Cambridge University, EPRG Conference 8.12.2023

EU electricity market reform for reliable and affordable power prices

Karsten Neuhoff, Fernanda Ballesteros, Mats Kröger, Jörn Richstein, Leon Stolle, *German Institute for Economic Research (DIW Berlin)*

1 State of debate in Germany

- Platform Climate Neutral Power Market Design (PKNS) started Feb 2023 *
  - (1) Financing RE (2) Flexibility (3) Dispatchable capacity (4) Local signals
  - No clear conclusions

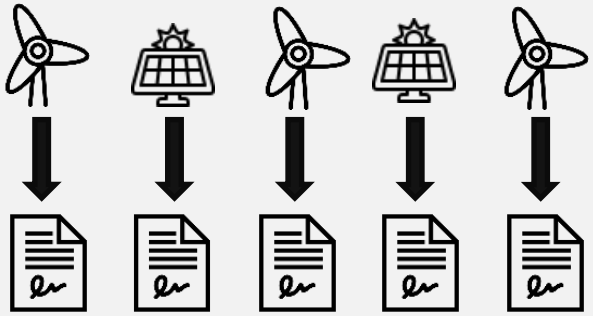
- Concerns about uncertain, and possibly high, power prices in coming years
  - Crisis. Industrial power price limit 130 Euro/MWh (for 70%) / Until 12.2023 ?
  - Longer-term perspective?

- Three key elements for reform
  - Renewable Energy Pool
  - Locational pricing
  - Reliability Reserve

* For details see https://www.bmwk.de/Redaktion/DE/Artikel/Klimaschutz/pkns-download-dokumente.html

2 RE Pool - What is the concept

1 Renewable power producers are awarded CfDs for their production

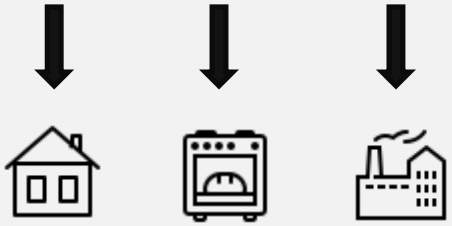


Each contract defines a strike price that is awarded for production volume

2 Government agency combines the contracts into a CfD Pool

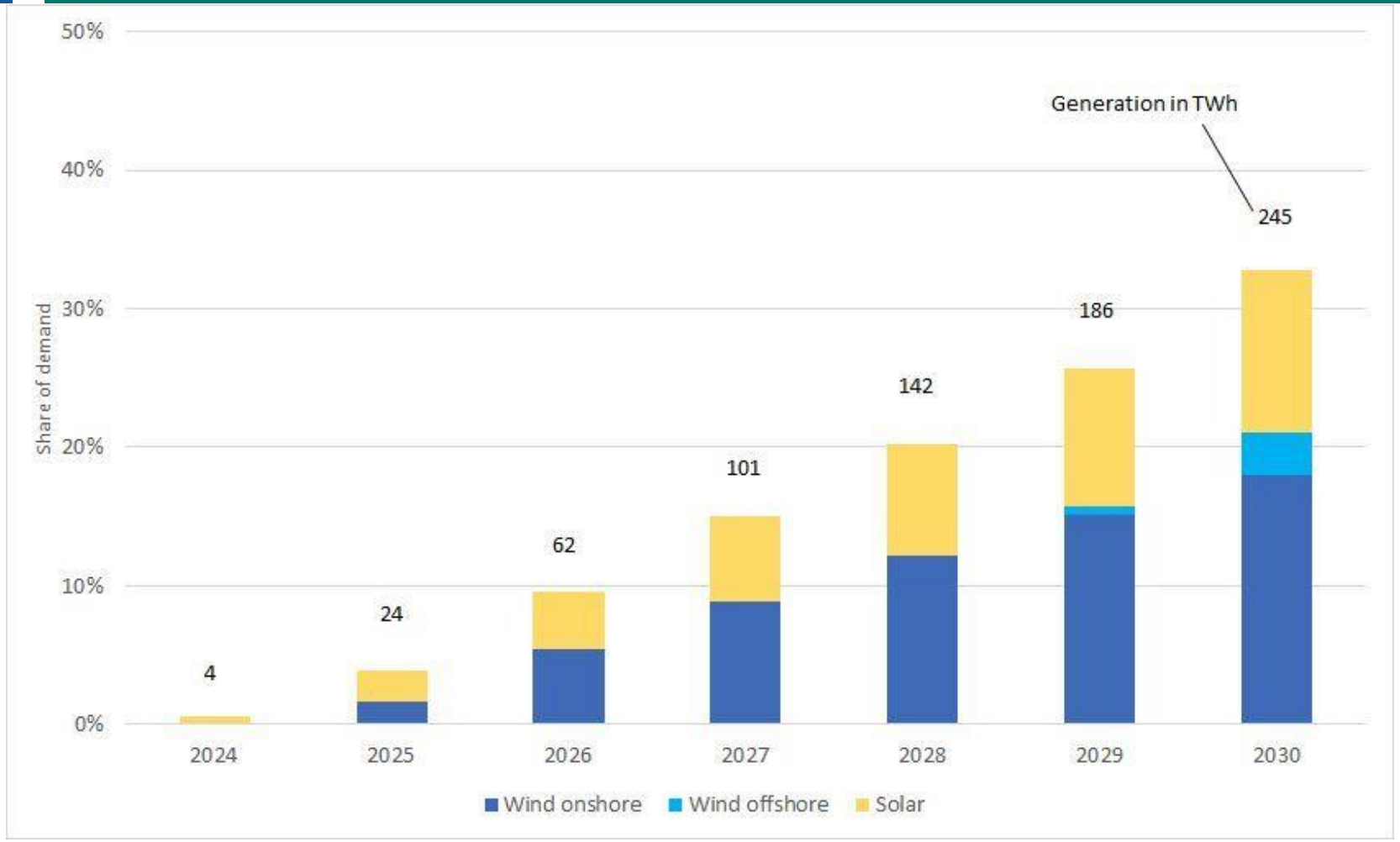
Pool is characterized by its average strike price and its sum of production volumes

3 Consumers are awarded share of the pool



Source: Karsten Neuhoff, Fernanda Ballesteros, Mats Kröger, Jörn Richstein (2023): Contracting Matters: Hedging Producers and Consumers with a Renewable Energy Pool. (link)

3 Volume of contracts in pool - if from 2024 all RE tenders are included



Source:https://www.diw.de/de/diw_01.c.885803.de/publikationen/politikberatung_kompakt/2023_0197/erneuerbare_energien_und_flexibilitaet__optionen_fuer_reduzierte_und_verlaessliche_stromkosten.html

DIW BERLIN

4 Who would be granted access to the RE Pool?

Basic principle

- RE pool is distributed to all electricity consumers (as in the EU proposal)
- Contract volumes independent from consumption to maintain incentives
- Complements PPAs and forward products of existing plants/ lifetime extensions/ other technologies

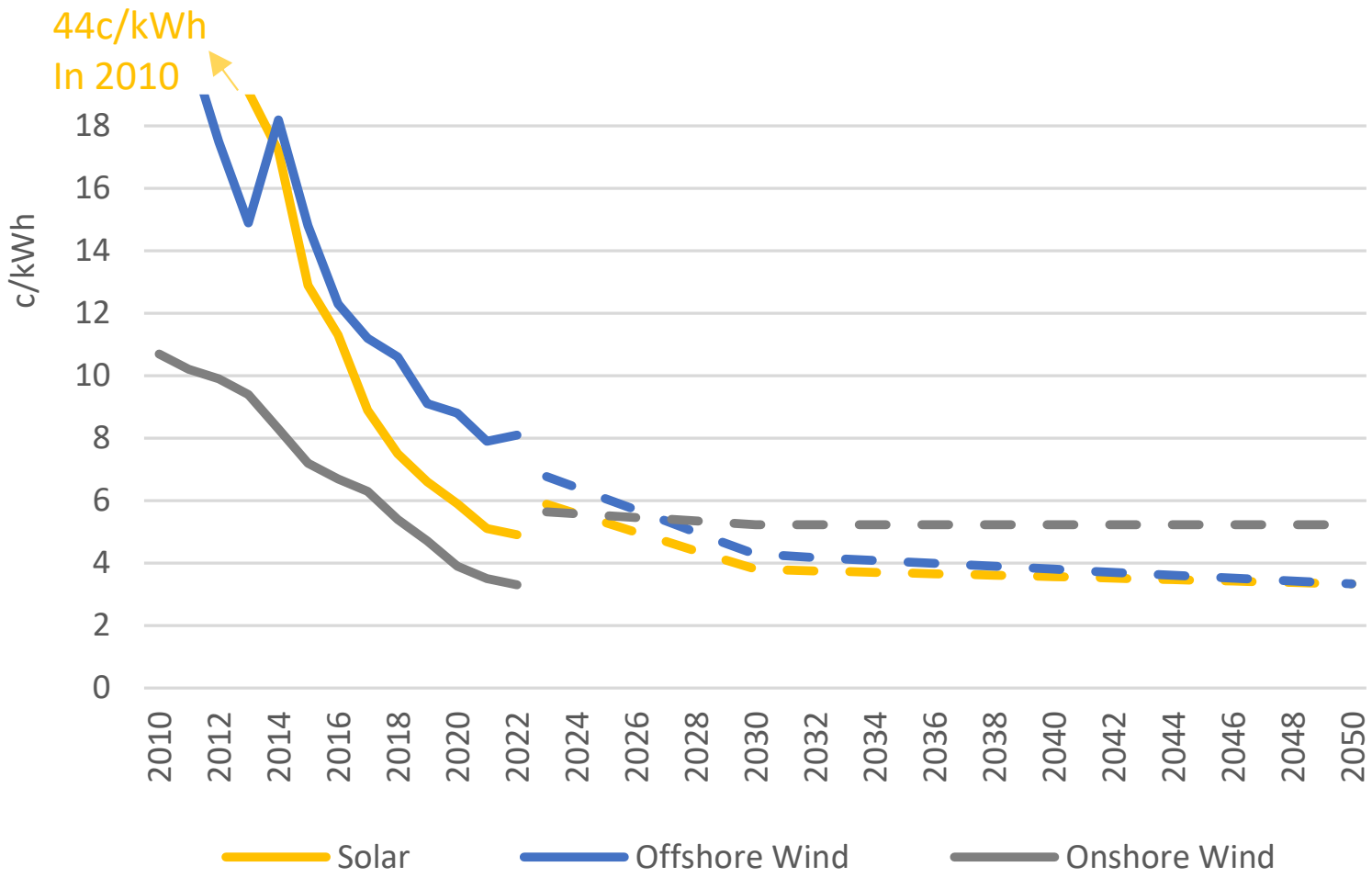
Short-term prioritization

- For transformational projects (electrification for emissions reductions)
- For neighbors of wind farms to strengthen acceptance
- For demand from electricity-intensive industries

Long-term question

- What do we do if there is long-term scarcity of sites … who gets rent?

5 What price to expect in RE pool?

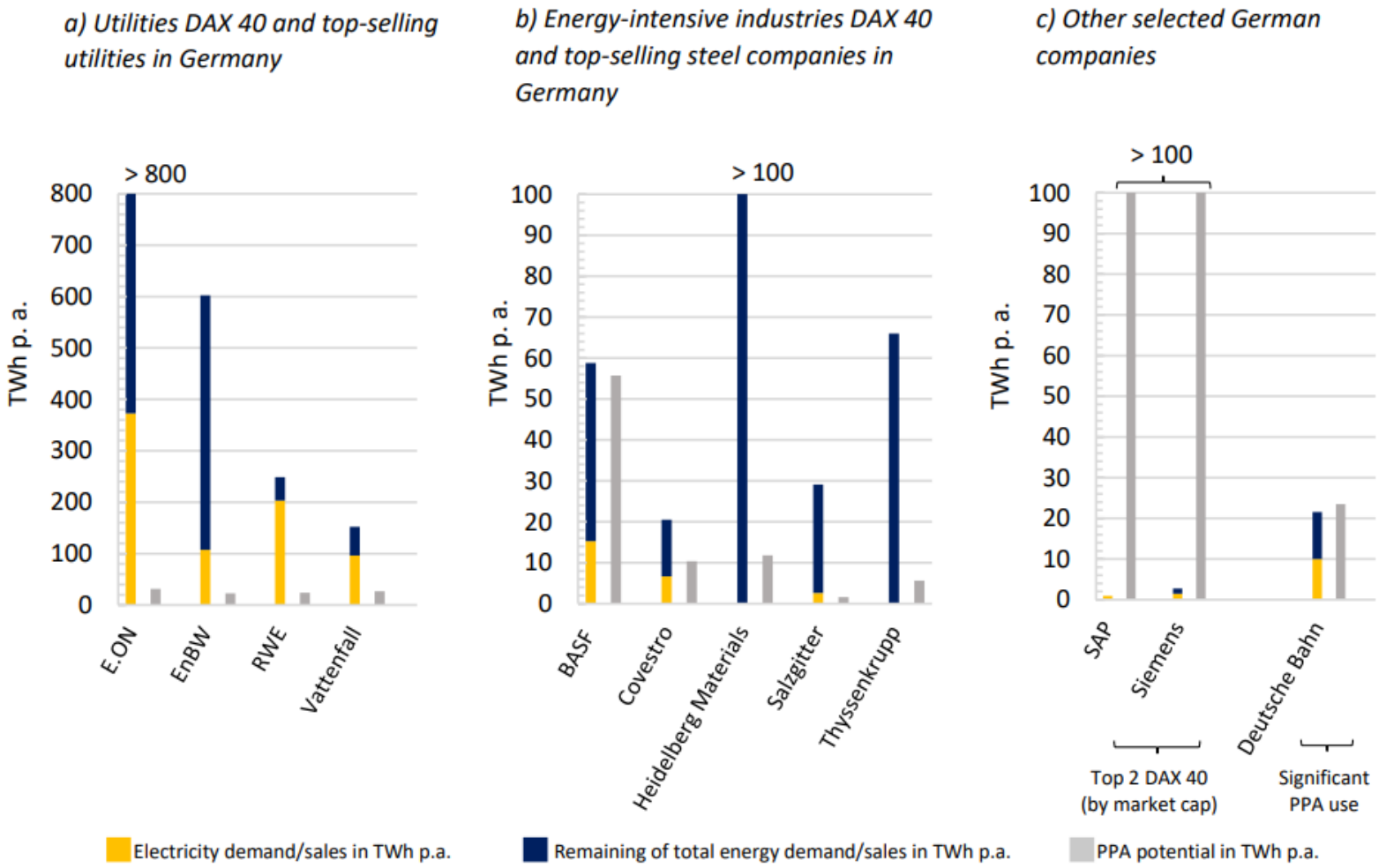


Until 2022, international average based on IRENA (2023). Beginning in 2023, European average based on World Energy Outlook Projections (IEA, 2023). Values in years in between the projections are interpolated linearly. In 2022 prices, exchange rate €/$ = 0,95.

Source:https://www.diw.de/de/diw_01.c.885803.de/publikationen/politikberatung_kompakt/2023_0197/erneuerbare_energien_und_flexibilitaet__optionen_fuer_reduzierte_und_verlaessliche_stromkosten.html

DIW BERLIN

6 Why RE Pool? Bilateral PPAs are insufficient to back scale of necessary wind- and solar-investments



PPA guarantees do not resolve issue
Supplier hedging obligations: How would it resolve concerns about new entrants?

Source: Karsten Neuhoff, Fernanda Ballesteros, Mats Kröger, Jörn Richstein (2023): Contracting Matters: Hedging Producers and Consumers with a Renewable Energy Pool. (link)

Why RE Pool rather than bilateral PPAs? Strengthening project pipeline and ensuring contract volume

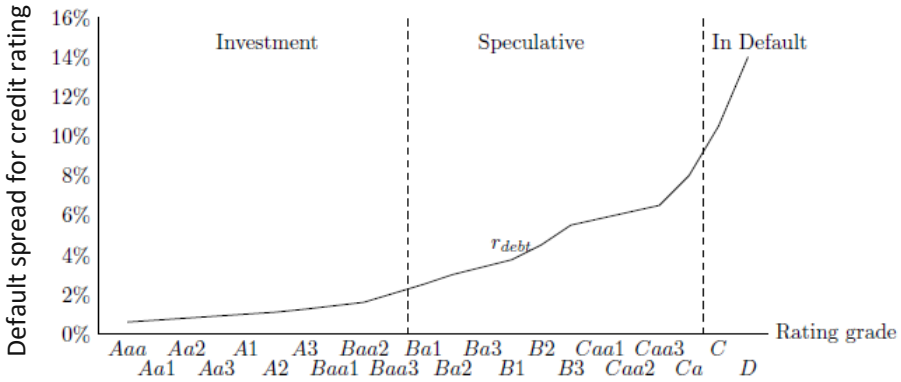
- Avoid constraints from limited contracting and thus financing capacity
- Eliminate policy risks that could jeopardize project
- Scale up project-pipeline by reducing equity requirements
- Enhance stability of investment pipeline – to scale up PV/wind manufacturing capacity

Source: May und Neuhoff (2019): Private langfristige Stromabnahmeverträge (PPAs) für erneuerbare Energien - kein Ersatz für öffentliche Ausschreibungen. DIW Aktuell.

Why RE Pool rather than bilateral PPAs? Reducing financing costs

1. Counter Party risk for developers increases with PPA, result in approximately 10% higher levelzsed costs of energy (LCoE)

2. Higher financing costs for demand side (via imputed debt increasing debt-equity ratios) imply increased LCoE of 20%



Graph from: Damodaran 2017

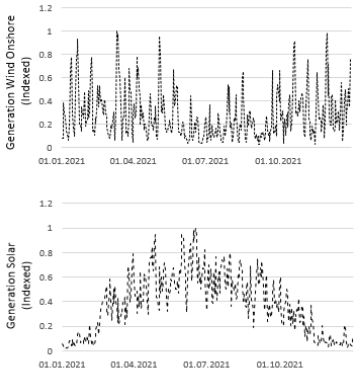
3. Total effect of higher financing costs and risks on balance sheet
   29% (DIW 2018/May 2021))
   28% (Aurora Energy Research, 2018)
   25% (Enertrag, 2019)

PPA guarantees can only address counter party risk (10%)

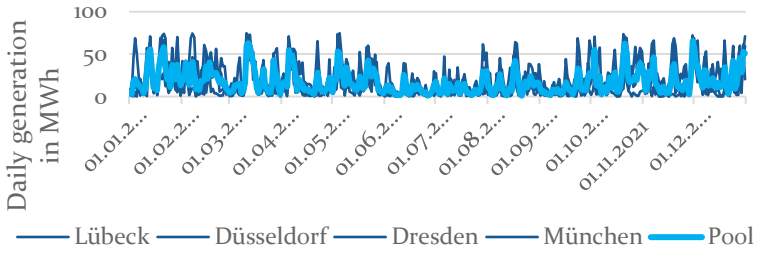
Source: May and Neuhoff (2021) Financing power: Impacts of energy policies in changing regulatory environments, The Energy Journal & Neuhoff, May and Richstein (2022) Financing Renewables in the Age of Falling Technology Costs, Resource and Energy Economics

Reliable and affordable power prices: Pooling + Flexibility

I. Combining technologies (Wind and Solar)



II. Combining sites

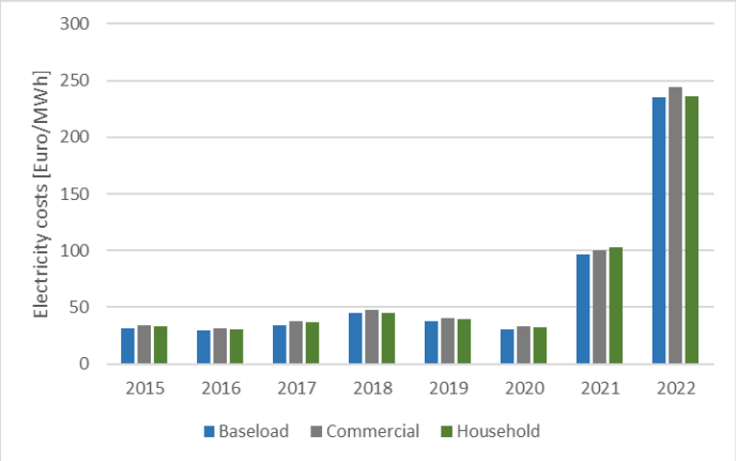


- Consumers (and their energy provider) have to fill gap between RE production and load profile
- Thus, investments in flexibility do reduce risks in addition to saving of costs
- The common RE profile helps to catalyse forward contracting of flexibility

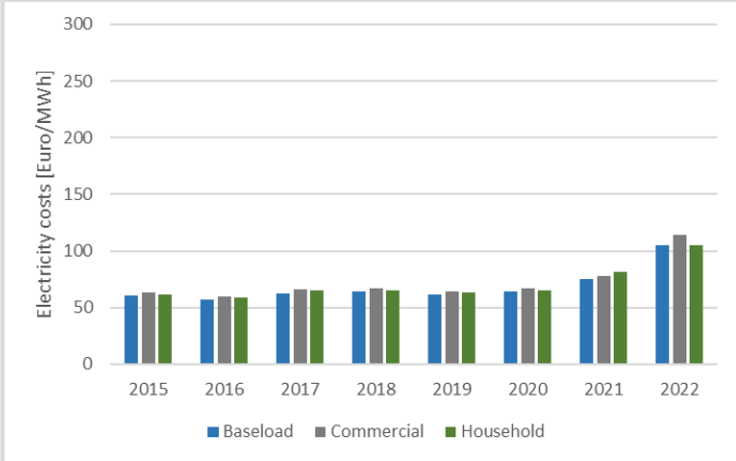
Source: Karsten Neuhoff, Fernanda Ballesteros, Mats Kröger, Jörn Richstein (2023): Contracting Matters: Hedging Producers and Consumers with a Renewable Energy Pool. (link)

Reliable and affordable power prices: Benefit consumers

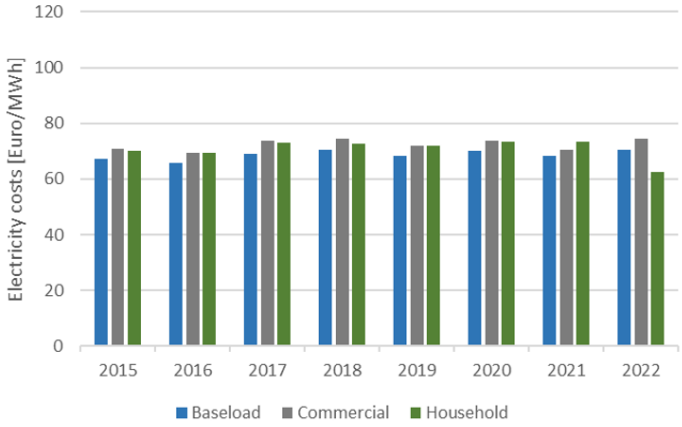
(i) Spot price



(ii) Spot price + 100% CfD Pool



(iii) Spot price + 100% CfD Pool + 4h battery storage/day



Source: Karsten Neuhoff, Fernanda Ballesteros, Mats Kröger, Jörn Richstein (2023): Contracting Matters: Hedging Producers and Consumers with a Renewable Energy Pool. (link)

Summary: RE-Pool for reliably affordable green energy

Key elements

- Tenders for contracts for differences for wind and solar projects
- Aggregating of contracts into a RE-Pool
- Allocating shares of RE-Pool to final consumers

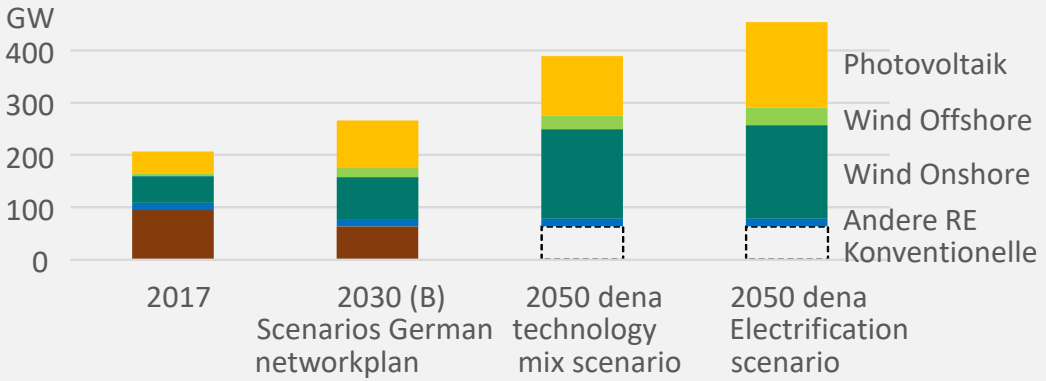
Benefits

- Strengthen project pipeline for necessary scale and speed of deployment
- Reduce financing costs – reducing cost of energy by 30%
- Ensure necessary incentives for system friendly technology choices
- Hedge price risks and ensure low generation costs are passed to consumers
- Facilitate hedging for flexibility products

Source: Karsten Neuhoff, Fernanda Ballesteros, Mats Kröger, Jörn Richstein (2023): Contracting Matters: Hedging Producers and Consumers with a Renewable Energy Pool. (link)

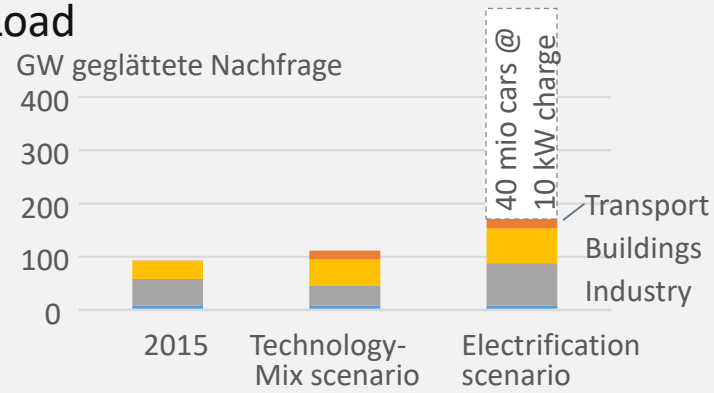
Power systems with increasing shares of wind and solar need to use flexibility locally

Generation



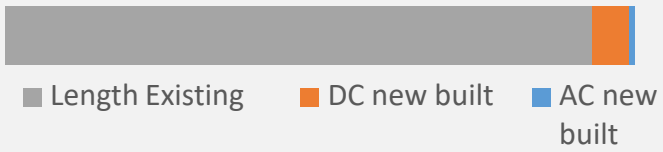
Wind and solar plants have already doubled the generation capacity connected to network, further doubling for decarbonisation until 2050.

Load

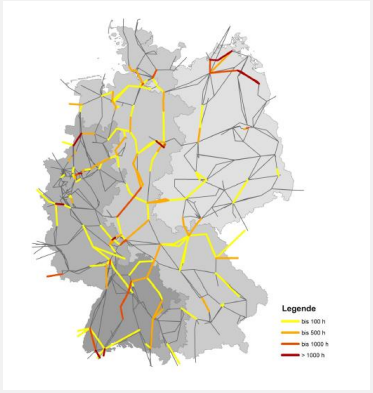


Electric cars and electrification multiple capacity of load, but also create flexibility.

Network



Networks extension is necessary and increases with renewable deployment, but less than connected capacity.



Effective load and storage management allow for wind/solar integration.

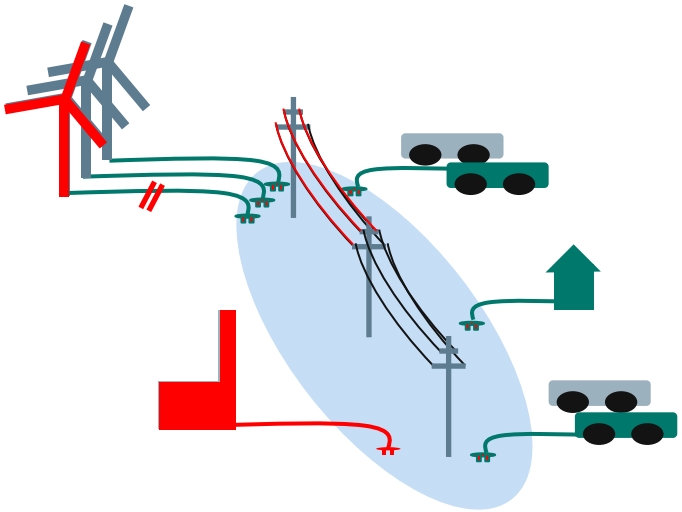
Flexibility needs to be used locally.

Hintergrund: Neuhoff, K., Wolter, S., Schwenen, S., 2016. Power Markets with Renewables: New Perspectives for the European Target Model. Energy Journal 37.

Local pricing necessary for effective use and remuneration of flexibility

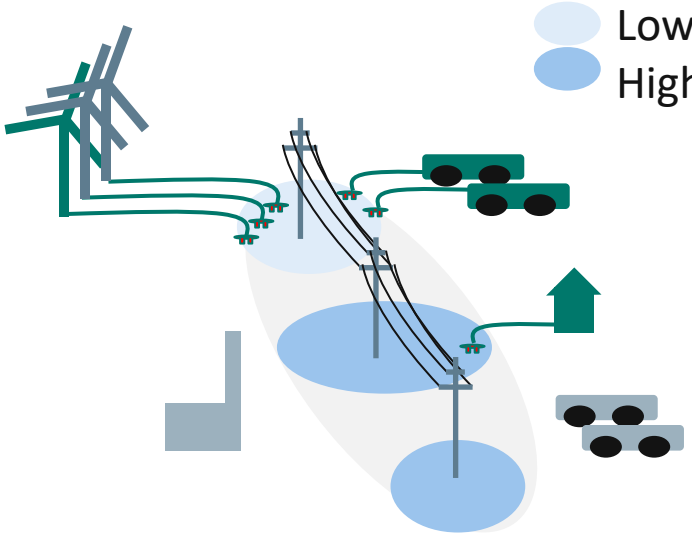
Illustration

Large pricing zone



- Zonal price balances demand, supply and imports/exports for zone.
- May result in transmission constraints.
- In such instances TSO mandates power stations to redispatch.

Local prices



- Local prices balance demand, supply and imports/exports.

- Demand flexibility and storage cannot be used for congestion management.
- Effective user of flexibility reduces wind-spill and conventional power generation.

Framework enabling regional introduction of locational pricing urgently required.

For detailed discussion on market design elements and pathways see: www.diw.de\fpm

Market based redispatch is impossible, if market participants can anticipate constraints

- Southern participant anticipates re-dispatch price to exceed spot price
  - Generator will only bid in re-dispatch market
  - Load increases day-ahead procurement to sell reduction in re-dispatch market (Inverse behaviour in North)

- Re-dispatch volume increases further – with two implications:
  - Nominated schedules as basis for network operation less reliable
  - Risk of insufficient operational generation in load pockets

- Similar inc-dec games resulted in failure of CA power market in 2001

Cost based/regulated re-dispatch not viable with storage and demand flexibility

External estimates for storage and flexibility options very imprecise

1. Create renewed incentives for inc-dec game
   - If for example cost estimate for load reduction >> real cost
   - Load buys additional power, benefits if cost estimate > spot price
   - Redispatch volume increases

   -> Nominated schedules as basis for network operation less reliable

   -> Risk of insufficient operational generation in load pockets

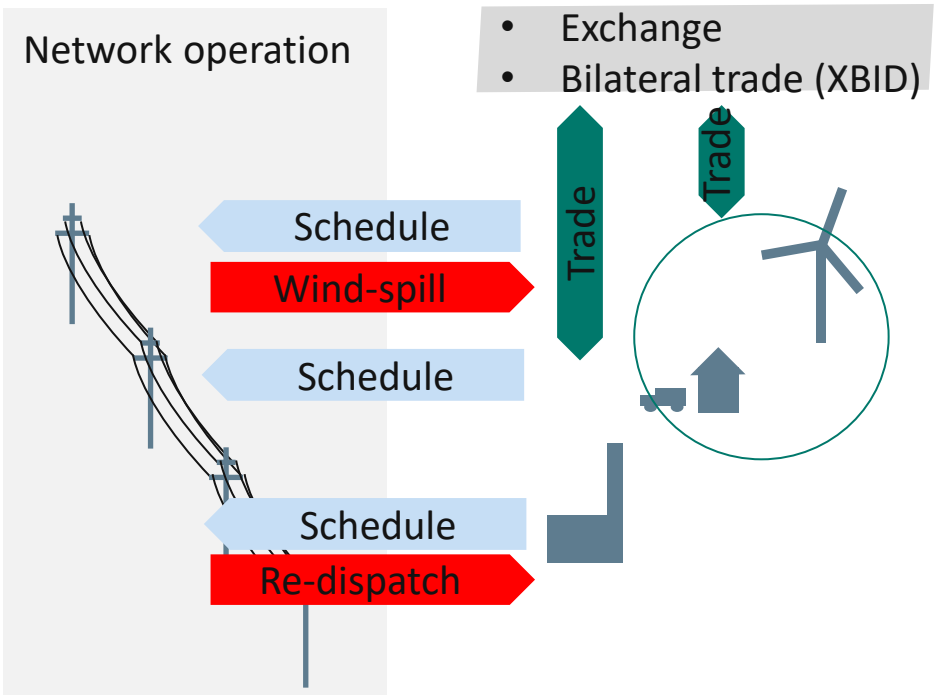
2. Inefficient merit order for load flexibility

   -> inefficient redispatch

   -> less flexibility remaining for system balancing

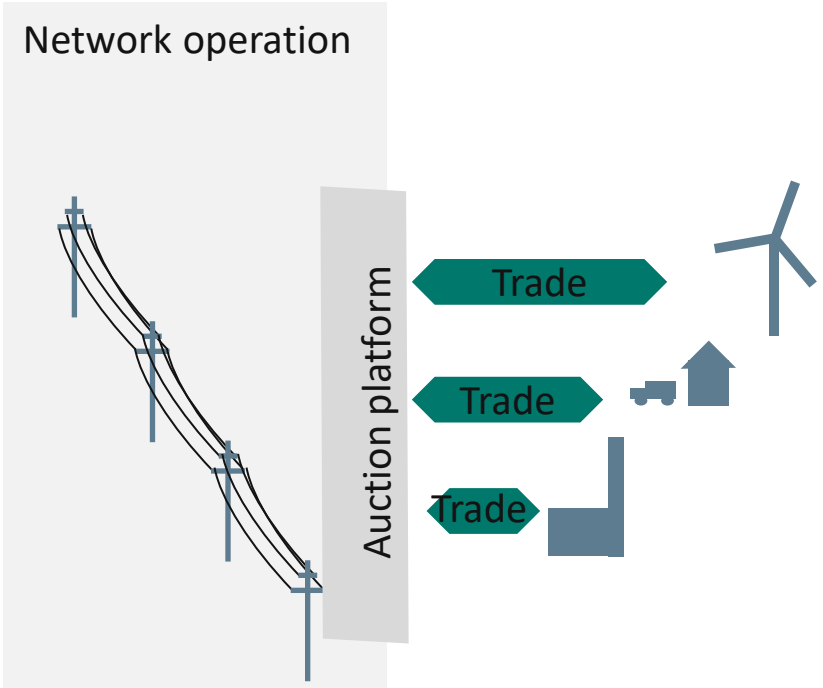
16 Power auctions with local prices create robust, liquid, simple, sustainable market

Large pricing zone



- Nomination of schedules at unit basis
- Re-dispatch at unit level
- Requires 24/7 trading floor

Local prices



- Auction clearing internalises T
- Market coupling maximises liquidity
- Simple market access for all
- Clear interface to local platforms

Source: For detailed discussion and transition strategy (using auctions), please see Reports of Future Power Markets Platform: www.diw.de\fpm

17 How to ensure reliability given larger uncertainties during transition to high shares of renewables and flexibility?

	Contribution	Design question
Energy market with forward contracting	• Retail competition limits contracting -> Implement mandatory contracting? • Government intervention in extreme events limits credibility/contracting -> Requires additional measure?	• Shift from base-load to renewable profile as reference contract? • Complement with contracts for flexibility (price spreads)? • Decision criteria: when are markets suspended in emergency?
Capacity mechanisms additional revenue for **all** resources	• Uncertain accreditation/qualification for flexibility reduces investment case • Increasing reserve levels reduces energy price variability and flexibility usage	• How to account for MW and MWh in capacity products?
Reliability reserve **only reserve** is remunerated, released at strike prices	• Historically disregarded as inefficient and not credible to investors • During transition could insure energy market with forward contracting • Environmental requirements could enhance credibility of mechanism	• What trigger-price is high enough for demand response and low enough to be regulatory robust? • Who can participate in reserve? • Alignment with curtailment mechanism in emergency?

For more discussion see: „A coordinated strategic reserve ..”, https://doi.org/10.1016/j.jup.2016.02.002

Vielen Dank für Ihre Aufmerksamkeit!

DIW Berlin - Deutsches Institut für Wirtschaftsforschung e.V.
Mohrenstraße 58, 10117 Berlin
www.diw.de

Karsten Neuhoff
Kneuhoff@diw.de