Towards a sustainable market model

Why there is a need for a modified market model

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Management Summary

The current electricity industry framework is designed around large scale fossil generation whereas the new energy world is centered around renewables. This leads to strange price signals, instability and increasing discussion within society over the unplanned side effects of the ongoing energy transition (tax & levies increase, perceived market distortion and doubts whether the security of supply is guaranteed in the long run). In on-going discussions, various solutions are being proposed, focused on repairing the existing market model in favor of certain participants and nearly always involving additional support mechanisms.

The fundamental issue is however that the current market model is not robust for the new energy world. As renewables will keep on growing and conventional generation will keep on shrinking, this problem will not solve it self. A structural solution in the form of a modified market model is therefore needed.

This presentation describes the need for a modified market model by analyzing the major issues of the current market model; the first part describes how we are currently moving from a market with some regulated elements towards a regulated system with some market element. The second part is focusing on the deeper effects; what are the real problems for the relevant stakeholders in the current framework. The analysis is based on the assumption that an electricity industry framework should enable continuous growth of renewables and maintain security of supply at reasonable low costs, assured by a well functioning (European) market (rather than being driven by detailed regulation and subsidies).

The main ‘red flags’ in the current market framework are the decreasing share of the market, the increasing dependency of intermittent renewables on subsidies, the various ‘free rides’ and ‘vicious circles’ related to back up power, taxes and levies, the lack of price incentives to limit the total costs of the energy transition and the jeopardizing of the single European Electricity Market by diverging (national) repair actions.

Introduction project “Towards a Sustainable Market Model”

- The current Electricity Industry framework has been designed at end of last century, based on
  - a system with a back bone of large scale generation
  - relative stable & predictable energy flows
  - intermittent renewables being a minor part of the energy mix
  - a roadmap towards a common European Energy Market
  - hassle free “don’t worry about technical constraints” energy market

- The new energy world is however centred around intermittent renewables, implying that the assumptions underlying the current framework are not valid anymore. In addition, several market elements are becoming unstable

- Working hypothesis was that a significantly modified market model is needed; to demonstrate that, we need to have an overarching vision why the current framework is not appropriate anymore

- UMS and E-bridge have done an analysis to come to such an overarching vision. We have discussed this analysis with various stakeholders (seven peers, in management positions with respectively a Stadtwerke, a Scandinavian utility, a Process Industry, a new entrant, an investor, a gas company and an energy exchange) in order to sharpen our vision and gain momentum to change the current framework. Results are embedded in this slide pack

- This “take off analysis” is commissioned by TenneT. To further bring this initiative forward, it is important it is supported by a wide range of stakeholders in Europe.

Content

- **Market share of the Market: Subsidized and Regulated Categories are rising at the expense of the Market Based Categories**
- Discussion of adequacy current model
- Conclusions

Introduction Electricity Market Structure

• The electricity market in most European countries has been liberalized in period 1995-2000, within the framework of the European Common Market

• Core principles:
  • Market based[(1)]: energy production, sales, trading and portfolio management
  • Regulated: grid infrastructure and system management
  • Exempted from Market: renewable production
    • reason was observation that renewables could not (yet) compete pricewise on the free market, but that they are needed to come to a sustainable energy supply and hence worth supporting. Member states got freedom to design national support schemes

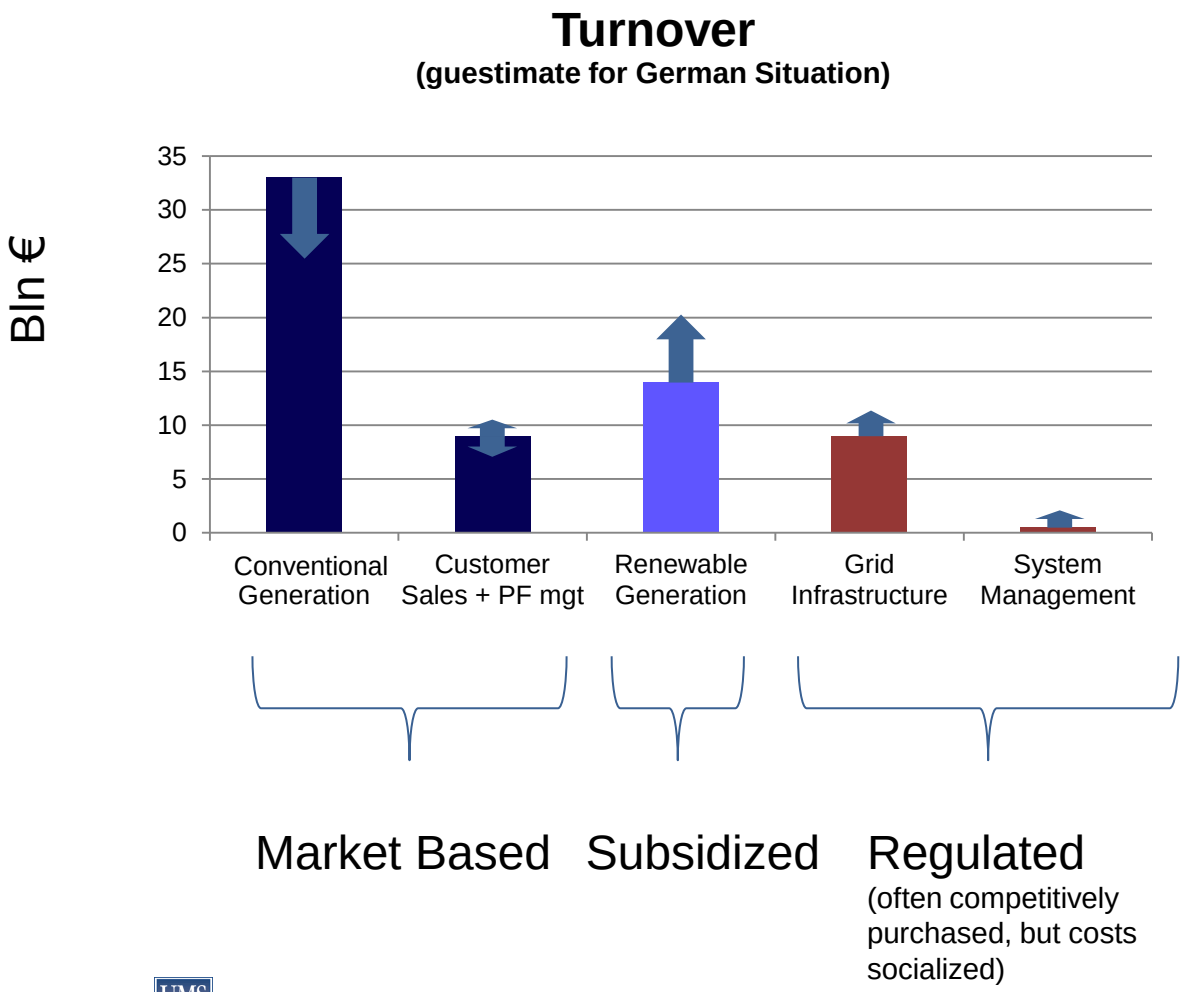
• Above design principles resulted originally in an electricity bill which was for the majority dependent on market based prices. Impact of renewables was small, both on the functioning of the total system as well on the energy bill

• In recent years, renewables have been growing fast and are contributing significantly to the 2020 targets. However, they are also impacting the functioning of the total system

•In next slides, we will discuss how the ratio in turnover of market based elements versus regulated & subsidized elements is changing.

[(1)] Definition Market : many buyers and many sellers determine the price without significant government influence

The Electricity Industry Framework: Subsidized and Regulated Categories are rising at the expense of the Market Based Categories



Conventional Generation (incl hydro): ~500 TWh
Weighted average price 65 e/MWh → **33** bln.
(2012 assumption; for 2013 lower prices)

Renewable Generation (in EEG): ~100 TWh.
EEG :**14** bln in 2012, 20.4 bln in 2013

Customer Sales + PF mgt: ~ 600 TWh
~15 euro gross margin per MWh → **9** bln

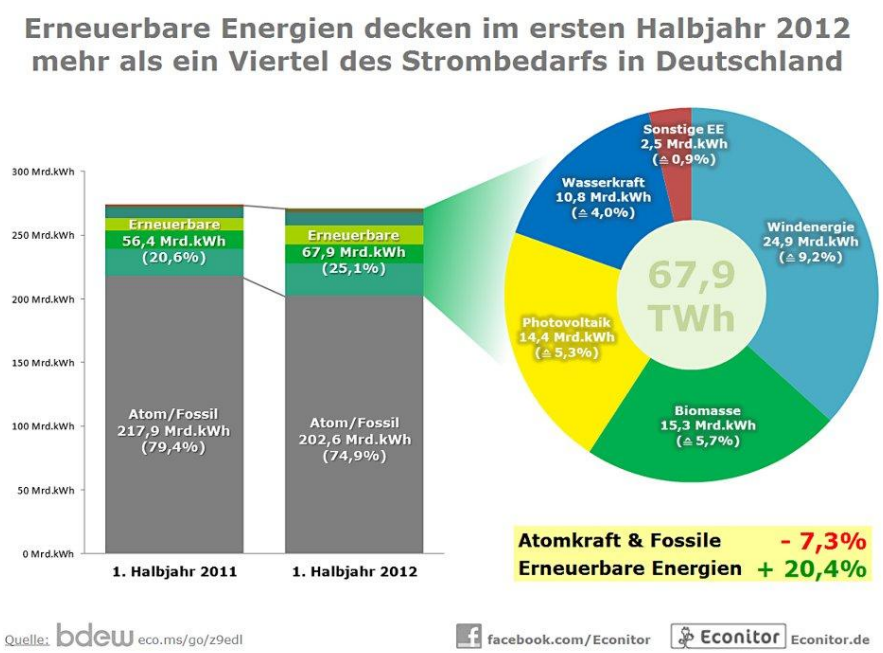
Grid Infrastructure: **9** bln
(~4 bln investments plus ~5 bln opex and profit)

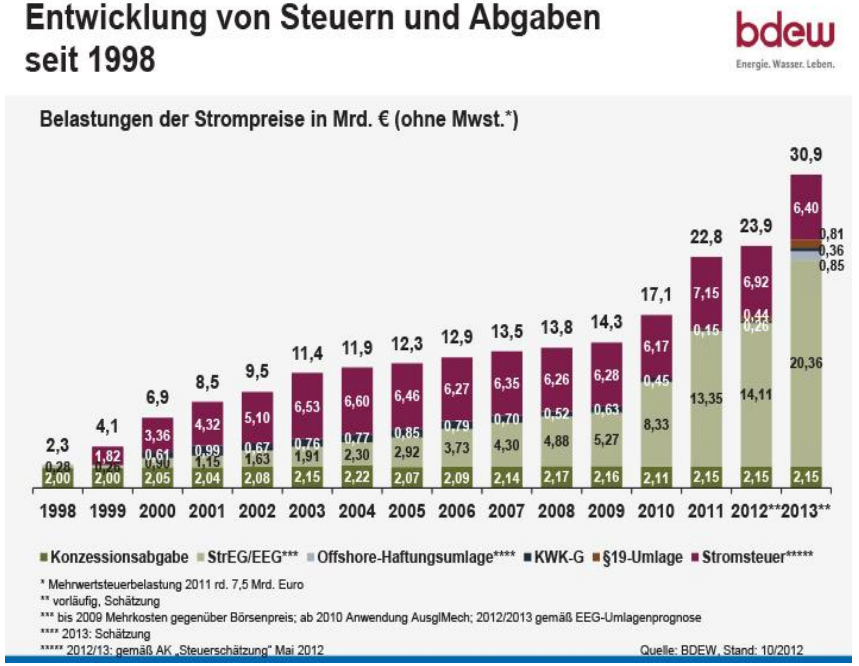
System Mgt: **0.5** bln
(based on 5000 MW balancing power @ 100 e/kW, excluding the energy component))

Note: BDEW estimates 65 bln turnover (2010, all excluding taxes)

Turnover of “subsidized business” is rising as subsidized renewables form a steadily increasing part of the electricity mix

- Market share of renewables is growing
- Support level of the 2 fastest growing categories is ~ 100 (wind) and ~200 (solar) e/MWh [(1)]
- Renewables will keep on growing
- Germany is leading the pack, but trend is same in all EU countries
- Trend will continue, as subsidies are guaranteed for 12 to 20 years and there is still a growing number of installations

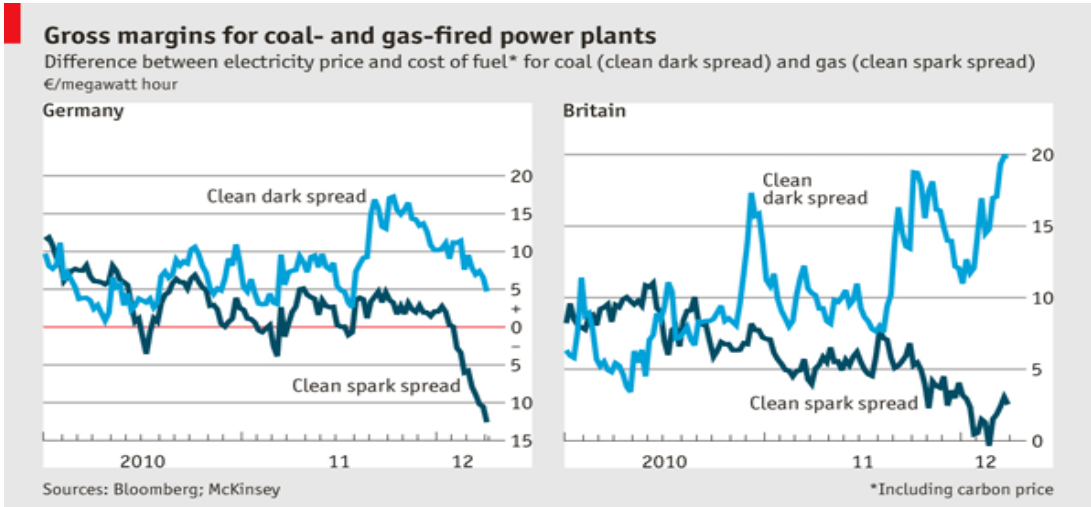




(1): exact support depending on wide range of factors

Turnover of “Market based generation” is dropping, as both volume and price of conventional generation are dropping fast

- Total Energy Consumption is stable, so growth in renewable energy means less traditional energy needed
- In addition, Market Power Prices are dropping, as renewables have 0 euro/MWh marginal costs
- So less Volume for Lower prices means less turnover. As coal and carbon prices have been dropping, but gas has been relative stable over last 2 years, this means that Gross Margin (“spark spread”) for Gas Power stations has become very low.



- Customers service and trading is not materially impacted by the market changes

On European scale, market reports suggest more focus on shorter term trading and more divergence between markets

Endex Review of 2012: Differences in European Electricity prices

"For the first time in years, markets witnessed differences in electricity prices between European countries. Price differences had been reduced as of 2006 after the introduction of the initiative called market coupling. This mechanism created substantial reduction of price differences in 2007 and further. In 2012, the price differences have started to increase again; this is evitable from the decreasing convergence between the markets in Central West Europe (CWE). While the price convergence within the entire CWE region in 2011 was 66%, during 2012 it was 46%. "(www.apxendex.com)'

EEX Review of 2012: Trend towards shorter term trading

"On the **Power Market**, the trend towards short-term trading continues. On the EEX Derivatives Market, the trading participants were increasingly active in short-term maturities, while they concluded fewer long-term trading transactions. For example, in 2012, 18 percent more power than in 2011 was traded in the day, weekend, week, quarter and month contracts on the Phelix Futures Market. In the year contracts, on the other hand, a volume which was 22 percent lower than in the previous year was generated." (www.eex.com)

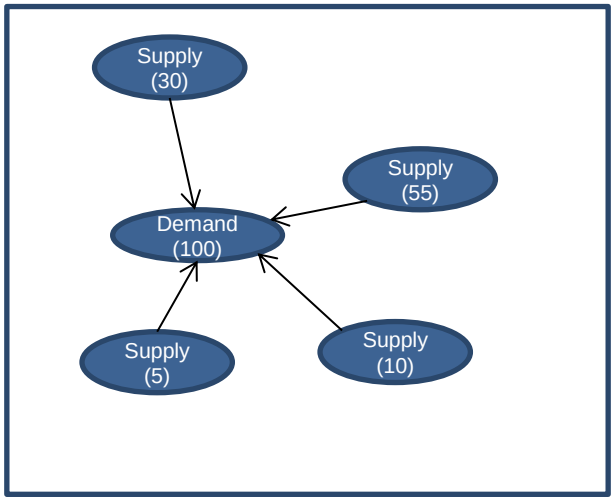
- Diverging prices between national markets can/should be interpreted as a signal that more import/export lines are needed. Fundamental driver of the increasing price differences seems however the diverging national regulation (and not country specific structural advantages within a common European Framework)

- The long term price signals are becoming less relevant/reliable to incentivize investments with long lead times.

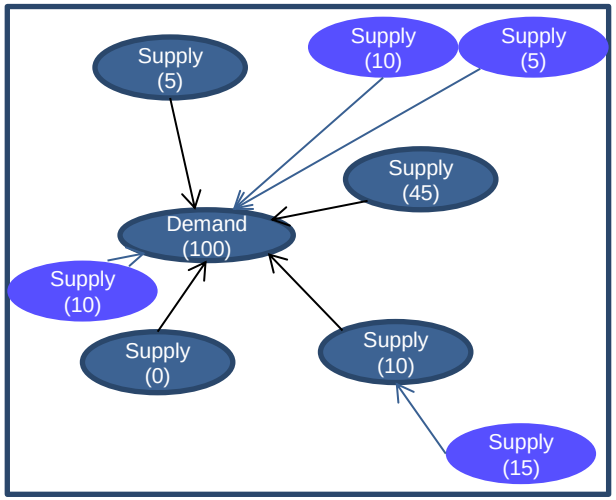
Turnover of “Regulated business” is rising, as the grid infrastructure is being expanded…

- Grid infrastructure is being expanded because
  - New generation is coming from new geographical locations (“wind at sea”)
  - New generation is coming from new parts of the grid (“solar panels in dispersed LV/MV grids”)
  - More flexibility is needed, as the split generation node/demand node is becoming less clear and most ‘traditional’ generation nodes are still needed (fact that it is needed less hours does not make a difference for the grid capacity planning)
  - Demand is (in general) inflexible; no “demand follows generation” trend
  - Building new transport capacity is seen as the preferred solution for enabling energy transition, irrespective of economics (socialized costs, so ‘nobodies’ problem).
  - Above effects result in higher costs per MWh_demand

Old System: few generation centres, well connected (over many years) to load centres



Current System: many generation centres, not all yet well connected to load centres



.. and role of system management is increasing

Regulated part of business is growing

- more effort needed to deal with locational constraints (see previous slide)
- more short term constraints (due to the intermittent character of renewables)
- divergence in approach of “security of supply” and “energy transition” between the various European countries

- Achieving security of supply is partly market based, partly regulated
  - on locational level (“local transmission constraints”), it is arranged by the SO
  - The SO is typical also responsible for the very short term security of supply on a (sub)national level
  - the short term security of supply (enough generation for tomorrow) is seen as task of the market;
  - the long term security of supply (“enough generation in 2015”) is also seen as a task of the market. However, in most countries, the SO reports on this and there is increasing discussion on this theme.

- The generation portfolio is expected to guarantee continuity of supply for 100% of the customers; however only a decreasing percentage of the generation portfolio can contribute

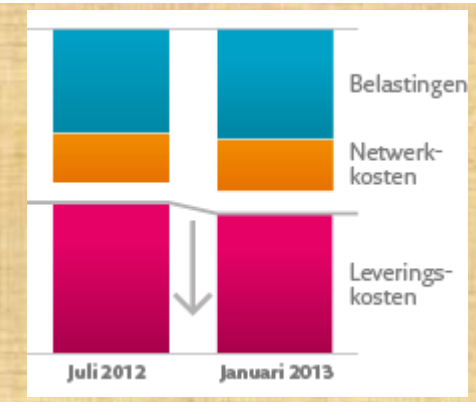
  Example: in a portfolio with 30% wind, 30% solar and 40% conventional generation, the 40% conventional generation needs to guarantee the continuity of supply for 100% of the customers

- Also “EU” sees increase of (possible) interventions, as demonstrated by their recent consultation paper

  “In this consultation we ask whether and how we can work better together to ensure a more coordinated approach to assessing generation adequacy and security in the internal electricity market. We ask also for views on different types of capacity mechanism and more detailed criteria, based on the principles of necessity and proportionality, which capacity mechanisms and other interventions should meet”
  http://ec.europa.eu/energy/gas_electricity/consultations/20130207_generation_adequacy_en.htm

The electricity market structure is moving from “market with regulated elements” towards a “regulated system with some market elements”

Example: Explanation bill to a Dutch customer

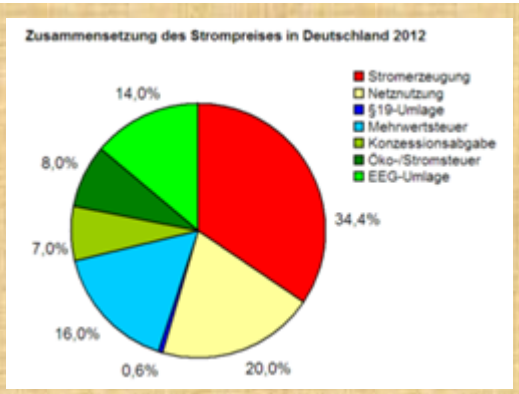


Essent heeft de leveringstarieven per 1 januari 2013 verlaagd. Een aantal vaste onderdelen op de rekening is echter gestegen, zoals netwerkkosten en belastingen. Hier heeft Essent geen invloed op. Per saldo blijft de totale energierekening bij een gelijkblijvend verbruik nagenoeg gelijk

Zo is de energiebelasting gestegen, is er een nieuwe post op de rekening gekomen namelijk ODE (opslag duurzame energie, een overheidssubsidie die investeringen in duurzame energie mogelijk moet maken) en zijn de netwerkkosten (afhankelijk van welke netbeheerder de klant heeft) gestegen

Summary translation: “Supply costs went down, however as Energy tax and grid costs are rising, total bill remains the same”. Source: RWE-Essent

Example: Explanation bill to a German customer



Im Zusammenhang mit der Diskussion um den starken Anstieg der EEG-Umlage 2013 weist der Bundesverband der Energie- und Wasserwirtschaft (BDEW)
darauf hin, dass der Anteil der staatlichen Steuern und Abgaben am Strompreis für Privatkunden im nächsten Jahr erstmalig auf voraussichtlich rund 50 Prozent steigen wird.
Gründe dafür sind nach ersten Berechnungen des BDEW die stark gestiegene EEG-Umlage für das Jahr 2013 mit 5,277 Cent pro Kilowattstunde und weitere gesetzliche Umlageregelungen.
Die Bundesnetzagentur geht davon aus, dass auch die Netzentgelte, die heute veröffentlicht werden, im nächsten Jahr steigen. Auf der Basis der Netzentgelte wiederum werden in den nächsten Wochen weitere staatlich festgelegte Preisbestandteile wie die Umlagen nach Paragraph 19 der Stromnetzentgeltverordnung und nach dem Kraft-Wärme-Kopplungsgesetz ermittelt. In die Netzentgelte wird auch die neue Offshore-Haftungsregelung aufgenommen. All diese Strompreisbestandteile werden entsprechend ansteigen. Allein für die Förderung der Ökostromerzeugung nach dem Erneuerbare-Energien-Gesetz (EEG) müssen die Stromkunden im Jahr 2013 voraussichtlich insgesamt etwa 20,4 Milliarden Euro (Mrd. Euro) aufbringen (2012: 14,1 Mrd. Euro, 2011: 13,4 Mrd. Euro, 2010: 8,3 Mrd. Euro).

Summary translation:“2013 prices went up due to various taxes and levies to support energy transition, expectation is that in addition grid costs will rise. Trend will continue in coming years”. Source: German Energy and Water Industry Organization BDEW

Content

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Discussion of current implementation issues
Is the current market model still adequate ?

In previous slides, we have showed that the current system design is leading to increase in regulated/supported turnover and decrease in market based turnover.

- this is not in line with the goal of the liberalization
- however, we also need to understand the deeper effects; what (if any) are the real problems for the relevant stakeholders

In coming slides, we will look at the mid term (~ 5 years) implementation effects of the current system design for

- conventional generation
- renewable generation
- grid infrastructure
- system management (including security of supply)
- customers & portfolio managers

The desired effects (in random order) are

- to enable continuous growth of renewables
- achieve a well functioning (European) *market*
- keep reasonable low costs
- maintain security of supply

Conventional generation: related market design issues

Trend

- Fewer running hours (demand stable, renewable generation grows)
- New units are still being commissioned (based on decisions in 2007-2009), some old units are being decommissioned
- Increasing requirements in flexibility of generation (operating planning for week, day, intra-day)
- Lower energy prices
  - Number of hours per year with strong competition is increasing. Prices are equal to ShortRunMarginalCosts. SRMC are decreasing due to increasing share of renewables with neglectable SRMC.
  - Only few price spikes, as apparently there is ample capacity, even during peak periods (periods of few renewable generation and high demand, e.g. foggy Monday morning)
  - After a period of overcapacity, significant price peaks are required to attract investments (fixed cost coverage)
- Some generators are experiencing that their running hours are increasingly determined by congestion management instead of the market. Income is highly regulated. The plant has hardly any (dis)advantage of its location.

TenneT reserviert Irsching 4 und 5 für Redispatch

…. Die aktuelle Vereinbarung fußt auf der Festlegung der Bundesnetzagentur, dass für Kraftwerke, die mehr als zehn Prozent auf Anforderung des Übertragungsnetzbetreibers laufen, die Übernahme der Fixkosten zur Abfederung der wirtschaftlichen Nachteile für den Kraftwerksbetreiber möglich sind…
Publication date: 26 April 2013, TenneT Website

Consequences

- There is overcapacity, so closing of some units is a normal course of action.
- Congestion management revenue will not incentivize investment decisions (incl. life time extensions), as it is based on SRMC
- Role of conventional generation is moving towards a back-up and reserve function and covering of heat & steam demand
- New investments (incl. life-time extensions) will be needed after the overcapacity period is over and in case the flexibility of existing units is not sufficient. Incentives for new investments may not be adequate.
  - As the risk profile of investments increases also the ROI requirements will increase. A business case based on making 20 euro over 5000 hours is much more attractive than a business case based on making 2000 euro over 50 hours.
  - Also, there may be a limited market for trading the higher risk premiums. Investors in a 2000 Euro 50 hours plant will try to hedge his risk by selling long-term high-price insurance, but the willingness of buyers will be limited due to price caps on exchanges, lack of political or regulatory acceptance of high prices, and comfort in other price damping activities and believe that ultimately the SO/government will rescue them

Related market design issues

- Missing money problem of energy-only markets will become more apparent. Market design is based on dispatch, not on investments
- Lack of acceptance of high price peaks
- No adequate market to trade back-up power (only sellers, no buyers as they have no incentive)
- No locational incentives

Renewable generation: related market design issues

Trend

- Continuous growth in installed capacity all over Europe
- Wind on Sea is suffering from grid connection problems in the transmission grid
- Costs reduction of wind generation is stagnating , decrease of generating costs of PV is slowing down
- Supporting schemes for new generation in PV are declining, but total subsidies are increasing due to growing volumes and long-term commitments. Increasing discussion within society about the costs.
- CO_2 market has become irrelevant, because the prices are very low.
- Renewables impact the market price in a significant way, but not vice versa.

Consequences

- Investments in PV will grow further, even in case subsidization will be reduced (driven by avoidance of tax, EEG levy, and other tariff components)
- The need for subsidies is increasing, as market prices go down
- Risks of unwillingness of society to pay is increasing in European markets (see Belgium, Czech Republic, recent comment of Altmaier) and this start impacting investment decisions (investors realize high likelihood of changes in tax and regulation)
- No risks for renewables from system or network congestions – i.e. free ride on the system
- After fade out of the subsidization schemes, renewables will hardly be able to earn any fixed costs (no relevant income; the more wind and solar will be installed, the lower the energy prices during the windy and/or sunny moments; this effect will be smaller when there is ample import/export capacity as the correlation on a European scale is less)
- In most countries, renewable generation is not directly responsible for the balancing costs they are causing (e.g. small household PV) – free ride
- Renewables, which were planned to be driven by the CO_2 abatement schemes, become solely depending on subsidies

Related market design issues

- In an renewable dominated energy-only market, renewables will always depend on subsidies, because they cannot recover their costs
- No locational incentives
- The reserve requirements posed by renewables are socialized, which is becoming an issue due to their growing market share
- Interrelation between CO_2 market and the support systems for renewables are ignored
- Investors are increasing holding back investments in anticipation of an end to the political uncertainty. I
- The different subsidy schemes in Europe hinder the common European Market

Grid infrastructure: related market design issues

Trend

- Grid infrastructure is being expanded, as generation gets more dispersed, both in location as well as in time
- No optimization between network and generation leading to increasing redispatch requirements
- No efforts from the renewable generators to adapt their planning to the planning and approval of the grid modification
- Smart grid penetration moves slower than expected, due to an unclear business case
- Volatility of physical flows is increasing, giving more operational risks

Consequences

- Planning of renewable plants while the grid capacity is not sufficiently available is creating additional stress on the network operator, which may lead to sub-optimal decision-making (incl. risk of stranded investments).
- Mismatch between the commissioning of the renewable plants and the network expansion leads to unnecessary overall costs (higher equipment costs, personnel costs, higher financing costs, etc.)
- Grid constraints have to be solved by redispatch, this leads to higher operational costs & risks
- Increased costs per “MWh consumed” as a larger grid is needed despite stable (or decreasing) energy consumption.

Related market design issues

- No locational incentive means there is no push for new generation to look for grid synergies. Increasing amount of redispatch gives a stronger impact of the regulated sectors of the value chain
- The infrastructure with the longest lead and life times (grid; > 5 years lead time, 40 year life time) has to follow shorter lead and life time infrastructure (renewable generation; < 5 years lead time, 15 year life time) but there is no incentive for generators to adapt their planning schedule to the grid expansion.
- Strong focus on physical grid expansion. Alternative solutions to minimize overall costs are difficult to implement, because grid expansion is the only possible solution for technical constraints in the current framework.
- Market design does not incentivize avoiding technical constraints (on the contrary), leading to potentially higher costs than needed and hindering the business case for smart grids.

System management: related market design issues

Trend

- Increasing need for Back Up power, due to the growth of intermittent generation (both for a well predicted cloudy foggy morning as well as for misprediction in wind/solar forecast)
- Increasing risk that the physical demand and generation equilibrium is distorted well before real-time. (e.g. several hours due to weather forecast risks and/or insufficient “flex” in the system)
- Pressure on system operators to pay ‘system security of supply’ premiums to generators. Increasing interest in capacity markets. Increased attention for demand side management, but limited incentives due small influence on total energy bill
- System Adequacy investments are seen as a national government responsibility, rather than a European task

Consequences

- Unclear how to cope with the increasing need for back-up and reserve power. Will the market provide enough ‘flex’ or should the System Operator step in?
- Unclear risk reward trade-off in contracting SR and TR (how much to contract for what price)
- Impact of System Operator is rising as it is directing more money flows
- No diversification in Continuity of Supply possible (apart from very large customers)
- The increased focus on national capacity payments means that Common European energy market is starting to break up and being replaced by national regulation
- No incentive for innovation (storage, “demand follows supply” projects etc.)

Related market design issues

- Unclear rules for the “right” level and location of Back Up power
- Unbundling means no integrated planning, however there is an increased need for that
- Limited incentive of the market to take their responsibility related to the Security of Supply
- Capacity premiums are clearly not part of the original market design and can be seen as a repair attempt, with unclear consequences
- Divergence of “Back Up”-premiums paid across Europe lead to a distorted European energy market

Customer Sales & Portfolio Management: related market design issues

Households/Small Companies

Trend

- Energy bill consists of an increasing amount of socialized costs (such as taxes, levies and grid costs)
- Energy bill is rising, without many possibilities to influence it.
- Retailers are eager to find their role in the energy transition
- Increasing risk of 'fuel poverty'
- Increasing awareness of costs associated to Energy Transition

Consequences

- Looking for ways to avoid the levies and taxes, buy installing own generation (solar, micro CHP) to reduce off take from the grid, using the 'banking' for free (increase in 'free ride' behavior)
- The more people avoid the levies and taxes, the higher the bill the remaining people have to pay, further stimulating avoidance of levies (vicious circle)
- Fuel poverty and risk of social injustice, as people in cheap rental houses have no possibilities to install own generation and de facto subsidize the energy of the wealthier home owners.

Related market design issues

- Clear incentive to install own generation (renewables/micro-CHP)
- No incentive to contribute to adequacy of the system, but strong incentive to use the 'free ride' of back up power
- Limited reaction on short term price signals, as nearly everything is in taxes and levies

Mid size/Large Industrials

- Energy bill for European Industry is becoming much higher than competitors in America or Far East
- Stable or decreasing demand
- Current system is increasingly perceived as unstable (reducing the tax base for EEG/ODE is triggering a vicious circle), adding uncertainty to investment decisions related to energy costs

- Increasing request from industry to be except from levies and socialized costs in order to compete with America/Far East
- Increasing fear that taxes/levies will increase, as it is obvious system is unstable, decreasing incentive to close longer term contracts & take investment decisions
- Increased request for diversification in transport costs/ continuity of supply, in order to reduce the total bill.

- Limited innovation incentive (e.g. "load follows generation") as no appropriate price signals
- No incentive to contribute to system adequacy; if things go wrong the SystemOperator/government will save the day (in some way comparable with pre-crises behavior of banks; they knew government would step in to rescue them in case things went wrong)

Summary of current market design issues

1. Market share of “market” is decreasing
2. Renewables will always depend on subsidies
3. Investments in conventional generation will not be attracted, even if needed
4. The contribution of market parties to Security of Supply in the operating planning phase is not incentivized
5. The need for back-up and reserve for intermittent generation is emerging, but it is not part of the current market design
6. Various unstable regulated components like the increasing amount of socialized cost, increasing use of “free rides” and the “vicious circle” related to tax and levies
7. No locational signals to smooth the problem of lagging grid expansion
8. The emerging single European energy market is jeopardized by diverging (national) repair actions

Frequently Asked Questions & Comments (1)

- Is it not too early to conclude the Market Model needs to be modified? Why not wait and see whether the market does its work?
  - There are lots of ‘free rides’ in the current system; use of ‘free rides’ is rising fast
  - The “market share” of the market is dropping fast, so the trend does not suggest the market will drive the needed change
  - The assumptions underlying the current market model are not valid anymore (slide 5)
  - Modifying a Market Model is a long trajectory and electricity is both capital intensive as well as an essential product; timely action is therefore needed
  - Currently, various repair actions (capacity markets) are already ongoing, those actions seems however to be driven by ad hoc problem solving rather than an integral view on the total value chain

- The gas market is also impacted by fundamental changes (less gas demand, potential new source of gas in form of shale gas, green gas, ..), however investments in security of supply are still happening (for example the large gas storage facilities in the Netherlands). What is the difference?
  - Infrastructure costs of gas are only a small percentage of the commodity price, giving more ‘room to maneuver’
  - Impact of “green gas” and “Shale Gas” is not (yet) comparable to “green power”.

Frequently Asked Questions & Comments (2)

- Let's assume there would be a modified market model which puts a stronger focus on "demand follows generation". Will the industry react?
  - Most industry needs a significant incentive to shift demand, as industrial sites consists often of various mutually dependent processes. However, if industry is convinced that a different mode of operation will bring value in the medium term, they will invest in it.
  - Smart Grids and concepts like steering household micro CHP (or demand) in the form of a virtual power plant are technical feasible and done (*). Roll out is however still modest, partly due to the unclear business case as mentioned on slide 17 and lack of ownership for security of supply as mentioned on slide 18

- System management is treated as "not market based". However, the System Operators are doing very competitive processes to purchase their services, why do we not call that market based ?
  - We reserve the term "market based" for situations where the price is determined by many willing buyers and many willing sellers.
  - The costs the SO makes for buying their services are typically socialized over all the captive clients of the SO within a framework set by the regulator.
  - Competition between SO's is not part of the current market model, neither do the captive clients of the SO's have the possibility to switch or stop buying the product
  - Please note that the energy component of the RegelEnergy Market is a real market; here the SO is just the facilitator between many buyers and many sellers; this component is not included in the System Management turnover on slide 6

(*) see for example www.lichtblick.de/schwarm-strom

Frequently Asked Questions & Comments (3)

- Why are windmills becoming increasingly dependent on subsidies?
  - When there is a lot of wind (and/or solar), the market price is low, as there is more than enough generation capacity and only low cost producers are needed to 'fill the demand'.
  - When there is no wind and no solar, market prices may be higher, as also high cost producers are needed to 'fill the demand'.
  - The wind and solar producers hence get only 'low prices' for their energy, as they only generate during low price moments (or differently phrased: prices are low when the wind is blowing because the wind is blowing in the whole country, pushing down prices)
  - The more wind and solar there is, the higher the 'cannibalization' effect. A 1000 MW of windmills in a 100.000 MW market do hardly impact the price, but 30.000 MW of windmills in a 100.000 MW market do significantly impact the price.
  - So even if windmills would reduce their costs by 50%, they would still be dependent on subsidies.
  - A highly interconnected European market would have a positive effect on the market value of wind energy (and solar), however we presume this effect to be secondary (*).

- Why do windmills not ask a higher price for their energy?
  - The marginal costs of generating wind are < 1 e/MWh. They can not store the wind (or energy) to sell it later, so it has to generate when the wind blows. In trader terms: there are no opportunity costs associated with selling wind power, it is now or never. A coal plant or a gas plant can however choose to not generate today (and save the fuel for a higher priced opportunity). A hydro plant can choose to leave the water in the reservoir and wait for better prices.

- But nuclear power is having the same problem as wind, they can not switch of their plant either, so how can they survive?
  - Nuclear power is also generating during high prices (and not like wind only during low prices)

(* would need to be analyzed in more detail to get definitive answer)

Frequently Asked Questions & Comments (4)

- How does the CO_2 market relate to renewable subsidies; are higher CO_2 prices the solution to drive the energy transition ?
  - The current CO_2 prices have a minor impact on the market (~ 2 euro per MWh).
  - Even higher CO_2 prices would have only a minor impact
    - It would mean a shift from coal to gas
    - It would not significantly impact the market value of renewables (see previous slides)
    - It would also not give a higher incentive to traditional generation to take up the back up role
    - There is simply no appropriate link between CO_2 prices and renewable subsidies; the more renewables there are, the more subsidy is needed, but the lower the CO_2 price….

- The authors are convinced that the CO_2 market in the current form has no 'reason to exist'; a modified market model should also take the role of the CO_2 market into account

(*) see for example www.lichtblick.de/schwarm-strom

Frequently Asked Questions & Comments (5)

- I understood that capacity markets should be introduced and that then the current market model will work just fine. Is that correct ?
  - Capacity markets can indeed be a piece of the solution.
  - However, most discussions seems to be driven by the demands of traditional generation to get extra income by recognizing that they are contributing to security of supply
  - Letting the SO hand out “capacity fees” would further reduce the role of the market (see slide 23) and lead to further growth in taxes and levies. It will also not solve the vicious circles (see slide 20)
  - It also does not incentivize innovation and investments (probably on the contrary), as it will just keep the existing generation facilities alive on a ‘year by year’ basis.
  - It will also significantly impact the current ‘energy only’ model, meaning that all the pro’s and con’s in the whole value chain have to be modeled before taking such a decision (for example, it will only solve 2 of the 8 key flaws as described on slide 20, and probably negatively impact 3 others)

- What is the process to modify the current market model ?
  - There is no clear process; the current market model has been designed over many years and is embedded in many rules and regulations. Also, “regulatory stability” is important, as most investments have long lead- and lifetimes. The authors are currently working on a road map. The year 2020 however seems a reasonable target year to have implemented the required changes

A decreasing gross margin impacts conventional generation in three distinct stages

Stage 0: Gross Margin covers full costs including profit margin.

Stage 1: Gross margin drops to level where fixed costs can just be covered

- No new plants will be build
- All existing plants keep on running
- Incentives on short run marginal cost base are enough to incentivize the plant to adept his schedule to request of SO

Stage 2: Gross margin drops to level below fixed costs coverage, but above yearly maintenance and biyearly overhaul costs

- Asset becomes distressed or goes bankrupt
- However, as unit is still adding value on a yearly basis, plant will keep running as that gives more income than shutting down
- Incentives on short run marginal cost base are still enough to incentivize the plant to adept his schedule to request of SO

Stage 3: Gross margin declines to level where yearly O&M costs/biyearly overhaul can not be paid anymore.

- Plant will run till failure and than be mothballed
- Once mothballed, a start up is taking many weeks/months.
- A long run margin cost compensation is needed to incentivize the plant to remain available

Fossil Generation Capacity in NW Europe was still growing in 2012, ~ compensating for nuclear phase out. Demand is stable or dropping.

Commissioned since 2010 (examples, not a complete list)

- 2200 MW lignite Neurath (RWE)
- 3700 MW gas NL and Germany
    - Claus (RWE), 1300 MW, replacing a 600 MW unit
    - Moerdijk (RWE), 400 MW
    - Diemen (Vattenfall) 400 MW plus Hemweg 9 (400 MW, replacement old 500 MW unit)
    - Flevo: 800 MW (GDF), replacing old 500 MW unit
    - Rotterdam: 800 MW (Eneco & Dong)
    - Lingen (RWE): 800 MW
    - Statkraft (Hurth-2): 400 MW

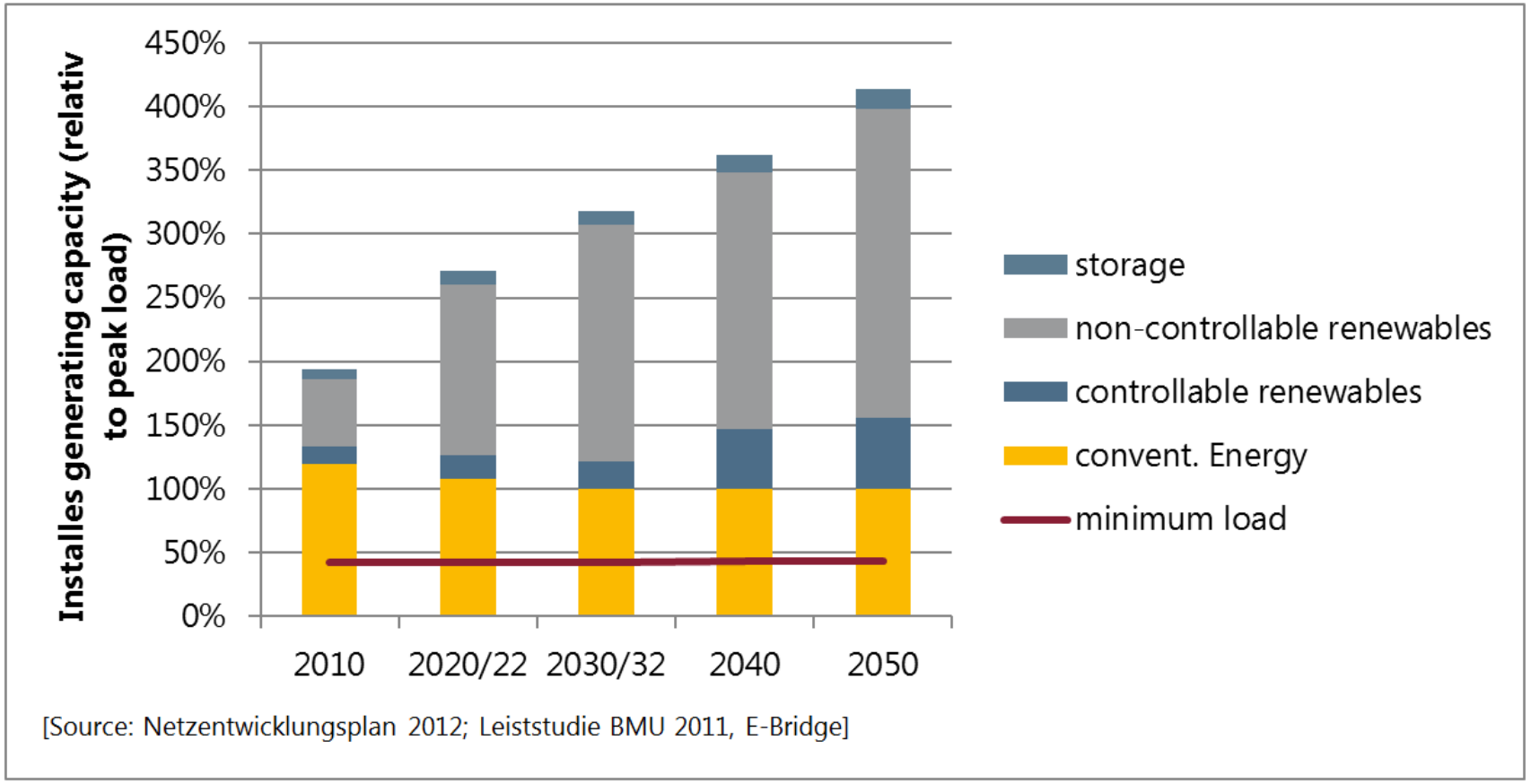
In addition, some ~ 10.000 MW coal and 2100 MW gas are being build (result of decisions taken before 2010)

- 3000 MW coal Hamm & Eemshaven, on line 2013/2014, replacing 320 MW of old units, RWE
- 1300 MW Eemshaven gas & 1600 MWE coal Moorburg, on line 2014, replacing a 250 MW unit, Vattenfall
- Rotterdam 800 MW coal (GDF)
- Rotterdam 1100 MW and Datteln 1100 MW coal (Eon)
- SWB (400), Statkraft (400), STEAG (750), ENBW (900), GKM (900) are also being build

Nuclear phase out: still 12.000 MW on line, 8500 MW was decommissioned in August 2011
Demand stable/dropping (BDEW: -1.4% in 2012)

However, in recent months more closures/mothballing have been announced, potentially changing the above picture of a stable amount conventional generation capacity.

High generating capacity indicates strong competition at periods of high generation of renewables



[Source: Netzentwicklungsplan 2012; Leiststudie BMU 2011, E-Bridge]