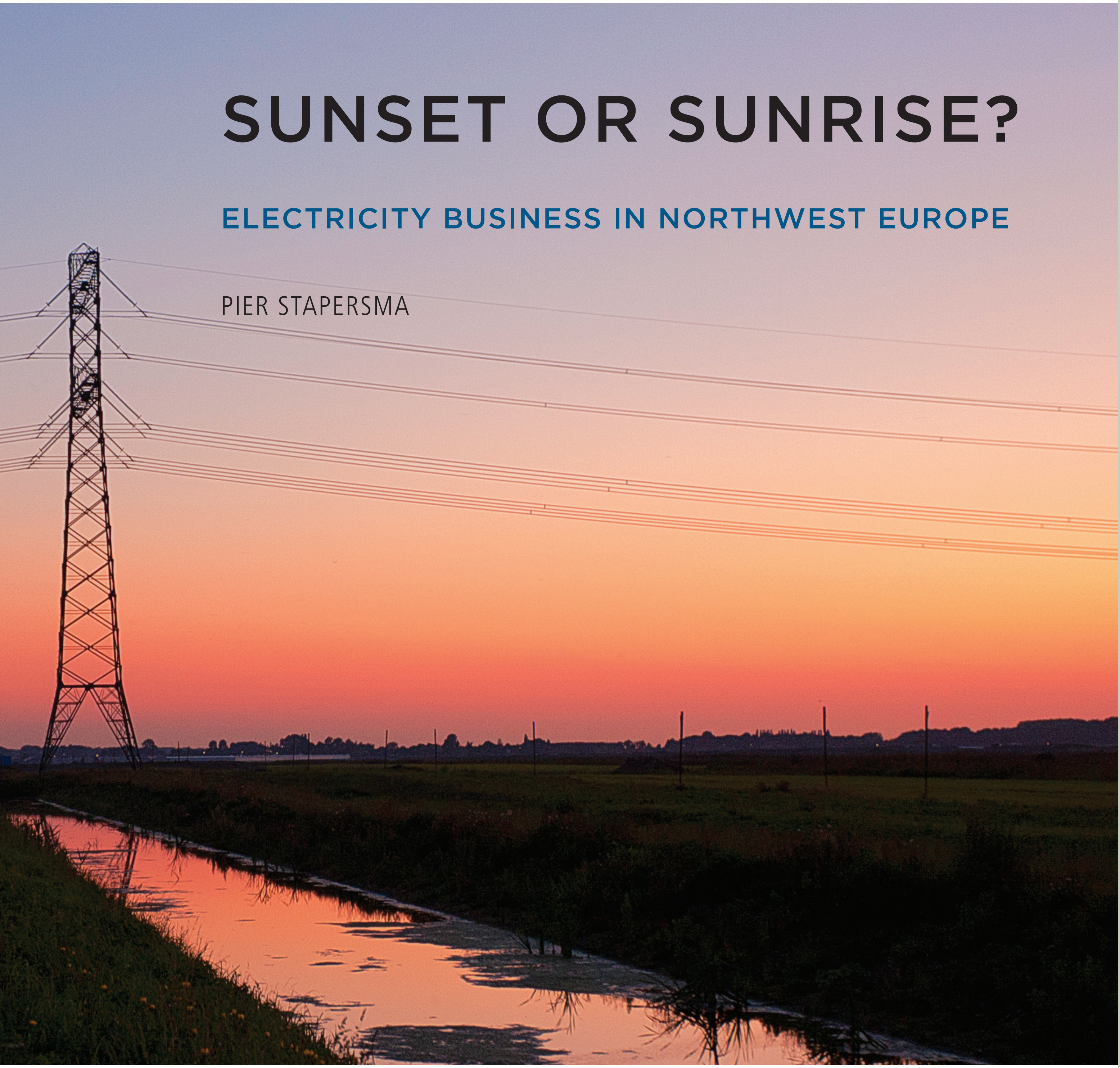
CLINGENDAEL
INTERNATIONAL
ENERGY
PROGRAMME
CIEP

SUNSET OR SUNRISE?

ELECTRICITY BUSINESS IN NORTHWEST EUROPE

PIER STAPERSMA



CIEP PAPER 2014 | 03

CLINGENDAEL
INTERNATIONAL
ENERGY
PROGRAMME

CIEP

CIEP is affiliated to the Netherlands Institute of International Relations 'Clingendael'. CIEP acts as an independent forum for governments, non-governmental organizations, the private sector, media, politicians and all others interested in changes and developments in the energy sector.

CIEP organizes lectures, seminars, conferences and roundtable discussions. In addition, CIEP members of staff lecture in a variety of courses and training programmes. CIEP's research, training and activities focus on two themes:

- European energy market developments and policy-making;
- Geopolitics of energy policy-making and energy markets

CIEP is endorsed by the Dutch Ministry of Economic Affairs, the Dutch Ministry of Foreign Affairs, the Dutch Ministry of Infrastructure and the Environment, BP Europe SE- BP Nederland, Delta N.V., GDF SUEZ Energie Nederland N.V., GDF SUEZ E&P Nederland B.V., Eneco, EBN B.V., Essent N.V., Esso Nederland B.V., GasTerra B.V., N.V. Nederlandse Gasunie, Heerema Marine Contractors Nederland B.V., ING Commercial Banking, Nederlandse Aardolie Maatschappij B.V., N.V. NUON Energy, TenneT TSO B.V., Oranje-Nassau Energie B.V., Havenbedrijf Rotterdam N.V., Shell Nederland B.V., TAQA Energy B.V.,Total E&P Nederland B.V., Koninklijke Vopak N.V. and Wintershall Nederland B.V..

CIEP Energy Papers are published on the CIEP website: www.clingendaelenergy.com/publications

TITLE
Sunset or Sunrise?

SUBTITLE
Electricity Business in Northwest Europe

AUTHOR
Pier Stapersma

COPYRIGHT
© 2014 Clingendael International Energy Programme (CIEP)

NUMBER
2014 | 03

EDITOR
Deborah Sherwood

DESIGN
Studio Maartje de Sonnaville

PUBLISHED BY
Clingendael International Energy Programme (CIEP)

ADDRESS
Clingendael 7, 2597 VH The Hague, The Netherlands
P.O. Box 93080, 2509 AB The Hague, The Netherlands

TELEPHONE
+31 70 374 66 16

TELEFAX
+31 70 374 66 88

EMAIL
ciep@clingendaelenergy.com

WEBSITE
www.clingendaelenergy.com

SUNSET OR SUNRISE?

ELECTRICITY BUSINESS IN NORTHWEST EUROPE

PIER STAPERSMA

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

CAPEX	Capital Expenses
CCGT	Combined Cycle Gas Turbine
CRM	Capacity Remuneration Mechanism
DSO	Distribution System Operator
EU	European Union
EU ETS	European Union Emission Trading Scheme
EUA	European Union Allowance
GW	Gigawatt
ICT	Information and Communication Technology
kW	Kilowatt
kWh	Kilowatt-hour
MW	Megawatt
MWh	Megawatt-hour
RES	Renewable Energy Sources
PV	Photovoltaic
TSO	Transmission System Operator
TWh	Terawatt-hour
UK	United Kingdom
US	United States

EXECUTIVE SUMMARY

The decarbonization agenda presently shapes business activity in the Northwest European electricity sector. With the embrace of decarbonization targets, the need for changes to the market design as well as for new utility business models is increasingly recognized. This report reflects on recent developments in the electricity sector and explores how the business logic and business models of incumbents are affected. It aims to contribute to the industry-wide process of rethinking market designs as well as utility business models, by providing insights into the complexities and challenges associated with it.

There have been transitions in the electricity mix in the past, most notably in national mixes. The process that is regularly referred to as transition may in fact be never-ending, as it is shaped by continuously changing societal demands on the electricity system. This is relevant for business in the electricity sector, because electricity markets are often strongly regulated markets.

As a result of the introduction of variable generation from Renewable Energy Resources (RES), the business logic for conventional generation has changed. With the increase of overall investment risks, the relative advantage of less capital-intensive new-built generation plants, such as gas-fired power plants, over more capital-intensive alternatives emerges. In the current market this seems counter-intuitive because many existing gas-fired power stations are being mothballed, while new coal-fired stations are coming on stream. Furthermore, subsidies as an indispensable driver for investment in RES can be expected to continue, challenging the major utilities to consider such income streams as part of their business models. Subsidy-averseness has implications for business model preferences. Apart from changes in supply, electricity consumers have become a heterogeneous group of electricity system clients who can seek services from other parties to make their activities work. As a consequence, the logic of having a vertically integrated business model in the Northwest European electricity sector could become weaker, especially given the currently stressed balance sheets among electric utilities.

Strategic responses can be expected to differ from one utility to another. The general picture that emerges is that generation-based business models in Northwest Europe have essentially become riskier, while there is a growing need for more services.

Consequently, the emphasis can be expected to shift towards service-oriented business models. The implications of such a shift are yet unclear. What is clear is that electricity generation and investment in new generation capacity continues to be needed and that a business model can only be successful as long as it fits in the electricity market design; here lies a shared responsibility for the public and private sectors.

Three high-level business models are sketched in this paper, and one 'alternative outcome'. The latter outcome is not so much the result of shifting business model preferences, but rather, it could emerge from the threat of a crucial utility default. The 2002 events surrounding British Energy in the United Kingdom are illustrative. If an electric utility's business model collapses while its generation assets are essential for the electricity system to function, the state may have to come to rescue.

Last, it is important to stress that decarbonization policies cannot be based solely upon the single component of introducing new supplies and technologies to the market; decarbonization policies should also provide a framework for assets and infrastructures that are vital for system adequacy and security of electricity supplies during the transition phase.

1 THE DECARBONIZATION AGENDA FOR ELECTRICITY

Transitions in the power sector have occurred before. In that respect, the current decarbonization agenda is not unique. In the United Kingdom (UK), the dash-for-gas greatly changed the power generation mix during the 1990s[1]. In France, the Mesmer plan, which implied a rapid introduction of nuclear power, effectively decarbonized the power sector, with carbon intensity falling some 80% over a 10-15 years period, illustrated in Figure 1. Presently, the power generation capacity mix is changing fast in the United States (US), with gas-fired capacity additions being dominant over coal-fired additions[2], which could be the start of a dash-for-gash as a result of abundant domestic (unconventional) gas supplies.

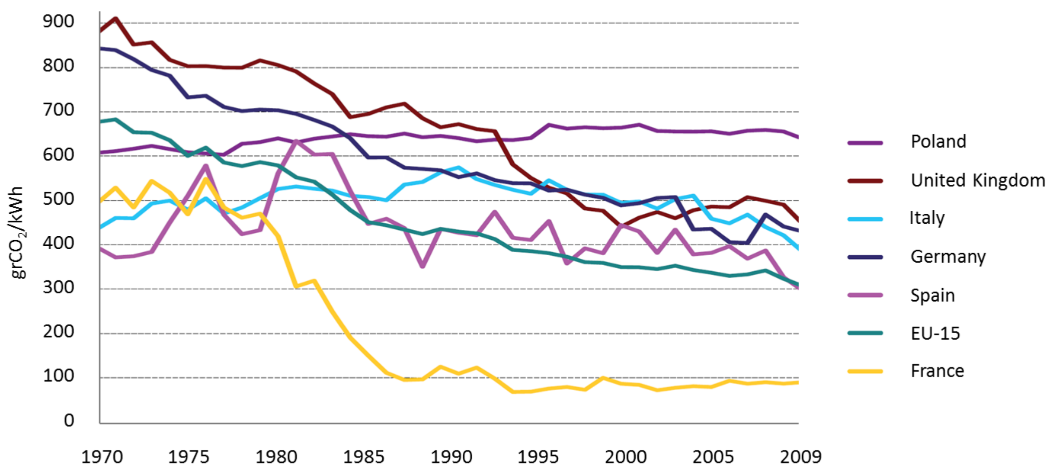


FIGURE 1. CARBON INTENSITY OF ELECTRICITY GENERATION (GR/KWH)[3]

1 UK Energy Research Centre (2012), Case Study 9 - The Development of CCGT and the 'Dash for Gas' in the UK Power Industry (1987-2000), www.ukerc.ac.uk/support/tiki-download_file.php?fileId=2325, retrieved on 20 March 2014. See also Figure 15 in Appendix A.

2 U.S. Energy Information Administration (2013), Annual Energy Outlook 2013 - With Projections to 2040, http://www.eia.gov/forecasts/ieo/pdf/0484(2013).pdf, retrieved 21 January 2014. See also Figure 16 in Appendix A.

3 Ministère de l'Écologie, du Développement durable et de l'Énergie (2012), Chiffres clés du Climat – France et Monde – Edition 2013, http://www.developpement-durable.gouv.fr/IMG/pdf/Rep_-_Chiffres_cles_du_climat.pdf, retrieved on 21 January 2014.

The European-wide decarbonization agenda has features in common with some of these examples, but it also differs greatly. It is strongly policy-driven, like the Mesmer plan in France[4]. Very different from the Mesmer plan, however, is that the current changes are taking place in liberalized markets. Moreover, the present transformation of the European electricity system does not focus solely on decarbonization, but includes additional objectives, most notably the introduction of generation from variable Renewable Energy Sources (RES). In this respect, consider Figure 2 for a range of decarbonization scenarios put forward by the European Commission, which all include generation from variable RES. This leads to a mix of features that can be considered challenging: the European decarbonization process is a policy-driven transformation of the electricity system in liberalized markets, in which electricity generation from (variable) RES plays an important role.

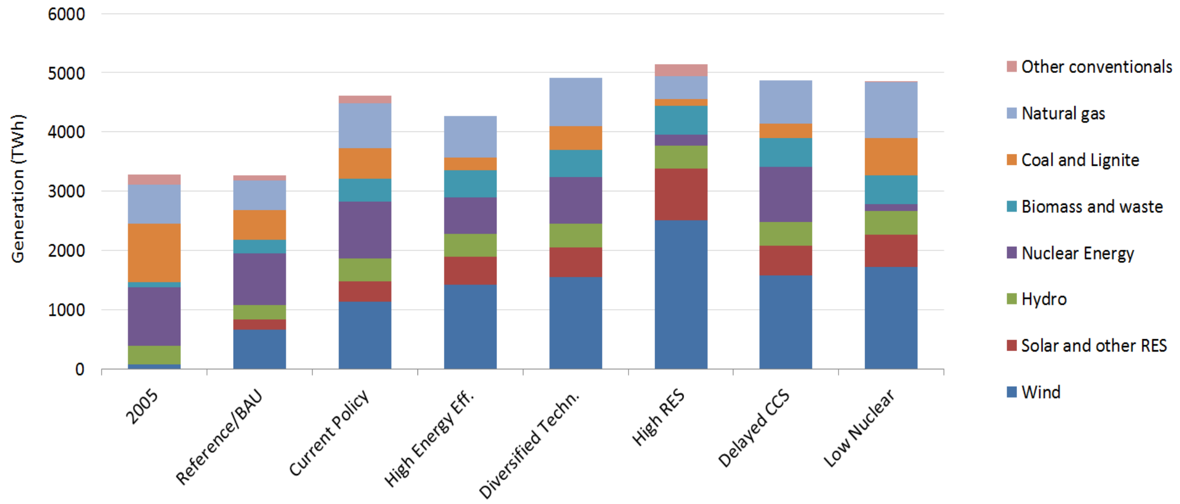


FIGURE 2. ELECTRICITY GENERATION MIX IN 2050 IN VARIOUS EC DECARBONIZATION SCENARIOS[5]

ELECTRICITY MARKETS

The power market can hardly be considered a natural market, because of the very nature of the product that is produced, traded, and consumed, i.e. a megawatt-hour (MWh) which cannot be put in a barrel or liquefied and stored in a tank. The power market and its functioning is the result of a set of rules that is agreed upon by a

4 AEN-NEA (2011), The Financing of Nuclear Power Plants (p. 60-63), http://www.oecd-nea.org/ndd/reports/2009/financing-plants.pdf, retrieved on 21 January 2014.

5 CIEP analysis of data provided by the European Commission (2011), Energy Roadmap 2050 - Impact Assessment and Scenario Analysis, http://ec.europa.eu/energy/energy2020/roadmap/doc/roadmap2050_ia_20120430_en.pdf, retrieved on 21 January 2014.

range of actors involved. These rules determine what is traded, what revenue streams exist for generators, and what costs they incur. Policy makers – past, present and future – strongly influence how a business case can work or not work for the actors involved. The 'quality' as well as the 'price' of the power supply system is a concern here. On the one hand, the (macro-economic) cost of supply (price) is a concern for economic and industrial policy as well as for employment reasons. On the other hand, quality is an issue, as the security of electricity supply must be guaranteed, as well as safety and a limited environmental footprint.

In recent years the views on what constitutes an acceptable quality of the electricity system have been gradually changing. Increasingly, in addition to the reliability requirement, this entails generation from RES, most notably from solar and wind resources. At the same time coal-fired power plants are clearly less favoured, and although views on nuclear power have been mixed in recent years, the Fukushima incident moved nuclear power further to the background, at least in some markets. It is this context that presently guides the evolution of the electricity supply system and power market regulation and policies.

PRESENT POWER MARKET ENVIRONMENT

Increasingly, public and private actors question the relevance of the current market coordination mechanism for the envisioned decarbonization process; they do this under the auspices of a new *market design*[6]. What constitutes the market design is not always clear, but at least three aspects of the present-day utility business environment can be considered central to it, all of which are heavily debated: (1) the European Union Emission Trading Scheme (EU ETS), (2) renewable support schemes, and (3) capacity mechanisms (as opposed to the absence of such mechanisms, resulting in a market situation frequently referred to as the 'energy-only market'). These three aspects must be considered in the context of the European Union (EU) internal energy market.

6 For instance, IEA (2012), Securing Power during the Transition, http://www.iea.org/publications/freepublications/publication/name,33897,en.html, retrieved on 27 January 2014; Electricity Market Reforms in the UK, information available at https://www.gov.uk/government/policies/maintaining-uk-energy-security--2/supporting-pages/electricity-market-reform; UMSGroup and E-Bridge (2013), Towards a Sustainable Market Model, http://www.umsgroup.com/documents/viewpoints/EndReportMarketModel_final14052013.pdf, retrieved on 20 March 2014; Oxford Institute for Energy Studies (2012), Decarbonization of the Electricity Industry - is there still a place for markets, https://www.oxfordenergy.org/2012/11/decarbonisation-of-the-electricity-sector-is-there-still-a-place-for-markets, retrieved on 27 January 2014; etc.

FIGURE 3. EU EMISSION ALLOWANCE (EUA) PRICES BETWEEN JANUARY 2011 AND JANUARY 2014 (EUA FUTURES)[7]

In contrast to command-and-control policy measures, the EU ETS is a market-based environmental policy instrument, as is an environmental tax or levy[8]. However, while a tax or levy is a price-based instrument, the EU ETS is a quantity-based instrument. As such, the quantity of emissions is fixed by setting the amount of emission allowances in the market, which in turn follows from long-term emission reduction objectives (e.g. 20-20-20)[9]; the price is not fixed and is merely a result of supply/demand balances. From this perspective, the EU ETS functions as it is supposed to, i.e. capping carbon emissions along a linearly declining pathway, defined by policy makers.

Now, several years down the road, it turns out that demand/supply balances are not tight. The availability of emission allowances well exceeds demand (see Figure 17 in Appendix A)[10], resulting in low prices for emission allowances in the carbon-trading scheme (Figure 3). In principle this should not be an issue, since emissions are capped by the very nature of the policy instrument. But it does have relevant side

7 Data retrieved from http://www.theice.com

8 Recommended further reading: Keohane, N. O., & Olmstead, S. M. (2007), Markets & The Environment. Washington, D. C.: Island Press.

9 As Article 9 of Directive 2003/87/EC (as amended by Directive 2009/29/EC) reads: 'The Community-wide quantity of allowances issued each year starting in 2013 shall decrease in a linear manner beginning from the mid-point of the period from 2008 to 2012. The quantity shall decrease by a linear factor of 1,74 % compared to the average annual total quantity of allowances issued by Member States in accordance with the Commission Decisions on their national allocation plans for the period from 2008 to 2012. […]'

10 European Commission (2012), The State of the European Carbon Market in 2012, http://ec.europa.eu/clima/policies/ets/reform/docs/com_2012_652_en.pdf, retrieved on 21 January 2014.

consequences. That is to say, at present it provides little incentive for market actors to take measures to (further) reduce carbon emissions. Hence, there is currently much discussion as to whether policy makers and regulators should intervene, in ways ranging from soft measures like 'back-loading', to price controls, to setting a more stringent reduction pathway and thereby creating more scarcity in the system[11]. Clearly, such discourse leads to uncertainty regarding the way forward.

At the same time, doubts are emerging as to whether an energy-only market (wholesale market) can provide for electricity system adequacy while also introducing variable RES[12]. In that respect, the introduction of capacity remuneration mechanisms (CRMs) is on the agenda of many national policy makers[13]. Such CRMs could create a new source of revenues for generators through the sale of available generation capacity (megawatts, MW), but it would have consequences for the traditional source of revenues (i.e. energy sales, MWh). As such, two central characteristics of the EU internal market for electricity, i.e. the market-based EU ETS as well as the energy-only market paradigm, are being heavily debated. The 2012 CIEP report 'Capacity Mechanisms in Northwest Europe' took a deep dive into this discussion[14].

In all, the nature of this market-based segment of European electricity supply raises much discussion. At the same time, this very segment is itself losing prominence since an increasing amount of investments in generation projects is not driven by the combined construct of wholesale markets and EU ETS, but by renewable support schemes, which vary greatly from one member state to another[15]. This clearly has implications for the functioning of the market and hence for the degree to which the present market design is optimal for delivering an electricity supply system that meets the costs and quality requirements set by society at large.

11 A public debate was initiated by the European Commission about options for structural reform of the EU ETS. See http://ec.europa.eu/clima/policies/ets/reform/index_en.htm, retrieved on 20 March 2014.

12 A relevant study is provided by the IEA (2012), Securing Power during the Transition, http://www.iea.org/publications/insights/SecuringPowerTransition_Secondeedition_WEB.pdf, retrieved on 21 January 2014.

13 See Figure 7 in publication by Eurelectric (2012), Powering Investments - Challenges for the Liberalized Electricity Sector, http://www.eurelectric.org/media/68619/powering_investments-_findings_and_recommendations-lr-2012-101-0003-01-e.pdf, retrieved 21 January 2014.

14 CIEP (2012), Capacity Mechanisms in Northwestern Europe, http://www.clingendaelenergy.com/publications/publication/capacity-mechanisms-in-northwest-europe, retrieved 3 March 2014.

15 An overview can be found in the Fraunhofer-ISI/Energy Economics Group/ Ecofys (2012) publication: Recent Developments of Feed-in Systems in the EU, http://www.feed-in-cooperation.org/wDefault_7/download-files/research/101105_feed-in_evaluation_update-January-2012_draft_final_ISI.pdf, retrieved on 21 January 2014.

2 ALTERED BUSINESS LOGIC

The introduction of substantial amounts of variable power generation changes the functioning of electricity markets. In recent years we have already seen an increase in power generation from variable RES in Northwest Europe (i.e. generation from wind and solar capacity[16]), incentivized by German feed-in tariffs, Dutch feed-in premiums, Belgian and UK quota obligations, etc. (Figure 4).

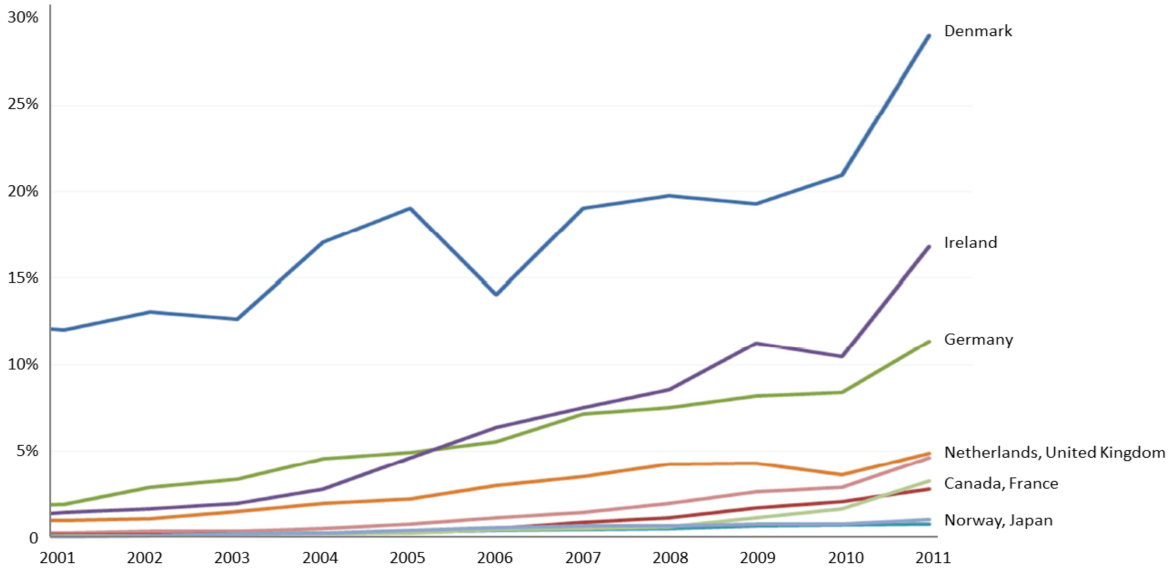


FIGURE 4. VARIABLE RES-E GENERATION AS A SHARE OF TOTAL GENERATION (IEA, 2013)[17]

Even if the renewable focus in electricity policy decreases post-2020, for instance as a result of non-binding national RES targets for 2030[18], the effects of what has happened in recent years and what can firmly be expected to happen in the coming

16 For wind, see The European Wind Energy Association (2013), Wind in Power - 2012 European Statistics, http://www.ewea.org/statistics/european, retrieved on 21 January 2014; for solar, see European Photovoltaic Industry Association (2013), Global Market Outlook for Photovoltaics 2013-2017, http://www.epia.org/news/publications/global-market-outlook-for-photovoltaics-2013-2017, retrieved on 21 January 2014.

17 IEA (2013): RES-E-NEXT, Next Generation of RES-E Policy Instruments, http://iea-retd.org/archives/publications/res-e-next, retrieved 27 January 2014.

18 European Commission (EC) press release of 22 January 2014, http://europa.eu/rapid/press-release_IP-14-54_en.htm, retrieved on 27 January 2014.

years will have consequences for the power markets in Northwest Europe for years to come (see Figures 20 and 21 in Appendix A, and Table 1 in Appendix B). Although annual generation figures from solar and wind capacity may be modest, the variable nature of generation implies that generation from these sources is substantial and significant at times.

Consider Figure 5 for solar photovoltaic (solar PV) in Germany and notice the continuous change in the actual utilization of the installed solar PV capacity (which is generally obscured by graphs showing annual production volumes)[19]. Some days utilization of the installed solar PV capacity is close to 24 GW, while on other days, most notably in the darker winter months, utilization is only several GWs. Even on a day when utilization reaches the 24 GW around noon, the following night-time utilization falls back to zero and electricity generation has to come from alternative generating capacity.

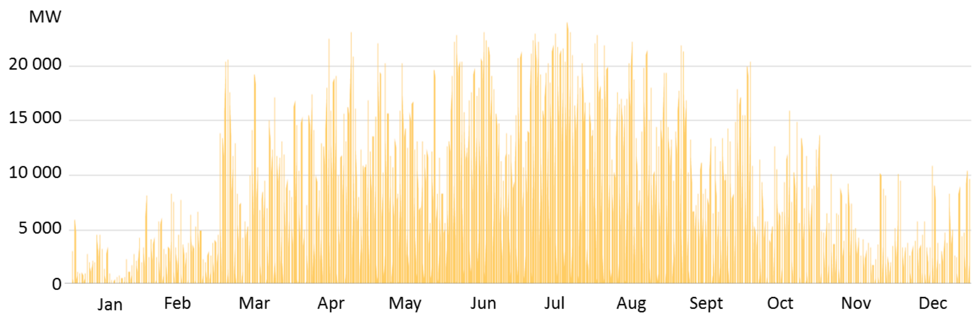


FIGURE 5. GENERATION FROM THE INSTALLED SOLAR-PV CAPACITY IN GERMANY IN 2013[19]

Given present numbers and the 2020 targets for European Union member states (see Figure 21 in Appendix A), variable generation can no longer be regarded as an anomaly in the electricity system; rather, it is 'the new base-load' around which the rest of the system is assumed to function and to which the rest of the system is supposed to adapt. The main difference with 'the traditional baseload', however, is that this base has varying output.

19 Illustration from slide 40 in Fraunhofer (2014), Electricity Production From Solar And Wind In Germany in 2013, http://www.ise.fraunhofer.de/en/downloads-englisch/pdf-files-englisch/news/electricity-production-from-solar-and-wind-in-germany-in-2013.pdf, retrieved on 21 January 2014.

THE BUSINESS CASE FOR CONVENTIONAL GENERATION

One example of changing business logic following from the changing functioning of the electricity market concerns the business case for conventional generation. This is the example being discussed most extensively in the present discourse regarding capacity mechanisms. As is increasingly recognized, the growing amount of variable generation has implications for the number of hours conventional power plants can run.

A less heard but relevant related issue is that the 'levelized costs of electricity generation' concept should consequently be treated with caution. This concept incorporates capital expenses, operational expenses, as well as fuel and carbon costs and transposes these onto a per-MWh-basis. It should be avoided, now more than ever, to start such a cost calculation with the (implicit) assumption that a generation technology operates in some sort of green-field situation in which no particular generation mix is installed and there is no competition with other sources. Such an assumption could imply that generation technologies produce according to technical availability, e.g. in the range of 6500 to 8500 hours for gas-fired, coal-fired and nuclear power plants. Levelized costs of electricity calculations could then show that gas-fired, coal-fired, and nuclear generation costs are relatively similar (see, for a recent overview of levelized costs of various generating technologies, Figure 22 in Appendix A).

In an electricity supply system in which substantial amounts of variable generation are a given, conventional power plants run substantially fewer hours. The effects on per-MWh-costs differ from one technology to the other, having more severe implications for capital-intensive technologies than for less capital-intensive ones[20], as is illustrated in Figure 6. This effect was extensively analyzed for gas-fired and coal-fired power plants in the 2011 CIEP study 'Wind and Gas'[21].

20 Exact cost levels vary with assumptions on fuel prices, carbon price levels, conversion efficiencies, CAPEX levels, costs of capital, economic lifetime of assets, etc. One things stands out, however. If a particular amount of capital expenses is to be earned back over a smaller quantity of product (power produced), then costs per unit (MWh produced) go up. The more capital-intensive a generation technology is, the stronger its effect.

21 CIEP (2011), Wind and Gas. Back-up or Back-out - 'That is the Question', http://www.clingendaelenergy.com/publications/publication/wind-and-gas, retrieved 21 January 2014.

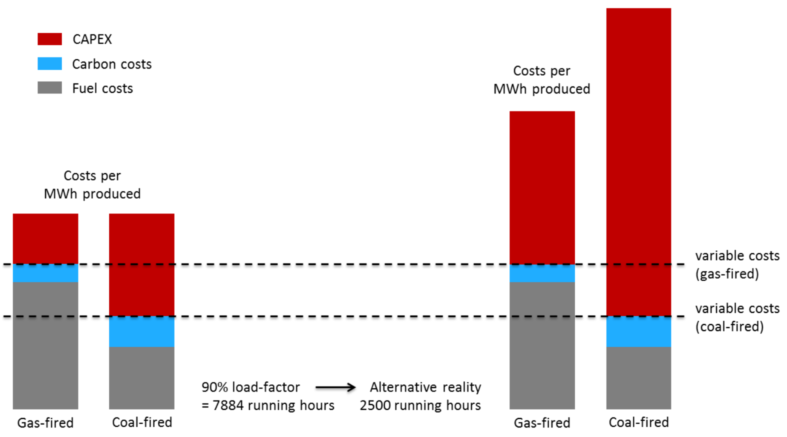


FIGURE 6. ILLUSTRATING THE EFFECT OF DECREASING NUMBERS OF RUNNING HOURS FOR CONVENTIONAL NEW-BUILDS[20]

Overall, generation costs per MWh from conventional sources are increasing in an electricity market that has substantial amounts of variable generation from RES, more so for the more capital-intensive coal-fired new-builds than for gas-fired new-builds, and even more so for nuclear new-builds that do not operate baseload. As a result, in a market with substantial amounts of variable generation from wind and solar, the technology preference for new-builds is affected.

It is important to stress that this is an investor's perspective. In contrast, once power plants have been built, variable costs determine which power plants are actually used; at that moment the capital expenses (CAPEX) are sunk costs. Because of lower variable costs, coal-fired power plants outcompete gas-fired plants in the daily operation in present Northwest European power markets (coal-fired power plants have a more favourable position in the 'merit order')[22]. However, paradoxically, with increasing amounts of variable generation in the system and decreasing amounts of running hours for conventional plants, such coal-fired power plants can actually be financially underwater, potentially more so than gas-fired generation facilities that do not produce.

22 This article illustrates these dynamics: Financieel Dagblad, 4 March 2013, De schoonste gascentrale van Nederland staat stil, http://fd.nl/economie-politiek/102413-1303/de-schoonste-gascentrale-van-nederland-staat-stil, retrieved on 27 January 2014.

While increasing amounts of variable electricity generation seemingly strengthen the business case for gas-fired generation projects relative to coal-fired new builds, this is not to say that the new environment is an attractive place to invest *per se*; it has become riskier, too. In a power market in which wholesale prices follow essentially from the variable costs of the marginal power plant, there is a risk of an increasing misfit between electricity prices and costs-per-MWh-produced (illustrated in Figure 6). This is the base of the discussion on the introduction of CRMs, which, as the argument goes, can decrease the risks for an investor by introducing an alternative revenue stream for generators.

BUILDING A BUSINESS ON SUBSIDIES?

In a similar vein, the concept of levelized costs must also be treated with caution when considering investments in renewable technologies. A blunt way to assess the competitiveness of a generation technology using the concept of levelized costs is to compare the particular cost level with baseload electricity prices in a market. If baseload futures, as traded on electricity exchanges, show prices higher than levelized costs of a particular generation technology, that technology could seemingly be the basis for a positive business case[23]. Reality, however, is more complicated.

The issue is that much of the wind energy produced can be expected to enter the market in the Northwest European region right at the same time. At these particular moments electricity prices drop as a result. Revenues for wind energy producers are consequently relatively low. This suggests that additional revenue streams continue to be necessary to realize a high share of (offshore) wind energy in the mix, and possibly even to sustain such a high share in the mix.

23 Baseload futures are derivatives traded at electricity exchanges such as ICE Endex, The European Energy Exchange (EEX), etc. Prices for baseload futures reflect expectations regarding the future value of electricity in a specific time frame, e.g. a future calendar year. Baseload futures are used by utilities to hedge price and volume risks.

	IR	FR	**UK**	**BE**	**NL**	**DE**	**DK**	SE	PL	LA	LT	ET	RU	FI	NO
IR	100%	43%	62%	37%	33%	26%	20%	13%	15%	13%	14%	12%	13%	4%	14%
FR	43%	100%	49%	59%	46%	37%	32%	20%	23%	16%	18%	10%	17%	2%	5%
UK	62%	49%	100%	66%	74%	67%	49%	27%	29%	20%	21%	16%	21%	7%	37%
BE	37%	59%	66%	100%	79%	67%	45%	22%	28%	20%	21%	12%	20%	2%	12%
NL	33%	46%	74%	79%	100%	87%	77%	49%	50%	32%	34%	22%	34%	10%	36%
DE	26%	37%	67%	67%	87%	100%	76%	43%	53%	28%	30%	18%	32%	6%	40%
DK	20%	32%	49%	45%	77%	76%	100%	73%	78%	44%	48%	32%	48%	17%	44%
SE	13%	20%	27%	22%	49%	43%	73%	100%	73%	69%	72%	69%	59%	49%	30%
PL	15%	23%	29%	28%	50%	53%	78%	73%	100%	55%	61%	36%	65%	16%	24%
LA	13%	16%	20%	20%	32%	28%	44%	69%	55%	100%	89%	66%	74%	30%	15%
LT	14%	18%	21%	21%	34%	30%	48%	72%	61%	89%	100%	66%	88%	34%	17%
ET	12%	10%	16%	12%	22%	18%	32%	69%	36%	66%	66%	100%	45%	51%	13%
RU	13%	17%	21%	20%	34%	32%	48%	59%	65%	74%	88%	45%	100%	19%	16%
FI	4%	2%	7%	2%	10%	6%	17%	49%	16%	30%	34%	51%	19%	100%	23%
NO	14%	5%	37%	12%	36%	40%	44%	30%	24%	15%	17%	13%	16%	23%	100%

FIGURE 7. CORRELATION COEFFICIENTS FOR ON- AND OFFSHORE WIND IN NORTHERN EUROPE (NORTH SEA REGION HIGHLIGHTED)[24,25]

Generation from wind capacity in different countries is correlated across geographical areas such as the North Sea region; see specifically the UK, Belgium, the Netherlands, Germany and Denmark in Figure 7. This implies that revenues can only be captured when a substantial amount of wind energy is available in a vast market area. Even though wholesale markets may show fairly high prices for baseload futures (effectively representing annual averages), reality can be that at times of abundant wind generation, prices are actually low and consequently captured revenues are also relatively low. At times when there is not much wind generation in the market, wholesale market prices are high and revenues are high for those generators producing electricity, but wind farms are unable to capture them. Modelling by Pöyry of the future UK electricity market, shown in Figure 8, illustrates this. With low levels of wind energy penetration, it is not a prominent issue; but with increasing levels of wind energy penetration, the issue becomes more relevant.

24 CIEP analysis of OffshoreGrid data, obtained through CEPS (2012), The Benefits of Investing in Electricity Transmission - Lessons from Northern Europe, http://www.ceps.eu/ceps/dld/6542/pdf, retrieved on 22 January 2014.

25 Data for Norway shows some correlation with (other) North Sea countries too, but due to the vast geography of Norway, data from Norway is not necessarily related to wind parks in the North Sea region. Therefore, Norway is not shown in the North Sea block.

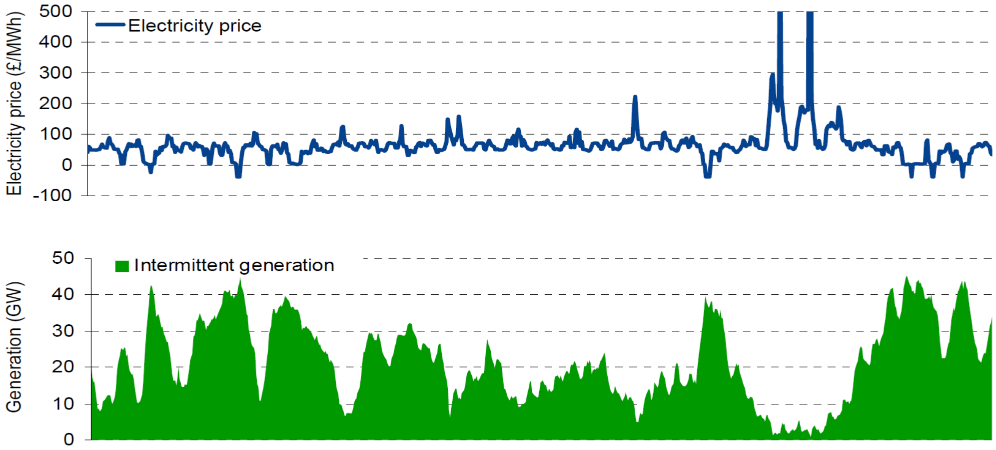


FIGURE 8. MODELLING UK ELECTRICITY MARKET IN JANUARY 2030 WITH 43 GW INSTALLED WIND CAPACITY[26]

Even though ambitious technological measures like an extensive pan-European high-voltage grid combined with the completion of the EU internal energy market could increase the absorption capacity of electricity markets in the long run, a commercial business developing an electricity generation project cannot ignore the risk that such an extensive grid and integrated European electricity market would not be present during the economic lifetime of the project at hand.

The time dimension is extremely important for electricity generation. So even though technological learning may drive down costs of generation technologies, revenue streams can be driven down, too. Similar reasoning could apply for other variable generation technologies such as solar energy that show high correlation in a market area. It remains to be seen as to what extent major utilities are willing to allow subsidy mechanisms to substantially determine their revenues; subsidy averseness could have implications for business model preferences.

FROM USER TO CONSUMER TO CLIENT

At the same time, traditional electricity users (who evolved into electricity 'consumers' in the liberalized market) increasingly not only consume electricity but also generate electricity (see Figure 23 in Appendix A for RES capacity ownership in Germany as of April 2013).

26 This graph shows the utilization of a hypothetical 43 GW of installed wind capacity in January 2030 in the UK, if the weather conditions in that month were similar to the conditions in January 2000. Pöyry (2009), Impact of Intermittency: How Wind Variability could change the shape of the British and Irish Electricity Markets, http://www.poyry.com/sites/default/files/imce/files/impactofintermittencygbandi-july2009-energy.pdf, retrieved on 21 January 2014. With permission.

Access to generation technologies through the advancement of distributed generation technologies, together with easier access to energy exchanges through the advancement of Information and Communication Technologies (ICT), implies that such actors can no longer be referred to as electricity consumers. Rather, they act as clients who expect services from a service provider; these services must enable them to engage in those activities they prefer, using the generation assets they prefer, as well as having the consumption pattern they prefer. As a result, clients are a heterogeneous group of actors. Consider Figure 24 in Appendix A for a classification.

A range of factors, of which recent technological advancements and technology cost reductions in combination with renewable support schemes are likely to be the most relevant, drive these changes. They can be ideologically driven, too, or driven by the desire of clients to capture rents themselves rather than consuming an all-in service regarding electricity supply where the rents are captured by another entity. In this respect, micro-economics for individual actors have become an increasingly relevant factor in electricity investments; clients embrace technologies such as solar PV (potentially in combination with small-scale electricity storage) as an energy-efficiency measure, enabling them to save on their electricity bills[27]. Such investment decisions do not follow the logic of commodity wholesale markets, but rather that of *consumer logic*.

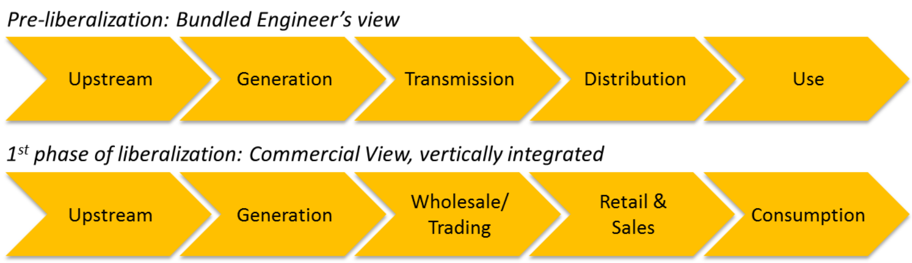


FIGURE 9. THE ELECTRICITY VALUE CHAIN

At the same time, however, for many clients the harsh reality is that the electricity system is a technologically complex, financially challenging and ICT-intensive system, in which at present true autonomy is either a dream or an illusion. Which is to say, many clients need services from a service provider to make their activities work. It is

27 For relevant calculations showing how micro-economics can be driving continued expansion of solar-PV capacity in a number of markets, consider reading UBS (2013), The unsubsidised solar revolution.

here that the service-oriented view on business activities in the electricity sector comes in, reinforced by the fact that some electric utilities have doubts on the future return on investment in electricity generation projects.

TOWARDS A SERVICE-ORIENTED VIEW?

Thinking of utility business models typically centres on the concept of the electricity value chain (Figure 9). Rethinking business models can therefore start with revisiting the electricity value chain and determining how it is changing. Implicitly, however, the concept itself seems to follow the logic of the vertically integrated electric utility, i.e. starting with generation, followed by electricity transport and distribution and ultimately leading to end-use.

Unbundled electric utilities operating in liberalized markets adopted a renewed version of the electricity value chain by seeking an integrated chain consisting of generation, wholesale/trading, retail/sales, and leading to consumption (see also Figure 9). This renewed view is still strongly rooted in the original concept, and might turn out to be too one-dimensional and one-directional for understanding changes in interactions between relevant actors in the electricity supply system.

One approach that could be better capable of grasping such changes is adopting a more service-oriented view on business activities[28]. Increasingly, the electricity system serves as a platform for a range of system users, i.e. clients as shown in Figure 24 in Appendix A. As explained, these clients are a heterogeneous group. They can include 'traditional' generators such as a CCGT-operator[29], industrial consumers such as an aluminium smelter, but also smaller-scale generators (distributed generation) and hybrid generator/consumers such as a household or a medium-sized business. A high-level graphic representation of such a service-oriented view which could serve as an example is shown in Figure 10.

28 Although not always clearly defined, service-oriented business models increasingly appear to be regarded as an answer to present challenges in the European Utility industry. One example of this can be found in the article: RWE Sheds Old Business Model, Embraces Transition, at http://www.energypost.eu/exclusive-rwe-sheds-old-business-model-embraces-energy-transition, retrieved on 22 January 2014. Another example is Dutch utility Eneco's view on its business model, expressed at http://annualreport2012.eneco.com/report-of-the-board/who-we-are-what-we-do/business-model, retrieved on 22 January 2014.

29 CCGT refers to Combined Cycle Gas Turbine.

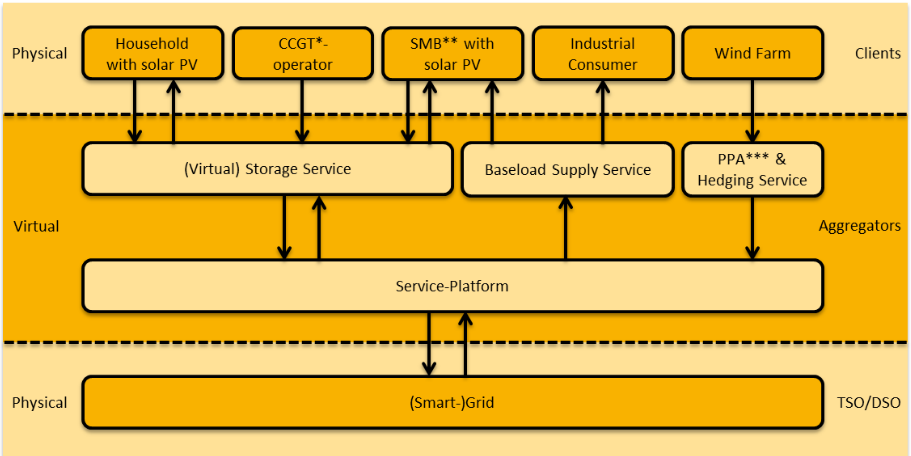


FIGURE 10. SERVICE-ORIENTED VIEW ON BUSINESS ACTIVITY IN THE ELECTRICITY SECTOR

Clients and the grid itself have a strong 'physical' nature (technology, hardware). At the same time, there is a layer with a 'virtual' nature that manages interactions between clients, building on the grid (similar to the role of software in ICT). These interactions entail virtual electricity flows[30]. It is the virtual layer that has become increasingly relevant for actors involved in electricity business.

In this respect, interesting lessons can be learned from the ICT business. Think of how Android and iOs operating systems for smart-phones have become platforms for a wide range of apps that serve smart-phone users. The platform developer and owner does not tightly control the complete value chain but manages to realize a strong position by having the most appealing platform for apps (which can be regarded as services)[31]. Crucially, the platform owner does not necessarily develop all services (apps) him/herself, but rather his/her platform is open for other service developers[32]. Another relevant observation can be made in online retailing. That is to say, think of the business model of eBay, which offers a platform for buyers and

30 The word 'virtual' is explicitly used here; in contrast to virtual flows and corresponding money flows, physical flows follow the technological characteristics of the electricity grid; these physical flows are managed by transmissions and distribution system operators (TSOs/DSOs).

31 In fact, one could also relate this thinking to 'franchising', as suggested by RWE CEO Peter Terium in a Q&A-session following his CIEP-lecture *Energy Transition — A European Challenge* at Huys Clingendael (The Hague, Netherlands), 14 March 2014.

32 For a brief overview of how the history Apple, iOs, and its apps store, consider reading: Wired.com, 7 October 2013, 5 Years On, The App Store Has Forever Changed the Face of Software, http://www.wired.com/gadgetlab/2013/07/five-years-of-the-app-store, retrieved on 31 January 2014.

sellers that enables them to interact[33]. eBay competes with retail stores not by keeping stocks and selling goods but by offering a digital platform.

Standardized platforms and services can be used by entrepreneurs to develop applications for clients. This line of reasoning is common in ICT business. A recent article in The Economist, ‘A Cambrian Moment’[34], argues that this principle is presently a driving force behind innovation and entrepreneurship in the wider economy. Given the virtual nature of electricity trading, sales and retailing, this principle could serve as a base for future business activity in the electricity sector. Such a service-oriented view to business activity could reveal that now, after the first phase of market-liberalization, preferences for vertical integration are becoming weaker.

33 The Financial Times reports: ’Now eBay is on its next three-year plan, positioning itself to be a platform for retailers by creating a suite of technology offerings that allow store owners to be their own Amazon, and forging partnerships with large retailers such as Best Buy, Home Depot, and Toys R Us that give eBay customers more product choices and shipping options.’ See Financial Times, 18 October 2012, http://www.ft.com/intl/cms/s/0/df3723ca-1773-11e2-8cbe-00144feabdc0.html#axzz2qMgyNKhN, retrieved on 23 January 2014.

34 The Economist, Jan 18th 2014. Tech Startups – A Cambrian Moment, http://www.economist.com/news/special-report/21593580-cheap-and-ubiquitous-building-blocks-digital-products-and-services-have-caused, retrieved on 22 January 2014.

3 SHIFTING BUSINESS MODELS

As explained in the previous chapter, the traditional view on business activity in the electricity sector centres around the electricity value chain. This value chain includes upstream (the procurement activities regarding inputs for generation), midstream (trading activities, as well as transport and distribution) and downstream (retail and sales) activities. However, these business activities can be revisited in a different fashion, as is shown in Figure 11. The objective of this the graph is not to provide a final, complete and perfect overview of business activity in the realm of the electric utility, but rather to show that activities can be clustered and that interfaces exist with actors in other industries.

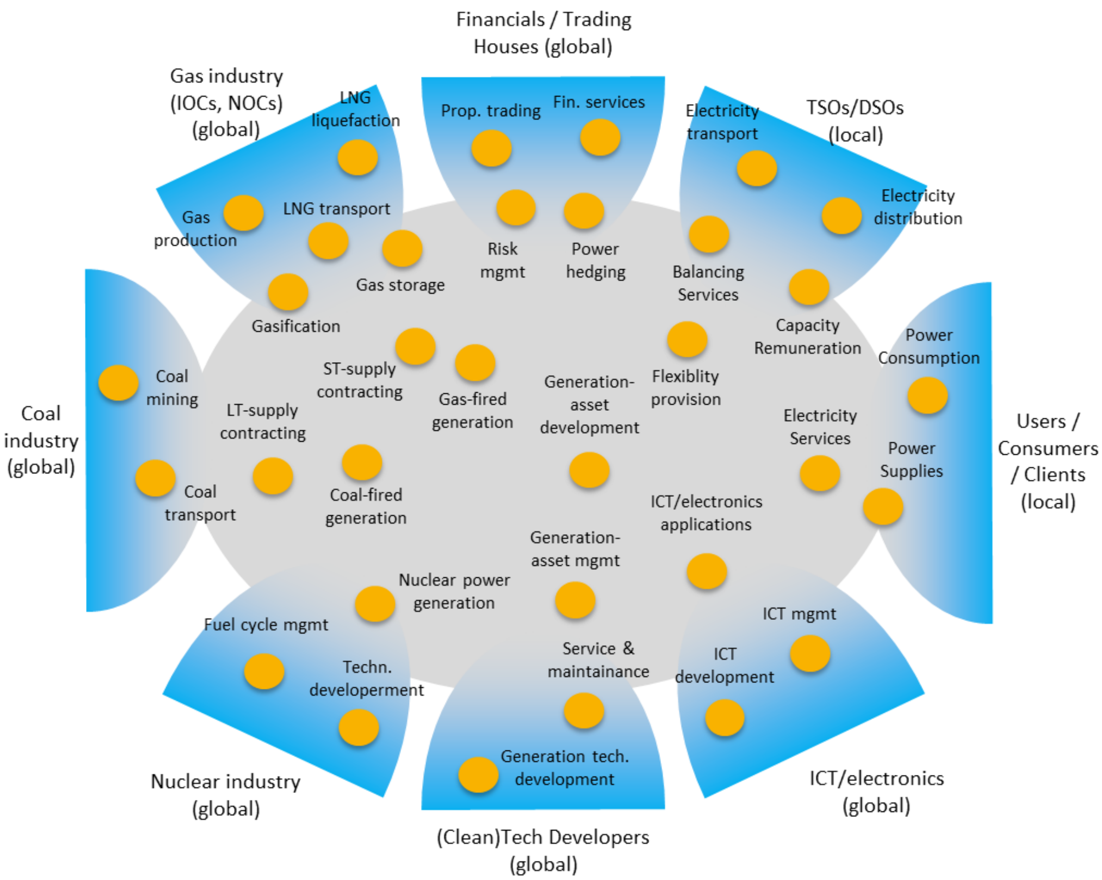


FIGURE 11. BUSINESS ACTIVITIES IN AND AROUND THE SPHERE OF THE UTILITY

The cluster of activities in the centre used to be the heart of 'the electric utility' as it emerged with market liberalization. It is relevant to realize that this cluster is not something that follows from laws of nature. As a result of the changing business logic, new clusters can be preferred and old clusters can split or dissipate. At the same time, actors from other industries can increasingly be drawn into activities in the electricity sector.

As an example, it can be argued that there is a growing disconnect between upstream activities (be it in the gas, coal or nuclear value chain) and downstream activities (retail, decentralized generation, energy services). While the former is closely related to activities for which the global market environment is strongly relevant and in which globally active actors continue to have a strong interest and expertise, the latter has a more local/regional dimension. At the same time, downstream activities are becoming technologically more complex, more integrated with grids, and have higher information (ICT) requirements, potentially attracting new types of actors.

This leads to a range of questions regarding to the way forward. Will generation activities based on combustible fuels turn out to be more attractive as a downstream outlet for international or state-owned oil and gas companies? Are nuclear generation activities more attractive for globally active nuclear enterprises than for an electric utility primarily operating in the future Northwest European electricity market? Is generation from conventional sources increasingly an extension of a transmission system operator's (TSO) or distribution system operator's (DSO) responsibility to guarantee system adequacy? Is the utility the logical 'platform owner' or 'service manager', or will ICT-enterprises enter the market that already manage other interactions with consumers?

The future is highly uncertain. Moreover, different electric utilities can have different responses, depending on their perceived strengths and existing portfolios. As such, the remainder of this chapter explores three potential models an electric utility could pursue, i.e. the Revitalized Electric Utility, the Large-Scale RES Generator and the New Electricity Service Platform. One additional 'model' is also explored, i.e. the State-Sponsored Utility, which is not so much an outcome of changing business model preferences but rather is the result of a utility default. It is relevant to note that in the real world, a variety of business models currently exist and can be expected to continue to exist in future. No utility is likely to put all its eggs in one basket, so hybrid models emerge, new ventures are started in order to experiment with new models, etc.

THE REVITALIZED ELECTRIC UTILITY

Some utilities may be seeking an extended future for the typical business model that emerged in past years with market liberalization, with innovations in particular business activities rather than in the whole business model. Alleviation from present financial stress in the sector is key here.

In principle, such alleviation could be the result of combined developments opposite to what caused the 'perfect storm' that was extensively reported in the 2013 CIEP publication 'European Power Utilities Under Pressure?'[35]. One can think of general economic recovery in Europe, leading to electricity demand growing faster than the further expansion of RES capacity; a growing market for conventional capacities could then re-emerge. A relevant factor here could be a post-2020 policy emphasizing carbon emissions reduction rather than RES share increases; the public policy focus could be on completion of the EU internal energy market and the EU ETS as a means of reducing greenhouse gases[36]. Such an approach to carbon emissions reductions would be most likely if affordability issues regarding RES continue to dominate the public discourse[37].

It is highly questionable whether such a road to recovery is truly realistic, however. As was explained in the previous chapter, RES capacity additions in recent years, combined with what can firmly be expected for the coming years, have long-lasting effects on power markets. And even if Europe were to focus less on the introduction of RES, individual member states could still make different choices; for the Northwest European region Germany is highly relevant in this respect (consider the 2023 forecasts by German TSOs shown in Table 1 in Appendix B).

In this context, it is important to note that an alternative route to regaining financial strength could be the introduction of aforementioned CRMs, which could create a revenue stream for generation in addition to revenues from energy sales. Such CRMs would create a market for generation capacity that can ensure security of electricity

35 CIEP (2013), European Power Utilities Under Pressure?, http://www.clingendaelenergy.com/publications/publication/european-power-utilities-under-pressure, retrieved 4 March 2014.

36 The EC proposals of January 2014 suggest that there may be no 2030 targets for member states regarding RES shares in the energy mix. See the press release of 22 January 2014, http://europa.eu/rapid/press-release_IP-14-54_en.htm, retrieved on 27 January 2014.

37 Spiegel, 4 September 2013, Germany's Energy Poverty: How Electricity Became a Luxury Good, http://www.spiegel.de/international/germany/high-costs-and-errors-of-german-transition-to-renewable-energy-a-920288.html, retrieved on 22 January 2014; Financial Times, 13 January 2014, EU Considers Scrapping 2030 Binding Renewables Targets, http://www.ft.com/intl/cms/s/0/b7de8ac2-7b98-11e3-a2da-00144feabdc0.html#axzz2qMgyNKhN, retrieved on 22 January 2014; Financial Times, 11 November 2013, Industry Warns Over German Move To Cut Green Energy Subsidies, http://www.ft.com/intl/cms/s/0/56f252aa-4adf-11e3-8c4c-00144feabdc0.html#axzz2kcykjkYc, retrieved on 22 January 2014.

supply for times when variable RES do not produce. Energy companies represented in the 'Magritte group' stress the need for such CRMs[38].

A strengthened future for conventional generation assets creates the strongest rationale for continued vertical integration across the electricity value chain; a revitalized electric utility could pursue continued presence in the entire cluster of business activities depicted in Figure 11. Inclusion of upstream activities would be most uncertain, however, since some utilities have decided but others are yet to decide about selling assets in order to generate cash[39].

There is a risk involved in anticipating revenue streams from CRMs, though. CRMs do not create substantial additional revenues *per se*. If a market-based approach is chosen for CRMs, revenues could turn out to be low. Indeed, if the price for reliable capacity is a function of demand for capacity vs. the availability of capacity, prices in a competitive capacity market can be expected to be low in market areas with substantial amounts of capacity installed, such as the Netherlands[40]. This is especially true if the completion process of the EU internal energy market is hampered and barriers between market areas continue to exist.

It is highly questionable whether the revitalized business model is a robust model for the long-term, given the changing business logic described in the previous chapter; but for the short- to medium term, it could enable a utility to initiate a more gradual longer-term transformation process; present debt-laden and cash-strapped utilities may not have this option.

THE LARGE-SCALE RES GENERATOR

Some utilities are increasingly attracted by electricity generation from large-scale RES. In Northwest Europe, offshore wind capacity in the North Sea region is highly relevant in this regard. A business model focusing on large-scale RES could be

38 EurActiv.com, 11 October 2013, Energy CEOs Call For End To Renewable Subsidies, http://www.euractiv.com/energy/energy-ceos-call-renewable-subsi-news-531024, retrieved on 22 January 2014.

39 ICIS, 10 February 2011, Vattenfall Puts Dutch Upstream Assets Up For Sale, http://www.icis.com/heren/articles/2011/02/10/9434316/vattenfall-puts-dutch-upstream-assets-up-for-sale.html, retrieved on 22 January 2014; ICIS, 17 March 2014, German Utility RWE Sells Natural Gas And Oil Arm To LetterOne Group, http://www.icis.com/heren/articles/2014/03/17/9763527/german-utility-rwe-sells-natural-gas-and-oil-arm-to-letterone.html, retrieved on 19 March 2014.

40 IPA PWC (2013), page 5, commissioned by Energie-Nederland, Financial and Economic Impact of a Changing Energy Market, http://www.energie-nederland.nl/wp-content/uploads/rapporten/PwC-Financial-and-economic-impact-of-a-changing-energy-market-Final.pdf, retrieved on 22 January 2014.

consistent with a continued public policy focus on renewables in environmental/ climate policy including 2030 targets[41].

However, the financial situation in the utility industry might have to improve for this business model to work[42]. Moreover, in many respects, offshore wind energy is still a risky undertaking, most certainly so in the near term[43]. Innovative approaches by utilities (financing models) as well as public policy makers (public support models) are therefore needed for this business model to work. As explained in the previous chapter in the section 'Building a Business on Subsidies?', the risk of falling wholesale prices due the strong correlation of generation from wind capacity in the Northwest European region may have to be accommodated in public support models; such (national) models must be designed in harmony with the EU internal energy market so as to avoid (further) distortion of (cross-border) electricity wholesale markets, as argued by Eurelectric[44].

Business activities by The Large-scale RES Generator are increasingly disconnected from nuclear and coal-fired generation activities. A utility anticipating a large role for variable RES in the electricity supply system must conclude that investments in relatively capital-intensive conventional technologies, such as nuclear and coal-fired capacity, are less attractive. As explained in the previous chapter in the section 'The Business Case for Conventional Generation', from an investor's perspective, new-build gas-fired power plants could become more attractive because of the lower CAPEX. Paradoxically, however, gas-fired power plants are currently outcompeted by coal-fired power plants due to daily operations based on variable costs combined with relatively low coal and carbon prices. Moreover, utilities may be forced to sell underutilized gas-fired power generation assets in order to generate cash to solve

41 Contrasting the statements by the Magritte group, a statement was expressed by a different group of companies involved in electricity business. See the open letter: EREC, October 2013, Industry Statement for Binding Renewable Energy Target in 2030 Framework, http://www.erec.org/fileadmin/erec_docs/Documents/Open_Letters/Industry_Statement_for_Binding_2030_RES_Target_October_2013.pdf, retrieved on 22 January 2014.

42 Financial Times, 26 November 2013, RWE Axes £4bn UK Wind-Farm Project, http://www.ft.com/intl/cms/s/0/464439ca-5672-11e3-ab12-00144feabdc0.html#axzz2llRXnig8, retrieved on 22 January 2014.

43 Standard & Poor's Rating Services, 13 December 2012, How The Explosive Growth In Offshore Wind Generation Could Affect European Utilities' Credit Quality, http://www.standardandpoors.com/spf/upload/Ratings_EMEA/HowTheExplosiveGrowthInOffshoreWin dGenerationCouldAffectEuropeanUtilities.pdf, retrieved on 22 January 2014.

44 Eurelectric, 5 November 2013, EURELECTRIC Welcomes EC's Pro-Market Stance on Public Intervention, http://www.eurelectric.org/news/2013/eurelectric-welcomes-ec%E2%80%99s-pro-market-stance-on-public-intervention, retrieved on 5 November 2013.

their short-term problems[45]; such assets may end up in the portfolio of upstream gas specialists who seek to diversify their outlet and find a strategic value in the asset[46].

There is a relevant risk connected with the business model of The Large-scale RES Generator. If distributed generation from solar PV becomes ever more dominant in the electricity supply system, then generation from offshore wind runs the risk of having a market only during hours that the sun is not shining. Just as the number of running hours for conventional generation plants are affected by the (subsidy-driven) introduction of variable RES, effectively driving up the cost-per-MWh-produced, in the long run large-scale RES can similarly be affected by the continued expansion of distributed solar PV. From an investor's perspective, capital-intensive generation technologies are most competitive when there is a market for every MWh produced; but if the market becomes smaller, then the costs per MWh produced would rise, as was shown in Figure 6 for coal-fired and gas-fired new-builds.

As a consequence, one could argue that in a future dominated by distributed solar PV generation, offshore wind could ultimately turn out to be a generation technology that entered the electricity supply system but hit a ceiling and phased out again. This risk would be greatest if, after the first wave of investment in offshore wind energy, cost reductions resulting from technological and organizational learning turned out to be relatively small compared to progress made with alternatives. If past cost reductions in the solar PV value chain are an indication for future developments, then competition for offshore wind energy from solar PV could turn out to be challenging.

A utility anticipating a grand future for distributed technologies may thus be hesitant to adopt a business model which focuses on generation from large-scale RES; The Large-scale RES Generator is therefore less likely to have a strong focus on distributed generation, as this utility makes a different bet on the future. It is relevant to note, however, that if risks can be transferred to other parties (e.g. project partners with different risk perceptions or appetites who are willing to sign a power-purchase-agreement, or government/society/consumers through RES support schemes), then a utility could nevertheless choose to be active in both the sphere of large-scale RES

45 While acquiring a 100% stake in three offshore wind energy projects in the Dutch North Sea, DONG put its Dutch clients base up for sale, as well as its stake in the EnecoGen gas-fired power plant. See Financieel Dagblad, 6 January 2014, Nederlandse Klanten Dong in Etalage, http://fd.nl/ondernemen/808428-1401/nederlandse-klanten-dong-in-etalage, retrieved on 22 January 2014.

46 Gazprom, 21 June 2013, Gazprom and Enel Sign Document on Possible Acquisition of Marcinelle Energie CCPP, http://www.gazprom.com/press/news/2013/june/article165058, retrieved on 22 January 2014.

and distributed technologies. However, such a utility would be more a large-scale RES *developer* than a *generator*.

THE NEW ELECTRICITY SERVICE PLATFORM

This business model builds heavily on consumer logic. The emergence of consumer logic as opposed to commodity logic was explained in the previous chapter in the section 'From User to Consumer to Client'. As such, this is the business model that differs most radically[47] from the typical model that emerged in the past decade with market liberalization in Northwest Europe.

The increasing role for consumer logic in energy investments may be the result of the combined effect of continued technological progress regarding distributed technologies (most notably solar-PV and battery technology) on the one hand and continuing incentives for end-users to engage in self-generation on the other[48]. Such incentives do not necessarily include direct support through feed-in tariffs, nor net metering[49]. These incentives can also follow from the basic option to avoid paying taxes and levies over kilowatt-hours consumed from the grid during some hours of the day.

Even in not particularly optimistic scenarios regarding solar PV cost reduction, solar PV will increasingly be a cost-effective energy-saving technology between now and 2020, from the perspective of electricity clients in several European countries[49]. Typical generation from a PV system coincides to some extent with actual electricity demand of such users throughout the day. Even without net metering, users can lower consumption of electricity from the grid (which is taxed) by having a solar PV system installed[50]. Some users may even take it a step further, as a result of continued technological progress, and it could make economic sense to 'oversize' their solar PV systems. By doing so, sufficient electricity can be generated for moments that solar influx is less optimal. Consider Figure 12 for a conceptual overview of how such

47 Edison Electric Institute (2013), Disruptive Challenges, Financial Implications and Strategic Responses to a Changing Retail Electric Business, http://www.eei.org/ourissues/finance/Documents/disruptivechallenges.pdf, retrieved on 22 January 2014.

48 For relevant calculations showing how micro-economics could be driving the continued expansion of solar-PV capacity in a number of markets, see UBS (2013), The Unsubsidised Solar Revolution.

49 Net metering refers to the option for consumer to deduct self-generated electricity from electricity consumed from the grid on an annual basis. For instance, if 3500 kWh is generated over the course of a year, and 3500 kWh was consumed during the same period, net metering implies that consumption was zero. In reality, however, the electricity client has been producing and selling electricity to the grid at times, while consuming electricity from the grid at other times. Net metering implies that the consumer receives retail price levels for its electricity sales, rather than (lower) wholesale prices.

50 See also Financial Times, 25 November 2013, Future Brightens for Unsubsidised Home Solar, http://www.ft.com/intl/cms/s/0/73c42d7c-47ab-11e3-9398-00144feabdc0.html#axzz2llRXnig8, retrieved on 22 January 2014.

generation relates to consumption for a household over the course of a day (the potential future role for small-scale distributed storage is also shown, enabling this household to consume self-generated electricity in the evening hours).

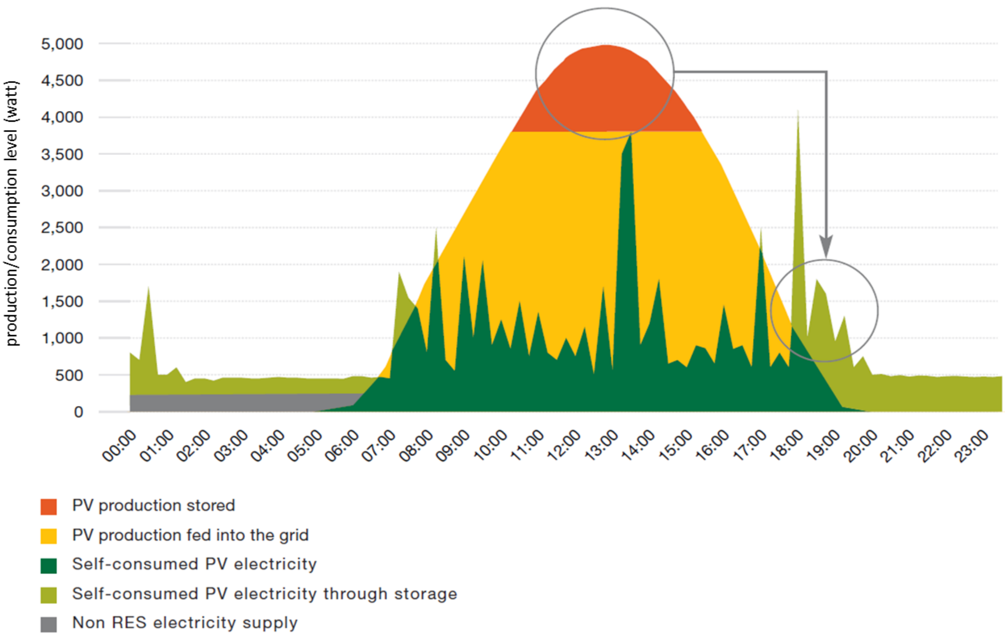


FIGURE 12. ILLUSTRATING HOUSEHOLD SOLAR PV GENERATION/CONSUMPTION (POTENTIAL ROLE FOR STORAGE INCLUDED)[51]

Crucially, such 'oversizing' would lead to an increasing number of days with surplus generation (from the perspective of the system owner). If these surpluses find their way to wholesale markets, continued downward pressure on wholesale prices could be the result. It is questionable whether such wholesale markets could still provide a sufficient basis for large-scale generation investments. It is at this point that a business model focusing on large-scale RES generation potentially comes under stress, as was explained in the previous section.

As said, a tension thus exists between a business model focusing on large-scale RES generation on the one hand, and a business model focusing on consumer logic and distributed technologies on the other. For large-scale generation to be commercially

51 European Photovoltaic Industry Association (EPIA) (2012), Connecting The Sun, http://www.epia.org/news/publications/connecting-the-sun, retrieved on 19 February 2014.

successful, revenue streams from wholesale markets are crucial. If wholesale markets no longer have a 'relevant' price, but merely serve as an outlet for distributed generation, large-scale electricity generation could become financially problematic. RES projects are supported through feed-in tariffs or premiums, but if RES generation is increasingly dependent on wholesale market prices, it could become a challenging business activity[52]. An electric utility that concludes that it does not want to be exposed to such risks could decide to focus on business development (rather than electricity generation itself) for clients or competitors who have a different risk perception, different risk appetites, or who are better capable of managing such risk.

In addition to such business development, the utility can focus on the role of aggregator, i.e. on managing electricity flows, displayed in the 'virtual' layer shown in Figure 10, and the related money flows. Due to the relatively large role ICT plays in these activities, coalitions between utilities with active trade floors, ICT-related businesses and innovative new entrants could emerge[53]. However, some electricity consumers may choose to go off-grid[54]. If self-generation increasingly means 'going off-grid', then it could turn out to be difficult to be successful as an aggregator.

In the provision of some services, an unbundled electric utility adopting a service-oriented business model could face competition from an entity related to a TSO or DSO. While a TSO or DSO is not allowed to be active in the business of electricity generation and sales, this is not necessarily the case for the wider range of services that can be provided around the electricity supply system. Since a TSO- or DSO-related entity could have easier access to low-cost capital because of its regulated asset base (the electricity grid as well as gas infrastructure), such competition could be challenging for the unbundled electric utility.

THE DEFAULT OPTION: THE STATE-SPONSORED ELECTRIC UTILITY

As electric utilities in Northwest Europe are facing challenging times, these market players are reconsidering their strategies. Some utilities may successfully adapt to the

52 In the Netherlands, for instance, RES projects are exposed to some power market risks. The Dutch feed-in premium SDE decreases risks for investors, but it is capped; if wholesale prices fall below a certain level, investors do face losses.

53 The recent move by Google to acquire Nest Labs, producer of intelligent thermostats, could be interesting in this regards, as it shows how 'big data' and energy become intertwined. See BBC News, 13 January 2014, Google to Buy Nest Labs for $3.2bn, http://www.bbc.co.uk/news/business-25722666, retrieved on 22 January 2014.

54 Wall Street Journal, 2 March 2014, German Companies Take Back the Power, http://online.wsj.com/article/SB10001424052702304899704579390871434033460.html, retrieved on 3 March 2014.

altered environment. Some, however, may be unable to do so. The State-Sponsored Electric Utility is the utility that cannot adapt in time and is entering troubled waters.

In many sectors, a private company would default; however, if a utility's generation assets are essential for the security of electricity supply, the state may come to rescue, as has happened before in Northwest Europe. In 2002, the UK government had to provide state aid to British Energy in order to ensure system adequacy in the UK[55] (see Table 2 in Appendix B for a clarifying Q&A by the BBC). It is not unthinkable that, for some European electric utilities, a scenario may unfold similar to the 2002 events in the UK. However, the continental equivalent of this story could have a different ending.

Recovering wholesale prices in the UK enabled the UK government to step back again[56]. The renewed role for nuclear power in the UK fuel mix even created a new future for British Energy[57]. But if electricity wholesale prices do not recover, a prolonged situation can emerge, in which revenue streams from wholesale markets would not support 'legacy assets'[58]. Continued expansion of low-marginal-cost generation technologies may contribute to this, be it through subsidy-driven capacity additions, or through increased dominance of consumer logic in energy investments, as was explained in the previous section. If these legacy assets are at the heart of an electric utility's business model, this could imply the collapse of the utility. This risk will be greatest if the utility is prevented from abandoning such assets, namely on security of supply grounds.

55 See the press release by the European Commission on this subject: European Commission (2004), Commission Approves Restructuring of British Energy, http://europa.eu/rapid/press-release_IP-04-1125_en.htm, retrieved on 22 January 2014.

56 The Guardian, 30 May 2007, Government to Sell British Energy Stake, http://www.theguardian.com/business/2007/may/30/utilities, retrieved on 22 January 2014.

57 The Guardian, 22 December 2008, EDF Takeover of British Energy Cleared, http://www.theguardian.com/business/2008/dec/22/british-energy-edf-nuclear, retreived on 22 January 2014.

58 A recent warning by RWE can be viewed in this light. See Frankfurter Allgemeine, 21 January 2014, RWE-Chef droht mit früherem Atom-Ausstieg, http://www.faz.net/aktuell/wirtschaft/wirtschaftspolitik/folgen-der-energiewende-rwe-chef-droht-mit-frueherem-atom-ausstieg-12761770.html, retrieved on 22 January 2014.

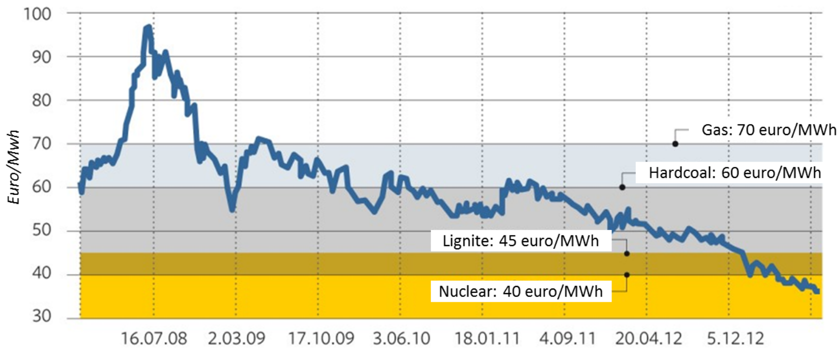


FIGURE 13. GERMAN ELECTRICITY PRICES (EEX) AND COMPETITIVENESS OF DIFFERENT TYPES OF POWER PLANTS[59]

It is important to note that a problematic situation can also occur when individual generation assets are still operated on a daily basis because of low marginal costs (think of relatively low fuel costs for nuclear power generation), while resulting revenue streams are insufficient in light of the wider range of liabilities of the utility (e.g. the wider liabilities around nuclear operations). Consider in this respect Figure 13, which shows cost estimates for different kinds of plants in Germany.

As explained in the first chapter, present national approaches to renewable support schemes, as well as capacity mechanisms, are at odds with the European integration process in the EU internal energy market. If a crisis situation emerges, as in the UK in 2002, national approaches to overcoming new challenges could become even more dominant[60]. The state or state-related entities may be forced to step into the electricity market. Despite a high amount of installed RES capacity, actual volumes generated with this RES capacity are modest relative to conventional volumes[61], as is shown in Figure 14. Generation from conventional plants is therefore unlikely to be ignored. Just as a British Energy default was avoided in 2002 through granting state aid, a similar story could unfold elsewhere.

59 Figure from Die Welt, 14 August 2013, Warum die Regierung bald Atomkraftwerke rettet, http://www.welt.de/wirtschaft/article119026760/Warum-die-Regierung-bald-Atomkraftwerke-rettet.html. The exact the cost levels are debatable. Die Welt indicates that data was provided by industry. If cost levels are in fact lower than indicated by industry, the situation could be less challenging at this moment. Nevertheless, the line-of-thought presented, combined with continued expansion of low-marginal-cost renewable generation leading to decreasing power prices, suggests a potentially challenging future.

60 One could ask the question of what the recent restructuring of Vattenfall reveals. Recently this Swedish state-owned company communicated that it would split its operations into a Nordic unit and a continental unit. See Financial Times, 23 July 2013, Writedown moves Vattenfall to restructure, http://www.ft.com/intl/cms/s/0/33d6abba-f38f-11e2-942f-00144feabdc0.html#axzz2kcykjkYc, retrieved on 22 January 2014.

61 As explained, in fact, it is not merely the substantial annual volume from conventional sources that counts; crucially, conventional assets play a vital role during hours that solar and wind capacity does not produce.

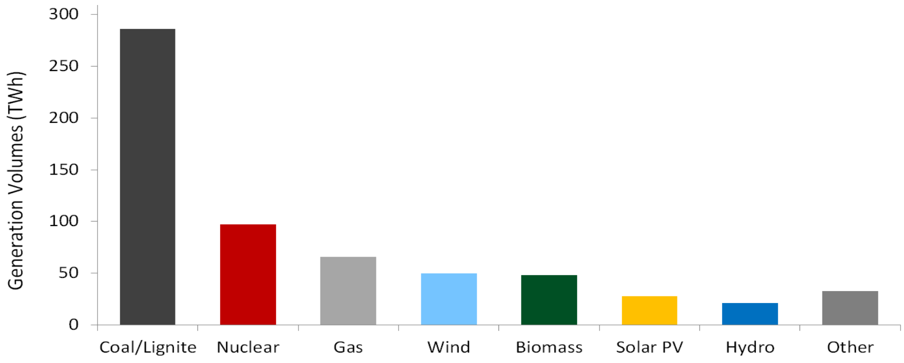


FIGURE 14. ELECTRICITY GENERATION IN GERMANY 2013[62]

It remains to be seen what the implications of an electricity crisis would be. Given the many challenges that lie ahead regarding the decarbonization of the electricity supply system, ad-hoc national approaches are not unthinkable. In a crisis situation, increased central coordination or even reintegration of previously unbundled entities could return to the political agenda. Ironically, from the perspective of present challenges regarding financing the decarbonization of the electricity supply system, there could even be advantages to such an outcome. As can be learned from Dieter Helm in his recent paper 'British Infrastructure Policy and the Gradual Return of the State'[63], a state-related entity could have easier access to low-cost capital. Moreover, a monopolist could have the debatable option to transfer 'market' risks to end-users (i.e. it could adopt a cost-pass-through approach). However, new entrants, new businesses or new business coalitions are likely to have relatively few opportunities to enter such a 'market', and it is questionable whether such an outcome is advantageous for long-term innovation in the electricity supply system.

62 Data from Agentur für Erneuerbare Energien, Strommix in Deutschland 2013, http://www.unendlich-viel-energie.de/mediathek/grafiken/strommix-in-deutschland-2013, retrieved on 20 March 2014.

63 Helm (2014). British Infrastructure Policy and the Gradual Return of the State. *Oxford Review of Economic Policy*, 29(2), 287-306. Available at http://www.dieterhelm.co.uk/node/1365. Retrieved on 20 March 2014.

CONCLUSION

With market liberalization, one function of commercial electric utilities has become the management of volume and price risks in electricity markets. Not only does this enable them to develop projects themselves, generate electricity and sell volumes to customers through a vertically integrated chain; it also enables other actors to develop generation projects. In the Dutch market, for instance, independent developers regularly seek long-term power-purchase-agreements with utilities in order to get RES projects financed; for utilities this means that they then effectively take over price and volume risks, presently strongly backed by public RES support schemes.

The picture that emerges in this paper is that the business logic for conventional generation projects as well as for large-scale RES has changed. Not only has conventional generation become riskier with decreasing numbers of running hours; there are also risks involved in new business models focusing on large-scale RES generation. Business model preferences could shift towards more service-orientated activities as opposed to electricity generation.

Such shifts in business model preferences do not only reflect the need for new business activities, but also reveal concerns of utilities regarding changing risk/reward balances in generation investments. If electric utilities consider volume and price risks in the Northwest European power market to be unmanageable and choose to avoid such risk, then the question arises as to which alternative parties will be willing and able to manage these risks. What type of actor will invest in future generation plants that are needed for security of supply? What kind of party will invest in RES projects or sign power-purchase-agreements with an (independent) RES project developer in order to make an offshore wind energy project or other project financeable?

An important first lesson from the exploration of business models presented here starts with two notions put forward in the first chapter. First, the present transition of the electricity supply system in Europe is policy-driven and, second, the electricity market can hardly be considered a natural market. A business model can only work to the extent that it fits well with the wider power market environment. Structural uncertainty regarding the way forward in the European decarbonization process translates into uncertainty regarding this environment, which in turn translates into uncertainty regarding the types of business models that can be successful. It is not only a challenge for electric utility strategists to develop a business model that works; it is as much of a challenge for public policy makers to guarantee a market environment in which business models can function.

A second lesson that can be learned relates to decarbonization policies, or more generally, energy transition policies. Building such policies merely upon one component of introducing new technologies and supplies in the market involves risks. Transition policies need another component. That is, they must also provide a framework for parts of the energy system that are set to decline but which do have a relevant role to play during the (long) transition phase.

In the electricity market, conventional power plants will be needed for years to come in order for the electricity system to function. Imagine that no business case can be made for assets that are required for the reliability of the electricity system and that a crisis situation emerges similar to the 2002 events in the UK. In such an instance, views regarding the decarbonization process may be affected and the transition could in fact be challenged.

APPENDIX A – FIGURES

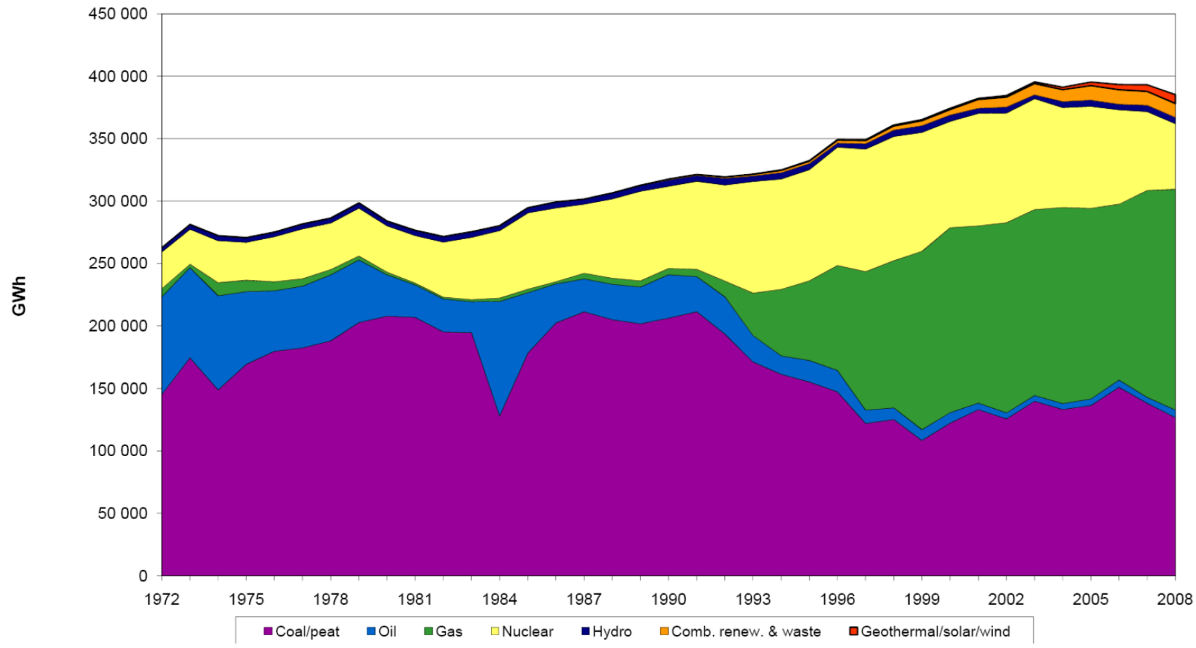


FIGURE 15. UK DASH-FOR-GAS IN THE 1990S (GWH)[64]

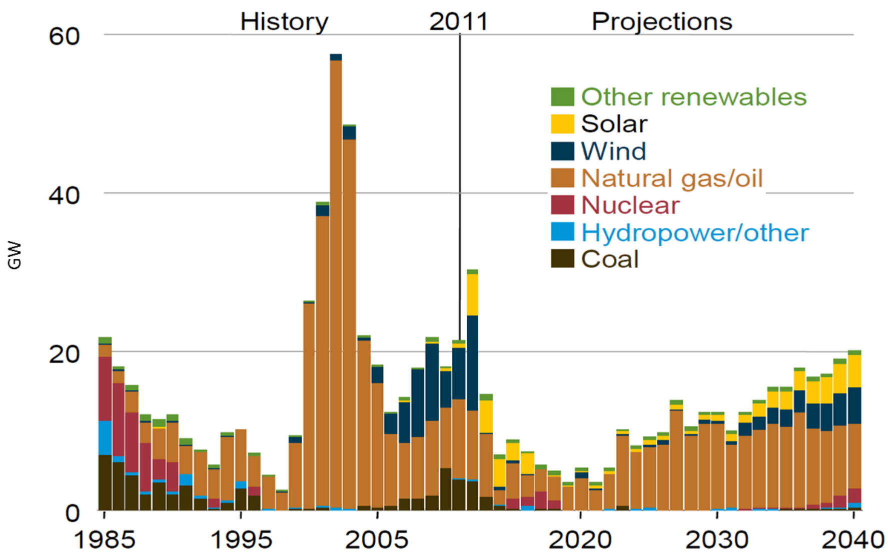


FIGURE 16. CAPACITY ADDITIONS US (GW)[65]

64 UK Energy Research Centre (2012), Case Study 9 - The Development of CCGT and the 'Dash for Gas' in the UK Power Industry (1987-2000), www.ukerc.ac.uk/support/tiki-download_file.php?fileId=2325, retrieved on 20 March 2014.

65 U.S. Energy Information Administration (2013), Annual Energy Outlook 2013 - With Projections to 2040, http://www.eia.gov/forecasts/ieo/pdf/0484(2013).pdf, retrieved 21 January 2014.

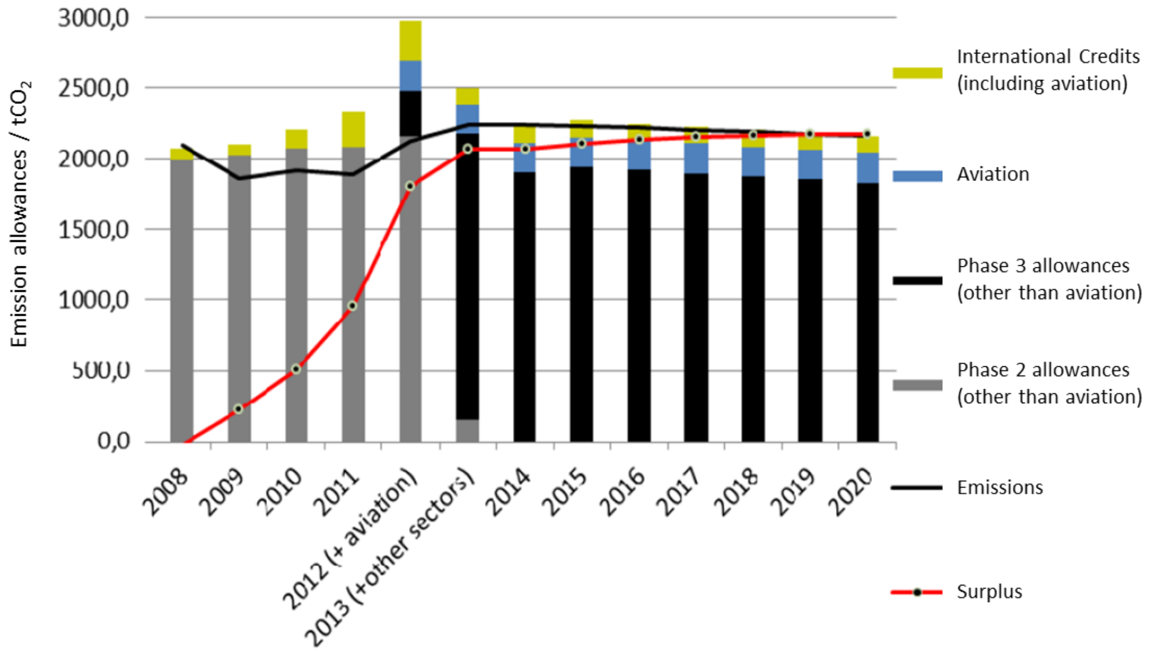


FIGURE 17. SUPPLY/DEMAND BALANCES IN THE EU ETS[66]

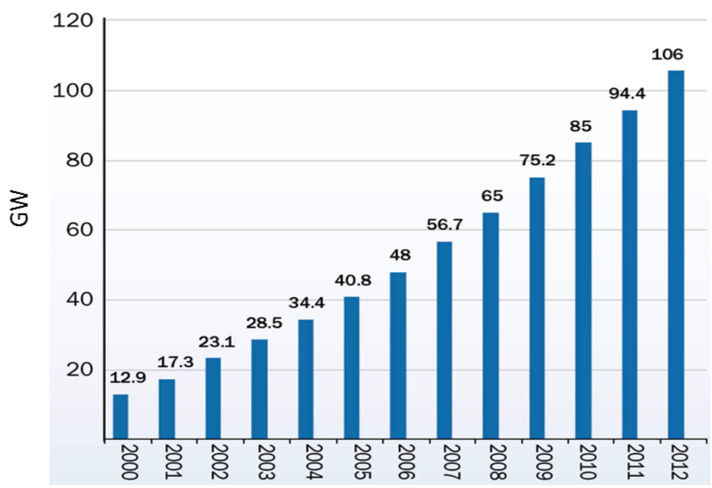


FIGURE 18. INSTALLED WIND CAPACITY IN EUROPE[67]

66 European Commission (2012), The State of the European Carbon Market in 2012, http://ec.europa.eu/clima/policies/ets/reform/docs/com_2012_652_en.pdf, retrieved on 21 January 2014.

67 European Wind Energy Association (2013), Wind in Power - 2012 European Statistics, http://www.ewea.org/statistics/european, retrieved on 21 January 2014.

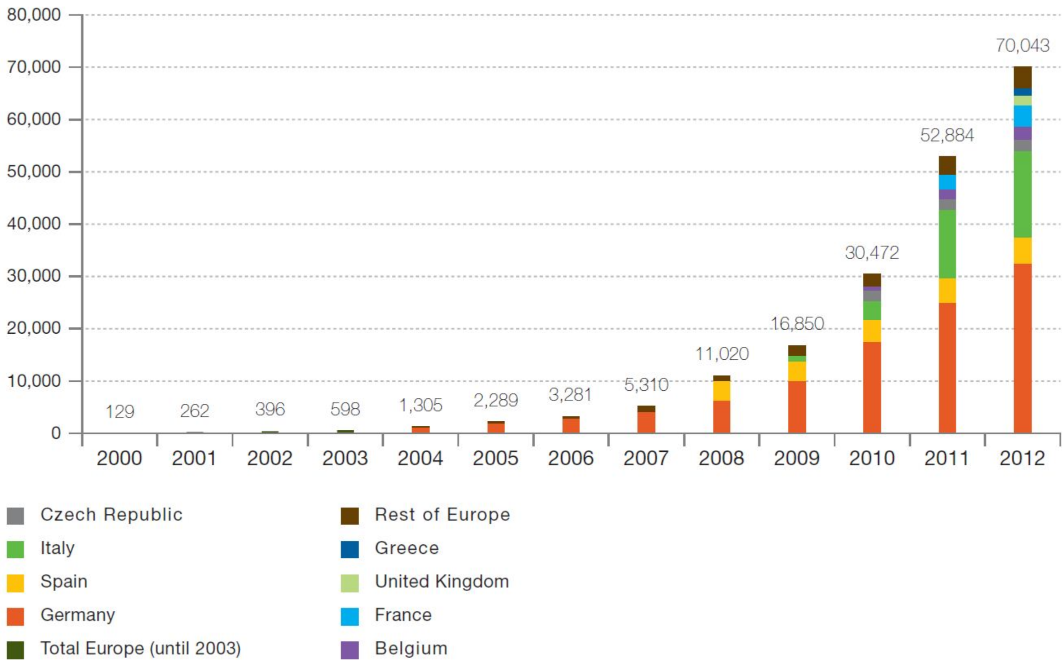


FIGURE 19. EVOLUTION OF PV CUMULATIVE INSTALLED CAPACITY 2000-2012 (MW) [68]

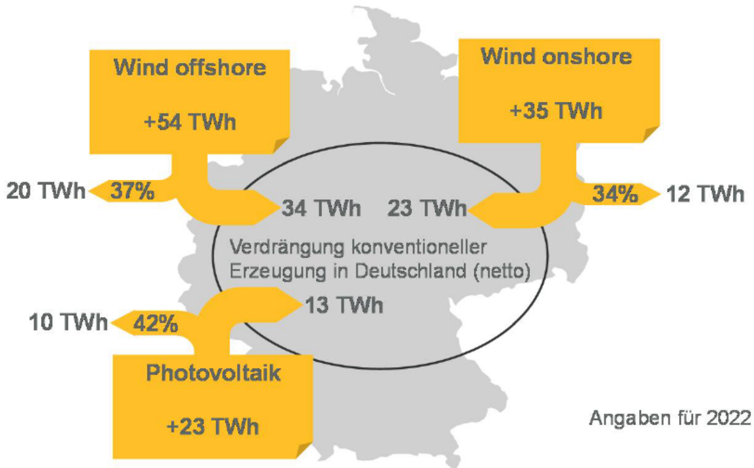


FIGURE 20. EFFECT OF RES INCREASES ON IMPORT/EXPORT BALANCES OF GERMANY[69]

68 European Photovoltaic Industry Association (2013), Global Market Outlook for Photovoltaics 2013-2017, Global Market Outlook for Photovoltaics 2013-2017, http://www.epia.org/news/publications/global-market-outlook-for-photovoltaics-2013-2017, retrieved on 21 January 2014.

69 RES capacity expected to be added in Germany in the 2012-2022 time-frame is only partly absorbed by the German market; substantial volumes will flow into neighbouring markets, i.e. 37% of generation from new offshore wind capacity, 34% of generation from new onshore wind capacity, and 42% of generation from new solar-PV capacity. in Institute of Energy Economics at the University of Cologne (EWI) (2013), Trendstudie Strom 2022 - Belastungstest für die Energiewende, http://www.ewi.uni-koeln.de/en/publications/studies, retreived 21 January 2014.

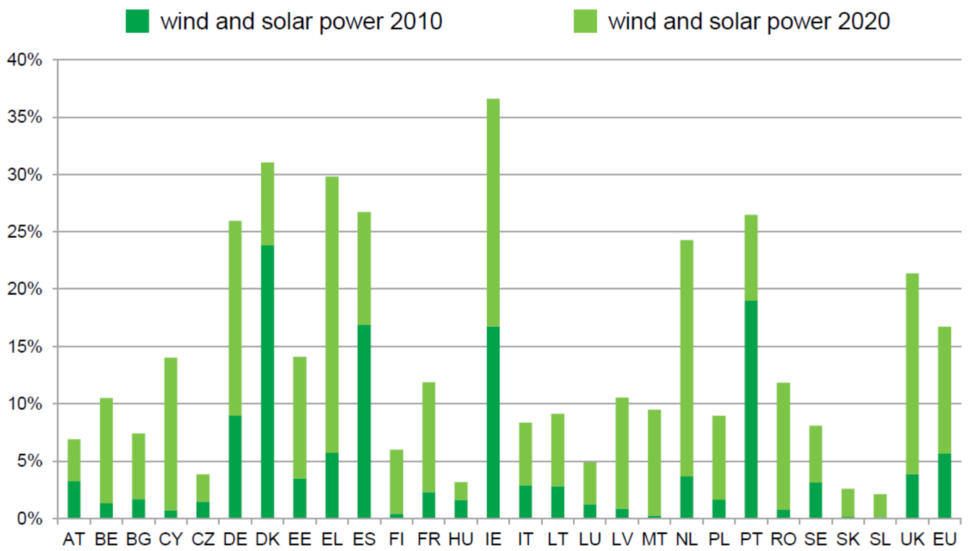
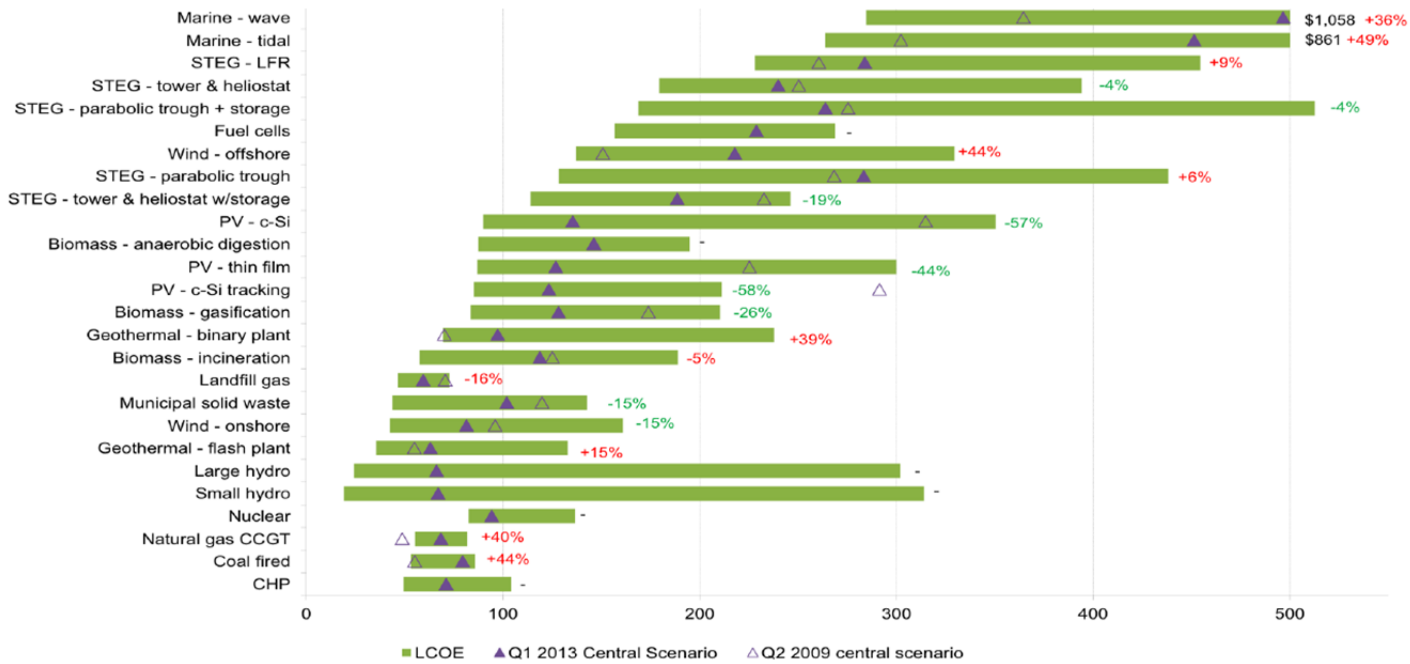


FIGURE 21. GENERATION FROM VARIABLE SOURCES, 2010 AND 2020 TARGETS (EC, 2013) [70]



CHP = combined heat and power; c-Si = crystalline silicon; STEG = solar thermal electricity generation or concentrated solar power; CCGT = combined cycle gas turbine

FIGURE 22. LEVELIZED COSTS OF ELECTRICITY ($/MWH)[71]

70 European Commission (2013), Energy Challenges and Policy - Commission Contribution to the European Council of 22 May 2013, http://ec.europa.eu/europe2020/pdf/energy2_en.pdf, retrieved on 22 January 2014.

71 Figure 26 in: Frankfurt School, UNEP Collaboration Centre, Bloomberg New Energy Finance (2013), Global Trends in Renewable Energy Investment 2013, http://www.unep.org/pdf/GTR-UNEP-FS-BNEF2.pdf, retrieved on 21 January 2014.

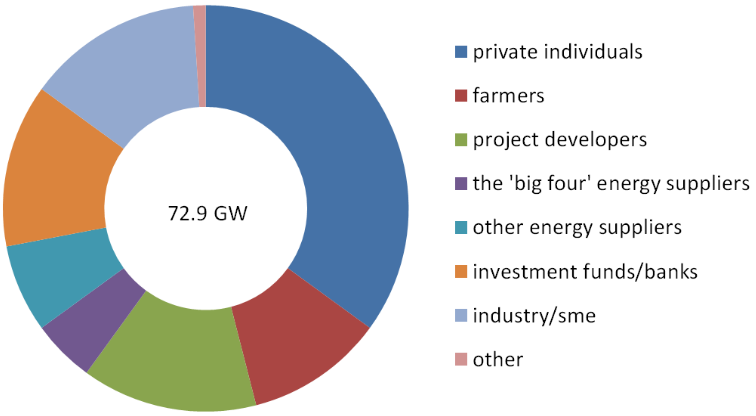


FIGURE 23. RES CAPACITY OWNERSHIP IN GERMANY AS OF APRIL 2013[1]

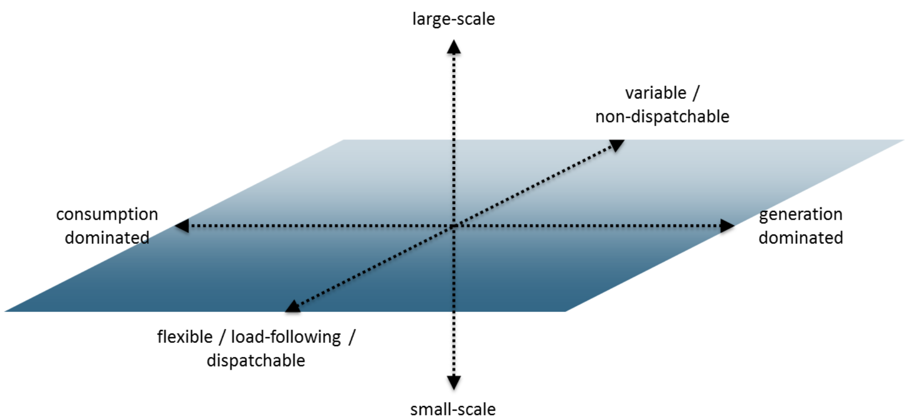


FIGURE 24. CLASSIFYING CLIENTS; USERS OF THE ELECTRICITY SYSTEM (CIEP-CLASSIFICATION)

1 Data from Agentur für Erneuerbare Energien, http://www.unendlich-viel-energie.de.

APPENDIX B – TABLES

Installed Capacities (GW)	2011 Reference	2023 Scenario A	2023 Scenario B	2023 Scenario C
RES				
Wind onshore	28.9	45.7	49.3	86
Wind offshore	0.2	10.3	14.1	17.8
Solar	25.3	55.3	61.3	55.6
Biomass	5.5	8.1	8.5	7.3
Hydro	4.4	4.5	4.8	4.8
Other	0.9	1	1.5	1.4
Other				
Nuclear	12.1	0	0	0
Lignite	20.2	18	17.6	17.6
Coal	26.3	31.9	25.7	25.7
Gas	26.5	23.2	33	33
Oil	3.8	2.7	2.7	2.7
Hydro-storage	6.4	11	11	11
Other	4.1	3.3	3.3	3.3
Totals				
Total RES	65.2	124.9	139.5	172.9
Total Other	99.4	90.1	93.3	93.3
Total Variable RES (solar & wind)	**54.4**	**111.3**	**124.7**	**159.4**
Max Peak Load (max demand)	**86.4**	**84**	**84**	**84**

TABLE 1. FORECASTS BY GERMAN TSOs REGARDING FUTURE INSTALLED CAPACITY IN GERMANY[72]

72 50Hertz, Amprion, TenneT TSO und TransnetBW (2013), Netzentwicklungsplan 2013, http://www.netzentwicklungsplan.de/content/netzentwicklungsplan-2013-zweiter-entwurf, retrieved on 22 January 2014.

Q&A BRITISH ENERGY CRISIS, BBC NEWS, THURSDAY, 28 NOVEMBER, 2002

The future of the UK power giant British Energy has been on the line since September 2002. The firm, which was privatised in 1996, made a loss of £500m in the past financial year and had to go cap-in-hand to the government to ask for cash. A total of £650m in emergency funding was granted but the group had until 14 February to sort out new financial restructuring or face administration. BBC News Online looks at what went wrong.

Is this another Railtrack-style fiasco in the making?

There are certainly some similarities. It is another privatised company that has had to go to the government and beg for money to save it from insolvency. And once again the government seems to have got rid of a state-owned company without getting rid of its responsibility for that business. But in other ways, this is very different from the Railtrack situation.

Please explain?

You could argue that many of Railtrack's problems were simply down to bad management. But the reason British Energy is losing so much money is that the price of electricity on the wholesale market has dropped 40% in the past four years. It is costing more for the company to produce electricity than it can earn from selling it in the marketplace. The sums just do not add up.

Why has the price of electricity fallen so much?

It is because the wholesale market was opened up to competition after years of inefficiency and price-rigging. There was too much electricity available and with more companies vying to sell the electricity, the price was forced down. Competition also exposed the fact that many of the plants being operated were uneconomic. Julian Sinclair, a fund manager from Gartmore, said it was not just a problem for the electricity industry. 'It happens in many industries where competition is opened up and so many people come into the industry that... supply exceeds demand and prices fall and players have to exit again.'

So British Energy is not the only one with problems then?

No, British Energy is not alone. All of the electricity generating companies are struggling to make money at the moment. Some generators have switched off plants while others have defaulted on debt repayments and one has gone bust.

But British Energy's problems are more serious than those of its peers because it is a nuclear power producer. That means it cannot simply switch off generators when prices fall. Big rivals such as Scottish Power and PowerGen also deliver power to end-users who pay the full price for electricity. That cushions them from the effect of a fall in wholesale prices. British Energy cannot do this as it does not have a retail arm.

Could it be game over for British Energy then?

That scenario is very unlikely. With British Energy supplying a quarter of the country's electricity, that would leave a very big hole in the electricity grid. The BBC's business correspondent Hugh Pym says that, if BE folds, the government is likely to take over the running of the company since it is a major creditor. But advisors have suggested a more likely scenario is for creditors to swap the £1.3bn debt owed to them by British Energy in return for a stake in the company. At the moment there is no money and little incentive to build new power stations. And it is hard to see who would run the nuclear stations in BE's absence.

Could the government come to the rescue?

British Energy says it needed the government cash for its immediate survival. The government meanwhile has insisted there is no question of taxpayers handing a blank cheque to British Energy. So while the emergency loan has been extended, no fresh cash has been injected by the government. But we are talking about a nuclear power company, and the government has said it has to be involved because it has a responsibility for the safety of nuclear power. Which is why the government has agreed to underwrite the multi-billion pound clean-up risk which British Energy would face if disaster struck.

What about the shareholders?

It looks like one of those investments where shares can go down as well as further down. If bondholders and creditors accept a large stake in the company in exchange for the debt, that will leave a much smaller piece of the pie to be divided among the other shareholders. They were worth 80.75p when British Energy announced it was appealing to the government for help earlier this month. And when trading resumed after the first emergency funding deal, they quickly slumped more than 80% to 14p. That have since fallen further to 6p per share.

TABLE 2. BOX: Q&A BRITISH ENERGY'S CRISIS FROM THE BBC[73]

73 BBC News, 28 November 2002, Q&A British Energy Crisis, http://news.bbc.co.uk/2/hi/business/2247019.stm, retrieved on 22 January 2014.

CLINGENDAEL INTERNATIONAL ENERGY PROGRAMME | CIEP

VISITING ADDRESS
Clingendael 12
2597 VH The Hague
The Netherlands

POSTAL ADDRESS
P.O. Box 93080
2509 AB The Hague
The Netherlands

TEL +31 (0)70-374 66 16
www.clingendaelenergy.com
ciep@clingendaelenergy.com