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# “Germany’s Energy Transition: Lessons Learned and Next Steps”

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Joint Minnesota PUC and EQB public meeting  
Minneapolis – 29 November 2016



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- The German Energy Transition
  - Recap of the German *Energiewende* decisions
  - Impacts of the German *Energiewende*
  - Solutions (amendments to the energy legislation)
- Grid Expansion Acceleration Act
- Renewables growth and reform of the Renewable Energy Act in Germany
- Amendments to the Energy Industry Act: the Electricity Market Design Act
- Challenges and tasks
- Conclusions



- **No change of direction** – the “*Energiewende*” is *the* project of the Government who committed in the coalition agreement 2013 to make the “*Energiewende*” a success story, but adjustments needed
- **Synchronization** of the grid expansion with the RES growth needed in order to integrate renewables into the grid, grid expansion lagging behind
- **Speed up grid expansion**, in particular build 3 new major HVDC transmission lines from North to South, planning and permitting by BNetzA to bring RES from the North to the load centres in the South
- **Reform** of the Renewable Energy Act for a more cost-effective and more **targeted renewables growth** in force since 1 August 2014 to stop/reduce „produce-and-forget“ mentality with a market-based approach; cabinet resolution 8 June 2016: corridors confirmed, but more cost-efficient growth
- **Generation**: conventional and renewable energy must be better balanced to ensure sufficient capacity is made available where and when needed, i.e. increase **flexibility** and find an appropriate market design: **EOM 2.0 (Draft Electricity Market Design Act proposed on 4th Nov. 2015)**
- **Smart markets**, i.e. make distribution grids smarter and foster flexible **demand side response** and increase **flexibility**
- **Energy efficiency** increased, but more to do
- **Conclusion**: let’s turn the big challenges of moving towards a low-carbon economy into chances by moving on jointly towards **a more market-based approach**, i.e. a smart market design providing **proper price signals**

# "Energiewende": Changes in the German energy mix



### Offshore wind power



Installed 2014:  
0.9 GW  
Expansion by 2025:  
**+9.6 GW**

### Onshore wind power

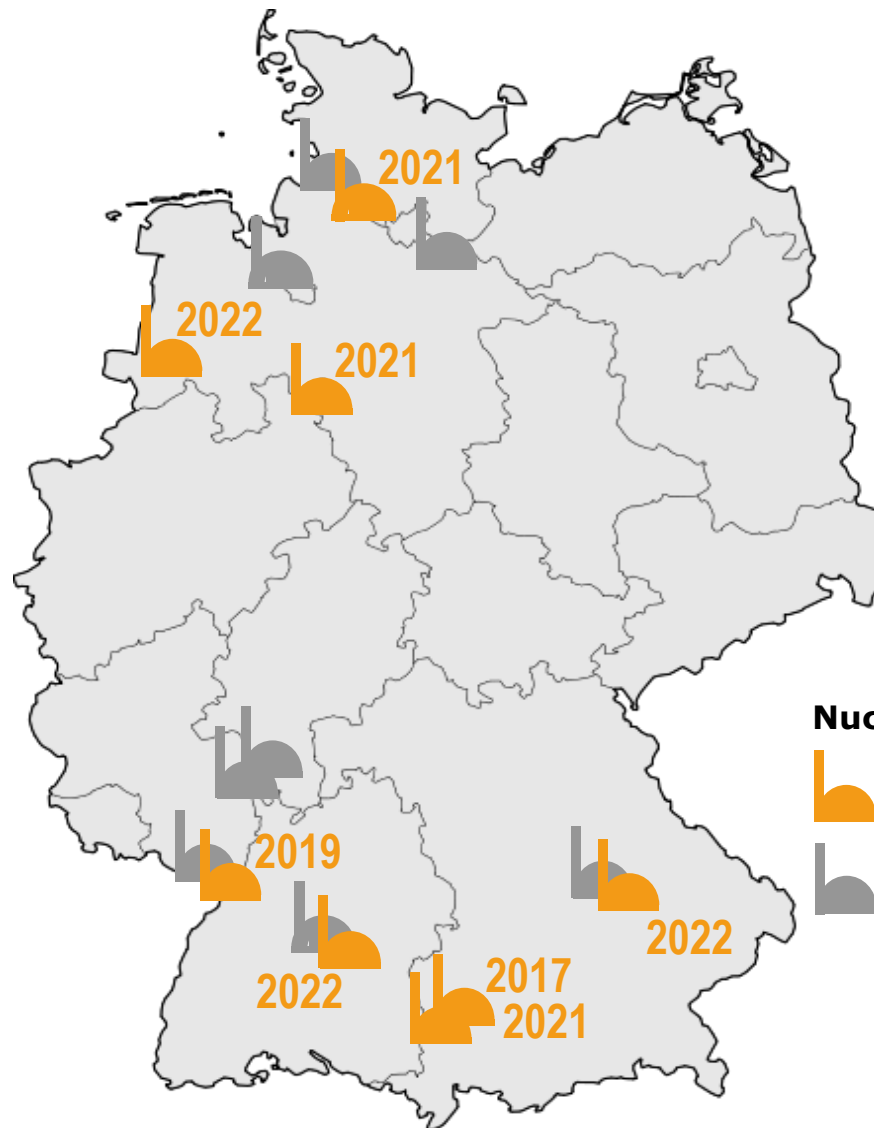


Installed 2014:  
38.1 GW  
Expansion by 2025:  
**+25.7 GW**

### PV



Installed 2014:  
38.2 GW  
Expansion by 2025:  
**+16.7 GW**



### Nuclear power plants

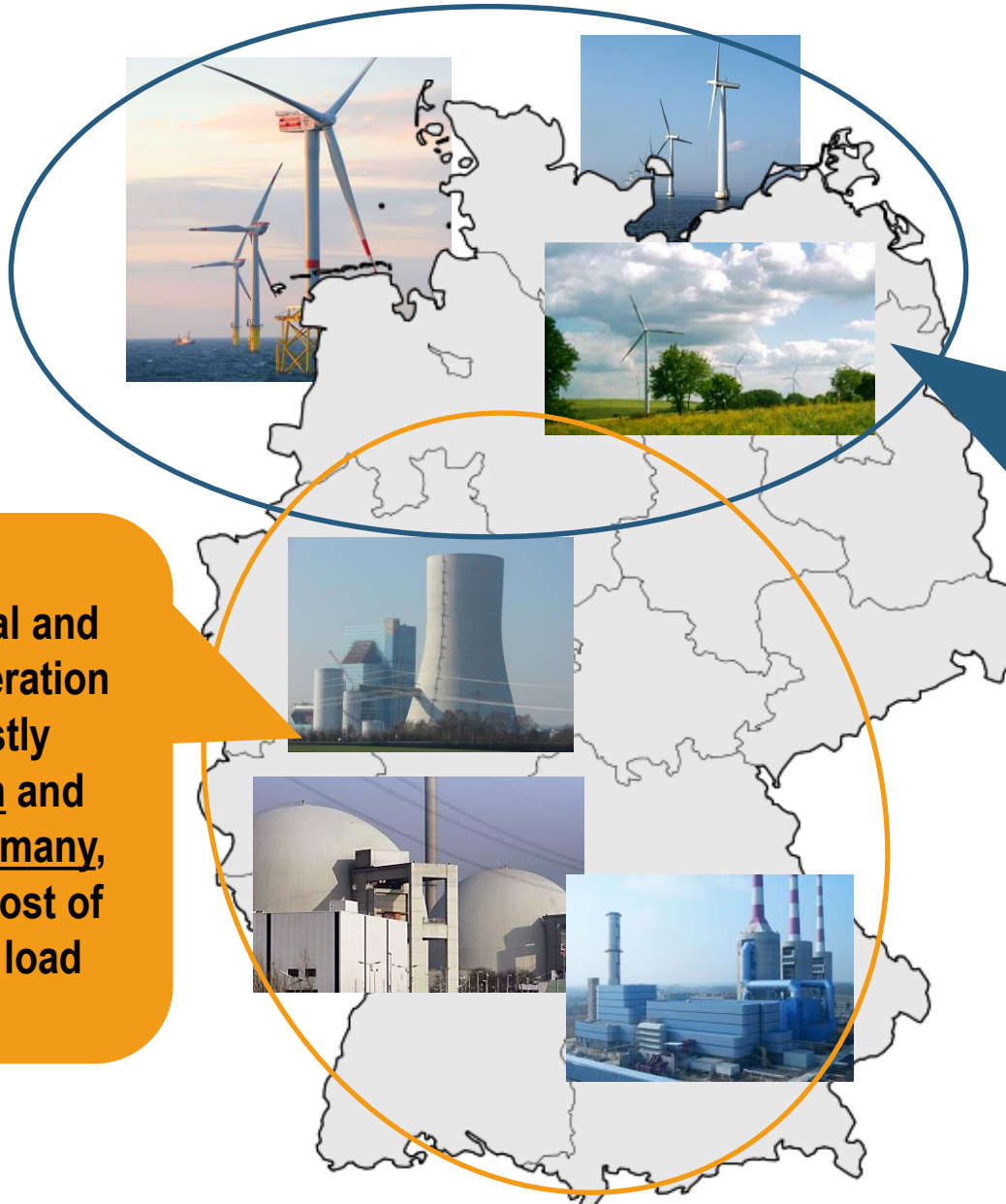


Planned shutdown



Already decommissioned

# Changes in the energy mix – Grid implications

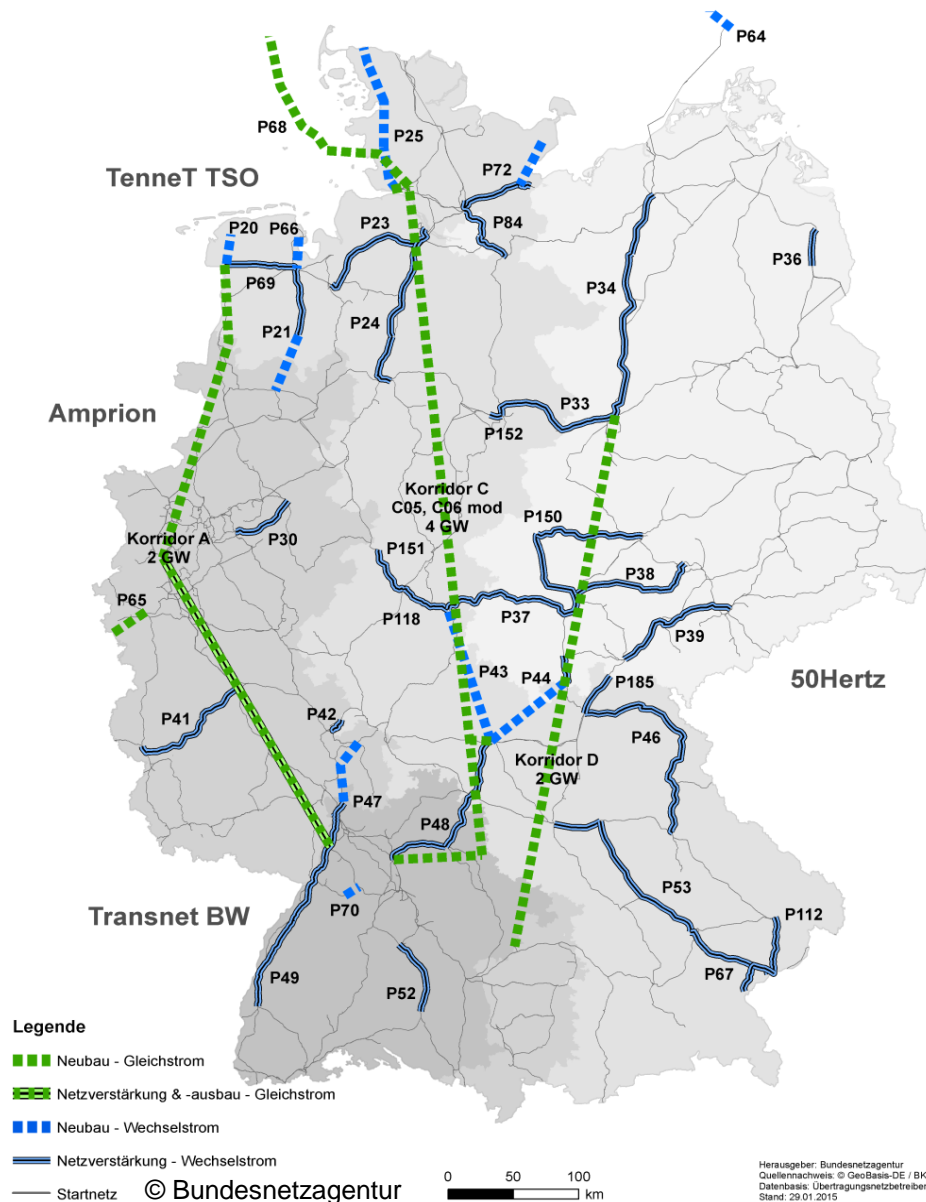


Renewable energy  
sited mostly  
in Northern Germany  
(esp. wind)

Conventional and  
nuclear generation  
sited mostly  
in Southern and  
Western Germany,  
as well as most of  
(industrial) load



## Confirmed NEP 2024 (Scenario B 2024)

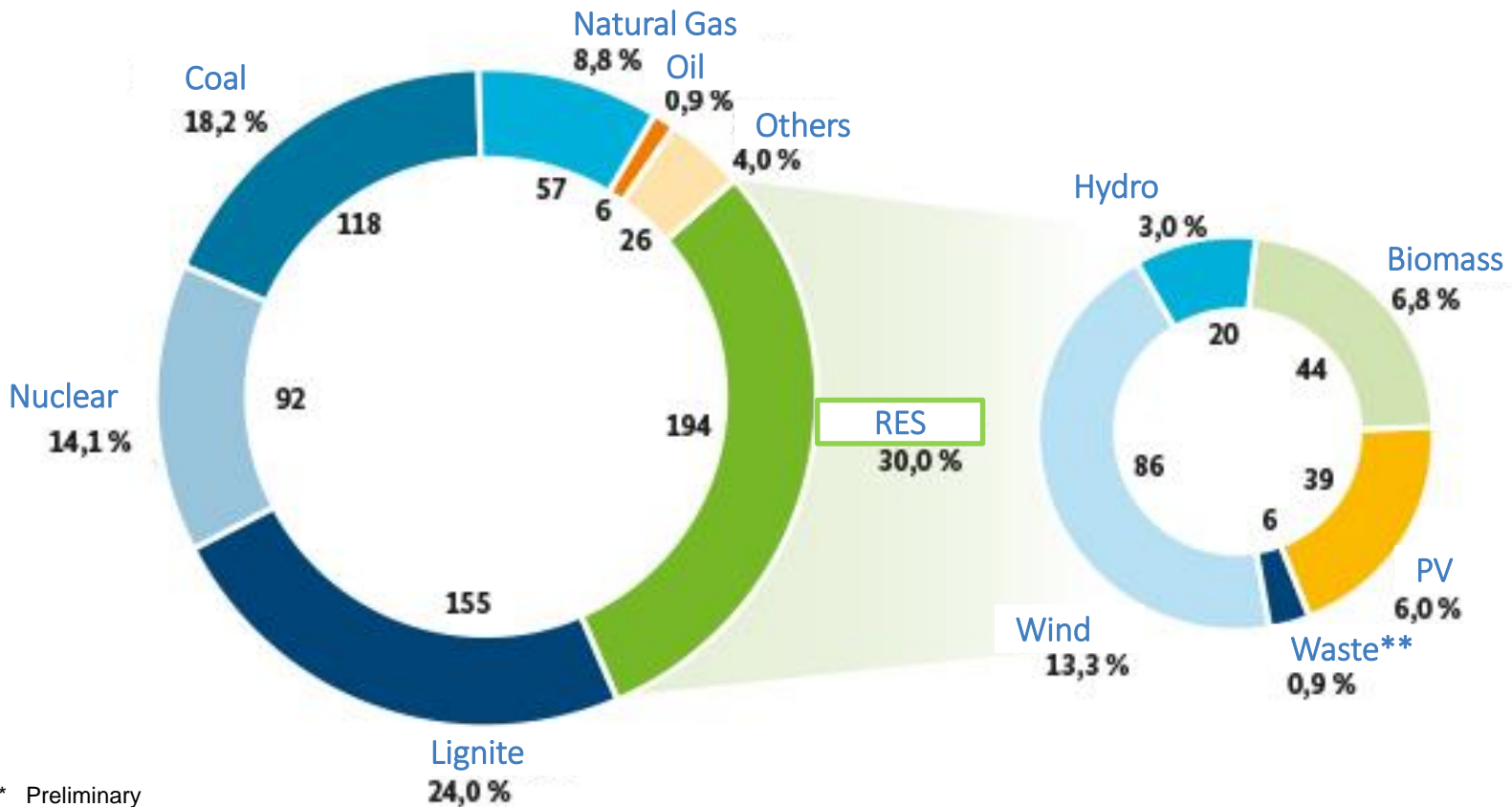


- Annual transmission network development plan process
- 34,841 km existing lines in 2012
- 63/92 transmission measures confirmed in 2014
- 5,800 km of lines (2,750 km new lines 3,050 km reinforcements)
- 3 main No-South HVDC corridors
- Estimated costs:
  - 16 billion € (if overhead lines only)
  - 26 billion € (if realized including 10% underground cable)
  - 31 billion Euro (if all DC lines and 20 % of AC lines are build as underground cables)
- 19 billion € offshore connection cable

# RES IS No 1 IN THE GERMAN ENERGY MIX



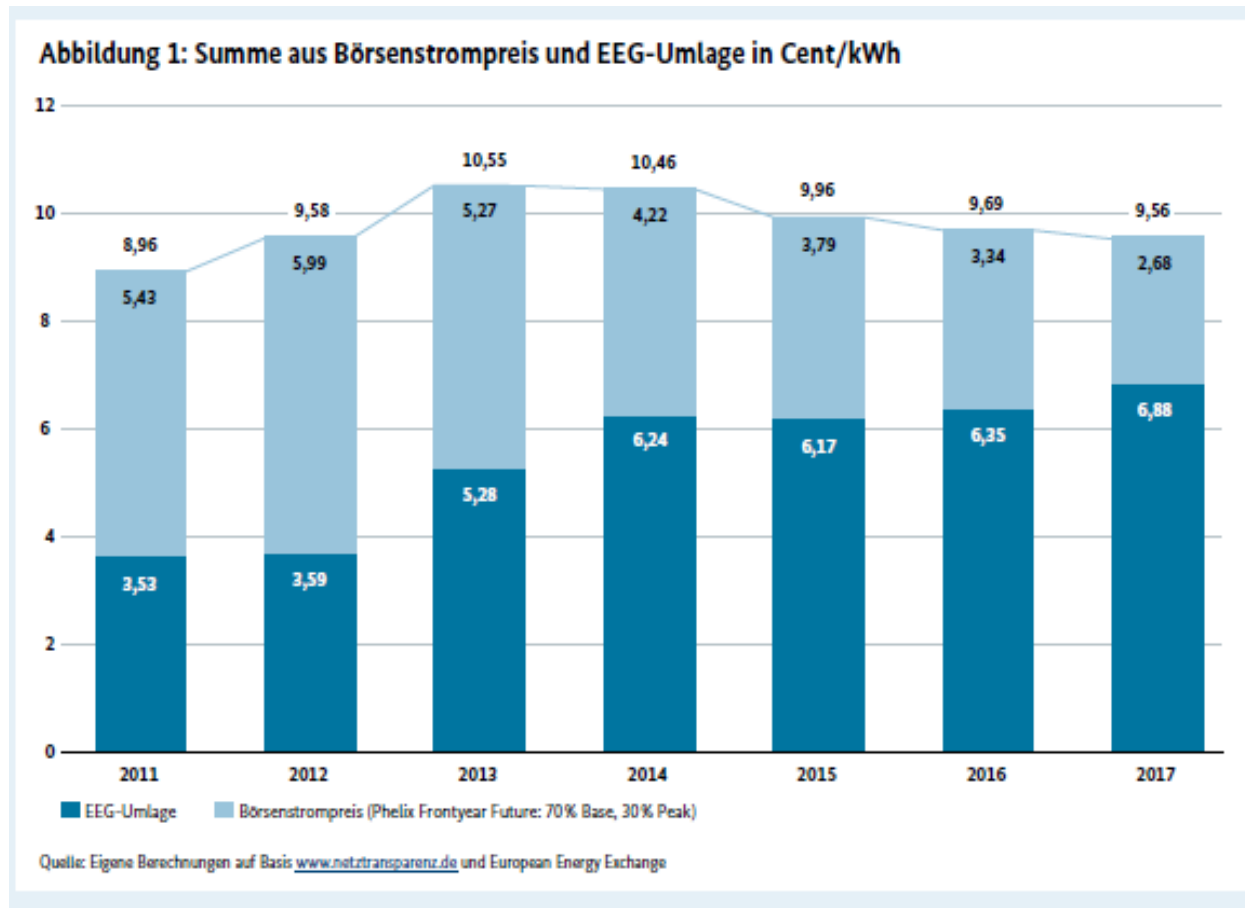
Gross electricity production in Germany 2015: 648 TWh\*



\* Preliminary

\*\* Renewable share

Source: BMWI



... but it comes with a cost for consumer: increase of RES surcharge since 2011 covering the difference between the power exchange price and the costs for subsidizing the expansion of RES





- The increase of RES capacity has **decreased wholesale prices** at the power exchange dramatically (sometimes we see even negative prices).
- Due to increased demand from abroad electricity **exports** from Germany have **increased**.
- Due to physical principles electricity always takes the way of least resistance: **physical flows may deviate from trading results**.
- Electricity from North East Germany may take the way through the grids of Poland and the Czech Republic to its consumers in Austria and in the South of Germany: unplanned transit flows and loop flows.
- RES produced electricity on its way from the North to the South of Germany or to Austria causes **network congestions**: TSOs have to carry out a lot of **redispatch** and to contract **reserve capacities**.
- **Grid expansion** is lagging behind RES growth and need to be **synchronized** – 2016 reform of the RES Act to offset 2015 change of Grid Expansion Acceleration Act giving priority to underground cabling (slowing down/delaying roll-out and increasing costs considerably)



- **Unplanned flows may endanger operational security.**
- TSOs have to take more and more **short term measures**:
  - Internal grid measures (redispatch), costs increased, but reliability of the grid is not affected (due to resilience stemming from the past)
  - Reduction of transmission capacity available for cross-border trade (needs to be done in conformity with European capacity allocation and congestion management rules)
  - Agreement with conventional power plants and consumers to reduce/increase load/feed-in
  - **Curtailement** of conventional electricity producers
  - Last option: Curtailement of RES electricity producers (as they have absolute priority), problem: produce and forget
- These short term measures can only be an **intermediate step**.
- Ultimately, the **grid has to be adapted** in order to handle the flows stemming from the German energy transition

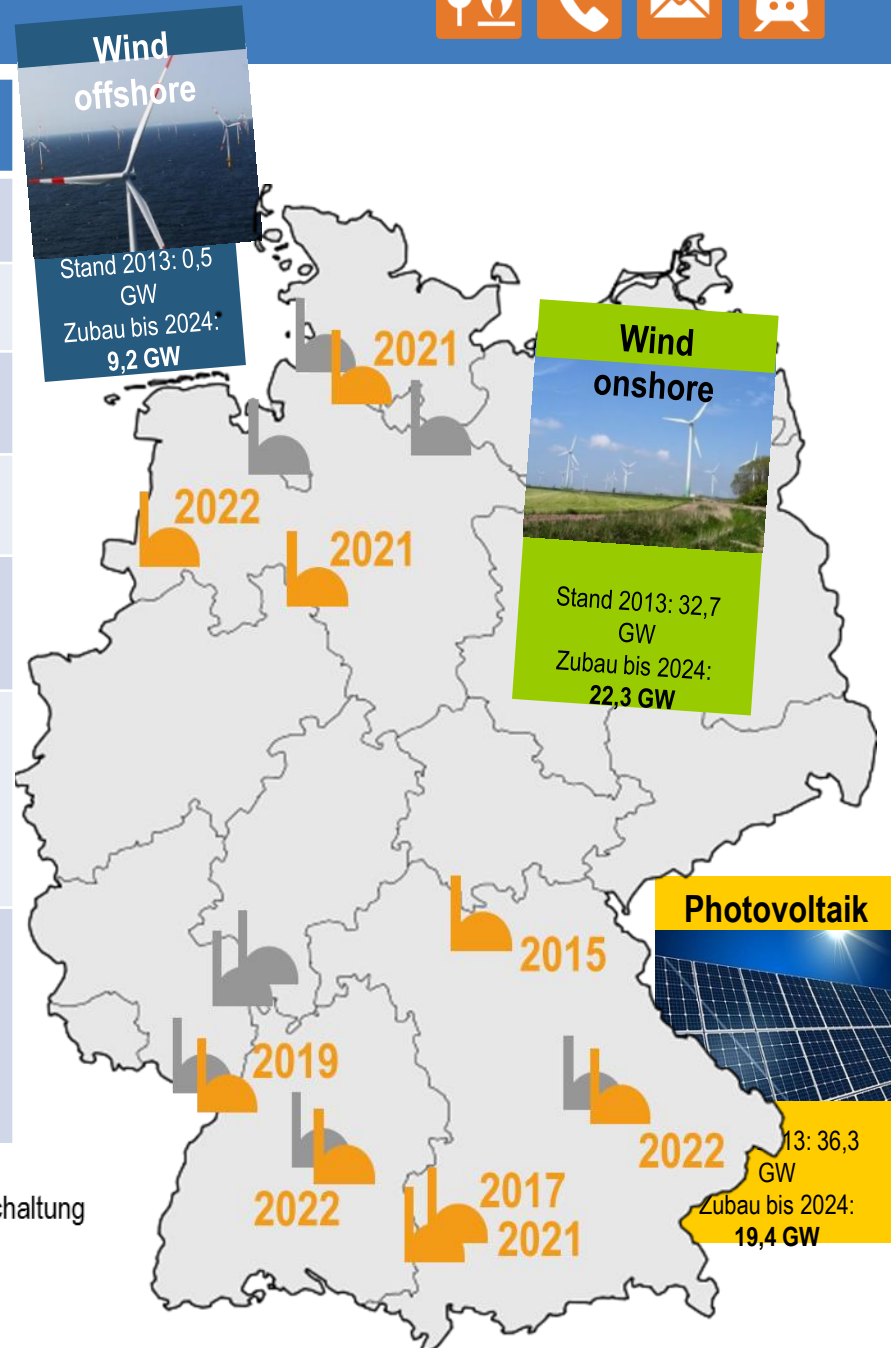


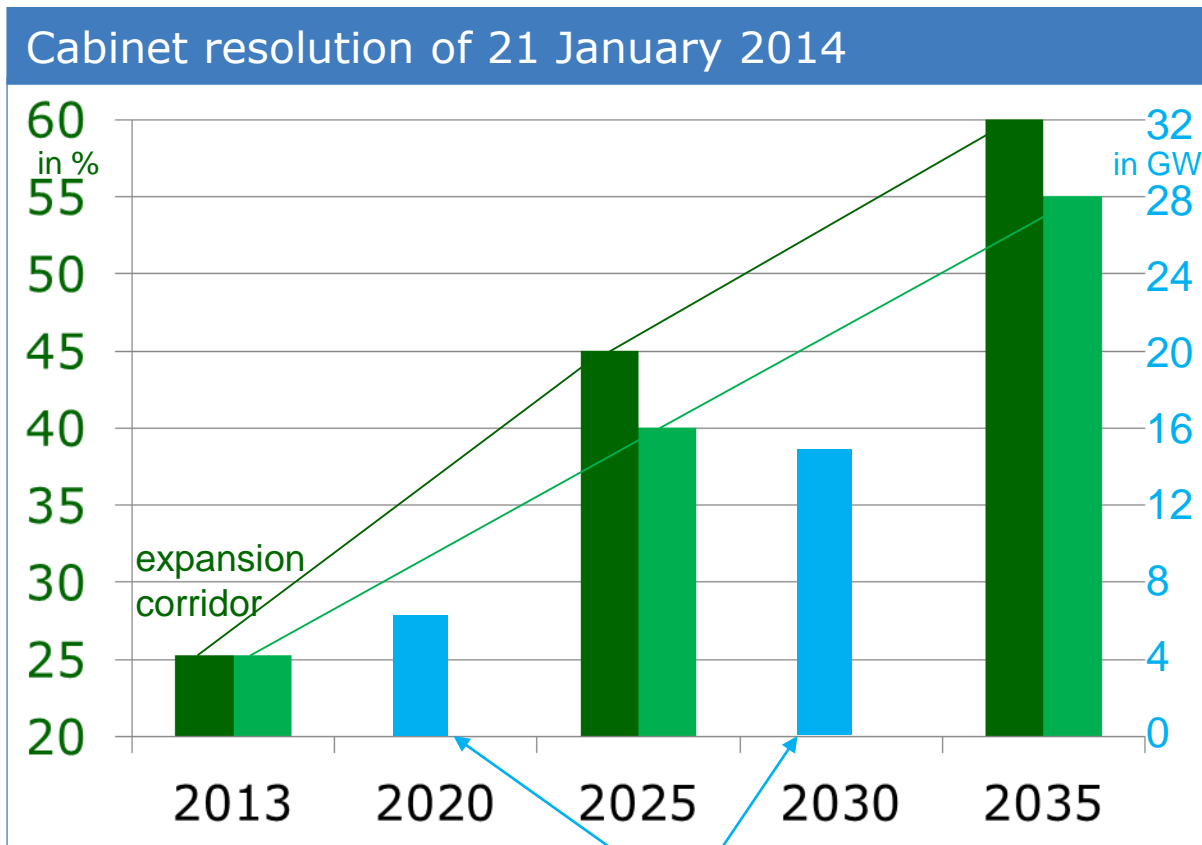
- **Important:** Germany has no generation adequacy or SoS problem (still overcapacity of conventional power plants), only regional imbalances (between the North and the South of Germany)
- Question arising regarding the need of a capacity mechanism (CRM) answered with the Draft Electricity Market Design Act presented in Sept. 2015: No, for the reason mentioned above there is **no need for a CRM**
- Draft Law foresees an **Energy Only Market – EOM 2.0** relying on proper **price signals**: market based approach (as also preferred by the European Commission that foresees CRM only as second best option because of the cross-border effects (cons. July 2015); adopted in parliament on 8 July 2016)
- Allowing price signals to work reacts to the need for more **flexibility** as in an environment that is increasingly volatile a “command and control” is no longer working, change can only be managed with a **market based approach** and will – with some further measures of the 2016 reform of the Renewable Energy Act – also ensure market integration of RES producers
- Changing roles for TSOs and above all for DSOs as they become energy service providers in a **smart market** (smart grids and smart meter roll out)

# The challenge



	2013	expectation 2025
peak load	82,8 GW	84 GW
net consumption	543,6 TWh	544 TWh
conventional generation capacity	101,1 GW	77,3
including storages	6,4 GW	8,6 GW
renewable generation capacity	81,1 GW	141,4 GW
including		
onshore wind	33,8 GW	63,8 GW
OffShore wind	0,5 GW	10,5 GW
photovoltaic	36,3 GW	54,9 GW
interconnector capacity to neighboring countries	from Germany to ... 29 GW	to Germany from ... 31,3





## Key aspects:

- **RES expansion corridor**  
40-45% (2025)  
50-60% (2035)
- **Offshore wind**  
6.5 GW (2020)  
15 GW (2030)
- **Volume control**  
PV + 2.5 GW/a  
Onshore wind + 2.5 GW/a  
Biomass + 0.1 GW/a

## 2016 – Cabinet resolution

- **RES corridors confirm., but steadying it and more cost-efficient**
- **Cap for expansion of wind in areas with network "bottlenecks"**
- **Safeguard prod. mix**

**RES-share on gross electricity consumption in %**

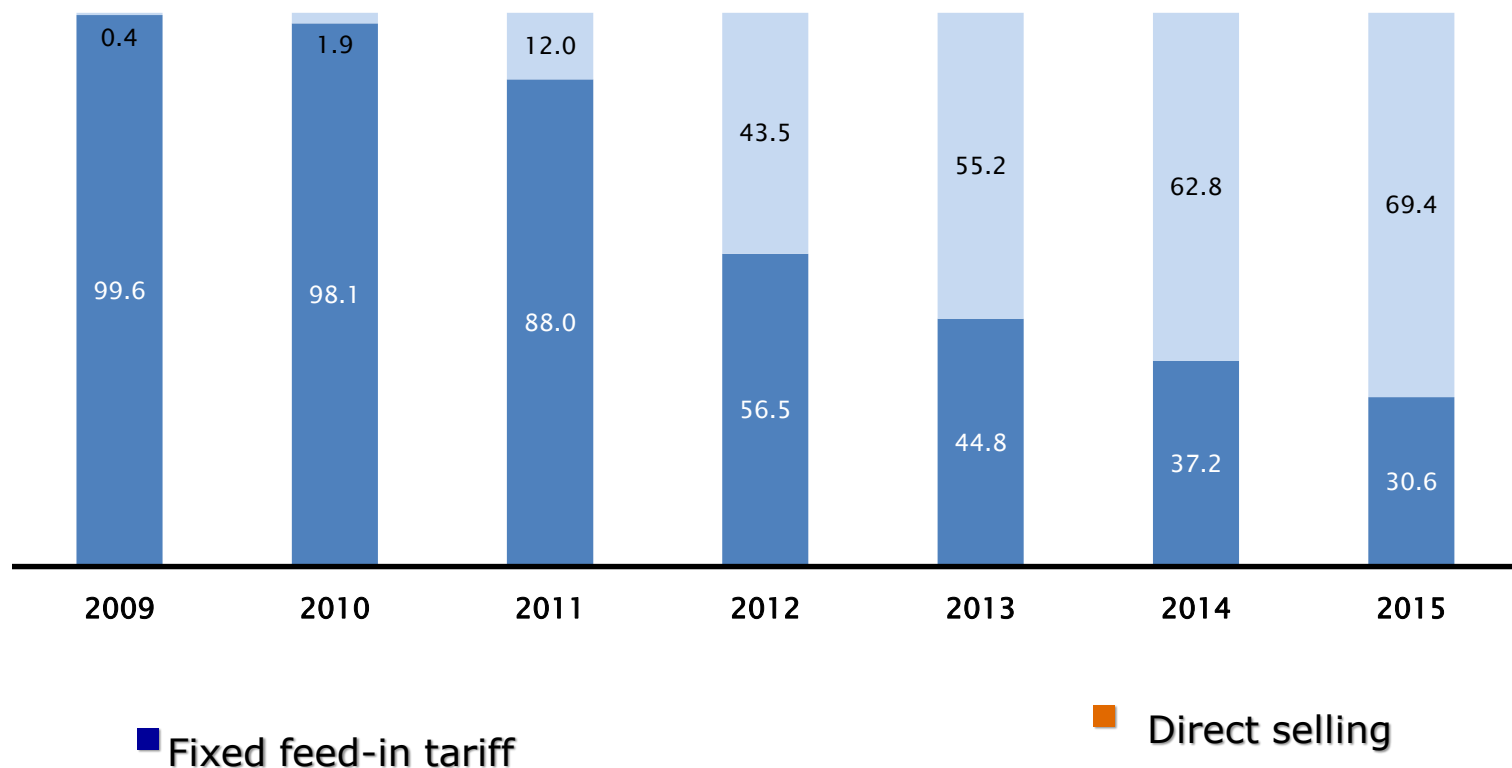
- expansion corridor's upper boundary
- expansion corridor's lower boundary



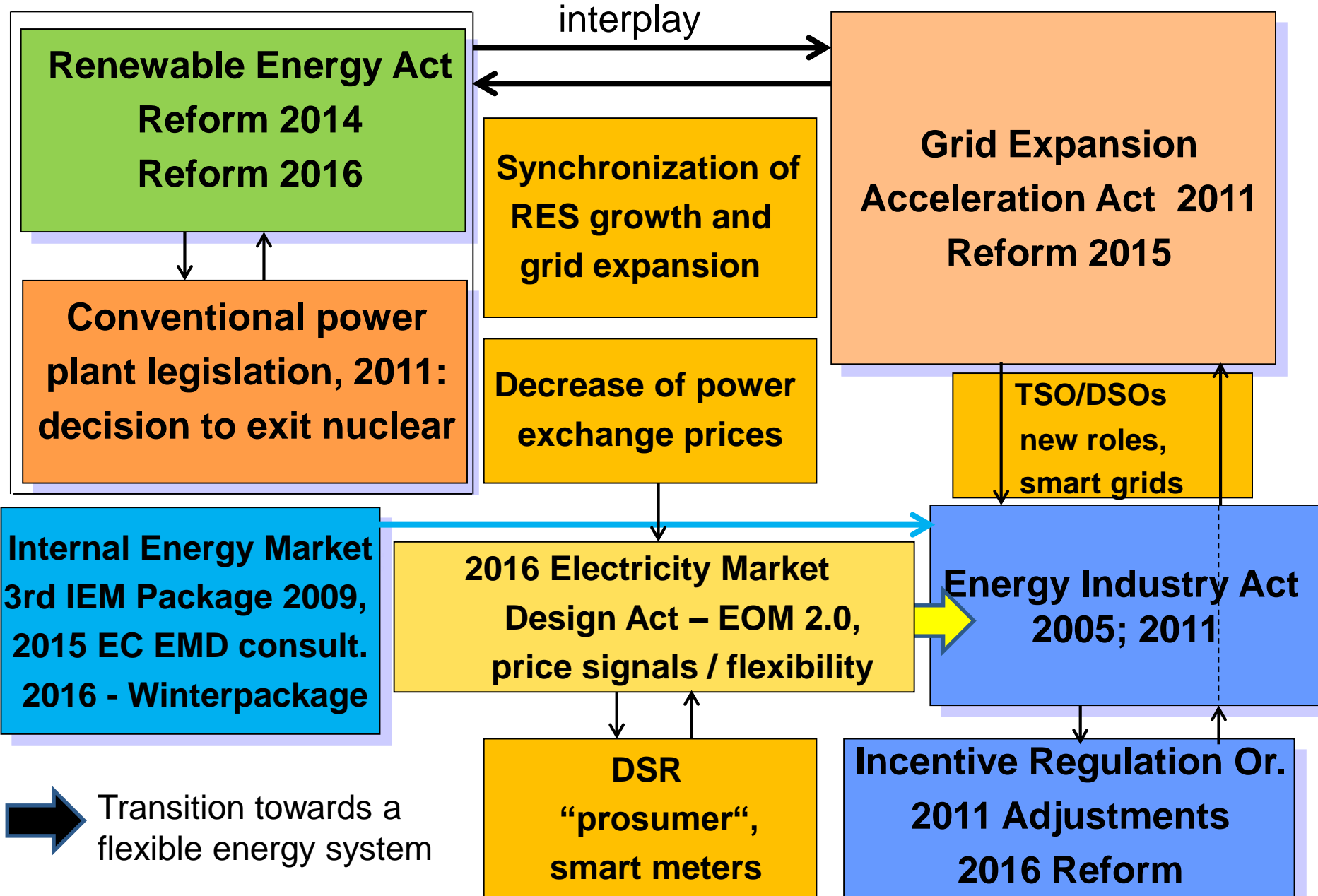
## *on the right track ...*

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



# Overview of German energy market legislation and regulation (incl. Energy transition laws)





## **„Energiewende“ in Germany:**

- Already high achievements regarding competition and SoS
- Nevertheless, the energy transition requires amendments: White Book of the Ministry (BMWi), 2015: Electricity Market 2.0

## **Main Amendments** (as adopted on 8 July 2016):

- German Energy Industry Act (Energiewirtschaftsgesetz, EnWG): strengthening market mechanisms while also introducing instruments to ensure security of supply
- Incentive Regulation (Anreizregulierungsverordnung, ARegV): Switch from revenue caps to cost-of-service regulation for capital costs of DSOs (strong lobbying)
- Renewable Energy Act (Erneuerbare-Energien-Gesetz, EEG): further integrating RES into the energy market (more tendering) and more cost efficient growth corridors of RES (targets)
- Act on Digitisation of the Energy Transition: Smart Meter as key elements of the future electricity market: promote the use of digital technologies to enable DSR and “prosumers”





- The „**Draft Electricity Market Act**“ was published on 14th September 2015 following largely the White Paper and the agreement of 1st July 2015
- **Electricity Market 2.0 (EOM)** considered sufficient to ensure generation adequacy
- Most important instrument to ensure the necessary capacity is financed and made available when required is an **undistorted price signal**, i.e. allowing also price peaks without intervention to give investors confidence
  - Principle of the Electricity Market Design is going to be incorporated into the Energy Act
  - No capacity remuneration mechanism foreseen
- A more efficient network expansion planning is incorporated as well to bring the network expansion in line with the faster than expected RES expansion corridors of the RES Act 2014 (**synchronisation**)



- On 4th Nov 2015 the Cabinet decided to initiate the following legislative acts:
  - **Electricity Market Act** („Electricity market 2.0“) (basically sticking to the Energy Only Market (EOM) with a capacity reserve to be activated only if needed to ensure security of supply) to integrate renewables and ensure the energy system is future proof
  - **Digitisation** of the „*Energiewende*“, i.e. mandatory roll-out of smart meters (for industry) when passing a certain threshold of annual consumption to increase energy efficiency (a. where the benefit outweighs the costs) starting in 2017, costs of installation are to be born by customers; strict rules on data security and privacy
- The **Electricity Market Act** clearly states the priority of competition and commits to not interfere in price setting



## Provision of several instruments

- Guaranteeing free price formation. The principle of unconstrained pricing in electricity trading will be anchored in the EnWG.
- Fostering the balancing energy market. More providers will have access which furthers more competition and lower prices.
- Additional backup instruments for the energy market:
  - continuous monitoring of security of supply
  - capacity reserve
  - network reserve } -> **SoS**
- capacities on-call (selected lignite power plants), „Sicherheitsbereitschaft“



- To ensure generation adequacy a so-called „**capacity and climate reserve**“ is established *outside* the market (i.e. not allowed to participate in the market) which is activated only if the market is not delivering the necessary capacity
- The capacity segment of the reserve will be tendered by BNetzA
- The climate segment of the reserve is made up of lignite plants
- This part is under scrutiny of the European Commission as it may be considered „state aid“, no final result yet
- Additionally the „network reserve“ (whereby power plants are contracted and „system-relevant“ plants cannot be mothballed) is extended beyond 2017
- Monitoring report of the SoS every 2 years foreseen
- The Ministry tabled the **Draft Electricity Market Act** in Nov. 2015
- After the parliamentary process the Act was finally adopted on 8 July 2016 and published in the Official Gazette on 26/29 July 16



## Security of Supply in terms of potential capacity shortfalls in the future

**Capacity reserves** serve as a buffer for times of insufficient supply, despite free pricing mechanisms

- The new capacity reserve is **intended as backup** in case of **unforeseeable events** in the electricity network and if market-based options are not available anymore.
- The reserve will be **contracted through auctions**. The auctions will not be limited to one technology only, but do not include demand side solutions.
- The aim is to **limit distortion of the electricity market** as much as possible and to avoid unjustified windfall profits for power plant operators.
- **Dual function possible:** power plants in Southern Germany may also serve as network reserve



Direction of travel: LEVEL OF SUPPORT WILL INCREASINGLY BE DETERMINED THROUGH COMPETITIVE BIDDING PROCEDURES

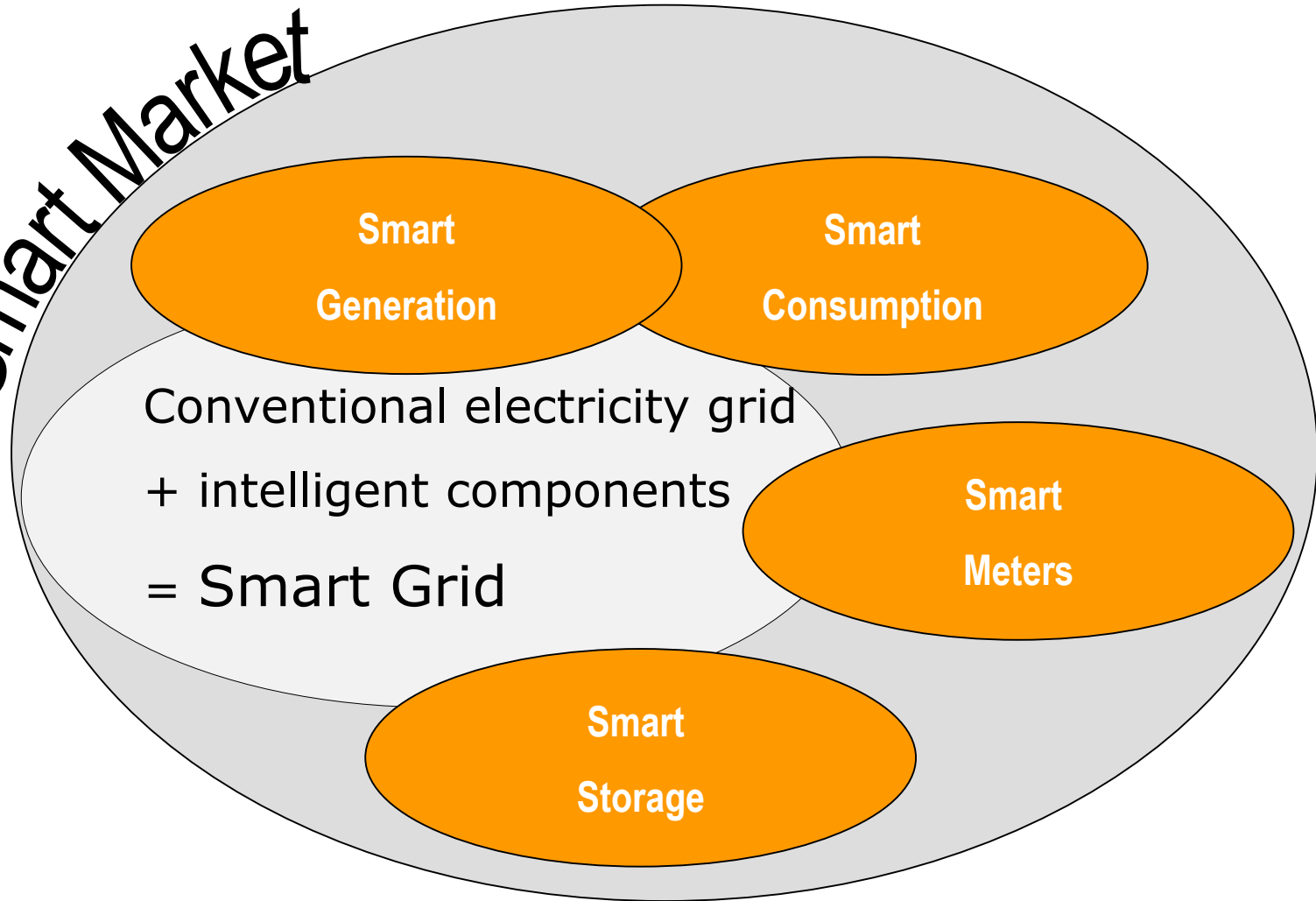
- **Pilot tendering procedure** for ground-mounted PV will **last until 2017** (third round in 2015).
- Reform of **Renewable Energy Act (“EEG 2017”)** towards more tendering
- **Major revision of legal framework 2016** to introduce **tendering processes** for wind onshore, wind offshore, PV rooftop panels (with de minimis threshold).
- For **other RES technologies** such as biomass, geothermal and hydropower, the reference support values will **continue to be determined through an administrative procedure** (reason: no competitive setting)
- **Regional cooperation** with neighboring Member States are under discussion



- Given the changes of the energy system needed to integrate RES into the grid and markets, the regulator has more responsibilities than in the past
- Not only the traditional regulation of the grid (access and rates regulation) as a natural monopoly, but
- More and more tasks regarding the **market integration of RES**, e.g. auctioning of RES
- Speeding up the grid expansion to ensure the grid structure and capacity is in line with the growth of RES (new tasks of planning and permitting were given to BNetzA in 2011) and confirmation of the network development plan submitted by the 4 TSOs
- Cooperation with all national regulators of EU Member States and observers in the European bodies (ACER) to ensure the development of the internal energy market is promoted and no cross-border barriers hamper energy trading and cooperation to ensure SoS
- Ensuring secure, efficient and sustainable energy supply at reasonable prices to consumers: moving towards a **customer-centric model** away from the current operator oriented model



## Smart Market







## **Regulatory challenges**

- The variety of the grid system operators in Germany is challenging for a regulatory system which is aimed to be tailor-made for all.
- Grid expansion is and will remain essential
- The energy transition involves large investments in transmission and distribution systems – even with the amended Renewable Energy Act.
- Ensure via incentive regulation that investments are made at efficient costs while ensuring investments can be made quickly
- Security of Supply in Germany is of high importance and requires a sufficient backup.
- The cost of grid and supply security measures will continue to increase



## Regulatory targets

- Costs of security of supply and network expansion must be limited as far as possible. In the short run, congestion management at the German-Austrian Border could lower the need for network reserve capacities
- Innovation and technological openness is important at all levels of the energy system.
- The energy transition („*Energiewende*“) needs a modern economic regulation of the grids to ensure adequate investments in the transmission and distribution systems in the long run.
- Liberalization is a high achievement. Prior accomplishments in liberalization must not be compromised. Measures to restrict competition should be avoided.

**Bundesnetzagentur considers itself a promoter of and a contributor to the energy transition.**



- Stable and **predictable** regulatory framework is key to ensure investors' confidence and avoid disruption
- Renewables require a more **flexible** energy system, which is best achieved by a more **market-based approach** with the participation of all players
- All players must adapt their business models to this energy system and react to new **incentives**
- Keep hands-off, i.e. let the market work and abstain from interventions distorting the price signals as well as the incentives to **invest in new infrastructure**
- **EOM 2.0** is embarking on this approach, at the same time the RES Act is reformed too to ensure a more **synchronised expansion** of the grid and the renewables: **interplay** of both is key
- Develop the **Internal Energy Market** to realize cross-border benefits (market coupling) and overall security of supply
- Germany's **Energiewende** is a test bed for the transformation of the energy system enabling the integration of increasing shares of RES and hopefully lessons can be learnt to avoid our mistakes!



Thank you for your attention

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# Backup

# Market Design: markets and fields of regulatory activity (1)



## Potentially competitive markets

### Electricity Wholesale Market

Balancing of generation and demand on the wholesale market

- Power Exchange / OTC
- Short/ Longterm

### Support Schemes for

- Generation (Renewables, CHP, Convention.)
- 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
- Reactive Power
- Redispatch
- Network Reserve

### Network Operation Resources

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

### Electricity Sales

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

### Metering Services

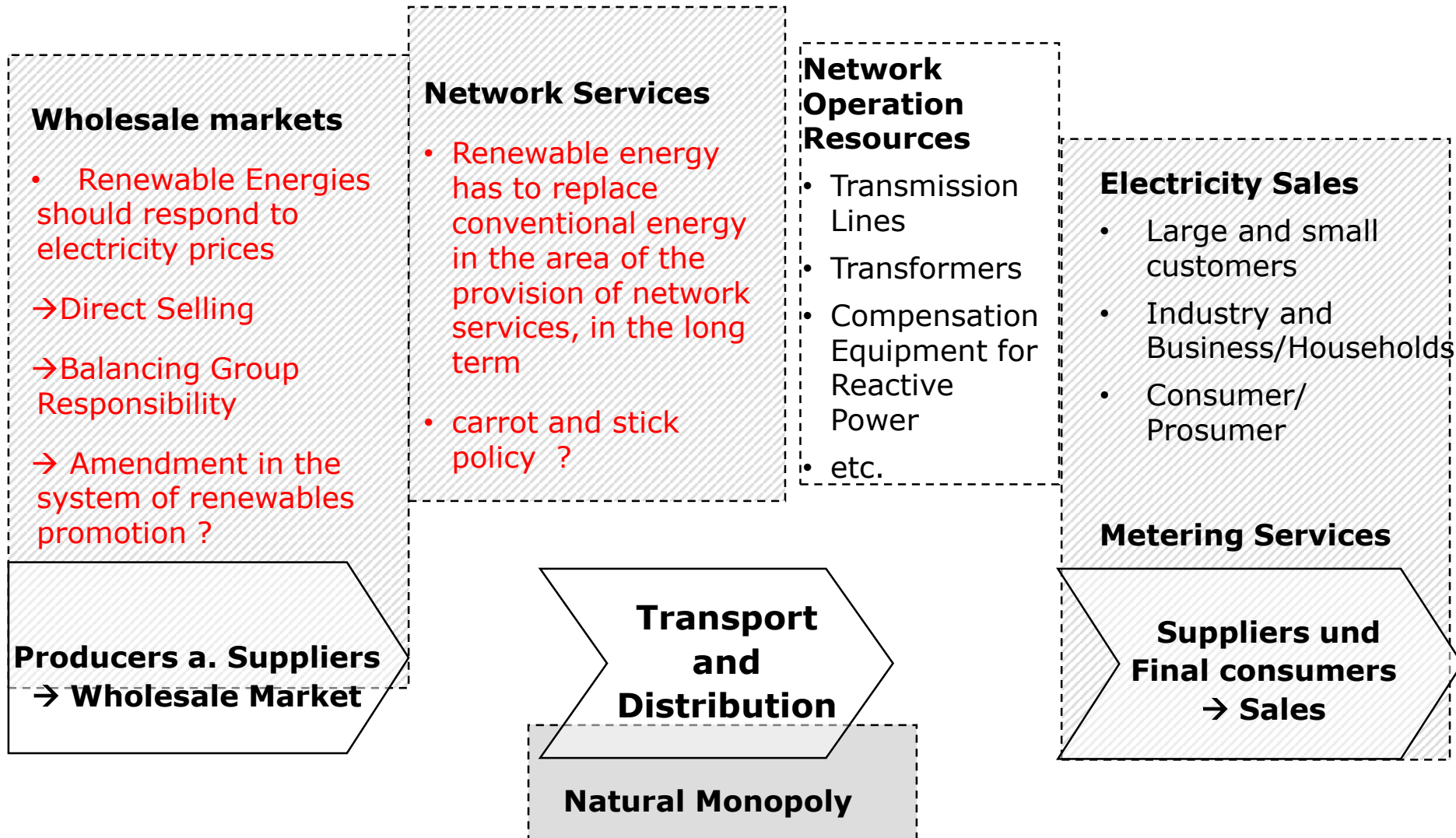
Suppliers und final Consumers  
→ Sales

Transport and Distribution

Natural Monopoly



## Requirements for renewable energy's role





- More than **98 %** of all renewable plants are connected to the distribution grid
- Distribution Grid-Study (Fed. Ministry of Economics, 2014) states the need of enormous grid expansion till 2032
- The lowest scenario “EEG 2014 - 128 GW” results in
  - 50,400 km in low voltage network (**+5 %** compared to 2012)
  - 70,100 km in medium voltage network (**+14 %**)
  - 10,800 km in high voltage network (**+11 %**)
- Till 2032 additional investments of **23.2 billion €** are necessary
- Attention: **need for grid expansion is very heterogeneous** (not all grid operators are equally affected)
- Innovative planning strategies and intelligent grid technologies lead to large savings
- Curtailment of wind and PV plants of max. **3 % in grid planning** results in a **15 %** reduction of the annual additional costs





## How can regulation incentivise the most efficient grid solutions?

1. Costs and benefits of smart planning concepts and technologies depend on the circumstances in the respective network



2. Network operator (not the regulator) should select appropriate planning concepts and intelligent technologies



3. Network operator should bear costs and enjoy benefits of its decisions



4. **German incentive regulation** works fairly well, nevertheless some adjustments should be made to the current scheme  
Additional incentives for long term efficient smart solutions (e.g. efficient carry over or “Bonus” for very efficient DSOs)  
Improving financial conditions for network extensions (abolishment of time delay of the expansion factor)



## ■ Incentive Regulation

- Evaluation of the incentive regulation scheme (Anreizregulierungsverordnung, ARegV) by BNetzA showed no barriers to investment
- An optimal combination of innovative planning concepts and using intelligent technologies can half the investment necessary and reduce average annual supplementary costs by up to 20%.
- Political discussion focusses nevertheless on the re-introduction of a cost-of-service regulation for capital costs



- However, the energy transition („*Energiewende*“) requires incentives for a **cost-optimal network development**
- Revenue caps (as currently applied) ensure that the network operator has the incentive to implement the optimal technological solution for each case
- Going back to a cost-of-service regulation will hamper innovations that have high cost of operation compared to the need for capital
- The Energy transition will in the end be more expensive than necessary – consumers will pay the bill!