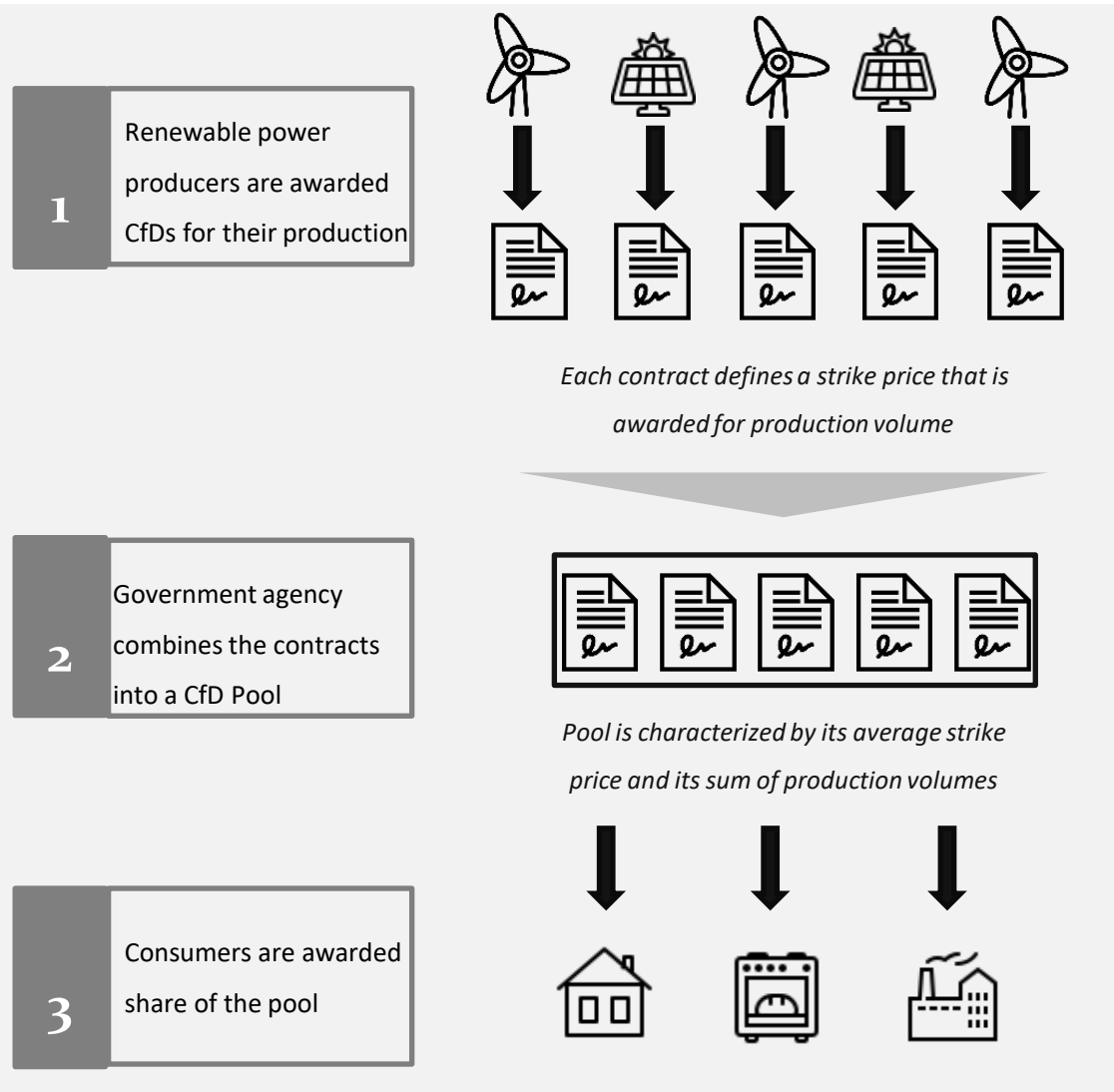DIW BERLIN

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)*

- 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

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

**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)

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# Who would be granted access to the RE Pool?
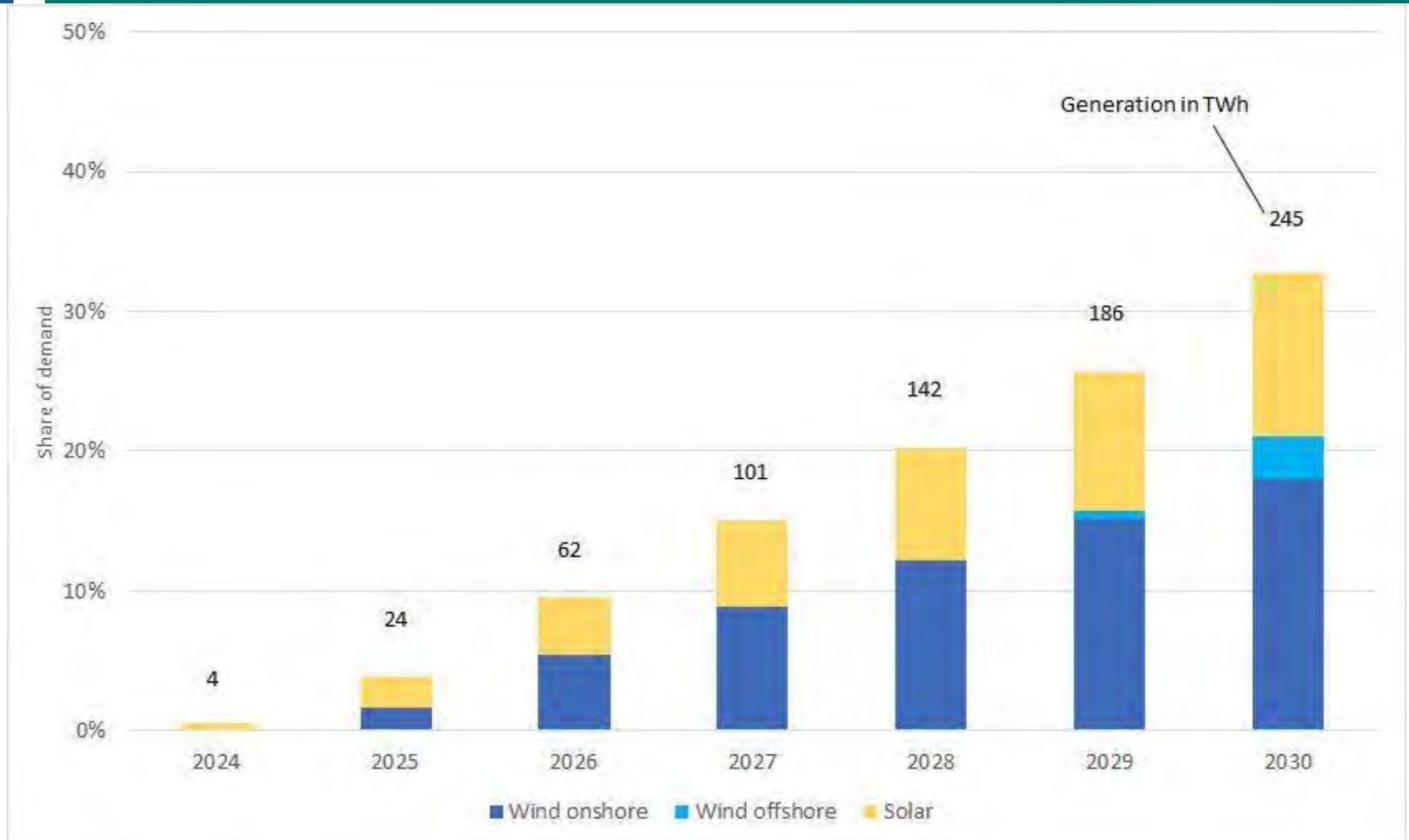
Basic principle

- 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?

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44c/kWh In 2010
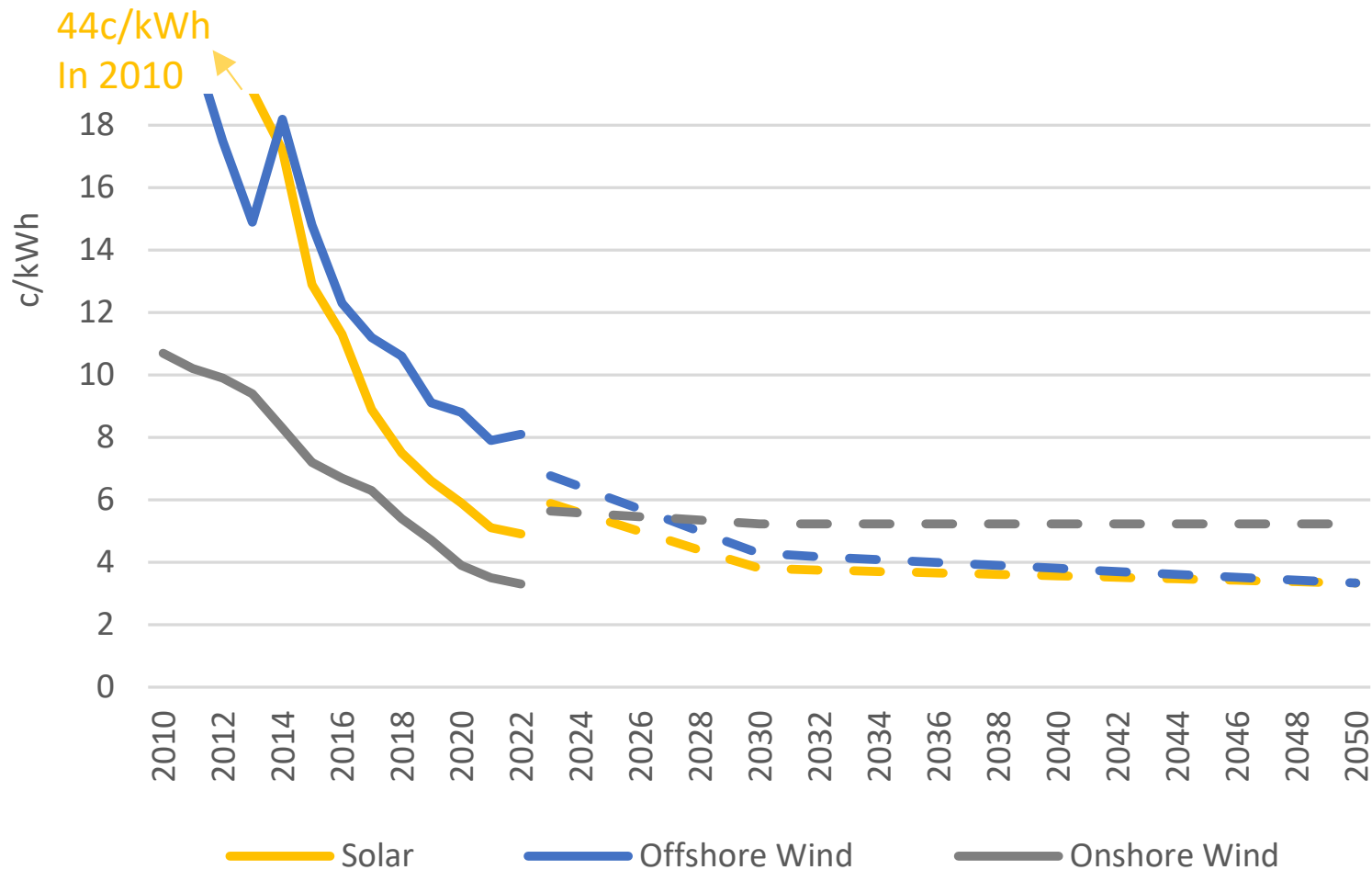
Until 2022, international average based on IRENA (2023). Beginning in 2023, European average based on World Energy Outlook Projections (IEA, 2023). Values in years in between the projections are interpolated linearly. In 2022 prices, exchange rate €/$ = 0,95.

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

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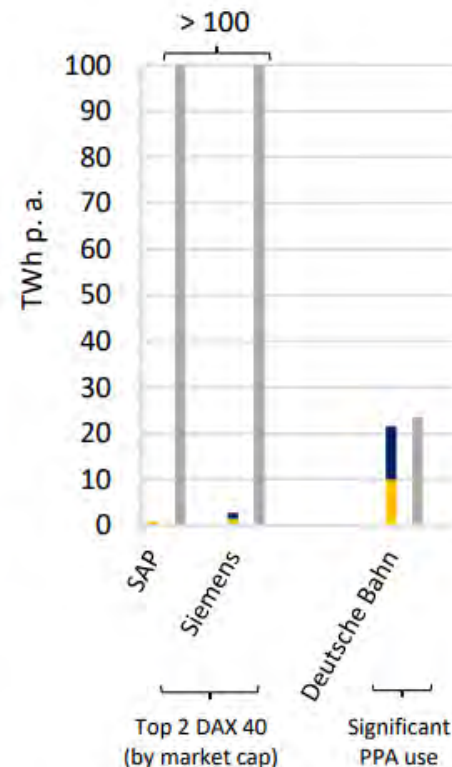


a) Utilities DAX 40 and top-selling utilities in Germany
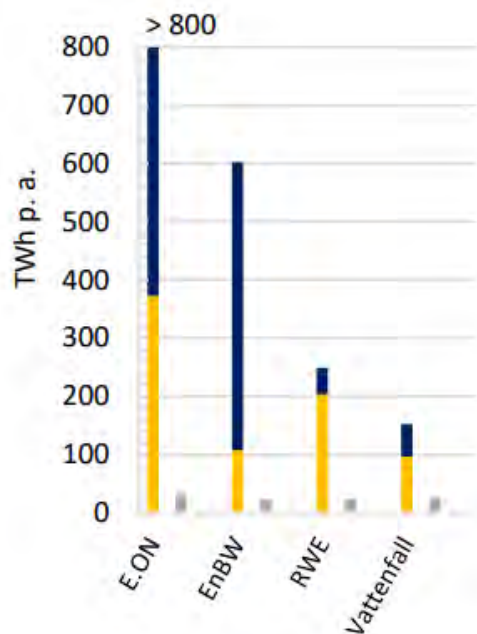
b) Energy-intensive industries DAX 40 and top-selling steel companies in Germany
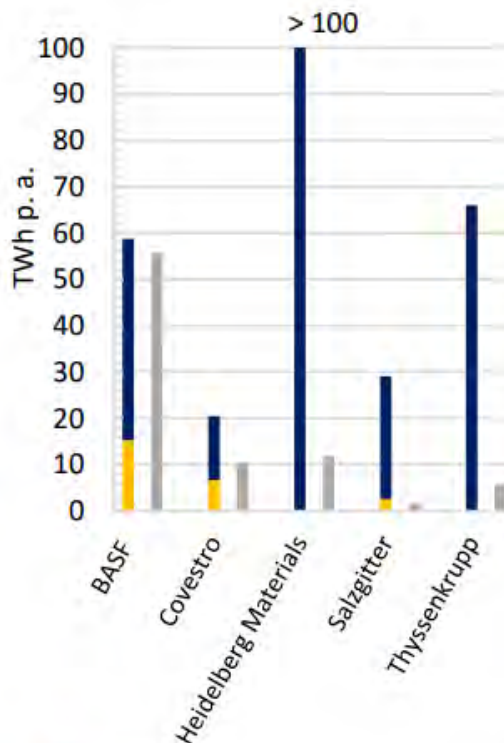
c) Other selected German companies

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

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- 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.

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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%
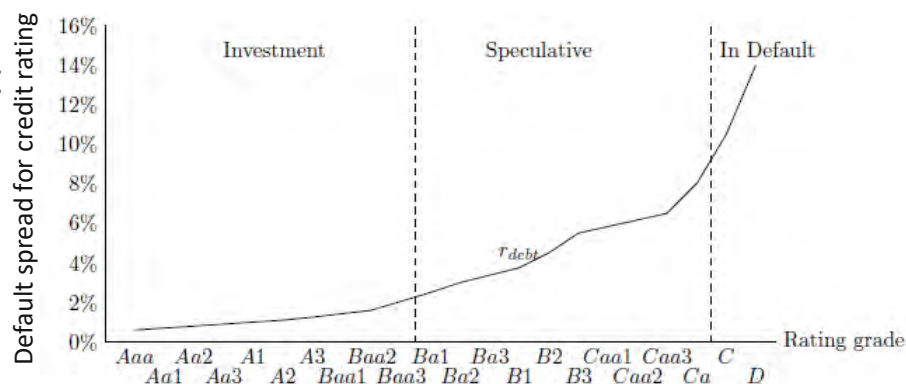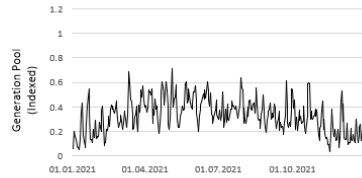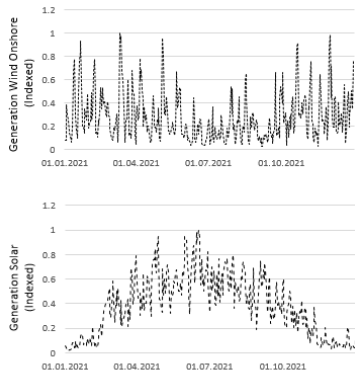


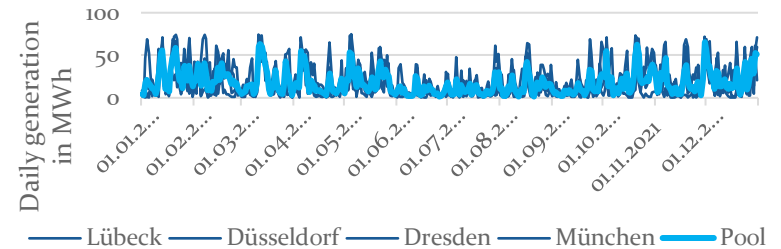*Graph from: Damodaran 2017*

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%)**

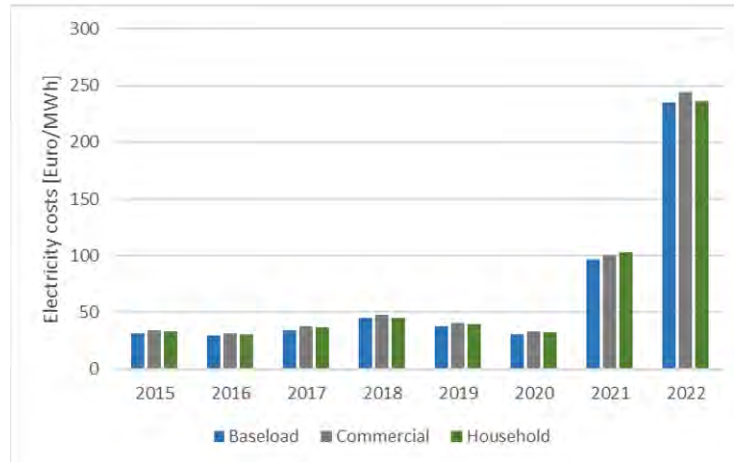## I. Combining technologies (Wind and Solar)  ## II. Combining sites



- 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

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### (i) Spot price

### (ii) Spot price + 100% CfD Pool
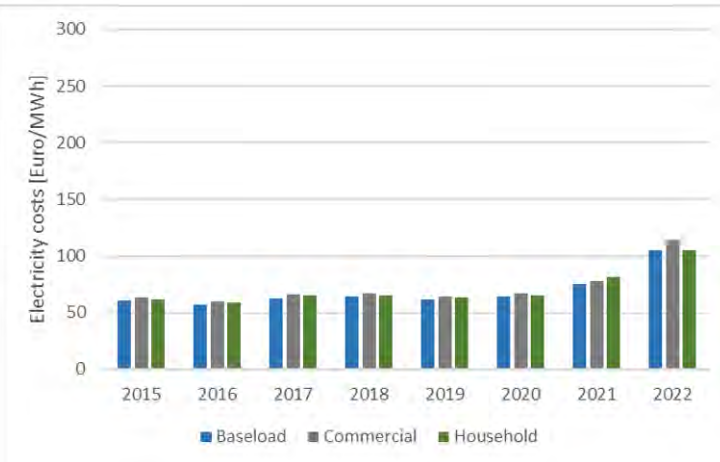




### (iii) Spot price +  100% CfD Pool + 4h battery storage/day



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

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# 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

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## Generation



GW

Photovoltaik
Wind Offshore
Wind Onshore
Andere RE
Konventionelle

2017 | 2030 (B) Scenarios German networkplan | 2050 dena technology mix scenario | 2050 dena Electrification scenario
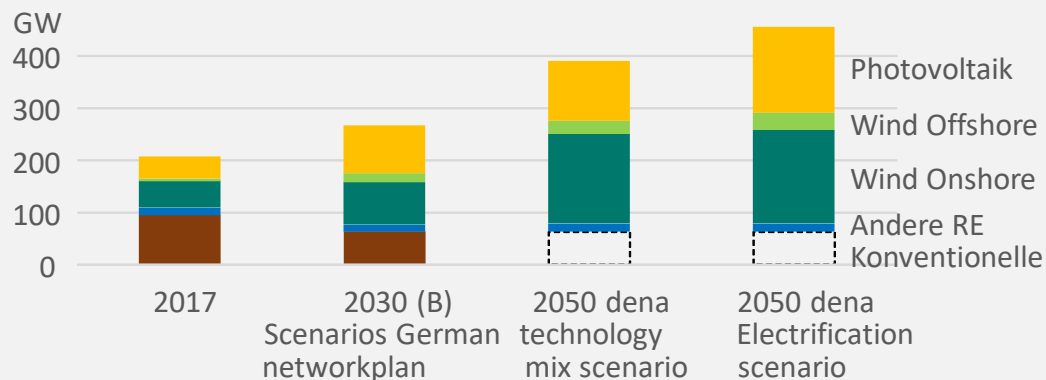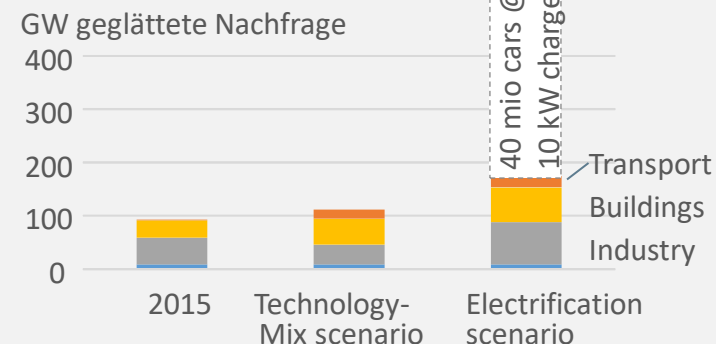
Wind and solar plants have already doubled the generation capacity connected to network, further doubling for decarbonisation until 2050.

## Load



GW geglättete Nachfrage

40 mio cars @ 10 kW charge

Transport
Buildings
Industry

2015 | Technology-Mix scenario | Electrification scenario

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

## Network



■ Length Existing   ■ DC new built   ■ AC new built
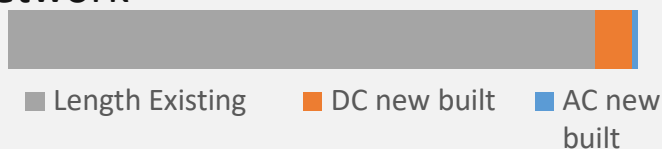
Networks extension is necessary and increases with renewable deployment, but less than connected capacity.
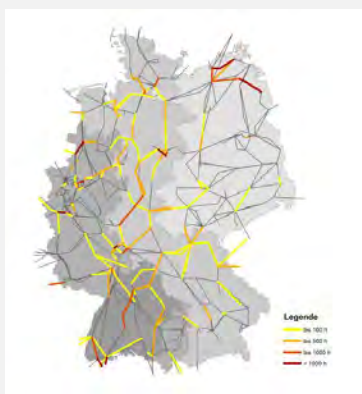
Effective load and storage management allow for wind/solar integration.

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 | Local prices |
|---|---|



Lower price
Higher price

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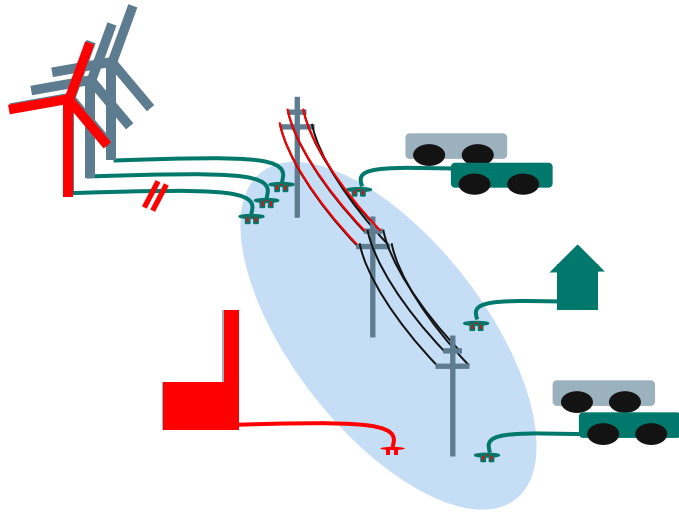
- Zonal price balances demand, supply and imports/exports for zone.
- May result in transmission constraints.
- In such instances TSO mandates power stations to redispatch.

- Demand flexibility and storage cannot be used for congestion management.

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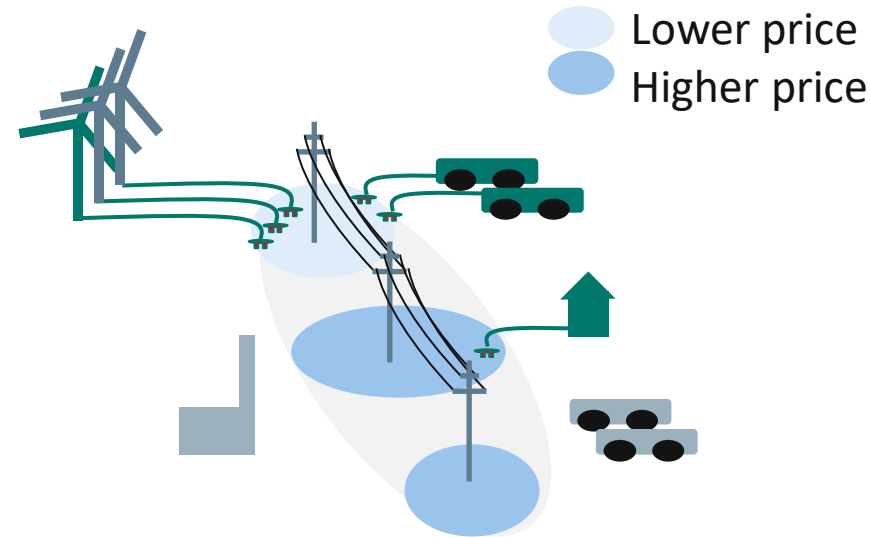
- Local prices balance demand, supply and imports/exports.

- Effective user of flexibility reduces wind-spill and conventional power generation.

**Framework enabling regional introduction of locational pricing urgently required.**

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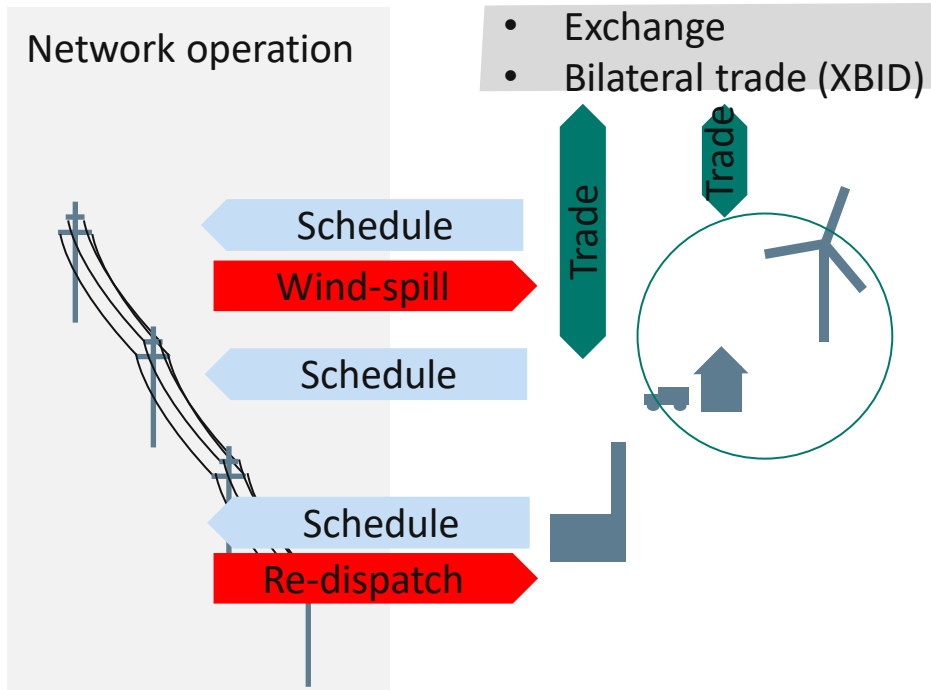
1. Create renewed incentives for inc-dec game
   - If for example cost estimate for load reduction >> real cost
   - Load buys additional power, benefits if cost estimate > spot price
   - Redispatch volume increases

     -> 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
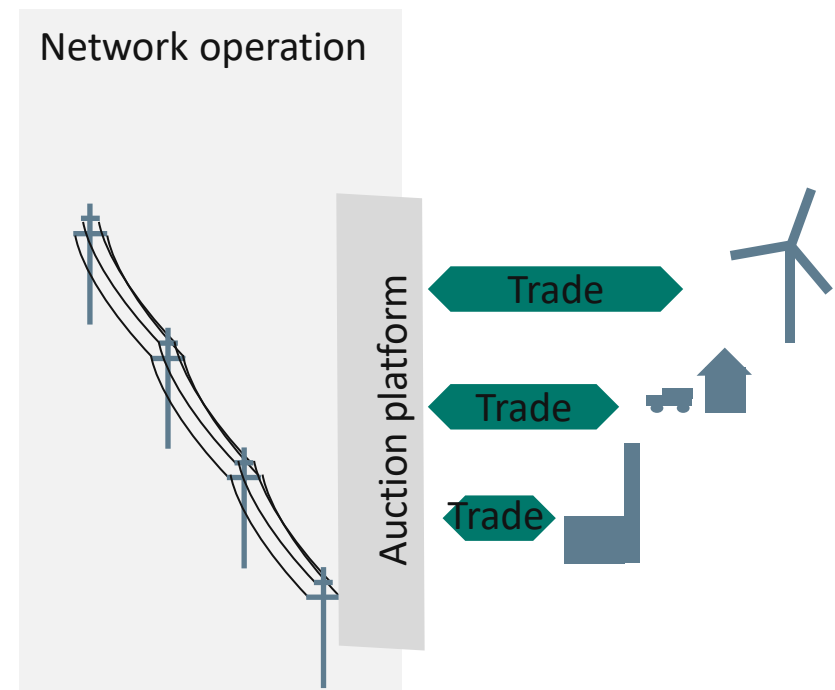
   -> less flexibility remaining for system balancing

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## Large pricing zone

Network operation

- Exchange
- Bilateral trade (XBID)

Trade

Trade

Schedule

Wind-spill

Schedule

Schedule

Re-dispatch

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

## Local prices

Network operation

Auction platform

Trade

Trade

Trade

- 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

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

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| | Contribution | Design question |
|---|---|---|
| **Energy market with forward contracting** | • Retail competition limits contracting -> Implement mandatory contracting?<br>• Government intervention in extreme events limits credibility/contracting -> Requires additional measure? | • Shift from base-load to renewable profile as reference contract?<br>• Complement with contracts for flexibility (price spreads)?<br>• Decision criteria: when are markets suspended in emergency? |
| **Capacity mechanisms** additional revenue for **all** resources | • Uncertain accreditation/qualification for flexibility reduces investment case<br>• 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<br>• During transition could insure energy market with forward contracting<br>• Environmental requirements could enhance credibility of mechanism | • What trigger-price is high enough for demand response and low enough to be regulatory robust?<br>• Who can participate in reserve?<br>• Alignment with curtailment mechanism in emergency? |

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

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Vielen Dank für Ihre Aufmerksamkeit!

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