Bundesnetzagentur

Regulatory challenges for the integration of renewable energy sources and regulatory requirements for a future market design

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Workshop: Design of smart electricity markets

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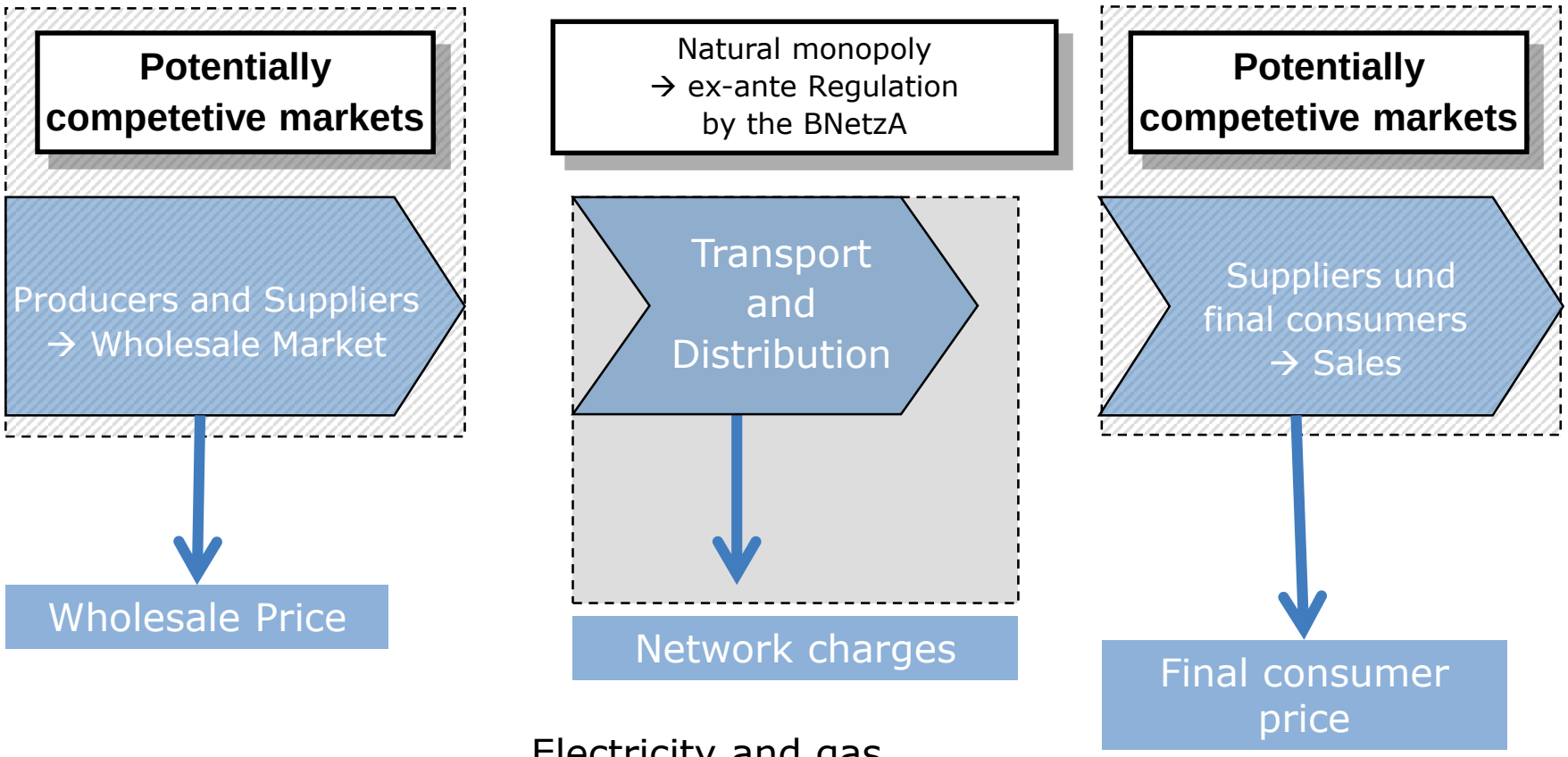
Market Design 1 General Notes

- Markets require commonly accepted rules
- "The electricity market" consists of several individual interacting markets, with the short-term market for electricity at its core
- The electricity market design is a set of rules which form a framework for the actions of market players
- Rules can develop from within the market, but they are often confirmed and enforced through regulation (eg laws or rules set by the regulatory authority)

Market Design 2: markets and monopoly



Electricity and gas networks are regulated with the aim of effectively enabling competition on the product markets

Market Design 3: markets and fields of regulatory activity

Potentially competetive markets

Electricity Wholesale Market

Balancing of generation and demand on the wholesale market

- Power Exchange / OTC
- Short/ Longterm

Support Schemes for

- Generation (**Renewables, CHP, Conventional**)
- **Consumption**

Producers and Suppliers → Wholesale Market

Network Services

1. Market based

- **Balancing** Reserve
- Transmission **Losses**
- **Capacity** Reserve
- **Network** Reserve

2. Non-market based (currently)

- **Black Start** Capability (starting capacity in case of blackout)
- **Reactive Power**
- **Redispatch**

Network Operation Ressources

- Transformers
- Overhead lines, undergound cables
- Phase shifters
- capacitors
- Compensation Equipment für Reactive Power

Transport and Distribution Natural Monopoly

Electricity Sales

- Large and small customers
- Industry and Business/Households
- Consumer/ Prosumer

Metering Services

Suppliers und final Consumers →Sales

Market Design 4: The Purposes

The market design should meet the **following requirements:**

- Providing affordable supply of electricity
- Safeguarding the security of supply
- Integration of energy from renewable sources

➢ Enable competition on the electricity market and pursue the objectives of section 1 EnWG (German Energy Act)

Market design challenges

- Numerous market interventions in the past and present, not only for renewables
- Discrimination in favour of the use of particular technologies
  - Consequential damages of coal mining are transferred to the general public
  - Liability risks in nuclear power are limited
  - Subsidies for combined heat and power
  - Privileges for own consumption (self supply)
  - Avoided network charges (in German: „vermiedene Netzentgelte“), a special kind of subsidies for thermal power plants

Concept of a future market design

- Approaches that aim to predict the contribution of certain technologies (such as Storage, DSM, Power to X) and subsidise them are incompatible with a competitive solution
- Promoting individual solutions endangers the business case of competing investments and provokes further government intervention

Market Design 7: markets and fields of regulatory activity

New Challenges for the Market Design resulting from the energy transition (_Energiewende_)

- Conventional power plants are driven out by renewable energy sources
  - Market Design should provide alternatives to conventional power plants for the provision of ancillary services
  - Example: renewable energy sources as a supplier of Balancing Reserve
- Number of small generating plants, in part self-supply, increases (Currently: Around 1.5 million PV systems)
  - Market integration of smaller generation facilities with self-supply reasonable and feasible through digitalisation
- Digitalisation
  - Digitalisation may enable consumers to respond quickly to low electricity prices and increase their consumption
  - This could burden the electricity grid
- Large regional differences in the construction of new generating plants
  - Wind power in the north, PV in the south of Germany
  - Discussion on European Electricity Market and Regional Market

Requirements for renewable energy's role

Wholesale markets

- Renewable Energies should respond to electricity prices

→Direct Selling

→Balancing Group Responsibility

→ Amendment in the system of renewables promotion ?

Network Services

- Renewable energy has to replace conventional energy in the area of the provision of network services, in the long term
- carrot and stick policy ?

Network Operation Resources

- Transmission Lines
- Transformers
- Compensation Equipment for Reactive Power
- etc.

Electricity Sales

- Large and small customers
- Industry and Business/Households
- Consumer/ Prosumer

Metering Services

Producers and Suppliers → Wholesale Market

Transport and Distribution

Natural Monopoly

Suppliers und Final consumers →Sales

Regulation for the market

Strengthening the electricity price signal and consolidating balancing group responsibilities

Better Market Integration of Renewable Energies

Better Market Integration of Prosumers

The Product:

- Electricity (kWh)
- Short and long term markets (futures/day-ahead/intraday)
  - Long-term risk hedging
  - Short-term selling and balancing group management
- Prices enable efficient reaction to scarcity in the respective markets

Market Volume:

- Value of electricity produced (simplified): nearly **20 bn. €/year** (assumed electricity price: *30 €/MWh* ; net power consumption: *600 TWh*)

Design:

- § 1a (2) S. 1. EnWG (German Energy Act, 2016): "The balancing group and balancing energy system is the key instrument for a secure power supply."
- Incentives for market players to realize quarter-hourly balance between supply and demand for electricity
- Obligation to fulfil balancing group commitments and risk of penalization by balancing energy prices incentivise good forecasts
- Authority given to Ruling Chamber 6 of the Bundesnetzagentur to strengthen the (financial) balancing energy system (in discussion, but no formal procedure has been launched yet)

Better market integration of Renewable Energies

The Product:

- Promotion and marketing of Renewable Energies to achieve the energy policy goals and integrate Renewable Energies into the electricity market
- Targets (EEG 2014): raising the share of electricity generated from renewable energies in electricity consumption to :
  - 40 to 45 percent by 2025
  - 55 to 60 percent by 2035

Market Volume:

- Current **Subsidy**: about **25 bn. € / year**

Better market integration of Renewable Energies

Design:

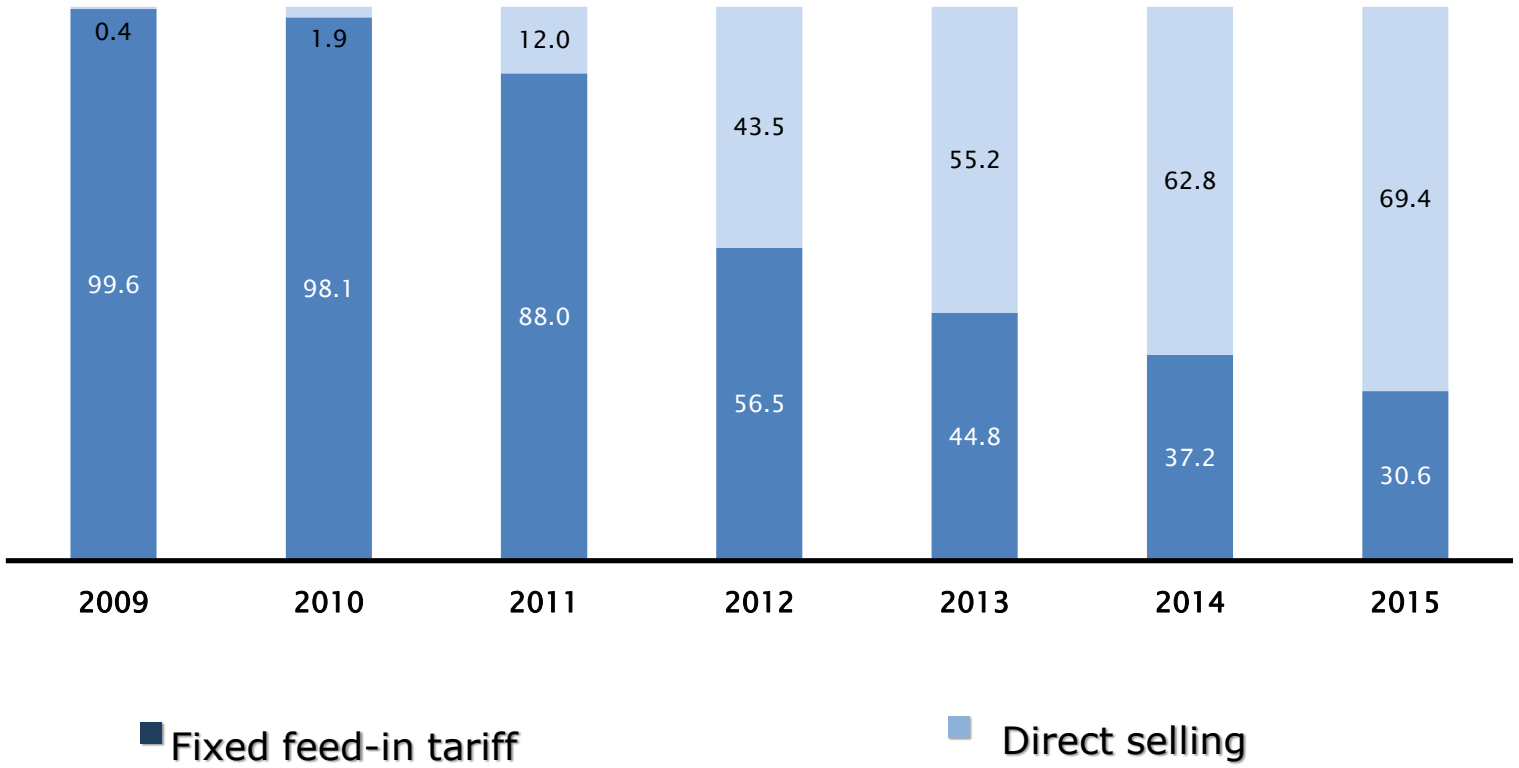
- Fixed feed-in tariff
  - From 2016: only for small plants with an installed capacity of up to 100 kW
  - No incentives to respond to electricity prices: “produce and forget”
- Market Premium in case of direct selling of renewable energy, the better way because:
  - Incentives for good forecasts as direct sellers carry the balancing energy price risk
  - Incentives to respond to fluctuations in market prices

Better market integration of Renewable Energies

on the right track …

~~Average annual feed-in by fixed feed-in tariff and direct selling~~

~~%~~ of electricity generated from RES by fixed feed-in tariff and direct selling



New market design features needed?

- Direct selling has proven to be successful and should be strengthened further
- Subsidy for a renewable energy power plant depends on the amount of energy produced
  - There are few incentives to stop production at negative prices
  - Production is only adjusted when prices fall so far below zero that the subsidy is consumed
- An interesting option to consider in the long run: partial promotion of installed capacity of renewable energies instead of the amount of energy produced

The Product:

- Prosumer: household customer producing all or part of their consumption in self generation while being connected to the grid
- Prosumers are supplied by suppliers on the basis of the standard load profile, which is predetermined by the DSO
- Currently
  - no incentive for suppliers to supply prosumers according to their actual consumption behaviour and to respond to short-term fluctuations in market prices
  - No incentive for the prosumer to react to market price signals

New market design features needed?

- *„taking prosumers seriously"*
- In the future no standardised load profiles, smart meter allows smarter solutions
- Everyone who produces all or part of their consumption through self-supply and remains connected has to be metered by a smart meter and has to be accounted in the regular ¼ hour balancing energy system
- Using the grid as an insurance has to be paid fair

Regulation for grid oriented markets

Balancing Reserve

Capacity Reserve

Reactive power ?

Redispatch ?

Balancing Reserve

The Product:

- Safeguarding security of supply by providing additional capacity to the market if the system is imbalanced.

Market Volume:

- Around 300 mn. € in 2015

Design:

- Joint procurement of control services by the TSO by auction

New market design features needed?

- Ruling Chamber 6: Formal procedure to redefine procurement rules of balancing reserve
- Goal: to stipulate the auction rules for balancing reserve in order to permit new, flexible providers to participate:
  - Flexible producers (especially operators of wind turbines)
  - Controllable loads
  - Operators of storage, etc.

Capacity Reserve

The Product:

- Safeguarding security of supply by providing additional capacity to the market if system adequacy is not met
- Capacity reserve is activated only if balancing power is nearly exhausted

Market volume:

- About 200 mn. € / year (*estimated from 2018 on*)

Market design features today:

- Capacity reserve is regulated by the Energy Act and the Capacity reserve ordinance (not yet in force)
- Capacity reserve starts operation in winter 2018, amount of capacity reserve is fixed by § 13 e Energy Act (2 GW)
- TSO procure capacity reserve by a tendering procedure

System Services 2: Capacity Reserve

New market design features needed?

- Functioning electricity market (EOM 2.0) may make capacity reserve dispensable. Incentives to procure sufficient capacity may come from the power balancing system
- Commitment to EOM 2.0 prohibits discussion of further capacity mechanisms. More comprehensive capacity market would require additional regulatory action
- Need for reserve capacity to be regularly reviewed by evaluation of system adequacy
- Use of capacity reserve plants in the electricity market is forbidden ("no market participation"):
  Credible Commitment in the long run?
  Yes, guaranteed by the EU commission, GD Competition

Reactive Power

The product:

- Provision of reactive power from generating plants is required for the operation of the power system, as far as the network does not have sufficient compensation equipment itself

Market Volume:

- Currently not assessable.

Market design features today:

- Reactive power can be obtained for example…
  - by network compensation systems or
  - through bilateral contracts with power plants

System Services 3: reactive power

New market design features needed?

- Decommissioning of conventional power plants reduces the potential of reactive power sources, additional sources required
- In discussion: procurement of reactive power via a separate market (with a remuneration determined by the market)
- Problem: Reactive power is needed locally specific, little competition expected
- At the TSO level: market may evolve since reactive power can be transported over long distances, which increases potential competition
- However: prices should not exceed costs of alternatives (provision by the network operators by compensation systems)

Redispatch or similar network unloading products

Design:

- No market,
  TSO and DSO order renewable or thermal generators to provide redispatch for a „fee“
- Charges („market“ volume): 950 mn. € in 2015

Chances for a new design ?

- Only, if the amount of redispatch or reduction of generation from renewable energy sources can be reduced significantly
- Currently each generator is pivotal
- More flexibility for the network operators has to be allowed by the law

Alternative Concepts for Market Design

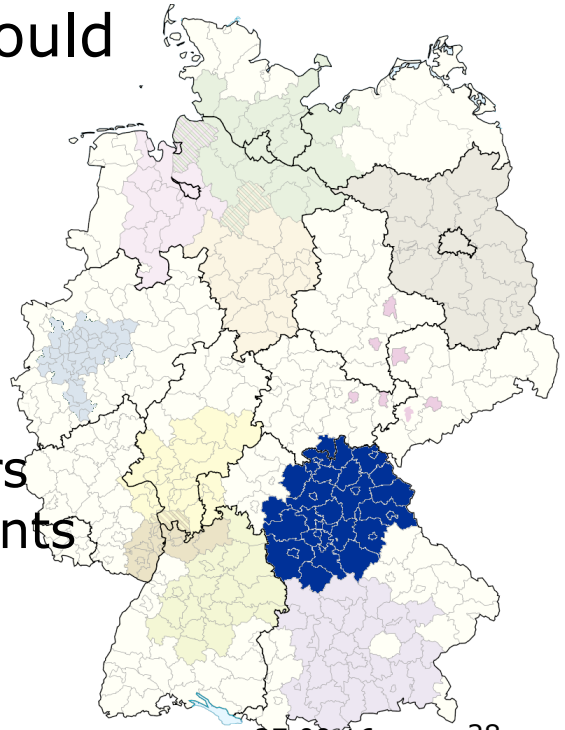
Regional markets vs. European Electricity Markets

Regional markets vs. European Electricity Markets

Can self-sufficient supply succeed in theory?

Example: Nuremberg region

- Population: 3.5 mn., Electricity Consumption: 19 bn. kWh/a, peak load: 3,6 GW (= 3 nuclear power stations).
- Supply from renewable energy plants would require:
  - 700,000 domestic PV systems during the days and
  - 3,000 wind turbines in the 3 MW class during the nights and winter and
  - As storage 60 million(parked) electric cars or 130 (filled) pumped storage power plants



Regional markets vs. European Electricity Markets

- There is nothing wrong with individual citizens and communities seeking energy independence
- But: no entitlement to the use of superior structures in terms of supply, eg if the sun is not shining, the wind is not blowing and the storage facilities are empty
- The Nuremberg example shows that this kind of self-sufficiency calculation is inefficient
- Security of supply cannot be ensured efficiently by fragmented market structures
- Cell-based approaches are not suitable as an organizing principle of the entire German electricity system
- Not the most efficient, but the spatially nearest facility is used
- Big markets enable security of supply, liquidity and competition; best and cheapest technology will be used

Regional markets vs. European Electricity Markets

Is the single bidding zone a market design issue?

- The bidding zone geographically defines the wholesale market for electricity for which a uniform price applies
- Within a bidding zone, the market is not informed about network "bottlenecks" or congestion. When trading between bidding zones, the limited transmission capacity of the network is considered (NTC). This capacity limits trade and thus influences price formation in both zones
- Network congestion within the bidding zone network is resolved by instruments such as redispatch or reduction of generation from renewable energy sources.

Why split up the German-Austrian Bidding Zone?

- With the split of the single bidding zone, the wholesale market for electricity can adapt to the limited available infrastructure. The need for remedies such as re-dispatch etc. is reduced.
- Network expansion is coordinated internationally through the TYNDP
- The separation is also planned because, although Austria is benefiting from EEG subsidies, but is not willing to bear a fair share of the cost of the network reserve and Redispatch

Thank You for your attention

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