

Lesson-learned in the Energy Transition

Some insights from Germany and Europe

*Climate Action Group meeting
Energy Community Secretariat*

Matthias Buck

VIENNA, 5 SEPTEMBER 2017



Agora Energiewende – Who are we



Independent think tank with more than 20 energy policy experts

Independent and non-partisan

Project duration 2012-2021

Financed by the Mercator Foundation and the European Climate Foundation

Mission: How do we make the energy transition in Germany and worldwide a success story?

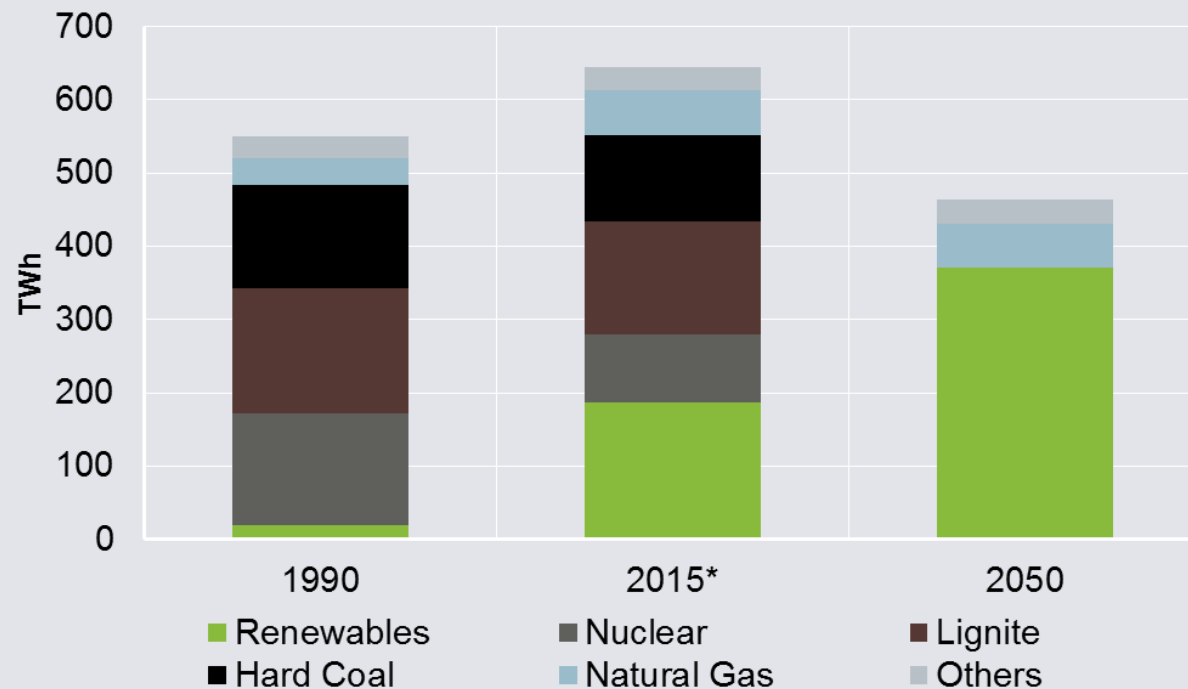
Scientific assessments

Dialogue

Putting forward proposals

The German *Energiewende* in the power sector: Phasing out nuclear and coal, and ramping up efficiency and renewables

Gross electricity generation 1990, 2016 and 2050



AGEB (2016), BReg (2010), EEG (2014), own calculations * preliminary

Phase out of Nuclear Power

Gradual shut down of all nuclear power plants until 2022

Reduction of Greenhouse Gas Emissions

Reduction targets below 1990 levels:

- 40% by 2020; - 55% by 2030; - 70% by 2040;
- 80% to - 95% by 2050

Development of renewable energies

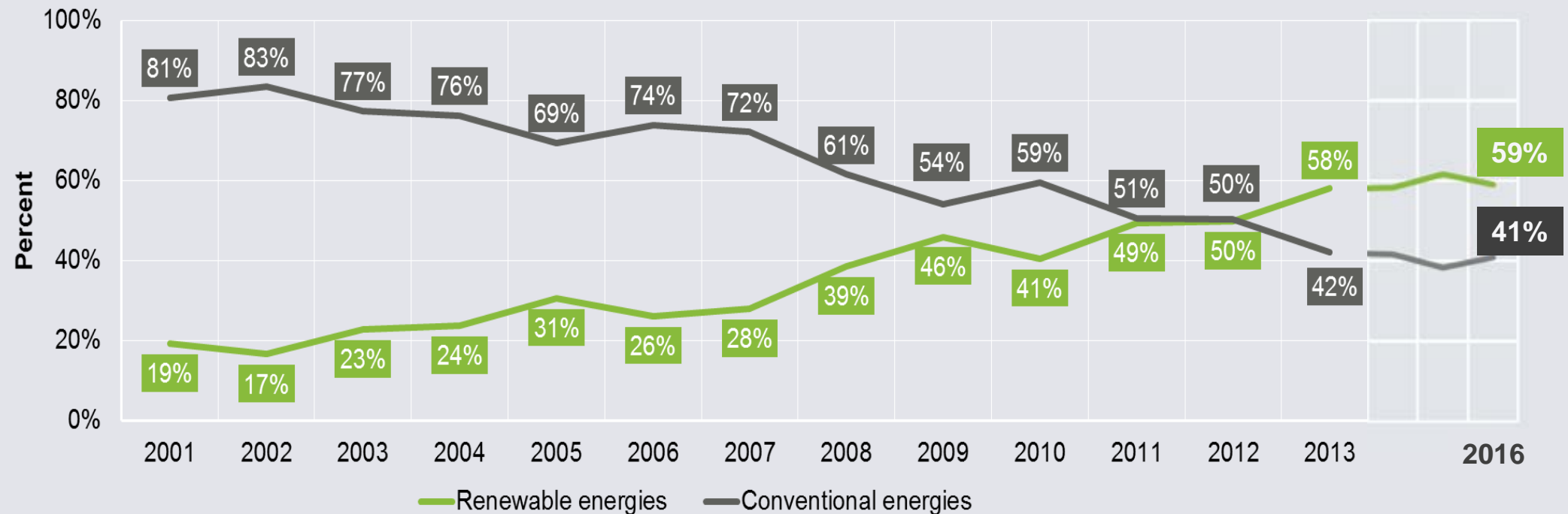
Share in power consumption to increase to:
40 - 45% in 2025; 55 - 60% in 2035; ≥ 80% in 2050

Increase in efficiency

Reduction of power consumption compared to 2008 levels: - 10% in 2020; - 25% in 2050

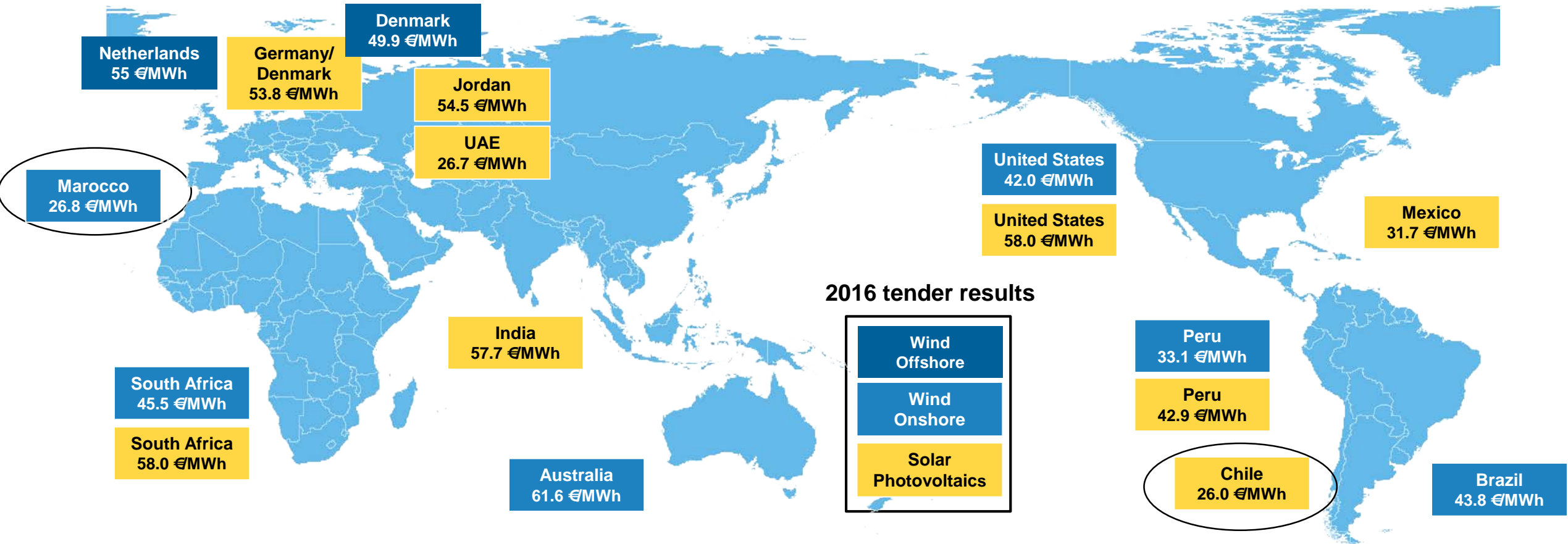
Germany is not going it alone. The energy sector is undergoing a transition across the globe

Share in global capacity additions 2001- 2013



IRENA (2014, 2015), FS UNEP (2017)

The transition is driven by economics. Dramatic cost reductions make wind and solar the cheapest low-carbon option & cost competitive to new fossil power plants



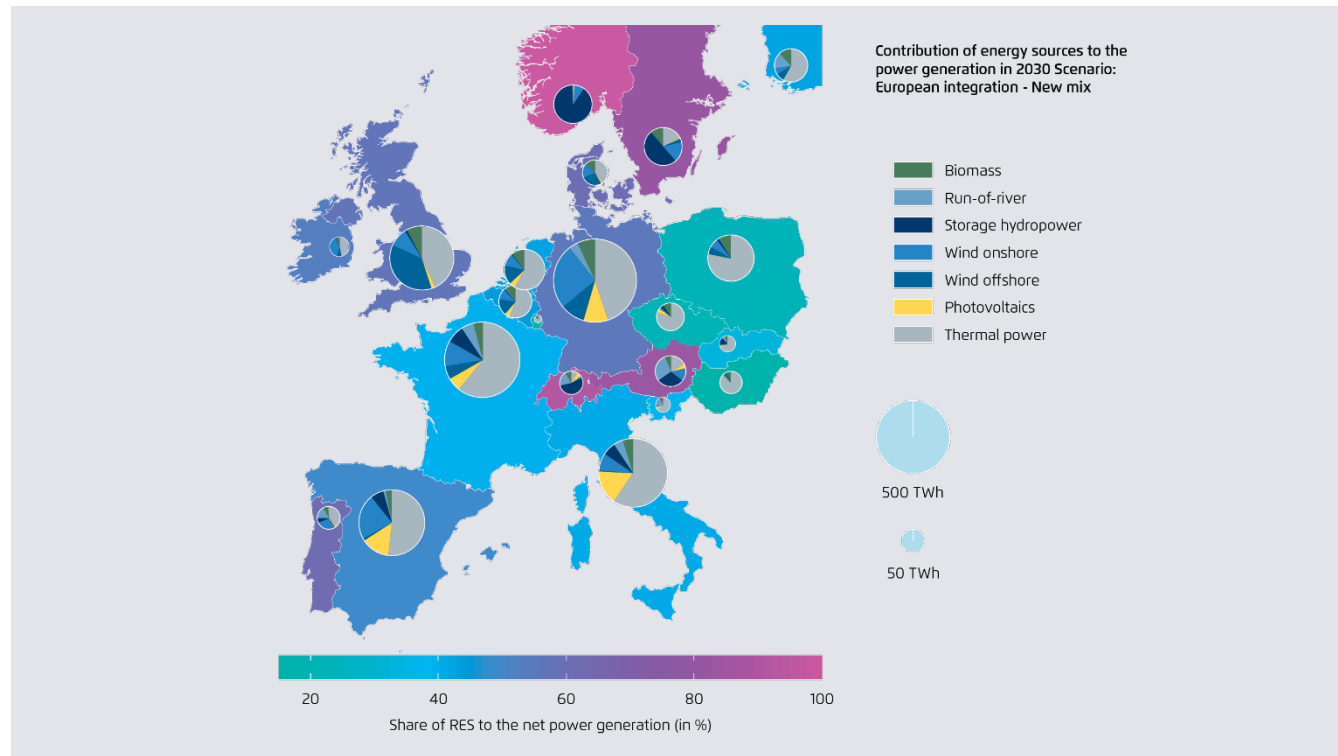
Fortum 2016; Sources: announcements by the investing companies and IEA report "Renewable Energy Medium-Term Market Report 2015" for US, Brazil, South Africa, Australia and Jordan. Values reported in nominal EUR, 1 EUR = 1,12 USD, 1 EUR = 75,3 INR, 1 EUR = 9,48 SEK. United States values calculated excluding tax credits. Typical contract lengths are 15-25 years. The prices indicate levels with which investors have been willing to invest, however, they may not describe the actual comparable costs as the bid prices may be reduced by preferential land prices, site exploration cost, targeted low-cost loans etc. The price level at which investors can hedge their renewable production for the next 4 years: average of 2017-2020 electricity (LUL) + elcertificates futures with 29.8.2016 closing prices. This low price levels still result in continuation of investments in onshore wind in Sweden.

**Where is the EU
heading?**



The EU's 2030 climate and energy targets imply an annual average share of 50% RES in the EU's power mix; almost the same Germany has set for itself (55% in 2030)

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

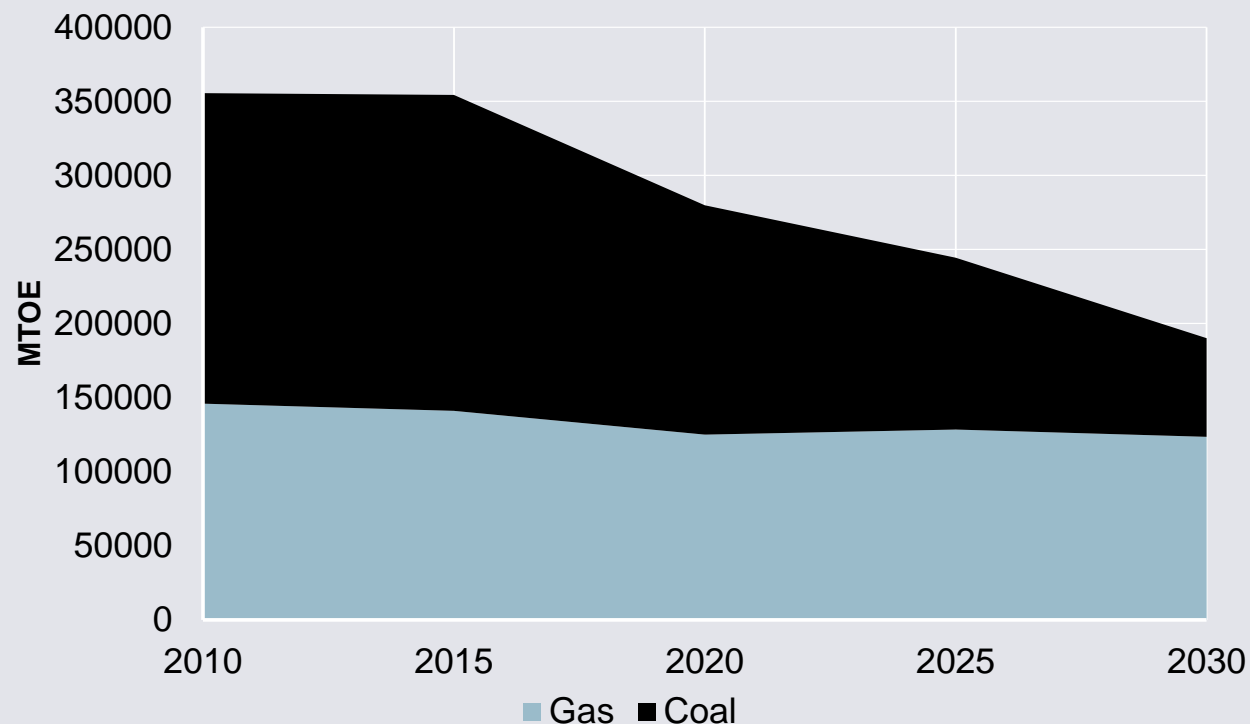
Thus, EU 2030 climate and energy targets imply

- 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“)

The EU's 2030 climate and energy targets imply a decline of 68% of coal use in power generation

Actual and projected coal use in EU power generation



A decline of coal use in power generation is key to 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

The EU 2030 climate and energy targets imply for coal

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

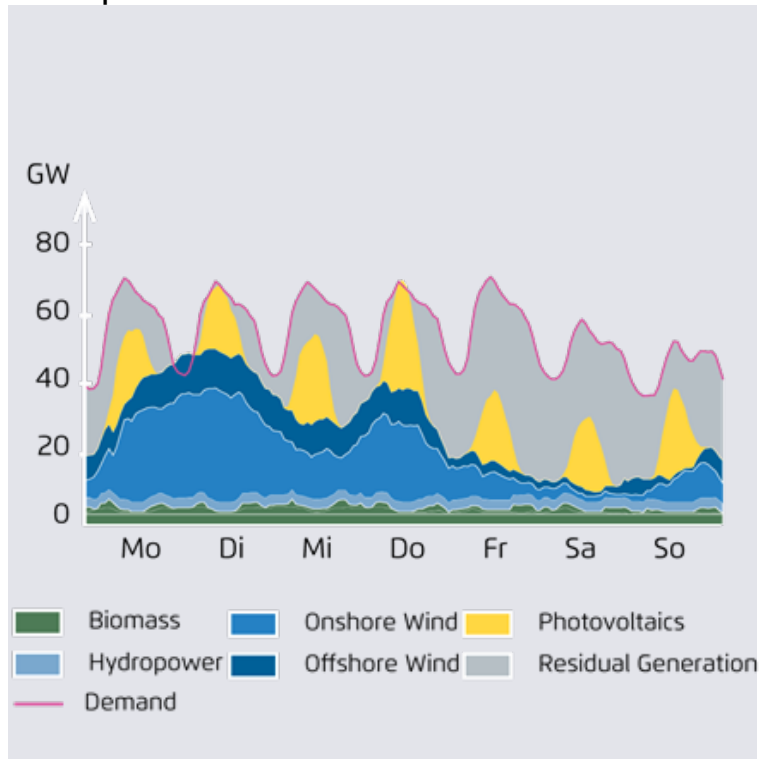
(* EU Commission (2011): Impact Assessment on EU 2050 Energy Roadmap, „Diversified supply technologies scenario“)

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

Main challenges in the transition

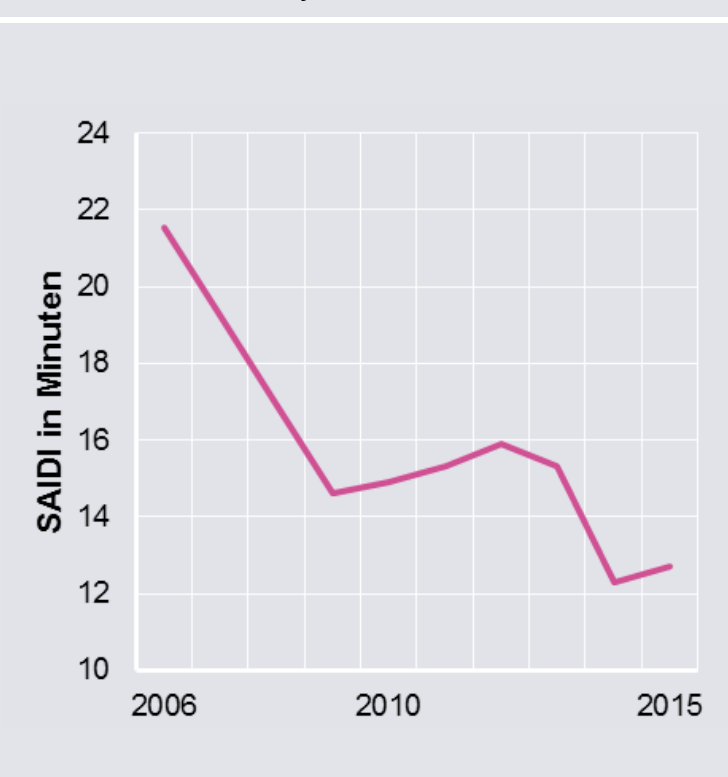
Flexibility is the paradigm of the new power system to ensure security of supply. SAIDI remains very low in Germany

Electricity generation and consumption in a sample week with 50% RES share



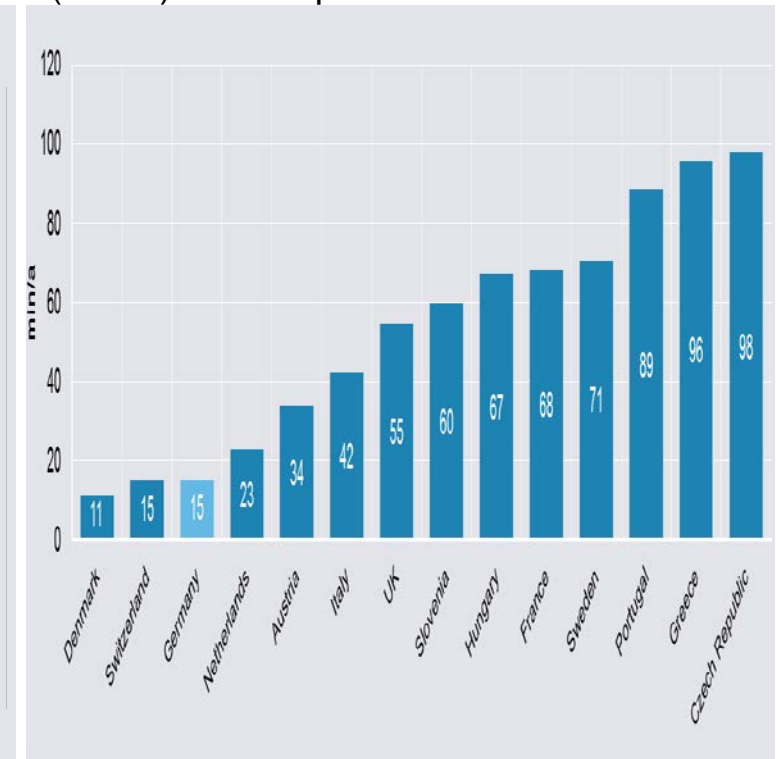
Agora Energiewende (2015)

SAIDI in Germany



BNetzA (2016)

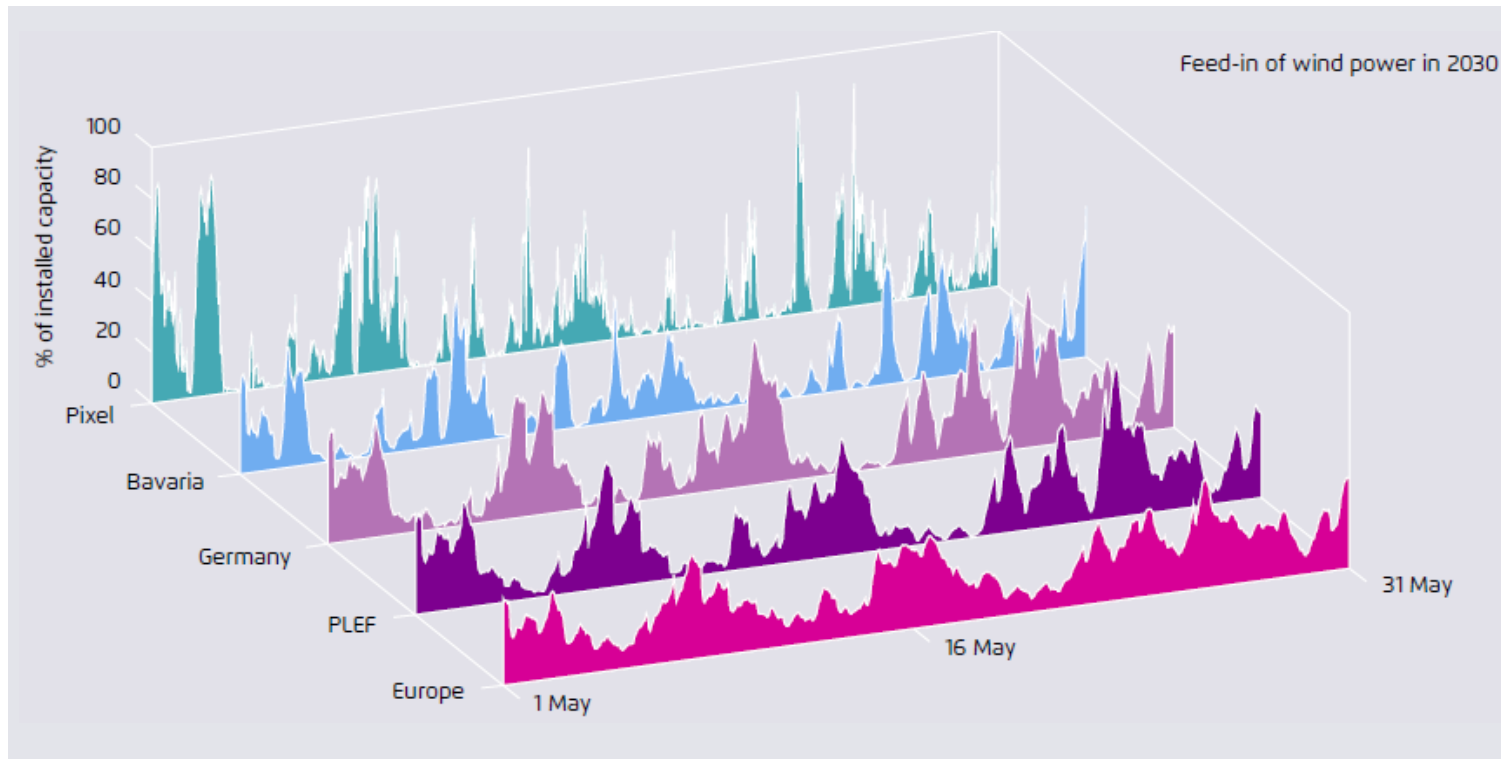
System Average Interruption Duration Index (SAIDI)* in Europe 2013



CEER (2015) * without exceptional events

Cross-border cooperation between neighbouring countries significantly reduces the flexibility challenge

Time series of onshore wind generation in May 2030 at different levels of aggregation



Power system integration mitigates flexibility needs due to smoothing effects

Hourly wind ramps decrease by ~50% comparing the national and European scale

Reduced residual load gradients & balancing requirements; Minimised renewables curtailment

Cross border system integration key for minimising flexibility challenge

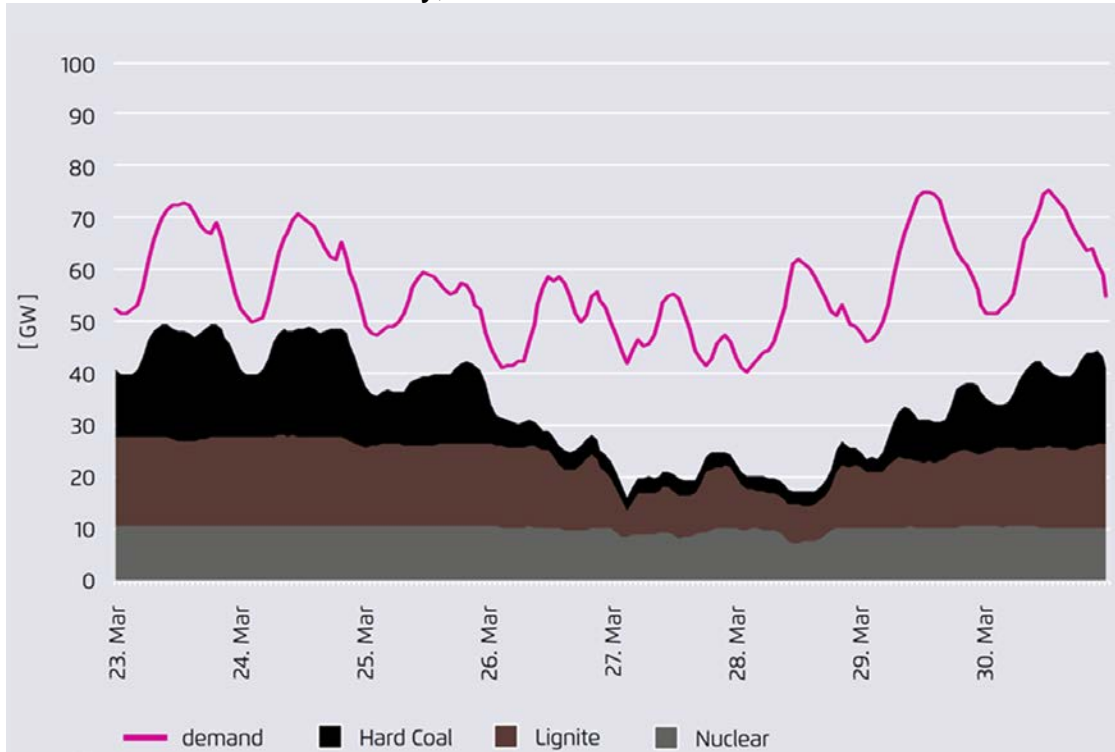
→ Grid interconnections, cooperation in system operations and market design

Fraunhofer IWES (2015)

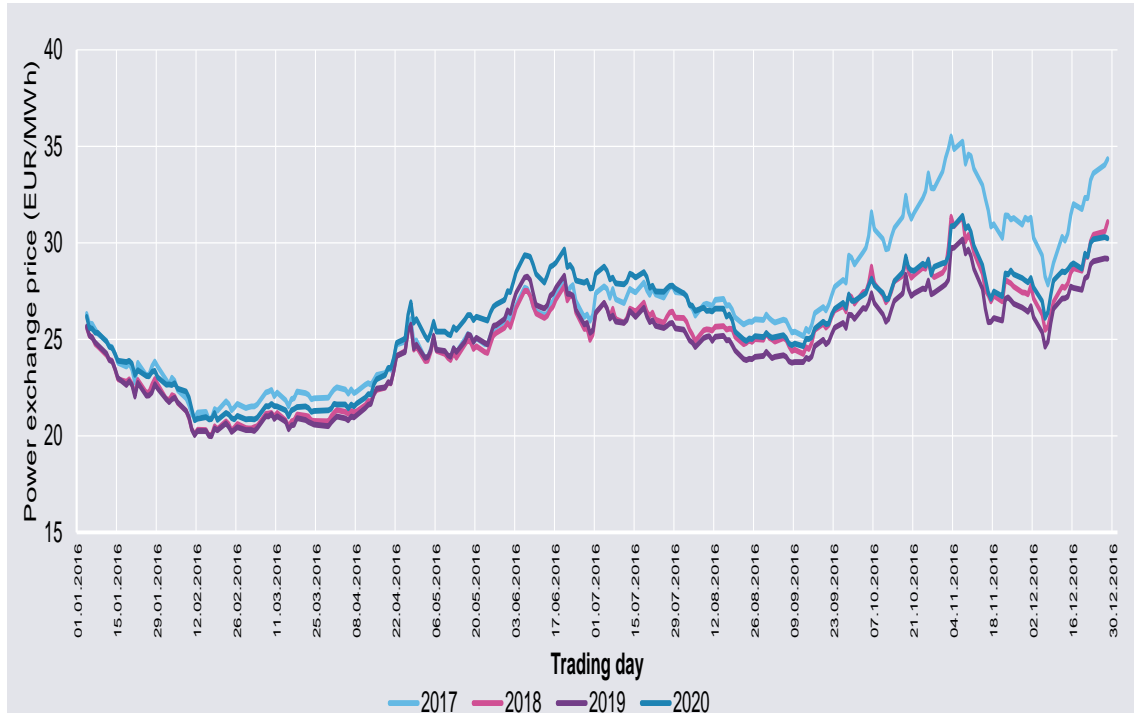
* One pixel is equivalent to an area of 2.8 x 2.8 km; PLEF are the countries AT, BE, CH, DE, FR, LU, NL

Existing coal power plants can provide more operational flexibility than is often considered. Investments in new fossil fuel plants unlikely to earn back their investment costs

Power generation from nuclear, hard coal and lignite power plants and demand in Germany, 23 to 30 March 2016



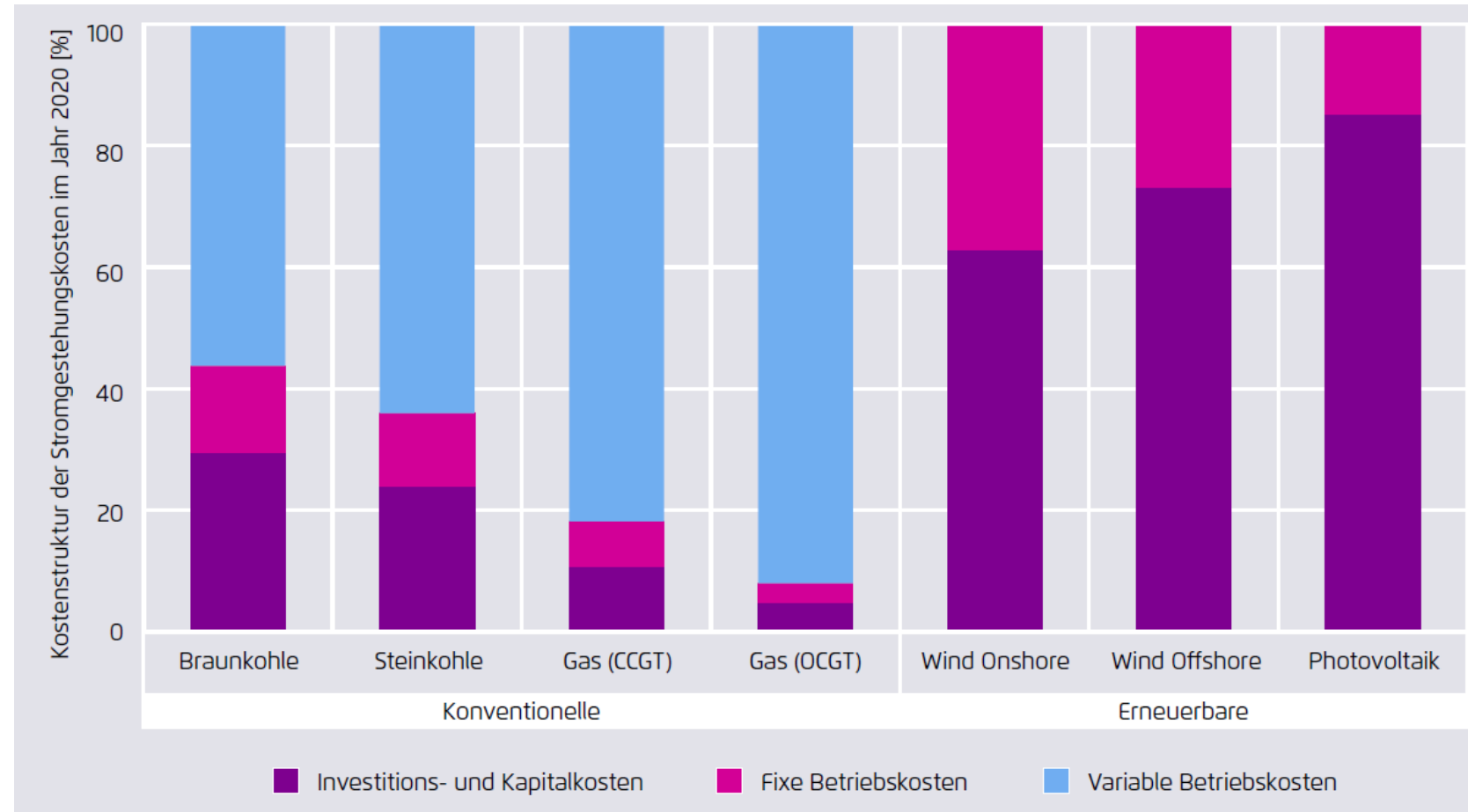
Forward prices for delivery of power in 2017, 2018, 2019 and 2020



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EEX

Wind power and solar PV have high upfront investment cost and very low operating cost. Financing conditions for upfront investment are critical for economic viability of RES projects



- Solar, wind and hydro power are characterized by a high share of fixed costs and very low (often close to zero) variable operating costs
- Conditions for the financing of the initial investment are major determinant of cost of generated electricity
- Financing conditions reflect ex ante risk perception
- Reducing ex ante risk is key to reducing investment cost
- Targets, stable regulatory frameworks, technology-specific pathways and innovative financing significantly reduce risk and thereby investment costs

Variable Betriebskosten sind v.a. Kosten für Brennstoffe und CO₂-Ausstoß, fixe Betriebskosten v.a. Personal, Wartung und Instandhaltung
Eigene Berechnungen auf Basis von IEA/NEA (2015)

Some conclusions

- An energy transition based on efficiency, renewables and reducing use of coal is economically sound, enhances energy security and delivers on climate change objectives
- South-Eastern Europe has a large economically attractive renewable energy potential and a large potential to enhance energy efficiency
- Countries in South-Eastern Europe have relatively high inter-connection levels. A cooperative approach could significantly reduce the flexibility challenge from higher shares of renewable power
- Renewables and efficiency investments come with significant co-benefits, in particular employment and clean air
- An integrated approach to energy and climate planning helps to identify the economic, energy security and climate protection opportunities from cheap renewables and enhanced efficiency
- Lessons can be learned from “first-mover” countries (positive and things to be avoided)



More information and studies available at our website
www.agora-energiewende.org



Agora Energiewende
Anna-Louisa-Karsch-Str.2
10178 Berlin

T +49 (0)30 700 1435 - 000
F +49 (0)30 700 1435 - 129

www.agora-energiewende.de

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Thank you for your attention!

Questions or Comments? Feel free to contact me:
matthias.buck@agora-energiewende.de

Agora Energiewende is a joint initiative of the Mercator
Foundation and the European Climate Foundation.

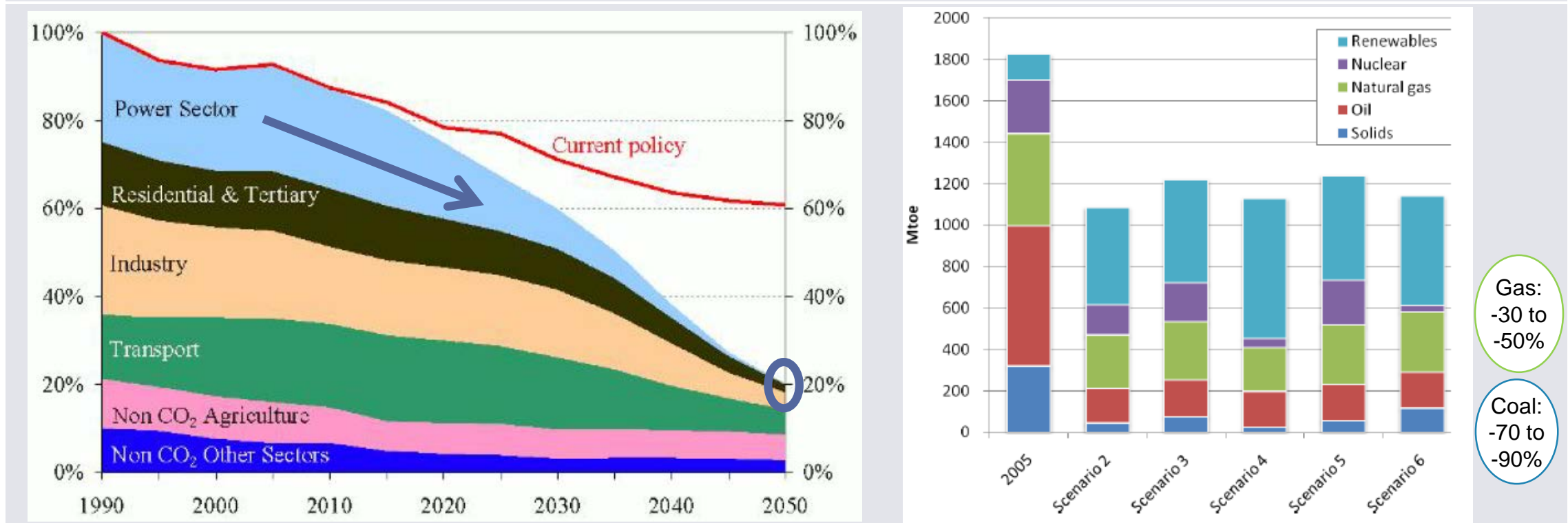


Back-Up Slides



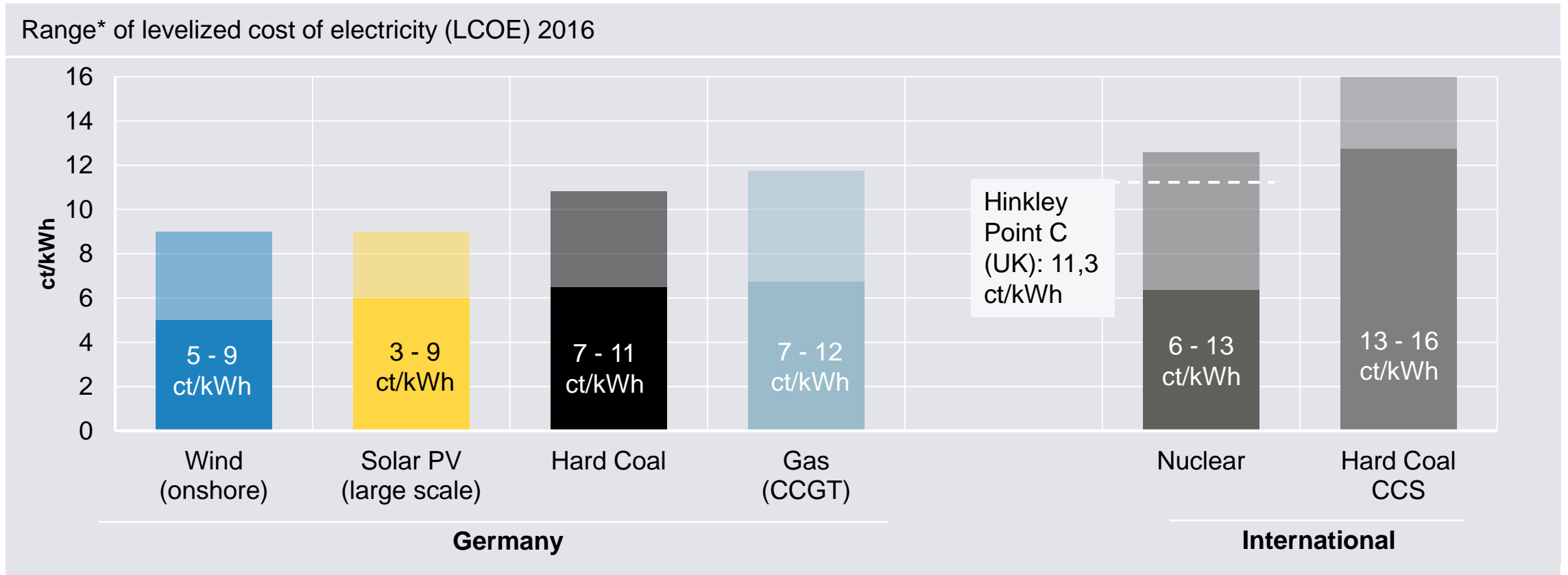
EU 2050 energy & climate targets imply significant reduction of the use of fossil fuels and decarbonisation of the power sector

EU sectoral GHG emissions (1990 = 100%) (left) and primary energy consumption in the EU 2050 energy roadmap (right)



EC (2011)

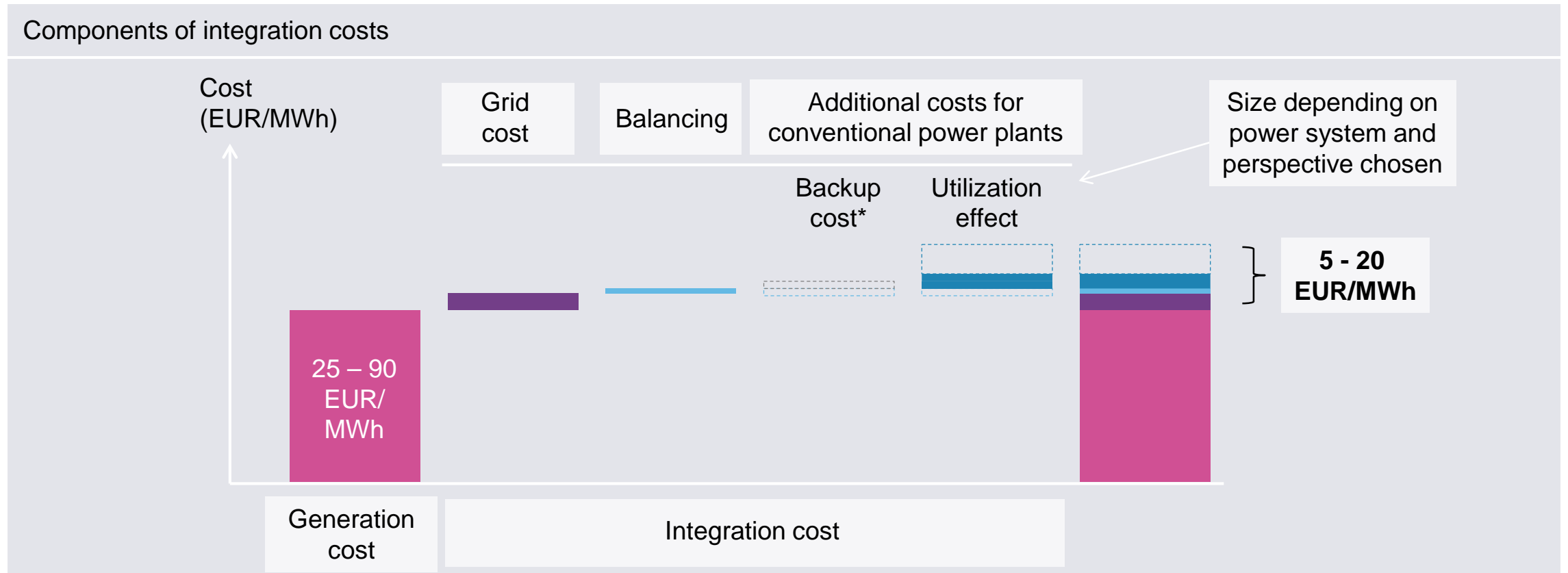
Wind & PV are in many parts of the world the cheapest low-carbon option and cost competitive to new fossil power plants



Agora Energiewende (2015, 2016)

* based on varying utilization, CO₂-price and investment cost

The integration cost of wind and solar (5 to 20 EUR/MWh) do not change the picture

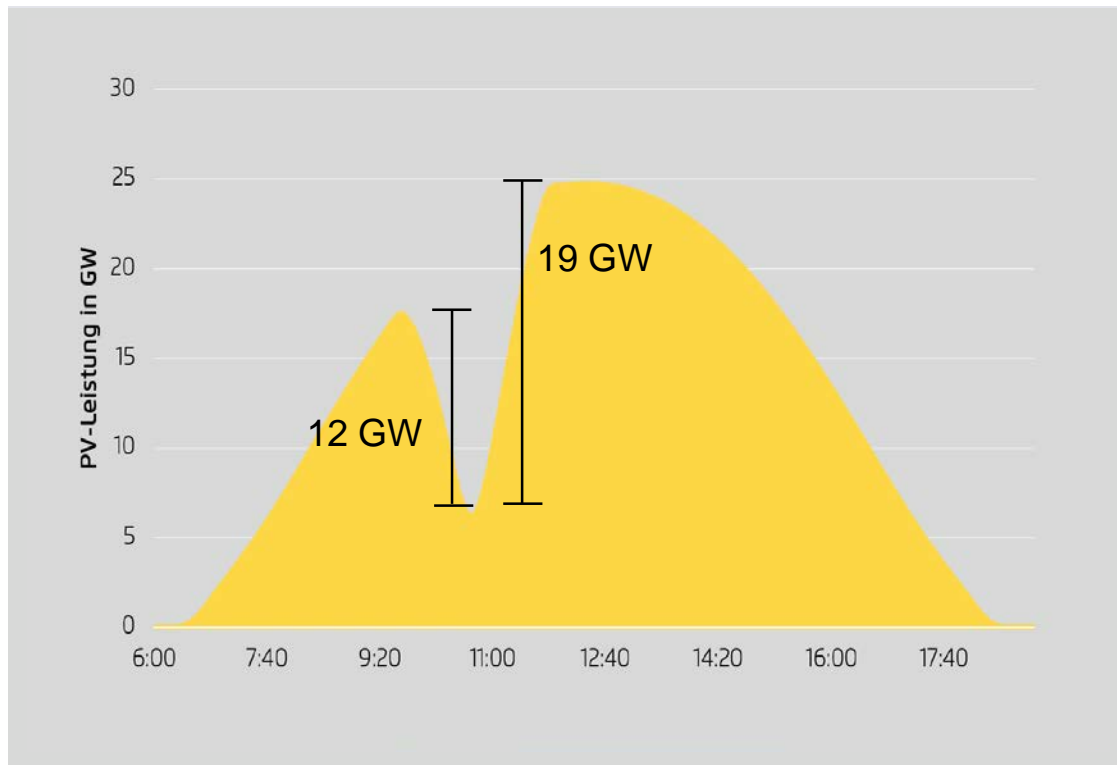


Agora Energiewende (2015a)

* part of utilization effect

There is no need to be afraid of the flexibility challenge: The solar eclipse in March 2015

Solar power production on March 20, 2015

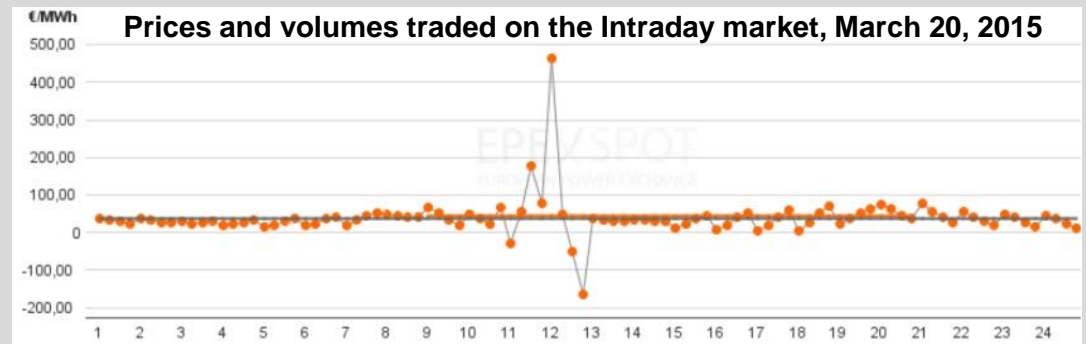


Agora Energiewende (2015)

Due to the solar eclipse, electricity production from solar PV ramped down 12 GW within 65 minutes, and ramped up again roughly 19 GW within 75 minutes

These ramps are unusual today, but will occur frequently in 2030 in Germany, when roughly 50% of electricity will be produced by renewables

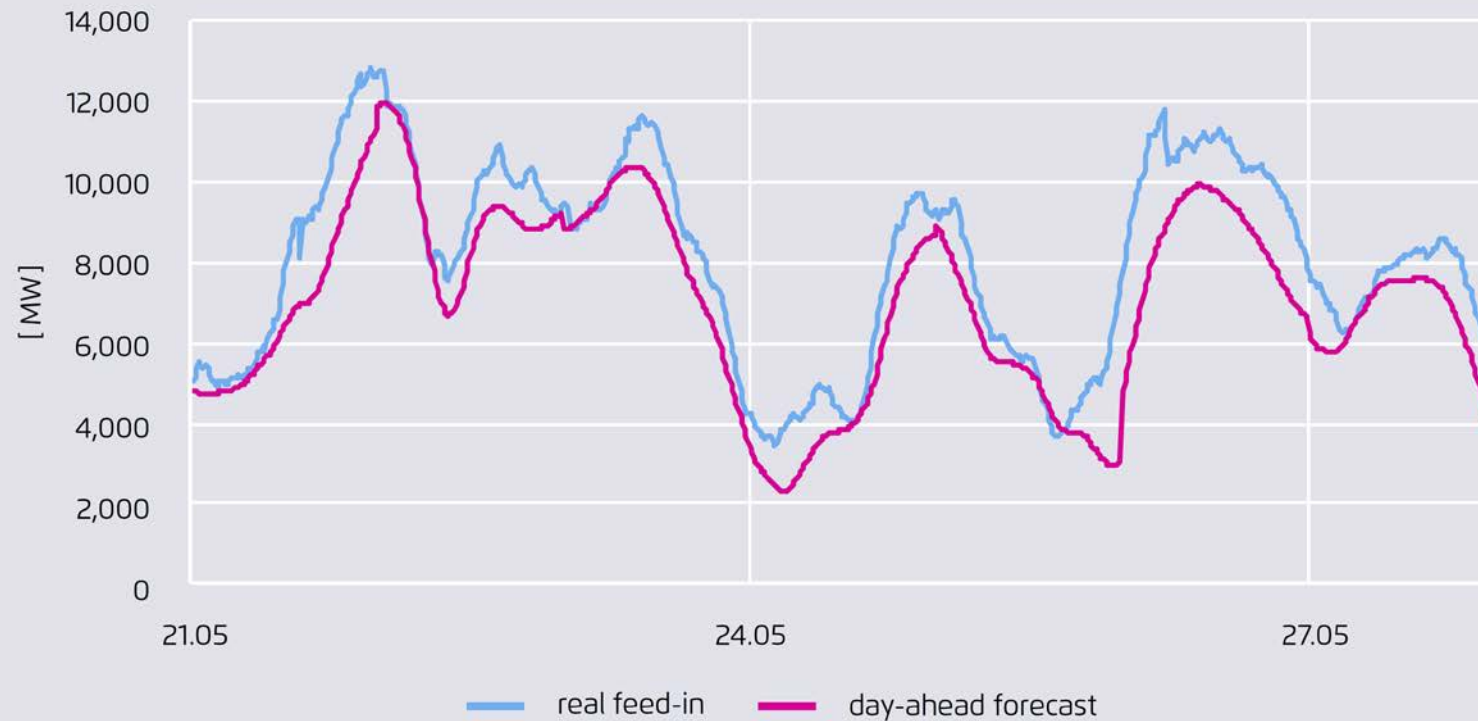
Electricity supply remained stable during the hours of the eclipse. Flexibility was traded in the intraday market.



www.epexspot.com

Variable output must not be confused with uncertain output!

Difference between day-ahead wind energy forecast and real feed-in (week in May 2015 in the North-East of Germany)



Improved forecasting, highly responsive control systems and well-functioning short-term markets (intraday and balancing) enable the integration of high share of renewables.

50 Hertz

Policy targets provide investor certainty and enable the market to find efficient solutions

Renewable targets allow market actors to make efficient investment decisions – for both non-renewable and renewable investments

