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South-East Europe Electricity Roadmap

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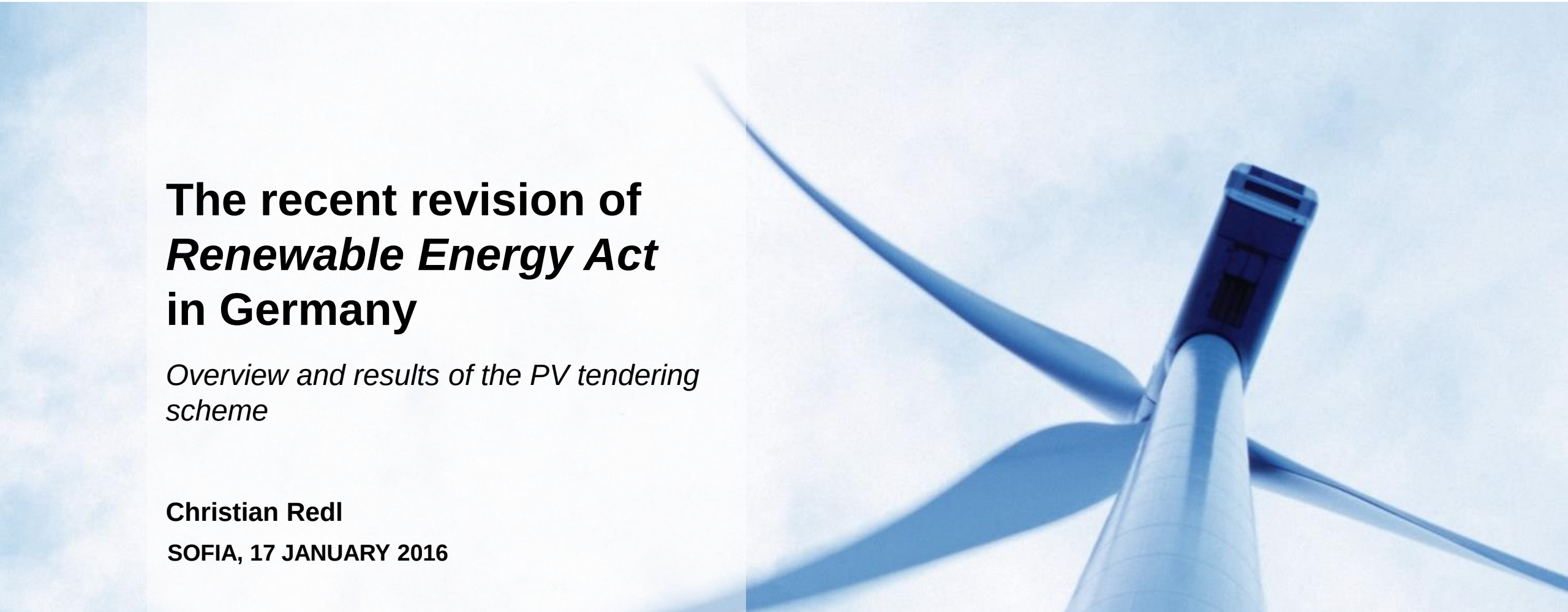

The recent revision of *Renewable Energy Act* in Germany

Overview and results of the PV tendering scheme

Christian Redl

SOFIA, 17 JANUARY 2016

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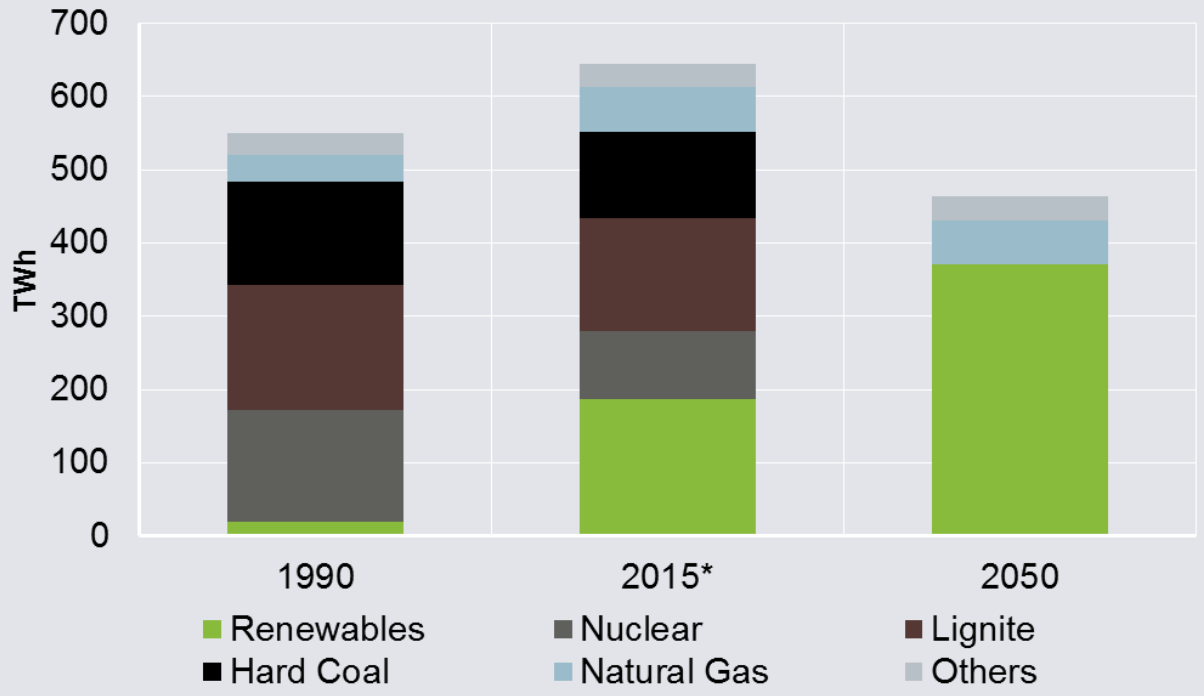
The *Energiewende* targets imply fundamental changes to the power system, and in turn the entire energy system

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

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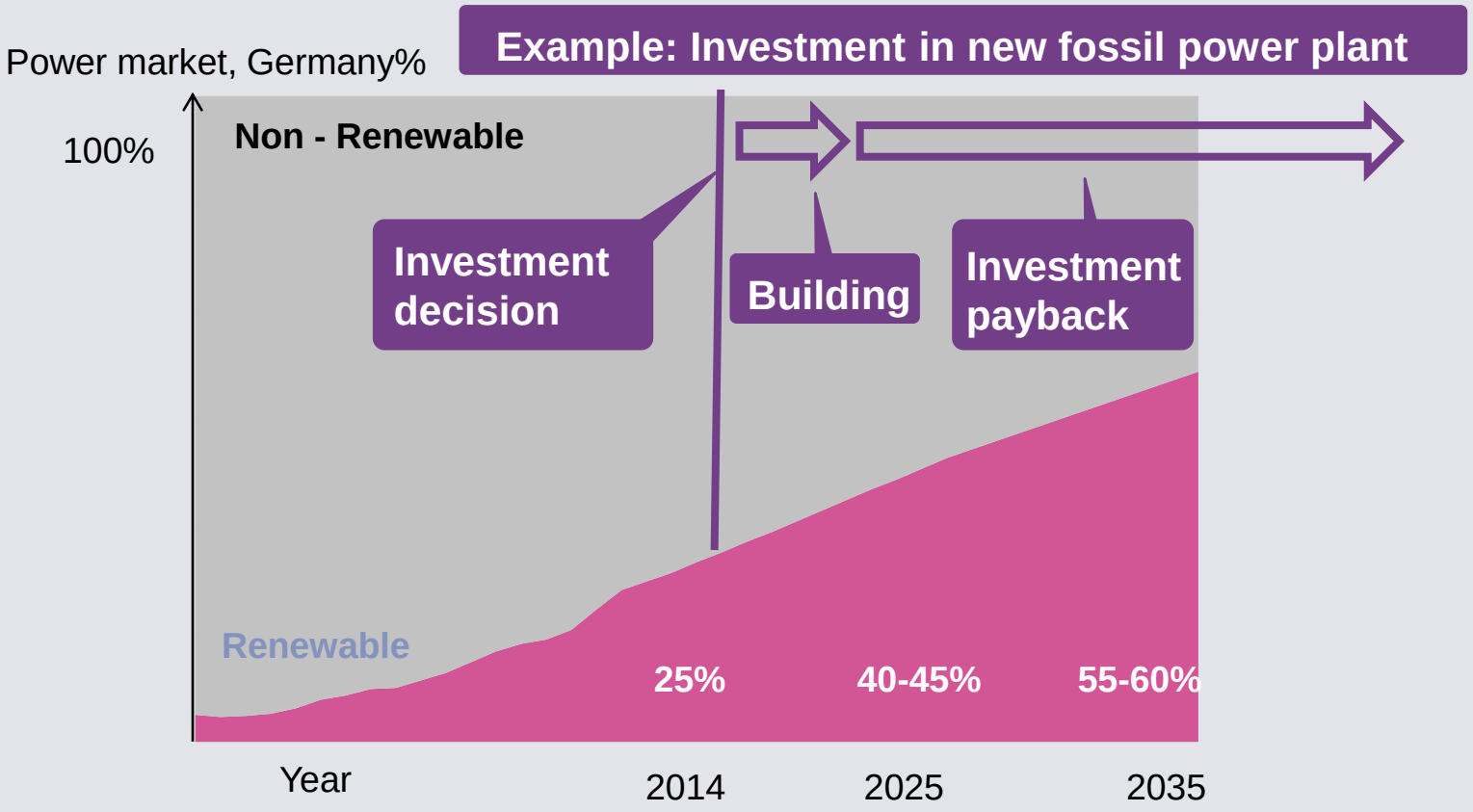
Policy targets required to enable the market to find efficient solutions and provide investor certainty

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



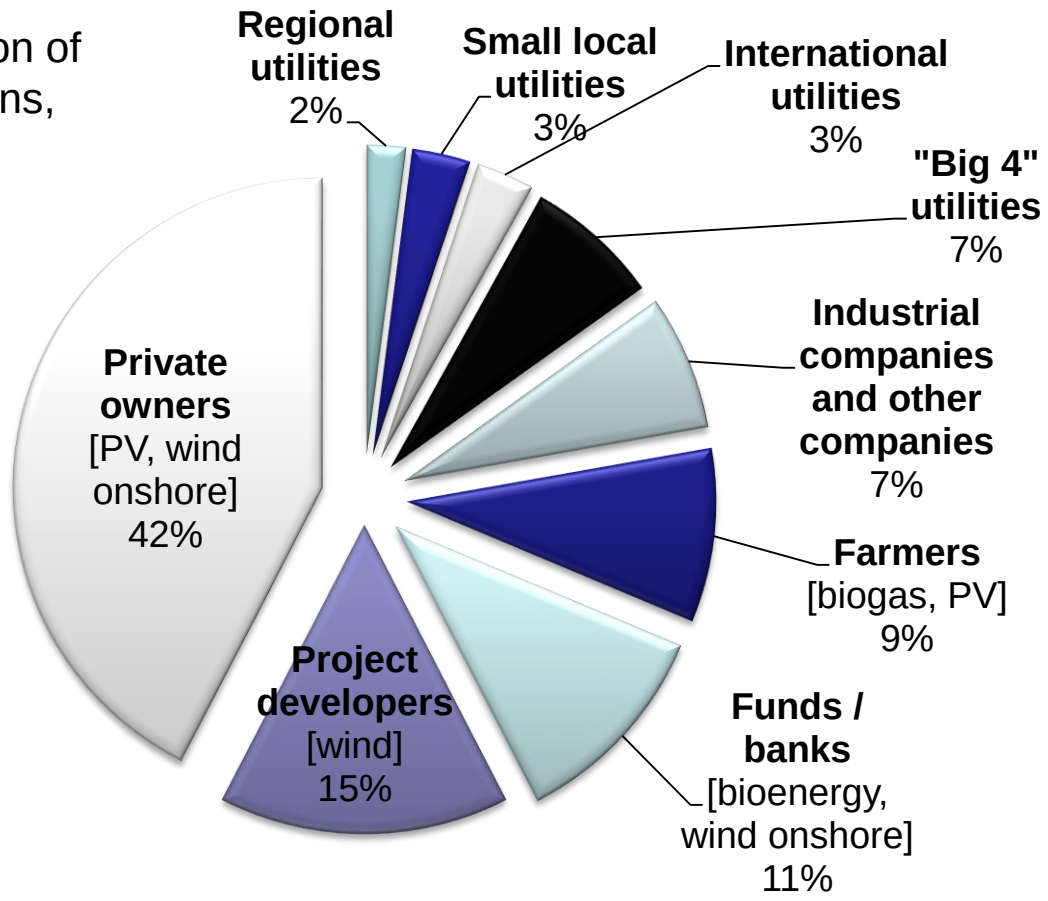
Nimble RES support policies (called “EEG” in Germany) adjusted along the way considering investment risks

Renewable Energy Law (EEG) – reform steps 2000 to 2014

Pre-EEG	EEG 2000	EEG 2004	EEG 2009	EEG 2012	EEG 2014	EEG 2017
1991: first Feed-in Tariff (FiT) in DE	Aim: double RES capacity by 2010; FiT started, priority dispatch, guaranteed grid access, grid follows generation paradigm, cost digression	Aim: 20% RES in 2020; changes in FiT	Aim: 30% RES in 2020; changes in FiT, curtailment regulation; feed-in management	Aim: min. 35% by 2020, FiT lowered, voluntary market premium (FiP); 52 GW cap on PV	Aim: 40-45% in 2025; auctions for PV; obligatory market premium (FiP); breathing cap for wind and PV	Auctions for PV & wind; obligatory market premium (FiP);

Renewables are being installed and owned by citizens enabled by policies: Involvement, ownership and acceptance

Ownership distribution of renewable installations, 2011



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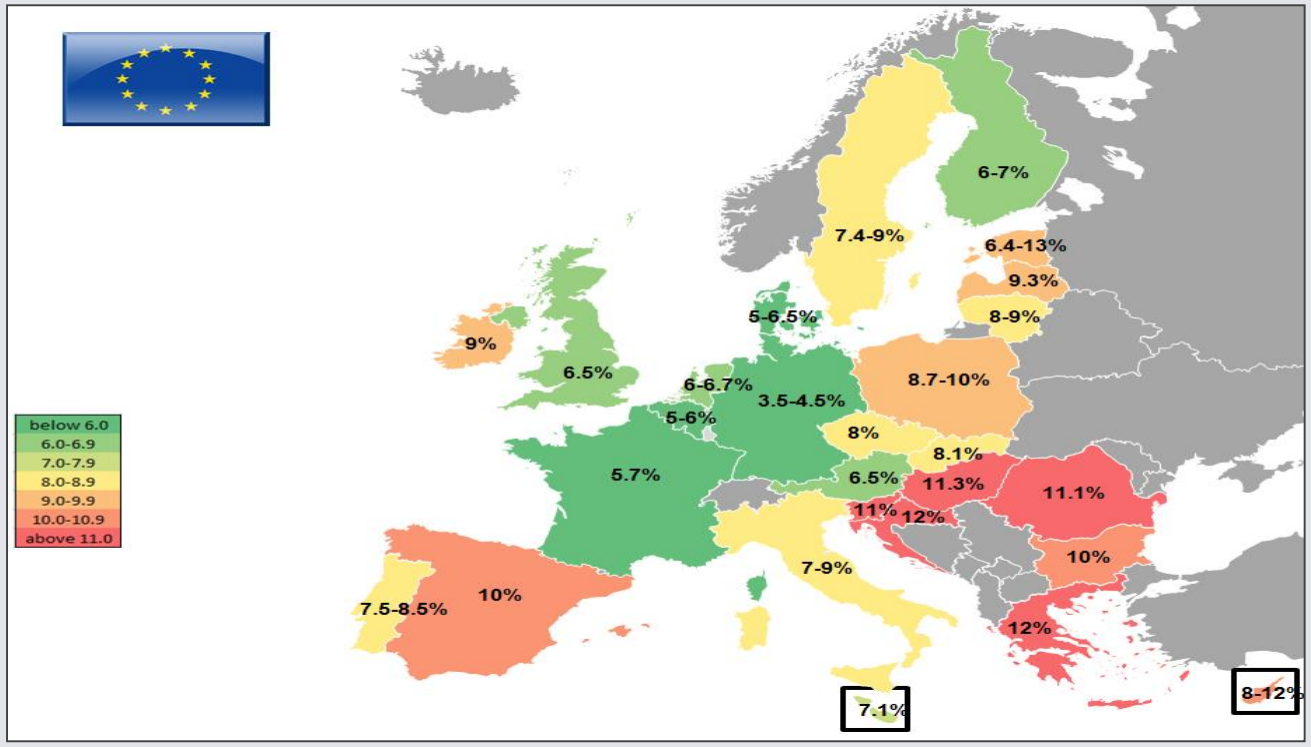
Stable regulatory and political frameworks as precondition for the cost-efficient increase in renewable energies

WACC for investments in wind onshore projects of EU Member States



DiaCore Project (2015)

Main factors creating uncertainty

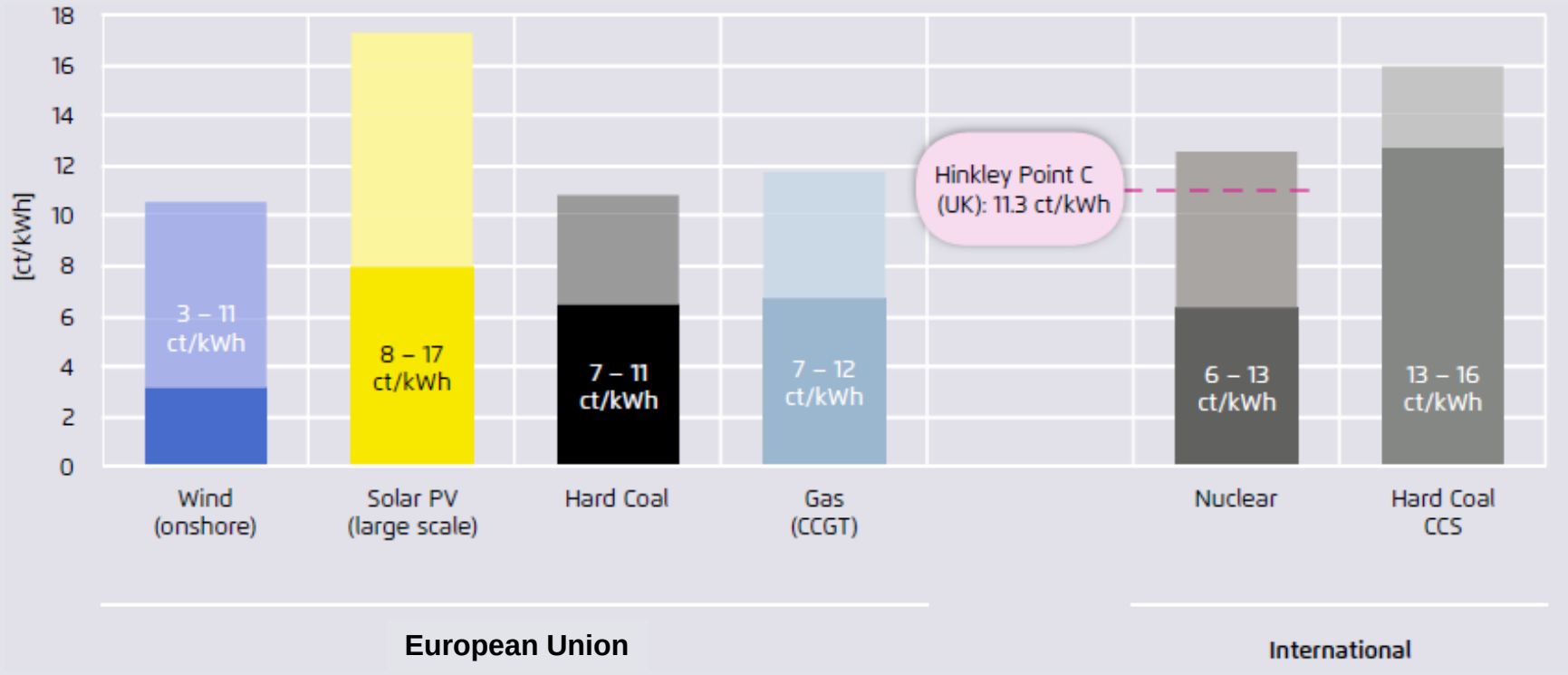
Future policy choices & changes

Administrative procedures

Market design & grid access

Wind & PV cost are lower than those of other decarbonisation options and comparable to new fossil fuel plants. Investment risk considerations cause large spread for wind & PV

Range* of levelised cost of electricity (LCOE) in Europe in 2015



Agora Energiewende (2016), IRENA (2015), BNetzA (2016)

* based on varying utilization, CO_2-price and investment cost

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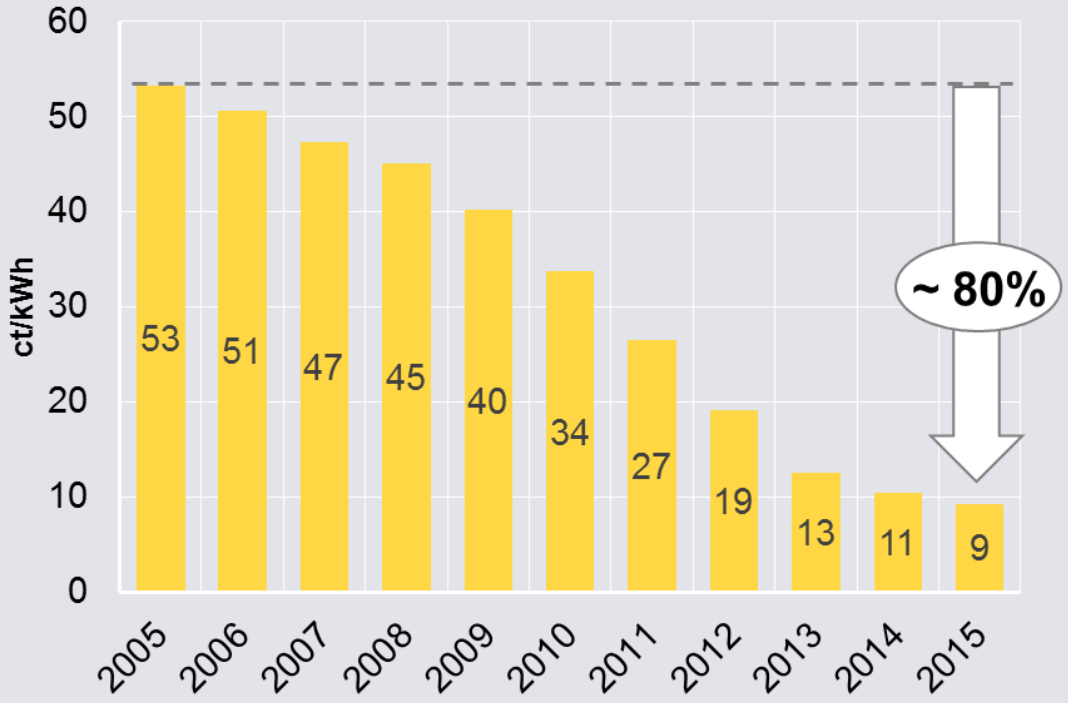
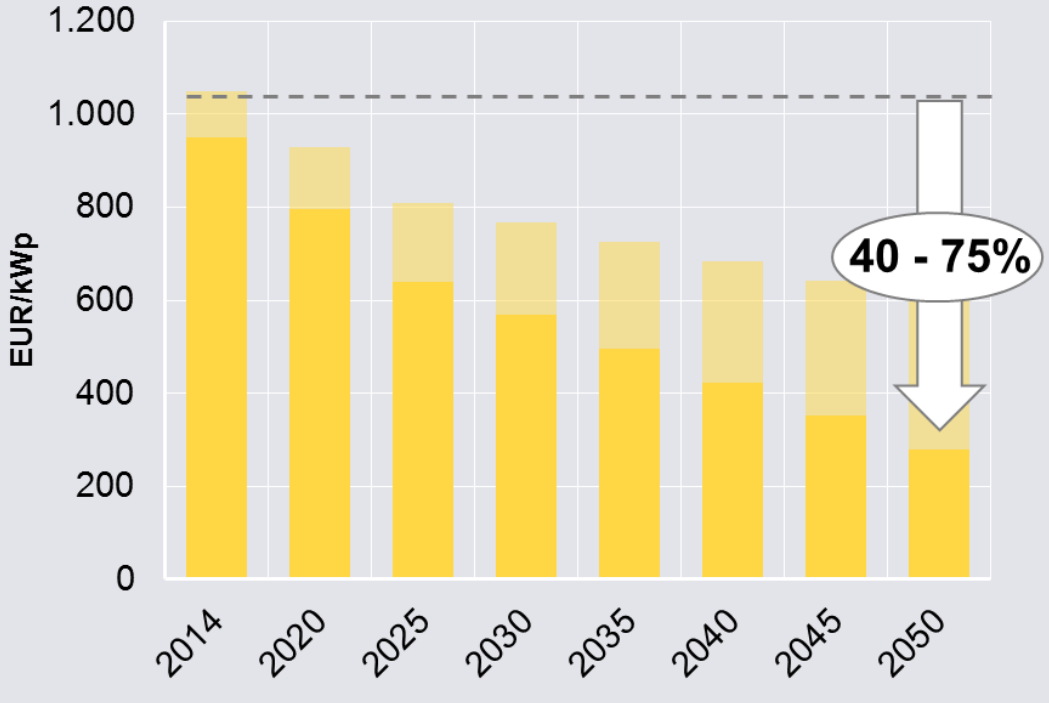
Deployment policies caused falling module prices, PV feed-in tariffs dropped and the end of cost digression is not reached

Average PV feed-in tariff for new installations 2005 - 2015



ZSW et. al (2014), own calculations

Expected cost digression for large-scale PV systems 2014 - 2050



Fraunhofer ISE (2015)

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Key features of the revised German Renewable Energy Act (EEG 2017)

1. **RES-E deployment based on expansion corridor (since EEG 2014)**

→ In order to reach the target of at least 80% of RES-E in electricity consumption by 2050, there are intermediate targets (indicated by a ”percentage corridor”) for 2025 and 2035

2. **Keep costs for future RES-E deployment at a minimum**

→ Increase of EEG surcharge until 2014. Awareness of cost debate for financing renewables is important for public acceptance of the *Energiewende*

3. **Introduction of auctions**

→ Introduction of auctions for onshore wind energy, solar PV, offshore wind energy and biomass

Some basics regarding the introduction of auctions in Germany (EEG 2017) *1/2*

The auctioning scheme...

→ ... encompasses more than 80% of newly installed renewable generation capacity

→ ... includes **technology differentiation** for the level of remuneration, including technology specific prequalification criteria

→ ... includes the following technologies:

- Onshore wind energy > 750 kW (calculation of support based on reference yield model)
- Solar PV, offshore wind energy > 750 kW
- Biomass > 150 kW (including already existing installations)

Some basics regarding the introduction of auctions in Germany (EEG 2017) *2/2*

- **Exempted** from auctioning scheme:
  - Geothermal, hydropower; landfill, sewage treatment and mine gas
  - Pilot projects onshore wind energy (cumulative capacity of 125 MW)

- **Level of support** determined by auctioning scheme (pay-as-bid)
- **Direct marketing of electricity** (Contract for Difference scheme)
- Transition period:
  - No retroactive effect for RES-E installations already in operation (previous ”EEG” still applies)
  - Exemption for onshore wind energy & biomass installations with permit until end of December 2016 and in operation until end of 2018 (do not have to participate in auction)

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Introduction of auctions and annual deployment according to expansion corridor

	As of 2017:	Additional remarks on auctions:
Onshore wind energy	2,800 MW p.a.	As of 2020, increase to 2,900 MW p.a.
Solar PV	2,500 MW p.a.	**600 MW** of these 2.5 GW to be allocated via auctioning scheme (e.g. ground-mounted solar PV). 1.9 GW receive EEG remuneration (small- and medium-scale rooftop installations < 750 kW)
Offshore wind energy	6.5 GW until 2020. 15 GW until 2030.	In case of higher deployment by 2020 (e.g., 7.7 GW instead of 6.5 GW) there will be a reduction of the deployment target for later auctions
Biomass	150 MW p.a. in 2017-2019. 200 MW p.a. in 2020-2022.	Existing biomass installations may be included in auctioning scheme
Hydropower, Geothermal, Landfill, sewage treatment and mine gas		No participation in auctioning scheme

Auction

Other features of auctions for RES-E in Germany

→ **New aspects included to gain additional experience:**

- *Joint* auctions for onshore wind energy and solar PV: 400 MW p.a. from 2018 to 2020 (Ordinance by May 2018)
- Auctions for *innovations*: no limitation to specific RES-E technologies, also combination possible. 50 MW p.a.from 2018 to 2020 (Ordinance by May 2018). Focus on system and grid benefits induced by technological innovation
- *Cross-border* auctions: joint auctions with one or more EU Member States for up to 5% of annually auctioned capacity (Ordinance will follow)

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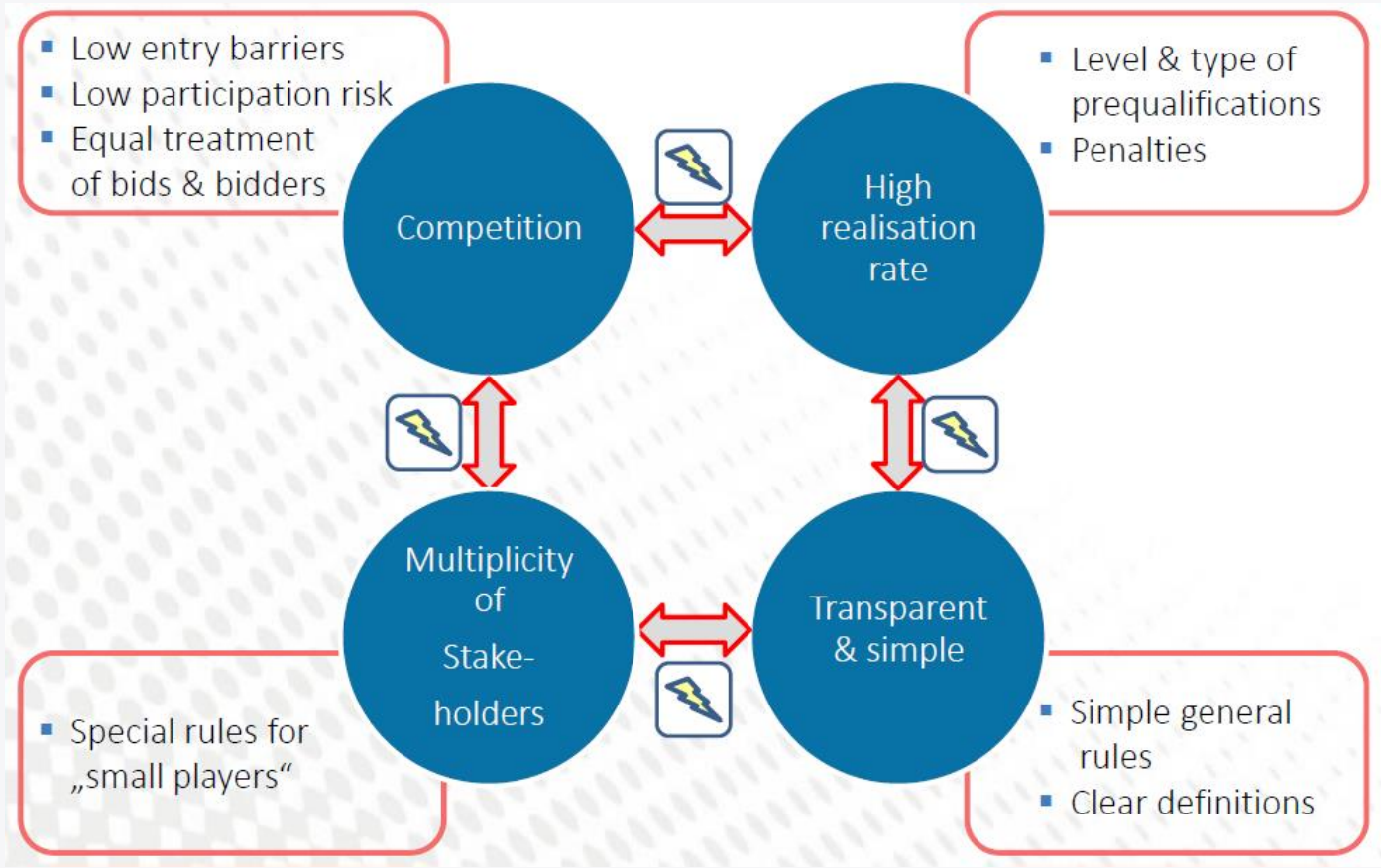
Main principle: market-based competition for setting support levels; Broad spectrum of design features (*DE EEG 2017 provisions are underlined*)

- **Product** – what should be tendered?
  - Required support level; Remuneration: FiT, FiP (sliding or fixed); Payment per kWh or per kW;
  - Technology-neutral vs. technology-specific; De-minimis exemptions
- **Auction procedure** – how to award the contract?
  - Format (sealed bid/descending clock); Sealed bid: Pay-as-bid/pay-as-cleared; Periodicity & timing
- **Project realisation** – how to reach expansion goals?
  - Auctioning of ”excess” quantity; Prequalification critera (e.g. Permits, concessions, deposits)
  - Penalties, expiration of support (in case of not built); Transfer support rights (secondary market)
- **Enabling actor variety**
  - Simplified prequalification / lower penalites for e.g. local cooperatives, private citizens
- **Geographical aspects** – how to achieve a balanced deployment? E.g. Spatial planning, reference yield models for onshore wind; location-specific compensation as a function of wind map

Trade-offs between the objectives of the German RES-E auctioning scheme



Source: BNetzA (2016)

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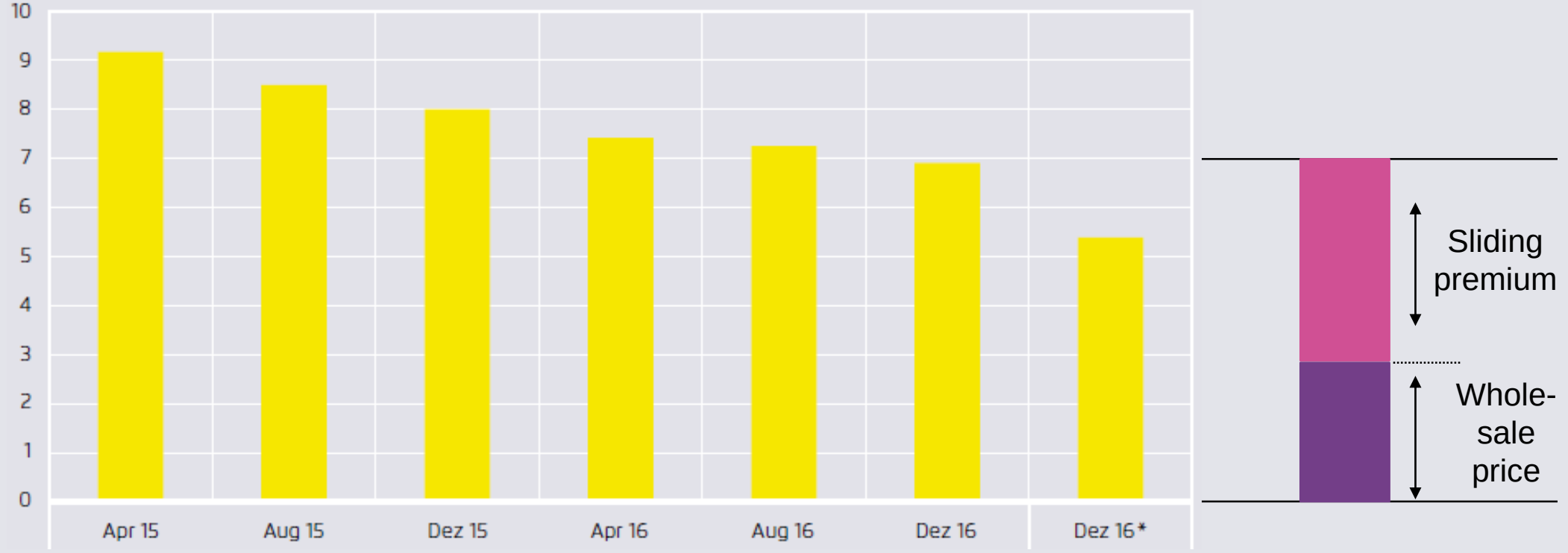
Some first insights from German PV auctions and open questions

- Explorative process of “learning by doing”
- Pilot projects with different designs to explore
- Large-scale PV seems particularly suitable for tendering (short planning periods, rather low investments required during project planning)
- Transparent and simple auction scheme design, yet no “one size fits all” solution
- Limited applicability of insights to other technologies; Pilots for all technologies required
- Is competition possible (scarcity in the auction)? How to avoid strategic behavior?
- How to maximize realization rate?
- Optimal design of penalties / prequalification requirements / deadlines for project realization?
- How to ensure actor variety?
- How to minimize financing costs to enable efficient auctions?

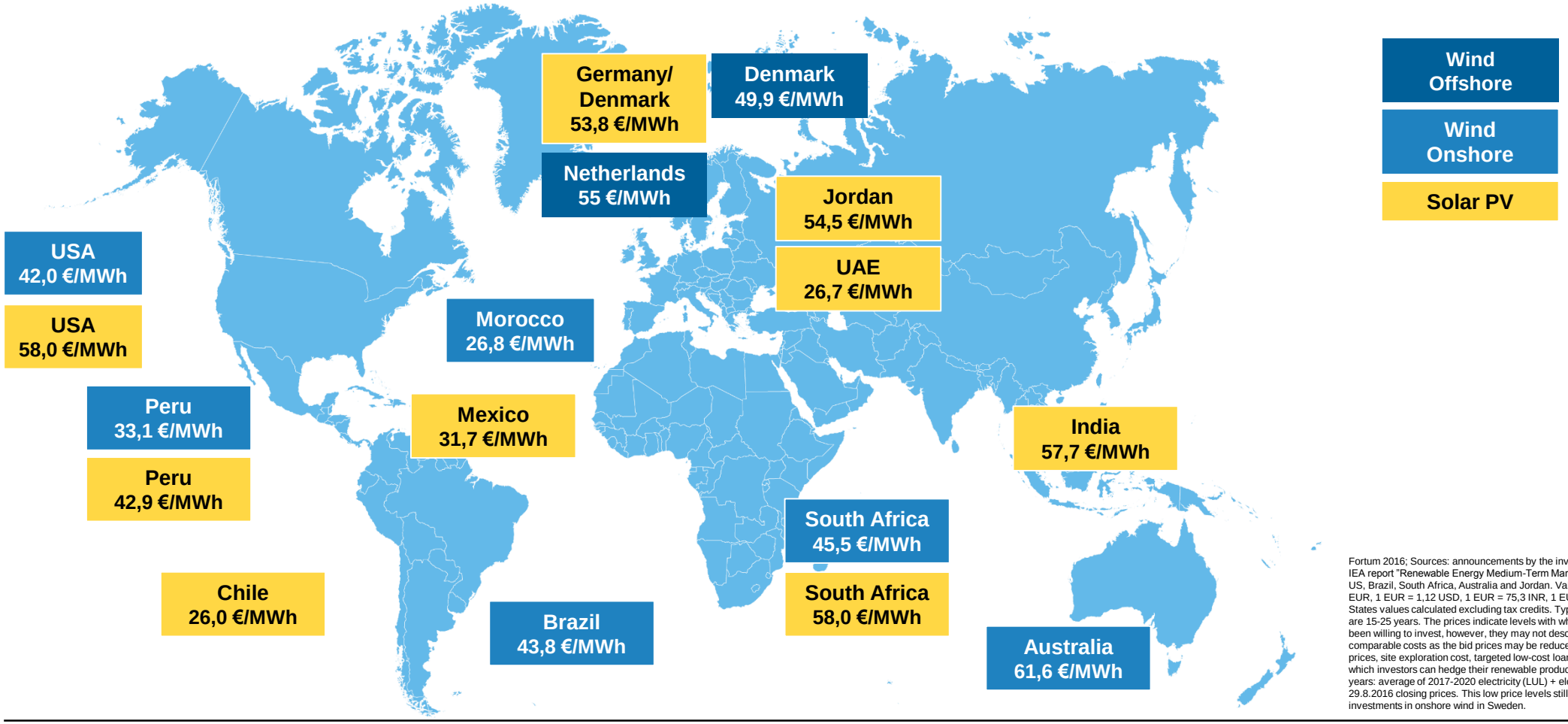
The new tender scheme for large-scale PV has yielded average remuneration levels decreasing from 92 to 69 EUR/MWh from April 2015 to December 2016

Average remuneration for large-scale PV in the PV auction rounds in Germany (PV receives the difference between the tender remuneration and the wholesale price as a sliding premium) and in the joint Danish/German tender in December 2016



BNetzA (2016)

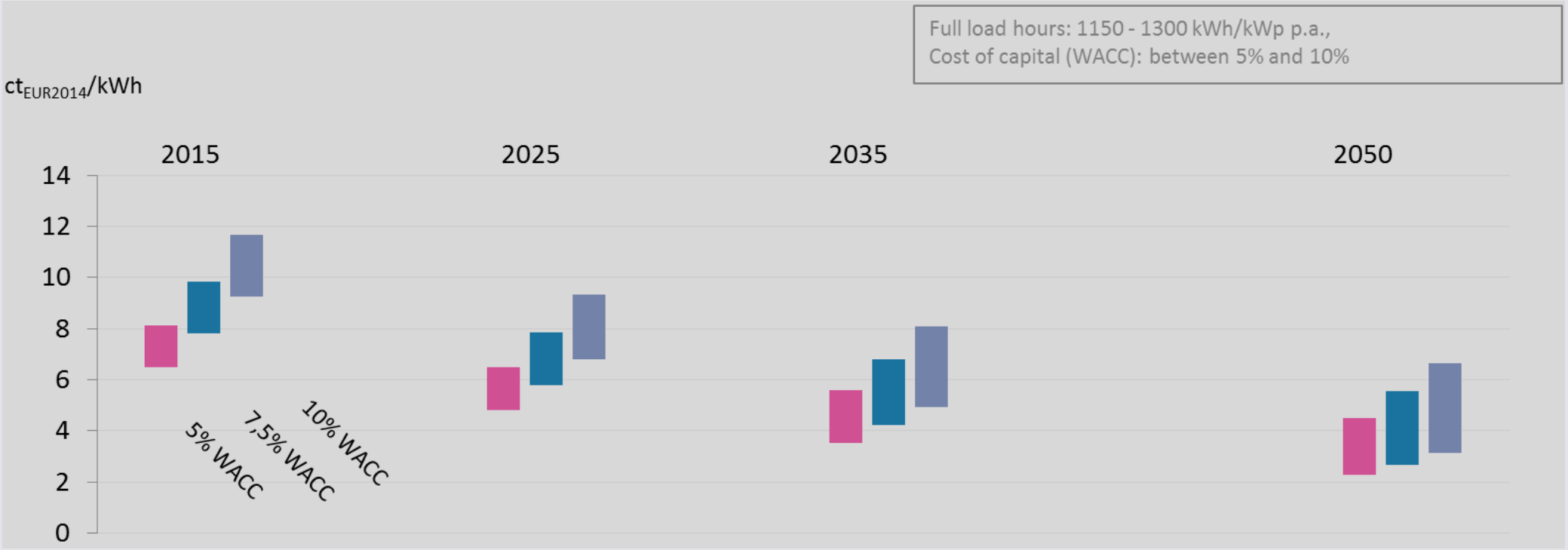
Worldwide costs of wind and PV plants are decreasing continuously: Auction results in 2016



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) + elcertificate futures with 29.8.2016 closing prices. This low price levels still result in continuation of investments in onshore wind in Sweden.

Bulgaria: Current and future cost of solar PV

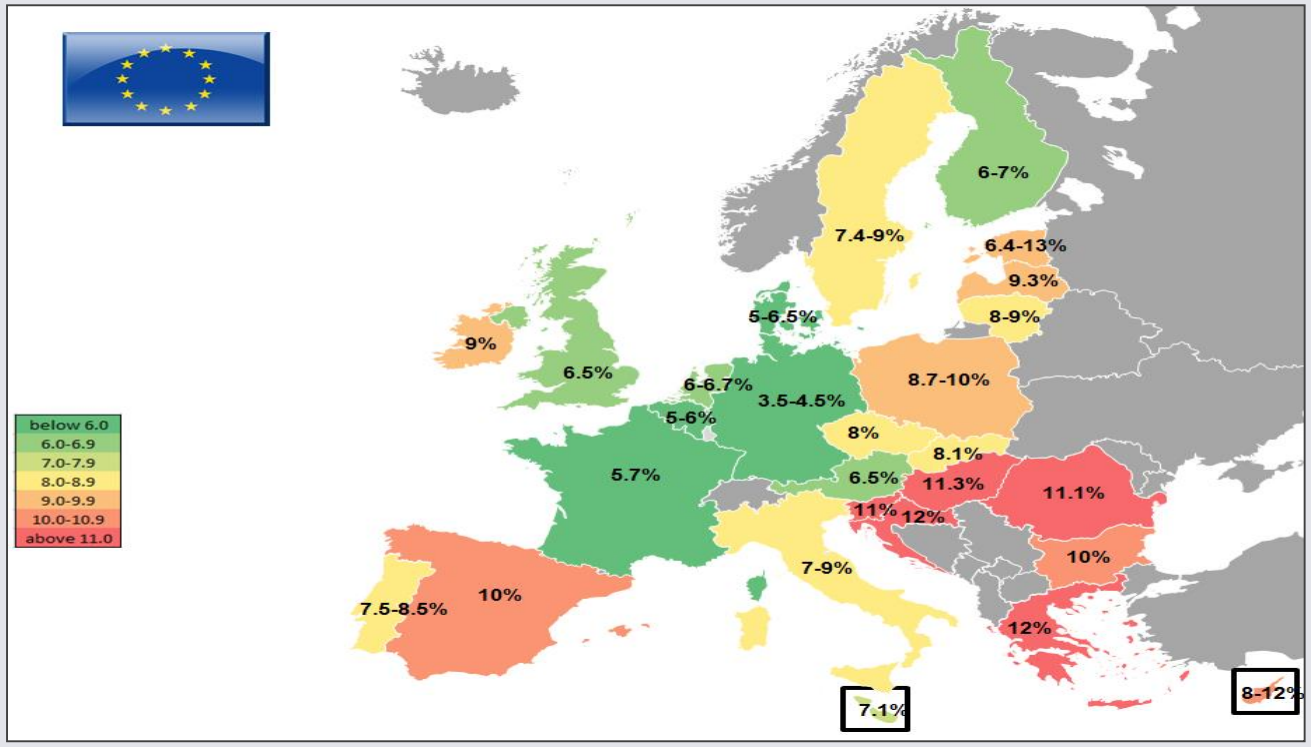
Levelised cost of electricity (LCOE) from large-scale solar PV in Bulgaria



Calculation based on Fraunhofer ISE (2015); Ranges include differences in irradiation within the country and scenarios of technology and global market development; global market for modules, inverters and other cost components is assumed, short-term effects of higher cost in new markets (e.g. 1st GW in a specific country) not considered

Stable regulatory and political frameworks are a precondition for the cost-efficient increase in renewable energies

WACC for investments in wind onshore projects of EU Member States



DiaCore Project (2015)

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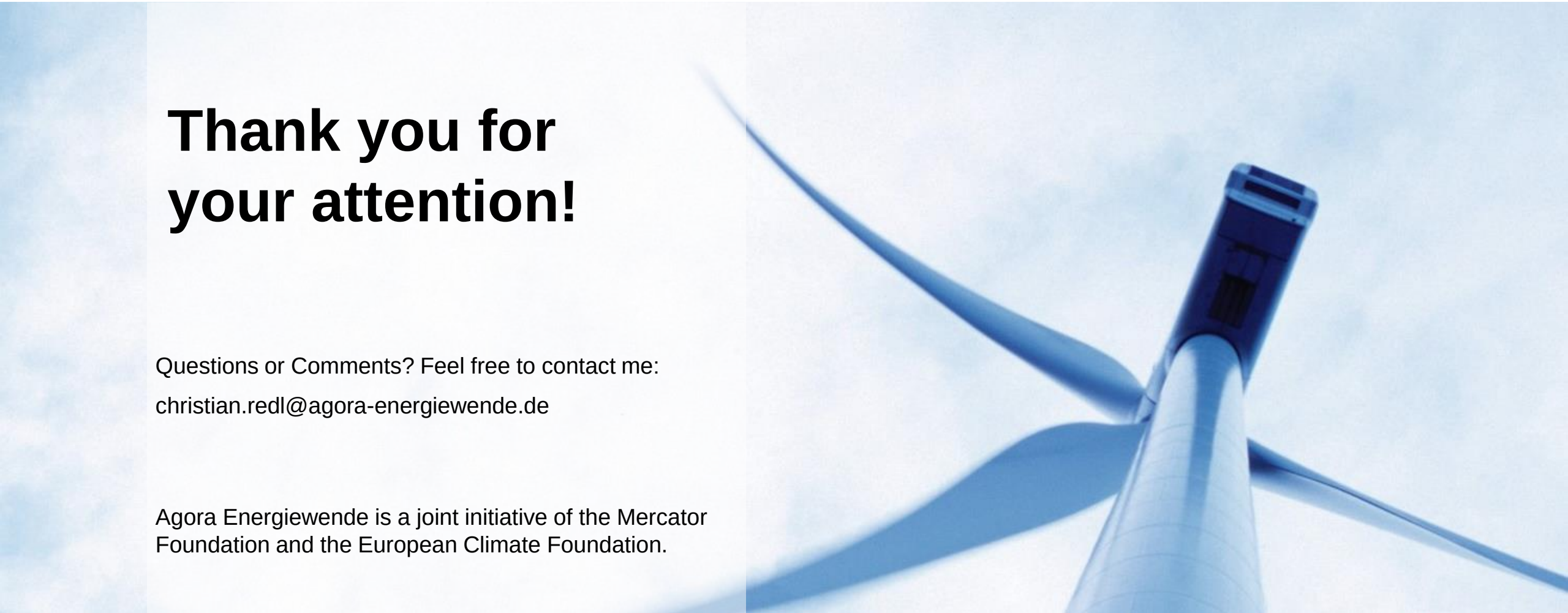

Thank you for your attention!

Questions or Comments? Feel free to contact me:

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

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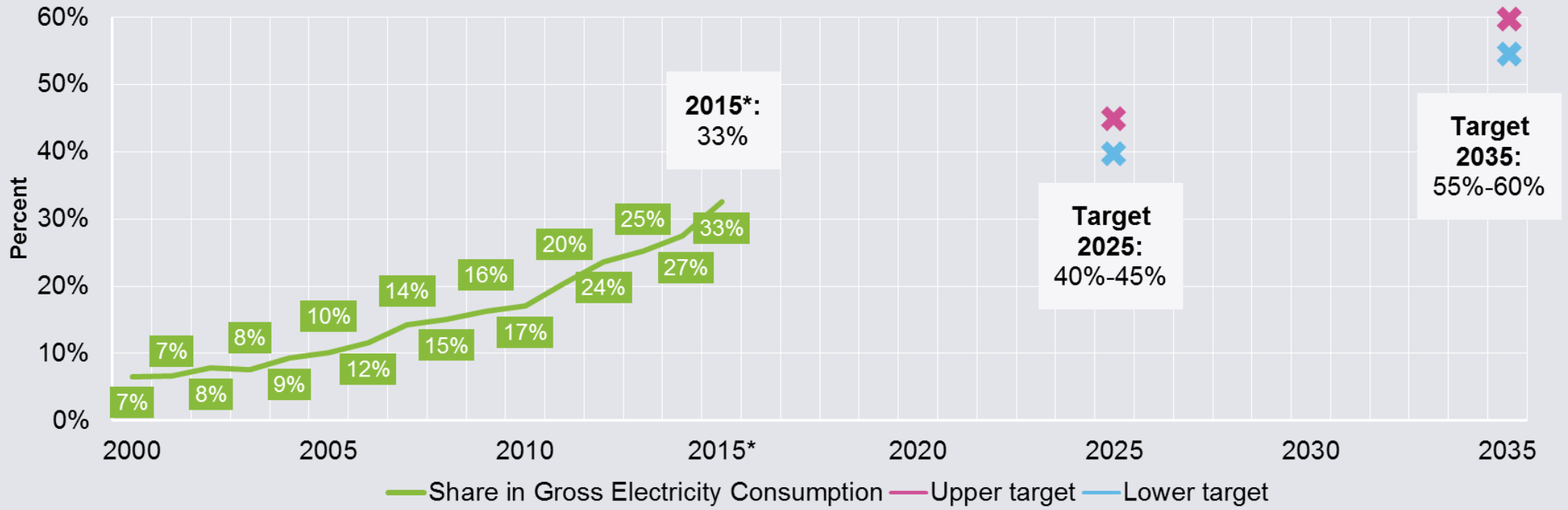
Expansion corridor for RES-E deployment: RES-E share of 40 - 45% by 2025 and 55 - 60% by 2030

Share of renewable energies in gross electricity consumption 2000 - 2015 and targets 2025 - 2035



AGEB (2016), EEG (2014)

* preliminary

Cost competitiveness and EEG surcharge
Initial experience was gained by implementing auctions for large-scale ground-mounted solar PV in 2015 (500 MW in total).

→ Inital phase, only for ground-mounted solar PV: 3 rounds of auctions were carried out in 2015.

	April 2015	August 2015	December 2015
Price for support (average)	9.17 ct/kWh	8.48 ct/kWh	8.00 ct/kWh
Capacity auctioned	150 MW	150 MW	200 MW
Auction volume awarded	157 MW	159 MW	204 MW
Auction volume submitted	715 MW	558 MW	562 MW
Excluded bids	144 MW (20%)	33 MW (5%)	33 MW (5%)
Pricing method	Pay-as-bid	Uniform pricing	Uniform pricing

500 MW in total

Source: BNetzA (2016). Report: *Pilotausschreibungen zur Ermittlung der Förderhöhe für Photovoltaik-Freiflächenanlagen*.

Expansion corridor for RES-E deployment
... broken down into gross deployment for the different technologies

	As of 2017:
Onshore wind energy	2,800 MW p.a.
Solar PV	2,500 MW p.a.
Offshore wind energy	6.5 GW until 2020. 15 GW until 2030.
Biomass	150 MW p.a. in 2017-2019. 200 MW p.a. in 2020-2022.
Hydropower, Geothermal, Landfill, sewage treatment and mine gas	

Auctions – when and how much?

	When? How much?
Onshore wind energy	2017: 3 rounds (2.8 GW in total) 2018 and 2019: 3 rounds (2.9 GW in total)
Solar PV	As of 2017: 3 rounds (600 MW in total)
Biomass	2017-19: 1 round (150 MW in total) 2020-22: 1 round (200 MW in total)
Offshore wind energy	As of 2021: installations to become operational in 2026 (on pre-investigated sites) will participate in auctioning scheme. Annually 700-900 MW auctioned (target: annual deployment of 840 MW as of 2026). Bids will be submitted for pre-investigated offshore wind sites (”Danish model”). 2017-18: 1,550 MW auctioned (only projects that have concluded permitting procedure); to turn into operation between 2021-2025.