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Evaluation of Strategy of Power Generation Business under Large-Scale Integration of Renewable Energy

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Evaluation of Strategy of Power Generation Business under Large-Scale Integration of Renewable Energy

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Abstract: The German energy transition massively alters the market structure of electricity supply and forces incumbent electric utilities to rethink their business strategies. We analyze three main developments that undermine the former market dominance of the "Big 4" incumbents in Germany. First, nuclear phase-out reduces their market shares and creates financial risk of nuclear waste decommissioning. Second, the large-scale integration of renewables fosters market entry from third parties and intensifies competition. Third, a possible coal-phase out in combination may have positive effects on market revenues but tends to increase regulatory risk. In total, incumbents face "disruptive Challenges" and need to find new value-creating products and services beyond sole energy supply. Promising focus areas are renewable energies, the distribution business, and smart, customer-oriented solutions.

Keywords: electric utilities, market structure, firm strategy

JEL-classification: L94, L11

1. Introduction

The electricity industry in many countries has been faced with a challenge of a massive introduction of renewable energy, often fostered by government support schemes such as a Feed-in-Tariff (FIT) mechanism, in a liberalized market environment. Most notably, Germany is taking the lead in supporting renewable energy by FIT while the market mechanisms were already functioning. More recently, Japan is likely to follow a similar path as the country introduced FIT for renewable energy while the wholesale and retail electricity markets will be further restructured to facilitate competition, with legal unbundling of transmission and distribution network of the incumbent utilities.

In Germany as well as other Western European countries, as a result of a large amount of renewable energy generation, the wholesale price has been low, making the conventional power generation business unprofitable. Such significant market changes, sometimes called “disruptive challenges” induce some of the large power companies to reconsider their business strategy. E.ON, for example, implemented corporate reorganization by separating conventional generation business in a newly established separate company with E.ON itself focusing on renewable energy, distribution network, and customer solution. Such a strategy with a clear focus on renewable and customers has been praised by various groups, especially environmental groups. One of them has recommended similar strategic shift for the electric power companies in Japan (Zissler, 2015).

It is not clear, though, whether the current business environment for power companies needs to be fixed in the first place before we encourage a fundamental change of business strategy. It is also important for policy makers in other countries following a similar path to examine what exactly is happening in Germany and what

conditions are necessary to succeed in the transition. Increased shares of RES indeed create some business opportunities, but it certainly incurs costs[1] and there would be risks that the society needs to recognize.

The purpose of this paper is to examine the changes in managerial environment for large power companies with conventional power plants in Germany, and evaluate their strategic options for power generation business in the market with a high share of renewable energy to derive implications for other countries with a similar situation, such as Japan. The organization of the paper is as follows: the second section describes the recent energy policy in Germany, while section three analyzes its impacts on the electricity market. The fourth section describes the strategic responses of the four largest power companies in Germany ("Big 4") and evaluates the risks associated with their strategy to derive implications for Japan and other countries. The final section concludes.

2. The Current Status of Energy Policy in Germany

In this section, we briefly review the current status of energy policy in Germany. Figure 1 illustrates the timeline for the three main pillars of German energy policy. The first row depicts the support for renewable energy supply (RES), which started with the renewable energy act in 2000. The second row relates to the development of nuclear policy from the first nuclear phase-out initiated 2002, which was later revoked by the new government, to the final decision in 2011 to phase out nuclear by 2023. Finally, the last row depicts the current discussion on a possible coal

[1] In February 2013 the Energy and Environment minister said that the costs of Energy transition in Germany could reach EUR 1 trillion. (http://www.world-nuclear.org/info/Country-Profiles/Countries-G-N/Germany/)

phase out.

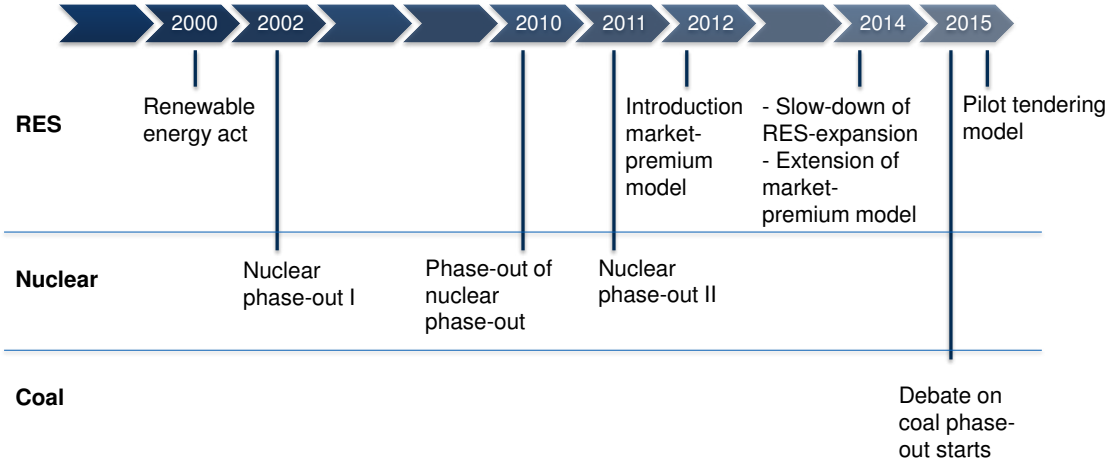


Figure 1: Timeline for RES, nuclear, and coal [own illustration]

2.1 Support for Renewable Energy Supply

With Renewable Energies Act, Germany aims to increase RES share to 40-45% by 2025, and 55-60% by 2035. Germany has supported renewable energy for many years through Feed-in-Tariff (FIT) mechanism. It indeed accelerates the growth of RES. RES now accounts for 27.4% of energy consumption in Germany, as shown in Figure 2. The share of RES in total energy consumption is expected to reach 35% in 2020.

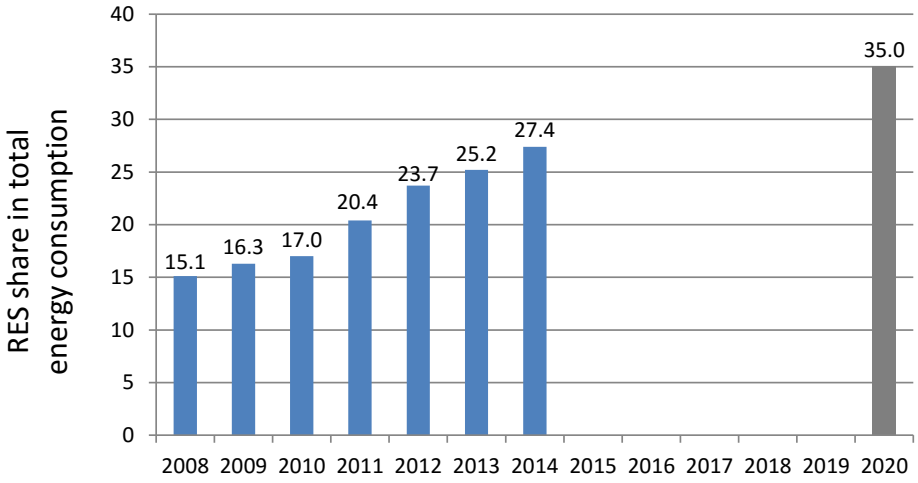


Figure 2: Development of Share of RES in gross consumption [BMWi, 2015a]

Since these RES were mainly developed by new entrants, the market share of the four major power companies decreased accordingly (Figure 3). Most of these new entrants in RES appear to be small-scale and decentralized power producers, which significantly alters the supply structure (Brunekreeft et al., 2016). Figure 4 confirms this development by relating the number of power plants to the amount of new capacity installations. The figure shows that starting with the renewable energy act in 2000 each MW of newly installed capacity has corresponded to a growing number of power plants. In other words, the structure of new capacity installations has changed from large-scale to small-scale power generators.

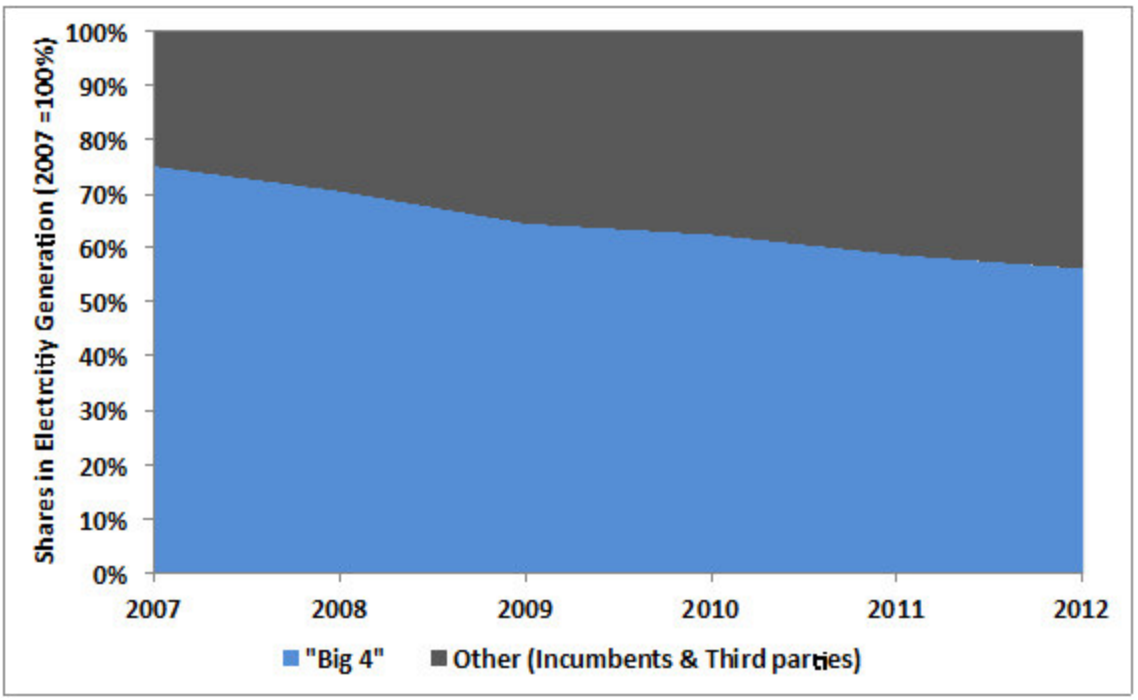


Figure 3: Relative cumulative share of Big 4 (capacities) [own illustration based on BNetzA, 2008-2013]

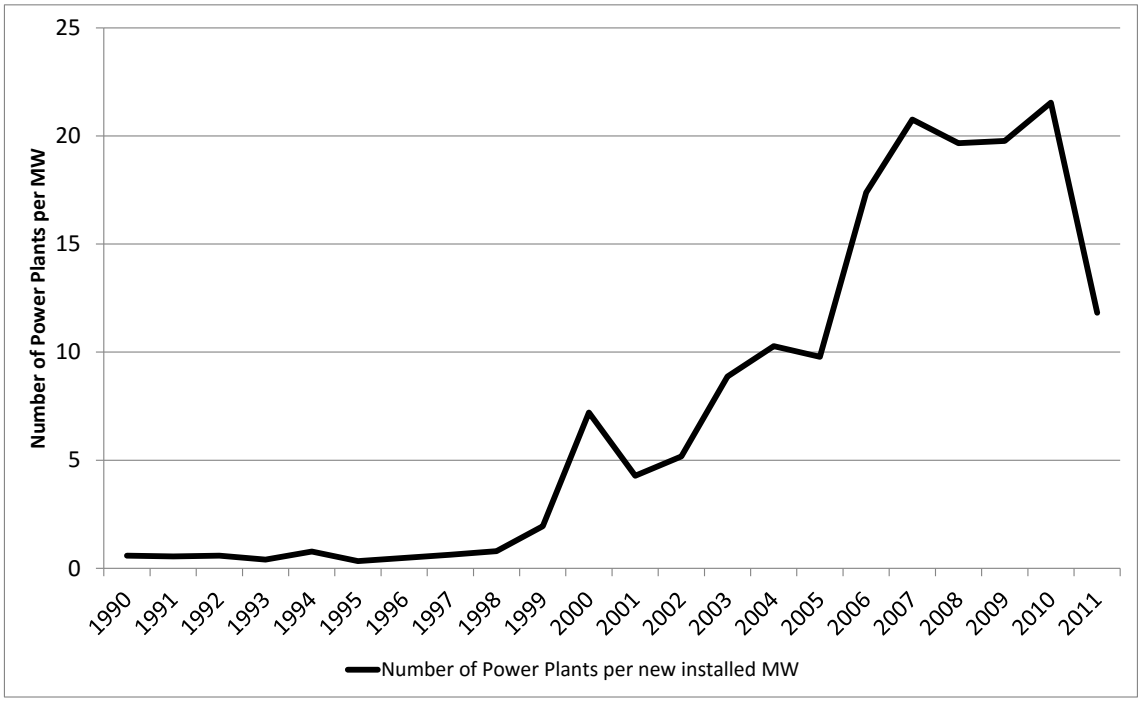


Figure 4: Number of power plants per MW additional capacity [own illustration based on data from BNetzA 2014a and 2014 b, and DGS, 2014]

As depicted in Figure 5, RES capacity and thereof most notably wind and solar power faced an enormous growth over recent decades. By 2015, RES capacity already reached the level of maximum load in Germany (around 82 GW) and is supposed to more than double by 2050 (Figure 6).

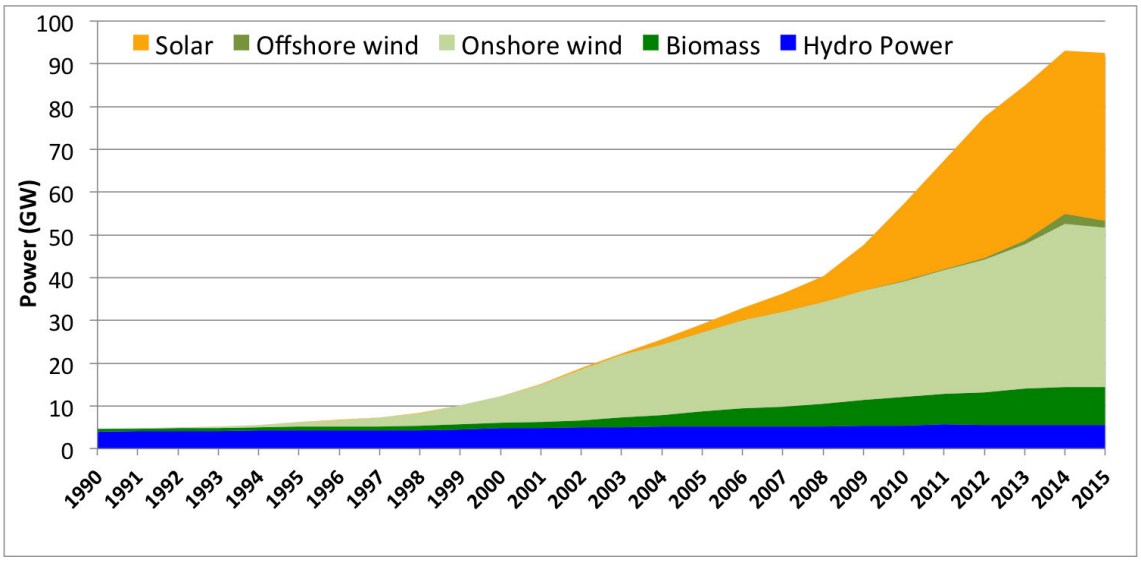


Figure 5: Development of renewable energies 1990-2015 (capacity) [BMWi , 2014a, and AGEEstat , 2014]

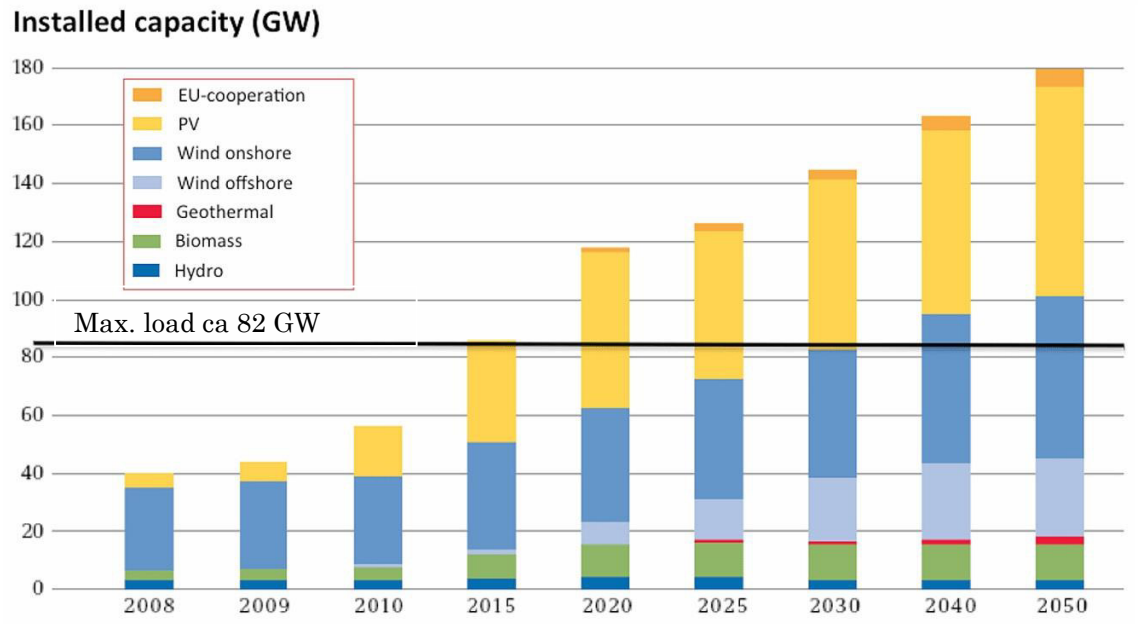


Figure 6: Projected development of renewable energies 2008 - 2050 (capacity) [dena, 2012]

With a change in the Renewable Energy Act in 2004, the support for RES has started to decrease, reflecting the fact that technological progress reduced the installation costs. Especially for new PV installations, the fixed feed-in tariff (FIT) was reduced, as shown in Figure 7. The changes in RES support also recognize the European

Commission's call for more competitive and market oriented approaches to support RES. In response to this, FIT in Germany will be gradually transformed to auctions to facilitate competition among RES projects. Although it is expected to reduce the overall cost of RES support, some environmental groups were skeptical about the effectiveness of auctions (e.g. Morris, 2015), pointing out the possibility of increasing price.

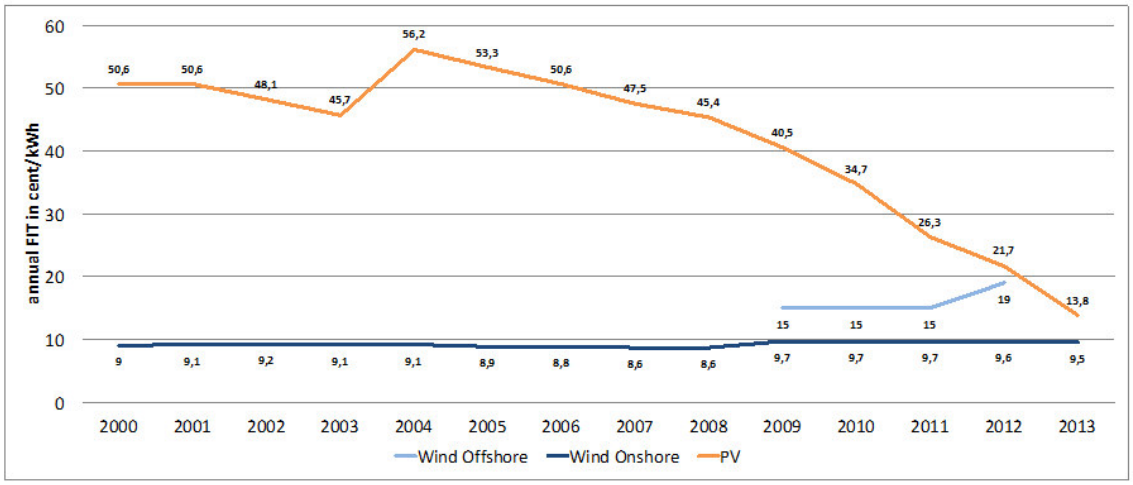


Figure 7: Development of average FIT for RES in Germany 2000-2015 [BMWi , 2014b]

Nevertheless, there has been a cost reduction among RES, thanks to technological innovation and mass-production. More recently, small scale battery storage also becomes commercially viable (Figure 8) and may accelerate the diffusion of small-scale distributed energy resources (DER). In combination with smart meter technologies (Digitalization), DERs create profit opportunities by selling their excess generation through aggregation. This allows RES to participate in the balancing market, which is the national real-time market jointly run by the TSOs for the purpose of managing short-time deviations between supply and demand.

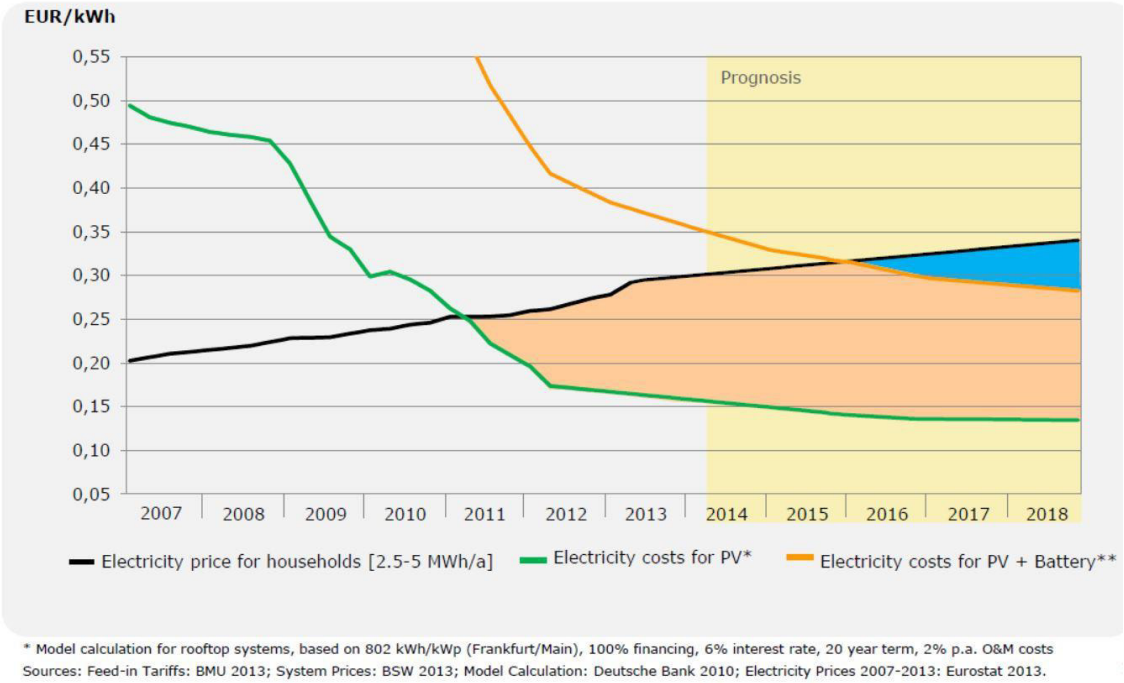


Figure 8: Calculated Costs of Electricity for PV and Battery [GTAI, 2014]

2.2 Nuclear Phase-out

Germany had relied upon nuclear energy for more than 20% of its electricity consumption before 2011. Nuclear power plants in Germany have been owned and operated by the four largest power companies ("Big 4"). After the Fukushima accident in 2011, the German government decided to phase-out nuclear power generation by 2022, as indicated in Figure 9, through the amendment of German Nuclear Energy Act. The decision led to immediate shut down of several existing reactors amounting to 8 GW of nuclear capacity. The power companies dispute policy changes at the court for compensation, but public opinion generally supports this decision and it is unlikely to be revised in the future.

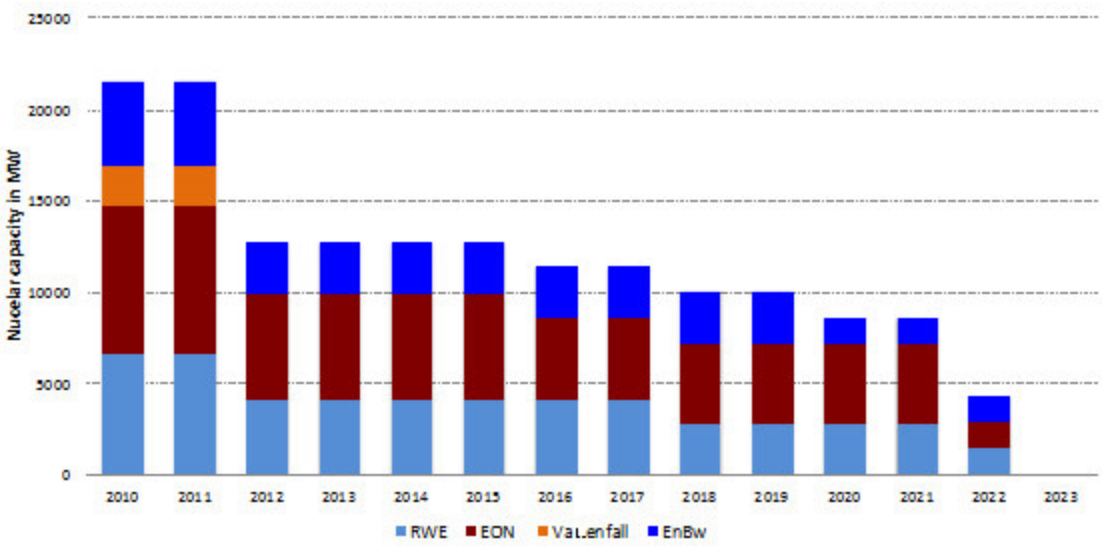


Figure 9: Projected development of nuclear energies 2010 - 2022 (capacity) [AtG §7, 2015]

A controversial issue remains in funding for decommissioning of nuclear power plants. The projected total cost of nuclear phase-out amount to € 48.2 bn. (including a risk premium accounting for uncertainty) (Figure 10). Nuclear power plant owners are required to accrue provisions for decommissioning and waste disposal. Currently, a total of 38 billion euro provisions are set aside and the companies claim that the provisions are sufficient, but there is a significant uncertainty regarding the cost as the final repository for nuclear waste still needs to be determined. In addition, the detailed structure of the provision is not very clear (FÖS, 2014), and the development of provision in each power company varies for no obvious reasons (Figure 11). Moreover, several companies increased the provision per MW since 2011, but RWE's provision is rather constant. Provisions can vary across different reactor types (boiling or pressurized water reactors) and the companies would have different decommissioning and dismantling strategies for each reactor by using different timetables and discount

periods for the outflow of funds (the later the spending of provisions is planned, the lower is the actual discounted present value), and the companies choose different discount rates (e.g. Vattenfall uses the lowest discount rate, which is one reason why we observe among the highest provisions per kW for Vattenfall). However, the detailed information on how each company calculates its provision is not available. Partly because of this lack of transparency, therefore, there is an argument calling for external fund to be managed by the government. After the government clearly opposed a state fund for financing the nuclear phase-out, E.ON, RWE and Vattenfall are now going to constitutional court to fight for compensation payments for financial damages experiences through the nuclear phase-out in 2011.

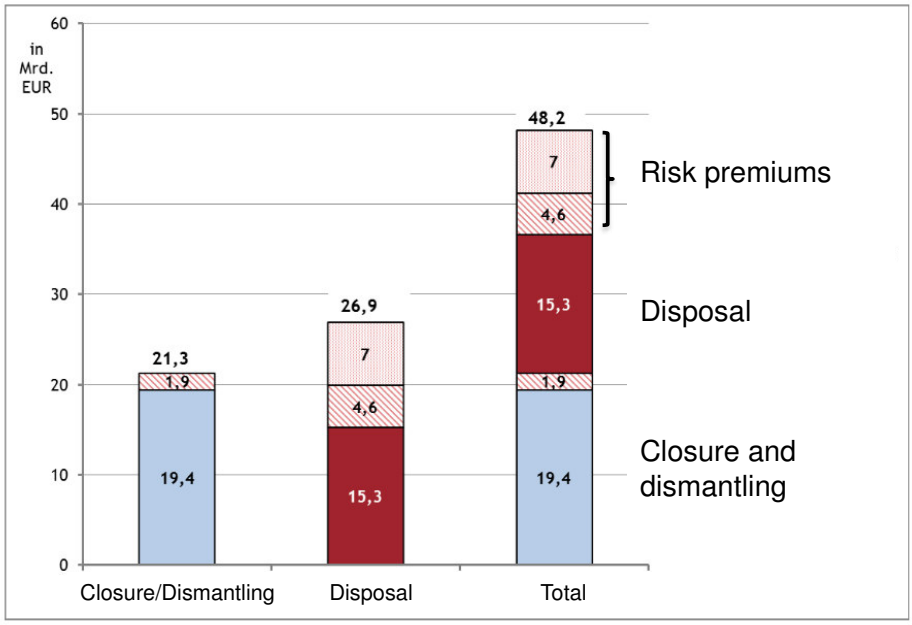


Figure 10: Projected costs of nuclear phase-out: decommissioning and disposal plus uncertainty [Meyer, 2014].

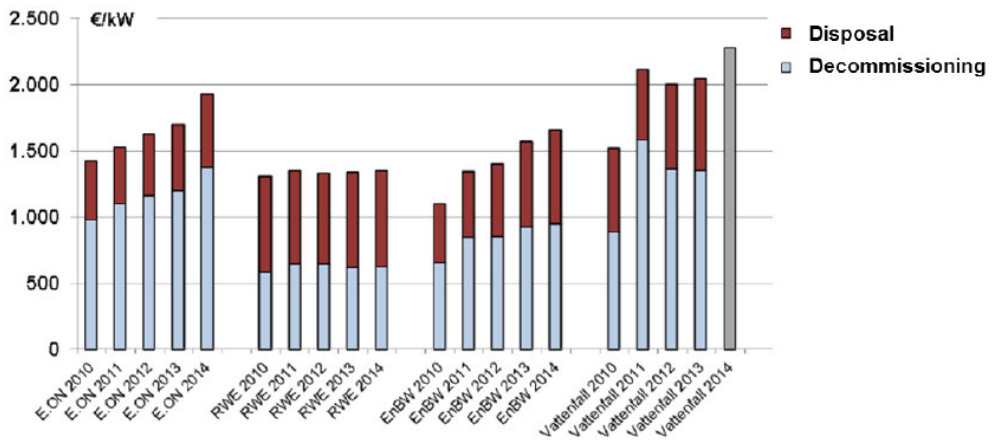


Figure 11: Provisions for Decommissioning and Disposal 2010-2014 by Power Companies [FÖS, 2014]

2.3 Climate Change Mitigation by Coal Phase-out

The share of coal-fired generation including lignite has been relatively high and stable in Germany. Immediately after the shutdown of old nuclear reactors in 2011, however, power generation from coal-fired power plants was even increased. Thus, although the share of RES has been increased, the CO2 emission reduction target of 40% by 2020 compared to 1990 is unlikely to be achieved.[2] This has led to a proposal of coal-tax by the government. The proposal for the coal tax has been withdrawn, and instead some coal-fired power plants will be taken out as "strategic reserves" (as will be explained in more detail further below).

The development of electricity production by different energy sources is shown in Figure 12. Development of RES and nuclear is mainly driven by policy, and that of fossil fuel is driven by the market, which we will explain in the next section.

[2] CO2 emissions in 2014 were 4.3% lower than in the previous year.

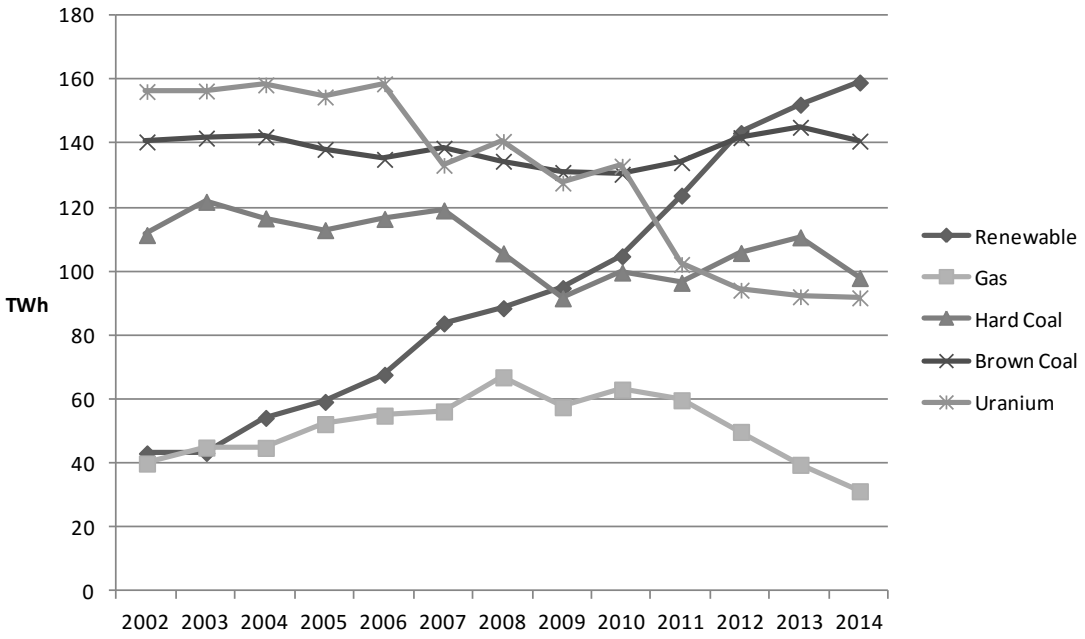


Figure 12: Generation mix (TWh) in 2002 – 2014 [Fraunhofer ISE, 2013]

3. Impact of RES on Electricity Market and Reform of the Market

In this section we will look at the impact of increasing share of RES on electricity wholesale market in Germany.

3.1 Development of the Wholesale Market Prices

Germany has a very liquid wholesale electricity market. Spot (day-ahead) market is operated by EPEX and derivative market is operated by European Energy Exchange (EEX). The day-ahead wholesale price for baseload was about 70 euro in 2008, but since then the price has decreased (Figure 13). Recently the wholesale prices of both peak load and base load are around 30 euro. The peak price had been often extremely high, causing price spikes before 2008. Recently, however, the lowest price during a week often turned out to be negative.

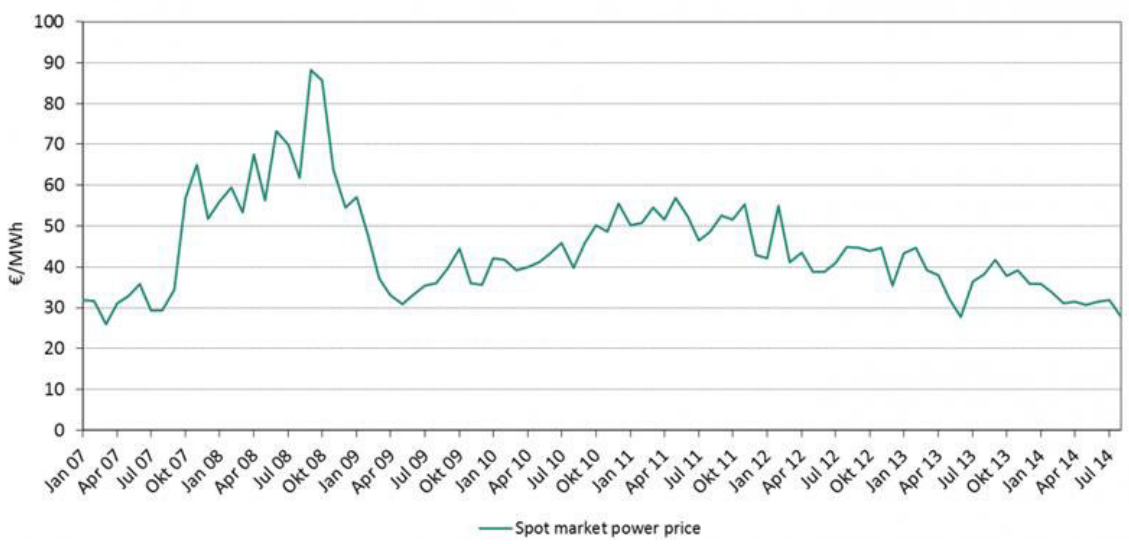


Figure 13: Development of EEX spot electricity prices since 2007 [EEX, 2015b]

There are several factors causing the lower wholesale prices: The large decline immediate after 2008 was mainly due to the declining demand caused by Lehman shock. The other reason is the declining price of emission certificate as shown in Figure 14. A possible explanation may be that the major power companies made over-investment in power plants based on too optimistic forecasts of electricity demand, resulting in excess supply to cause lower prices.

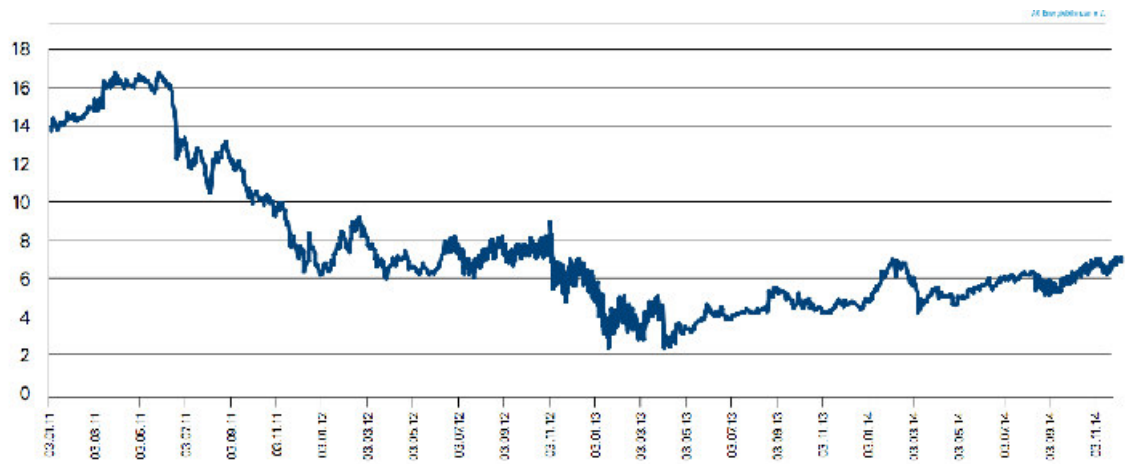


Figure 14: CO2 certificate prices 2011 to 2014 Settlement prices in Euro/EU allowances [EEX, 2015a]

However, the main reason for continuing decrease in wholesale price is likely to be due to the "merit-order effect" by the expansion of RES, as shown in Figure 15. The merit order is the ranking of generators according to their price bids to the market and thereby determines the order in which generators are dispatched and the corresponding market prices. Prices are set by the so-called "marginal generator", which is the highest cost generator needed to meet demand at a certain time. With increasing RES capacity, the merit order shifts to the right-hand side due to RES having low marginal cost. As a result, both prices and load factors for conventional power plants are reduced, and conventional plants suffer from lower revenues. This "missing-money problem" is depicted in Figure 15 comparing the German merit order in 2013 with the prospected one in 2020.[3] With growing RES, future prices are expected to decrease even further, while at the same time, load factors for coal and gas will decrease (Figure 16).

[3] The term "missing-money" traces back to Cramton and Stoft (2006) who analysed this problem in a more general setting for so called energy-only markets, where generators are paid only per MWh of supply and not for installed capacity which is not dispatched.

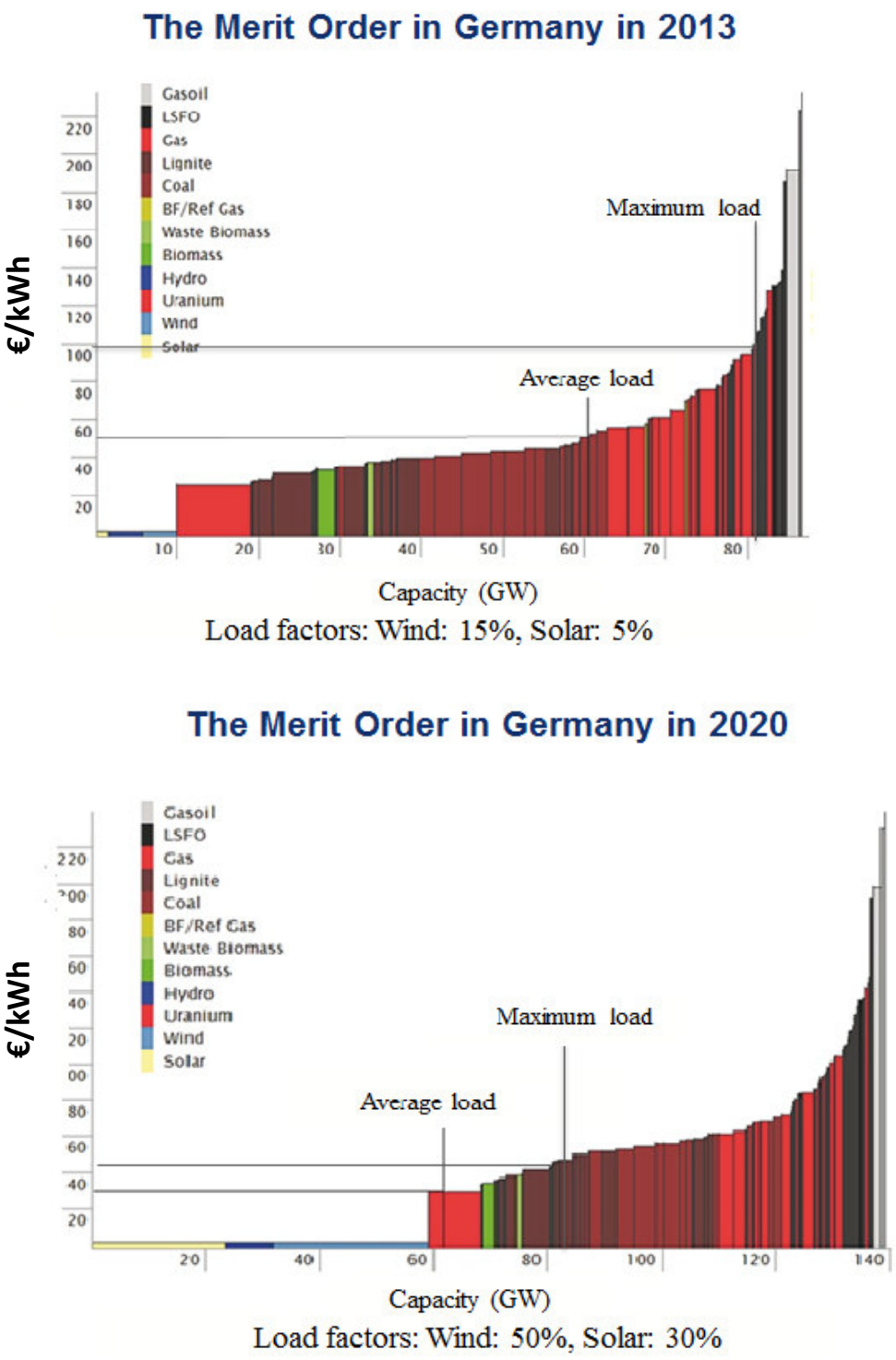


Figure 15: Merit Order Effect in Germany 2013 and 2020 [*Based on Kranner & Sharma, 2013*]

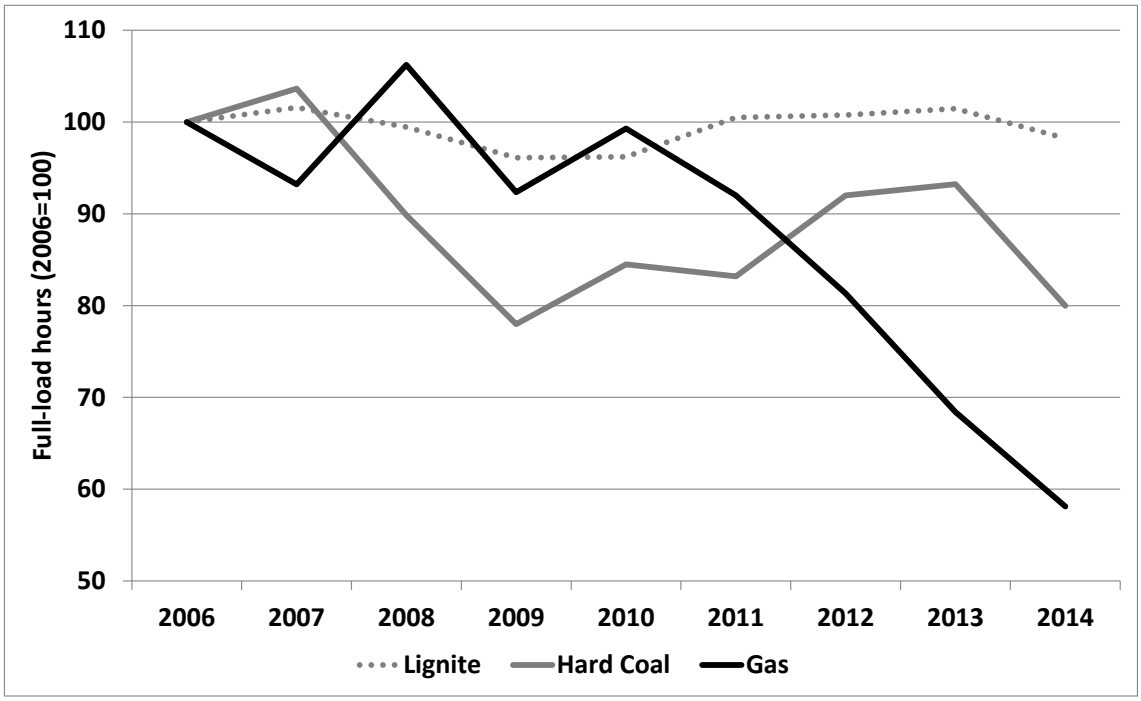


Figure 16: Load factors lignite, coal and gas 2006 - 2014 [own illustration based on data from BDEW, 2014, and BNetzA , 2008-2014]

The wholesale prices are expected to stay low as indicated by the forward prices (Figure 17 and Figure 18). Gross margin of a coal-fired power plant (Clean-Dark-Spread Base) are still positive but at a very low level, while the gross margin of gas-fired power plant (Clean-Spark-Spread Peak) are negative (Figure 19). In fact, coal and lignite fired power plants are still running and produce stable amount of energy, but the gas fired power plants are running only a limited time and their utilization rate has been falling.

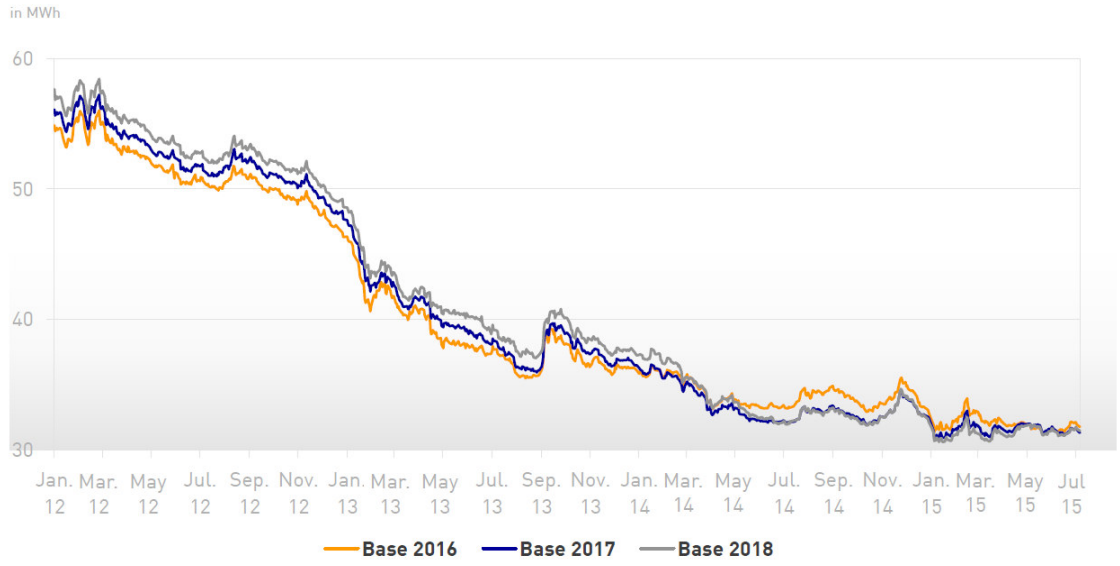


Figure 17: Forward price for electricity baseload in Germany [EnBW, 2015]

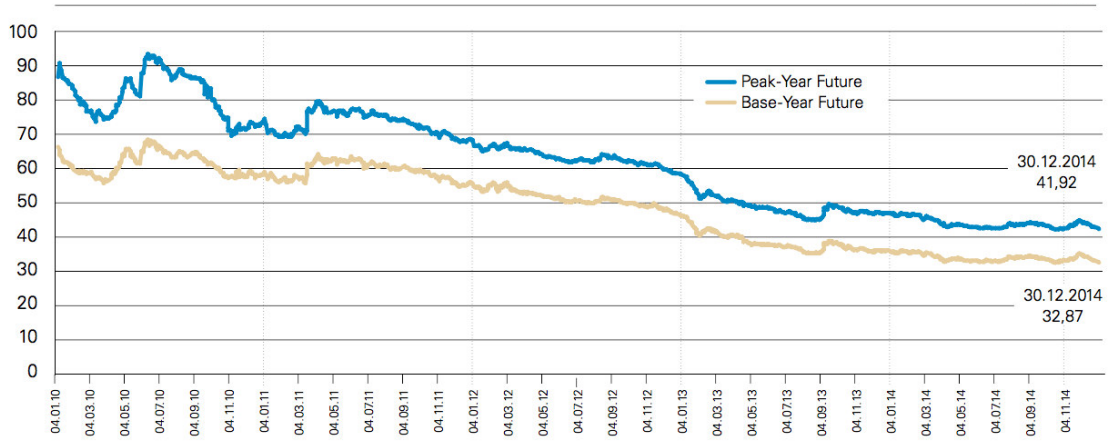


Figure 18: Development of EEX futures for electricity 2010-2014 for delivery period 2016 [EEX, 2015c]

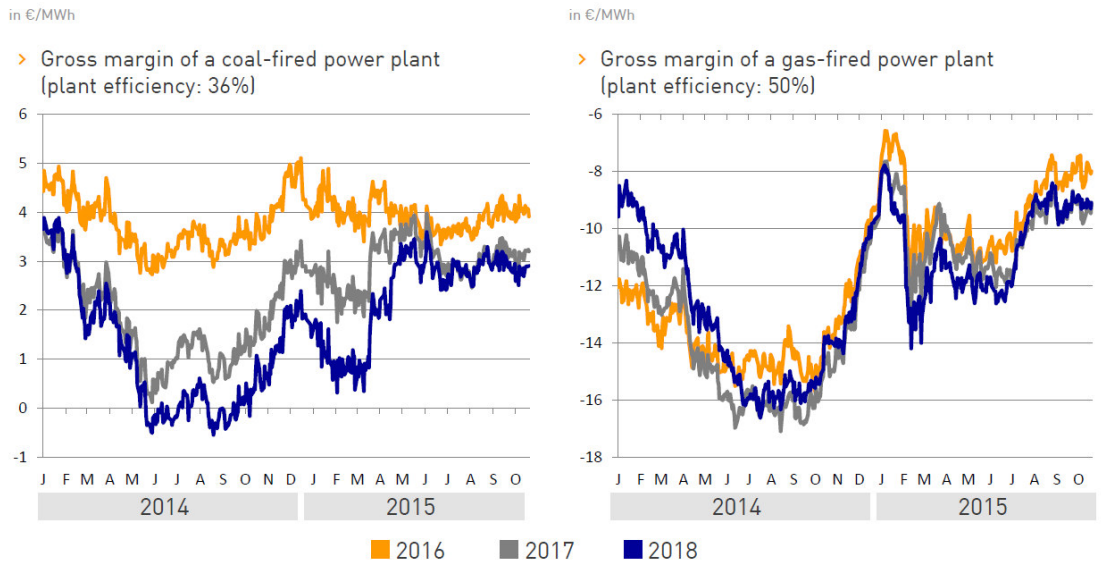


Figure 19: Clean-Dark-Spread Base (left) and Clean-Spark-Spread Peak (right) [EnBW, 2015]

Such low prices and low or negative margins induce the conventional power plants to exit from the market. It is now anticipated that the current excess capacity eventually vanishes and threaten the future security of supply. Figure 20 shows the expected development of capacity margins (i.e. excess capacity over peak demand) with and without import and export capacity. Especially during the winter periods, there is concern that capacity will fall short to meet peak demand, especially if relying on imports is politically considered undesirable. This concern motivates the discussion on capacity mechanism in Germany and lead to a government proposal of electricity market reform.

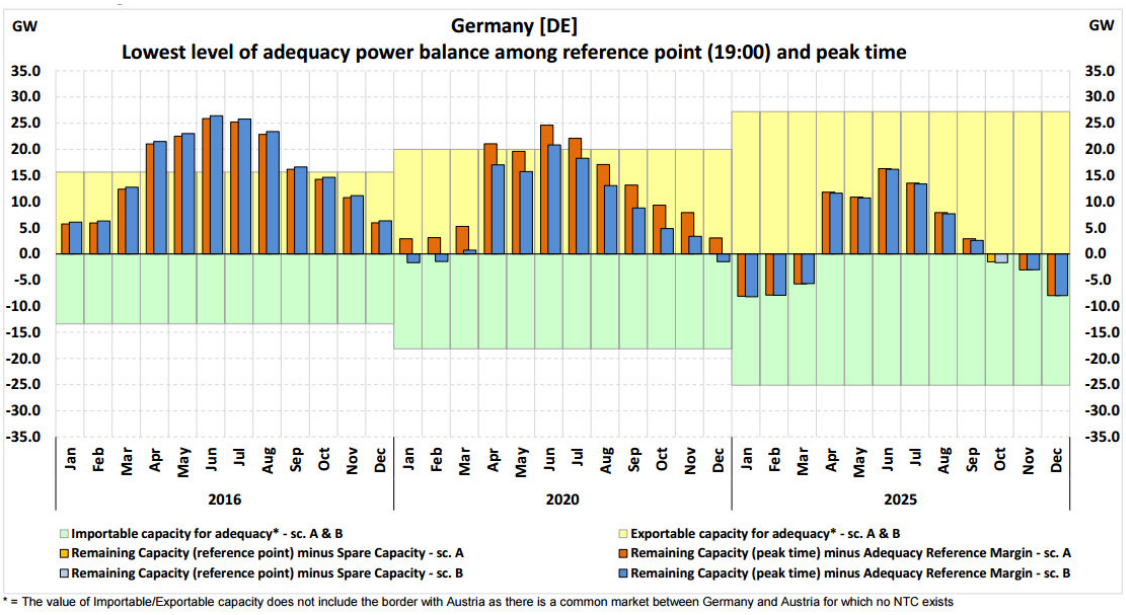


Figure 20: Forecast of capacity margin in Germany [ENTSO-E, 2015]

3.2 Impacts on Power Companies Performance

Due to the continuing low wholesale power price, the major power companies who own and operate conventional power generation have suffered from significant losses in recent years. Profits often turned out to be negative as shown in Figure 21. As a result, share prices of the major power companies have decreased, and stayed far behind the rate of increase of the overall stock exchange index (DAX), as shown in Figure 22 and Figure 23.

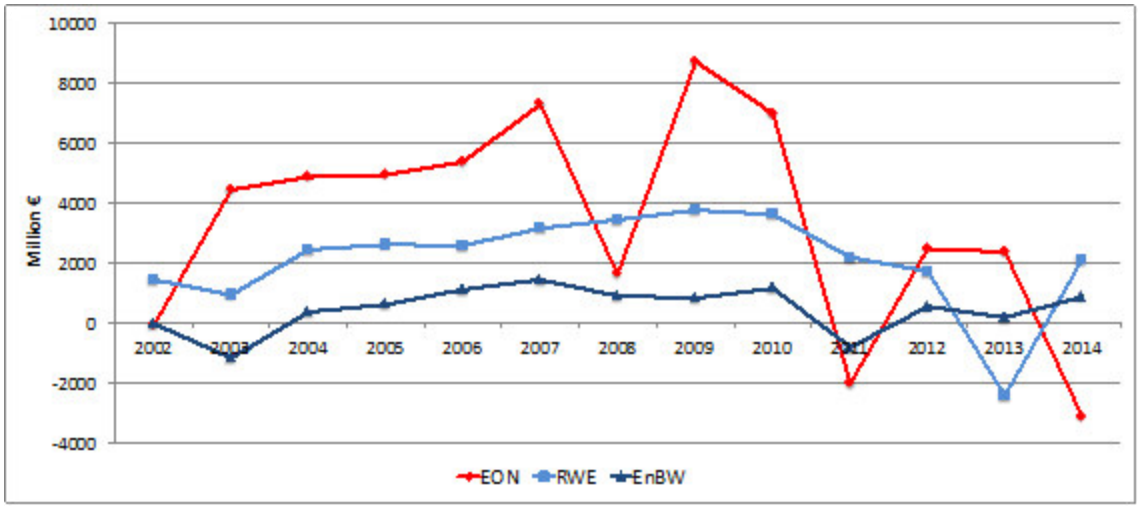


Figure 21: Development of profits of Eon, RWE and EnBW 2002 – 2014 [Own illustration based on data from EON and RWE business reports, 2002-2014, and Bontrup & Marquardt, 2015]

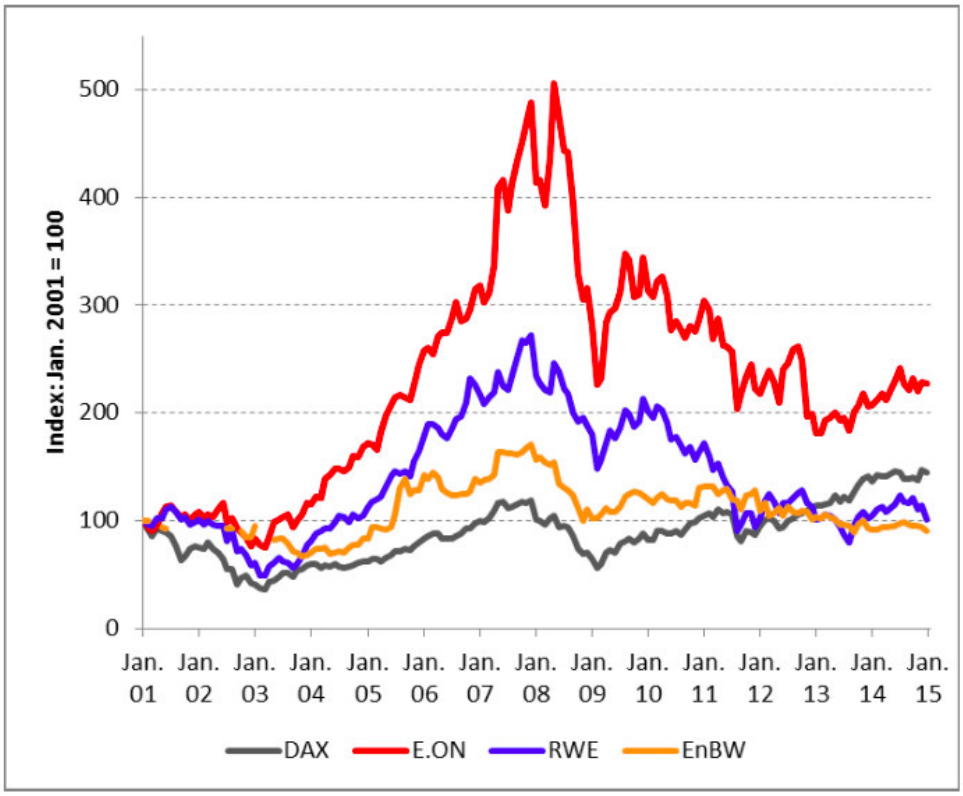


Figure 22: Share prices of EON, RWE, EnBW and DAX, 2001 – 2015 [Bontrup & Marquardt, 2015]

Figure 23: Share prices of RWE and EON compared to DAX (7-year-trend), 2009 – 2014 [DAB, 2015]

3.3 Electricity Market Reform

The German government plans to reform the electricity market. In its white paper (BMWi, 2015b), this reform plan is called "Electricity Market 2.0". This reform aims to adapt the electricity market design to the challenges raised by an RES-dominated and decentralized electricity supply. The main political goals are to ensure generation adequacy and cost efficiency for future electricity supply.

One of the key aspects in the discussion relates to the "missing-money problem" described in section 3.1. The question is whether an energy-only market, where generators are only paid based on marginal cost, is able to ensure sufficient investment in generation capacity. Given the prospected reduction of prices and load factors, the

alternative would be so-called capacity mechanisms to trigger the necessary investments in back-up capacity for intermittent RES (Brunekreeft et al., 2011; Brunekreeft & Meyer, 2013).

An appropriate capacity mechanism for Germany had been discussed for several years, but in the white paper the government concluded that there is no need for market-wide capacity mechanism, such as capacity market. Nevertheless, in order to ensure generation adequacy, the government decides to introduce “Capacity Reserve”. This is known as “Strategic Reserve” in other countries. The idea is to withdraw a certain amount of capacity from the market by auctioning a backup reserve, which is dispatched by a central authority like the transmission system operator. This may be done for capacity, which would otherwise be mothballed due to insufficient market revenues (so-called mothball reserve); or it could include additional capacity to actively shorten the market to trigger prices increases and investments

In essence, a system for strategic reserves actually already exists. In Germany, there has been a mechanism called “Winter Reserve” which is similar to a mothball reserve. It aims to keep old power plants running to secure the grid stability in scarcity situations. This type of reserve is going to remain in the future.

Despite the prospects of additional revenues through a full capacity market, the major power companies seem to welcome the decision against such a fundamental change of market design. Especially EnBW and Vattenfall have preferred a strategic reserve. An explanation for the resistance against full capacity markets may be the risk of market design flaws and the additional need for regulation assigned with these mechanisms, as past experiences from the U.S. indicate (see Brunekreeft et al., 2011).

The strategy behind the planned capacity reserve is twofold. One would be a

coal phase-out aiming at mitigating climate change, as mentioned above. Withdrawing old coal plants from the market might increase production of newer power plants with lower emissions, thus increasing the load factors of the remaining power plants. A second aim would be to shorten the market by reducing generation capacity. This may increase market prices for the remaining generators and trigger new investments, while at the same time guaranteeing availability of the reserve in emergency cases.

The question is, however, how much capacity should be taken out for the reserves and what implications it will have. A pure mothball reserve will have a low impact on environmental goals, given that these plants already suffer from a low utilization. Also it would hardly have an effect on market prices and therefore investments. To achieve the intended goals of a reserve, a larger reserve is needed. In October 2015, a Ministerial Draft for a new capacity reserve ordinance ("*Kapazitätsreserveverordnung*") was published which announces a capacity reserve target of 5% of maximum peak load, i.e. roughly 5 GW. The cost for such a reserve is estimated to amount to €130 to €260 mio (BMWi, 2015c). Energy Brainpool (2015) analyzes the possible effects of a coal phase-out, assuming a capacity reserve of 15 GW (8.6 GW of lignite, and 6.4 GW of hard coal). Figure 24 shows the expected price effects of such a reserve for different scenarios. Although the size of the capacity reserve analyzed is three times larger than the BWMi announcement, the price effects are moderate. Frequent price spikes are not likely to occur in the near future. But even if price spikes would occur, companies would still face the risk of government intervention to suppress these high prices. As a result, there is concern that investment will be prevented by regulatory risks of market intervention, possibly bringing back the missing-money problem through the back door (Brunekreeft & Meyer, 2013).

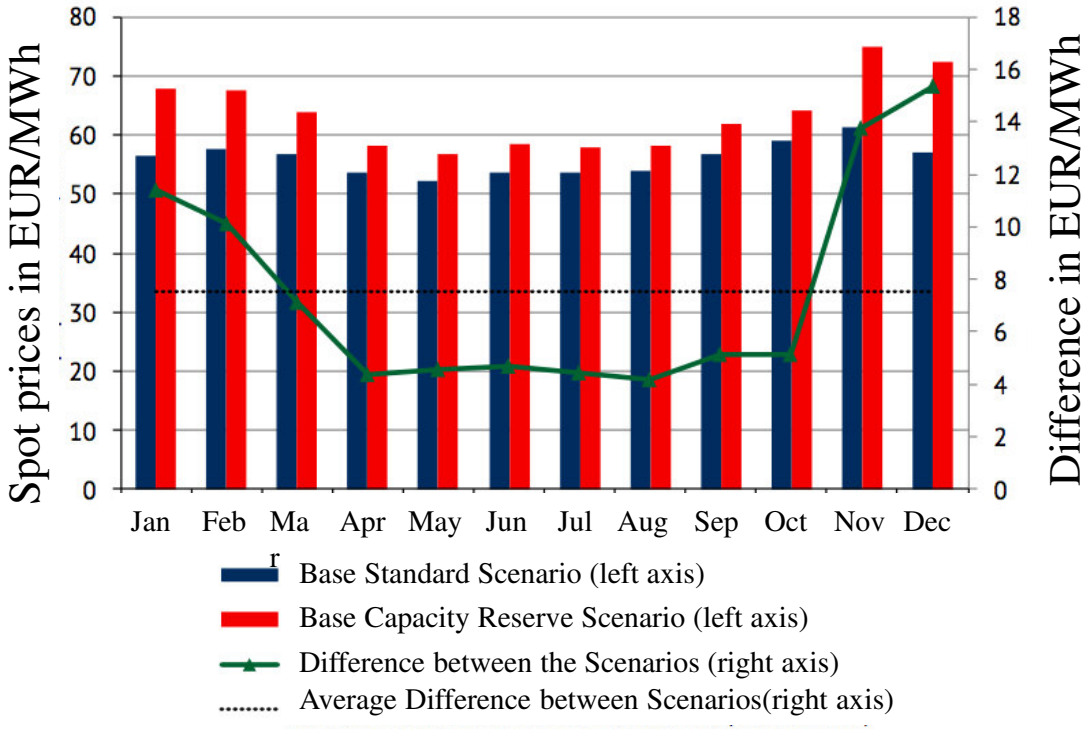


Figure 24: Coal Phase Out 2023 – increase in spot prices [Energy Brainpool, 2015]

4. Strategies of the Major Power Companies in Germany

Given the low wholesale prices as well as the energy policy, the major power companies in Germany have been forced to reconsider their business strategy. As we will describe below, the conventional utilities focus on the business areas: 1) renewable energy, 2) distribution network (smart grids), and 3) customer solution. In this section, we first summarize the strategies of the major power companies in Germany (E.ON, RWE, EnBW, and Vattenfall). We then examine whether these strategies are vital for the companies.

4.1 Summary of the major power companies' strategy

E.ON

In November 2014, E.ON announced its corporate reorganization plan to separate it into two companies as shown in Figure 25. The new E.ON will focus on renewable energy, distribution network and customer solution. The conventional generation (fossil fuel and nuclear) as well as exploitation and energy trading will be transferred to a new company, later named "UNIPER" (meaning: Unique Performance). The main argument behind this split is that E.ON considers these two businesses so different as to require different corporate cultures. This may be achieved more easily by splitting the companies into a traditional and a modern part.

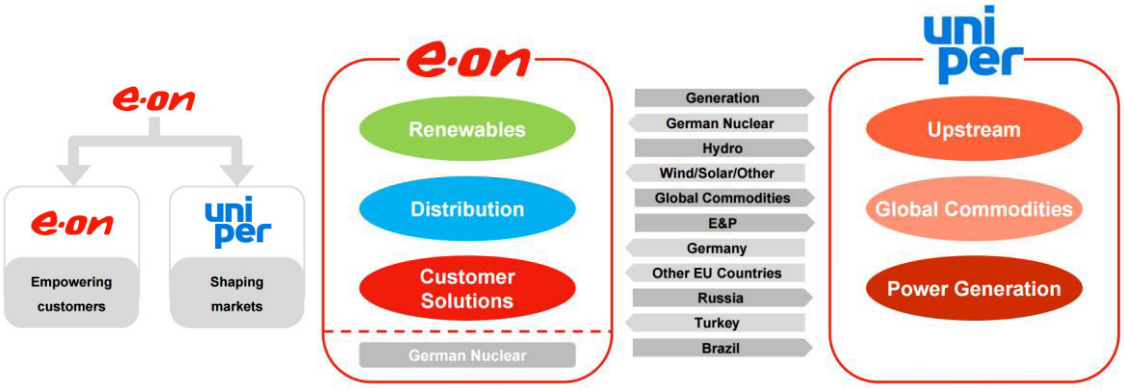


Figure 25: Split of E.ON [E.ON, 2016]

In September 2015, E.ON announced that it will retain nuclear power generation in Uniper. The reaction of the investors to this announcement was negative, as retaining the nuclear power plants means that liability for financial risk of waste disposal will remain with the group. As a result, the share price of E.ON dropped significantly after the announcement (Figure 26). This retention of nuclear power generation will not affect the original strategy of new E.ON.

E.ON has been quite active in overseas business, but some of them resulted in the loss of billion Euros.

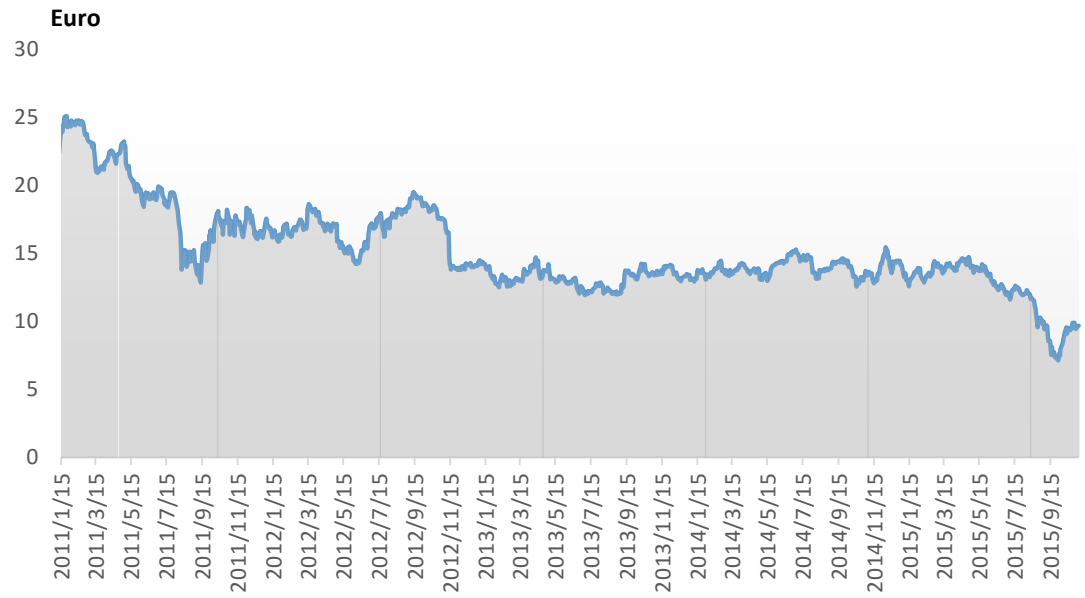


Figure 26: Development of Share prices of E.ON [E.ON, 2015]

As mentioned the new E.ON will focus on RES, distribution network and customer solutions. The specific business model it has in mind is described in Figure 27. Regarding the new business models in particular, E.ON has been quite active in co-investment in various start-ups mostly in the US but also include some German start-ups. For example, Orcan Energy GmbH is a spin-off from Technische Universität München, Germany. The area for strategic co-investment includes customer engagement platform, IOT (Internet of Things) infrastructure/Machine-to-Machine platform, big data analytics, energy efficiency solutions, solar energy solutions, storage solutions.

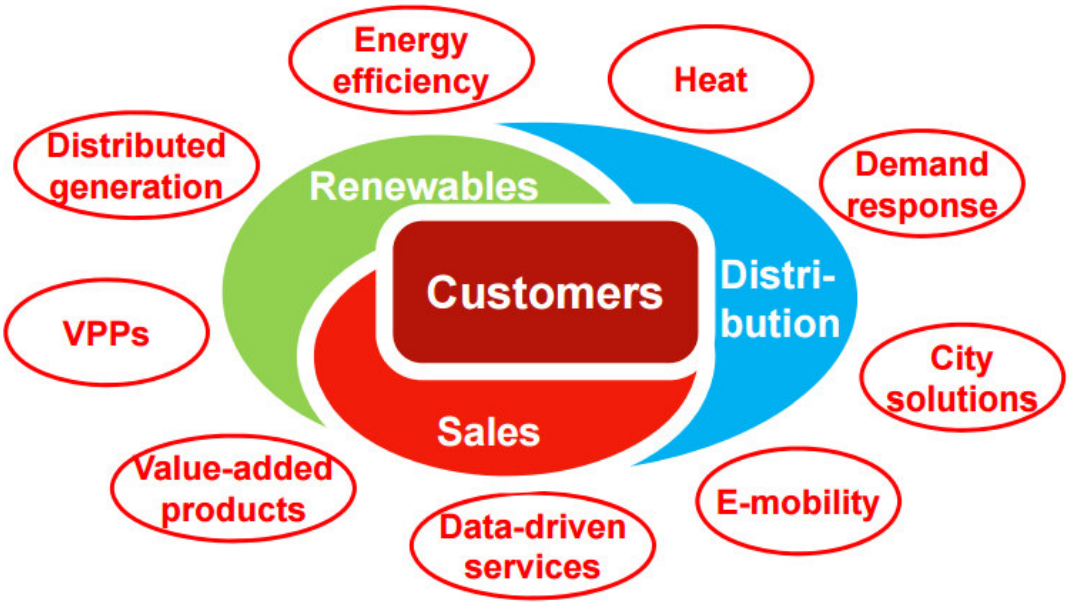
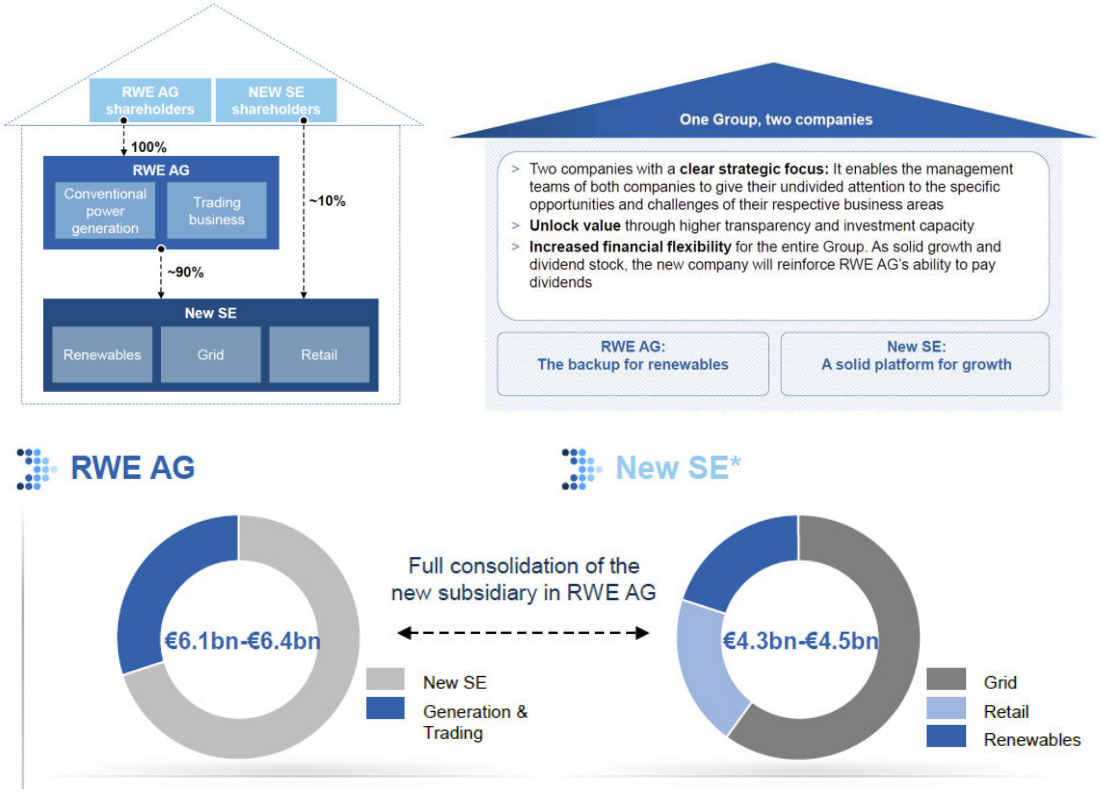


Figure 27: New Energy World for E.ON [E.ON, 2016]

RWE

In December 2015, RWE also announced its plan to create a new company with its 90% of shares owned by RWE that will focus on the three business fields: renewable generation, distribution network, and customer solution (Figure 28). RWE itself continues to own and operate conventional generation facilities and to be engaged in trading business as well. Thus, their naming strategy is different from that of E.ON. The investors' reaction to this decision was positive as was indicated by a large increase in share price after the announcement (1 December), though it soon decreased to a level before the announcement (Figure 29).



Source: RWE (2015) "One Group - Two companies with a clear strategic focus to unlock value"

Figure 28: RWE creating a new company [RWE, 2015]

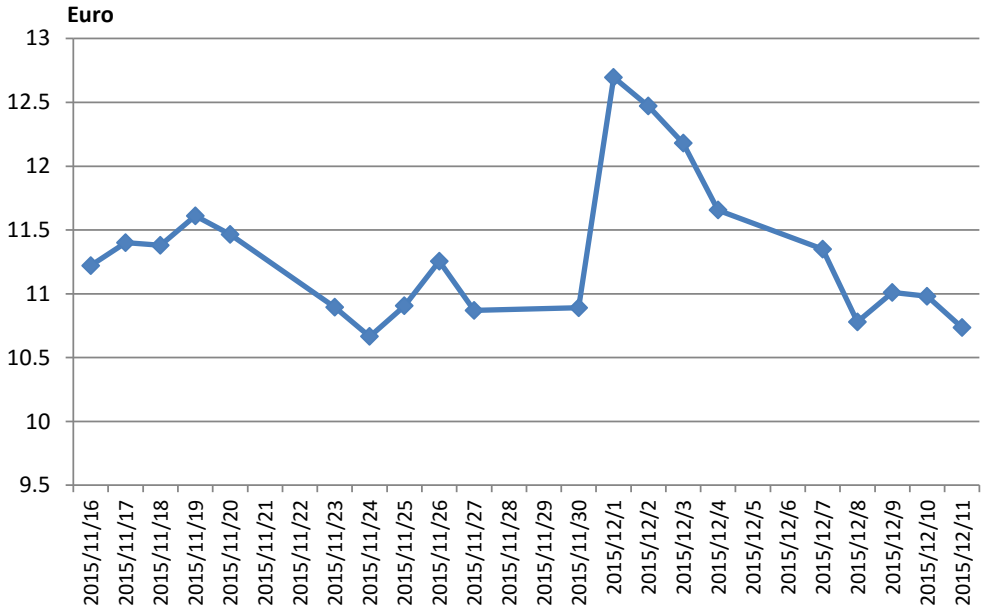


Figure 29: Development of Share Price of RWE [RWE, 2015]

Prior to this, RWE transformed its holding company structure to operating companies.

EnBW

EnBW has the highest share of renewable energy among the four major power companies. As of this writing, EnBW has no plan to separate companies, though it also started to realign its focus to the three business fields: renewable energy, electricity distribution, and customer solution as part of the "EnBW 2020 Strategy" (EnBW, 2013). We should note that EnBW apart from focussing on smart distribution grids, also own a transmission grids and seems to have no plans to change this. EnBW also expands its gas business by acquiring the shares of VNG.

As the annual report of EnBW states, "We are countering the falling earnings from conventional generation and trading by expanding generation from renewable sources of energy, extending the stable grids business and engaging in an innovation and service-based campaign to promote the area of 'customer proximity'" (EnBW, 2015, p. 3). EnBW's 2020 Strategy includes large investments to modernize their generation capacity as well as electricity networks, which on the other hand requires organizational "simplifications" or – in other words – cost savings. EnBW aims to achieve these cost reductions by mergers, while at the same time developing strategic partnerships to share costs and risks of new business opportunities (EnBW, 2013).

Vattenfall

Owned by the Swedish government, Vattenfall is largely influenced by the

energy policy of Sweden. It is going to sell its lignite power plants that account for a half of its generation fleet in Germany. Vattenfall only had the concessions of two distribution network areas: Hamburg and Berlin. It recently lost Hamburg and to sell the network and as of writing the status of Berlin concession is uncertain. As a result of these developments, Vattenfall is likely to be out from the “Big 4”.

4.2 Evaluation of New Strategy and Implications for Other Countries

The increased share of RES threatens the conventional power generation business, but it may also create business opportunities like customer solutions, smart homes, and energy consulting. (Oliver Wyman, 2016). The “Big 4” seem to have realized that the electricity supply industry is moving to a strongly decentralized and renewables-based supply structure embedded in a smart and customer-orientated network. To their traditional business plans this development means a “disruptive innovation” (see Christensen, 1997). As Graffy & Kihm (2014) point out, a “cost recovery” strategy, which is mainly a backward-looking cost cutting strategy may deepen the disruptive competition risks, while a focus on forward-looking “value creation” might be a more promising business plan, though requiring a more fundamental re-organization of the companies. Although the “Big 4” are following both strategies, a strong focus of their structural reorganization is on adapting to the new business opportunities based on three main pillars: renewable energy, distribution network, and customer solution. The question is, however, whether these strategies will be successful. In the following we will in turn evaluate the prospects and possible risk of these three focus areas.

1) Prospects of renewables investments

The German incumbents have started to engage actively in RES investments to catch-up with market developments. Next to PV and onshore-wind, a main focus is put on off-shore wind. Given their large capital endowment, the "Big 4" are in a good position to undertake these large and lumpy investment, while new smaller market entrants typically face difficulties raising the necessary capital.

However, these investments are highly uncertain both with respect to costs and revenues. The highly innovative nature of off-shore projects strongly increase investments risks compared to other RES sources. On the other hand, given the rapid RES developments in the past, the RES support scheme has been changed recently. The former support of RES through fixed feed-in tariffs changed to a market premium model and is now replaced by auctions. The level of support is likely to be decreased further in the future. In other words, RES is no longer a secure regulated business, but both market and regulatory uncertainty apply. Hence, a success in these RES strategies is far from guaranteed. Other RES like PV and onshore wind are less risky, but competition has become strong. In other words, it seems to be rather late for incumbents entering the RES market, given the large number of third party players, already having gained experience in the business.

2) Prospects of the smart distribution grid business

The electricity network has long been a low-risk business that provided a moderate but stable regulated revenue stream. Two major developments changed this situation. First, with the introduction of revenue-cap regulation, regulatory risk has

increased. Under increasing investment requirement, cost recovery, and therefore investment profitability, is no longer guaranteed (Brunekreeft & Meyer, 2015). Second, following stricter unbundling requirements by the European Commission, three out of the "Big 4" sold or split their transmission network from their parent company. As a result, the incumbents now strongly focus on the distribution network which – at least to date – is not subject to strict unbundling.

The trend towards distributed generation and consumer orientation clearly benefits the distribution focus. However, the combination of increased regulatory risk and high investment requirements to cope with the spread of distributed energy resources and increasing number of prosumers also renders the distribution sector a risky business. Regulatory risks are further increased by the innovative investments needed for the development smart grids. Operational and investment risks require changes to the regulatory system. By now it is not clear how and to what extent these risks will be handled by future regulation, while research and investments have to start right now.

3) Prospects of customer solutions

The trend towards distributed generation and the emergence of more active consumers render electricity supply a "premium product" with additional services that potentially allow for higher profit margins compared to traditional retail. One example is the "bundling" of products for prosumers by offering PV installations and storage in combination with market- and network-related like "aggregation". A recent international management survey of major utilities shows that two third of the respondents consider such services around distributed generation successful (Figure 30).

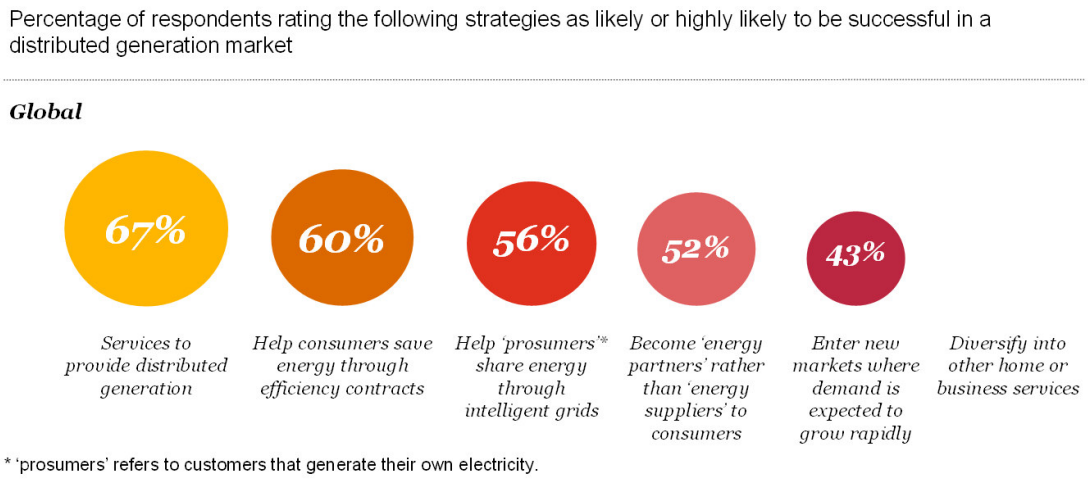


Figure 30: Strategies for dealing with distributed generation [Nillesen et al., 2014]

As Figure 30 also shows, energy suppliers may turn into "energy partners" offering energy consultancy services around energy saving and market participation. As a result of active prosumers emerging in distribution networks, Nillesen et al. (2014) state that "The value-added is then in matching supply and demand, not in meeting demand itself".

The positive evaluation of supply services seems to be confirmed by a survey of Oliver Wyman (2016) showing that consumers are highly interested in "bundled services" like PV & storage or smart home solutions, as well as energy consulting. What will be the economic implications of these developments? Brunekreeft et al. (2012, p. 27) argue that the growing importance of market services may be "changing the consumers' perception of electricity from that of an abstract, low involvement product into that of an interesting premium product". This may create additional margins by lowering consumers' incentives to switch suppliers only based on prices. Hence, former price competition may turn into quality competition leaving more room for value

creating products. On the other hand, however, the impacts on the "Big 4" are ambiguous, as these developments will also attract new competitors entering the market for such services.

Concerning the prospects for incumbents, Nillesen et al. (2014) refer to the concept of the "fast second", developed by Markides & Geroski (2005). Incumbents at first leave the risky innovations with the new market players, who have little to lose but potentially a lot to gain. Some of these innovations will be successful, while others will not. After the smoke clears, and it starts to get clear, which innovations may be successful, the incumbents step in, buy up the successful start-ups and market the innovation large-scale. As a result, one of the "Big 4's" strategies seems to be the support of innovative start-up companies to maintain the option of taking over these companies in case the innovations turn out successful (e.g. EnBW, 2015). By doing so, companies avoid the high risks of innovation, while at the same time being "at the front" of the new markets.

Even though the "Big 4" have the advantage of sector experience, their often bureaucratic organizational structure may be an obstacle in adapting to the new market environments. RWE and E.ON seem to have recognized that the fundamental change of their business strategies requires a fundamental reorganization of their companies in order to lift the new business opportunities. Compared to new competitors, this need for reorganization may be a competitive disadvantage. This creates a dilemma for the "Big 4": given the fast developments ahead, "wait and see" does not seem to be a viable option, while innovation and reorganization is costly and risky. Although new businesses offer growth opportunities, profitability and market size for new businesses are highly uncertain. The success of new business models such as Virtual Power Plants

and other smart-grid related installations, critically depend on future developments of smart markets, well-functioning balancing markets and regulatory frameworks. Hence, both market and regulatory risks create uncertainty for future profits. In addition to that, raising the market potential of those smart applications requires collaboration with experienced ICT businesses and may size down the market shares for traditional electric utilities.

5. Concluding Remarks

The experiences of the German energy transition are valuable for other countries trying to follow a similar path. The electricity supply industry (ESI) in Germany is in transition, and incumbent companies face „disruptive challenges“. The German major power companies are practically forced to revisit and alter their business model to take advantages in energy transition, given the strong political commitment to the transition backed by the support from the general public.

The most important developments in the German market following the energy transition are the following:

- After the Fukushima incident, the nuclear phase-out was decided; this is to be finalized in 2022. The phase-out as such is no longer debated. The debate currently is about who is liable for uncertain cost of decommissioning and storage of nuclear waste. This will largely fall upon the incumbent producers, causing an additional financial burden.
- Large-scale integration of renewables; Germany is actually well underway towards its 80%-renewables target. Impressive as this is on the one hand, it also causes

multiple problems on the other hand. Firstly, the feed-in system as the main RES support system has started to be in conflict with the rest of the market and it is being changed towards a more market-compatible system. Secondly, the large-scale RES suppresses wholesale prices and puts incumbent producers under severe financial pressure. Thirdly, the energy transition provides ample opportunity for new market players to enter the market; many of these are direct or indirect competitors for the incumbent producers, which face deterioration of the market shares and business models. Fourthly, following distributed generation and smart grids, the market is changing from a top-down centralized supply chain towards a decentralized, bottom up supply chain where the end-user is the focus.

- A further development recently started with the debate about a coal-phase-out. At the time of writing, it is still unclear where this debate will be heading for.

The incumbent producers (REW, EON, EnBW and Vattenfall) indeed face disruptive challenges. They are in severe financial distress and are currently in the process of reorganization of the companies and transforming the business model. We observe the following trends in strategies to address the disruptive challenges:

- RWE and E.ON explicitly restructure the company. Basically the companies are split in a new and an old part. The new part focuses on future business models (renewables, networks and customers); where the old businesses (conventional generation, coal mines, nuclear) will be in the old part. The main reason behind the split seems to be that corporate culture for these two business strategies is too different; this concerns both management as well as perception by the public and the customers. It is yet unclear whether the companies will retain ownership of the old

parts in the future.

- The companies (RWE, E.ON and EnBW) focus their future strategy on three pillars:
    1. Renewables, which for these three companies is mainly off-shore wind.
    2. Networks, which, given unbundling rules for transmission, by and large concern the distribution networks. The companies hope to move into the world of smart grids. The networks provide a stable, low-risk stream of regulated revenues.
    3. Customer orientation. Larger end-user involvement with premium products is a big trend. So far, however, no one seems to know precisely what this contains and perhaps more importantly, whether this is a profitable business model at all.

It is important for the power companies in Japan and other countries that investing in RES and customer solution is a strategic growth option to be acquired in order to respond to a changing environment in energy business. There is no guarantee that these investments actually will pay off in the future, but it is like ensuring against the complete change of energy business landscape.

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