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Unbundling of electricity transmission system operators in Germany – An experience report

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Unbundling of electricity transmission system operators in Germany – An experience report

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Bremen Energy Research / Jacobs University Bremen

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CRIEPI, Tokyo

Report for joint research project "Evaluation of Vertical Unbundling in Germany: Impact on the Electric Utilities, Market, and Security of Supply"

March 31, 2014

Abstract

The purpose of this research is to evaluate the impact of vertical unbundling on German electric utilities. Our research mainly relies on in-depth interviews with sector-experts from the German utilities. We will discuss both short-term changes and the long-term impact on competition in the electricity market as well as the impact on costs and security of supply. Overall, we have two main conclusions. First, the major step in the unbundling process is from "lean legal unbundling" to "fat legal unbundling"; additional steps beyond that are small, both in benefits and in costs. Second, the benefits of unbundling in terms of increased competition do not come for free: unbundling is costly and it is important to balance cost and benefits in the reform process.

Keywords: electricity, unbundling, regulation, competition policy

JEL-classification: L43, L51, L94

[1] The authors gratefully acknowledge the discussions with sector experts from the utilities, including the TSOs, in Germany, who willingly shared their experience with us.

Content

1 Introduction

What are the experiences with TSO network unbundling in Germany five years after the 3rd European Electricity Directive? In order to facilitate competition in generation and retail, many countries restructure their electricity industry by vertical unbundling of the incumbent utilities. In Europe, far-reaching legal separation of generation and transmission is mandatory; some countries have gone a step further and have implemented ownership unbundling. The argument is that this restructuring effort will lead to an increased efficiency, and thereby lower the electricity prices. However, unbundling changes the operation of electric utility business, management strategy as well as organizational structure. In addition, the effects on competition, short-term efficiency, investment and security of supply are not well known.

In Germany, there are four major utilities. Ownership structure of these four is mixed. Two are predominantly in public ownership. The other two are predominantly in private ownership. These four major electric utilities had retained vertical integration for many years, even though they implemented legal separation of the transmission system operator (TSO). However, some of them recently sold their TSO to third parties (or effectively implemented ownership unbundling). The other utilities adopted a stricter form of legal unbundling in response to the 3rd directive of the EU, transforming their transmission system operator to a so-called Independent Transmission Operator (ITO). Understanding the causes and effects of their decisions would be very useful for other countries following a similar restructuring process. However, detailed analysis of the German experiences to date is rare.

The purpose of this research is to evaluate the impact of vertical unbundling on German electric utilities. We will discuss both short-term changes and the long-term impact on competition in the electricity market as well as the impact on costs and security of supply. Overall, we have two main conclusions. First, the major step in the unbundling process is from “lean legal unbundling” to “fat legal unbundling”; additional steps beyond that are small, both in benefits and in costs. Second, the benefits of unbundling in terms of increased competition do not come for free: unbundling is costly and it is important to balance cost and benefits in the reform process.

In our study of the experiences we focus on the following five topics:

- Coordination and misaligned incentives
- Financing investment

- Cost effects
- Strategic effects on generation
- Productivity and financial results

This study is on electricity-TSOs only. The EU directives are equally valid for the gas-TSOs, and so the main principles apply. However, in our view, the economics of unbundling in gas and electricity differ too strongly to transfer the insights of electricity directly to gas. Moreover, this study focuses on transmission system operators (TSO). The situation for distribution system operators (DSO) is comparable only to a limited extent, and significant differences remain. Therefore, although occasionally we do refer to DSOs, the conclusions apply only to TSOs.

The main method of our research relies on interviews with sector experts and literature review. We held expert-interviews with German companies – both TSO and parent companies – from Winter 2012 to Summer 2013. We make the following disclaimer. Whereas many of the insights and claims made in this report rely on the information from the interviews with the companies, at no point we literally quote any of the companies. All statements are the sole responsibility of the authors of this report and do not necessarily represent the views of individual companies or their representatives.

2 Unbundling in the 3rd energy directive: Europe and Germany

2.1 Key steps in the EU directives and their implementation in Germany

European energy sector follows now the 3rd Directive of 2009, which was implemented by the Member States in 2011.[2] In all, the measures concerning network unbundling have been severely strengthened from the 1st to the 3rd Directive, but stopped short of mandatory ownership unbundling. The directives with the subsequent rules on unbundling and their implementation in Germany are summarized in figures 1 and 2 below.

[2] According to Article 49(1) of Directive 2009/72/EC, Member States shall bring into force laws, regulations and administrative provisions necessary to comply with this Directive by 3 March 2011. However, in some Member States it is not transposed yet. For example, on 25 April 2013 the Commission sent an additional reasoned opinion to Ireland urging it again to fully transpose the Electricity Directive of the third energy package. According to the Commission, some Member States do not notify a decision on the certification of a transmission system operator as laid down in Article 10(6) of Directive 2009/72/EC.

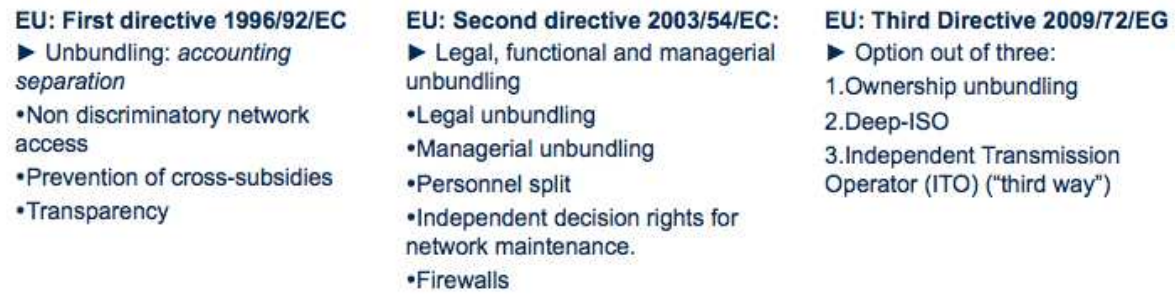


Figure 1: Overview of the EU directives

Figure 2: Overview of implementation of unbundling rules in Germany

The 1st Directive of 1996[3] set liberalisation into motion. The unbundling requirements were relatively weak; the overall approach can be called "accounting separation" and comprises:

- Separate accounts for monopoly and commercial businesses
- A ban on cross-subsidies
- Non-discrimination
- Third-party access (TPA).

At that moment, third-party access (TPA) could be regulated (rTPA) or negotiated (nTPA).

Germany implemented the minimal requirements half-heartedly. Indeed, only the minimum requirements were implemented, Germany opted for negotiated TPA and did neither install a sector-specific regulator, nor ex-ante network regulation. Instead, ex-post monitoring and enforcing a level playing-field was left to the Competition Commission, backed-up by general Competition Law. This was challenging, as reported by the Competition Commission (BKartA, 2001).

[3] CEC, 1996, Directive 96/92/EC of the European Parliament and of the Council of 19 December 1996 concerning common rules for the internal market in electricity, Official Journal L 027, 30/01/1997 P. 0020 – 0029.

The 2nd Directive of 2003[4] introduced two main elements. Firstly, it enforced regulated TPA, which includes a sector-specific energy regulator equipped with the necessary tools backed-up by national law. Secondly, the enforcement of "legal and functional unbundling"; this strengthened the rules as compared to the 1st directive.

This directive was important for Germany and enforced the establishment of the regulator "BNetzA" (= *Bundesnetzagentur*), starting in 2005.[5] The BNetzA enforced ex-ante network regulation, regulated TPA and the implementation of legal unbundling. As a sector-specific regulator, backed-up by the Energy Act 2005, the BNetzA was far more powerful and effective than the Competition Commission. Ex-ante disaggregated network regulation (instead of regulation of end-user prices) is important: it widens the margins for the commercial businesses and thereby opens up the market for entry by third parties (cf. Brunekreeft, 2003, ch. 6, or Brunekreeft, 2002).

The 3rd Directive[6] followed the so-called Sector Inquiry 2007[7]. The Inquiry concluded that the developments in liberalisation in European energy markets were unsatisfactory, and that stronger policy reforms were called for. At this point the European Commission proposed (gas and electricity) full ownership unbundling as the first-best option and the deep-ISO as a second-best option. Eight member states, including Germany and France insisted on the 3rd option: the ITO. Ultimately, a compromise with three options followed

- Ownership unbundling
- Deep Independent System Operator (ISO)
- Independent Transmission Operator (ITO).

Essentially, ITO is a stronger form of legal and functional unbundling. It creates fully independent and fully functional network companies, stopping just short of ownership unbundling. Legally, the German government opted for the ITO model as the minimal requirement. Yet, a process had been set into motion. Although it was not legally required, some of the vertically integrated utilities (VIU) in Germany decided to sell the TSO. .We will explore the reasoning of the companies to sell or keep the TSO in more detail below.

[4] CEC, 2003, Directive 2003/54/EC, Directive 2003/54/EC concerning common rules for the internal market in electricity and repealing directive 96/92/EC, 26 June 2003. O.J. L176/37.
[5] On 1 January 1998, Regulierungsbehörde für Telekommunikation und Post (RegTP) was established by Telecommunications Act 1996, and on 13 May 2005, it was renamed BNetzA and responsibilities were expanded to electricity and gas markets. On 1 January 2006, its responsibility was expanded to railway market.
[6] EU-Commission, 2009, „DIRECTIVE 2009/72/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC", 14.08.2009, Brussels.
[7] EU-Commission, 2007, DG Competition report on energy sector inquiry (SEC(2006)1724, 10 January 2007).

Legal and functional unbundling

In the Sector Inquiry 2007, the EU commission states that legal and functional unbundling was not sufficiently strong. But what exactly is legal and functional unbundling? Following the minimal requirements in the 2nd directive, legal und functional unbundling comprises the following steps:

- Legal unbundling, which requires the network departments to represent separate legal entities. According to Article 10(1) of Directive 2003/54/EC, integrated undertaking shall separate TSO at least in terms of its legal form. However, the Directive does not require integrated undertaking to transfer their transmission assets to other legal entities (e.g. TSO). This will be picked up further below.
- Operational unbundling, which secures the independent operation of the network company compared to the parent company,
- Informational unbundling, which is the implementation of effective information firewalls.
- Accounting separation, which is the same as under the 1st directive.

Of particular importance is operational unbundling. A handbook by PWC (2012, ch. 4) goes into extreme detail on how to do this (under German law, which reflects by and large minimal implementation of the EU directives). Following the directives on legal unbundling, the subset operational unbundling requires five steps:

- Separation of personnel; staff cannot be employed on both sides,
- Ensuring professional (financial) independence of staff of the network from the commercial business,
- Securing effective decisions-making power (day-to-day and strategic) of the network operator,
- Installation of a compliance program and compliance officer,
- Securing separate corporate identity of the network and commercial business towards the external parties.

Of these five steps, the third attracts attention in two important respects. First, effective decision-making powers require that the network operators have a minimum independent equipment available. This concerns:

- Material
- Personnel

- Technical equipment
- Financial resources

In total, this setup aims to place the network operator into a situation as-if it were a company on its own. These minimum equipment requirements shift costs from the parent to the network company or require additional expense.

Second, under legal unbundling, independent decision-making power concerning network investment is restricted. Art. 10.3 of the 2nd Directive states: "This should not prevent the existence of appropriate coordination mechanisms to ensure that the economic and management supervision rights of the parent company in respect of return on assets, regulated indirectly in accordance with Article 23(2), in a subsidiary are protected. In particular, this shall enable the parent company to approve the annual financial plan, or any equivalent instrument, of the transmission system operator and to set global limits on the levels of indebtedness of its subsidiary." This is an important limitation. Ultimately, the board of the holding is responsible for the financial results overall. The board needs to have all information of all decisions that significantly affect the financial situation of the firms. Therefore, at board level the firewall rules could be by-passed and investment decisions be coordinated. This restriction of unbundling has been lifted to a large extent under the ITO-approach, giving the ITO more strategic independent decision-making powers.

The requirements for minimum equipment for the network company, as outlined above, have been subject to debate. The debate in The Netherlands around DNO unbundling in 2004 illustrates this very well. The precise specification of which tasks belong to the network and which can belong to the parent company has not been laid down (cf. PWC, 2012, ch. 3.3.1); yet, it determines the severity of legal unbundling and sets the difference between "legal-lean" and "legal-fat" (cf. CPB, 2004, p. 35 ff.). Networks with only little own equipment are called "lean", and networks with a lot of own equipment are called "fat". CPB (2004, p. 36) cites a report by the Dutch regulator, which sets out the following strategic tasks, for which the network should be equipped and which cannot be outsourced (at least not to the parent company):

- Investment decisions regarding the extension and maintenance of the network;
- Operational management (e.g., dispatch, negotiations on contracts over the access to the network, responsibility about information systems);
- Contracting of the parties that perform outsourced activities;
- Financial policy (setting up the annual reports, billing, contact with clients);

- Supervision of the design of new and maintained networks;
- Management of information systems.

Note in particular the independent responsibility for IT-systems, which reflects information unbundling. As the detailed description in PWC (2012) suggests, this is an extensive measure with far-reaching consequences.

Independent Transmission Operator (ITO)

What precisely is an ITO? Basically, the ITO approach "merely" strengthens the rules of legal and functional unbundling to create fully functional TSO, as if they were a completely different and independent firm. From an unbundling perspective, they only step left is to sell the shares, which makes the decisive and only difference to the ownership unbundling.

In the Sector Inquiry 2007 (p. 12) and in the comments to the 3rd Directive, the EU commission argues that only ownership unbundling can effectively ensure a level playing field and ensure incentives for the network investment. The Impact Assessment (2007, p. 32 ff.) mentions three "fundamental problems" with legal and functional unbundling of the 2nd directive:

- The incentives to discriminate third parties remain,
- Exchange of information (despite the firewalls) is still possible and cannot effectively be controlled,
- The network investment problem remains.

Principally, this is correct. The more relevant question is the extent to which this is a problem. Moreover, these fundamental points are not resolved by the ITO approach. The ITO was the political compromise, as it became clear that mandatory ownership unbundling as the sole option in the directive was too ambitious and faced too strong political opposition. It should be stressed, however, that the ITO is a stronger form of legal & functional unbundling, and not something fundamentally different.

The ITO is fully independently functioning body. The 3rd directive lists inter alia the following requirements:

- Complete human, technical, physical and financial resources
- ITO has to be organised as a legal entity
- Independent Corporate Identity, neutral name, separate premises
- Prohibition of the use of company internal services (notably IT)
- Guarantee independence of investment decisions

- Supervision by a supervisory body, representing the VIU
- Independence of management
- Increased control and monitoring competences of the regulatory authorities

The first bullet point ensures complete equipment to be independently functional. Note that these are no longer formulated as quasi non-binding minimal requirements; instead, full equipment is prescribed. This in effect is a formalization of the legal-fat approach explained above.

The fifth bullet point deserves attention. As explained above, legal and functional unbundling retained the possibility that investment decisions were coordinated at board level. This coordination concerned general high-level investment decisions (like the annual budget). The board was not allowed to participate in day-to-day decision-making. However, the coordination at the board level also means, that the conflict of interest in network investment decisions between the network operator and power plants is not fully resolved. The EU commission stressed the problem that VIU have inadequate incentives to invest in the network, in particular, interconnectors. Under the ITO structure, the strategic control of the parent company on network investment decisions has been further weakened. As the flipside of the same coin, this also means that coordination of investments decisions (network and generators) has suffered. We will discuss the investment issue in more detail below. For now, it should be noted, that the EU commission stresses that necessary expansion of interconnector capacity suffers from the lack of ownership unbundling. A recent report by Roland Berger (2011) for the EU commission explores the reasons for slow interconnector expansion: ownership unbundling is not one of these.[8]

How large are the steps?

Why is all this important? Figure 3 plots different steps of unbundling with an increasing degree of severity.

[8] Instead, the regulatory environment (rate-of-return on investment), access to finance and the NIMBY-problem are identified as main hurdles.

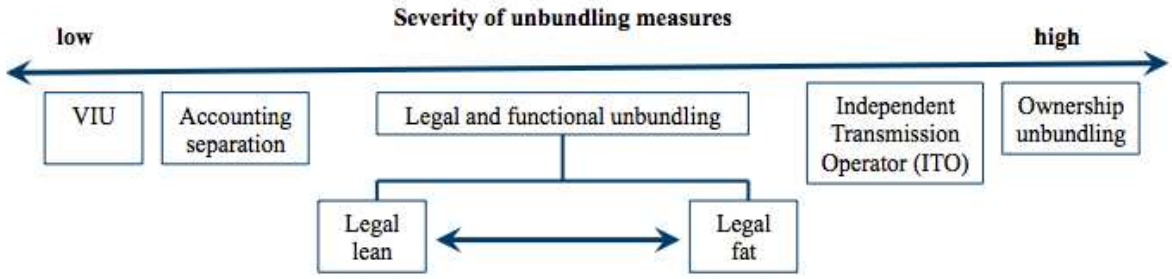


Figure 3: The unbundling steps in overview
Source: authors

We want to stress that the decisive step is made *within* "legal unbundling"; however, it is ambiguous how legal unbundling exactly looks like. Unless specified by law, legal and functional unbundling is a range from "legal-lean" to "legal fat". Legal-lean is quite minimal and is close to the weak requirements of the 1st directive under accounting separation. In contrast, legal-fat is a big step and is close to the ITO-approach. As we see, the step from ITO to ownership unbundling is also small. The significant effects, both in benefits and costs, take place in the switch from legal-lean to legal-fat, not from legal fat to ITO or to ownership unbundling. CPB (2004, p. 73) notes: "Therefore, when comparing the (…) policy options, the main cost of losing economies of scope arises with introducing a proper task allocation when moving from Legal-Lean to Legal-Fat. (…) Additionally, ownership unbundling adds only small extra cost."

2.2 Corporate decisions to unbundling: to sell or to keep?

On paper, the legal situation in Germany, as laid down in the Energy Act of 2005, implementing the 3rd Directive is the ITO-approach. The German government opposed the proposal of mandatory ownership unbundling and has not changed this position since. Implementation of the 3rd Directive of 2009, due by 2011, has been finalized. The ITO-approach is a minimal requirement; both the deep-ISO and ownership unbundling go further and are thus also allowed. In practice, the picture in Germany is blurred: the four formerly integrated VIU (RWE, EnBW, E.On and Vattenfall) each followed a different route and the result is a mixed picture. It is likely that at the moment of writing (early 2014) the situation is not steady state and further change may come. For us, this is speculation and we leave this for the future to tell.

After consolidation of the electricity and gas sectors with mergers and take-overs in the 1990s, the sector stabilized with four VIU for generation and transmission: RWE, EnBW, E.On and Vattenfall.

RWE AG is a Germany-based electricity and gas company. It diversifies its activities into seven divisions: Germany, which consists of the Power Generation and Sales and Distribution Networks business areas; Netherlands/Belgium; Great Britain; The Central Eastern and South Eastern Europe; Renewables; Upstream Gas and Oil, and Trading/Gas Midstream. Under the Netherlands/Belgium division it reports on wholly-owned Essent, which provides gas, electricity, heat and energy services. The United Kingdom division represents RWE power; The Central Eastern and South Eastern Europe division covers its subsidiaries in Poland, Hungary, the Czech Republic, Turkey and Slovakia. The Renewables division comprises all of the activities of RWE Innogy, which specializes in electricity and heat generation from renewables. The Upstream Gas & Oil division produces gas and oil through RWE Dea, which was sold to a Russian investor in March 2014. The Trading/Gas Midstream division encompasses energy trading, gas midstream activities, and sales to German clients.

E.ON SE is a Germany-based provider of energy solutions. It manages the E.ON Group, which consists of five global units and 12 regional units. Global units consist of Generation, Renewables, Gas, Trading (which are also Company's business segments) and New Building & Technology that comprises project management and engineering related to construction of power plants and the operation of existing plants across the Group, and research and development projects for the E.ON Innovation Centers. Generation segment consists of the Group's conventional (fossil and nuclear) generation assets in Europe. Renewables segment comprises the carbon-sourcing and renewables businesses. Gas segment is responsible for gas procurement, including its gas production, and for project and product development in gas storage, gas transport, liquefied natural gas and technical asset support. Trading segment comprises the trading activities on energy exchanges. In June 2013, it started venture capital activities.

EnBW Energie Baden Wuerttemberg AG (EnBW) is a Germany-based holding company of the EnBW Group, operating in the energy sector. The core activities of EnBW are divided into three business areas: Electricity, Gas, and Energy and Environmental Services. The Electricity business area is divided into Electricity generation and trading, and Electricity grid and sales divisions. It generates electricity from nuclear power, hydropower, solar power, geothermal energy and wind power, among others. The Gas business area consists of the midstream area, including the import agreements and infrastructure, storage, trading, as well as the downstream

area, including the distribution and sales. The Energy and Environmental Services business area includes such areas as thermal and non-thermal disposal, water and other energy related services. The Company also has sales offices and subsidiaries in Germany and throughout central and eastern Europe.

Vattenfall AB is a Sweden-based company active in the energy sector. Its main products are electricity, heat and gas. In electricity and heat, it works in all parts of the value chain: generation, distribution and sales. It is also engaged in energy trading and lignite mining. Its business is divided into three segments, Generation, Distribution and Sales, and Renewables. Vattenfall AB produces different types of energy, such as biomass, coal power, hydro power, natural gas, nuclear power and wind power. Its core markets are Sweden, Germany and Netherlands, as well as France, the United Kingdom, Denmark, Belgium, and Poland. It operates a number of subsidiaries in Sweden, Denmark, Finland, Germany, the Netherlands and the United Kingdom. As of December 31, 2011, the Company was wholly owned by the Swedish state.

It is important to note that they are very different in ownership structure. As mentioned above, Vattenfall is a company owned by the Swedish state. In addition, EnBW is a company whose 94% shares are owned by the state government of Baden-Württemberg as of February 2014. In contrast, the percentages of floating shares are 96% and 75% for E.ON and RWE, respectively. Such differences in ownership structure may influence the stability of financial performance of those companies.

Figure 4 plots the current situation in overview:

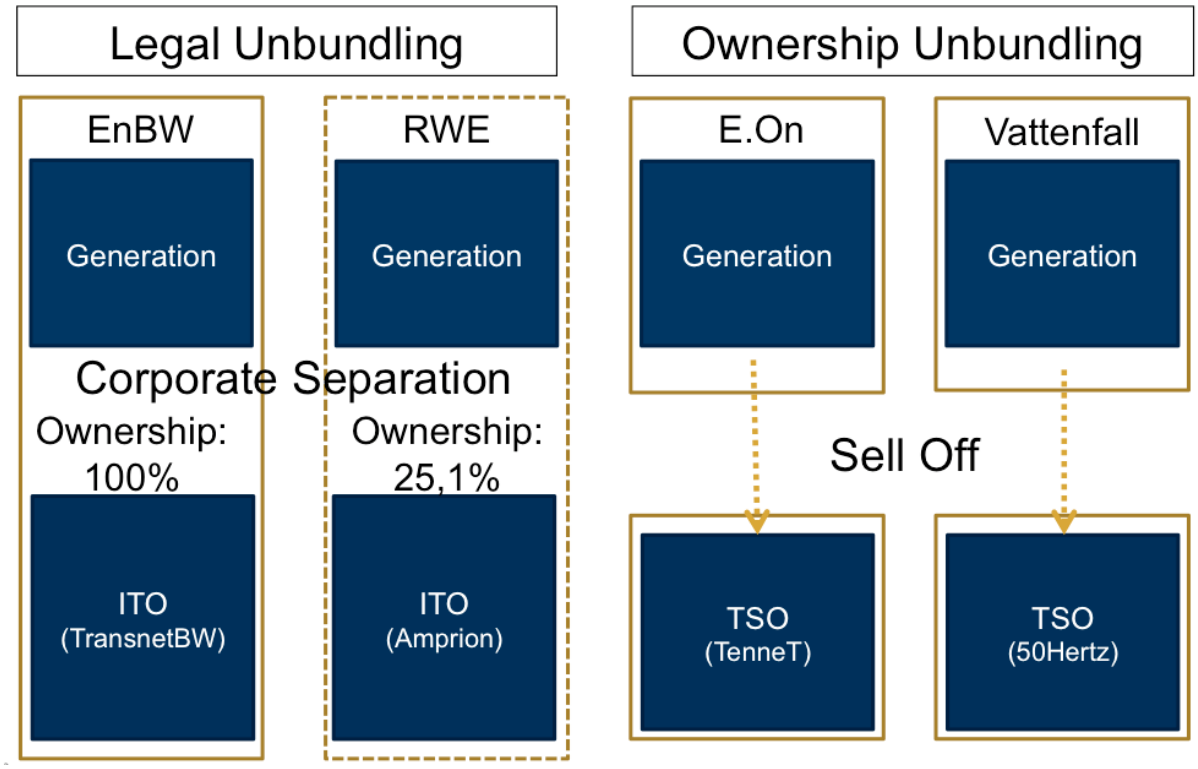


Figure 4: the four companies in overview.

- E.On sold its TSO (then called Transpower) to the Netherlands-based TSO TenneT, which is owned by the Dutch state.
- Vattenfall sold its TSO to a consortium consisting of the Belgium-based TSO Elia and financial investors from Australia. The independent TSO is now called “50 Hertz”.
- RWE has partly sold its TSO Amprion, but still holds a decisive minority share of 25.1%; the other owner is a consortium of predominantly German financial institutions. Because of the minority ownership Amprion qualifies as an ITO of RWE.
- EnBW decided not to sell its TSO, now called TransnetBW, and retains a 100% ownership. TransnetBW is a genuine ITO.

Figure 5 shows the control areas of the four TSOs in Germany. Note in particular the position of TenneT, which ranges from the south-east up the north-west and borders of the German north-sea coast. This means that TenneT is primarily responsible for the HV offshore lines to the offshore wind parks to be built in the North Sea, and much of the onshore transmission network expansion in north-south direction are also the responsibility of TenneT. We will discuss this in more detail further below.

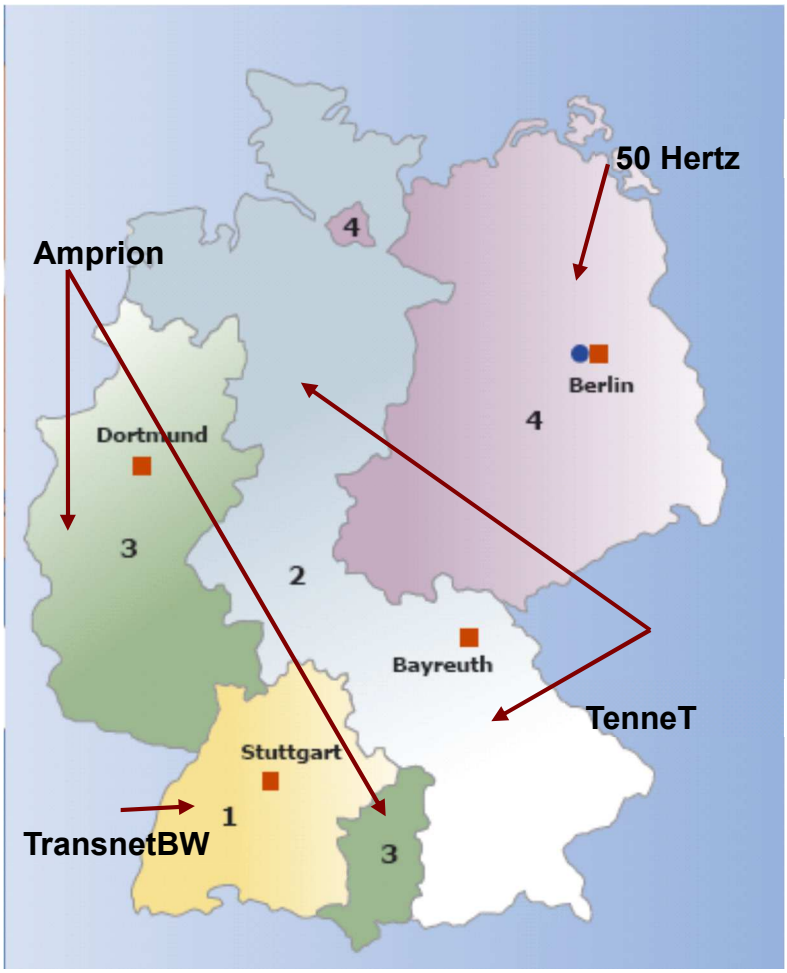


Figure 5: the four TSOs in Germany.

We will now discuss the strategies to sell or keep the TSOs.

E.On sold its transmission network "voluntarily". The sale to TenneT was concluded in February 2010, after considerable difficulty to find a buyer. TenneT is the state-owned TSO in The Netherlands; with the E.On network, TenneT started cross-border expansion.

Why did E.On sell the TSO "voluntarily"? In fact, it was not voluntary. As mentioned above, the EU commission did not succeed to pursue its proposal for mandatory ownership unbundling. Shortly before the conclusion of the 3rd directive by European Parliament the EU commission started an antitrust procedure against E.On, relying on illegal cartel agreements. As the result of a negotiated settlement, the EU commission agreed the drop the cartel allegations, after E.On agreed to sell the electricity-TSO and sell 5 GW of power plant (in Germany).

The split of electricity-TSO was clearly not voluntary. Nevertheless, E.On might have sold anyhow. It is felt that the ITO rules are sufficiently strong such that there is no strategic interaction or control between the TSO and the parent company. In fact, in 2012, E.On sold its

gas-TSO genuinely voluntarily to the financial investor Macquarie to raise equity and improve credit rating.

Vattenfall sold its TSO genuinely voluntarily in March 2010, only one month later than E.On. The decision to sell was made as early as 2008, this is before the 3rd Directive was concluded. It was sold to a financial consortium combining the Belgium TSO Elia, and Australian infrastructure fund "Industry Funds Management (IFM)" and was renamed "50Hertz Transmission". Notably, both new owners are privately owned. Yet, while Elia has a genuine electricity related interest, IFM only has a financial interest. As a pension fund, it invests funds for a long-term, relatively secure rate-of-return. Whether the rate of return is high enough is for IFM to decide; apparently, it is.

Why did Vattenfall decide to sell the TSO? Three reasons contribute to the explanation. Firstly, the Swedish owner Vattenfall had a different corporate culture and different views on market design and market governance than the generally held views in Germany. In Sweden the commercial parts of the electricity sector (Vattenfall AB) and the TSO (Svenske Kraftnet) are separated. However, both companies are fully state-owned, and therefore not strictly speaking ownership unbundled. Nevertheless, ownership unbundling as a governance structure was not controversial policy in Sweden. Secondly, in 2007 and 2008, Vattenfall Europe Transmission (the German TSO of Vattenfall) was actually lossmaking (€-92m in 2008 and €-167m in 2007) [9] and presumably thus, selling was a business case to increase overall profitability and increase credit rating of the company. More formally, in 2008, the profit-transfer-contract between VE Transmission and Vattenfall Europe was cancelled, meaning that the TSO had to cover its own losses as from 2009 onward. As mentioned above, similar reasoning seems to have inspired E.On to sell the gas-TSO. Thirdly, and somewhat remarkably, the Wikipedia entry on Vattenfall explicitly mentions a background in competition policy (http://de.wikipedia.org/wiki/Vattenfall_Europe). This is somewhat paradox as mandatory ownership unbundling is not prescribed by the 3rd Directive. Vattenfall was very early in its ambitions to sell and may have anticipated others to sell as well; it may be recalled that Vattenfall decided to sell in 2008. This strategy would have given a head-start in a possibly "race for the best price". Something similar happened in New Zealand in the 1990s, when the distributors sold the retail departments. These were sold very quickly (for more detail, see e.g. Brunekreeft, 2003, p. 192).

[9] See the annual accounting report 2008 of Vattenfall Europe Transmission GmbH („Jahresabschluss zum Geschäftsjahr vom 01.01.2008 bis zum 31.12.2008").

RWE sold a significant part of its TSO Amprion. At the moment, RWE holds a decisive minority share of 25.1%, with no plans to sell any further. The buyers of the shares were primarily financial investors from Germany (a consortium led by Commerzbank).

What are the reasons for this mixed strategy? Firstly, and importantly, under the ITO, the TSO is a mere financial asset for the parent company, raising straightforward risk-return considerations. Importantly, the revenues of the network are regulated and are only a moderate profit-centre. Secondly, as the other VIU, RWE as well is currently under severe financial stress. Selling the TSO would raise additional funds. Thirdly, under the ITO, there is no strategic control left. The strategic interaction between TSO and parent company is low. In fact, as explained above, the restrictions under ITO are severe such that the parent company takes the risk while not having control. We may conclude that the ITO-approach (as a far-reaching form of legal & functional unbundling) actually works and the strategic interaction is gone.

Interestingly, RWE sold 74.9% shares of Amprion stepwise. The new, purely financial shareholders had no experience with transmission system operation and first wanted to include the experience of RWE. In time, experience grew and the financial institutions were ready to accept more responsibility.

EnBW decided not to sell its TSO, TransnetBW, which is also the current state of affairs. Why is this? Firstly perhaps, for a couple of years, EDF from France was a major owner with decision-making powers. Unlike Vattenfall from Sweden, France and EDF never supported ownership unbundling. Towards the end of 2010, EDF sold its EnBW shares to the Baden-Württemberg state-government. EnBW is almost completely state-owned, although at different state-levels, and almost completely within the state Baden-Württemberg. Secondly, the "regional" state-owners in Baden-Württemberg did not want to give up political control of the TSO in Baden-Württemberg. We stress the state-character because the TSO control area by and large overlaps with the state-borders. Thirdly, selling the TSO would have raised funds, but as the TSO is small compared to the overall company it would not contribute much. Moreover, the state Baden-Württemberg is a rich state and is not in urgent need of money. Fourthly, and this is a new argument which did not apply in 2007, owning a regulated network is good for credit rating in times where commercial businesses have difficulty. Momentarily, trading and generation are in financial distress,[10] and the regulated network adds positively to the overall financial situation. This is different when generation and trading are highly profitable.

[10] This will be discussed in more detail in section 4.

Whether EnBW will sell the TSO or not is difficult to tell. Currently, there are no signs in this direction and we can only speculate. However, similar to the other three major utilities, EnBW severely suffers from the "energy transition" and is in a process of major restructuring and re-orientation. Perhaps, views change in time.

3 Experiences with TSO unbundling in Germany

What are the experiences with the TSO unbundling steps in Germany so far? Below we present an evaluation. The assessment relies on the interviews with the companies and on insights from the literature. Because recent data are simply not sufficiently available, we refrained from a statistical analysis, and focussed on a qualitative analysis instead. The analysis relies on five main points:

- Loss of coordination
- Financial investment
- Corporate costs of unbundling
- Strategic interaction with generation
- Effects on productivity and financial situation

We stress that unbundling has to balance between competition and coordination. The merits of competition have been discussed in extension and have been in foreground of the discussion on unbundling. In this study, we focus on the other side: what are the experiences with the downside of unbundling?

3.1 Coordination and misaligned incentives

As explained above, one of the main arguments of the EU commission for ownership unbundling was the concern that VIU have insufficient incentives to invest in network expansion; this argument may be called "strategic investment withholding". We will explore this argument in more detail below. Importantly, the argument focuses on cross-border interconnectors, not so much on system-internal network expansion. As explained above, the rules of the ITO under 3rd Directive further cut the power of the parent company to control the investment by the TSO: the parent company can only set an annual investment budget, but cannot determine how the budget is spent. As explicitly stated in the 2nd Directive (see above), under legal unbundling the power of the parent company to coordinate investment in network and power plant was stronger. This is genuine trade-off: far-reaching unbundling may

strengthen the incentives (if at all), but weakens coordination between various activities in the value-chain. With flawed coordination, the overall system will still function, but it will be inefficient. In an in-depth study on the British Rail system for the UK government, the so-called McNulty-report (2011) makes two main conclusions (see for discussion Brunekreeft, 2014): 1) the UK railway system is significantly less efficient than comparable peers, 2) the main cause of the inefficiency is far-reaching fragmentation of the system leading to misaligned incentives.

The discussion on this trade-off raises two questions. What is the strategic withholding argument? What is the cost of coordination? We discuss these two questions below; we note, however, that empirical evidence is not available and that it was not the aim of this study to do an empirical analysis on this.

Strategic Investment Withholding

Strategic investment withholding captures the notion that vertically integrated utilities would have inadequate incentives to invest in line capacity (mainly cross-border transmission lines). The European Commission always stresses this argument, because more interconnector capacity is expected to increase cross-border competition and strengthen the internal European market. The argument runs as follows: in order to protect the position in generation, the integrated TSO will have inadequate incentives to build the lines into its service area. In contrast, an unbundled TSO does not have an incentive to protect a local generation monopoly and will therefore invest more or faster in lines.

There are limits to this argument. If vertically integrated utilities export their power, they would actually have an interest to increase line capacity. Interconnector capacity can lead to more imports or to more exports; if the interconnector capacity is used predominantly for more exports, we find that competition actually decreases locally. This seems to be particularly important for the German case. Due to excess capacity and low wholesale prices induced by large-scale RES, Germany has become a net exporter. Moreover, even if the strategic investment withholding argument may hold in principle, in practice other investment limitations may be more important. In Germany as in other countries, permitting and siting for new lines is a major hurdle. Lastly, the argument may be more important in theory than in practice. A recent study by Roland Berger (2011) for the EU Commission examines in-depth the reasons why cross-border expansion proceeds only very slowly: vertical integration (or the lack of unbundling) is not one of the reasons mentioned by Roland Berger.

Gugler, Rammerstorfer and Schmitt (2013) provide a panel data study of policy reforms, which relates unbundling to investment in the European electricity sector. In particular, they conclude that ownership unbundling leads to less investment. However, the study does not distinguish between generation and network investment.

Coordination

The steps in an electricity value chain are strongly interrelated and the actions need to be coordinated to secure optimal operation and investment. In the old world with closed monopolies and vertically integrated utilities, coordination was *internal* within one and the same firm. Liberalization, competition, unbundling, and the emergence of new players result in fragmentation with a large set of decentralized actors with widely different incentives; these need to be coordinated *externally* by a market mechanism. To be sure, in many markets this is completely normal and we trust that Adam Smith's "invisible hand" guides the decentralized actions. However, does this actually work in practice? How far are we with the design of market mechanisms?

One of the more prominent coordination problems is the timing and location of new power plants and the effect on the network development. This issue was already raised by ENTSOE in the Ten-Year-Network-Development-Plan (2010, p. 38): "As a matter of fact, the most important source of uncertainty came as the consequence of the more complex coordination between generation and transmission planning due to the unbundling of the industry enacted in 1999". There are two main problems. On the one hand, planning and life duration of the networks is far longer than for the power plants and the network planners must partly rely on short-term, quite unreliable information from the market. On the other hand, network planners may try to guide the decisions by investor of power plants with contracts and side-payments. Under German law this is possible but only in a restricted sense. Basically, there is no locational network pricing (unless in exceptional cases). In Germany, TSOs and power plant investors do talk, and compensations are made, but only for a selection of exceptions. The general rule is that the network facilitates new connections. For RES, the rules are more restrictive and by and large the rule is that the network must be upgraded and the cost socialized. Effectively, there are no signals to RES investors reflecting the effects on the network.

Similar difficulties occur short term: the transmission network in Germany is heavily congested in north-south direction. This is mainly the result of large-scale integration of RES: wind is in the North and load is in the South. In Germany, there is no market-based congestion

management system, which sets efficient signals to network users. The predominant congestion management system is redispatch. This functions technically, but is inefficient.

Overall, we have to expect that network development will be inefficient. Theoretically, we should expect incentives that the network will be "too" large. This expectation is confirmed by theory-based simulation model by Grimm et al, (2014). We see four reasons for the expectation that the incentives to invest in the network in an unbundled setting may be too large. First, and foremost, the network and therefore network investment is the sole business case for an unbundled TSO. Second, cost-based regulation promotes investment as long as the regulated rate of return is sufficiently high. In Germany, on paper, the regulation of TSO-revenues is an incentive-based revenue cap. After long discussion on the detrimental effects of this type of regulation on the investment incentives, the regulation was adjusted to facilitate network investment. Third, as mentioned above, the network follows generation. If generators choose their locations with regard to the network, and the network simply adjusts, we must expect an inefficiently large network. Fourth, without proper congestion management, network use is suboptimal, meaning that expansion to relieve congestion will be suboptimal.

It is ambiguous how much strategic control the parent company has on the investment decisions of the TSO under various unbundling regimes; under ownership unbundling, clearly none. Under legal unbundling, there will remain some interaction which is precisely the concern of the EU Commission. On the other hand, this will retain some coordination. In the current state of affairs, the concern that the network may become too large may be largely academic. The main current concern in practice is that network expansion is too slow, and therefore any incentives in the opposite direction would actually be helpful. We should note that we are not aware of any empirical evidence about the magnitude of the costs of coordination. Lastly, we should note that coordination costs are whole-system costs and are not felt by the companies individually.

The difficulties with network charging

In the old, pre-reform world with vertically integrated utilities, coordination was *internal* within one and the same firm. The incentives of different actors within the company were aligned at shareholder level. In the new world, enforced unbundling results in fragmentation with a large set of decentralized actors with widely different incentives; these need to be coordinated *externally* by a market mechanism. What are the problems experienced so far?

We may face a regulation versus unbundling dilemma. The network owner can leave a commercial activity to a third party and internalize spill-overs with revenue sharing, unless regulation prohibits this; or the network owner can undertake the commercial activity itself and make the profit on the commercial side, unless unbundling prohibits this. A problem arises if both strict regulation and strict unbundling apply. Taken together this is a "regulation versus unbundling" dilemma.

Optimal network charging is difficult to implement in practice. Network charging starts to develop from a financing tool to a signalling device. This is easier said than done. As discussed in Brunekreeft (2014), implementation in practice runs into many problems, not the least, due to regulation, competition policy and politics.

The McNulty report (2011, p. 36) draws attention to "an unhelpful degree of short-termism". Different actors will have different interests. Even if we streamline information exchange, we must expect strategic behaviour. Contractual frameworks to align and enforce incentives are complex.

To conclude, once again, we have to observe that there is no free lunch. Unbundling balances between competition and coordination. When we split up an interactive value chain, we must expect coordination problems to arise. Limits to unbundling or even re-integration to some extent may be one approach to resolve the dilemma. Another approach would be to promote market mechanisms to take over the coordination task: network pricing (including revenue sharing models and contracting) should have high priority.

3.2 Financing investments

The need for network investment is high: Germany needs ca. ca. €27-42 billion for DNO expansion (to 2030) (dena-VNS, 2012) and ca. €20 billion for TSO expansion (to 2022) (NEP, 2013) to facilitate the energy transition. The numbers for replacement of old assets are higher. Europe overall needs ca. €104 billion for TSO expansion (to 2022) and ca. €140 billion for cross-border E-transmission (incl. offshore) alone (until 2020) (cf. Roland Berger, 2011).

Roland Berger (2011, p. 55) notes that "Smaller TSOs relatively new to the market due to recent unbundling often lack the necessary financing capabilities. They face the challenge of obtaining the required volumes of debt and equity at favourable conditions." and at p. 56: "TSOs with a long history of pure equity financing or which have recently gone through unbundling processes face challenges when it comes to defining a financing strategy for obtaining in the required financial means for planned investments." In all, this report by Roland Berger for the EU commission studies challenges associated with network expansion, focussing on interconnectors and offshore networks. Of the challenges, unbundling is one, albeit a modest one.

What are the arguments on the relation between unbundling and financing capabilities?

The effect of unbundling on credit ratings gives a mixed picture. As mentioned above, Roland Berger points out that smaller unbundled TSOs without credit rating will have a problem with debt financing.

Currently (since the last 2 years), generation is a risky, loss-making business, at least in Germany and immediate neighbours. This is the direct effect of large integration of RES. Having a network provides solid cash-flow and reduces risks. The rate-of return may be low, but it is safe and therefore good for credit rating. If generation is high-profit, high-risk business, the combination with low-risk, low-return network may hinder access to capital. It is sometimes said that the different risk-return profiles of the network vis-a-vis the commercial businesses are a problem for investors, which seek one specific profile rather than the combination. Typically, hedge funds will be interested in the commercial businesses, whereas pension funds will be more interested in the network. On the other hands, we were told that in the customary in the business to have corporate finance strategy: debts and equity is acquired by the holding, which subsequently provides the funds for the departments. This, so the argument goes, is easier for the investors.

Henriot (2013) suggests that there are three basic ways in which TSOs can finance capital expenditure: raising debt, raising internal equity, and raising external equity.

Unbundled TSOs may have difficulty raising equity. The regulated rate-of-return may be adequate for remuneration of existing equity, but does not allow building up of internal equity. Moreover, unbundled TSO cannot ask parent companies for equity. Especially facing

large investment requirements, unbundled TSOs will have to go onto capital market for equity. It may be recalled that E.On sold the gas-TSO to raise equity.

The TSO may have difficulty raising debt as well. Too much debt would negatively affect the credit rating and debt would become more expensive. Roland Berger (2011, p. 48) argues that limitations of Basel II and III for commercial banks further restrict the possibilities for bank-loans, especially with long-term commitment.

In part, network investments are considered risky; we have to distinguish interconnectors and offshore networks from normal onshore network investments. For offshore networks, costs and technology are considered uncertain. In an unbundled context, some of these uncertainties are not internalized. Examples are:

- Liability in case of outages
- Timing of construction vis-a-vis wind parks
- Liability for the case where a planned wind park backs-out and the line investment is stranded.

Typically, these risks would be internalized if the parties where in the same firm. The loss of one part is the gain of the other part. If they are different companies, gains and losses are no longer internalized and we should expect detrimental effects on incentives and actions.

Access to equity may be foremost an ownership issue, as also pointed out by Roland Berger (2011, p. 49). State-ownership stands in the way of effective access to private equity. This is also the TenneT experience, after which the Dutch government decided a part-privatization, to allow TenneT to raise private equity for its offshore projects. 50Hertz has a 40% ownership by the private financial institution IFM and seems to have no difficulty to get equity.

Yet another issue is “access to investors”. As mentioned, the unbundled TSO have difficulty raising internal equity and have to go onto the market for external equity. However, who actually qualifies for providing external equity? Many large financial institutions already own generation assets and would thus, strictly speaking, not be allowed to own transmission-assets. This is a real issue and currently, the EU-commission is making exemptions on a case-by-case basis, loosening the restrictions on unbundling (Findeisen and Koch, 2012). Clearly, the unbundling framework reached its limits.

Overall, financing the necessary investments is an issue, but unbundling is not the major obstacle. There seems to be sufficient capital in the market. Unbundling is an issue and it complicates the problem, but only to a limited extent. More important obstacles to efficient network expansion are the regulatory regime and the permitting issues (cf. Roland Berger, 2011). Henriot (2013) suggests that the financing strategies of TSO cannot substitute fully to an increase in tariffs in order to achieve the whole scale of the investment programs required under the European Commission's Roadmap scenario.

3.3 Cost effects

What do we know about the cost of unbundling? Empirical evidence is still thin, but some insights exist nevertheless. We will discuss these below. Basically, we conclude that the costs of the step from no unbundling to strong ("fat") legal unbundling are high, but the costs of fat legal unbundling to ITO or to ownership unbundling are low.

In the following we distinguish between whole-system costs and corporate costs. Typically, the studies on whole-system costs rely on econometrics and/or benchmarking techniques. Usually these are top-down studies using macro-data. Studies on corporate costs are bottom-up management studies and rely on experience values of different cost items.

System costs (which includes coordination costs):

Increasing system costs due to ownership unbundling may be explained by coordination losses that arise from technological interdependencies between the electricity supply stages. As Joskow and Schmalensee (1983) argue, informational flows may be handled more efficiently within an integrated firm than between a (possibly large) number of separate firms. Given the progress in IT systems, however, it seems that the major concern is rather one of incentives. In case of investments, for instance, separate generators would not take account of network externalities caused by inefficient locational decisions, for instance. Vertical unbundling removes incentives for integrated network planning which would take overall system costs into account (see Baldick and Kahn, 1993; Nemoto and Goto, 2004). The degree of synergy losses by vertical separation depends on how efficiently a decentralized market mechanism can replace firm internal coordination.[11]

[11] For investment coordination, a market-based solution is to implement locational pricing to send efficient long-term investment signals to generators (see Brunekreeft et al., 2005).

Most of the quantitative studies measuring system costs of ownership unbundling are based on cost function estimations. The U.S. electricity market provides excellent data for such studies given its heterogeneous industry structure covering the full range between fully integrated suppliers and different types of ownership or operational unbundling. Several studies have measured vertical scope economies, but only few of them explicitly address transmission unbundling.[12]

Meyer (2012b) estimates a joint cost function for U.S. utilities that distinguishes between the three supply stages generation, transmission, and distribution (supply). Results indicate the existence of vertical economies of scope by showing that total cost do not only depend on the separate output levels on each supply stage but are significantly affected by integrated production across the supply stages. For transmission unbundling Meyer (2012b) finds that total costs may increase by around 5% compared to vertical integration. Meyer (2011) uses a benchmarking approach to analyse cost differences between integrated and separate generators and transmission companies. With 2% on average, these results are somewhat smaller compared to the costs function approach, but they still confirm that unbundling comes at a cost.

Corporate costs

First and perhaps surprisingly, with few exceptions, the companies themselves hardly mentioned cost effects. One TSO mentioned a steep increase of staff following the process towards a fully functioning ITO; however, from a system perspective, this may have been a shift from the parent company to the TSO and thus not a cost-increase for the system overall. Moreover, a significant cost-effect is the duplication of IT systems. As mentioned above, PWC (2012) stressed this exact point, which seems to be confirmed in practice. It was also mentioned that TSOs are small compared to the overall company. In this process the TSO loses bargaining power in procurement: cost increase because of a loss of scale effects. On the other hand, specialization in procurement ("shopping around") brings costs down.

The debate on ownership unbundling of distribution networks in The Netherlands in 2004/5 provides very useful information on the estimated costs because detailed studies were made.

Figure 6 shows the results of an in-depth bottom-up management study by management consultants Deloitte (2005) on the cost-effects of unbundling for the DNO in The Netherlands.

[12] See Meyer (2012a) for an overview of empirical studies on different types of unbundling.

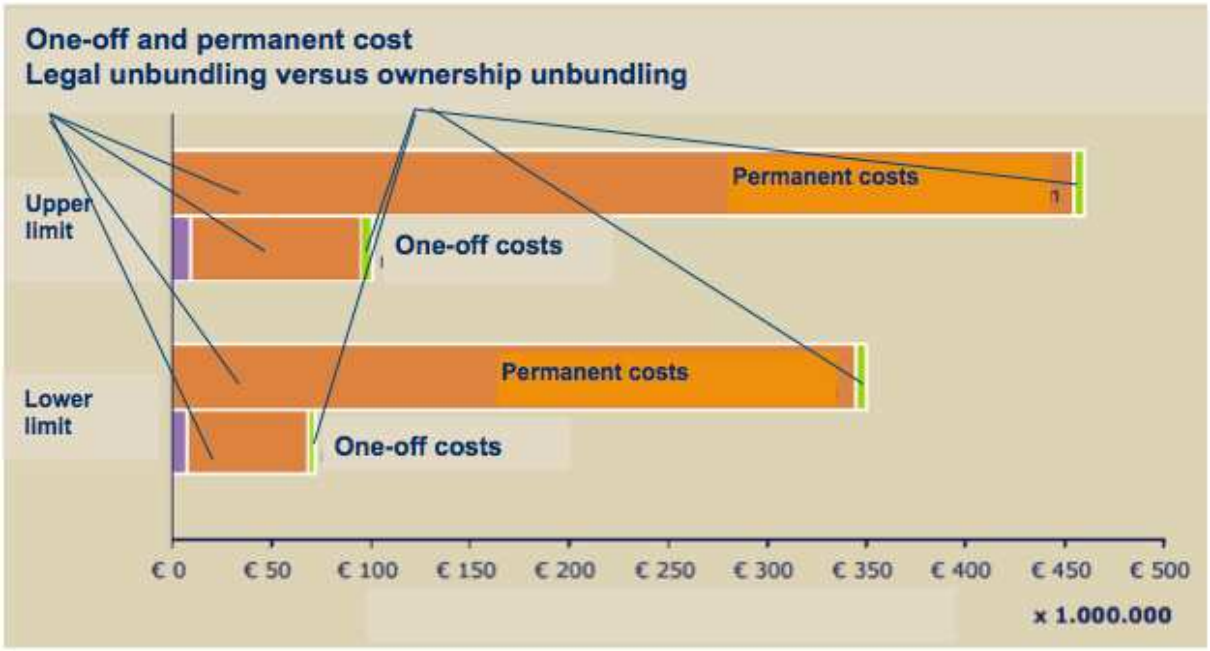


Figure 6: Estimated cost for unbundling of distribution networks in The Netherlands (Deloitte, 2005)

The figure shows "one-off costs" and "permanent (or recurring) costs"; the former occur only once as a results of the reform, whereas the latter are permanent synergy losses and occur each year. Moreover, the cost figure distinguishes between (fat) legal unbundling and ownership unbundling. Lastly, Deloitte estimated a low-cost scenario and a high-cost scenario. One conclusion stands out in particular: the step from no unbundling to (fat) legal unbundling (in orange) is by far more important than the step from (fat) legal unbundling to ownership unbundling (in green). What are these costs? The study by Deloitte (2005, p. 27) goes into detail and suggests that IT seems to be the decisive cost item. We stress that information unbundling is part of legal unbundling and is not unique to ownership unbundling.

3.4 Strategic effects on generation

More competition in generation and wholesale markets has been a primary aim of unbundling policy reforms. The markets were characterized by concentrated markets, relatively high prices and profits and suspected market power. Things have changed recently: Currently, the conventional generators are in major financial distress and wholesale prices and load factor are low. This results in margins which do not recover full costs. Should we thus conclude that unbundling was successful? The immediate answer is no. We cannot conclude that because large-scale RES drives these developments.

There are no obvious direct effects of strong legal unbundling on generation strategies. It seems reasonable to state that the step from no unbundling to (strong) legal unbundling, as preconditions for TPA, did have very significant effects. But once the governance structure is strong legal unbundling, additional steps will achieve little. Non-discrimination had already been secured under legal unbundling and other rules. Delayed network connection has long been a source of discriminatory potential. The obvious argument is that the VIU has an incentive to delay network connection of competitors. The problem was solved by law in 2007 (*KraftNAV*). No formal complaints about delayed network connections were reported since. Wholesale markets (spot, OTC and financial) have been liquid and have worked well for a long time with the 3rd Directive not affecting this. It would be reasonable to claim that legal unbundling, supported by other acts, like the *KraftNAV* and by institutions like a powerful, independent regulator, already curbed discriminatory incentives. The EU commission may be correct if it states that without ownership unbundling the incentives are still there, but apparently the restrictions under strong legal unbundling can effectively curb strategic interaction.

There may be indirect effects of unbundling on generation strategies though. As already mentioned, unbundling can affect overall credit rating and profitability and thus the options to raise debt and equity. In the past, generation was a (relatively) high-profit, high-risk business compared to the network. For some investors, this may have been an awkward combination and selling the network may have improved the rating indicators. Currently, the commercial businesses are doing very poorly. Owning a network with a secure steady revenue stream actually improves credit ratings. A further indirect effect is that in a setting with ownership unbundling, generation and transmission have standing-alone strategic goals. It is unclear however how this works out.

In the midst of financial difficulties in generation business, there would be a radical shift in generation business strategy in the future. A report from Energy Post revealed the discussion of a new strategy of RWE, one of the major German power producers[13]. According to the report, RWE has decided to depart from its traditional business model based on large-scale thermal power production and to become an "enabler" in the renewable energy sector. Although it is not yet certain if this kind of radical change in business strategy becomes mainstream, the impact of unbundling on generation strategy may ultimately depend on the success of such new business model.

[13] "Exclusive report: RWE sheds old business model embraces energy transition" *Energy Post*, October 21, 2013.

As mentioned above, the wholesale market in Germany and thereby in neighbouring countries, are under severe pressure. The large-scale integration of RES starts to burden the markets. The effects run through two channels: 1) the merit-order effects pushes conventional plant out of the market and brings prices down, and 2) RES comes onto the market as additional capacity and creates excess capacity, which in turn creates more severe competitive pressure.

Figure 7 shows the generation shares of the big four versus other firms and versus RES. The steady decline of the position of the "big 4" is evident.

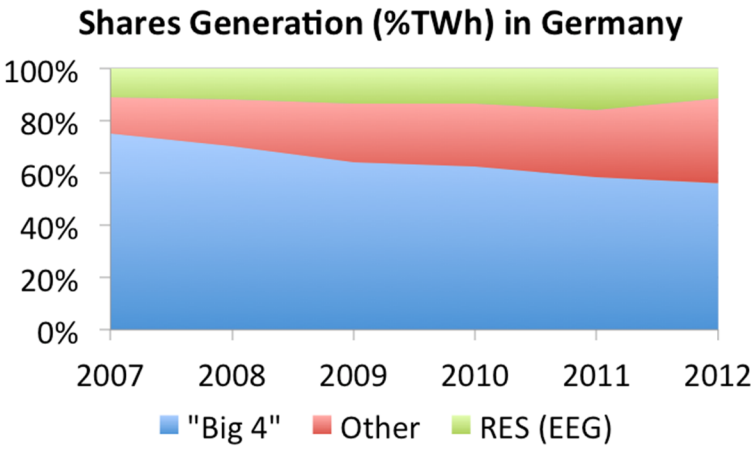


Figure 7: Shares in generation (%TWh) in Germany.

As gets clear from figure 8 below, the cumulative capacity (in GW) is still more or less the same, but given new, independent capacity, the dominant position declines. This is a controversial issue. For example, the regulator (BNetzA, 2012) tends to argue that RES is not part of the market and should be excluded from market power analysis. If doing so, CR4 still looks rather high and following conventional wisdom we would have to expect market power. This is in sharp contrast to current developments on the market though. We argue that market power is determined to a large extent by the relation of total available capacity versus load.[14] If available capacity is high compared to load, we expect strong competitive pressure and reverse. From this perspective, RES creates strong competitive pressure.

[14] The reader may recognize the so-called "Residual Supply Index" approach.

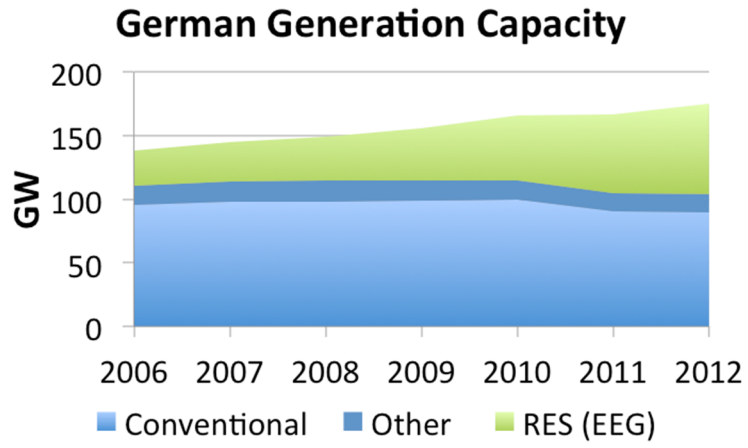


Figure 8: Generation capacity in Germany.
Note: load is approximately 80GW.

The difficulty of current conventional capacity is illustrated well by the following two figures. First, figure 9 shows the indexed energy prices in Germany. These include, gas, coal and electricity wholesale price. The figure indicates that especially gas prices have risen from 2009 to 2013 quite significantly, coal moderately while the wholesale power price remained more or less constant. Clearly thus, gas fuelled power plants have faced decreasing margins.

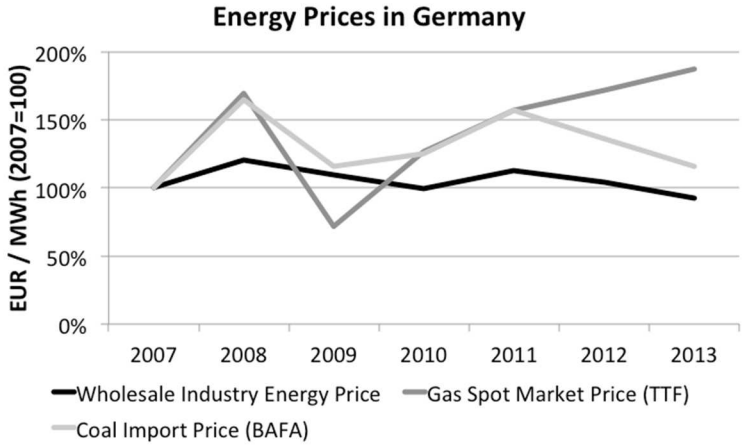


Figure 9: Energy prices in Germany
Note: Indexed with 2007=100.

Second, figure 10 shows the load factors of lignite, hard coal and gas-fired power plant in Germany, indexed at 2006. The rapid and significant decline of the load factor of especially gas is striking: gas suffers from large-scale integration of RES. The load-factor of coal started to decline as well, but is restoring lately. Figure 10 also shows that the load factor of lignite is relatively stable and actually slightly increasing lately. Lignite and coal compensate for the nuclear phase-out. Moreover, due to low wholesale power prices and low CO2 prices, Germany has become net exporter, which is mainly lignite, but lately also coal.

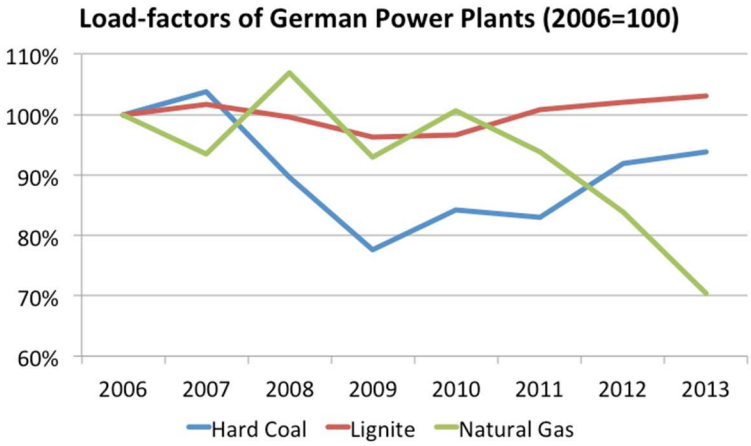


Figure 10: Load-factors of power plants in Germany
Note: Indexed with 2006= 100.

To conclude, conventional capacity has a difficult time because of large-scale integration of RES. The merit-order effect and excess capacity suppress wholesale power prices. Especially gas-fuelled plant suffers from low margin and low load-factors.

Why are capacity mechanisms discussed?

The recent discussion on market design is mainly driven by generation adequacy: first, reserve for large-scale intermittent RES and second, the financial pressure on conventional power plant, as explained above. The concern that energy markets may not provide enough revenues to ensure an optimal level of generation investment has become known as the "missing-money problem" (see Cramton and Stoft, 2006). In energy-only markets, generators are remunerated only for electricity produced and sold to the market, while there are no explicit payments for capacity reserves needed to back-up exceptional supply or demand situations. The rapid growth in electricity supply from renewable energy sources (RES) has further fuelled the discussion for two reasons. First, RES supply is highly intermittent and therefore reinforces the need for reliable and flexible back-up capacity to compensate for shortfalls in renewable generation. Second, RES capacity is characterized by low marginal cost. Hence, the higher the share of RES capacity in the market, the more often are electricity market prices determined by the low energy bids from wind and solar power producers. This reduces margins for conventional generators, notably for reserves whose remuneration depends on price spikes during short scarcity periods.

In case of Germany we observe that investment plans for conventional generators are abolished, and even existing plants are being shut down due to low margins. Although there is

still excess capacity in the German electricity market, empirical studies show that the reserve margin will decrease from 2016 onwards (see Brunekreeft and Meyer, 2013). This raises the question of how times with low sun and wind power production will be compensated in the future to avoid costly power interruptions. The solution may be a capacity mechanism, which provides payments for available capacity (in addition to energy-only payments) in order to directly reward capacity reserves. Such systems seem to work well in several U.S. markets as well as in some European markets. Several studies discuss the pros and cons of different forms of capacity mechanisms (see e.g. Brunekreeft et al., 2011). A question that still needs to be analysed in more detail is which effects capacity mechanisms have on neighbouring countries within the European context. In other words, do capacity mechanisms favour or harm the idea of an internal European energy market?

3.5 Productivity and financial results

This section reviews productivity and financial performance of the four big energy companies. First we review labour productivity, followed by analysis of the major (consolidated) financial ratio, ROA (Return of Assets) and an enterprise value before and after the liberalization from 2000 to 2012. Then we focus on the other performance ratios/measures in recent five years.

Table 1, Figures 11 and 12 indicate trends of revenue and a number of employees in terms of the four companies from 2000 to 2012. There is an apparent trend that revenue increases during the period for all companies, whereas the number of employees decreases with the exception of Vattenfall. It suggests that there has been an increase in labour productivity under the progress of market liberalization, which is presented in Figure 13 below. More precisely, labour productivity of RWE, EnBW and Vattenfall seems to have increased steadily. E.On is a special case. Since a couple of years, E.On has followed a strategy of selling subsidiaries (among which the gas- and power-TSO, but also the ordered sale of 5 GW generation assets). The company needed to raise equity and reduce debt. In addition, since 2010, focus away from the European market towards emerging markets became the company's policy. This explains the rapid (but temporary) increase in revenues and the steep decrease of the number of employees.

Table 1: Trends of revenue and number of employees of four big utilities in Germany

Company	2000	2005	2010	2012
	Revenue			
E.ON	71,344	51,616	105,346	142,938
EnBW	6,420	11,617	18,368	20,318
RWE	45,475	40,509	51,998	50,771
Vattenfall	3,578	13,758	23,680	19,508
	# of Employees			
E.ON	166,183	79,570	77,173	65,778
EnBW	33,940	17,764		18,912
RWE	152,132	85,928	70,856	70,208
Vattenfall	13,123	32,321	40,363	

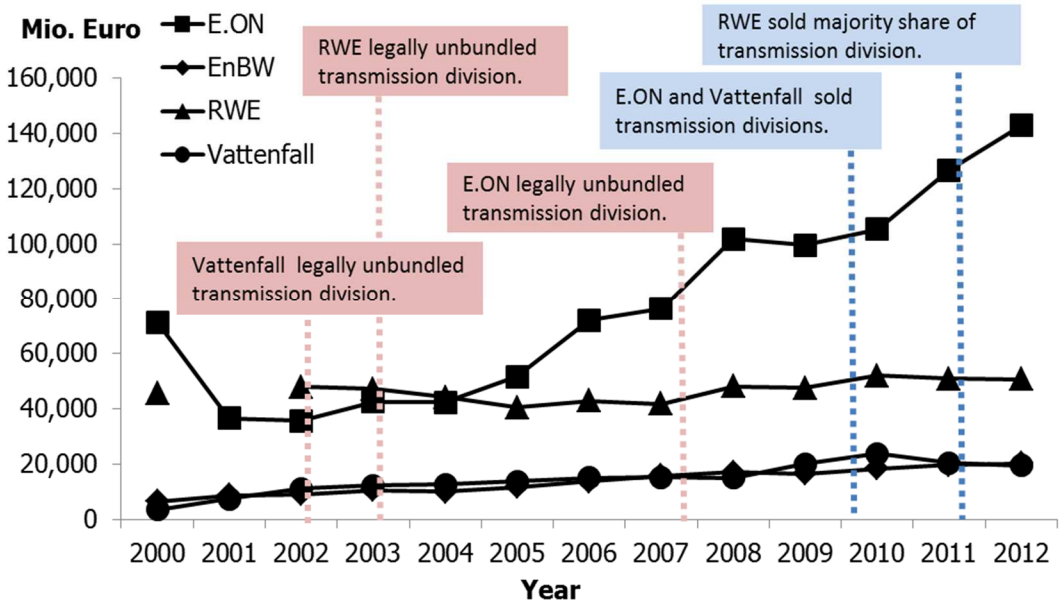


Figure 11: Trend of revenue

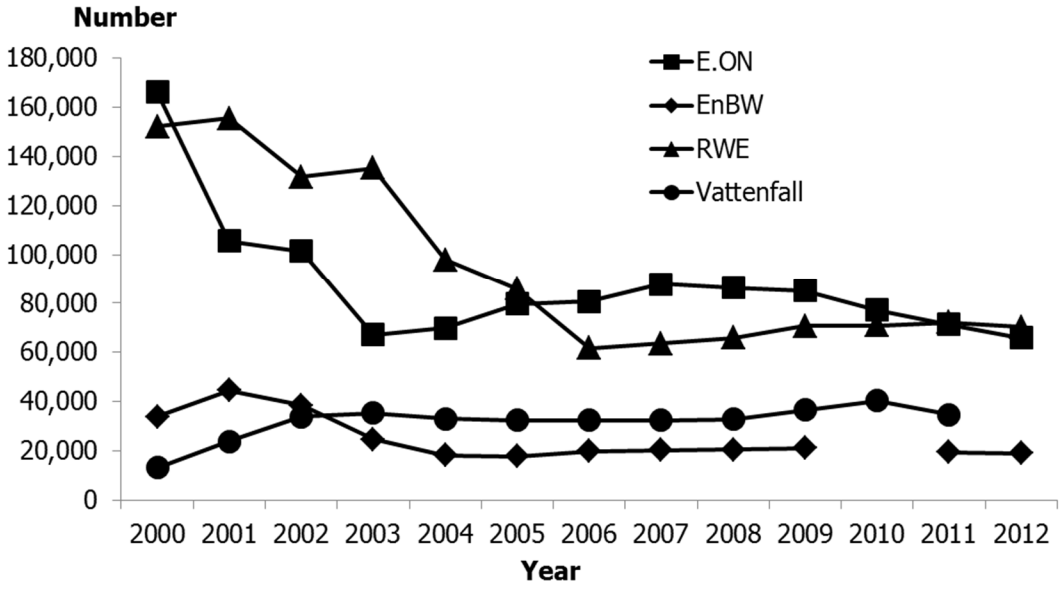


Figure 12: Trend of number of employees

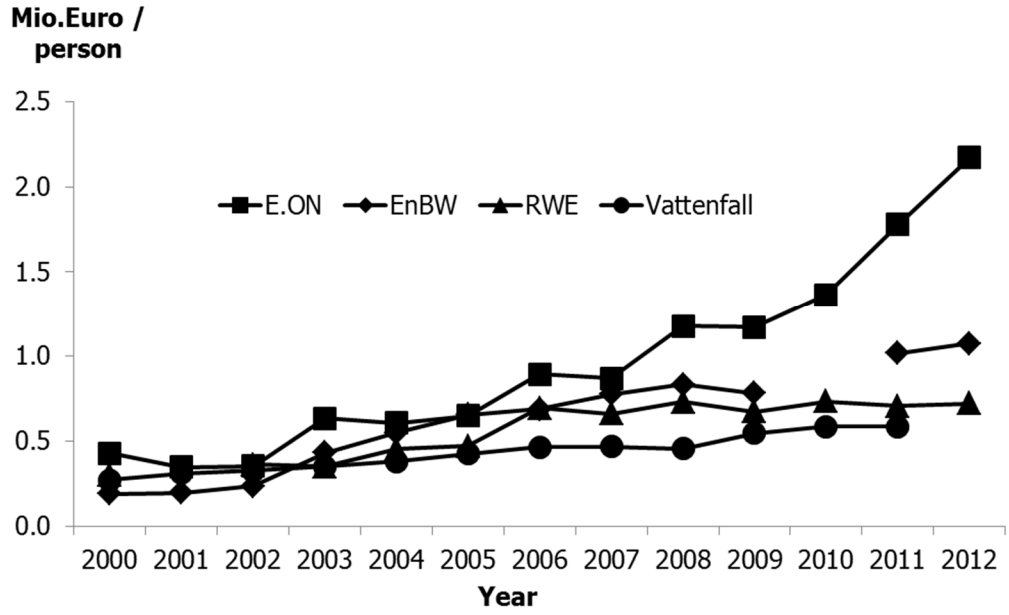


Figure 13: Trend of labour productivity

Figure 14 describes a trend for return on assets (ROA) for the four companies. The trends of RWE and E.ON show some up and down, but the degrees of the ratio did not change significantly over the period. That is, the degrees are stable in the long run even after the market liberalization.

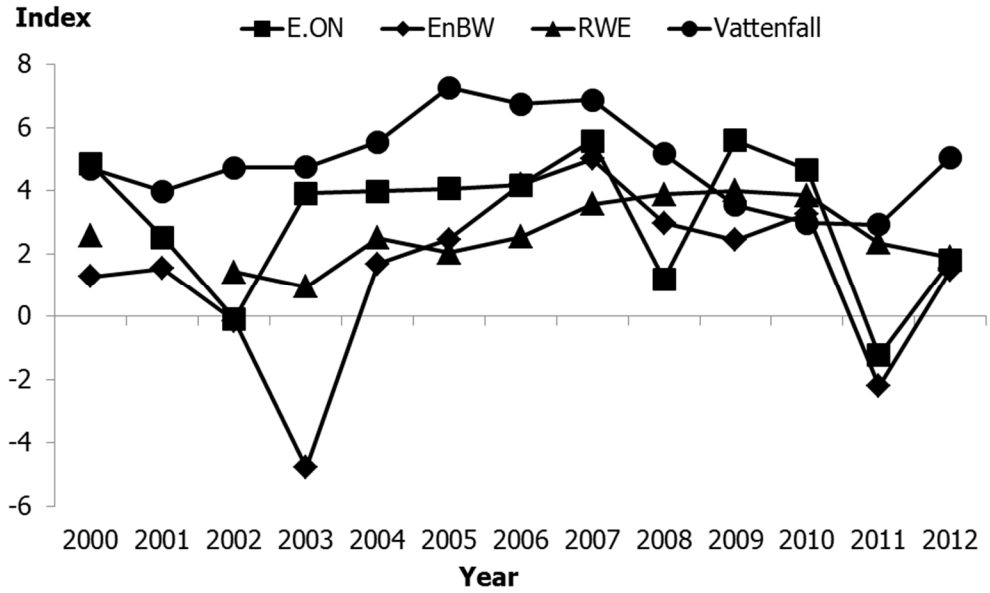


Figure 14: Trend of ROA

In addition, Figure 15 describes a trend of enterprise value of the companies. Note that the data are not available for Vattenfall because the company is owned by Swedish government. There

was a peak increase toward 2007 and a decrease since then in the value of E.ON. The enterprise value decreased over the period from approximately 61,775 million Euro in 2000 to 48,517 million Euro in 2012. It indicates the point made previously. E.On has been following a strategy to sell subsidiaries and other assets. However, the other two companies gradually increased their enterprise values over the period. This may be a result of increased efficiency after the liberalization, but the effect is not as large as it would be expected from the trend of the labour productivity that was presented above.

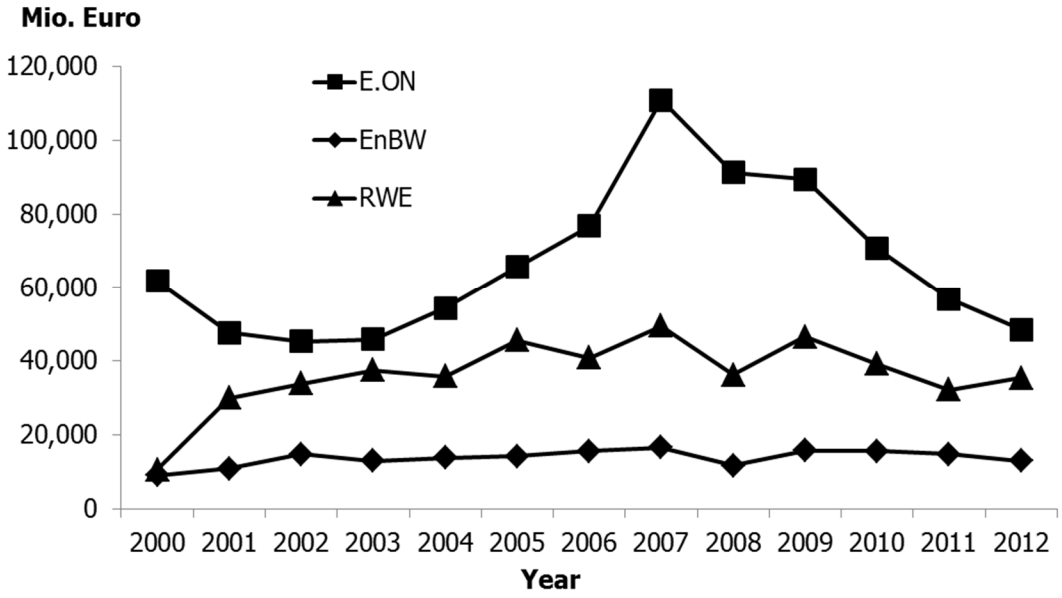


Figure 15: Trend of Enterprise Value

Next we review recent financial performance ratios/measures. First, figure 16 depicts a recent trend of EBITDA-Margin.[15] The EBITDA-Margin measures profitability of the company that accrued by the main business from 2008 to 2012. The figure shows that only Vattenfall increased the EBITDA-Margin over the period, while the other three German-based companies resulted in the decrease in the margin. In particular, E.ON largely decreased the margin by half with approximately 6.5% point drop from 2008: E.On sold businesses which increased (one-time) revenues, while EBITDA dropped. Although the other two companies, RWE and EnBW, decreased it by approximately 4% point, the number was relatively modest compared to that of E.ON.

[15] To be precise: EBITDA-margin is "earnings before interest, taxes, depreciation and amortization" over "revenues".

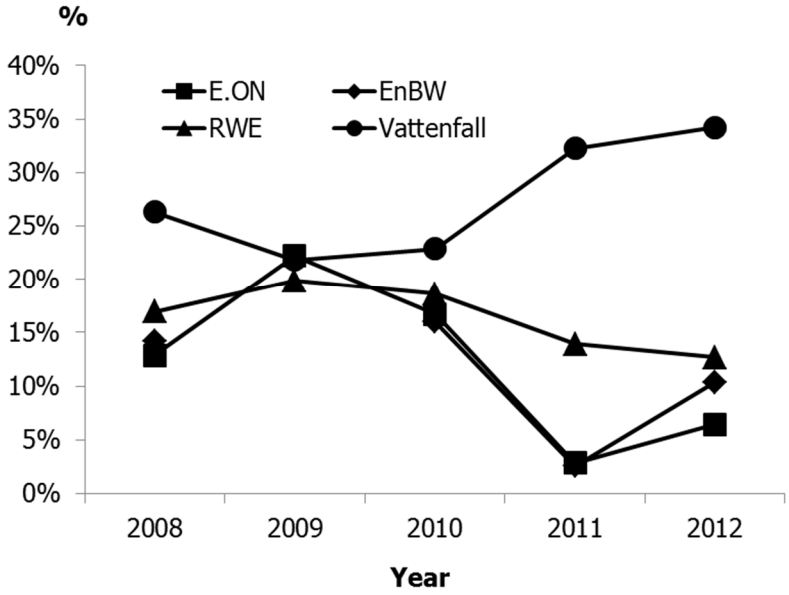


Figure 16: Recent Trend of EBITDA-Margin

Figure 17 describes the capital structure of the companies measured by the ratio of total liabilities to total assets. The higher the ratio, the more company relies on debt for funding.

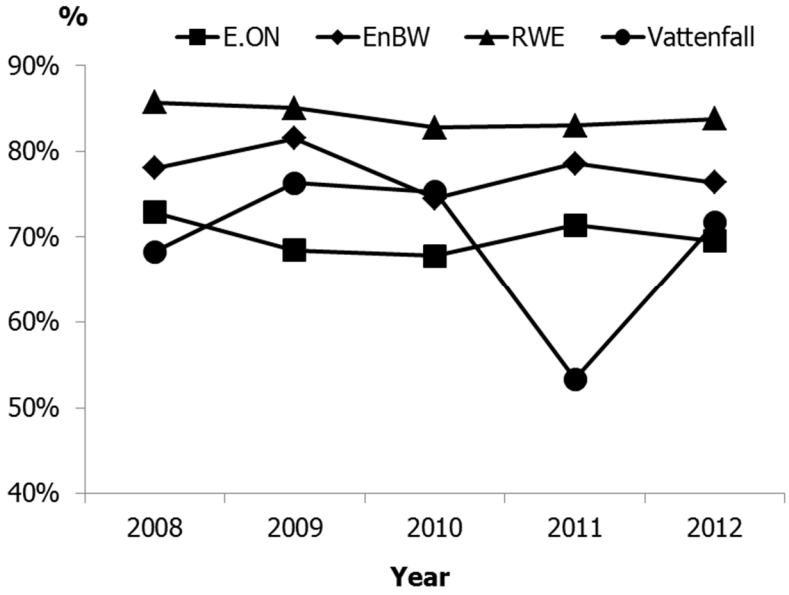


Figure 17: Trend of ratio between total liabilities and total assets

From Figure 17, RWE highly relies on debt for the funding compared to the other three companies, while E.ON is relatively low on the ratio. We can easily imagine that RWE faces strong financial constraints by the debt and their demand for fund was higher among the four companies.

Overall, EnBW is very stable in most of financial ratios/measures, while the other companies, particularly E.ON, are much more volatile. RWE relies more on debt financing for investment.

Overall, generation has long been the cash-cow of the sector. Wholesale prices have long been reasonably high and conventional power plants were largely depreciated. It seems that liberalization and unbundling did not have major detrimental effects on profitability. Presumably, more intense competition was matched with productivity increases. During the last 2 years the picture changed: large-scale integration of RES does have a major impact. Higher penetration of renewable generation into the wholesale power market pushes fossil-fuel power generation out of the market, consequently the profitability of the fossil-fuel power plants decrease in Germany and the other European countries. Unfortunately, consolidated data are not yet available. A recent investors' presentation by RWE (March 4th, 2014) illustrates the problem well. The picture may be representative for the other major utilities heavy in conventional generation assets.

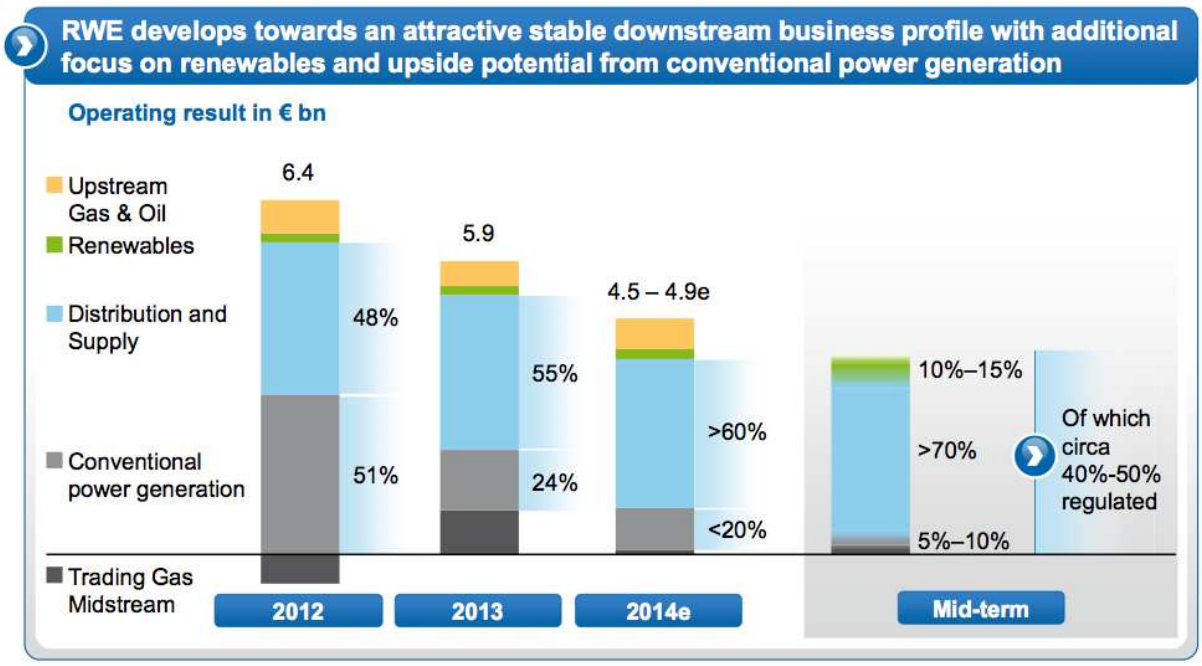


Figure 18: RWE's mid-term outlook.
Source: RWE Investors' Presentation; March 4th, 2014.

Figure 18 indicates RWE's midterm strategy. Strikingly, conventional generation is already declining steeply and will almost completely vanish. Also we see that RES will not compensate for this. Instead, distribution and supply (notably not transmission) will become core-business.

As retail is relatively small in operating result, the future core business is the distribution network.

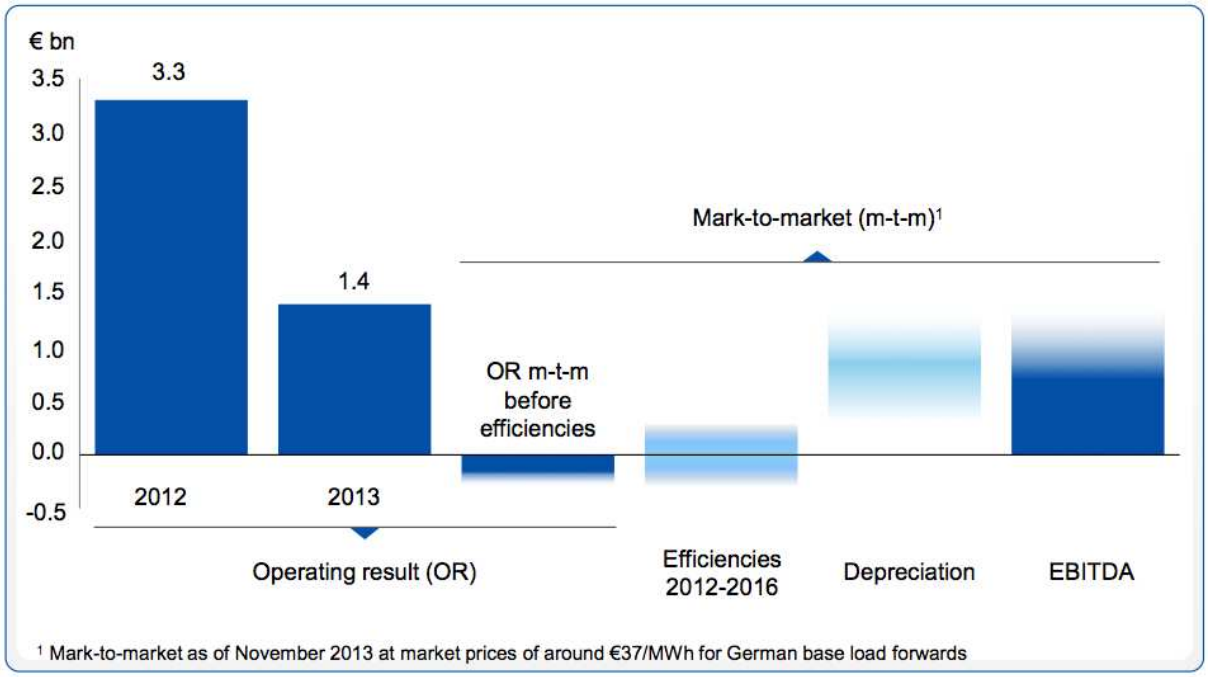
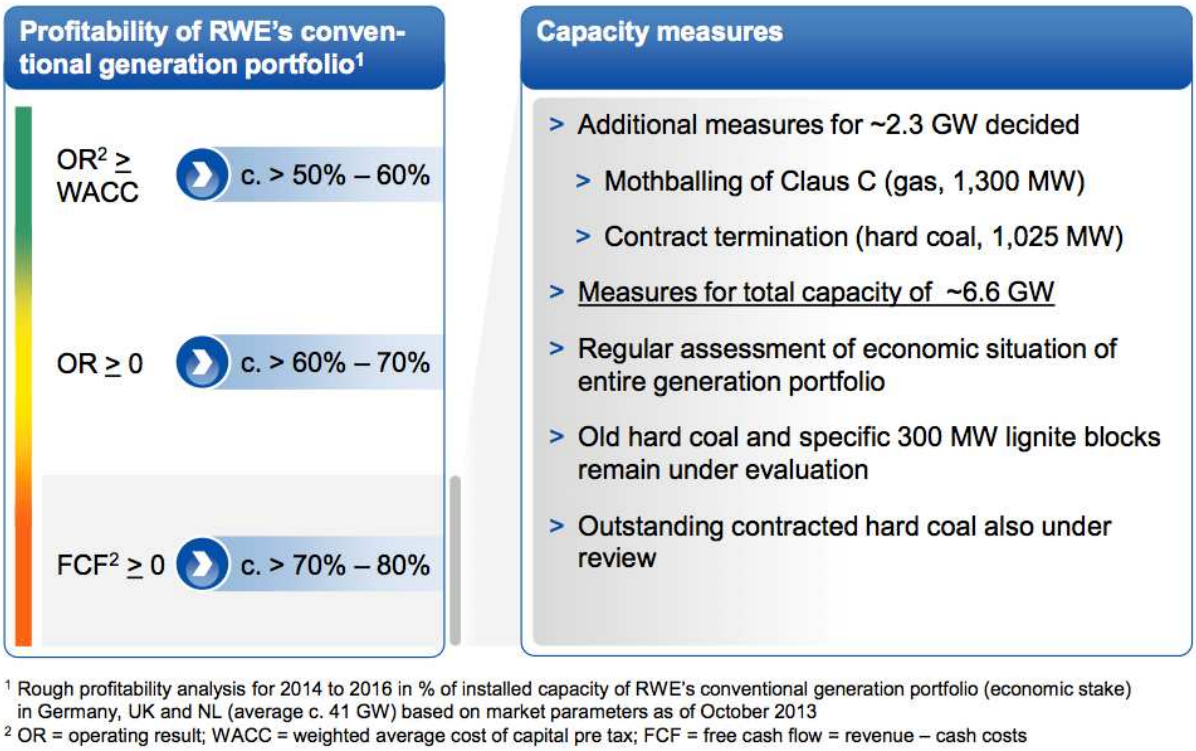


Figure 19: Conventional power generation: a mark-to-market perspective
Source: RWE Investors' Presentation; March 4th, 2014.

Figure 19 shows that the operating results in 2013 heavily dropped as compared to 2012. There is no contribution to the capital costs. If nothing changes in governmental energy policy, this trend is likely to continue in the near future. Note how RWE calculates with a base price of €37/MWh.



[1] Rough profitability analysis for 2014 to 2016 in % of installed capacity of RWE's conventional generation portfolio (economic stake) in Germany, UK and NL (average c. 41 GW) based on market parameters as of October 2013
[2] OR = operating result; WACC = weighted average cost of capital pre tax; FCF = free cash flow = revenue – cash costs

Figure 20: RWE's generation assets under review.
Source: RWE Investors' Presentation; March 4th, 2014.

Lastly, figure 20 gives an indication of the profitability of the generation assets. Only half the assets reach a rate of return above WACC. 30% does not reach a positive operating result, and 20% does not reach of positive free cash flow; the latter are being closed and/or mothballed. It is safe to conclude that conventional generation in Germany is having a hard time.

4 Conclusions

This report studies the experiences with TSO unbundling in Germany, five years after the 3rd European Electricity Directive. The research relies predominantly on interviews with sector experts, mainly form the German utilities. Additional information stems from the literature. The study makes two major conclusions. First, the major step in the unbundling process is from "lean legal unbundling" to "fat legal unbundling". Additional steps beyond that are small both in benefits and in costs. Second, the benefits of unbundling in term of increased competition do not come for free: unbundling is costly and it is important to balance cost and benefits in the reform process.

Section 2 of the report discusses in detail the route towards unbundling in Europe from the 1st EU Directive of 1996 to the 3rd EU Directive of 2009 to now, and the implementation in

Germany. We stress two major points. First, the key step in the unbundling process is not full ownership unbundling, but somewhere in the process of legal unbundling. Legal unbundling is a grey area where details matter decisively. The figure below depicts the situation.

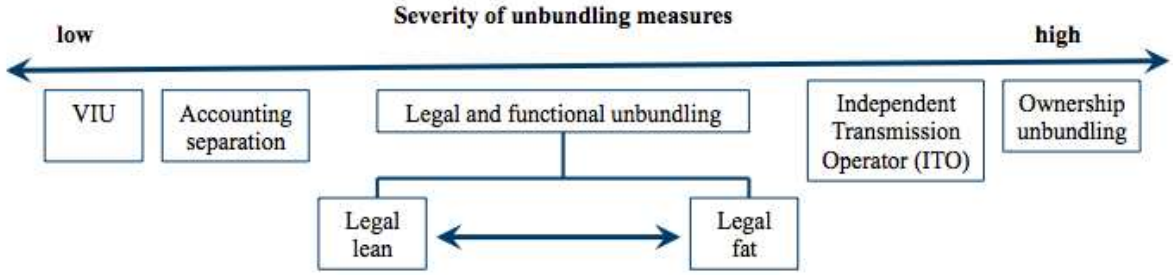


Figure 21: Overview of unbundling steps
Source: authors

If legal unbundling is very strict ("legal fat"), the additional steps towards an ITO or FOU are small both in terms of costs and benefits. As CPB (2004, p. 73) states nicely: "Therefore, when comparing the (…) policy options, the main cost of losing economies of scope arises with introducing a proper task allocation when moving from Legal-Lean to Legal-Fat. (…) Additionally, ownership unbundling adds only small extra cost."

The second key point follows immediately: the strategies of the companies whether to sell or keep the TSO are very different. The German government formally opted for the ITO approach as a minimal requirement. Four formerly vertically integrated utilities had to fulfil the requirements of the ITO approach, but were free to go beyond this and sell the TSO if so desired (voluntary ownership unbundling). Ownership unbundling is not mandatory. We discussed and evaluated the strategies of the four VIUs, which are very different. Two are now ownership unbundled (Vattenfall and E.On), a third only holds a (decisive) minority share in the TSO (RWE), while the fourth (EnBW) still holds 100% share of the TSO and is a genuine ITO.

To assess the impact of unbundling, we make the following main conclusions:

- Unbundling balances between competition and coordination. When we split up an interactive value chain, we must expect coordination problems to arise. Limits to unbundling or even re-integration to some extent may be one approach to resolve the dilemma. Another approach would be to promote market mechanisms to take over the coordination task: network pricing (including revenue sharing models and contracting) should have high priority.

- Investment requirements are currently huge. Financing the necessary investments is an issue, but unbundling is not the major obstacle. There seems to be sufficient capital in the market. Unbundling is an issue and it complicates the problem, but only to a limited extent.
- The costs of unbundling (both system- and corporate-cost) can be substantial and can easily offset potential benefits. At least, it is important to make a careful cost-benefit analysis of the steps in the unbundling process. Importantly, the major costs are incurred with the step from lean legal unbundling to fat legal unbundling. Additional costs as well as additional benefits beyond that are small. The main important source of costs is IT: implementing the firewall.
- In the value chain, generation suffers currently. Generation has long been the cash-cow of the sector: wholesale prices have long been reasonably high and conventional power plants were largely depreciated. It seems that liberalization and unbundling did not have major detrimental effects on profitability. Presumably, more intense competition was matched with productivity increases. During the last 2 years the picture changed: large-scale integration of RES does have a major impact. Large-scale integration of RES decreases the load-factor of conventional power plants and suppresses wholesale prices. It is safe to say, that conventional generation in Germany is currently having a hard time. Interestingly, because of the bleak outlook for conventional generation, the networks have regained the companies' interest. Only recently, the companies focussed on high-profit, high-risk generation and not on low-profit, low-risk networks. This is changing: the networks generate cash flow and are good for credit ratings.

What are next steps in the debate in Europe and in Germany? We observe that the debate in Brussels is intensifying on the *distribution* network level. Large-scale integration of decentralized RES at distribution level increases commercial interests at DSO-level (the "competition" aspect) and strengthens the need for coordination of the network and the network users, especially feed-in (the "coordination" aspect). It appears though that the debate is moving away from the rather one-dimensional choice of *how much* unbundling would be good, towards *alternative* models to achieve a better balance between competition and coordination.

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