, a credit ratings agency. Moody's assigns a generic rating classification from Aaa (highest quality) through to Caa (lowest quality) to its 'Long-term Corporate Ratings Obligations'.[2] The ratings reflect both the likelihood of default and any financial loss suffered in the event of default. Moody's downgraded the five utilities as follows:

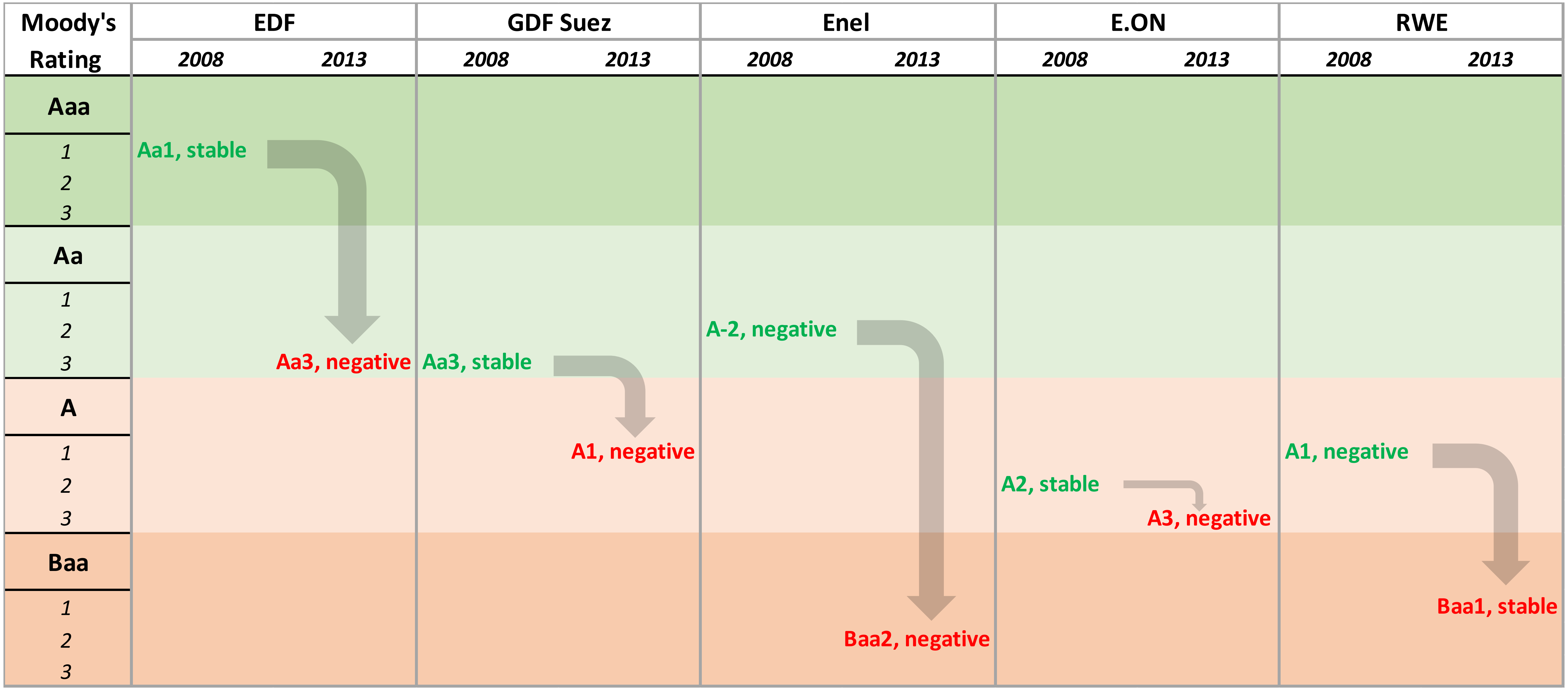
- In December 2012, EDF's Aa3 stable rating was changed to Aa3 negative. This change was as a result of a recent ruling by France's Conseil d'Etat which reversed the decision to increase electricity distribution tariffs, adding "…. to the challenges faced by the group from rising debt and pressured profitability."[3]

2 For more information on Moody's Long-term Corporate Ratings Obligations, see: https://www.moodys.com/sites/products/AboutMoodysRatingsAttachments/MoodysRatingsSymbolsand%20Definitions.pdf
3 Moody's Investor Service, 2012; Moody's changes outlook on EDF's Aa3 rating to negative from stable; Available: http://www.moodys.com/research/Moodys-changes-outlook-on-EDFs-Aa3-rating-to-negative-from--PR_261414

- GDF Suez was downgraded to A1 in February 2011 following the completion of its acquisition of International Power and the impact this purchase would likely have on the Group's business risk profile.[4]
- In December 2011, Enel's rating changed from A2 negative to Baa2 owing to "the heightened macroeconomic, political and regulatory challenges for utilities in Enel's core Spanish and Italian markets."[5]
- Germany's two largest utilities also suffered downgrades in 2011 and 2013, respectively, due to deteriorating market conditions:
    - E.ON was downgraded to A3 negative due to increased pressure from "a combination of the permanent closure of 3.2 gigawatts of nuclear generation capacity, the German nuclear fuel tax, the negative oil/gas spread, and lower achieved electricity prices"[6]; and
    - RWE was downgraded to Baa1 stable (from A1 negative) for similar reasons as E.ON: "The downgrades reflect that the outlook is for the pressure on RWE's core generation earnings to intensify because of structural changes taking place in its domestic power markets and steeper than expected declines in power prices."[7]

4 Moody's Investor Service, 2011; Moody's downgrades GDF SUEZ to A1; outlook stable; Available: https://www.moodys.com/research/Moodys-downgrades-GDF-SUEZ-to-A1-outlook-stable--PR_213569
5 Moody's Investor Service, 2012; Moody's downgrades Enel's ratings to Baa2; outlook negative; Available: https://www.moodys.com/research/Moodys-downgrades-Enels-ratings-to-Baa2-outlook-negative--PR_259028
6 Moody's Investor Service, 2011; Moody's downgrades E.ON's ratings to A3/P-2; stable outlook; Available: https://www.moodys.com/research/Moodys-downgrades-EONs-ratings-to-A3P-2-stable-outlook--PR_227617
7 Moody's Investor Service, 2013; Moody's downgrades RWE's ratings to Baa1; outlook stable; Available: https://www.moodys.com/research/Moodys-downgrades-RWEs-ratings-to-Baa1-outlook-stable--PR_276095

Figure 4. Moody's long-term corporate obligation ratings in 2008 and 2013[8]



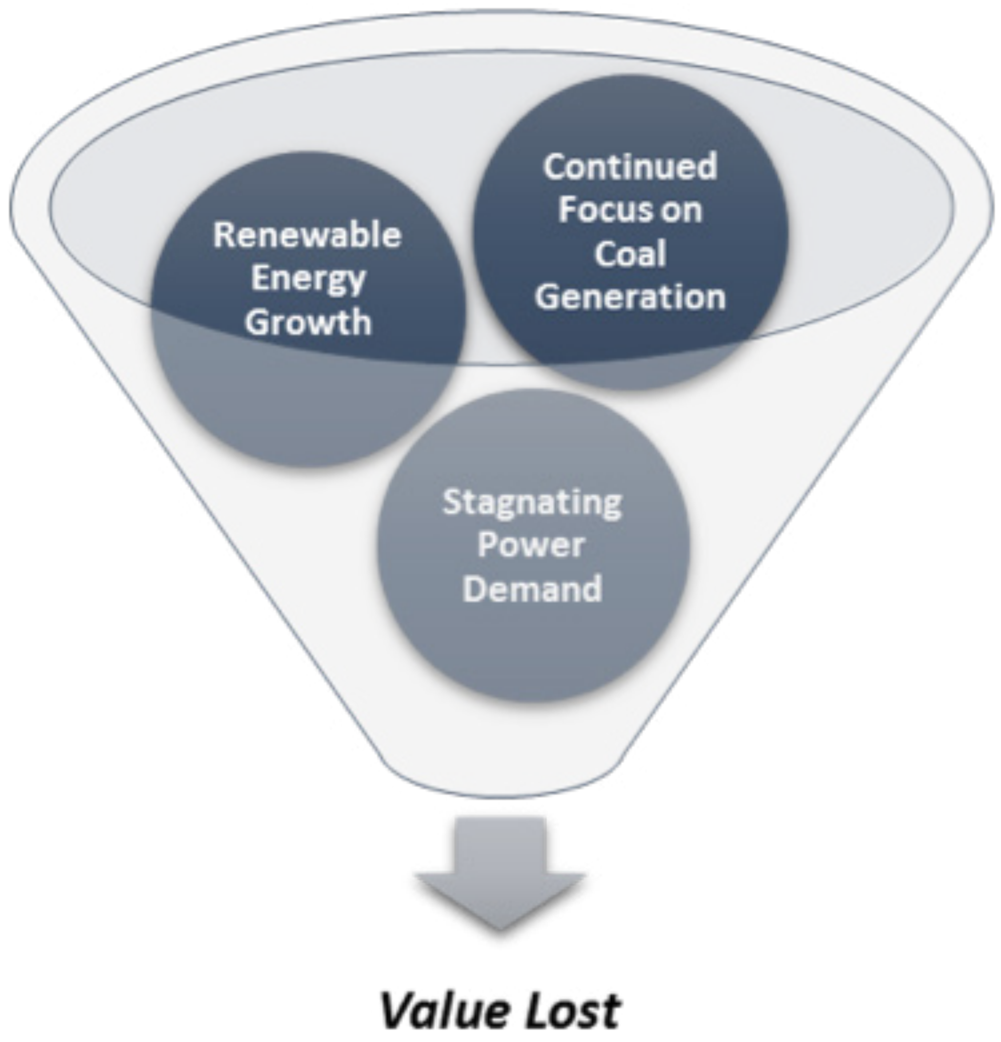
Source: Moody's data, Carbon Tracker illustration

8 *Gradations of creditworthiness are indicated by rating symbols, with each symbol representing a group in which the credit characteristics are broadly the same. There are nine symbols as shown below, from that used to designate least credit risk to that denoting greatest credit risk: Aaa Aa A Baa Ba B Caa Ca and C. Moody's appends numerical modifiers 1, 2, and 3 to each generic rating classification from Aa through Caa.*

Catalysts

No single factor or event is wholly responsible for the financial underperformance of Europe's electricity utilities. Instead a confluence of factors – stemming from policy developments, renewable energy technologies, fuel costs and business model decisions – have caused European utilities to lose value. These factors have interacted and influenced each other and are discussed in detail below.

Figure 5. Catalysts causing utility value destruction



Source: Carbon Tracker Illustration

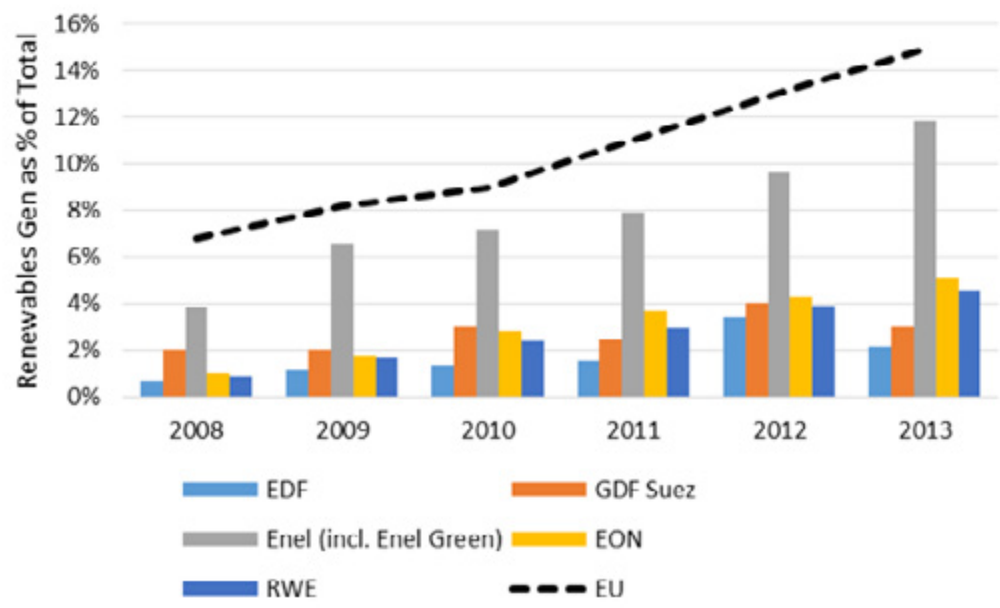
Renewables Energy Growth

"There appears to be little hope that [solar photovoltaic] systems linked to the power grid will ever manage to generate electric power in a truly cost-efficient manner – at least in Central Europe – without the help of subsidies." **RWE's World Energy Report, 2005**[9]

"I grant we have made mistakes. We were late entering into the renewables market – possibly too late." **RWE's CEO, Peter Terium, 2014**[10]

For the most part, the five utilities have failed to embrace renewable energy and still lag well behind the European regional average. Out of the five utilities surveyed, renewables generation as a percentage of total generation averaged 5% in 2013, significantly below the 15% generated across Europe. The exception is Enel who opted to separate its conventional generation business from its renewables activities via an initial public offering of Enel Green Power in December 2008. This coincided with Enel's renewable generation as a percentage of total generation increasing from 4% in 2008 to 12% in 2013.

Figure 6. Renewable generation (excluding hydro) as a percentage of total generation



Source: Bloomberg LP data, Eurostat data

9 RWE, 2005; World Energy Report 2005; Available: http://s3.amazonaws.com/zanran_storage/www.rwe.com/ContentPages/16434854.pdf

10 Reuters, 2014; RWE warns of frugal future after historic net loss; Available: http://uk.reuters.com/article/2014/03/04/uk-rwe-results-idUKBREA230YD20140304

Europe's collective agreement to increase renewable energy production stems from the 2008 Climate and Energy Package or the 2020 Package (see Box 1)[11]. The 2020 Package required the EU to increase its share of energy consumption produced from renewable sources to 20% by 2020. Member States were obligated to take on binding national targets for raising the share of renewable energy under the Renewable Energy Directive.[12] These targets spawned a number of national renewable subsidy schemes and subsequently, from 2008 to 2013, renewable energy capacity (excluding hydro) increased 136%, while wind and solar generation rose 158% over the same timeframe.[13]

Box 1

The EU's 2020 Package

In early 2007 the European Commission adopted a Communication and Energy policy for Europe and issued an accompanying Communication: "Limiting Global Limiting Global Climate Change to 2 degrees Celsius"[1]. The targets were set by EU leaders in March 2007 and were enacted through the EU 2020 Package in 2009[2]. As a result of the 2020 Package the "20-20-20" targets were developed, which set three key objectives for 2020: (i) Cutting greenhouse gases by at least 20% of 1990 levels (30% if other developed countries commit to comparable cuts); (ii) Reducing energy consumption by 20% of projected 2020 levels by improving energy efficiency; and (iii) Increasing use of renewables to 20% of total energy production.

1 Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions, 2007; See: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0002:FIN:EN:PDF

2 See: http://ec.europa.eu/clima/policies/package/documentation_en.htm

11 Some Member States had renewable energy policy long before the 2020 Package. For example, Germany's Renewable Energy Act of 2000, resulted in renewable energy increase steadily, with onshore wind and solar as the main drivers.

12 European Commission, 2008; Directive 2009/28/EC on the promotion of the use of energy from renewable sources; See: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32009L0028

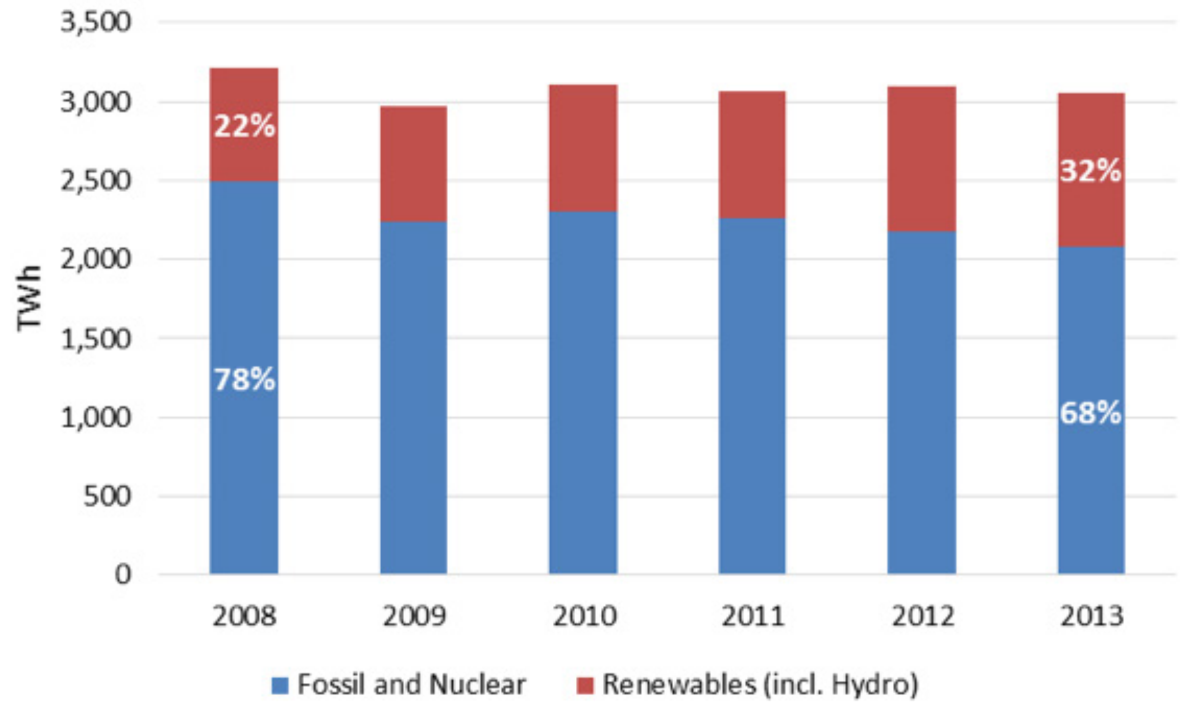
13 Based on Bloomberg LP statistics.

Renewable energy growth resulted in five negative side-effects for those of Europe's utilities which did not align with the direction of travel indicated by the policy.

1. Renewables increased their market share at the expense of conventional generation

Due to effective subsidies and improving economics, renewable energies (including hydro) increased their market share at the expense of fossil and nuclear generation: increasing from 22% in 2008 to 32% in 2013.

Figure 7. Fossil and nuclear generation versus renewables generation, GWh



Source: Bloomberg LP data

2. Renewables add to market oversupply

New renewable energy capacity added to electricity market oversupply, particularly after the financial crisis. Excess capacity plus depressed demand resulted in lower wholesale prices. From 2008 to 2013 the German wholesale power price declined 46%.

Figure 8. German wholesale power price

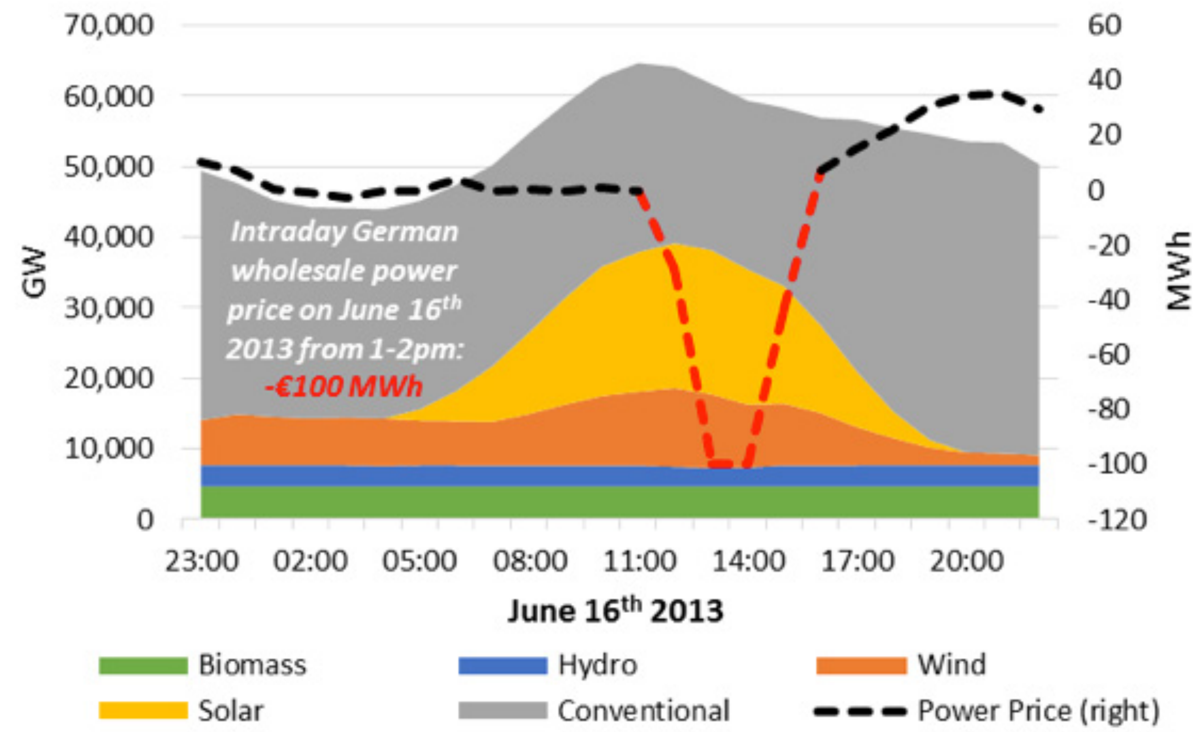
Source: Bloomberg LP data

3. Renewables have grid priority

Renewable energies have grid priority, meaning the grid must take their electricity first. To date this has often been a legal requirement to encourage the build-out of renewable energy in Europe.[14] But it also makes economic sense: since the marginal cost of wind and solar electricity is very low, the grid would take their electricity first anyway. Unlike most baseload power plants, which are designed to run continuously to satisfy minimum demand and cannot easily reduce production, solar and wind electricity is variable, rising and falling with weather conditions. When solar and wind electricity surges, conventional plants must be reduced or switched off altogether to avoid the grid overloading and potentially becoming unstable. This happened in Germany on June 16th 2013. From 12 to 2pm on that day, solar and wind represented 50% of total generation, causing the wholesale electricity price to fall to minus €100 per MWh. That is, utilities operating conventional plants in Germany had to pay the grid management company to take their electricity.

14 *Germany's Act on Granting Priority to Renewable Energy Sources (EEG), for example, specifies that renewable electricity has a priority on the grid, meaning that conventional power generators have to ramp down production. Furthermore, German law specifies the conditions under which grid operators must expand the grid to provide a connection for wind turbines, biomass units, and solar arrays. See: http://www.lexadin.nl/wlg/legis/nofr/eur/arch/ger/resact.pdf*

Figure 9. German power generation (GW) versus wholesale power price (MWh) on June 16th 2013

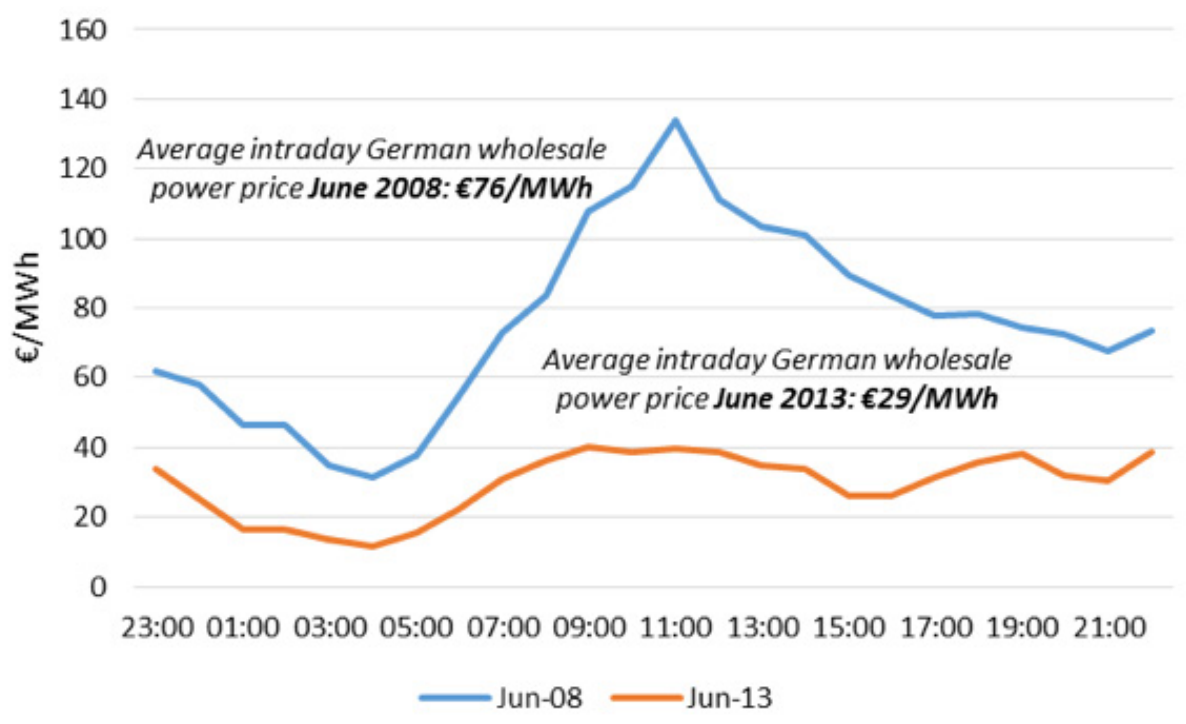


Source: Agora Energiewende data

4. Renewables erode demand during peak hours

The increased production of solar and wind energy has dramatically reduced intraday electricity prices. Under the old system, electricity prices spiked during peak hours (the middle of the day and early evening), falling at night as demand subsided. Utilities made a lot of their money during peak periods. However, the middle of the day is when solar generation is strongest. Thanks to grid priority, solar tends to take a big chunk of peak demand and has competed away the price spike, resulting in lower average intraday prices. As displayed in Figure 10, in Germany in June 2008 intraday power prices averaged €76 MWh. In June 2013 they averaged €29 MWh.

Figure 10. Average intraday German wholesale power prices June 2008 versus June 2013, €MWh[15]



Source: European Power Exchange data

5. Renewables turn utility customers into competitors

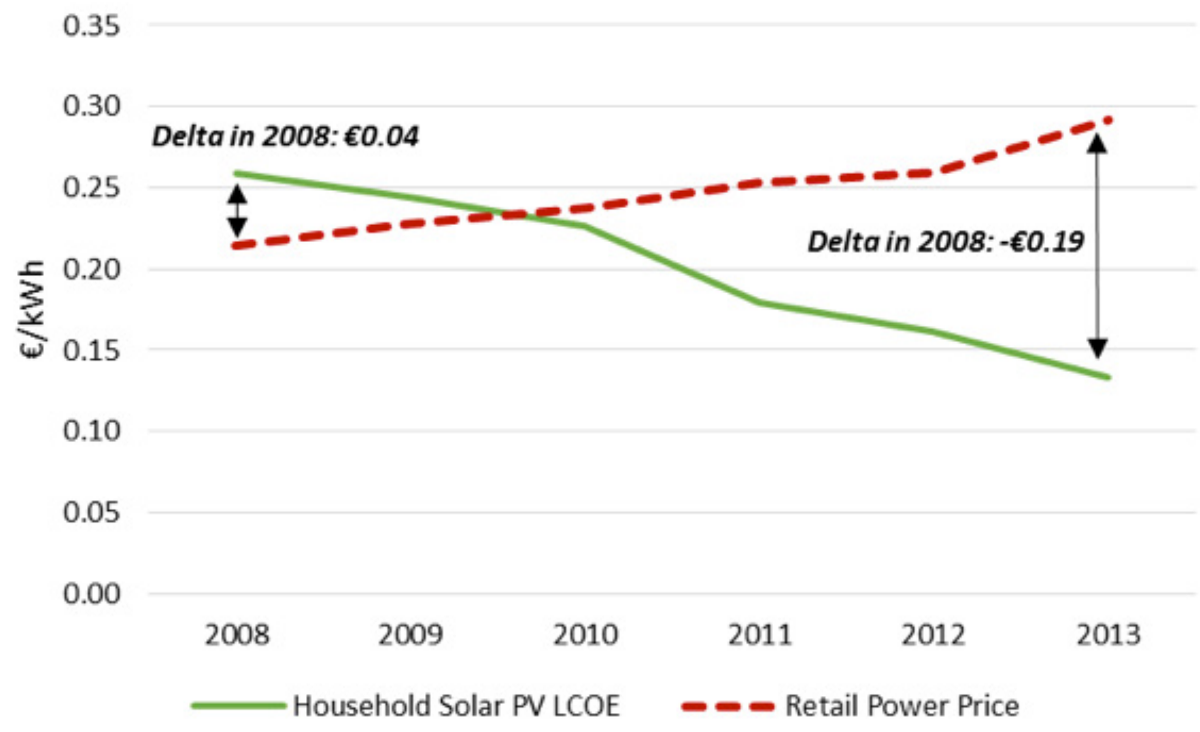
From 2008 to 2013, solar improved from a heavily-subsidised marginal technology to a mainstream source of electricity generation. A levelised cost of energy (LCOE) analysis can explain how solar PV made this transformation. The LCOE is the price at which electricity must be generated from a specific source to break even over the lifetime of a project. It is an economic assessment of the cost of electricity generation. The real cost of solar PV decreased significantly from 2008 to 2013 due to learning curve effects commonly referred to as Swanson's Law. Swanson's Law is an observation that the price of solar PV modules tends to drop 20% for every doubling of cumulative shipped volume.[16]

15 *Data is nominal and not volume-weighed.*

16 *Scientific American, 2011; Smaller, cheaper, faster: Does Moore's law apply to solar cells? Available: http://blogs.scientificamerican.com/guest-blog/smaller-cheaper-faster-does-moores-law-apply-to-solar-cells/*

Yu and van Sark[17] studied the factors behind the learning curve of solar PV and found that, from 1998 to 2006, approximately 50% of price reductions came from learning-by-doing and scale effects, with the balance derived from significant technology improvements. Yu and van Sark also found that research and development played a significant role at the early stages of solar PV. Figure 11 compares the LCOE of solar PV with retail power prices. The residential German solar market became cost-effective five years ago, whereby households have a strong economic incentive to generate their own electricity from solar PV rather than purchasing it from a utility.

Figure 11. LOCE of German household solar PV versus retail power price, €/kWh



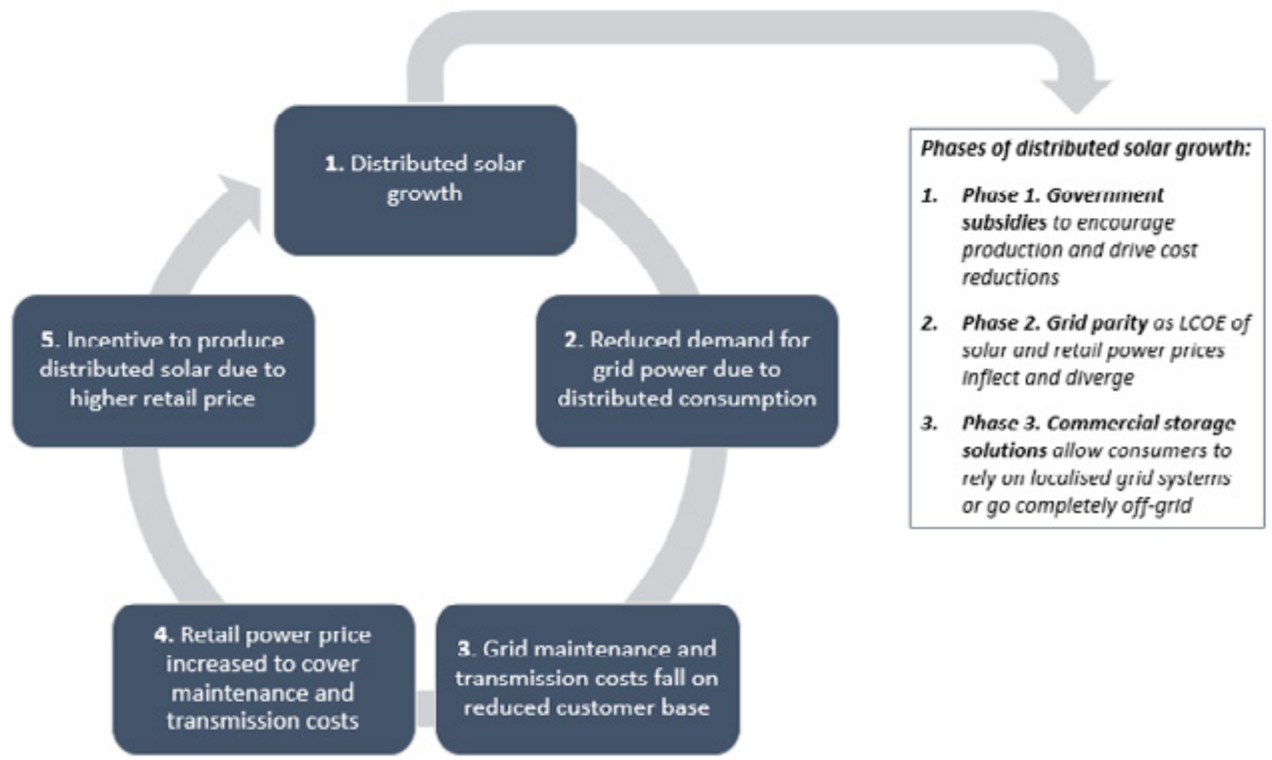
Source: Eurostat data, German Solar Industry Association data, Carbon Tracker analysis

17 *C.F. Yu and W.G.J.H.M. van Sark, 2010; Renewable and Sustainable Energy Reviews; Unravelling the photovoltaic technology learning curve by incorporation of input price changes and scale effects; Available: http://www.sciencedirect.com/science/article/pii/S1364032110002881*

Utility Death Spiral

Solar PV build-out created a virtuous cycle which is now commonly referred to as the utility 'death spiral'. The more distributed solar PV generated, the fewer customers there are to share grid maintenance and transmission costs, which in turn pushes the retail price of electricity higher and thus further incentivises the uptake of distributed solar PV. High retail electricity prices will also drive the uptake of distributed residential storage applications going forward as the new Tesla gigafactory is commissioned and cost-competitive supply is increased. We believe the utility 'death spiral' has possibly been over-egged by some commentators, due in part to 'soft costs' and non-price barriers which could delay the uptake of distributed electricity. However, a 2013 study by UBS estimated that up to 18% of electricity demand could be replaced by rooftop solar in Germany, Italy and Spanish markets.[18] Many European utilities underestimated the impact of distributed solar PV, perhaps because it was considered by many researchers at the time to be unscalable, inefficient and cost-ineffective.[19]

Figure 12. The utility 'death spiral' explained



Source: Carbon Tracker illustration

18 UBS, 2013; The unsubsidised solar revolution; Available: http://www.qualenergia.it/sites/default/files/articolo-doc/UBS.pdf

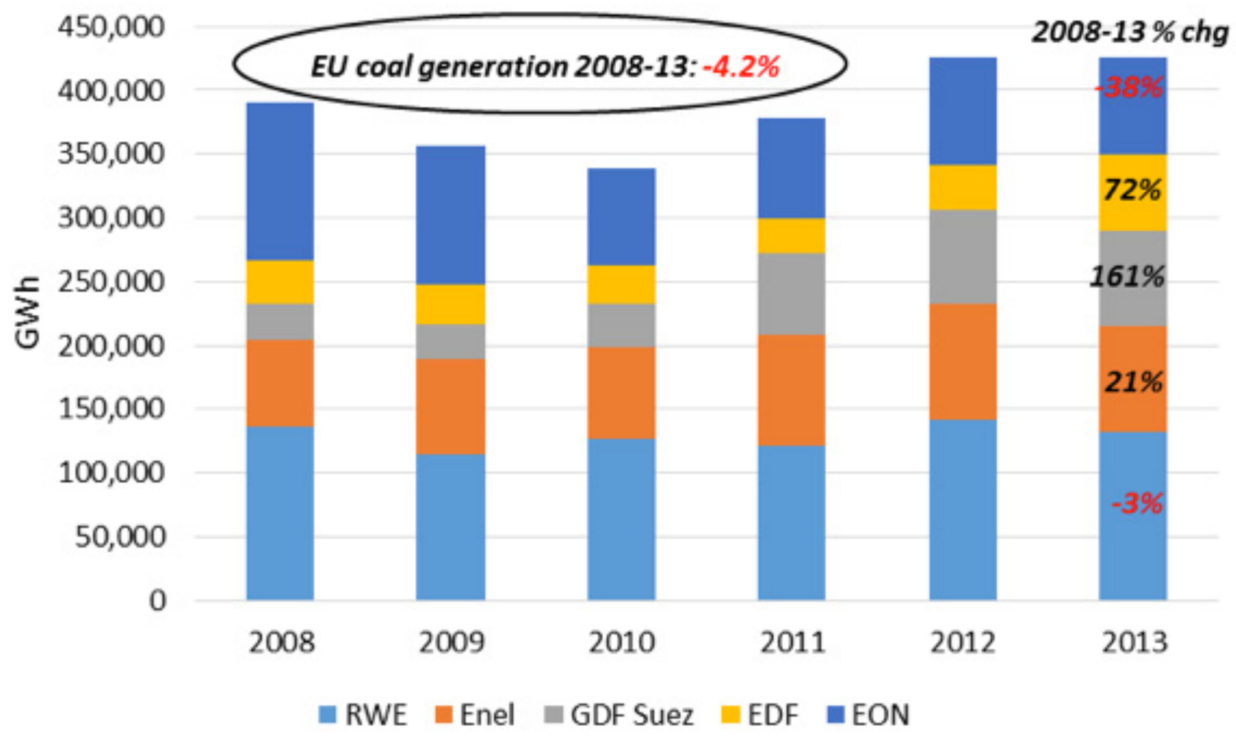
19 See for e.g., David McKay, 2009; Sustainable Energy – without hot air; Available: http://www.withouthotair.com/Contents.html

Continued Focus on Coal-Fired Generation

"Our competitiveness depends on whether we succeed in bringing electricity generation based on fossil fuels—especially coal—in line with the goal of protecting the climate" **RWE, 2008 Annual Report**[20]

Coal use in Europe has been widely discussed in the media over the last five years. Despite claims of a coal renaissance in Europe, use of the fuel in Europe as a whole actually declined 4.7% in total and 4.2% in electricity generation from 2008 to 2013 (see Box 2)[21]. This statistic is contrary to the surveyed companies who, as a collective, increased their reliance on coal-fired generation 9% over the same period.

Figure 13. Coal generation from 2008 to 2013, GWh



Source: Bloomberg LP data

20 RWE, 2008; Annual Report; Available: http://www.rwe.com/web/cms/en/280318/rwe/investor-relations/reports/2008/

21 Based on Eurostat and Bloomberg LP data. Eurostat data is available here: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_101a&lang=en

Box 2

European Coal Consumption – The Renaissance That Never Was

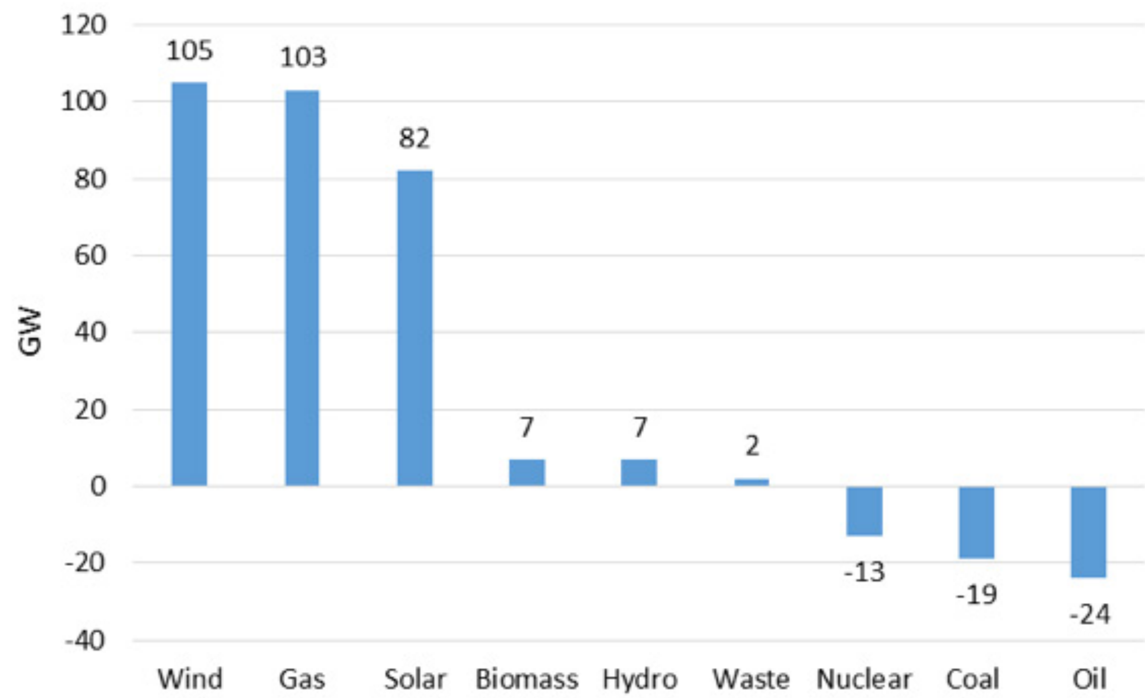
Over the last five years many media reports have cited a 'coal renaissance' in Europe.[1] There is also no shortage of hard coal either in Europe or in world markets. However, because the underlying trend in the period since 2000 was showing hard coal use decreasing, it is not surprising that evidence seemingly showing the opposite is news. In summary of the facts, for around 18 months hard coal use grew. This growth was short lived and by 2013 hard coal use was falling by 3.9% year-on-year. From 2013 to 2014 hard coal use decreased a further 9.6%, partially due to an unseasonably warm winter.

Europe has seen the construction of 18 coal plants originally permitted before 2008. Since 2008 there were more than 100 new coal plants announced that have not been built. With the addition of closures, from 2000 to 2013 there has been a net coal plant closure of 19 GW. This compares to renewables adding 203 GW over the same period - more than ten times the net amount that coal generation reduced.

There have been some coal capacity additions within the net coal decline. The financial crisis marked the end of a utility investment boom that had unfolded since the early 2000s. That included 18 new coal plants being proposed, permitted and entering construction, so in the end 19 GW of new coal from this era will enter service between 2012 and 2016. But the coal plants that are now entering service may never amortize costs. The economics of newly built coal plants is analyzed in Section 2 of this report.

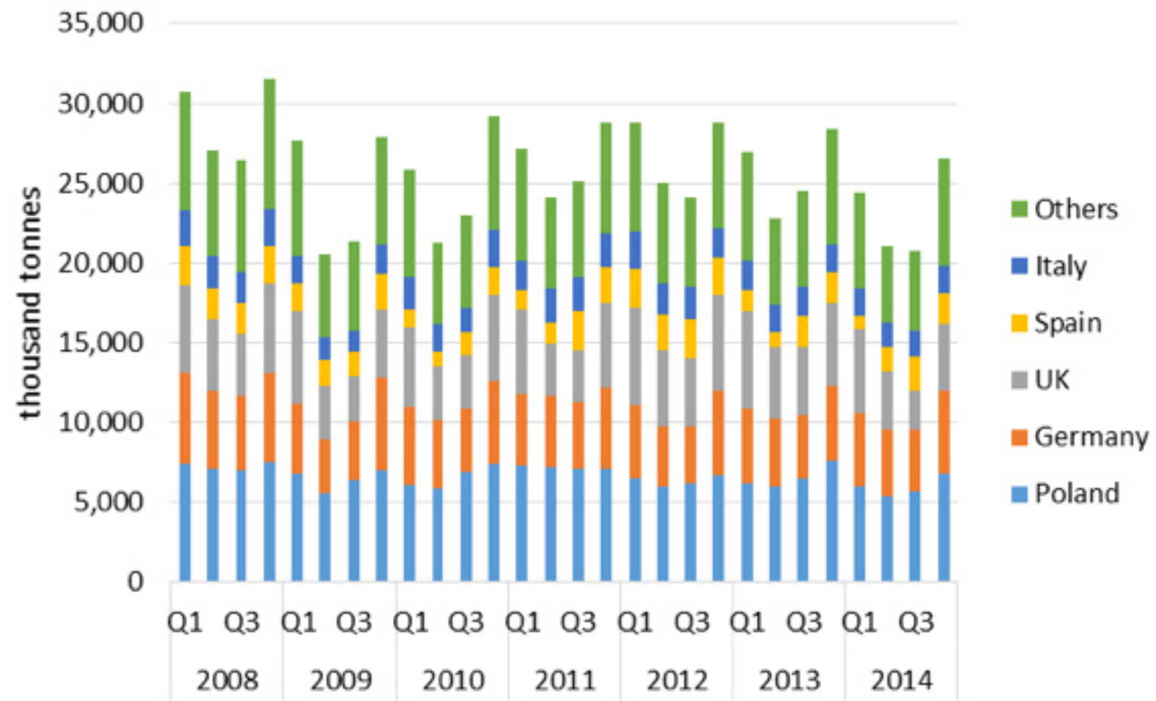
1 The Economist, 2013; Europe's dirty secret: the unwelcome renaissance; Available: http://www.economist.com/news/briefing/21569039-europes-energy-policy-delivers-worst-all-possible-worlds-unwelcome-renaissance

Figure 14. Net power generation installations in the Europe from 2000 to 2013, GW



Source: European Wind Energy Association

Figure 15. Quarterly consumption of hard coal in Europe from 2008 to 2014, thousand tonnes



Source: Eurostat data

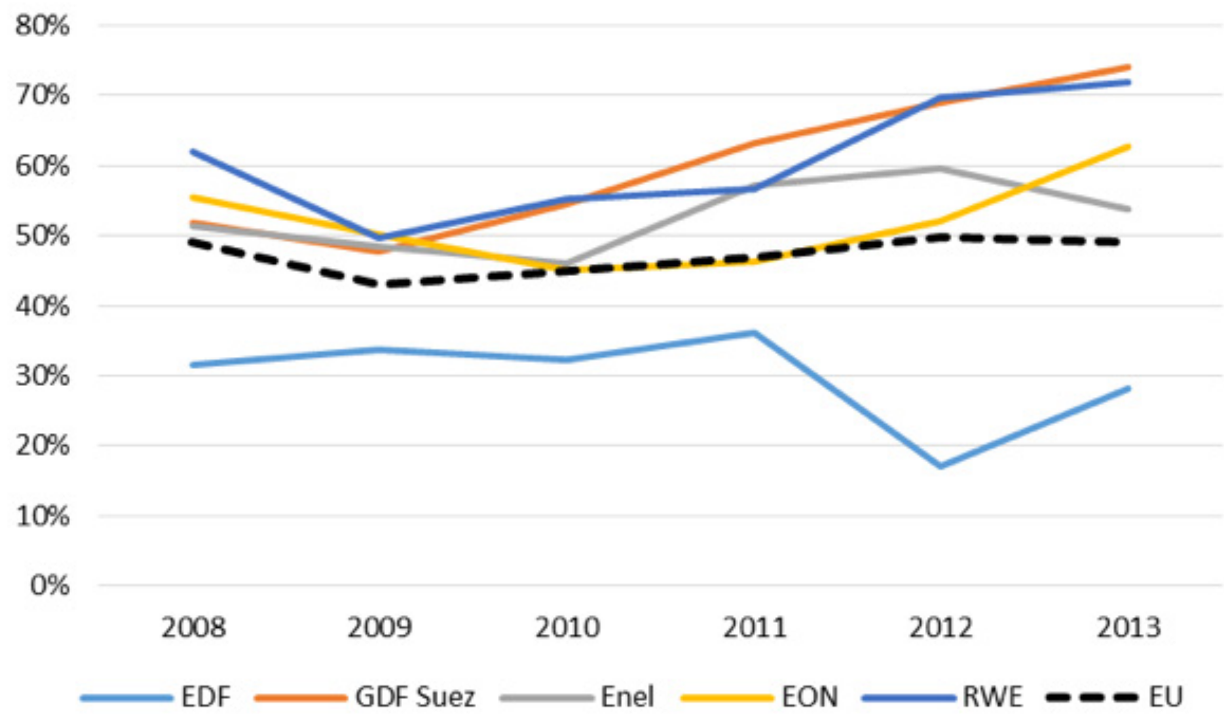
Table 1. European coal plants permitted/under construction by early 2008

Country	Developer	Plant	Status	GW	Fuel	Operational
Bulgaria	AES	Maritsa Iztok-1	In operation	0.67	lignite	2011
Czech Republic	Alpiq	Kladno	In operation	0.135	coal	2014
Czech Republic	CEZ	Ledvice	In operation	0.66	lignite	2014
Germany	Vattenfall	Boxberg	In operation	0.675	lignite	2013
Germany	Evonik	Duisburg-Walsum	In operation	0.79	coal	2013
Germany	RWE	Grevenbroich-Neurath	In operation	2.2	lignite	2012
Germany	Vattenfall	Hamburg-Moorburg	In operation	1.68	coal	2015
Germany	RWE	Hamm-Uentrop	In operation	1.64	coal	2014
Germany	EnBW	Karlsruhe-Rheinhafen	In operation	0.91	coal	2014
Germany	GKM AG	Mannheim, Neckarau	Under construction	0.912	coal	2015
Germany	GDF Suez	Wilhelmshaven	In operation	0.83	coal	2013
Italy	Enel	Citaveccia	In operation	1.98	coal	2009
Poland	PGE	Belchatow	In operation	0.858	lignite	2011
Germany	E.ON	Datteln	Under construction	1.1	coal	2015
Germany	Trianel	Lünen	In operation	0.81	coal	2014
Netherlands	RWE	Eemshaven	Under construction	1.6	coal	2016
Netherlands	E.ON	Maasvlakte Port	Under construction	1.1	coal	2015
Netherlands	GDF Suez	Maasvlakte Port	In operation	0.8	coal	2014

Source: European Climate Foundation data

This increased coal generation has been reflected in the optimisation of coal plants. Figure 16 below shows the load factor of the utilities' coal plants compared to the EU average. The load factor is calculated as the full load hours (annual electricity generation divided by the capacity) divided by annual hours per year. Figure 16 illustrates how the utilities surveyed have been sweating their coal assets, due to more favourable economics compared to gas-fired generation. Notably, apart from EDF, the load factor of each of the other four utilities was higher than the EU as a whole in 2013, with two companies achieving a load factor of around 70-75%.

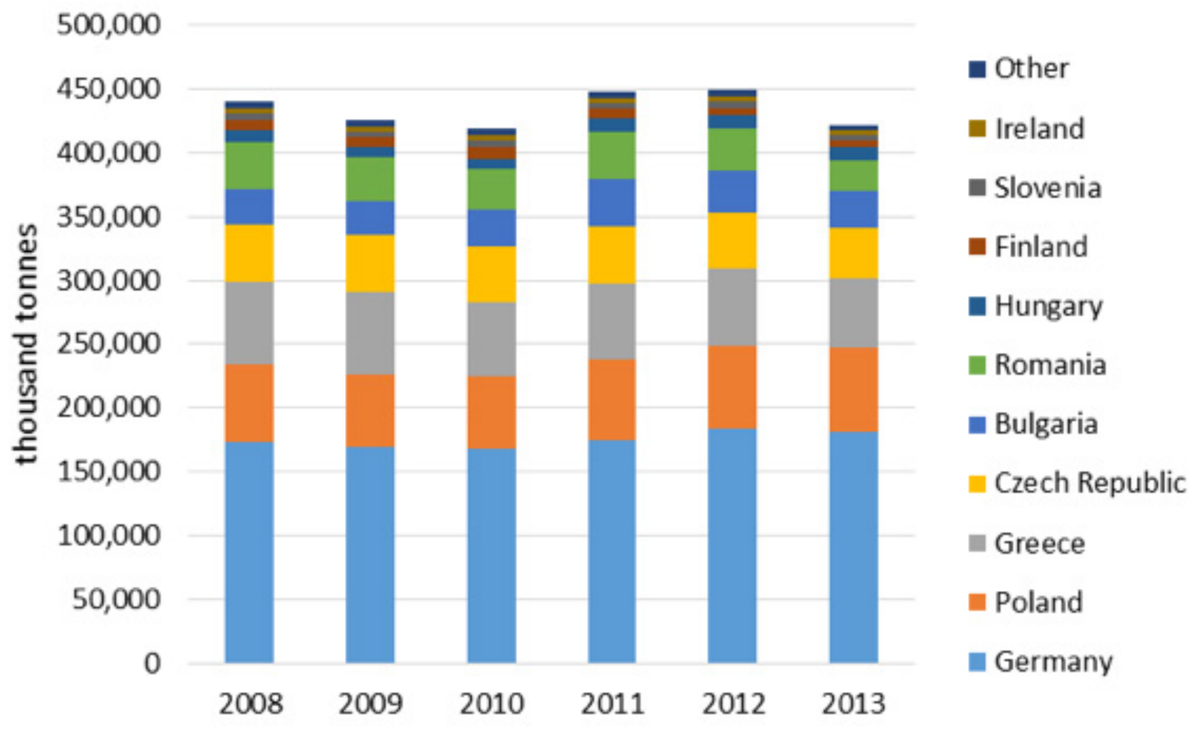
Figure 16. Load factor of coal assets from 2008 to 2013



Source: Bloomberg LP data, Carbon Tracker analysis

There are two aspects to European coal use. The first aspect is lignite. Use of lignite has increased in four out of the ten largest lignite markets in Europe from 2008 to 2013, but decreased 4.1% across the region as a whole. Most notably, Germany and Poland, which comprise 60% of Europe's lignite consumption, increased their use of the fuel by 4.2% and 10.6%, respectively, from 2008 to 2013. Lignite is mined locally and is rarely exported. This is an important distinction from hard coal – which is traded internationally via the seaborne market – as lignite use has not been affected by regional changes in gas prices and foreign exchange rates (such as the EUR/USD and EUR/ROB).

Figure 17. Gross inland consumption of lignite in Europe from 2008 to 2013, thousand tonnes

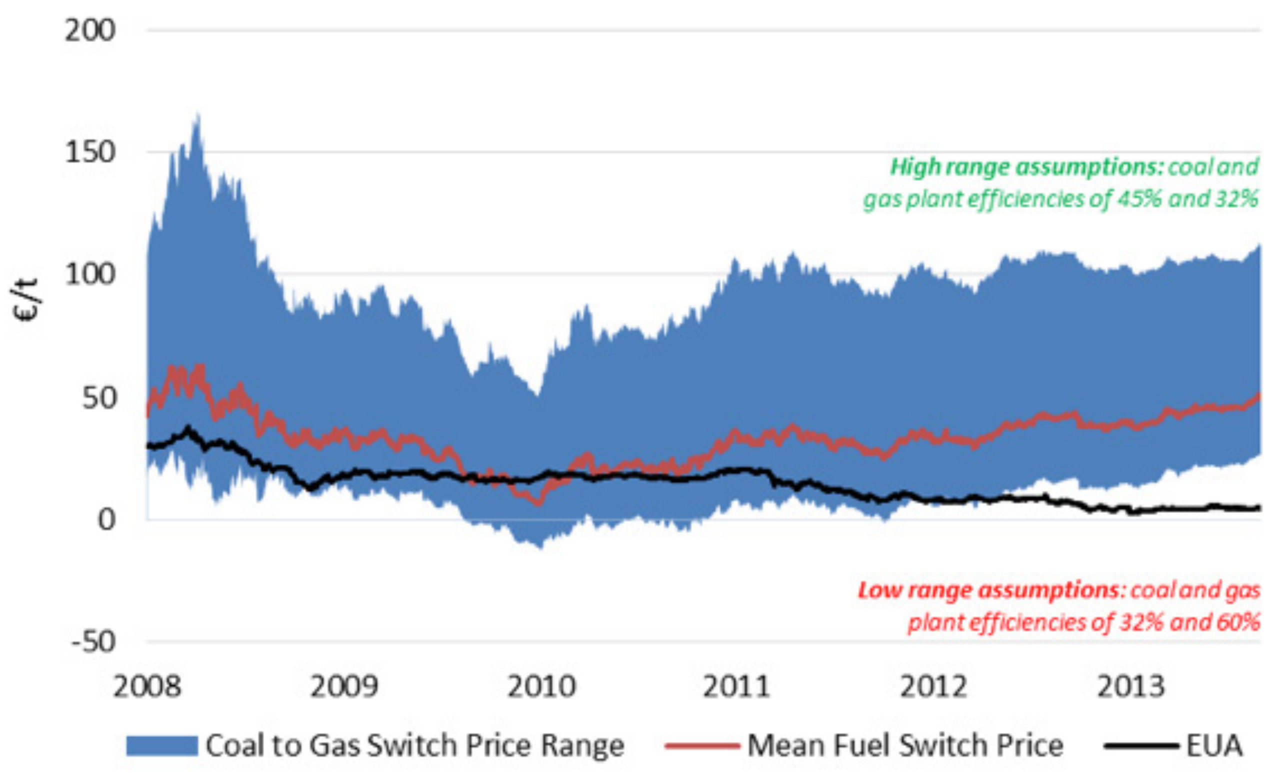


Source: Eurostat data

The second aspect is hard coal. As mentioned above, hard coal is traded internationally and therefore its economics is impacted by changes in gas and carbon prices, and foreign exchange rates. Market oversupply, primarily from the US shale gas boom, is considered one of the catalysts behind the changing economics of hard coal and gas generation in Europe. As US shale gas supply diverted hard coal towards the EU, the profitability of hard coal generation increased relative to gas. This dynamic happened concurrently with significant decreases in the European carbon price (see Box 3).

Taking average hard coal and gas plant efficiencies for Europe, we can identify the average carbon price (termed European Union Allowance, or EUA) required to incentivize short term fuel switching from hard coal to gas in European electricity generation. By comparing the most inefficient hard coal plants with the most efficient gas plants, we can also identify a low fuel switching range, and vice versa, for the European electricity market as a whole. Figure 18 below compares the European fuel switch price range with the EUA price and highlights the limited effectiveness of the European Emissions Trading System (EU ETS) since 2011, and the potentially high carbon price needed, to promote hard coal to gas switching.

Figure 18. Short-term economics of coal to gas switching compared with the EUA price, €/t



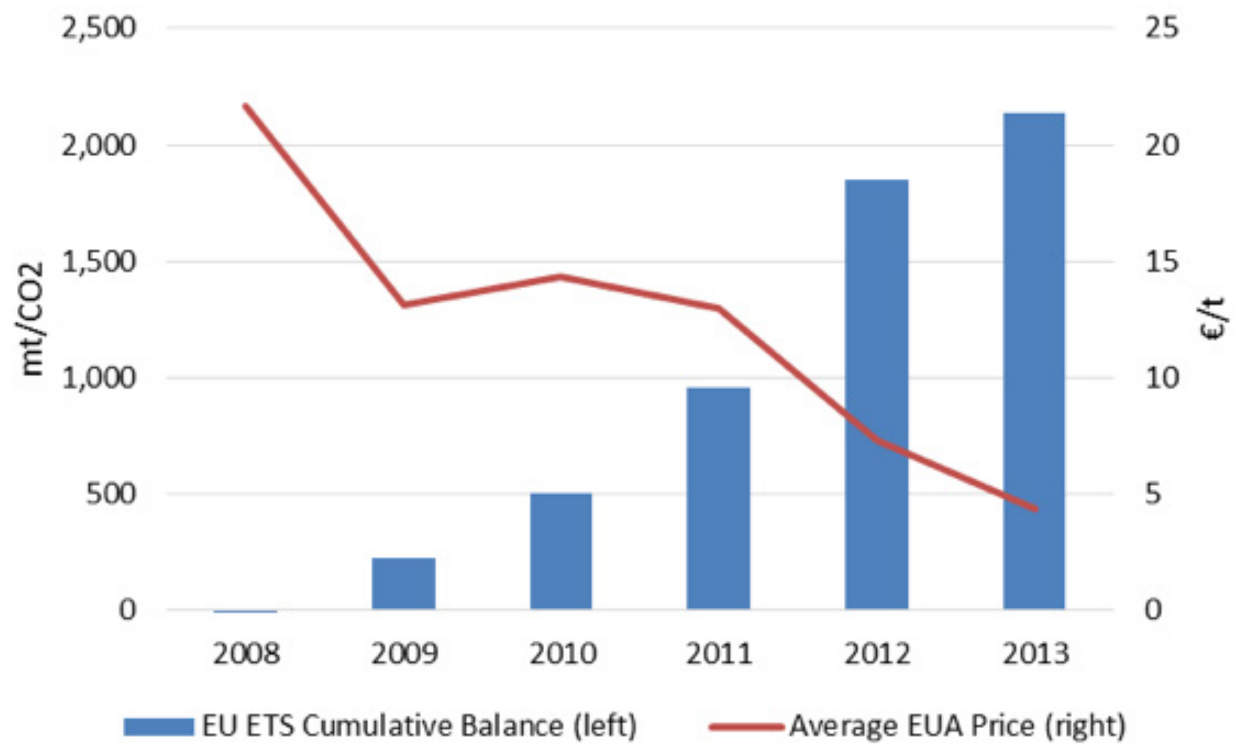
Source: Bloomberg LP data, Carbon Tracker analysis

Box 3

EU ETS from 2008 to 2013 – Europe's zombie climate policy

The EU ETS was introduced in 2005 and is widely regarded as Europe's flagship climate policy. The EU ETS regulates over twelve thousand installations in thirty-one countries by capping approximately 45% of the EU's emissions and putting a price on carbon. The installations regulated under the EU ETS are electricity generators and companies whose net heat exceeds 20 MW. The installations whose emissions are currently capped under the EU ETS are from the following sectors: electricity generation, cement and lime; mineral oil; iron and steel; chemicals; pulp and paper; coke ovens; glass; non-ferrous metals; ceramics; aviation (intra-EU); and metal ore roasting. All 28 EU Member States plus Iceland, Norway, and Liechtenstein are included in the EU ETS. Since 2008 the EU ETS has become increasingly oversupplied which has caused significant declines in carbon prices. Access to international offsets from the UN's flexible mechanisms (the Clean Development and Joint Implementation mechanisms), policy interactions from other climate and energy policy, and exogenous factors have all contributed to the oversupply of allowances in the EU ETS. Section 2 of this report explores the oversupply issue in more detail.

Figure 19. EU ETS cumulative balance versus average EUA price from 2008 to 2013



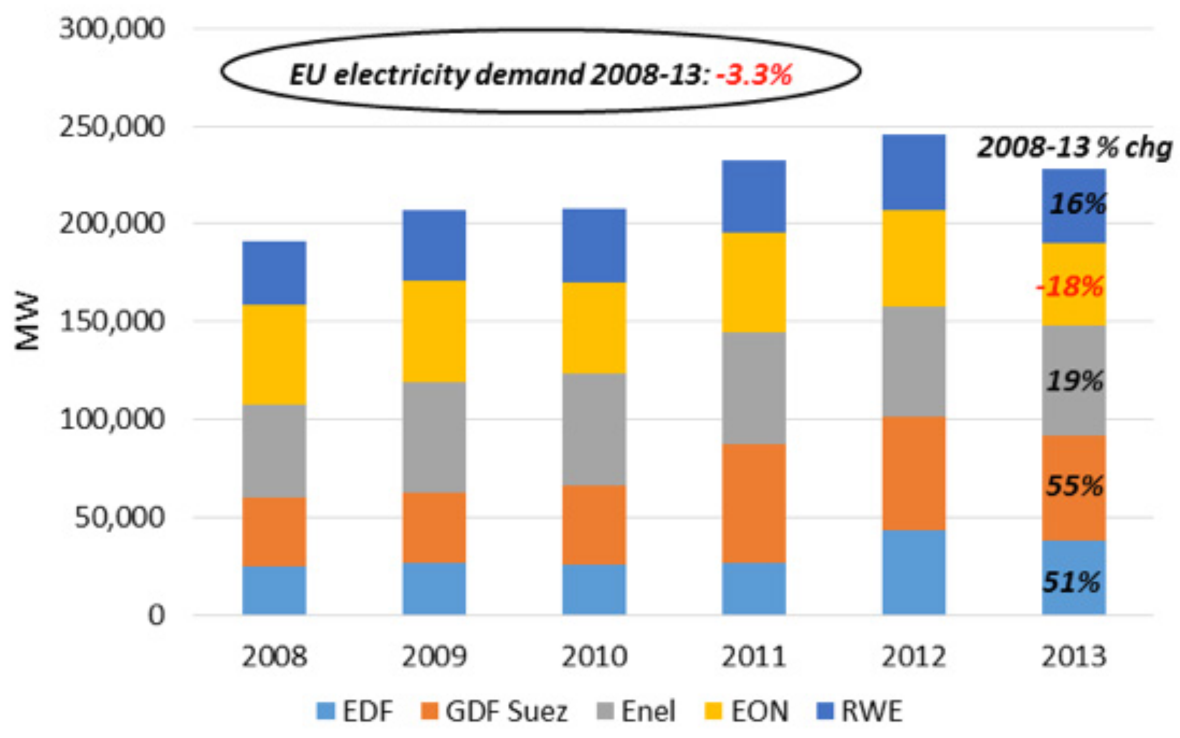
Source: European Commission data, Carbon Tracker analysis

Stagnating Power Demand

Throughout the 2000s generating capacity from fossil fuels grew by 26% across Europe as a whole and by more in certain countries (capacity increased 135% in Spain, for example).[22] With the exception of E.ON, which reduced its fossil fuel capacity 18% from 2008 to 2013, all of the utilities surveyed increased their fossil fuel capacity: EDF by 51%, GDF Suez by 55%, Enel by 19% and RWE by 16%. Unfortunately, this increase in capacity was not matched by electricity demand which declined 3.3% from 2008 to 2013, driving down average capacity utilisation rates.

22 *Based on Eurostat statistics. Available: http://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity_and_heat_statistics*

Figure 20. Fossil capacity from 2008 to 2013 (MW)



Source: Bloomberg LP data

Besides the obvious impact of the financial crisis, the consumption of less electricity can be attributed to three factors:

1. Energy efficiency policies: Many policies implemented to encourage energy efficiency relate to finance. Germany, for example, lent a staggering €10 billion for energy efficiency construction and refurbishment in 2012 and from 2006 to 2012 distributed on average €6.9 billion per annum through the state-owned KfW development bank.[23]

2. Power prices: Since the 1980s, European retail electricity prices have been gradually increasing in real terms.[24] These increases have intensified with the introduction of policies to reduce carbon emissions, increase renewable energy and improve energy efficiency. For example, German retail prices increased 41% from 2008 to 2013.

23 *Federal Ministry for Economic Affairs and Energy, 2014; German Strategy for Energy-Efficient-Buildings & CO2 -Rehabilitation Programme (operated by KfW on behalf of Federal Ministry for Economic Affairs and Energy, Germany); Available: http://www.gbpn.org/sites/default/files/4.%20Andreas%20Germany_GBPNwebinar%5B1%5D.pdf*

24 *DECC publishes comparisons of industrial energy prices by consumer size against other EU and G7 countries, using data from both Eurostat and the International Energy Agency (IEA). This data shows OECD countries domestic household prices have risen nearly five-fold from 1980 to 2013. Available: https://www.gov.uk/government/statistical-data-sets/international-domestic-energy-prices*

3. Technological improvements: Technological improvements across several key sectors of the economy are driving significant efficiency gains.

The impact of policy, power prices and technological improvements in Germany are illustrated in Table 2 below.

Table 2. German public energy efficiency financing, power prices and energy intensity of GDP

	Unit	2008	2009	2010	2011	2012	2013	08-13 %
Energy efficiency financing	billion €	5.4	8.9	8.7	6.5	9.9	10.4	93%
Retail electricity power price including taxes	pence per kWh	17.6	20.4	20.6	21.9	21.4	24.8	41%
GDP per unit of energy use	GDP per kg of oil equivalent used	9.4	9.7	9.8	11.1	11.3	12.8	36%
Electricity intensity	GWh of power generated per GDP (constant 2005 US$)	0.25	0.24	0.25	0.23	0.23	0.22	-12%

Source: Federal Ministry for Economic Affairs and Energy data, Department of Energy and Climate Change data, World Bank data, European Commission data, Carbon Tracker analysis

The Future

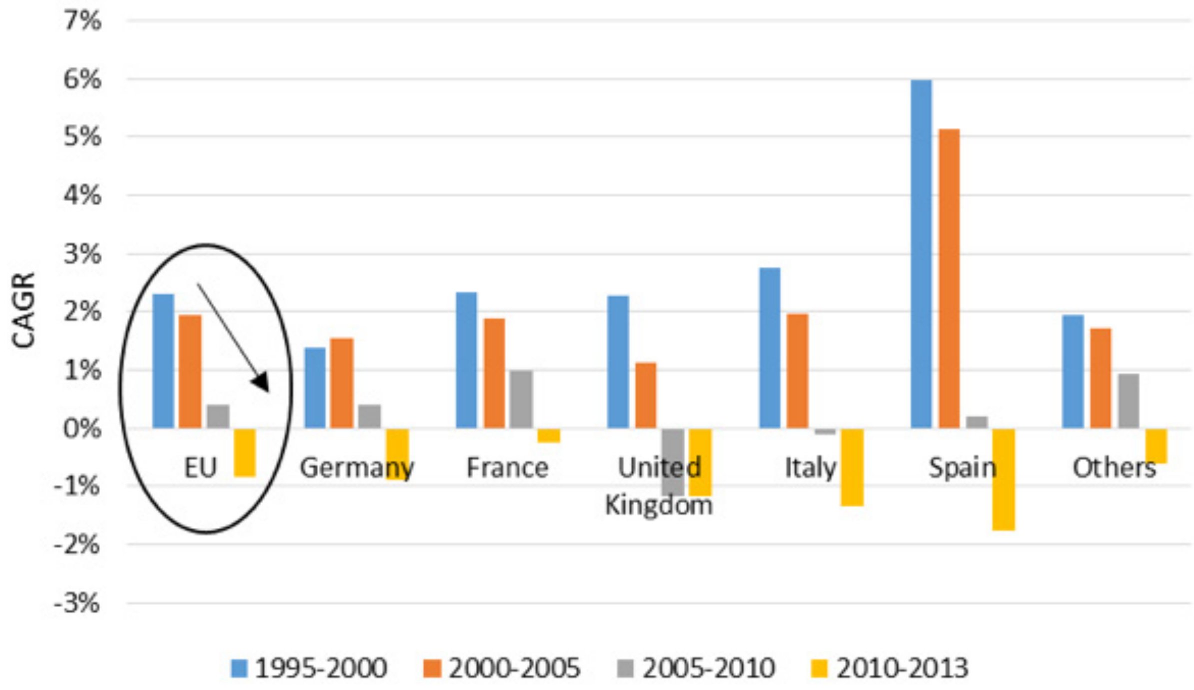
3

In this section we analyse how increased energy efficiency, continued renewable energy growth and strengthening carbon pricing will impact those European utilities who continue to focus on conventional forms of generation. We also review the potential for asset stranding by modelling the project economics of a newly built coal plant in Germany.

Power Demand/Energy Efficiency

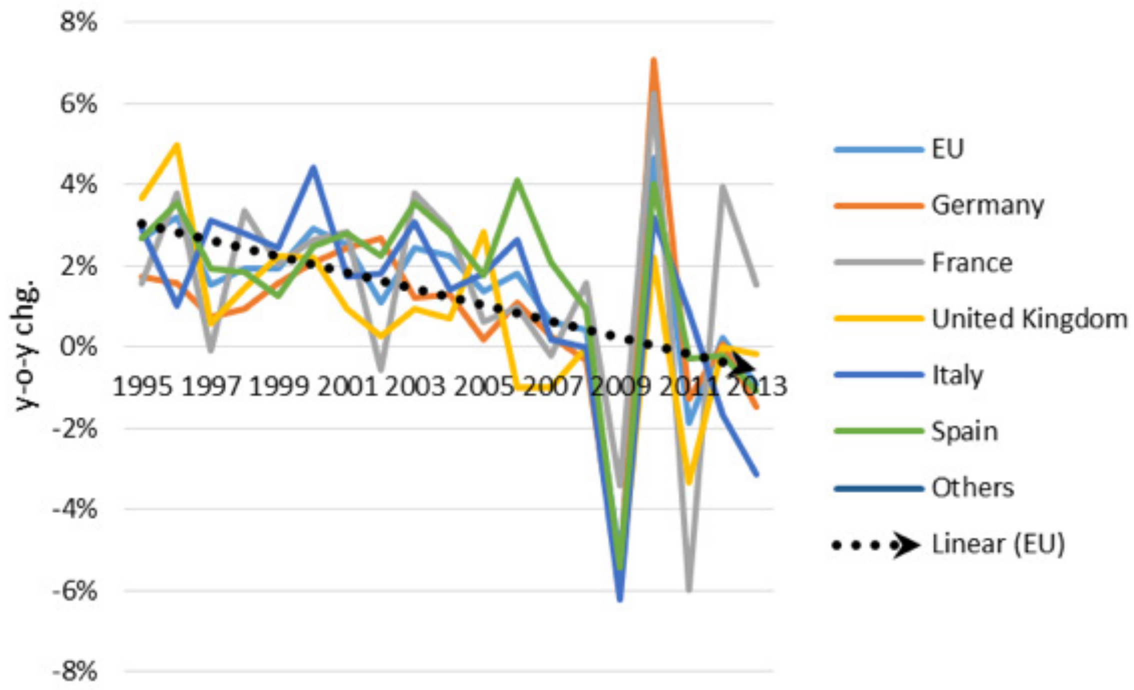
As mentioned in Section 1, European electricity demand growth had been declining well before the financial crisis hit. As illustrated in Figures 21 and 22, the five-yearly compounded annual growth rate or CAGR of electricity demand and year-on-year changes since 1995 show a clear downward trend.

Figure 21. CAGR of European electricity demand



Source: Eurostat data

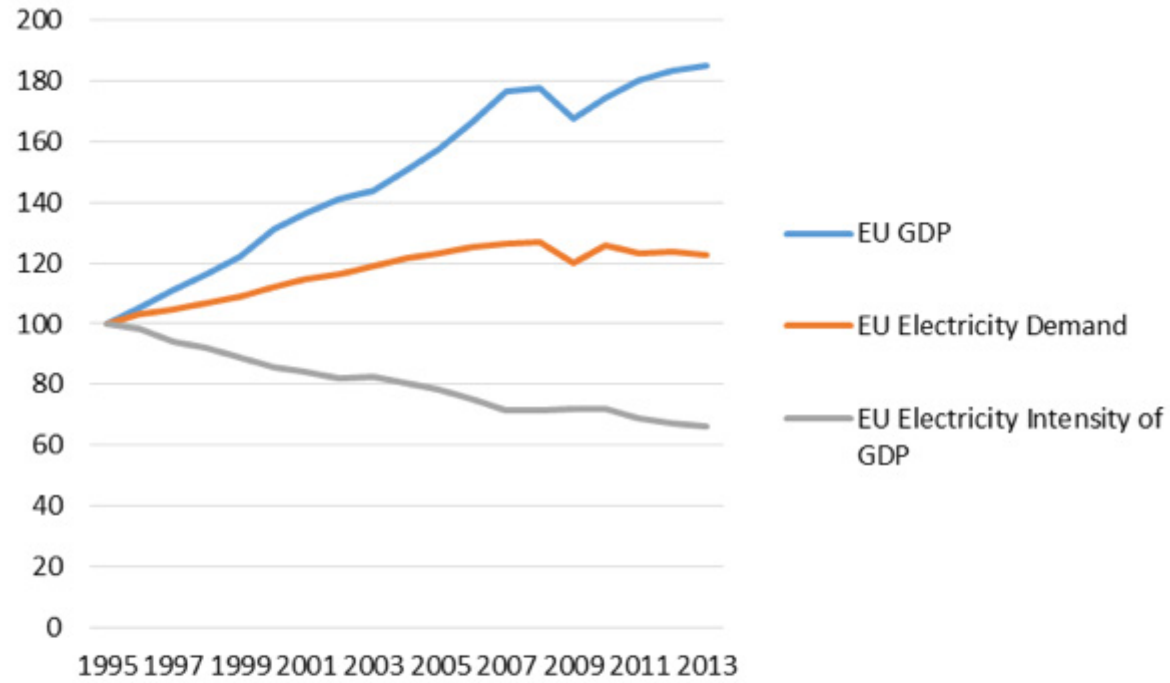
Figure 22. Year-on-year change in European electricity demand



Source: Eurostat data

While electricity demand only increased 23% in the period from 1995 to 2013, GDP increased 85% over the same period, making Europe's electricity intensity of GDP decrease by a considerable 34%.

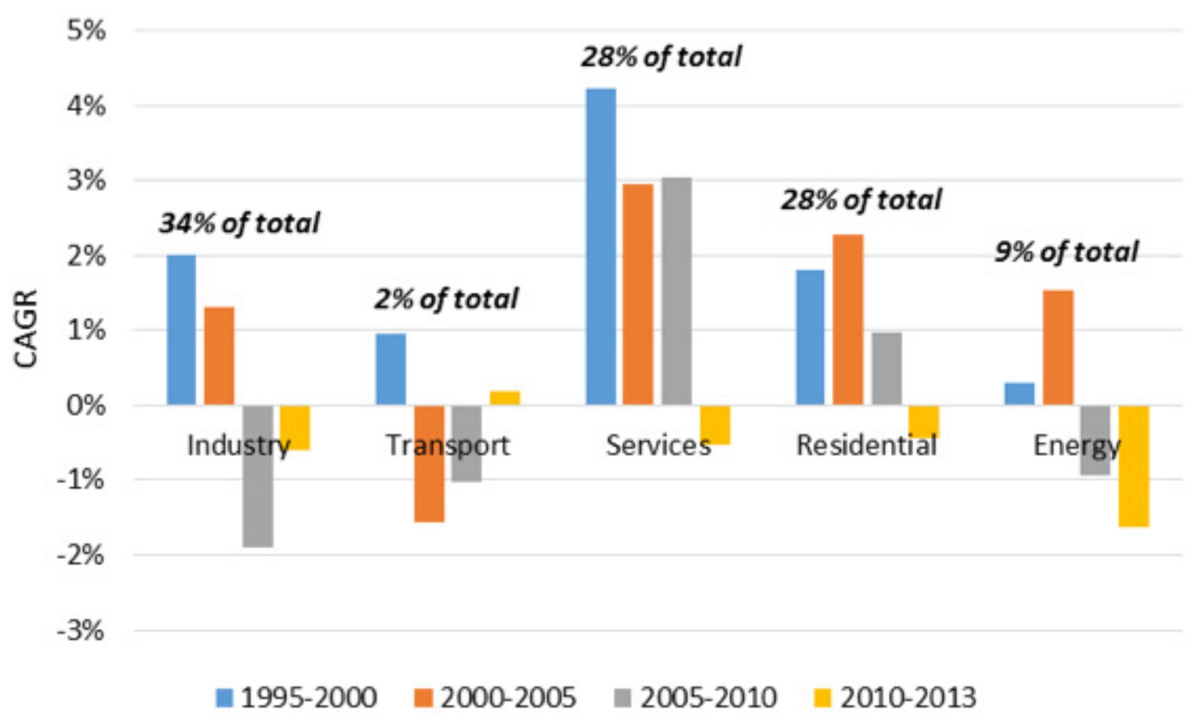
Figure 23. EU electricity demand versus EU GDP and EU electricity intensity of GDP (1995 = 100)



Source: Eurostat data

A sectoral analysis of five-yearly trends over the last two decades paints a more clouded picture. Industry, residential and energy sectors – which together comprised 70% of total demand in 2013 – broadly mimicked the overall declining trend depicted in Figure 21. In contrast, demand within the services sector (28% of total) remained firm between 2005 and 2010. Further, demand from the transport sector (2% of total) showed positive growth in the period from 2010 to 2013 after a decade of negative growth.

Figure 24. CAGR of electricity demand from various sectors



Source: Eurostat data

Europe aims to reduce end-use energy consumption by 20% by 2020 and at least 27% by 2030. The European Commission first pitched the 20% by 2020 goal in 2006 through the auspices of the Action Plan for Energy Efficiency (APEE).[25] The APEE ran from 2007 to 2012 and has since been legislated through the Energy Services Directive (ESD) and Energy Efficiency Directive (EED). The ESD required Member States to adopt and achieve an indicative energy saving target of 9% by 2016.

25 Europa, 2006; Communication from the Commission of 19 October 2006 entitled: Action Plan for Energy Efficiency: Realising the Potential; Available: http://europa.eu/legislation_summaries/energy/energy_efficiency/l27064_en.htm

To reach Europe's 20% energy efficiency target by 2020, the EED also required Member States to set their own indicative national energy efficiency targets.[26] The specific measures of the EED that relate to electricity include:

- Eco-design Directive. The Eco-design Directive provides a set of consistent EU-wide rules for improving the environmental performance of energy related products. According to Ecofys, the implementation of Eco-design will "yield yearly savings of up to 600 TWh of electricity and 600 TWh of heat in 2020, equivalent to 17% and 10% of the EU total electricity and heat consumption, respectively."[27]
- Zero Energy Buildings. Directive 2010/31/EU (EPBD) Article 9 requires that: "Member States shall ensure that by 31 December 2020 all new buildings are nearly zero-energy buildings; and after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings".[28]
- Smart Meter Deployment. The EU aims to replace at least 80% of electricity meters with smart meters by 2020 wherever it is cost-effective to do so. In 2014, a European Commission report[29] found that: 1) 200 million smart meters for electricity will be rolled out in the EU by 2020, representing almost 72% of European consumers; and 2) smart meters provide savings of €160 for gas and €309 for electricity per metering point as well as an average energy saving of 3%.
- Compulsory Energy Audits. All large organizations (defined as those with revenues of over €50 million) are required to undergo an energy audit every 4 years, with the first being due before December 2015. All Member State governments have an obligation to promote the general availability of energy audits to "encourage SME's to undergo energy audits and the subsequent implementation of the recommendations from these audits".[30]

26 European Commission, 2012; Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC; Available: http://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficiency-directive
27 Ecofys, 2012; Economic benefits of the EU Ecodesign Directive Improving European economies Available: http://www.ecofys.com/files/files/ecofys_2012_economic_benefits_ecodesign.pdf
28 European Commission, 2010; Directive 2010/31/EU (EPBD), 2010; Available: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF

29 Further information on smart grids and meters is available here: https://ec.europa.eu/energy/en/topics/markets-and-consumers/smart-grids-and-meters
30 European Commission, 2012; Guidance note on Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EC; Available: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52013SC0447

In addition, a study published by the UK's Department of Energy and Climate Change illustrated how the EU's minimum energy performance standards and energy labels have helped improve the energy efficiency of common domestic appliances and products such as refrigerators, washing machines, TVs and lighting.[31] The study showed that, as a result of improving energy efficiency, such products are cheaper to run than in the past – and cost less to purchase in real terms. Furthermore, the study predicted energy consumption from washing machines and refrigerators will continue to decline from 2014 to 2030 as these items become more efficient. In contrast, energy from televisions is expected to decline between 2014 and 2020 and then upturn in the 2020's as a result of both the anticipated increase in the average numbers of TVs used in the home, and increasing screen size. As shown in Table 3, all the UK stock for refrigerators, washing machines and televisions will meet the EU's minimum standards between 2025 and 2030, saving an estimated 2,930 GWh per year by 2030.

Table 3. Projected stocks, sales and energy savings for washing machines 2011-2030

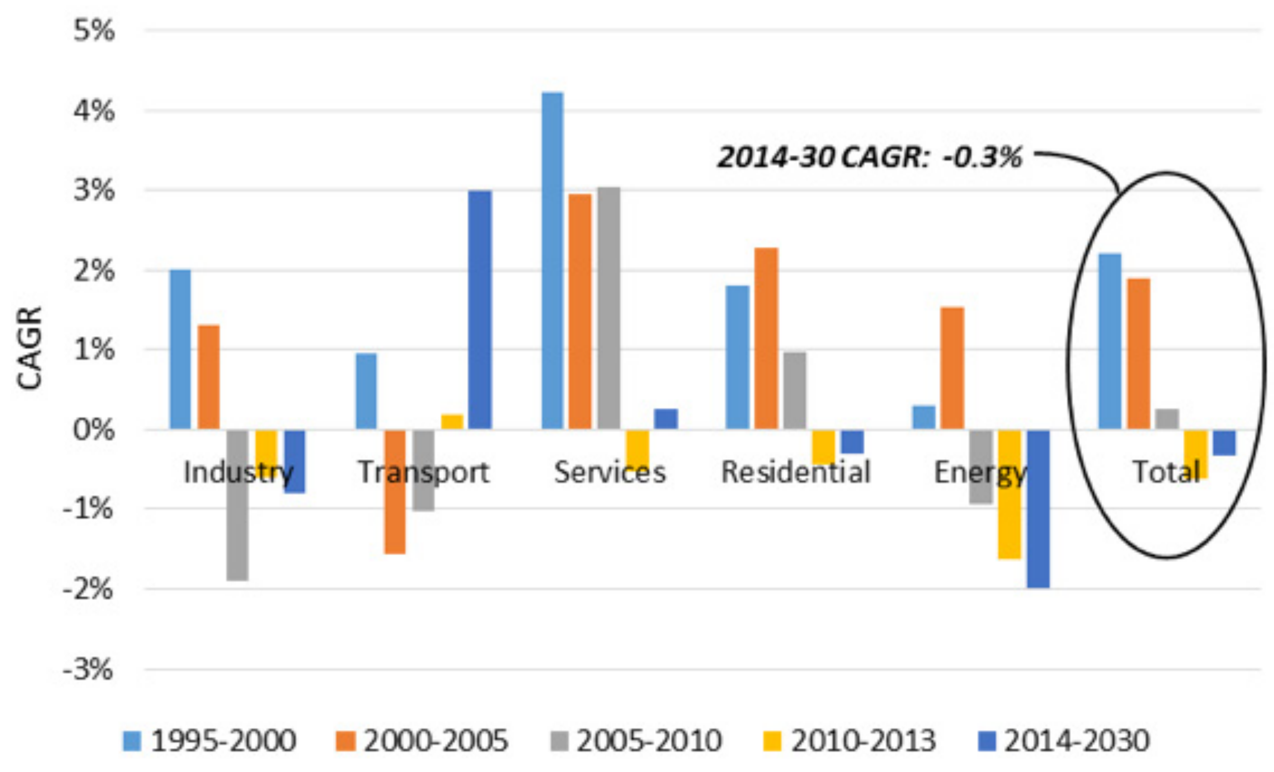
	Refrigerators		Domestic electrical appliances		Televisions	
	Sales since 2010 as % of stock	Energy Savings (GWh)	Sales since 2010 as % of stock	Energy Savings (GWh)	Sales since 2010 as % of stock	Energy Savings (GWh)
2014	35%	56	26%	130	58%	800
2015	43%	67	34%	150	68%	1,000
2020	76%	160	71%	280	99%	1,900
2025	95%	250	93%	310	100%	2,100
2030	100%	320	99%	310	100%	2,300

Source: DECC (2014)

Based on the above, we have created a low demand scenario with a CAGR of European electricity of -0.3% from 2014 to 2030. Services and transport are the only sectors in which we are forecasting growth (a CAGR of 0.3% and 3% respectively). We expect industry, residential and energy sectors to decline at a CAGR of -0.8%, -0.3% and -2% respectively.

31 DECC, 2014; Energy efficient products - helping us cut energy use; Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/328083/Energy_efficient_products_-helping_us_to_cut_energy_use_-_publication_version_final.pdf

Figure 25. Historical and forecasted CAGR of electricity demand from various sectors and the EU



Source: Eurostat data, Carbon Tracker analysis

This fall will obviously have implications for the amount of electricity generated and therefore the potential market for electricity in Europe. Table 4 (below) compares demand projections from Carbon Tracker, the European Commission's 2013 Energy Trends Reference Scenario (ETRS) and the International Energy Agency's New Policy Scenario (NPS).[32 33] Since methodological differences complicate comparing the level of projected electricity demand from different sources, Table 4 also compares projections of 2014-2030 growth in electricity demand (in both absolute and relative terms). Both the ETRS and the NPS include all binding targets at the time of writing, which were mid-2012 and 2014 respectively. Crucially, for the ETRS, this includes the impact of the EED, on which political agreement was reached by that time.

32 The EU's Energy Trends publications present energy market scenarios for 2030 and 2050 based on current trends and policies. They highlight possible energy demand, energy prices, greenhouse gas emissions, and other potential developments. For more information, see: http://ec.europa.eu/energy/en/statistics/energy-trends-2050

33 The NPS is the central scenario of the IEA's WEO report and takes into account "policies and implementing measures affecting energy markets that had been adopted as of mid-2014, together with relevant policy proposals, even though specific measures needed to put them into effect have yet to be fully developed. These proposals include targets and programmes to support renewable energy, energy efficiency, and alternative fuels and vehicles, as well as commitments to reduce carbon emissions, reform and energy subsidies and expand or phase out nuclear power." For more information on the WEO, see: http://www.worldenergyoutlook.org/

Nevertheless, we have included a breakdown for 2020 and 2030, given the uncertainty around the post-2020 policy environment.

Table 4. Projected change in electricity demand under different scenarios from 2014 to 2035 (absolute change in GWh, growth rate in CAGR)

	Absolute Chg. 2020	CAGR 2014-20	Absolute Chg. 2030	CAGR 2014-2030
Carbon Tracker	- 55,494	-0.3%	- 161,416	-0.3%
IEA - NPS	105,421	0.5%	267,894	0.5%
Energy Trends	29,337	0.1%	265,324	0.5%

Source: European Commission (2013), IEA (2014), Carbon Tracker analysis

Renewable Energy

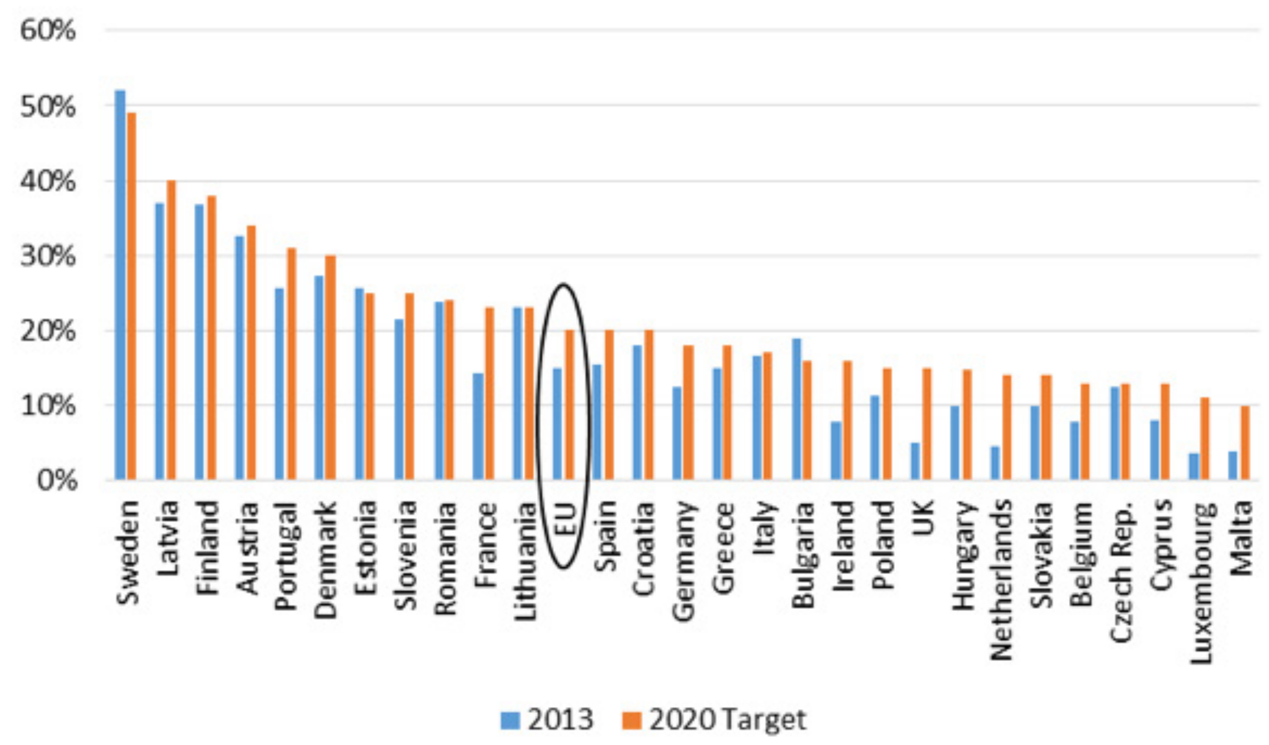
The potential market for electricity in Europe may not only decrease, but competition to supply that electricity will likely increase as policy and technology costs continue to erode the competitiveness of conventional generation.

The EU aims to raise the share of energy consumption produced from renewable resources to 20% by 2020 and 27% by 2030. The Renewable Energy Directive[34] establishes an overall policy to meet the initial target of 20% by 2020. This directive requires Member States to submit national renewable energy action plans to meet their legally binding renewables targets. Each action plan is to take into account the relevant Member State's starting point and overall potential for renewables. By way of example, the lowest target is 10% in Malta and the highest target is 49% in Sweden. The EU has increased its share of renewable energy in gross final energy consumption from 10.5% in 2008 to 15% in 2013 and looks set to easily meet its 2020 target.[35]

34 European Commission, 2009; Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC; Available: http://ec.europa.eu/energy/en/topics/renewable-energy/renewable-energy-directive

35 European Environmental Agency, 2014; Share of renewable energy in gross final energy consumption (ENER 028) - Assessment published Oct 2014; Available: http://www.eea.europa.eu/data-and-maps/indicators/renewable-gross-final-energy-consumption-3/assessmen

Figure 26. Member State share of renewable energy in gross final energy consumption versus 2020 targets



Source: Eurostat data

The policy environment for renewables in Europe after 2020 is uncertain. The 27% target is only binding at the EU level, and, in contrast to the present approach, the 2030 package explicitly mentions that the renewables goal will not be translated into nationally binding targets.[36] Moreover, according to European Commission modelling, a 24% renewable share of energy by 2030 will be achieved through business as usual, making the target of 27% very unambitious.[37]

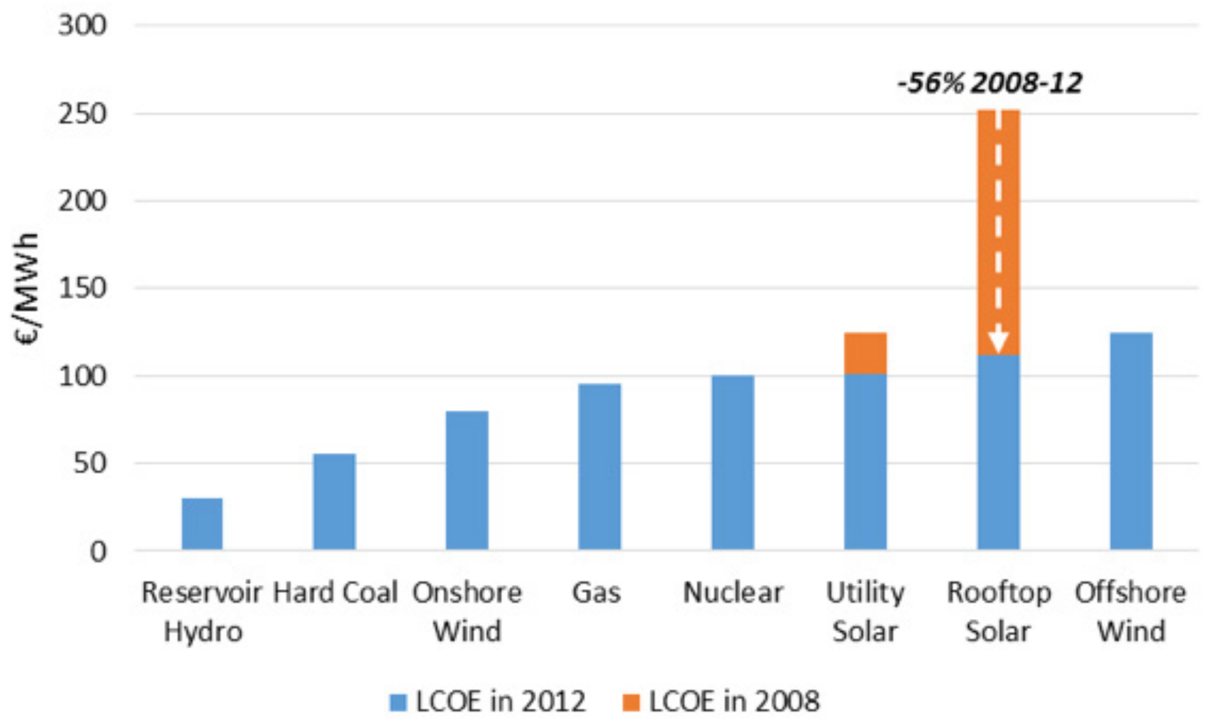
This lack of ambition on renewables deployment will likely please governments throughout the Eastern Bloc and the UK; the former has openly expressed opposition to European ambition on climate change while the latter favours building new nuclear facilities. However, the UK should not be under any illusion that this will be cheaper than onshore wind and solar.

36 European Commission, 2014; 2030 framework for climate and energy policies; Available: http://ec.europa.eu/clima/policies/2030/index_en.htm

37 According to the initial impact assessment for the 2030 Package: "For 2030, the EN 5 EN new reference scenario results in a GHG reduction in the EU of 32% below 1990 levels; a renewable energy share of 24% of final energy consumption; and primary energy savings compared to the baseline for 2030 (as projected by PRIMES 2007 baseline) of 21%."

The European Commission published a comprehensive study in late 2014 on subsidies and costs of EU energy, which found that, of fuel types used in European electricity, onshore wind was the third cheapest on an unsubsidised LCOE basis, with hydro and coal being the first and second cheapest, respectively.[38] One feature of the study – which has been echoed by numerous analysts and was touched upon in Section 1 – is the changing position of solar PV between 2008 and 2012. At just over €100/MWh it costs little more than gas or nuclear power as of 2012. That is less than half the estimated cost in 2008 of about €250/MWh.

Figure 27. Unsubsidised LCOE of fuel types used in European electricity based on full load hours from 2008 to 2012, €/MWh



Source: Ecofys/European Commission (2014)

Figure 27 does not take into consideration the extent fossil fuels are being subsidised. The IMF recently looked at this issue by taking a broad notion of all post-tax energy subsidies: "which arise when consumer prices are below supply costs plus a tax to reflect environmental damage and an additional tax applied to all consumption goods to raise government revenues."[39] The IMF estimated that post-tax subsidies for all fossil fuels were $4.9 trillion (or 6.5 percent of global GDP) in 2013, with coal and gas making up $2.5 and $0.5 trillion of this amount, respectively.

Even in the absence of a strong and prescriptive policy environment, the growing competitiveness of renewable energies coupled with

38 *Ecofys and European Commission, 2014; Full dataset on energy costs and subsidies for EU28 across power generation technologies; Available: https://ec.europa.eu/energy/en/studies*

39 *IMF, 2015; IMF Working Paper: How Large Are Global Energy Subsidies? Available: http://www.imf.org/external/np/fad/subsidies/*

strengthening carbon pricing and air quality regulation (see Box 4) will likely ensure growth post-2020. For example, the IEA's 2014 Solar Photovoltaic Technology Roadmap forecasts an average 45% cost reduction in solar by 2030 and 65% reduction by 2050.[40] In contrast, although the fossil fuel industry has made technological gains, these have been countered by two factors: 1) discovery sizes for oil and gas have been on a downward trend pushing up unit costs; and 2) rising capital intensity combined with a higher oil price has caused industry specific inflation, which tends to track the oil price.[41]

Box 4

The EU's Air Quality Regulation

The main EU air quality legislation impacting the electricity sector includes the Large Combustion Plant Directive (LCPD) and the Industrial Emissions Directive (IED). The LCPD regulates sulphur dioxide, nitrogen oxides and particulate matter emissions. EU-regulated plants are given a choice to opt in or out. Plants opting out are allocated 20,000 hours to run over the years 2008-2015. Plants opting in must comply with emissions limit values for the above pollutants. In 2010, the LCPD was combined with six other existing directives to form the IED. LCPD plants which opted in to the IED must agree to stricter emissions limits. To comply with the IED, plants have to fit nitrogen oxide abatement equipment to keep running at 2012 levels beyond 2015. Plants that opted into the LCPD but choose not to opt in to the IED will have their hours capped at 17,500 for the period 2016-2023. There is also a plethora of regulations at Member State level. For example, as part of the UK Energy Act 2014, any new fossil-fuel power station in the UK must comply with an EPS of 450gCO2/kWh, with some exemptions for CCS projects.[1]

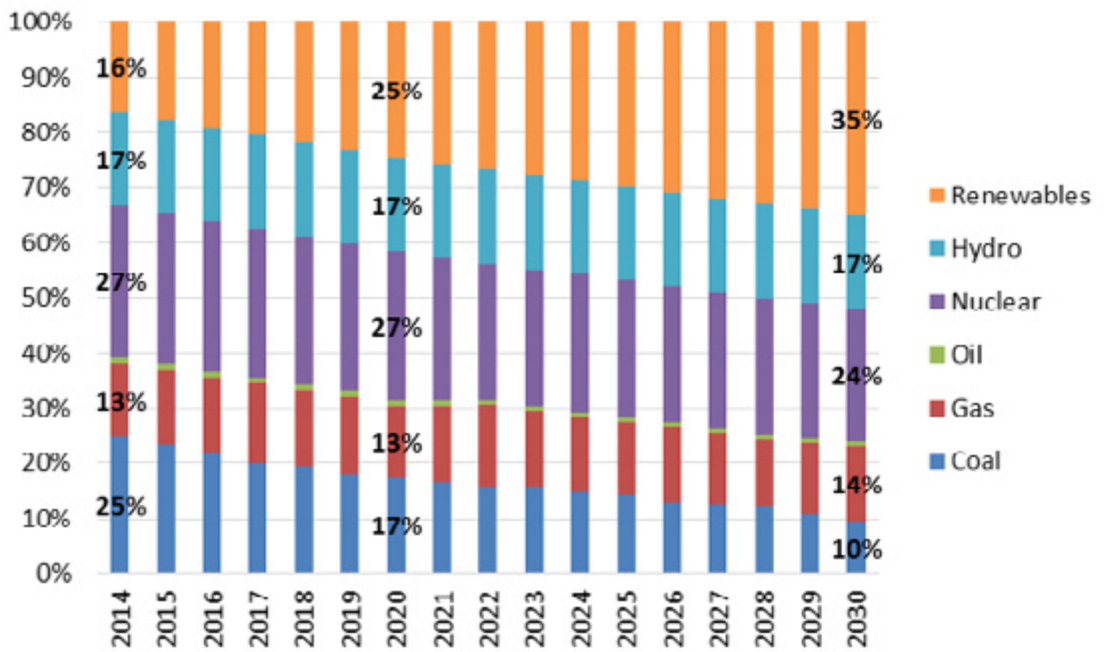
1 *An EPS was introduced in the Energy Act 2014 to prevent the building of new unabated coal stations. Energy Electricity market reform: Update on the emissions performance standard, Annex D; See: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48375/5350-emr-annex-d--update-on-the-emissions-performance-s.pdf*

40 *IEA, 2014; Technology Roadmap: Solar Photovoltaic Energy - 2014 edition; Available: https://www.iea.org/publications/freepublications/publication/technology-roadmap-solar-photovoltaic-energy---2014-edition.html*

41 *For further analysis on these topics please refer to: Carbon Tracker, 2014; Carbon Supply Cost Curves – Evaluating Financial Risk to Oil Capital Expenditures; See: http://www.carbontracker.org/wp-content/uploads/2014/05/Chapter2ETAcapexfinal1.pdf*

Below, we estimate the output from the various technologies as a percentage of total generation. Renewable energies could increase their market share from 16% in 2014 to 35% in 2030. Coal will likely suffer the most significant reduction in production over the 16-year period, potentially seeing its market share drop from 25% in 2014 to 10% in 2030. This estimated decline is greater than the IEA (NPS from WEO, 2014) and the European Commission (Energy Trends, 2013) who expect the market share of coal to decline to 15% and 13%, respectively, by 2030. Overall, we expect fossil generation (coal, gas and oil) to reduce its market share from 39% in 2014 to 24% in 2030.

Figure 28. Generation of fuels used in EU electricity as a percentage of total



Source: Carbon Tracker analysis

Carbon Pricing

As outlined in Section 1 and Box 2, the EU ETS has had a chequered past. The system has become vastly oversupplied, as other policies cannibalised demand for allowances and exogenous factors, such as the financial crisis, suppressed demand for electricity. However, the EU ETS is going through a period of structural reform which should see prices rise from current levels.

In March 2014 the European Commission implemented the backloading proposal – an amendment to the EU ETS Directive to temporarily delay the auctioning of 900 million EUAs from 2014 until 2016. Furthermore, in January 2014 the European Commission put forward a proposal to structurally reform the EU ETS. The proposal included two reforms: (1) increase the linear reduction factor from 1.74% to 2.2%; and (2) create a Market Stability Reserve (MSR).

The MSR will work by controlling the number of allowances in the market. When the cumulative balance exceeds 833 million tonnes, 12% of the surplus will be put into the MSR. Once the surplus (excluding the allowances in the reserve) falls below 400 million tonnes, 100 million allowances will be returned to the market each year. Since January 2014 the MSR proposal has been negotiated by Member States. On May 5th 2015, following 'trilogue' negotiations with the European Council, Parliament and European Commission, an agreement was reached on the wording of the bill. The principles of this agreement included:

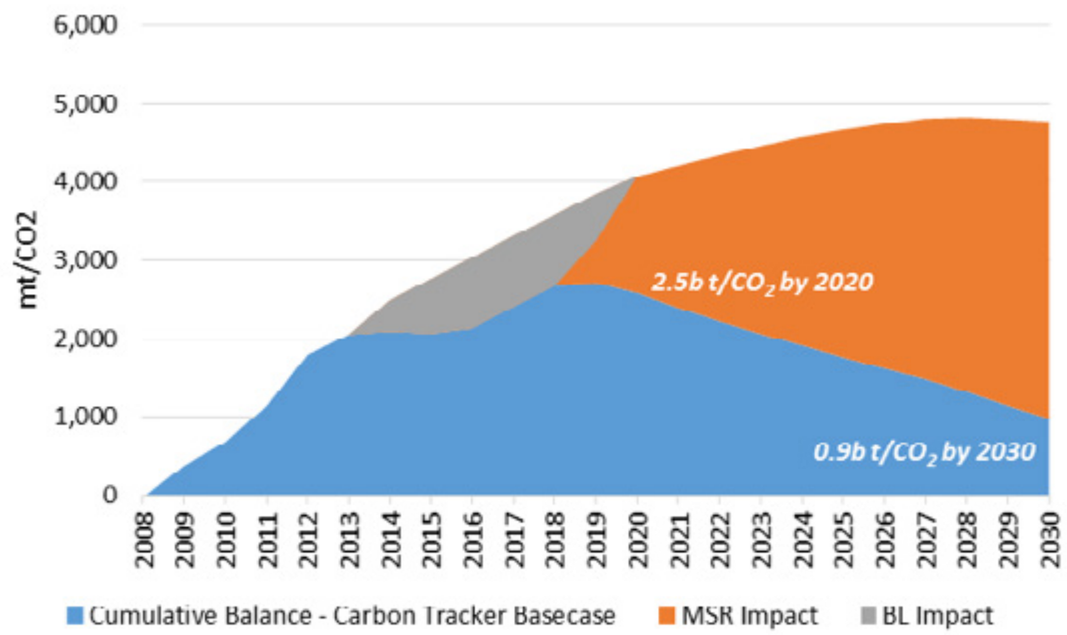
- To support a January 2019 start to the MSR, two years earlier than the original European Commission proposal;
- To place hundreds of millions of unallocated allowances into the MSR instead of allowing them to return to market in 2020;[42] and
- To place 900 million backloaded allowances into the MSR instead of allowing them to return to the market in 2019 and 2020.

The MSR bill was approved on May 13th 2015 by the European Council, as agreed by the trilogue. The bill now moves to the European Parliament where it requires a majority vote from its environment committee and the assembly. After Parliament ratification, the bill will be submitted for final approval at any formal Council meeting of national ministers, before being made law by appearing in the Official Journal of the EU.

Assuming the MSR bill goes through as proposed we see the cumulative balance decreasing from around 2 billion tonnes in 2014 to 0.9 billion tonnes in 2030. Without implementation of the MSR, the cumulative balance will increase to 4 billion tonnes by 2020 and peak towards the end of Phase 4 (2020-2030) at 4.8 billion tonnes.

42 *We note that the MSR bill does leave open the possibility for the unallocated allowances to be issued as free allocations to address carbon leakage concerns.*

Figure 29. EU ETS cumulative balance with and without reform from 2008 to 2030, mt/CO2[43]



Source: European Commission data, Carbon Tracker analysis

This forecast is based on the following assumptions in the period from 2014 to 2030:

- Annual GDP growth of 1.7% (IEA 2014 WEO);
- CAGR of carbon intensity of electricity generation of -1.1% (Carbon Tracker estimate);
- CAGR of electricity demand growth of -0.3% (Carbon Tracker estimate);
- CAGR industry growth of -0.8% (Carbon Tracker estimate); and
- This outlook does not take a position on the unallocated allowances which are subject to a forthcoming review. We assume the NER400 fund will be monetized proportionally from 2021 to 2024 (i.e. 100 million tonnes per year).

We forecast allowance prices to average €9.70/t in Phase 3 and €19.40/t in Phase 4 (in real terms). Further information on our pricing approach can be found in Box 5.

43 *All scenarios assume a 1.74% and 2.2% linear reduction in Phase 3 and 4, respectively.*

Box 5

Pricing European Carbon – An Options Model Approach

As depicted in Figure 29, the system is still net long at the end of 2030, which compromises our ability to forecast the price of allowances in the future. Models to generate allowance prices are typically based upon abatement cost curves matched against demand for abatement. However, in the event of oversupply this approach to generating the market equilibrium price using supply and demand curves does not work because demand for abatement drops to zero. There is an important question when modelling the latter part of Phase 4 about how far forward looking demand is for carbon, because you may need to take the Phase 5 balance, which is a big unknown, into account.

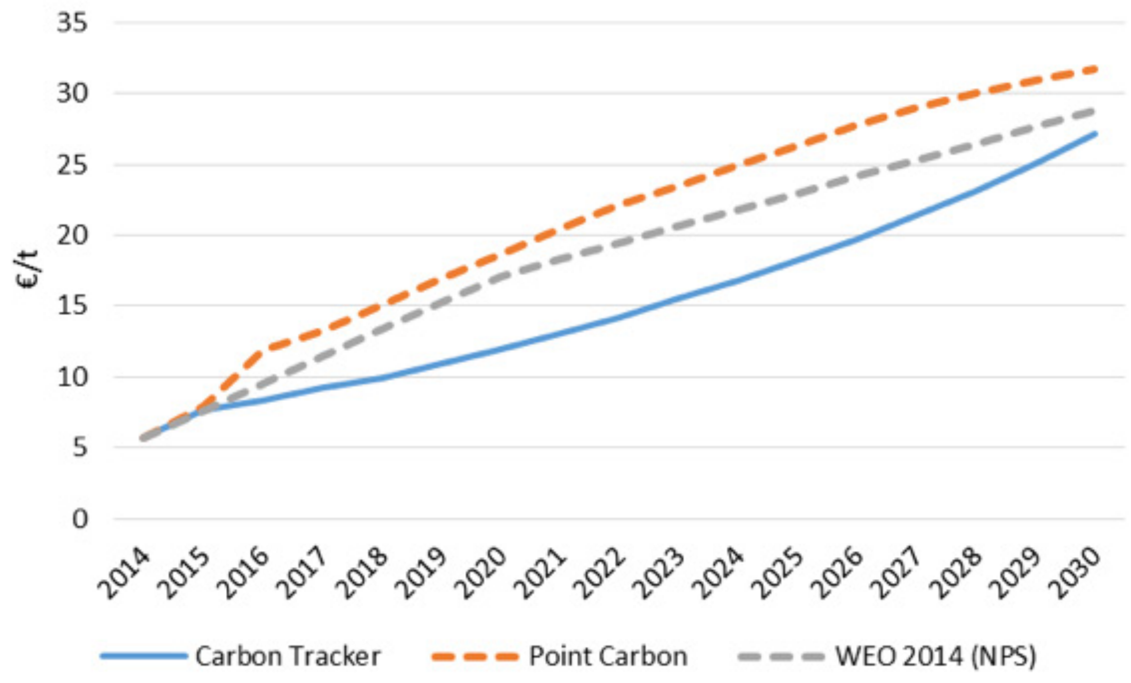
We use a digital spread option price model to forecast the price of carbon. A digital spread option price model pays out a fixed sum if the spread between two underlying assets exceeds a fixed value at the time of expiry. If we choose one of our underlying assets to be cumulative supply and the other to be demand and set the spread to be zero then we can calibrate the model to pay out the cost of abatement if demand in a given year exceeds supply in that year. Since abatement cost curves are effectively useless in the case of oversupply we choose one abatement option, the cost of switching from coal to gas, as the pay-out for our option model. Based on current forward curves for coal and gas our fuel switch price is currently around €40/t. We model demand in a given year as the expected emissions in that year. As may be expected, we make demand forward looking as utilities hedge their carbon exposure up to four years in advance and fossil plant investors have allowance price exposure throughout the loan amortisation period. In defining the digital spread option we must determine expectation and volatility for our underlying assets. Our forecasts for emissions and the cap enable us to derive expected value for both supply and demand. Looking at historical volatility of emissions data and expected volatility of GDP in the future we ascribe volatility of 8% to both supply and demand, since they are related to one another. Using this model generates a spot price of a EUA based on the probability of abatement being required in the year of delivery and the cost of that abatement.

We forecast allowance prices to average €9.70/t in Phase 3 and €19.40/t in Phase 4. In an efficient market, with unlimited banking between periods, today's price theoretically reflects the most valuable expected price in the future, discounted back at the appropriate cost of carry. However, due to the recent politicization of the EU ETS and the role of carbon pricing in Europe, over the short to medium term allowance prices will likely be motivated by annual imbalances between buyers and sellers. With the onset of auctioning in Phase 3 and the implementation of the backloading proposal in 2014, there is a gap between the purchasing demand from utilities and auction supply. Those utilities that have no surplus reserves must enter the market to meet their hedging requirements. The cheapest source of supply to meet this gap is to purchase the surplus accumulated by industrials. The level at which industrials start selling their surplus allowances is entirely subjective and depends on their planning horizon, price expectations, how quickly they need cash, and their cost of capital.[1] This dynamic makes industrials the quasi Organization of the Petroleum Exporting Countries or OPEC of the EU ETS, because of their perceived ability to control allowance prices. In Figure 30 below we present our allowance price outlook in comparison with the IEA's NPS and Thomson Reuters Point Carbon, a highly regarded EU ETS forecaster.[2]

1 *The cost of capital for utilities can be understood through credit default swap, or CDS, rates. CDS rates are a proxy for the interest rate premium corporates pay to access the capital markets. Industrials with a surplus of allowances have an opportunity cost of holding allowances. For example, in a high interest rate environment, industrials could opt to sell their free allowances to raise cash rather than access the capital markets.*

2 *Received by email on May 13th and based on a research note published on May 5th.*

Figure 30. European carbon price forecasts, €/t



Source: IEA data, Thomson Reuters Point Carbon data, Carbon Tracker analysis

Analysing Asset Stranding Potential – Moorburg Coal Plant

We have analysed the project economics of the Moorburg Coal Plant, a newly built German coal plant, to establish the potential for asset stranding. The term 'stranded asset' is a financial one. Carbon Tracker introduced the concept of stranded assets to get people thinking about the implications of not adjusting investment in line with the emissions trajectories required to limit global warming. There have been a number of interpretations, including: regulatory stranding – due to a change in policy of legislation; economic stranding – due to a change in relative costs/prices; and physical stranding – due to distance/flood/drought.

Carbon Tracker defines a stranded asset as: "fossil fuel energy and generation resources which, at some time prior to the end of their economic life (as assumed at the investment decision point), are no longer able to earn an economic return (i.e. meet the company's internal rate of return), as a result of changes in the market and regulatory environment associated with the transition to a low-carbon economy."[44] Electricity generation assets become uneconomic to operate when their marginal cost of generation exceeds the price of electricity over an extended period of time.

44 *See: http://www.carbontracker.org/resources/*

A financial metric commonly used to understand the potential for asset stranding is Net Present Value, or NPV, which is the difference between the present value of cash inflows and the present value of cash outflows. NPV is used to analyse the profitability of an investment or project.

Background

Operated by Vattenfall Europe, the Moorburg Coal Plant is located at Moorburg, Hamburg, Germany. Moorburg is a supercritical plant with a design capacity of 1640 MW; it has two units. Construction began in 2007 with the first unit becoming operational in February 2015. It is anticipated that the second unit will be operational in mid-2015.[45] Initially, the project intended to generate 650 MW of district heating output, which would have raised the efficiency of the plant from 46.5% to 60%. However, Hamburg City did not approve the infrastructure required for this aspect of the project.[46] The plant was also expected to be equipped with Carbon Capture and Storage (CCS) technology, but land availability has prevented this portion of the project from going ahead to date. According to Vattenfall in May 2013: "As soon as the legal, technical and economic requirements have been met, the Moorburg power plant will be equipped with a facility for CO2 capture. In Germany, however, these requirements are still pending."[47]

Assumptions

We developed a best-case and worst-case scenario to capture an optimistic and pessimistic outlook of the future. The variables changed to reflect the best-case and worst-case scenarios include the load factor, the carbon price and the coal price.

For the best-case scenario we assume a load factor of 80% for the period through to 2030. From 2030 onwards we assume a linear reduction consistent with Germany's decarbonisation objective of at least 80% of electricity produced by renewable energy sources by 2050. For the coal price we used the CIF ARA forward curve as of May 20th 2015. Carbon Tracker's carbon price outlook is used as it is lower than IEA and Thomson Reuters Point Carbon (see Box 5).

For the worse-case scenario we assume a load factor of 60% for the period through to 2030. From 2030 onwards we assume a linear reduction consistent with Germany's decarbonisation objective of at least 80% of electricity produced by renewable energy sources by 2050. For the coal price we use the IEA's NPS.

45 Platts, 2015; Vattenfall to start new 800 MW German coal unit Moorburg B on Sat; Available: http://www.platts.com/latest-news/coal/london/vattenfall-to-start-new-800-mw-german-coal-unit-26022006

46 Inside Climate News, 2013; Why Is Germany's Greenest City Building a Coal-Fired Power Plant? Available: http://insideclimatenews.org/news/20130724/why-germanys-greenest-city-building-coal-fired-power-plant

47 Vattenfall, 2013; Reliable energy for Hamburg; Available: http://corporate.vattenfall.de/globalassets/deutschland/geschaeftsfelder/erzeugung/neubauprojekte/moorburg_und_fischtreppe/140617_broschuere_moorburg_englisch.pdf

Thomson Reuters Point Carbon's carbon price outlook is used as it is higher than Carbon Tracker and the IEA (see Box 5).

In both scenarios the electricity price is based on the 2014 day-ahead average plus 0.0004/kWh for every 1 €/t rise in the carbon price. Although it is commonplace for utilities to sell power up to four years in advance, this analysis makes no assumptions on hedging sales.

Table 5. Moorburg plant and financing assumptions

Parameter	Unit	Value	Source
Size	kW	1,640,000	Company data
Life Time	Years	40	IEA 2010
O&M Costs	€/kW	51	IEA 2014
Efficiency	%	46.5%	Company data
Total CAPEX	€	3,087,000,000	Company data
Loan	60%	1,568,448,000	Carbon Tracker estimate
Equity	40%	1,045,632,000	Carbon Tracker estimate
Interest Rate	%	4.5%	Carbon Tracker estimate
Exchange rate	USD/EUR	0.7800	IEA 2014
NPV Rate	%	10%	Carbon Tracker estimate

Source: IEA data, Vattenfall data, Carbon Tracker analysis

Table 6. Moorburg plant load factor and fuel cost assumptions

Parameter	Unit	Value			Source and Notes
		2020	2030	2040	
Load Factor (Best-case)	%	80%	80%	50%	Carbon Tracker estimate
Load Factor (Worst-case)	%	60%	60%	40%	Carbon Tracker estimate
Coal Price (Best-case)	$/t	58	58	58	Forward curve May 20th 2015
Coal Price (Worst-case)	$/t	101	108	112	IEA 2014
Carbon Price (Best-case)	€/t	12	27	27	Carbon Tracker estimate (forecast unchanged from 2030)
Carbon Price (Worst-case)	€/t	19	32	32	Point Carbon (forecast unchanged from 2030)
Carbon Price Impact on Power Price	€/kWh	0.0004	0.0004	0.0004	Carbon Tracker estimate
Electricity Price (Peak)	€/kWh	0.039	0.045	0.045	Carbon Tracker estimate (based on 2014 day-ahead average plus carbon price impact on the power price)
Electricity Price (Off Peak)	€/kWh	0.035	0.041	0.041	Carbon Tracker estimate (based on 2014 day-ahead average plus carbon price impact on the power price)

Source: IEA data, Vattenfall data, Carbon Tracker analysis

Results

The results are presented in Table 7 and 8 below. Under both scenarios the Moorburg plant would be cash-flow negative throughout its project lifecycle. If the Moorburg plant is not closed down prematurely, it could generate a negative NPV of €3.3 billion under the best-case scenario and a negative NPV of €4.4 billion under the worse-case scenario. The key unchanged variable in this analysis is the electricity price. If the electricity price remained at 2008 levels throughout the project lifecycle then the Moorburg plant would have likely been cashflow positive and generated a positive NPV. As an example, we ran our model under the best case scenario with the 2008 day-ahead average electricity price and a positive NPV of €416 million was generated.

Table 7. Forecasted project economics of the Moorburg plant – best case scenario

(million €)	2016	2020	2025	2030	2035	2040	2045	2050	2055
Revenues	413	432	467	501	407	313	219	125	125
Expenses1	452	473	517	560	474	392	323	254	254
Net Operating Profit2	-39	-41	-50	-59	-67	-78	-103	-128	-128
Free Cash Flow3	-3,126	-3,291	-3,524	-3,801	-4,119	-4,481	-4,948	-5,539	-6,181
Project NPV4	-3,276								

1. Expenses include operation and maintenance costs, interest, depreciation, carbon and fuel.
2. Refers to the income after deducting for operating expenses but before deducting for tax.
3. Cash generated as operating cash flow minus capital expenditures.
4. Net Present Value, or NPV, which is the difference between the present value of cash inflows and the present value of cash outflows.

Source: Carbon Tracker analysis

Table 8. Forecasted project economics of the Moorburg plant – worst case scenario

(million €)	2016	2020	2025	2030	2035	2040	2045	2050	2055
Revenues	324	354	376	399	344	285	214	142	142
Expenses1	480	536	564	593	534	468	391	314	314
Net Operating Profit2	-156	-182	-188	-195	-189	-183	-177	-176	-175
Free Cash Flow3	-3,243	-3,932	-4,859	-5,819	-6,778	-7,699	-8,596	-9,467	-10,327
Project NPV4	-4,401								

1. Expenses include operation and maintenance costs, interest, depreciation, carbon and fuel.
2. Refers to the income after deducting for operating expenses but before deducting for tax.
3. Cash generated as operating cash flow minus capital expenditures.
4. Net Present Value, or NPV, which is the difference between the present value of cash inflows and the present value of cash outflows.

Source: Carbon Tracker analysis

Lessons for Investors

This report highlights the financial consequences of ignoring the transition to a low carbon economy. The false comfort of the status quo has cost the surveyed utilities dearly. There appear to be no signs of improvement for E.ON and RWE. In its 2014 annual report, E.ON wrote off €4,802 million in 2014 for unscheduled impairments on fixed assets.[48] Similarly, in its 2014 annual report, RWE detailed unscheduled impairments of €600 million on power stations in the UK and Germany alone.[49]The RWE Chief Executive Officer Peter Terium recently described German energy policy as an existential threat: "The so-called climate contribution for conventional power stations affects our very existence."[50]

There have been several excellent studies on how investors and policymakers can respond to changes within the electricity sector.[51] Looking across the electricity supply chain, these studies highlight the considerable challenges for electricity generators, but also the significant opportunities associated with distribution and customer management. However, in the context of this report, we offer two recommendations.

1. New German coal plant economics don't add up – shareholders should challenge utilities proposing new plants in OECD markets.

Our analysis of the Moorburg coal plant highlight how the economics of large-scale conventional generation has been compromised by the transition to a low carbon economy. As Germany's renewable generation grew the wholesale electricity price decreased and the load profile flattened, dramatically reducing the returns for conventional generators. At the same time, Germany's energy consumption continues to fall while renewable energy rises. In many respects, Europe's electricity sector has been the 'canary in the coal mine' with regards to understanding how a transition to a low carbon economy will create winners and losers. What has happened in Europe over the last five years should send a warning signal to investors. Shareholders should challenge utilities proposing new coal plants in OECD markets to ensure technology and policy risks have been properly considered over the project timeline.

48 E.ON, 2014; Annual Report; Available: http://www.eon.com/en/about-us/publications/annual-report.html
49 RWE, 2014; Annual Report; Available: http://www.rwe.com/app/wartung/hv2014/bpk_docs/RWE-Annual-Report-2014.pdf
50 Bloomberg LP, 2015; RWE Says Germany's Coal-Power Policy Threatens Its Existence; Available: http://www.bloomberg.com/news/articles/2015-04-23/rwe-chief-says-german-coal-power-policy-threatens-its-existence
51 For example, Climate Policy Initiative, 2014; Roadmap to a Low Carbon Electricity System in the U.S. and Europe; Available: http://climatepolicyinitiative.org/publication/roadmap-to-a-low-carbon-electricity-system-in-the-u-s-and-europe/

2. European utilities need a new business model/structure to reflect the changing market conditions.

This report has also highlighted the need for European utilities to pursue different business models. Many positive announcements have been made in this regard. E.ON decided in December 2014 to split its business up. E.ON will focus entirely on renewables, distribution networks, and customer management, while conventional generation, global energy trading, and exploration and production will be placed into a new, independent company. During this announcement Johannes Teyssen, the CEO of E.ON, explained how renewable energy had changed the electricity sector forever:

> *More money is invested in renewables than in any other generation technology. Far from diminishing, this trend will actually increase. At the same time, the costs of some renewables technologies—such as onshore wind farms—have sunk to parity with, or below, those of conventional generation technologies. We expect that other renewables technologies could become economic in the foreseeable future. Renewables aren't just revolutionizing power generation. Together with other technological innovations, they're changing the role of customers, who can already use solar panels to produce a portion of their energy. As energy storage devices become more prevalent, customers will be able to make themselves largely independent of the conventional power and gas supply network.*[52]

RWE has also invested in a new renewables business and hasn't ruled out following E.ON's example[53] In its own strategy document, EnBW, another large European utility, made a simple declaration about its future: "Conventional business models of larger power supply companies no longer work."[54] Only time will reveal whether this shift in focus will prove to be too little too late, or key decisions that ensured their survival in a low carbon economy. However, it is important to acknowledge: what E.ON did last year, Enel did six years ago. It should come as little surprise that Enel outperformed its peers from 2008 to 2013.

52 E.ON, 2014; Press Conference E.ON SE, December 1, 2014; Available: http://www.eon.com/content/dam/eon-com/Presse/2014121_Statement_Strategy_en.pdf
53 Bloomberg, 2015; German Utility RWE Won't Rule Out EON-Style Split, CFO Says; Available: http://www.bloomberg.com/news/articles/2015-01-19/german-utility-rwe-hasn-t-ruled-out-eon-style-split-cfo-says
54 https://www.enbw.com/media/downloadcenter-konzern/factbook/enbw-factbook-2013.pdf

Appendix 1.
EU ETS Fundamentals

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cap	2,008	1,970	1,931	1,893	1,855	1,816	1,768	1,720	1,671	1,623	1,575	1,526	1,478	1,429	1,381	1,333
Emissions	1,760	1,724	1,680	1,654	1,611	1,616	1,631	1,590	1,550	1,508	1,486	1,449	1,408	1,414	1,403	1,361
Offsets	25	25	25	25	25	25	-	-	-	-	-	-	-	-	-	-
Net Balance (1)	-27	71	276	264	269	225	137	130	122	115	89	77	70	15	-22	-29
Cumulative Balance - No Reform (2)	2,766	3,037	3,313	3,577	3,846	4,072	4,209	4,339	4,460	4,575	4,664	4,741	4,810	4,825	4,804	4,775
Cumulative Balance – Reform (3)	2,066	2,137	2,413	2,677	2,711	2,584	2,394	2,221	2,062	1,915	1,764	1,620	1,486	1,321	1,144	981
EUA Price																
Carbon Tracker	7.64	8.38	9.21	9.97	10.95	11.90	13.09	14.19	15.52	16.77	18.29	19.71	21.43	23.07	25.04	27.09
IEA (WEO 2014 -NPS)	7.60	9.51	11.41	13.31	15.21	17.12	18.28	19.45	20.62	21.78	22.95	24.12	25.29	26.45	27.62	28.79
Point Carbon	8.00	11.90	13.20	15.00	16.90	18.70	20.50	22.10	23.50	24.90	26.30	27.80	29.00	30.00	30.90	31.70

Source: European Commission data, IEA data, Eurostat data, Carbon Tracker analysis

(1) Cap to emissions, including offsets.

(2) Assumes no reform, including the return of the 900 million backloaded allowances.

(3) Assumes MSR implemented consistent with agreement on May 5th 2015. For more information: http://www.consilium.europa.eu/en/press/press-releases/2015/05/13-market-stability-reserve/

Appendix 2
Company Statistics

EDF		2008	2009	2010	2011	2012	2013
Financials							
Enterprise Value	m/€	100,630	123,488	94,115	71,680	72,895	85,889
Capital Expenditures	m/€	-9,703	-11,777	-12,241	-11,134	-13,386	-12,096
Free Cash Flow	m/€	-2,131	-564	-1,131	-2,637	-3,462	-1,231
Market Capitalisation	m/€	75,485	76,829	56,734	34,737	25,847	47,774
Share Price	m/€	57	36	35	25	17	20
Moody's Credit Rating	n/a	Aa1, stable	Aa3, stable	Aa3, stable	Aa3, stable	Aa3, negative	Aa3, negative
Power Capacity							
Total	MW	127,100	140,300	133,900	134,600	144,069	140,400
Coal	MW	12,508	10,428	10,502	8,595	23,800	24,008
Gas	MW	4,970	8,548	9,400	10,768	14,000	13,619
Oil	MW	7,403	7,185	5,939	7,195	5,080	--
Nuclear	MW	65,863	75,048	74,300	74,838	75,600	74,833
Hydro	MW	23,170	22,947	21,500	21,401	19,600	22,043
Other Renewables	MW	1,640	2,526	3,300	3,903	4,064	5,890
Power Generation							
Total	GWh	609,900	618,500	630,400	628,200	609,600	653,900
Coal	GWh	34,500	30,800	29,600	27,200	35,500	59,505
Gas	GWh	26,226	26,800	34,900	30,154	41,600	37,926
Oil	GWh	2,500	2,000	2,400	100	800	--
Nuclear	GWh	438,518	466,100	475,600	500,047	485,500	487,155
Hydro	GWh	53,061	49,900	49,800	37,064	46,300	55,581
Other Renewables	GWh	4,269	6,700	8,500	9,423	20,900	13,732
Renewables and Coal							
Renewables as % of Capacity	%	1%	2%	2%	3%	3%	4%
Renewables as % of Generation	%	1%	1%	1%	2%	3%	2%
Coal Use	kt	25,300	20,248	20,211	21,024	24,277	25,314

Sources: Bloomberg LP data, Company Data

GDF Suez		2008	2009	2010	2011	2012	2013
Financials							
Enterprise Value	m/€	111,505	105,207	104,961	107,513	94,352	76,436
Capital Expenditures	m/€	-9,125	-9,646	-9,292	-8,898	-9,177	-6,518
Free Cash Flow	m/€	-6,214	2,687	1,475	2,962	2,516	3,908
Market Capitalisation	m/€	75,783	67,107	59,726	47,576	36,715	40,349
Share Price	m/€	38	28	27	24	18	16
Moody's Credit Rating	n/a	Aa3, stable	Aa3, stable	Aa3, stable	A1, stable	A1, stable	A1, negative
Power Capacity							
Total	MW	57,200	60,500	64,400	89,700	86,000	82,000
Coal	MW	6,292	6,655	7,084	11,660	12,040	11,480
Gas	MW	28,600	30,250	32,844	49,340	46,440	42,640
Oil	MW	n/a	n/a	n/a	n/a	n/a	n/a
Nuclear	MW	6,292	6,050	6,440	6,279	6,020	5,740
Hydro	MW	12,012	12,705	12,236	14,350	14,620	13,940
Other Renewables	MW	1,716	1,815	2,576	4,487	4,300	4,100
Power Generation							
Total	GWh	238,000	253,100	282,000	358,700	346,000	339,000
Coal	GWh	28,557	27,841	33,840	64,500	72,660	74,580
Gas	GWh	109,480	124,019	132,540	179,400	166,080	152,550
Oil	GWh	n/a	n/a	n/a	n/a	n/a	n/a
Nuclear	GWh	47,600	45,558	45,120	44,600	38,060	37,290
Hydro	GWh	45,220	45,558	53,580	51,600	48,440	54,240
Other Renewables	GWh	4,760	5,062	8,460	8,800	13,840	10,170
Renewables and Coal							
Renewables as % of Capacity	%	3%	3%	4%	5%	5%	5%
Renewables as % of Generation	%	2%	2%	3%	2%	4%	3%
Coal Use	kt	12492	12173	14161	25677	29454	28996

Sources: Bloomberg LP data, Company Data

Enel Green		2008	2009	2010	2011	2012	2013
Financials							
Enterprise Value	m/€	--	--	12,251	13,581	13,368	16,119
Capital Expenditures	m/€	-882	-674	-1,039	-1,536	-1,226	-1,204
Free Cash Flow	m/€	-529	223	-391	-278	-167	-439
Market Capitalisation	m/€	-	-	7,905	8,070	7,025	9,155
Share Price	m/€	-	-	1.6	1.7	1.3	1.6
Moody's Credit Rating	n/a	-	-	-	-	-	-
Power Capacity							
Total	MW	n/a	4,808	6,102	7,079	8,001	8,883
Coal	MW	n/a					
Gas	MW	n/a					
Oil	MW	n/a					
Nuclear	MW	n/a					
Hydro	MW	n/a	2,504	2,539	2,540	2,635	2,624
Other Renewables	MW	n/a	2,304	3,563	4,539	5,366	6,259
Power Generation							
Total	GWh		18,903	21,834	22,480	25,100	29,500
Coal	GWh	n/a					
Gas	GWh	n/a					
Oil	GWh	n/a					
Nuclear	GWh	n/a					
Hydro	GWh	n/a	10,689	11,071	10,097	9,800	10,900
Other Renewables	GWh		8,214	10,763	12,383	15,300	18,600
Renewables and Coal							
Renewables as % of Capacity	%	n/a	48%	58%	64%	67%	70%
Renewables as % of Generation	%	n/a	43%	49%	55%	61%	63%
Coal Use	kt	n/a					

Sources: Bloomberg LP data, Company Data

Enel		2008	2009	2010	2011	2012	2013
Financials							
Enterprise Value	m/€	90,999	115,820	111,928	103,680	102,468	91,304
Capital Expenditures	m/€	-7,059	-6,591	-6,468	-6,957	-6,522	-5,311
Free Cash Flow	m/€	3,451	2,335	5,257	4,756	3,893	1,943
Market Capitalisation	m/€	27,978	38,060	35,169	29,564	29,508	29,846
Share Price	m/€	5.6	3.8	3.9	3.9	2.7	2.9
Moody's Credit Rating	n/a	A-2, negative	A-2, negative	A-2, negative	A3, negative	Baa2, negative	Baa2, negative
Power Capacity							
Total	MW	82,510	95,326	97,281	97,383	97,839	98,916
Coal	MW	15,054	17,400	18,122	17,215	17,589	17,501
Gas	MW	9,959	11,977	13,248	15,390	15,684	16,584
Oil	MW	22,616	26,449	25,852	24,454	23,286	22,592
Nuclear	MW	4,466	5,284	5,332	5,344	5,351	5,370
Hydro	MW	27,186	31,018	31,033	30,265	30,436	30,463
Other Renewables	MW	3,229	3,199	3,694	4,715	5,493	6,406
Power Generation							
Total	GWh	253,200	267,860	290,200	293,900	295,800	286,146
Coal	GWh	67,900	73,900	73,100	86,100	91,800	82,388
Gas	GWh	44,200	34,500	38,200	47,400	43,200	40,766
Oil	GWh	34,200	40,900	45,400	38,100	35,300	29,312
Nuclear	GWh	32,900	31,900	41,200	39,500	41,400	40,591
Hydro	GWh	64,300	76,100	80,800	70,200	68,700	74,344
Other Renewables	GWh	9,700	10,560	11,530	12,600	15,400	18,745
Renewables and Coal							
Renewables as % of Capacity	%	4%	3%	4%	5%	6%	6%
Renewables as % of Generation	%	4%	4%	4%	4%	5%	7%
Coal Use	kt	38600	42800	42800	33198	35761	32595

Sources: Bloomberg LP data, Company Data

EON		2008	2009	2010	2011	2012	2013
Financials							
Enterprise Value	m/€	93,387	91,149	72,284	58,623	50,575	44,057
Capital Expenditures	m/€	-8,996	-7,831	-7,904	-6,216	-6,379	-4,480
Free Cash Flow	m/€	-2,258	1,223	3,181	394	2,429	1,969
Market Capitalisation	m/€	54,165	55,697	43,701	31,764	26,866	25,593
Share Price	m/€	38	26	24	19	17	13
Moody's Credit Rating	n/a	A2, stable	A2, stable	A2, stable	A3, stable	A3, stable	A3, negative
Power Capacity							
Total	MW	74,366	73,266	68,475	69,557	67,732	61,090
Coal	MW	25,433	24,710	19,278	19,240	18,517	14,064
Gas	MW	21,952	23,415	23,377	27,795	26,132	25,114
Oil	MW	3,654	4,178	4,140	4,016	4,253	2,831
Nuclear	MW	11,141	11,325	11,329	8,177	8,185	8,202
Hydro	MW	7,320	5,526	5,548	5,516	5,230	4,970
Other Renewables	MW	1,951	2,957	3,573	4,035	4,627	4,727
Power Generation							
Total	GWh	317,600	300,900	275,500	271,200	263,200	245,200
Coal	GWh	123,864	108,500	76,300	78,200	84,500	77,200
Gas	GWh	85,752	91,400	96,100	102,500	89,500	81,100
Oil	GWh	--	--	--	--	--	--
Nuclear	GWh	76,224	71,800	72,000	60,900	57,400	56,100
Hydro	GWh	22,232	18,500	16,900	16,300	17,200	15,900
Other Renewables	GWh	3,176	5,161	7,700	9,800	11,200	12,400
Renewables and Coal							
Renewables as % of Capacity	%	3%	4%	5%	6%	7%	8%
Renewables as % of Generation	%	1%	2%	3%	4%	4%	5%
Coal Use	kt	46700	42900	21800	23800	24900	24000

Sources: Bloomberg LP data, Company Data

RWE		2008	2009	2010	2011	2012	2013
Financials							
Enterprise Value	m/€	41,877	50,971	44,965	34,645	38,087	32,548
Capital Expenditures	m/€	- 4,454	- 5,913	- 6,379	- 6,353	- 5,493	- 3,926
Free Cash Flow	m/€	4,872	- 603	- 879	- 843	- 1,098	1,650
Market Capitalisation	m/€	35,825	36,264	27,984	16,623	19,099	16,224
Share Price	m/€	74.6	59.0	56.8	37.4	32.6	26.3
Moody's Credit Rating	n/a	A1, negative	A2, negative	A2, negative	A3, negative	A3, negative	Baa1, stable
Power Capacity		50%	38%	43%	42%	44%	44%
Total	MW	45,197	49,649	52,278	49,240	51,977	49,036
Coal	MW	25,011	26,465	26,068	24,574	23,201	21,021
Gas	MW	7,223	9,144	11,745	11,873	15,596	16,440
Oil	MW	--	--	--	--	--	--
Nuclear	MW	6,295	6,295	6,295	3,901	3,901	3,901
Hydro	MW	500	785	936	798	802	781
Other Renewables	MW	811	1,814	2,088	2,948	3,331	2,715
Power Generation							
Total	GWh	224,100	187,200	225,300	205,700	227,100	216,700
Coal	GWh	135,900	115,000	126,200	121,900	141,600	132,500
Gas	GWh	31,200	29,700	42,800	38,500	39,600	37,000
Oil	GWh	--	--	--	--	--	--
Nuclear	GWh	49,300	33,900	45,200	34,300	30,700	30,500
Hydro	GWh	3,400	3,400	3,500	2,800	3,600	4,000
Other Renewables	GWh	1,900	3,100	5,400	6,000	8,800	9,800
Renewables and Coal							
Renewables as % of Capacity	%	1.8%	3.7%	4.0%	6.0%	6.4%	5.5%
Renewables as % of Generation	%	0.8%	1.7%	2.4%	2.9%	3.9%	4.5%
Coal Use	kt	107500	101900	102000	104600	114500	108500

Sources: Bloomberg LP data, Company Data

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