



The Power Market Pentagon

*A Pragmatic Power Market Design for
Europe's Energy Transition*

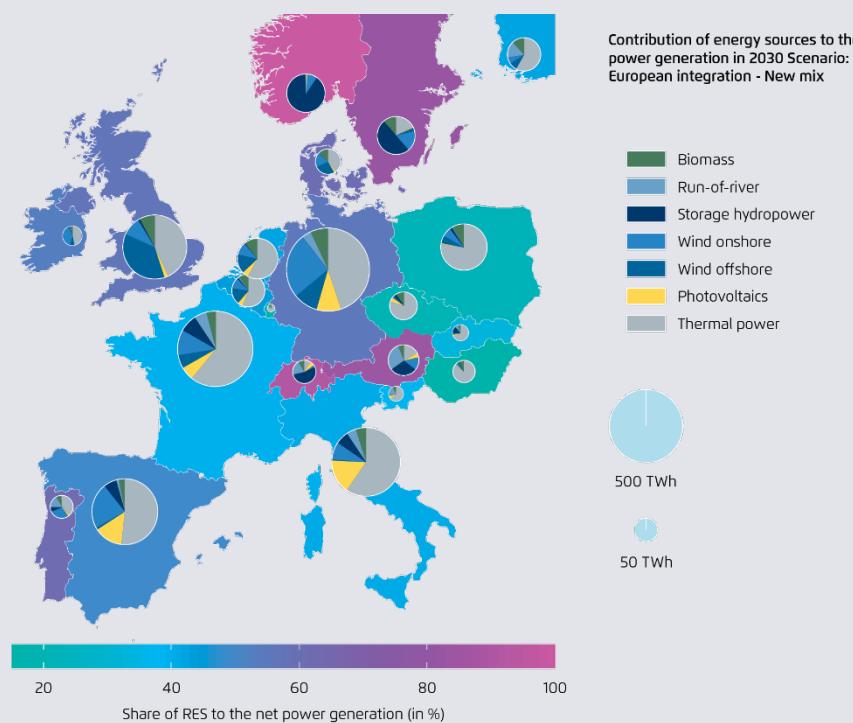
Matthias Buck, Christian Redl
BERLIN, 28 APRIL 2016



What do Europe's 2030 climate and energy targets imply for the power sector?

(1) A share of 50% RES in its power mix

RES-E share in the EU generation mix 2030



Fraunhofer IWES (2015): Assumptions based on national energy strategies and ENTSO-E scenarios in line with EU 2030 targets

RES-E are key for EU's 2030 strategy:

- EU's 2030 climate target of -40% THG below 1990 puts power sector in centre: Emissions are to reduce by 65% by 2030 compared to 1990*
- EU's RES target of 27% by 2030 will largely be delivered by power sector, as biofuels and RES heating sources are limited

Thus, EU 2030 climate and energy targets imply

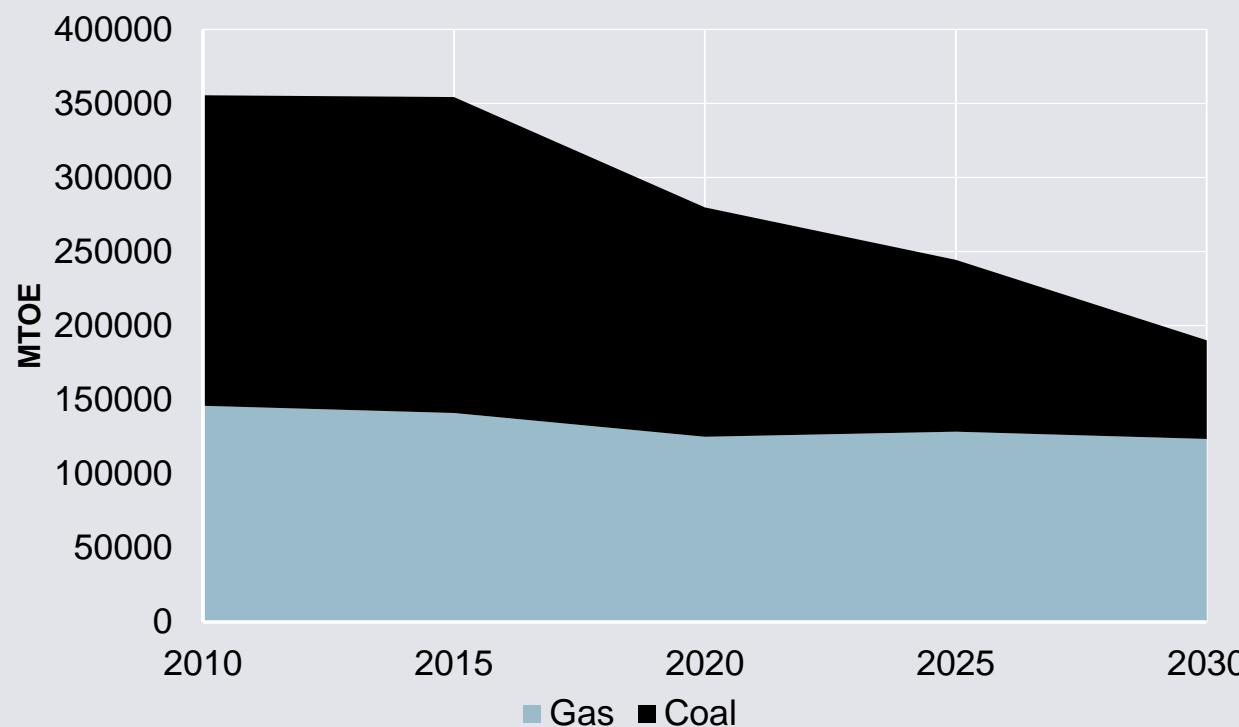
- 50% Renewables in the power mix
- 30% Wind and Solar in the power mix

(* EU Commission (2011): Impact Assessment on EU 2050 Energy Roadmap, „Diversified supply technologies scenario“)

What do Europe's 2030 climate and energy targets imply for the power sector?

(2) A decline of 68% of coal use in power generation

Actual and projected coal use in EU power generation



EU Commission (2011): Impact Assessment on the 2050 Energy Roadmap

A decline of coal use in power generation is key for the EU's 2030 strategy:

- Power sector emissions are to reduce by 65% by 2030 compared to 1990
- In 2015, ~ 3/4 of total CO₂ emissions stem from coal- and lignite-fired power plants, although these make up only 1/4 of total EU power generation

Thus, EU 2030 climate and energy targets imply for coal power production

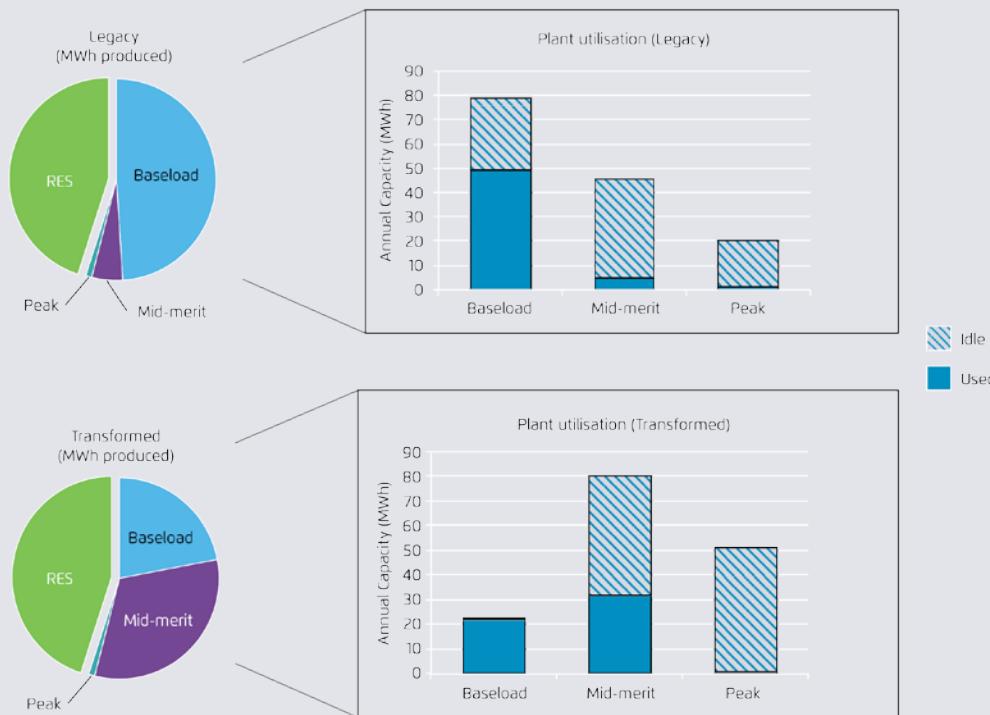
- Minus 68% of coal use in power generation*
- Decommissioning of roughly half of the coal fleet

(* EU Commission (2011): Impact Assessment on EU 2050 Energy Roadmap, „Diversified supply technologies scenario“)

What do Europe's 2030 climate and energy targets imply for the power sector?

(3) Transition to more flexible mix

Impact of thermal plant mix on plant utilisation rates and investments in a 45% RES-E system



RAP (2014) based on IEA (2014)

Increasing share of flexible resources and decreasing share of inflexible resources should go hand in hand with a growing share of variable renewables

- If mix remains essentially unchanged during transition all power plants have lower utilisation rates compared with shift to more flexible capacity mix
- 40% less investment required if capacity mix is transformed towards greater flexibility
- In transformed scenario all market participants are economically better off
- System adequacy ensured at lower cost in a “transformed mix”

Which market design will get us cost-effectively to a 2030 power system with 50% RES-E, -68% coal and a flexible mix?

Market design based on simple textbook economics

**Energy-only market,
System adequacy through peak
pricing**

**Emissions Trading
(with CO₂ price reflecting social
cost of carbon, i.e. > 60 EUR/t)**

Agora Energiewende (2016): The Power Market Pentagon

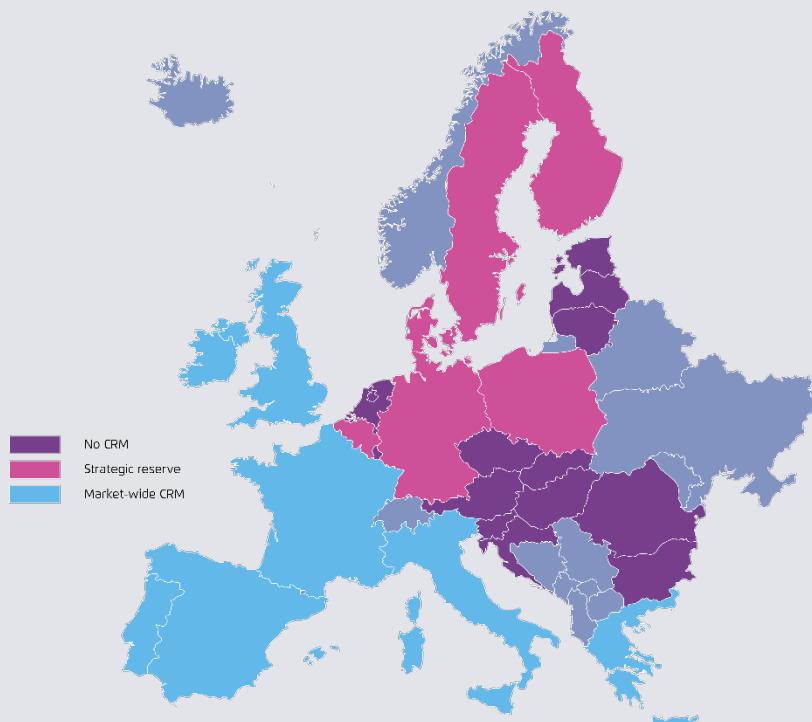
Energy-only markets increasingly complemented by out-of-market mechanisms

Market design based on simple textbook economics

Energy-only market,
System adequacy through peak pricing

Emissions Trading
(with CO₂ price reflecting social cost of carbon, i.e. > 60 EUR/t)

Capacity mechanisms in the EU 2015



Agora Energiewende (2016)

Agora Energiewende (2016) based on ACER/CEER (2015)

Huge CO₂ allowance surplus in EU ETS will keep CO₂ prices well below 30 EUR/t for another 15 years

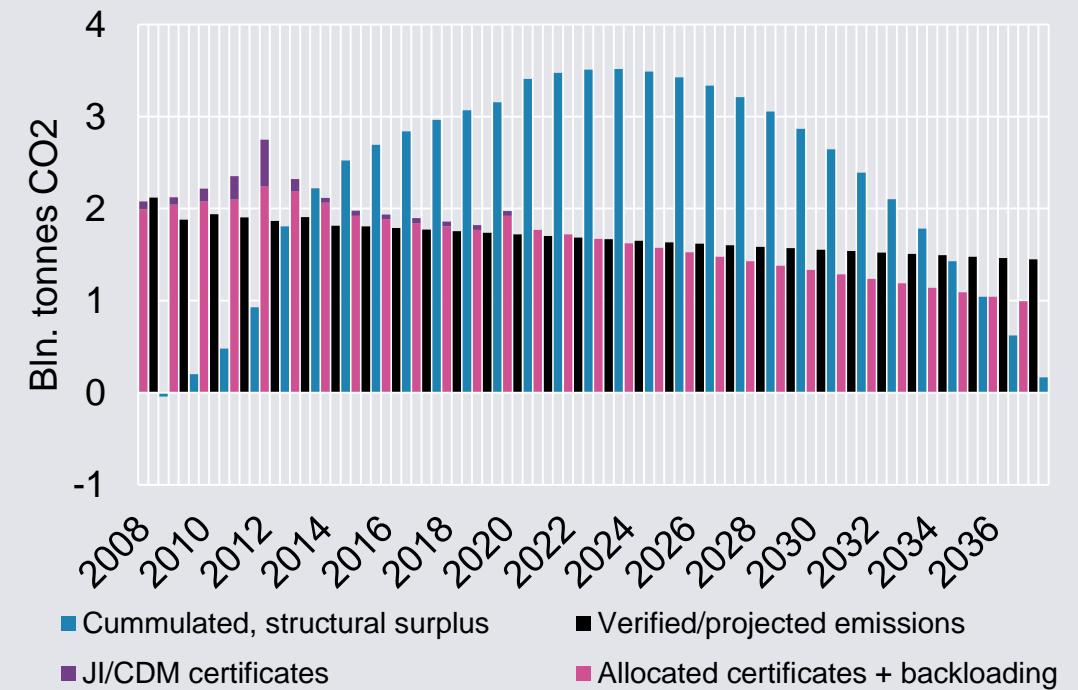
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Agora Energiewende (2016)

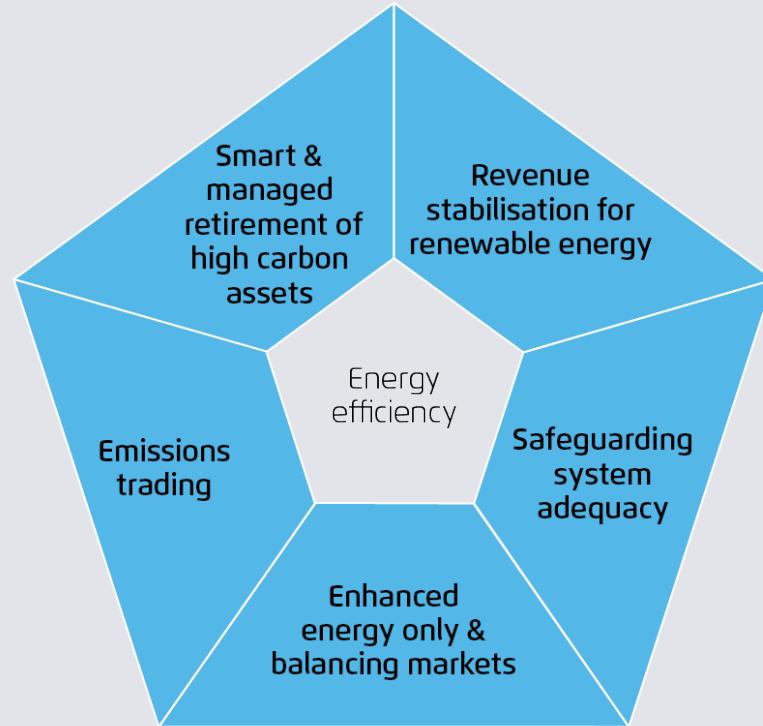
Cumulated allowance surplus in the EU Emissions Trading System



Agora Energiewende (2016)

A market design that fits: EU-level provisions on EOM, ETS, Smart retirement, RES-E revenue stabilisation and System adequacy safeguards

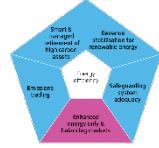
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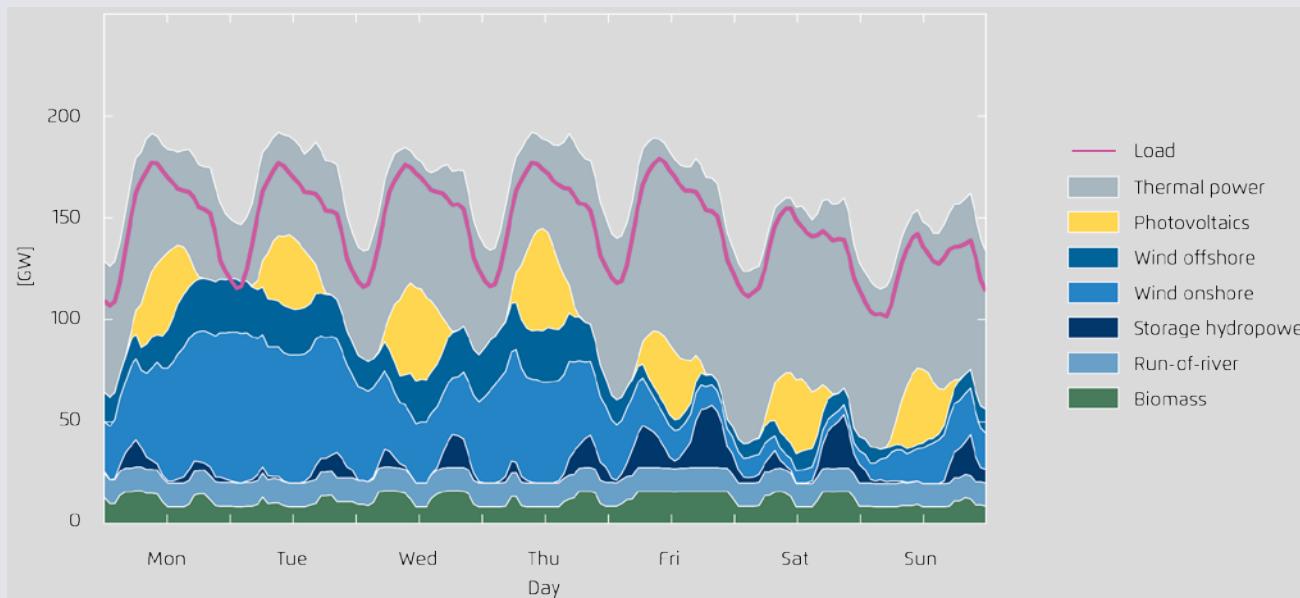
Real-life constraints of EOM and ETS require broadening of perspective and consideration of policy interactions:

- Refining EOM design is no-regret, but reaches limits due to old, high carbon, inflexible capacity in legacy mix
- Smart retirement of old, high-carbon, inflexible capacity is prerequisite for market design reform to be fully effective
- Reformed ETS will not deliver smart retirement, but must complement it
- Reformed ETS will not close revenue gap for RES-E investments
- System adequacy safeguards must be consistent with RES-E integration and retirement of high-carbon assets



Element 1: Enhanced energy-only and balancing markets to manage the flexibility challenge

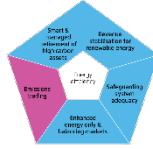
Electricity generation* and consumption* in the CWE region in a week in late summer 2030 (calendar week 32)



Fraunhofer IWES (2015)

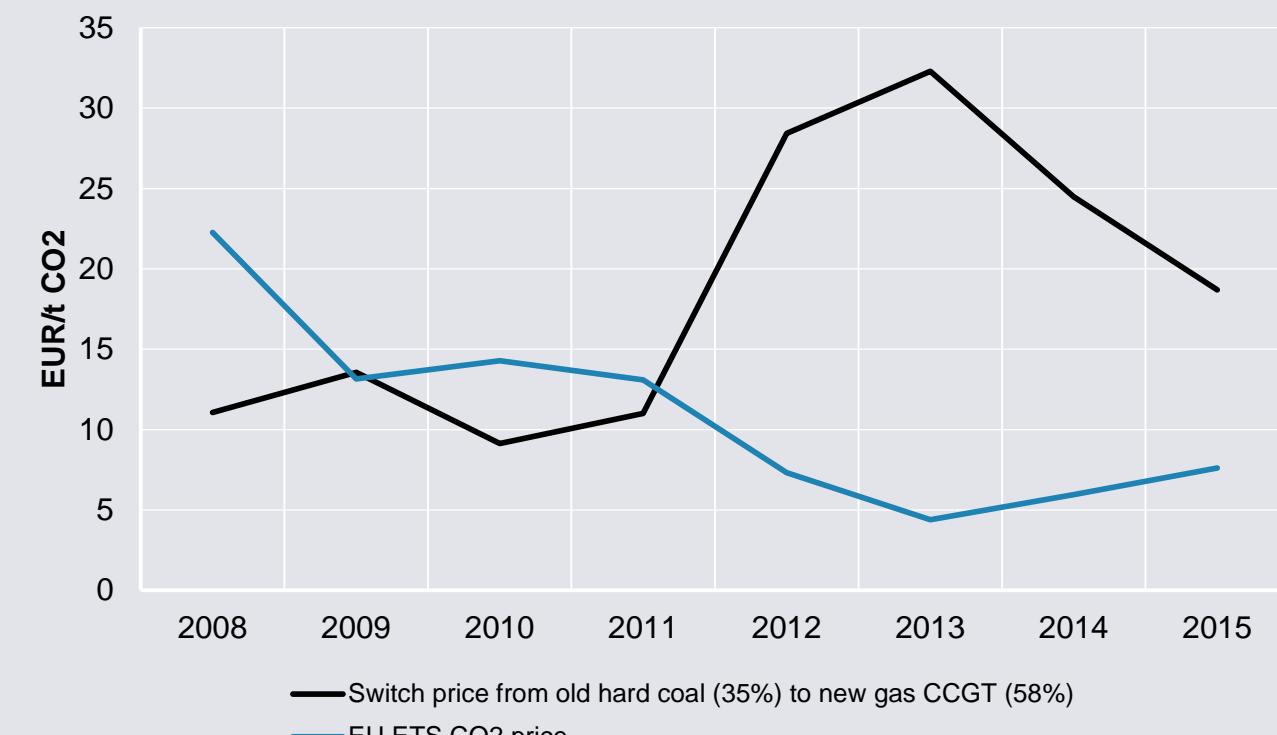
*Modelling based on 2011 weather and load data

- Power market has to become highly flexible for continuous interplay between generation, consumption and storage
- Efficient dispatch requires power prices reflecting real-time value of electricity. Key features of market design:
 - Coupling energy markets and making them faster (e.g. 15 minute products with 30 minute gate closure and progressive improvements)
 - Improving predictability of scarcity prices to reduce risks and support efficient flexibility investments
 - Enable level-playing field for demand-side and supply side flexibility
 - Balancing market design (products, contracting of reserves) must not distort incentives for energy market operations
 - Linking day-ahead, intraday and balancing markets to achieve prices that reflect real-time value of power



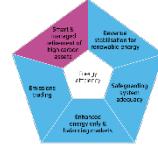
Element 2: The EU Emissions Trading Scheme should provide a stable mid-level carbon price (~30 EUR/t CO₂)

Comparison of the hard coal-to-gas CO₂ switching price* and the actual CO₂ price in the EU-ETS



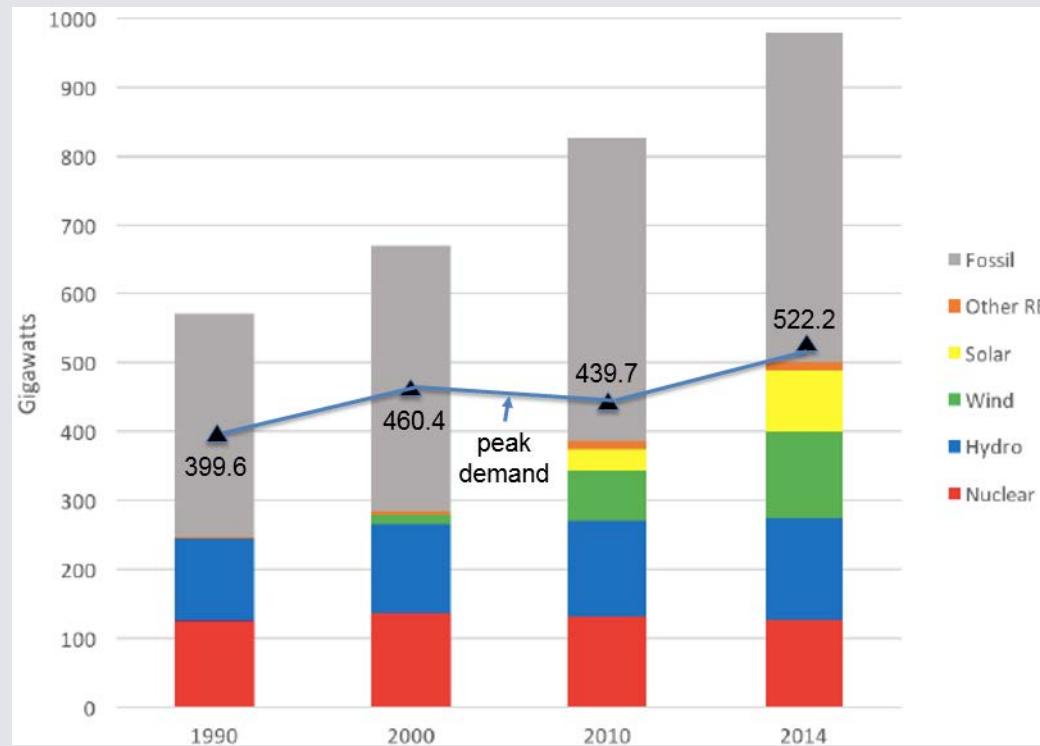
BAFA, DEHSt, EEA, Lazard, Federal Statistical Office Germany, UBA, own calculations. *Assuming an electrical efficiency of 35% for (old) hard coal plants and 58% for (new) gas-fired plants.

- Main role of ETS in power sector: Shift fossil generation mix from high- to lower-carbon
- ETS not right instrument to drive investments in zero-carbon assets like renewables
- ETS cap must interact smartly with CO₂ reductions from other climate instruments (RES, EE and smart retirement policies) and should enable national climate policies
- Key measures for EU policies:
 - Cancellation mechanism for additional domestic or EU climate policy measures
 - Stabilisation of ETS price through carbon floor price (e.g. 30 EUR/t CO₂)
 - Cancellation of EU ETS surplus as part of EU's contribution to Post-Paris-ratcheting-up mechanism



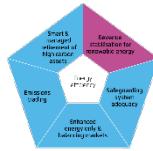
Element 3: Smart & managed retirement – The active removal of old, high carbon, inflexible capacity

Installed capacity vs. peak demand EU



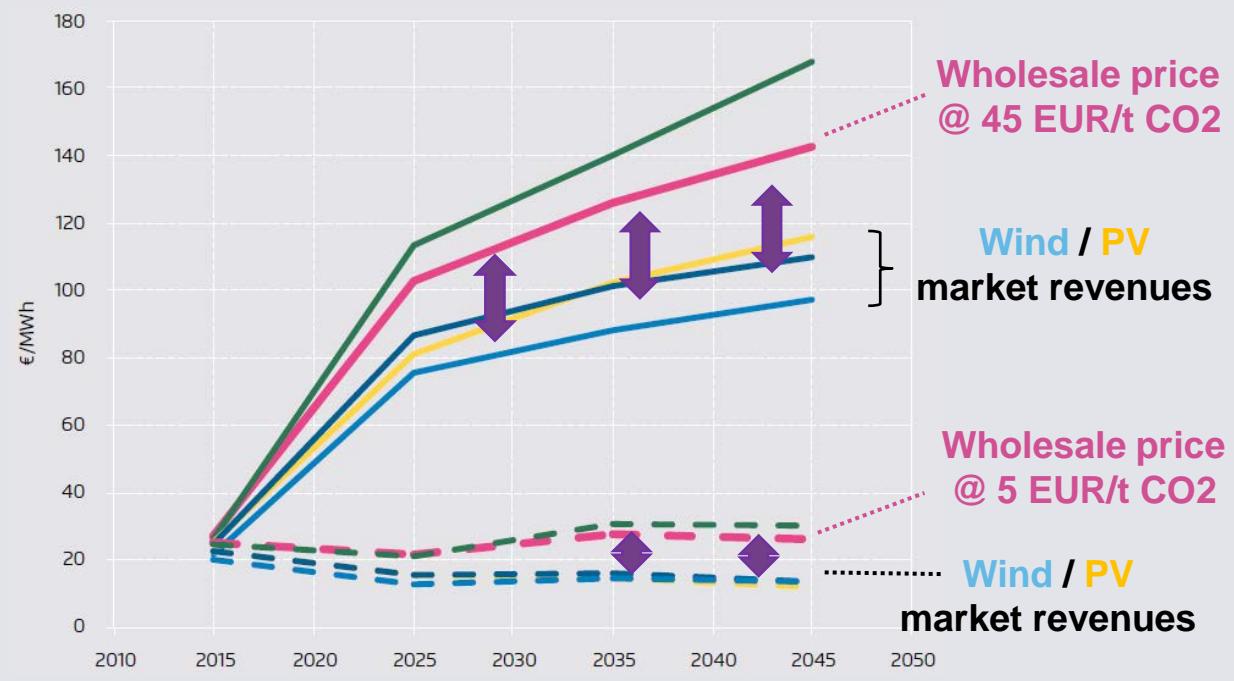
Michael Hogan, RAP (2016)

- Most urgent challenge of EU power markets are implications of legacy investments in high-carbon, inflexible generation; Market design alone reaches limits
- Smart retirement of old, high-carbon, inflexible capacity is prerequisite for successful market design; Required EU level action:
 - Efforts to close gaps in Industrial Emissions Directive
 - Appropriate emission performance standards (EEAGs)
 - Spotlight on system adequacy, flexibility challenge and required reduction of carbon intensity in *national energy and climate plans*
 - Transparent flexibility check of national power systems (IEM and RE Directive revisions)
 - EU budget to offer opportunities to assist lower-than-average GDP member states



Element 4: Providing stable revenues for new RES-E investments to achieve EU target at least cost

Average wholesale prices versus market revenues of variable renewables



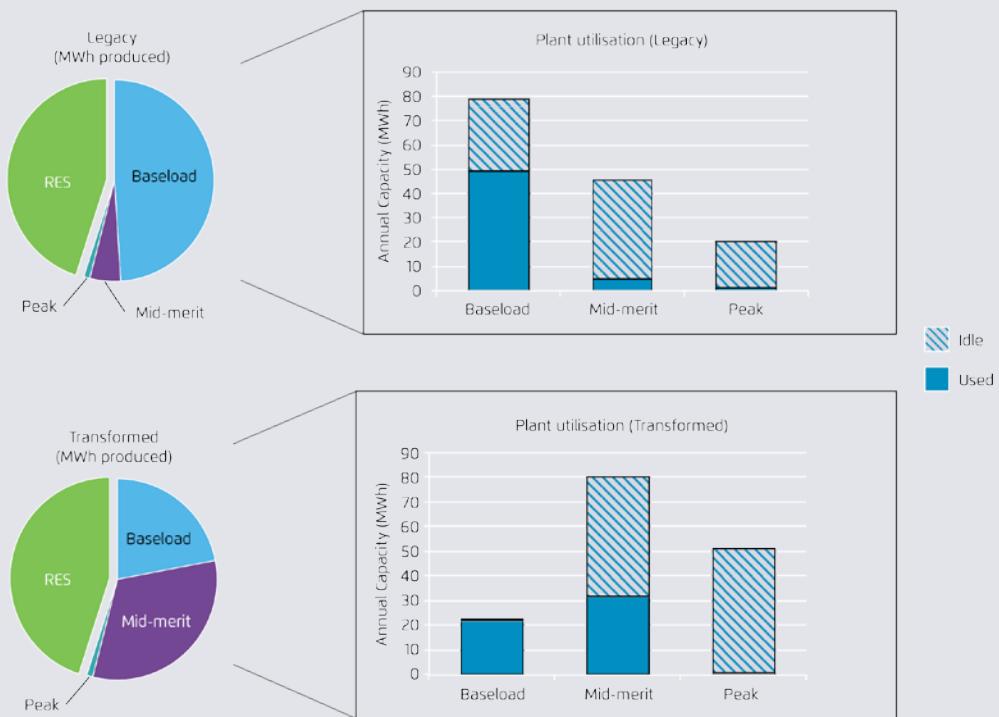
Öko-Institut (2014)

*1% WACC increase yields 8%
LCOE increase for wind onshore

- Wind / PV require revenue stabilisation throughout 2020-2030. High risks for investors lead to high cost of capital and LCOE*
- Future RES framework should:
 - Acknowledge key role of revenue stabilisation to close gaps btw market revenues and returns on investment
 - Competitive tendering will show where and when market conditions are sufficient
 - Prohibit retroactive devaluing of investments
 - Maintain priority grid access and priority dispatch
 - Translate some state aid elements into ordinary EU legislation (e.g. technology-specific support)
 - Make national assessments of RES barriers obligatory and include EU mechanism for de-risking RES investments
 - Framework for closing possible gaps between national contributions and EU-wide 2030 RES target

Element 5: Safeguarding system adequacy consistent with long-term decarbonisation and flexibility needs

Impact of thermal plant mix on plant utilisation rates and investments in a 45% RES-E system



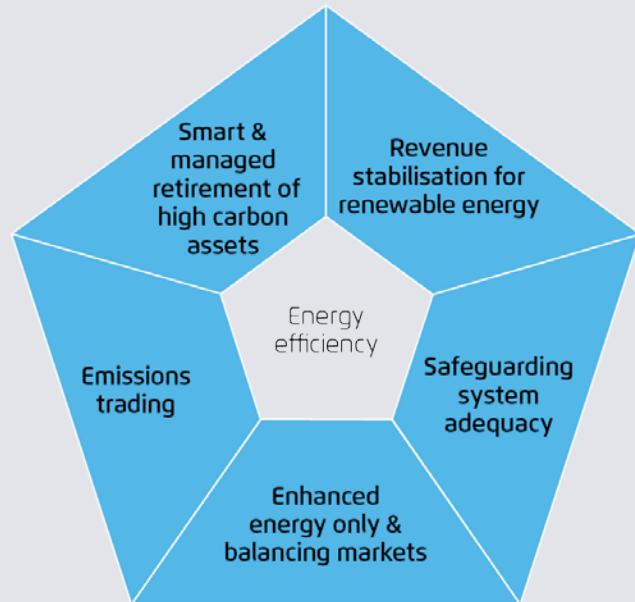
RAP (2014) based on IEA (2014)

- Increasingly flexible power mix required → Adequacy not only about “*how much*” but “*what kind*” of capacities
- Interventions must be consistent with long-term decarbonisation and flexibility needs
 - *Strategic or capacity reserves* operating fully outside energy and balancing markets
 - *Energy-based payments* by stabilising scarcity prices
 - *Capability remuneration mechanisms*: Resource capability rather than capacity has to be primary focus
- Cross-border adequacy assessment should be requirement for domestic CRMs
- MS to develop national/ regional roadmaps to enhance power system flexibility and NECPs used as reference point to ensure SoS interventions consistent with decarbonisation

The real-life challenge:

Designing the elements of the Power Market Pentagon so that they are mutually supportive and do not contradict each other

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Agora Energiewende (2016)

Things *not to do* include:

- Introduce a capacity market which grants money to high-carbon & inflexible assets
 - Reform the ETS under the assumption it would enable full refinancing of RES-e
 - Enhance the energy-only market without letting demand side and RES-e fully participate in the balancing markets and implementing smart retirement policies
 - Redesign renewables remuneration mechanisms without taking their effects on the energy-only market into account,
- ...

Rather: Think of market design in a holistic way, combining all five elements sensibly!

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Pentagon**

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IMPULSE



**Power Market Operations
and System Reliability**

A contribution to the market design debate in the
Pentalateral Energy Forum

IMPULSE



**Understanding the
Energiewende**

FAQ on the ongoing transition of the
German power system

BACKGROUND



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