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EU Industrial Deal – How to Create Reliability for Investments in a Volatile World?

Professor Karsten Neuhoff, TU Berlin and DIW Berlin
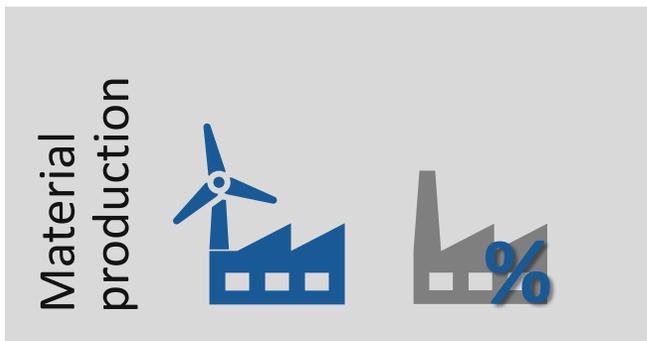Brno, March 26, 2025

Industrial decarbonisation in a fragmented world: an effective carbon price with a 'climate contribution'
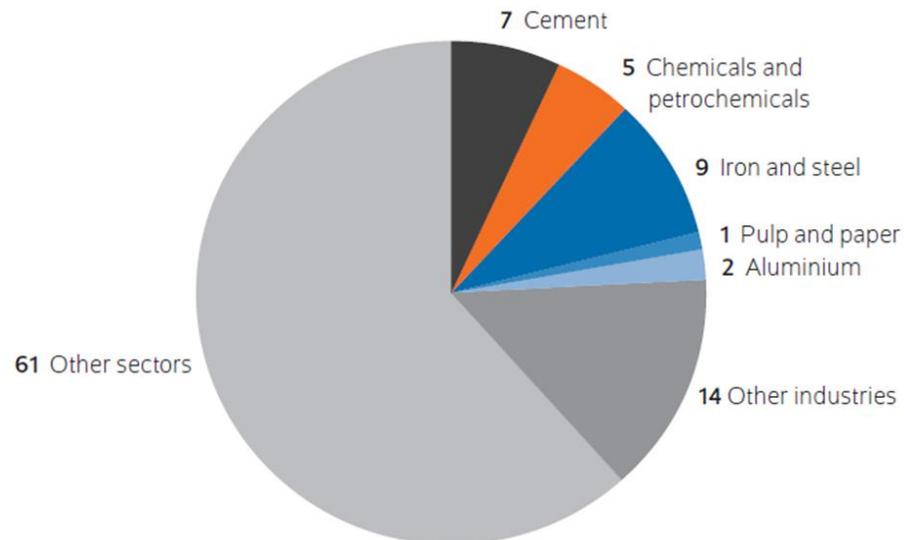
Policy insight

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Source: https://www.lse.ac.uk/granthaminstitute/publication/industrial-decarbonisation-in-a-fragmented-world-an-effective-carbon-price-with-a-climate-contribution/

Industry transition to climate neutrality requires portfolio of mitigation options

Material production

Material use

Production of basic materials large part of global CO_2 emissions

Pie chart:
- 7 Cement
- 5 Chemicals and petrochemicals
- 9 Iron and steel
- 1 Pulp and paper
- 2 Aluminium
- 14 Other industries
- 61 Other sectors

Climate neutrality requires portfolio of mitigation options

- (Carbon) efficiency improvement of existing production

- Efficient material use, circularity and material substitution

- Shift to climate neutral production processes

Source: DIW calculations based on IEA ETP 2017

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Carbon pricing can – in principle – incentivize climate neutral choices
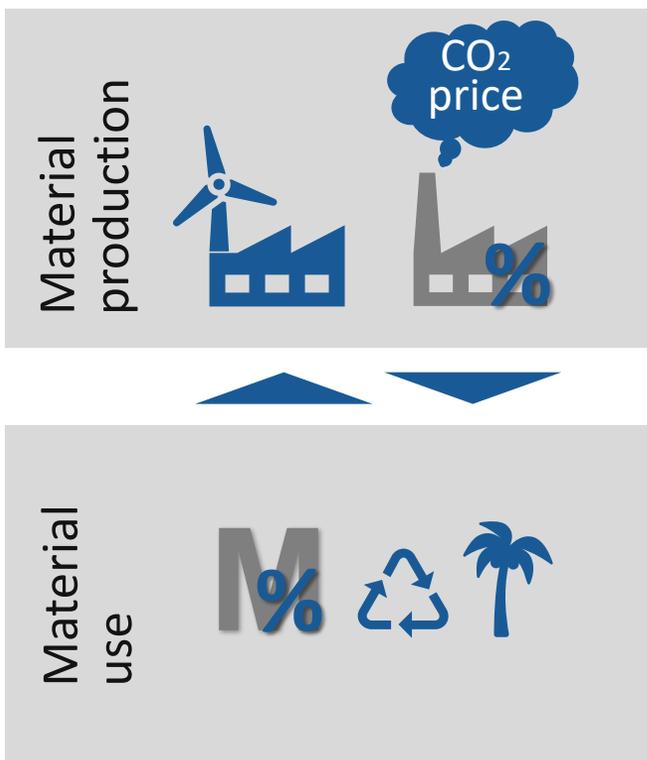
Global harmonized carbon prices incentivise all mitigation options

- Polluter pays (statutory incidence)
- Price signal propagates to material use (economic incidence)

How do unilateral carbon prices impact cost of basic material production?
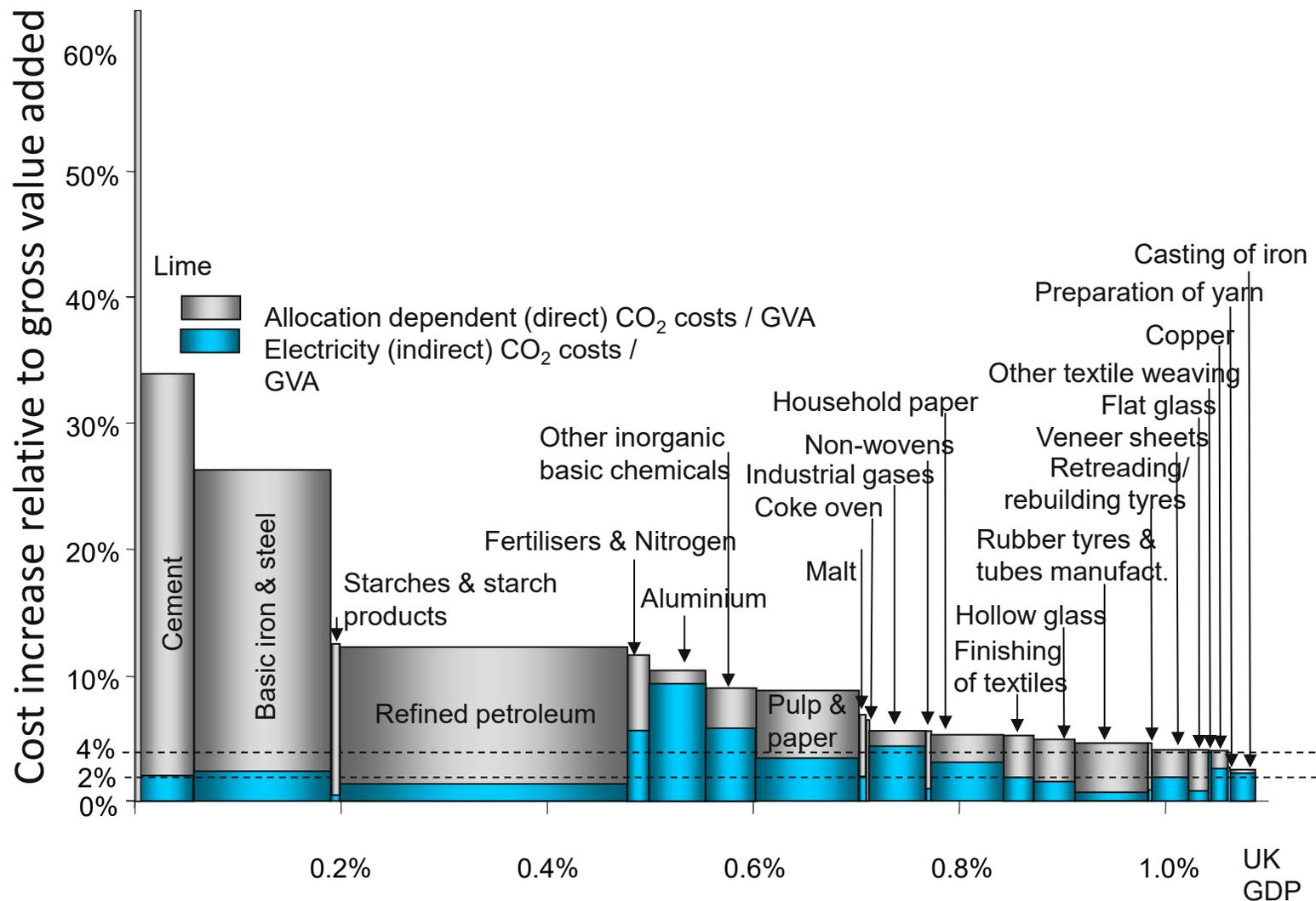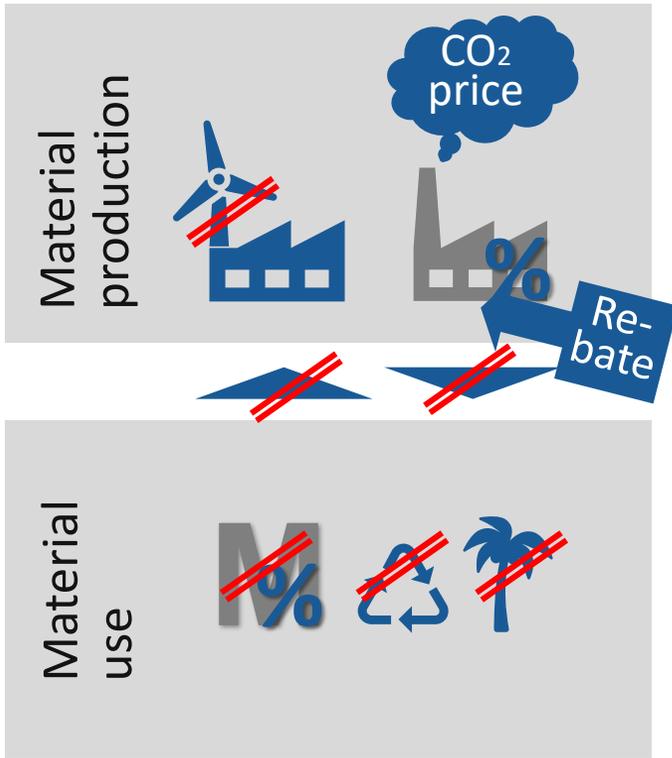
20€/t CO_2 and 10€/MWh

Result in costs for material producers > 5% gross value added

Options for policy response to avoid risk of carbon leakage:

1. Rebate of carbon cost

2. Carbon border adjustment

3. Dedicated pricing for production & use of materials

Source: Sato, S., Neuhoff, K., Graichen, V., Schumacher, K., Matthes, F. (2015). Sectors under Scrutiny: Evaluation of Indicators to Assess the Risk of Carbon Leakage in the UK and Germany. Environmental & Resource Economics, p. 99-124.

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1. To avoid carbon (and job) leakage – free allowances are granted to producers
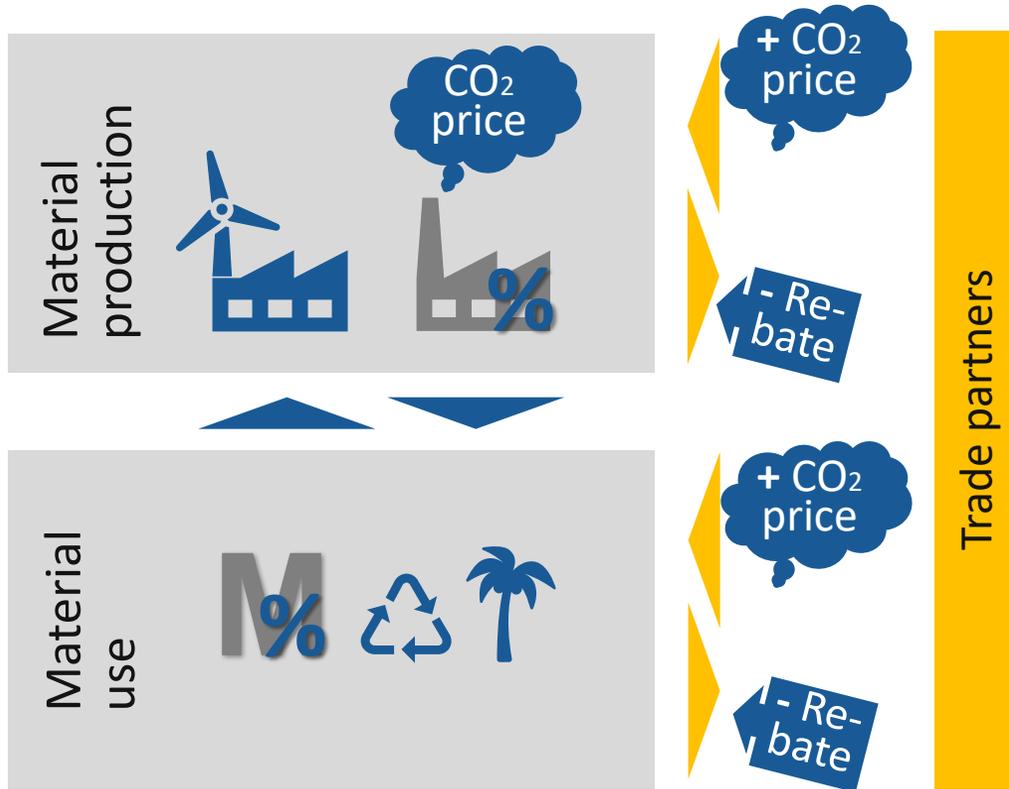
Free allocation: partial and uncertain carbon cost internalization
→ This undermines almost all incentives for mitigation
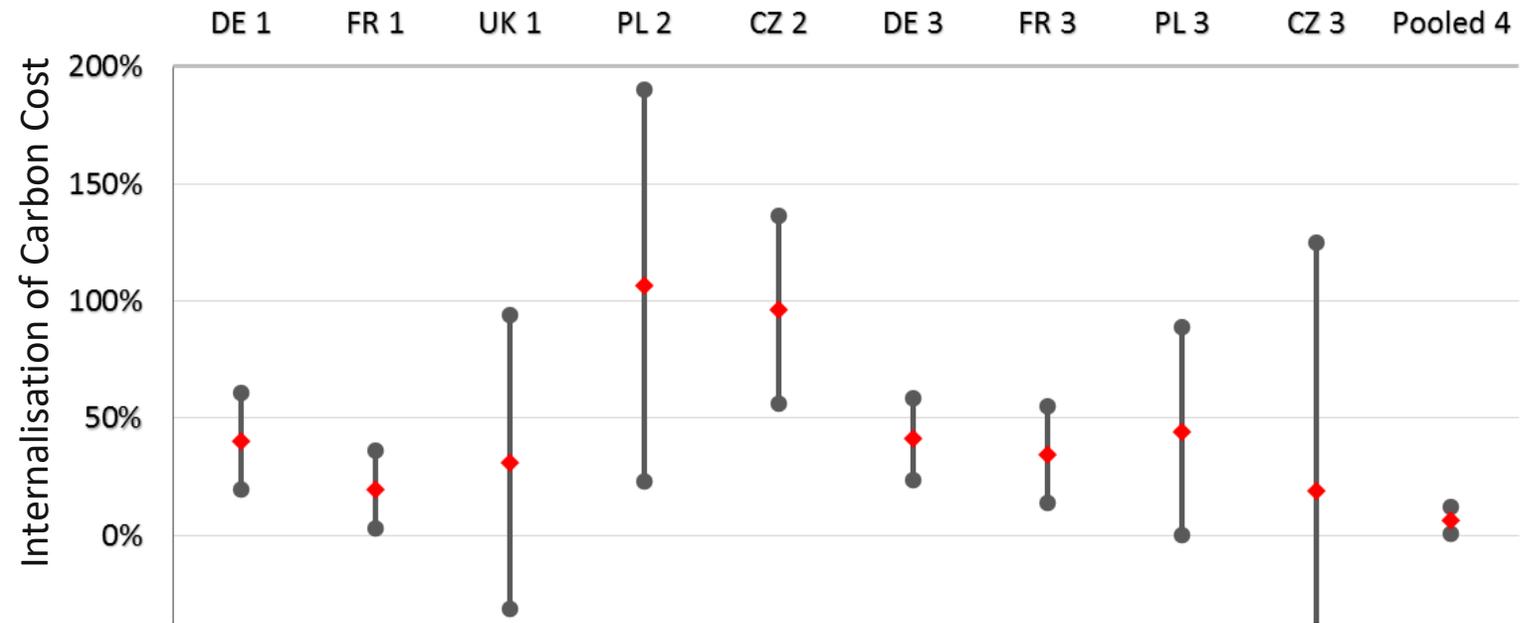
The graph depicts 95% confidence intervals (DIW calculations). 1 represents total cement, 2 represents Portland Cement, 3 represents Clinker, Pooled 4 represents Portland Cement estimates for FR, UK, and DE

Source: K. Neuhoff and R. A. Ritz (2019) Carbon cost pass-through in industrial sectors, Cambridge Working Paper in Economics Nr. 1988.

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- Address carbon leakage at border (no free allocation)
- Levy carbon costs on imports
- Rebate carbon costs on exports
  - ➔ Idea: Carbon price propagates along value chain

- External concerns about carbon border adjustment
  - Non-tariff barriers: administrative requirements
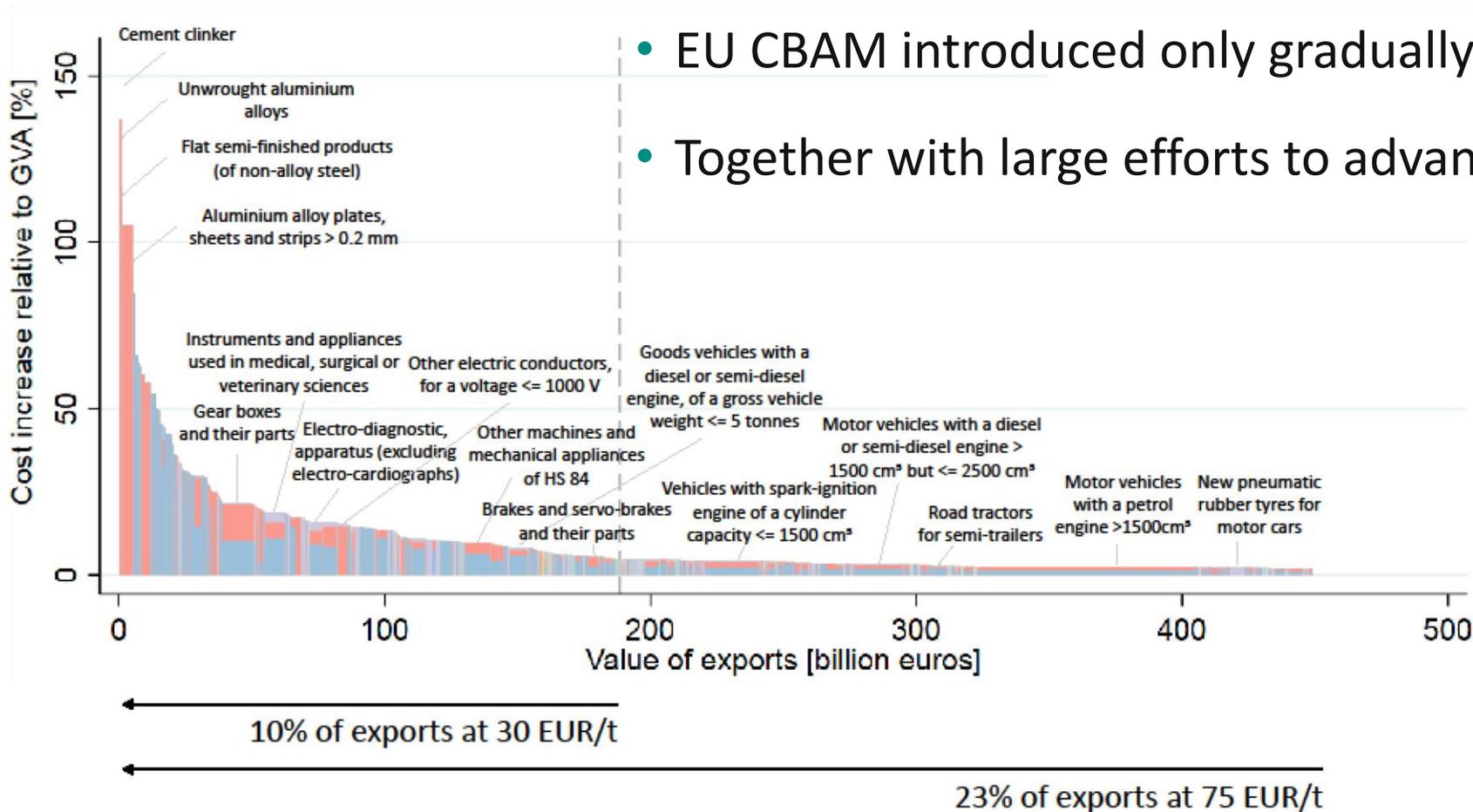 - Discrimination: not really
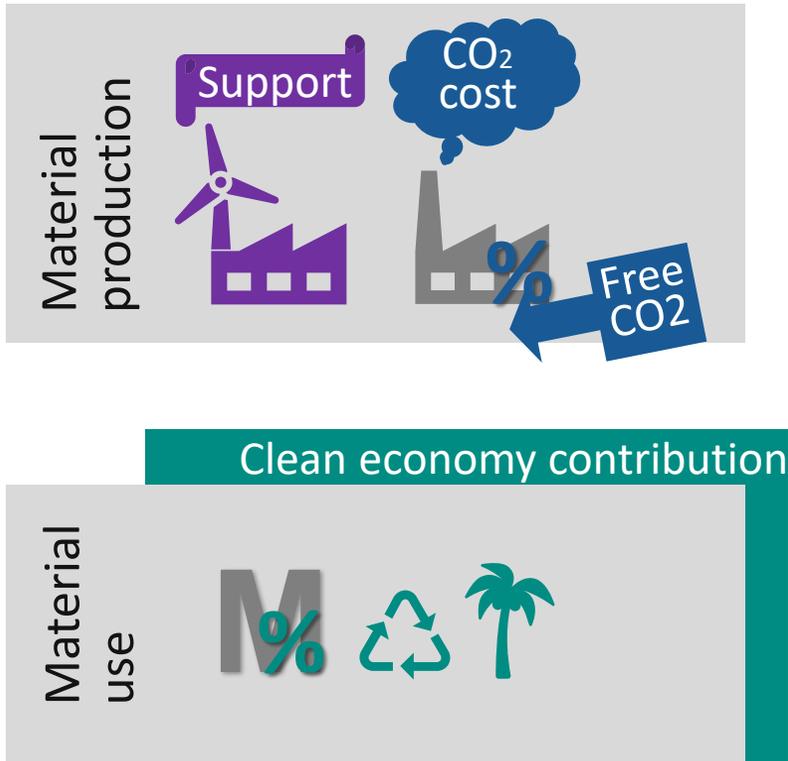 - Interference in domestic politics
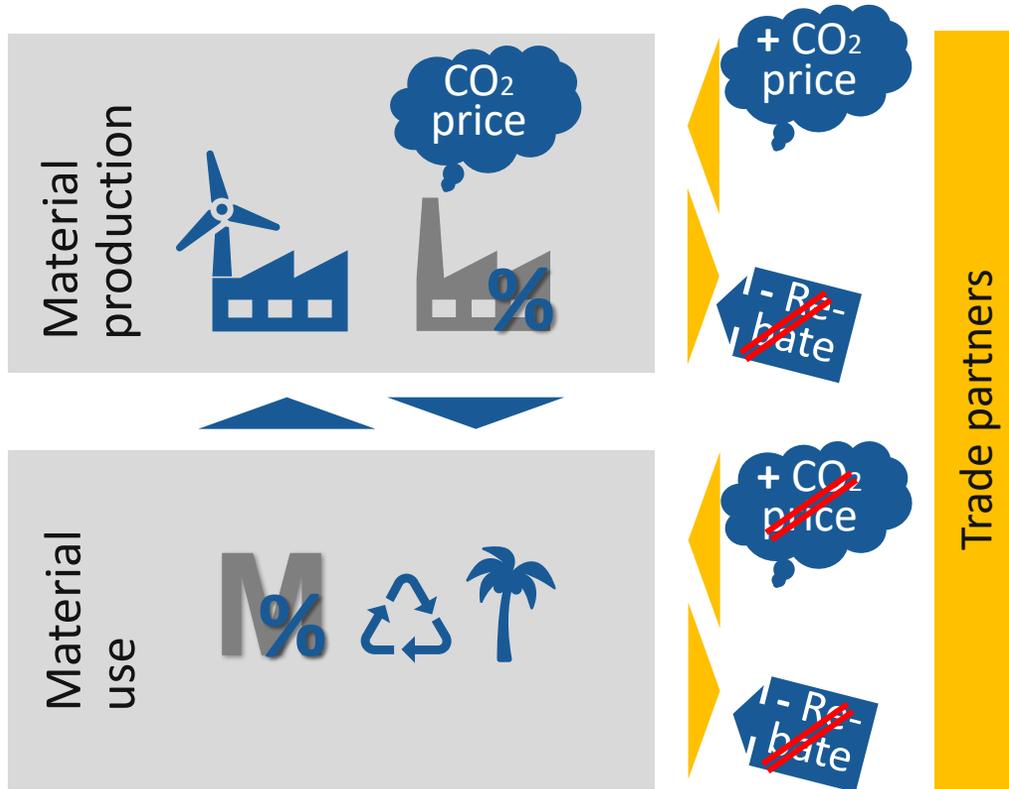
- Legal (WTO) constraints: No refunds of carbon costs

- Administrative complexity: No coverage of value chain

- Resource shuffling: Limits environmental incentives and leakage protection (imports and exports)

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- At 75 Euro/€ CO_2 up to 23% exports at risk of carbon leakage

- EU CBAM introduced only gradually till 2034 + review stages

- Together with large efforts to advance global carbon pricing

Jan Stede et al., "Carbon pricing of basic materials: Incentives and risks for the value chain and consumers," Ecological Economics (2021) (link)

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Material production

Support

CO_2 cost

%

Free CO2

Clean economy contribution

M %

Material use

- Improved production: ETS with free allocation to industry implementing transition plan

- Clean material production: Carbon contracts for difference

- Material use: Clean economy contribution at benchmark level on basic material production and import, waved on exports

https://climatestrategies.org/projects/inclusion-of-consumption-in-emissions-trading/
Ismer e.a. (2021) Climate neutral production, free allocation and the WTO: How to secure compatibility with the ASCM, DIW Discussion Paper.

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3. Clean economy contribution – the mechanism

- Level set at an emission benchmark for emissions from conventional process * carbon price (e.g. of previous year)
- Liability created with domestic production and imports
  - Liability can be passed along the value chain
  - Liability due if sold to domestic consumers
  - Liability waved if material (also as part of products) is exported
- Simple administration (weight based)
  - No international monitoring, reporting, verification required
  - Simple information requirements domestic
  - Low fraud risk (no refund)
  - Low administrative effort (public&private) compared to other tax

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3. Clean economy contribution – building on established excise charges
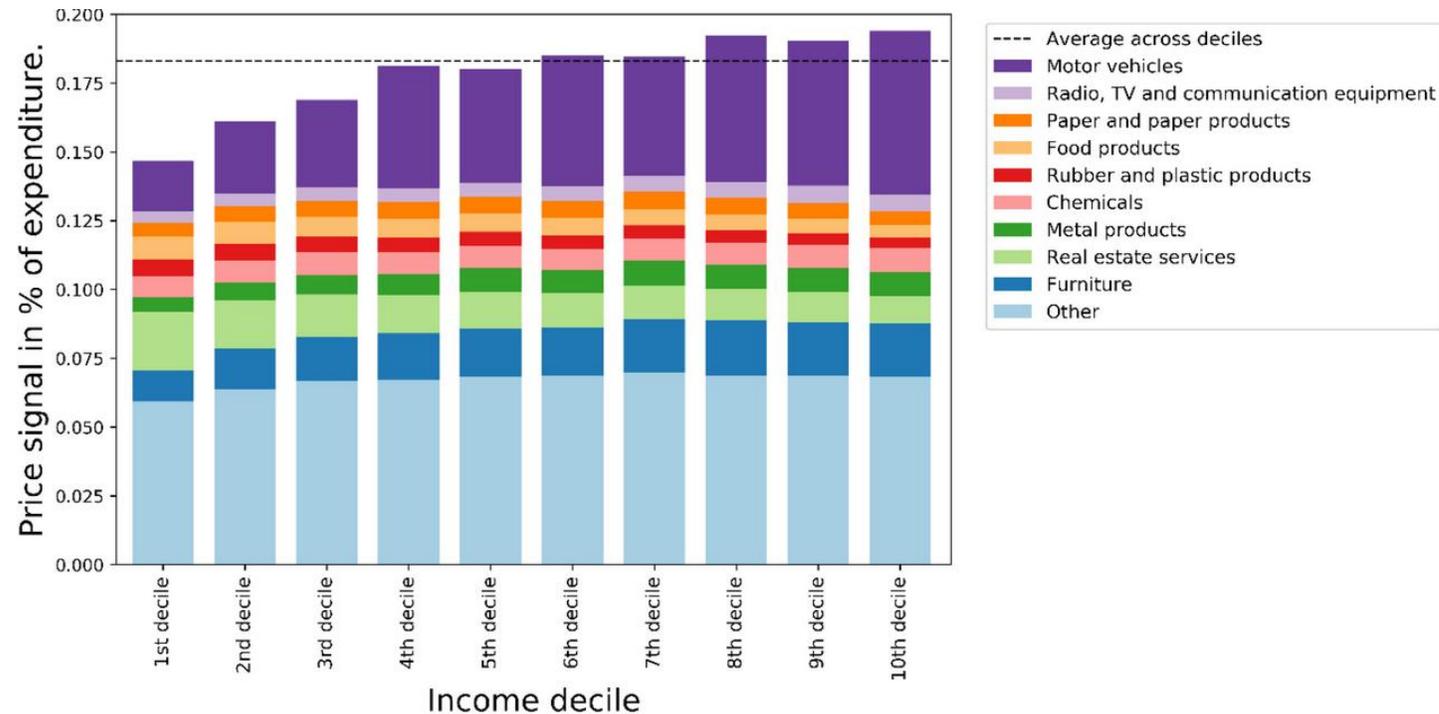
- Same increases in product prices as in the case of the global CO2 price
- Clear motivation strengthens acceptance - incentives & financing for modernization
- *Relatively low* and progressive price increases for end products

Jan Stede et al., "Carbon pricing of basic materials: Incentives and risks for the value chain and consumers," Ecological Economics (2021 (link)

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3. Legal and political anchoring

European

- Can be implemented as an environmental regulation with a qualified majority

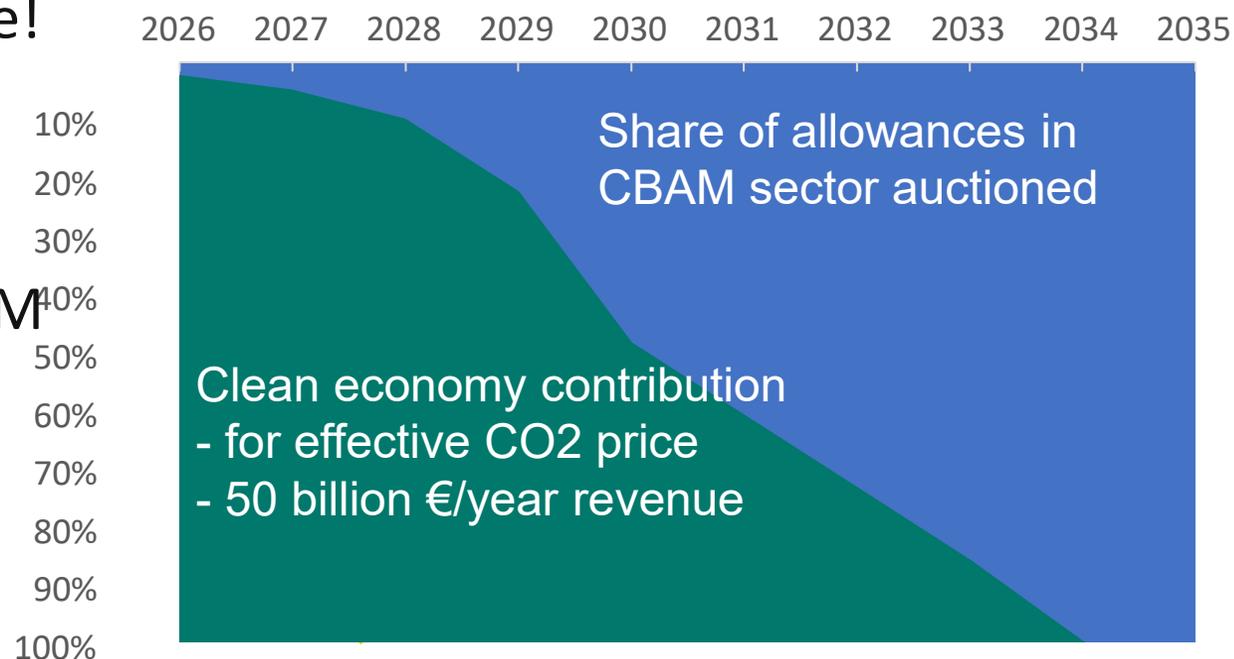- Also requires clear commitment of funds - industrial transformation

International

- Robustly anchored within the framework of WTO rules

- Consistent CO_2 prices (full ETS price reflected in product prices)

- Using part of the climate contribution revenue for international climate action
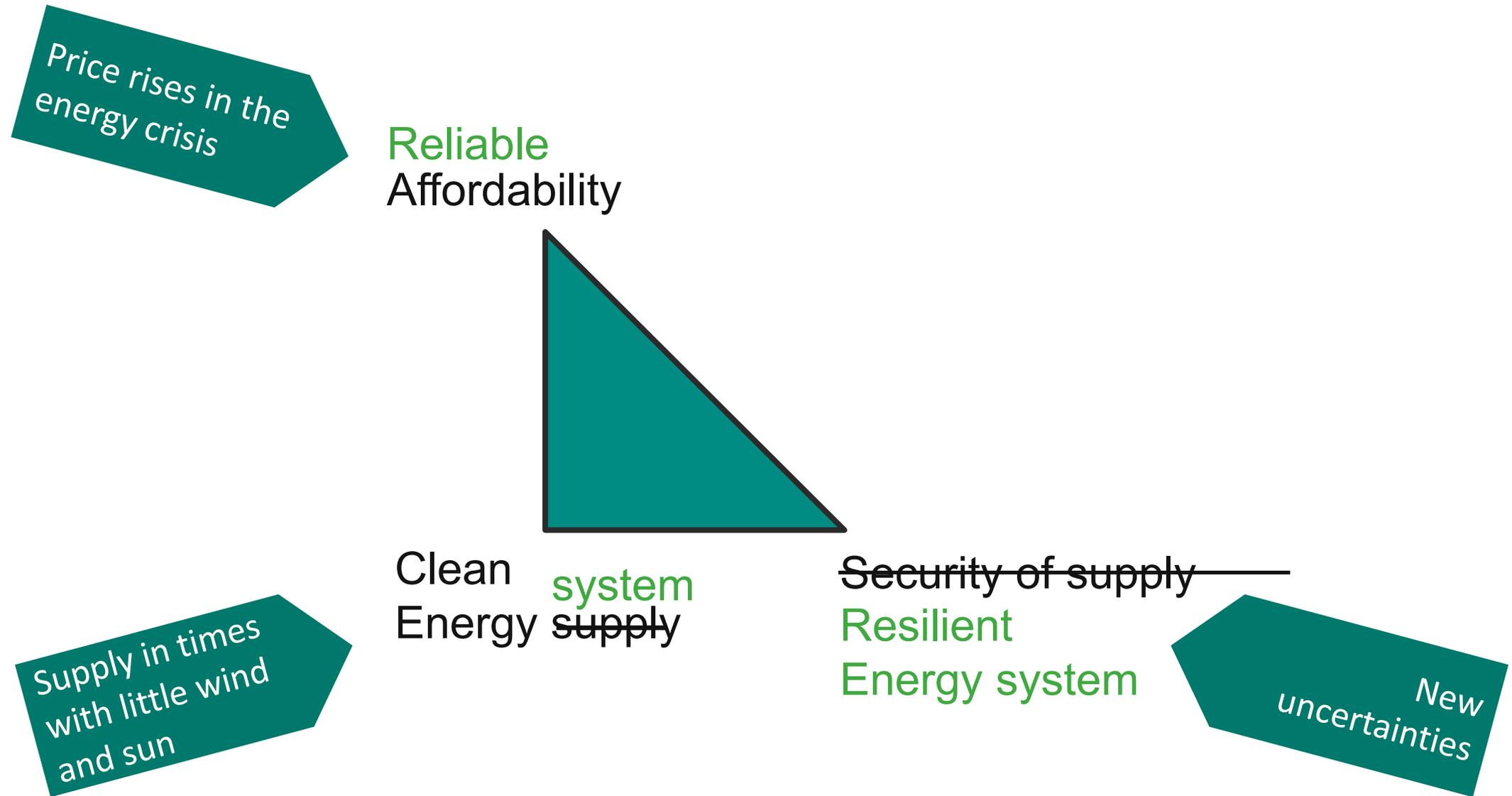
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3. Conclusion: Carbon pricing in a fragmented world

- A carbon price high enough for transition triggers carbon leakage risks

- Free allocation: addresses leakage risks – but mutes mitigation incentives

- Carbon border adjustments: global reach – but economic and WTO limitations

- Dedicated polices for production and use: work – but have limited global reach

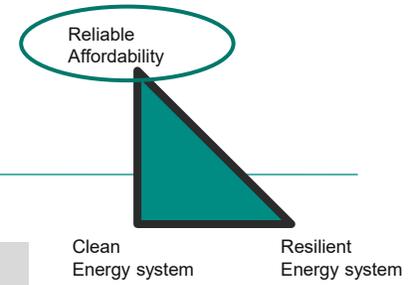- Consider carbon pricing in policy package!

- Pragmatic EU perspective:
  - Clean economy contribution AND CBAM
  - At level of remaining free allocation
  - Fills incentive and funding gap
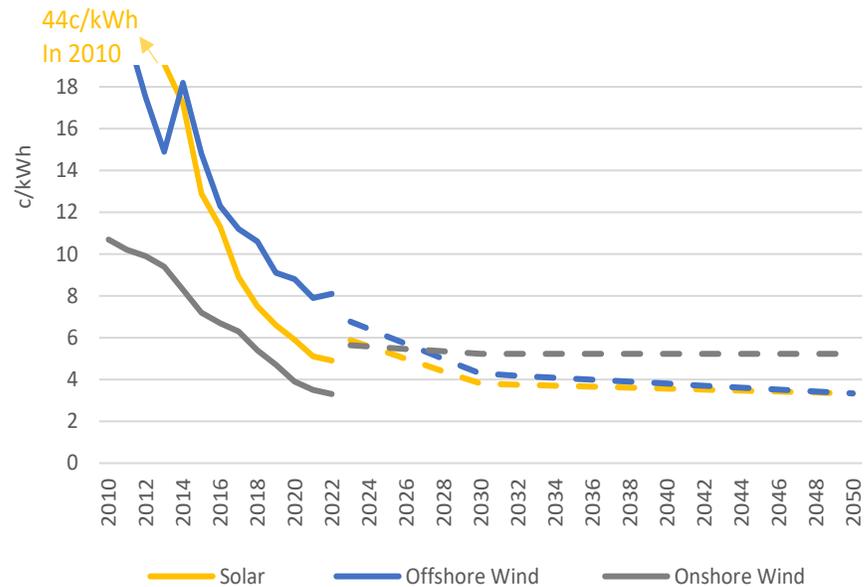 - Is insurance, if CBAM delayed

Share of allowances in CBAM sector auctioned

Clean economy contribution
- for effective CO2 price
- 50 billion €/year revenue

2026 2027 2028 2029 2030 2031 2032 2033 2034 2035

10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

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Energy crisis and new technologies have changed energy policy goals

Price rises in the energy crisis

Supply in times with little wind and sun

New uncertainties

Reliable
Affordability

Clean system
Energy supply

~~Security of supply~~
Resilient
Energy system

Source: Karsten Neuhoff, Jörn Richstein, Mats Kröger (2023): Reacting to Changing Paradigms: How and Why to Reform Electricity Markets. (Link)

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Long-term contracts make wind and solar energy reliably affordable

Electricity generation costs are falling rapidly...

... but costs exploded during the crisis.

44c/kWh In 2010

Solar — Offshore Wind — Onshore Wind

Baseload ▪ Commercial ▪ Household
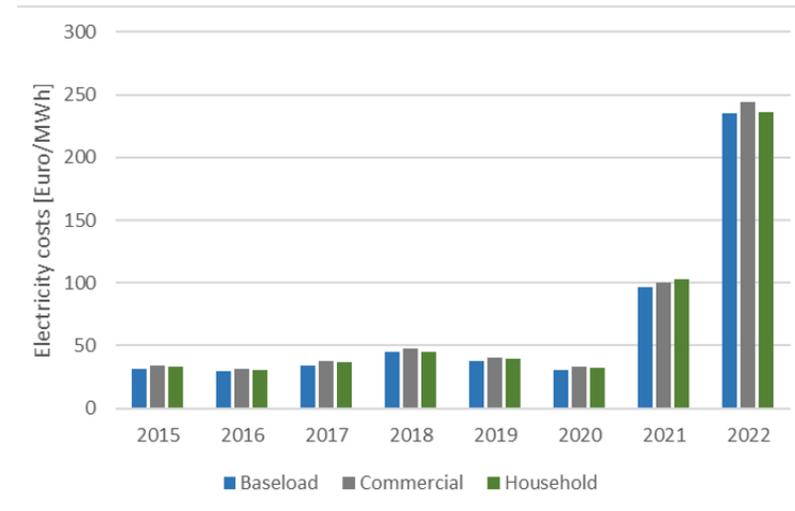
If the market is only geared to the short term, then...:
- ... the volatility of the marginal price leads to fluctuating electricity costs
- ... inframarginal and scarcity rents increase electricity costs

Until 2022: international average based on IRENA (2023). From 2023: European average based on the World Energy Outlook Projections (IEA, 2023). The values in the years between the projections are interpolated linearly. In 2022 prices, exchange rate €/$ = 0.95.
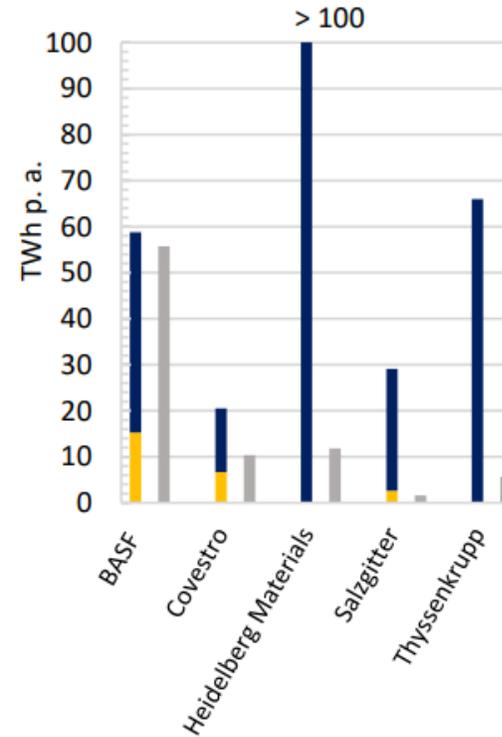
Challenge for private long-term contracts (1): Lack of capacity to sign necessary contracts

Reliable
Affordability

Clean
Energy system
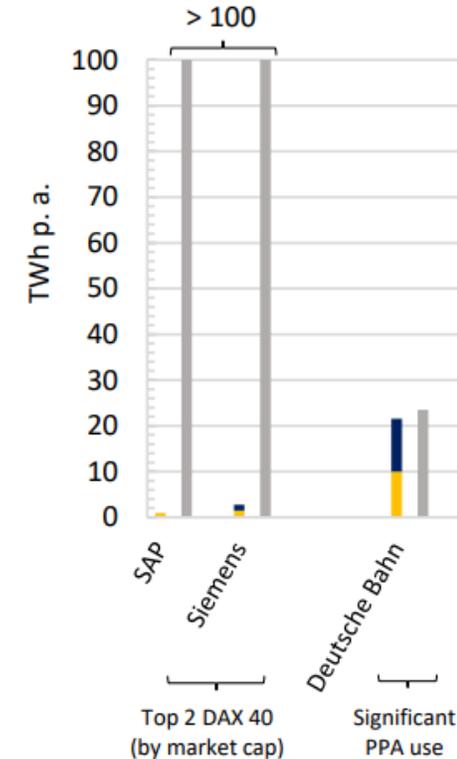
Resilient
Energy system
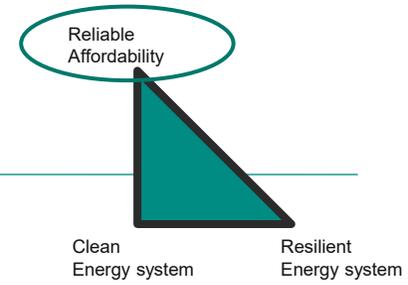
a) Utilities DAX 40 and top-selling utilities in Germany
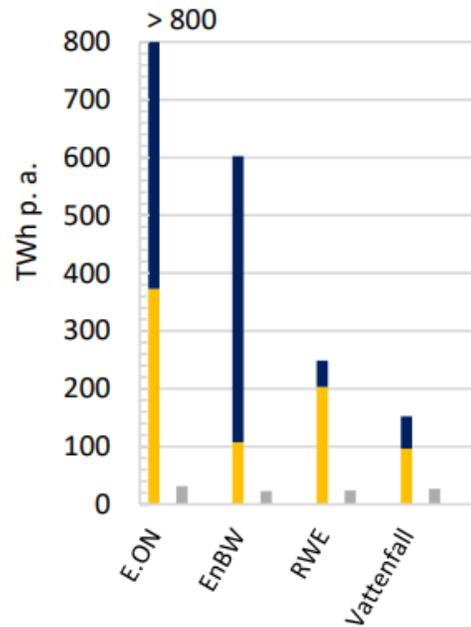
b) Energy-intensive industries DAX 40 and top-selling steel companies in Germany

c) Other selected German companies

Top 2 DAX 40 (by market cap)

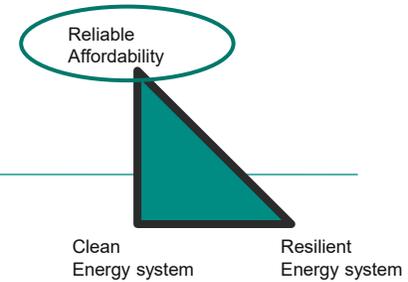Significant PPA use

■ Electricity demand/sales in TWh p.a.　　■ Remaining of total energy demand/sales in TWh p.a.　　■ PPA potential in TWh p.a.

Guarantees for individual projects do not solve this problem.

Source: Karsten Neuhoff, Fernanda Ballesteros, Mats Kröger, Jörn Richstein (2023): Contracting Matters: safeguarding producers and consumers with a renewable energy pool. (Link)

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Reliable
Affordability

Clean
Energy system

Resilient
Energy system

1. The counterparty risk for project developers increases with private long-term contracts (PPAs): electricity generation costs around 10% higher

2. Higher financing costs on the demand side mean a 20% increase in the electricity generation costs for wind and solar energy.

*Graphic from: Damodaran 2017*
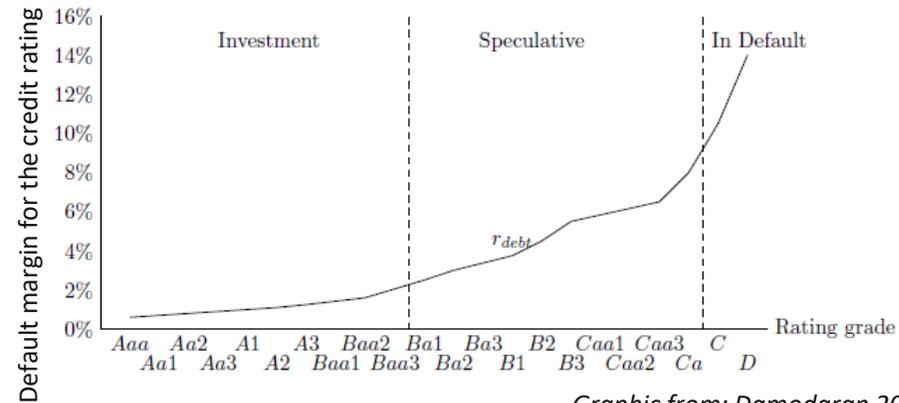
3. Overall effect of increased financing costs and risks on the balance sheet
   - 29% (DIW, 2018 / May, 2021)
   - 28% (Aurora Energy Research, 2018)
   - 25% (Enertrag, 2019)

Public guarantees only cover the counterparty risk (10%)

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Elimination of market failures due to lack of private contracts: Publicly guaranteed pool for renewable energies

Clean Energy system

Resilient Energy system

Wind and solar projects take part in the tender for long-term contracts
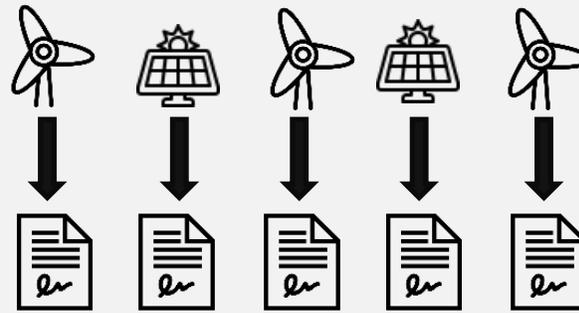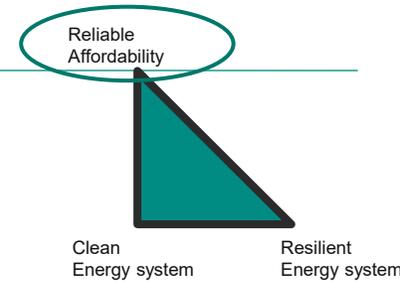
Each contract specifies a strike price that is awarded for the production volume

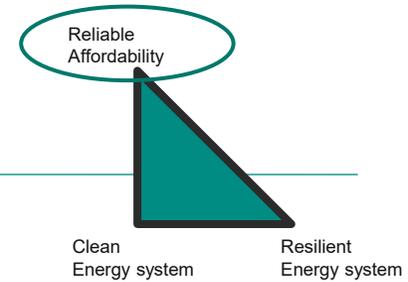**All long-term contracts are summarised in a pool for renewable energy**

The pool is characterised by its average strike price and the sum of the production volumes

The electricity consumers (or wholesalers) receive shares in the pool

Source: Karsten Neuhoff, Fernanda Ballesteros, Mats Kröger, Jörn Richstein (2023): Contracting Matters: safeguarding producers and consumers with a renewable energy pool. (Link)

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Characteristics of a pool for renewable energies

Reliable
Affordability

Clean
Energy system

Resilient
Energy system

Public guarantee for the pool, 5-year exit option for customers

- Provides legal certainty: participants are not disadvantaged

- Avoidance of a 30% surcharge on financing costs for long-term private contracts

- Securing financing, higher probability of project realisation and thus securing the project pipeline

Tenders for long-term contracts for projects

- Enabling differentiation of resources to reduce costs for consumers

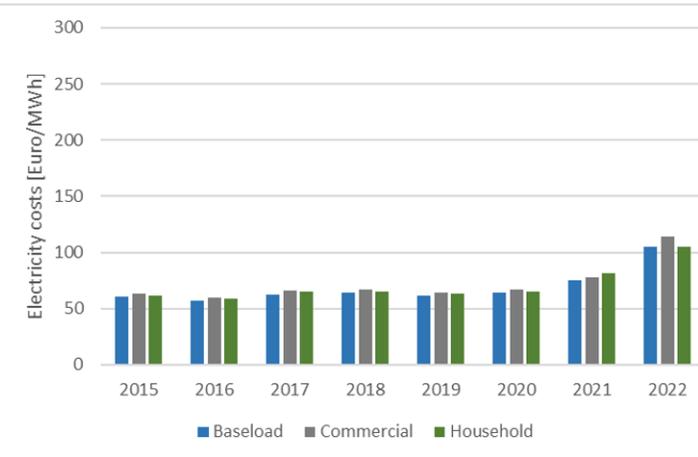- May include comprehensive incentives for system-friendly technologies

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Renewable energy pool completely stabilises electricity costs
- only in combination with flexibility -

Reliable Affordability

Clean Energy system
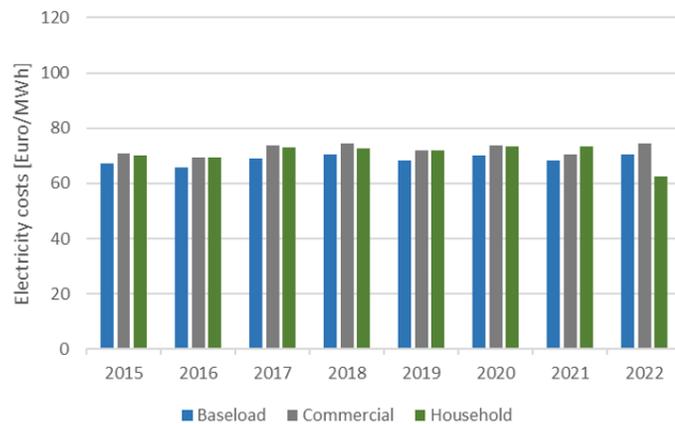
Resilient Energy system
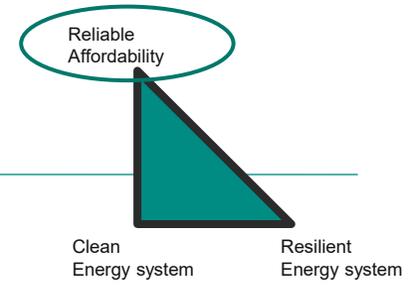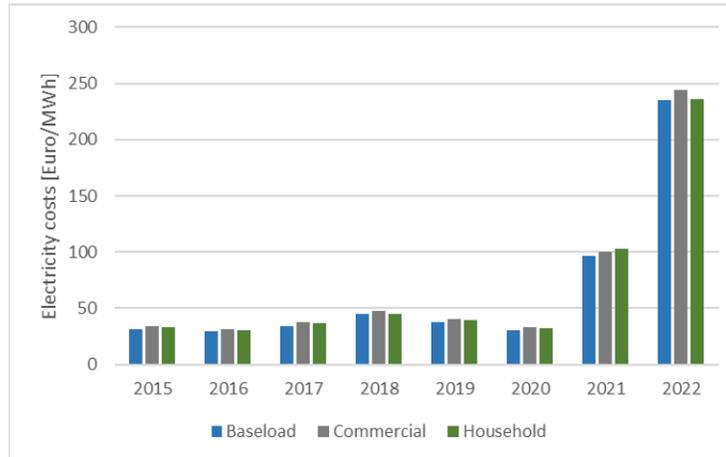
(i) Spot price

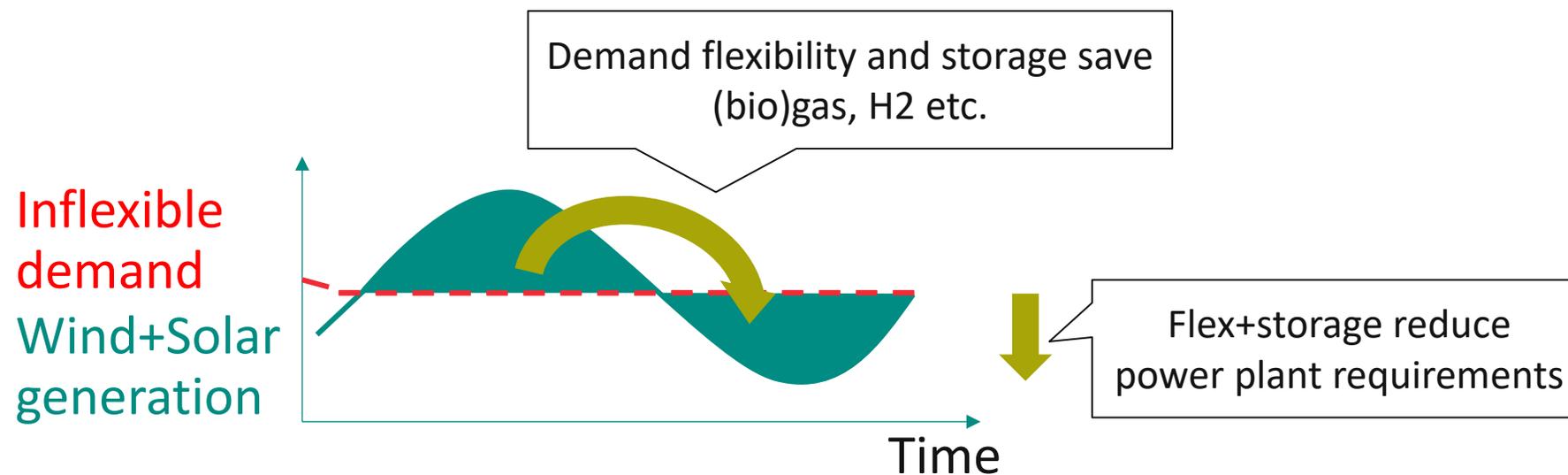### (ii) Spot price + 100% CfD pool

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

Source: Karsten Neuhoff, Fernanda Ballesteros, Mats Kröger, Jörn Richstein (2023): Contracting Matters: securing producers and consumers with a renewable energy pool. (Link)

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Flexibility reduces costs in hours with less wind/solar

Demand flexibility and storage save (bio)gas, H2 etc.

Inflexible demand

Wind+Solar generation

Flex+storage reduce power plant requirements

Time

Sector coupling offers great & cost-effective flexibility potential

- Transport: Time-flexible charging of electric cars

- Buildings and neighbourhoods: Heat storage for heat pumps

- Industry: Climate-neutral basic material production (storing intermediate products)

- Supplemented by batteries (especially in the distribution grid)

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Portfolio of storage technologies minimises costs

[1] https://www.wittlich.de/de/aktuelles/wittlich/2023/oktober/eco-stor-plant-eines-der-groessten-batteriespeicherwerkes-europas-in-der-kreisstadt-wittlich-stadtteil-wengerohr/; Image: ECO STOR GmbH; Investment costs: Elalfy, Dina A., et.al. (2024), Danish Energy Agency (2024)

[2] MVV Energie AG: Annual Report 2012/13, investment costs (Arnold, Karin (2019)); assumptions for the conversion of kWh_{th} into kWh_{el} via heat pump COP = 2 (AgoraEnergiewende(2023)), storage efficiency = 0.9 (Arnold, Karin (2019))

Lithium-ion battery Wittlich[1] :

- Storage: 600 MWh_{el}
- Investment: € 250 million
- About 400 €/kWh
- Size: 6 ha

District heating Mannheim[2]

- Storage: 1500 MWh_{th}
  $\triangleq$ approx. 650 MWh_{el}
- Investment: € 27 million
- About 40 €/kWh
- 40 m diameter,
- 36 m height

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Local prices unlock demand flexibility/storage for congestion management

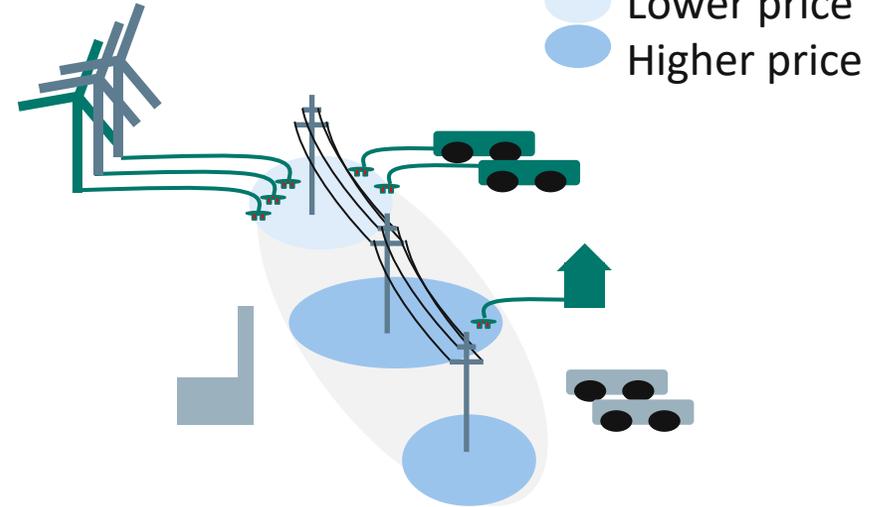*Illustration*

Large pricing zone

Local prices

Lower price
Higher price
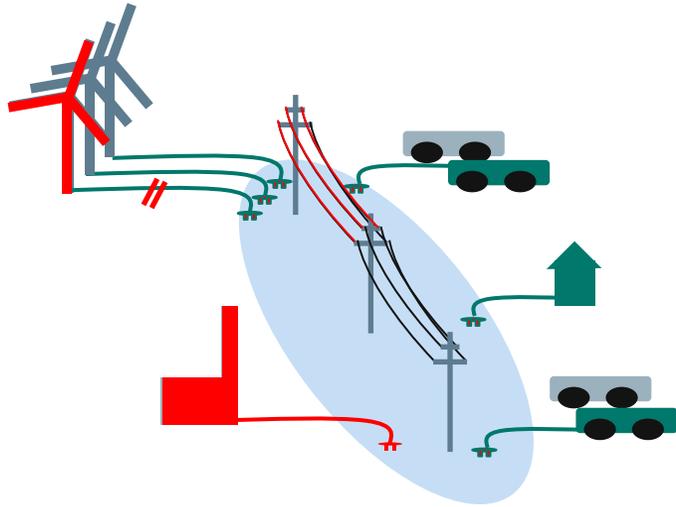
- Zonal price balances demand, supply and imports/exports for zone.
- May result in transmission constraints.
- In such instances TSO mandates power stations to redispatch.
- Demand flexibility and storage cannot be used for congestion management.

- Local prices balance demand, supply and imports/exports.
- Including demand flexibility and storage in congestion management reduces wind-spill and conventional power generation.

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Local marketplaces - congestion revenues instead of redispatch costs

Status quo:

- Market participants are promised de facto unlimited network capacity

- Is a bad cheque - if more is used than is available, the grid operator must buy it back (redispatch)

- Redispatch costs in 2023 were € 4 bn c.a. € 10 /MWh extra grid fee

Local marketplaces

- Grid is used to transport energy from markets to markets with higher prices

- If price differences remain, this results in bottleneck revenues

- These remain with the national market platform (grid operator & exchange)

- This protects electricity customers against local price risks

Title and subtitle
Name + date (set via header and footer)

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Transition to local pricing must be well organised

Address price risks during the transition

- Quantification of the impact: more moderate than feared[1]

- Congestion management generates revenue (instead of the previous redispatch costs). With these

- Option 1: Issue financial transmission rights to hedge local price risks[2]

- Option 2: Participants in the renewable energy pool hedge against local price risks

Focus on the benefits for consumers - example of local marketplaces :[3]

- Can be accessible and attractive to the consumer

- Development of flexibility for the system (avoidance of self-sufficiency)

- Clear interface for the operation of transmission and distribution

[1] Knörr, Bichler, Dobos (2024) Zonal vs. Nodal Pricing: An Analysis of Different Pricing Rules in the German Day-Ahead Market, https://arxiv.org/abs/2403.09265
[2] Friedrich Kunz, Karsten Neuhoff, Juan Rosellón (2016): FTR allocations to facilitate the transition to nodal prices: An application to the German power system. (Link)
[3] Forthcoming report on www.diw.de\fpm

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Three key reform steps for a reliably cost-effective electricity supply

Reliable
Affordability
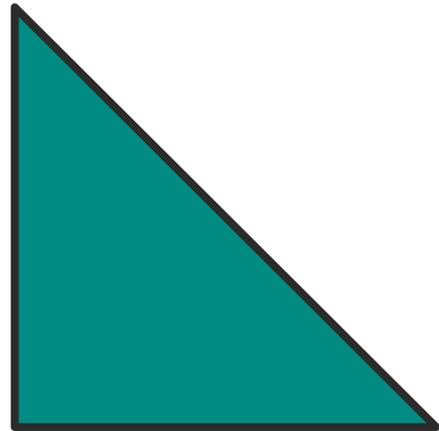
Clean
Energy system

Resilient
Energy system

→ Utilise long-term contracts so that electricity customers benefit from wind and solar: RE pool

→ Utilise demand flexibility in the system to reduce energy and grid costs: Local marketplaces for nodal prices

→ Use the capacity mechanism to strengthen the energy market in order to utilise all flexibility potential: Security of supply reserve

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