DIW BERLIN

SNAPFI Webinar

Carbon contracts-for-difference for industrial decarbonisation

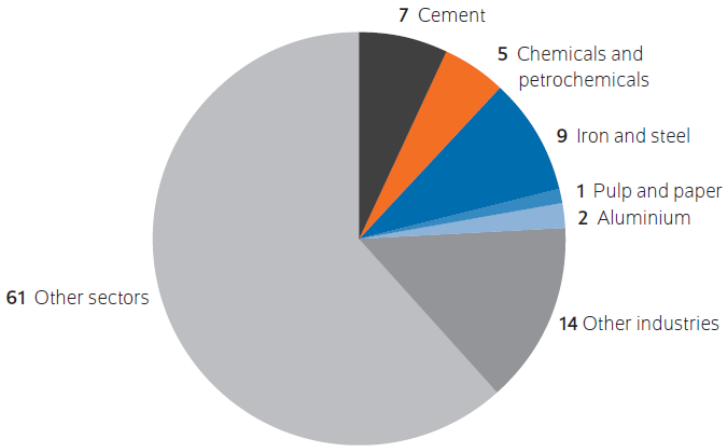
Dr. Jörn C. Richstein, DIW

16.12.2022

Introduction

- **Basic materials production accounts for 25% of global, and 16% of EU emissions**
- **Climate net-zero targets cannot be reached without climate-neutral solutions in these sectors**
- Due to size of the sector, and nature of abatement (investment in long-lived assets), efficient to start early[1]

Percentage contribution of various basic materials in global CO2 emissions (2014)



Source: DIW calculations based on IEA ETP 2017

[1] Vogt-Schilb, Meunier, and Hallegatte 2018

Introduction

- Basic materials production accounts for 25% of global, and 16% of EU emissions
- Climate targets cannot be reached without climate-neutral solutions in these sectors
- **Due to size of the sector, and nature of abatement (investment in long-lived assets), efficient to start early[1]**

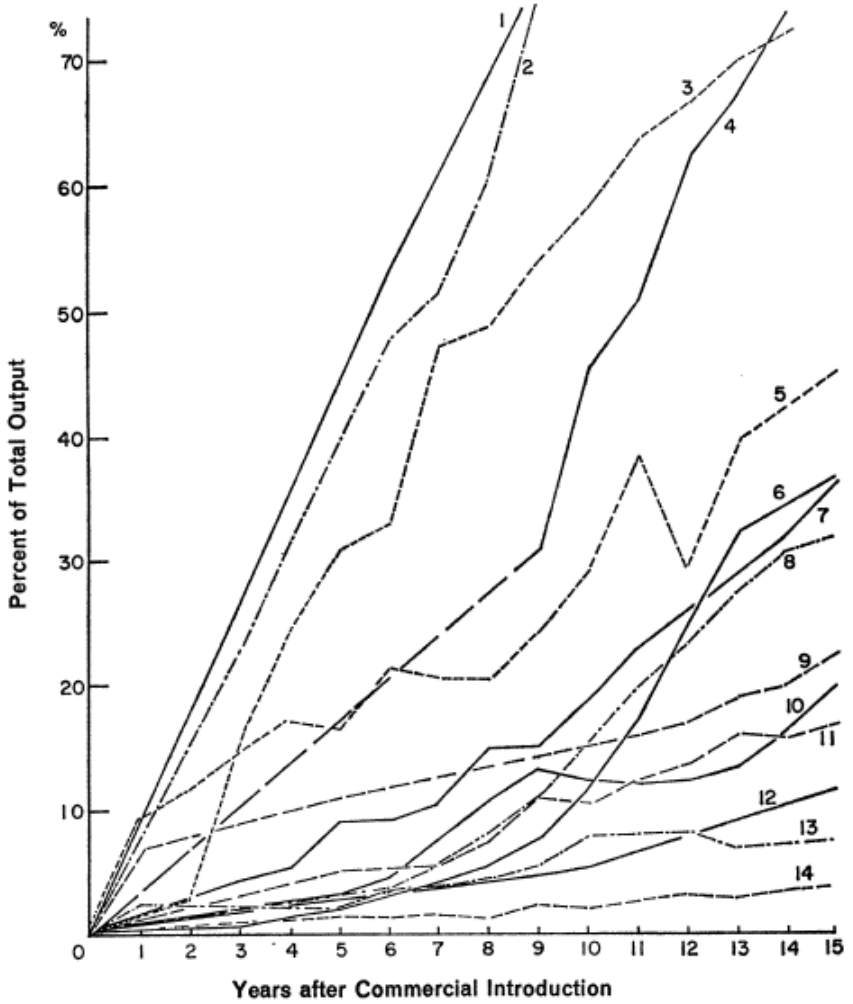


CHART I. Output by new technology as per cent of total output during first 15 years after indicated date of initial commercial use.

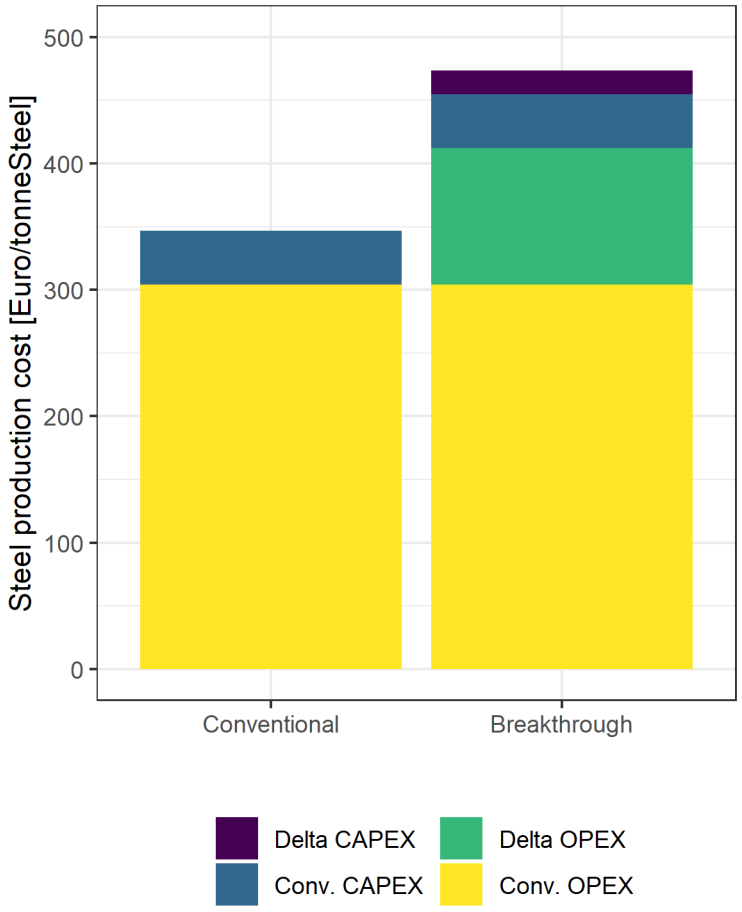
1. Bessemer Furnace (1865)
2. Cont. Cold Rolling, Sheets (1927)
3. Electrolytic Tinplating (1940)
4. Continuous Hot Strip Mill (1926)
5. Cont. Cold Rolling, Strip (1930)
6. Basic Oxygen Furnace (1954)
7. Pelletizing (1956)
8. Continuous Miner (1948)
9. Washing Coking Coal (1889)
10. Machine Loading, Coal (1923)
11. By-product Coking (1895)
12. Machine Cutting, Coal (1882)
13. Open Hearth (1870)
14. Strip Mining, Coal (1914)

[1] Vogt-Schilb, Meunier, and Hallegatte 2018
Figure from Gold et. al. 1970

The challenges of investing in climate-neutral material production

Challenges to private investors

1. First-of-kind costs
2. Higher (and different!) operation and investment costs
3. Insufficient and uncertain carbon prices



Steel production costs for conventional (BF-BOF) and H2-DRI route (prospective costs)

The challenges of investing in climate-neutral material production & corresponding market failures

Challenges to private investors

1. First-of-kind costs (1)
2. Higher (and different!) operation and investment costs (2)
3. Insufficient and uncertain carbon prices (3+4)

Corresponding economic market failures

1. Technology spill-overs & need for directed innovation[1]
2. Insufficiently priced externality (CO2) [1,2]
3. Commitment problem of governments & political uncertainty[3,4]
4. Incomplete (risk) markets[5,6] for CO_2 & clean fuel prices → early abatement investments inefficiently[7] postponed.

[1] Acemoglu et al. 2012, [2] Cai and Lontzek 2019, [3] Helm and Hepburn 2007, [4]Chiappinelli and Neuhoff 2020, [5] Newbery, Reiner, and Ritz 2019, [6] Greenwald and Stiglitz 1986, [7] Vogt-Schilb, Meunier, and Hallegatte 2018

Example of CO_2 policy risk

Zombie carbon markets to be shocked back to life

Arthur Neslen — 2. Juli 2013 (updated: 3. Juli 2013)

Matthias-Groote-ENVI-chairman-European-Parliament.jpg

Languages: Français — Comments — Print

A patched-up plan to shock Europe's zombie carbon markets back to life will pass a plenary vote at the European Parliament on Wednesday (3 July), but this will only "buy time" for more fundamental reform, says the chairman of the Parliament's environment committee.

"The indications are that we will win," said German MEP Matthias Groote (Socialists and Democrats). "The proposal will be going through."

"But backloading is only an instrument to buy the necessary time to maintain the Emissions Trading System (ETS) as we need structural reform," he added. "If the carbon price falls below €3 a tonne, it will have no more effect."

The EU's original proposal to 'backload' or temporarily withhold 900-million carbon allowances in a bid to raise prices, was defeated in a European Parliament plenary vote in April.

Lead EU lawmaker proposes carbon market rules to respond to price spikes

EURACTIV.com with Reuters — 16. Feb. 2022 (updated: 7:39)

The conservative EU lawmaker Peter Liese wants to balance out price spikes in the EU's carbon market. [EPA-EFE/ROBERT PERRY]

Comments — Print

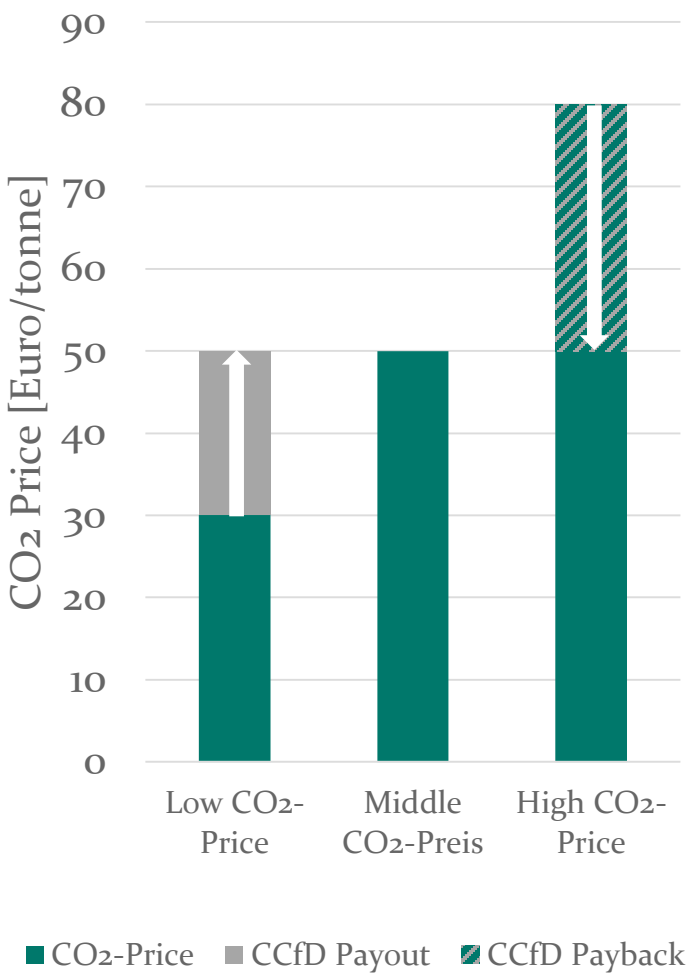
The European Parliament's lead lawmaker on reforms to the EU carbon market on Wednesday (16 February) proposed rules to make it easier for policymakers to intervene in the scheme if prices rise too fast.

European Union policymakers are preparing to negotiate reforms to the market, the bloc's core policy tool for curbing emissions. The EU emissions trading system (ETS) contains a gradually decreasing amount of CO2 permits that power plants and industry are required to buy to cover their

[1] Helm and Hepburn 2007, [2]Chiappinelli and Neuhoff 2020, [3] Newbery, Reiner, and Ritz 2019, [4] Greenwald and Stiglitz 1986, [5] Vogt-Schilb, Meunier, and Hallegatte 2018

DIW BERLIN

How do Carbon Contracts for Difference work?



- With project-based carbon contract for difference, the public sector guarantees a CO_2 price for innovative projects
- Differential payment between EU CO2 price and contract price for emission savings below benchmark level
- Addressing regulatory and market risks and reduction of financing costs
- Reduction of funding costs

cf. Richstein (2017)

Research Question & model overview

What is the effect of carbon price derisking instruments such as *price floors* and *CCfDs* on break-even CO_2 prices (of a Clean vs Dirty steel making process)?

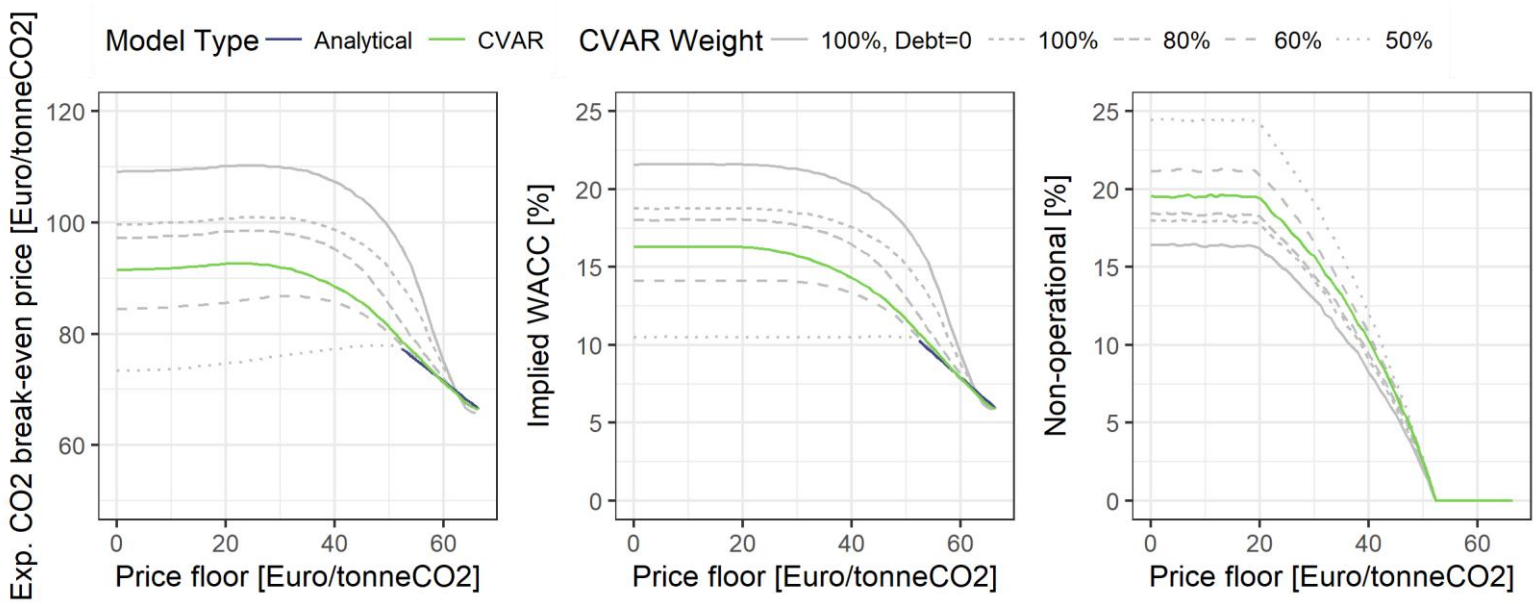
Analytical two-period project finance model

- Tractable
- For deriving insights
- Limited to debt-equity financed projects

CVaR Model

- Extends and generalises analytical model
  - To equity risk premiums
  - Sensitivity analyses of assumed risk aversion

Determining equity risk premiums for higher risk investments

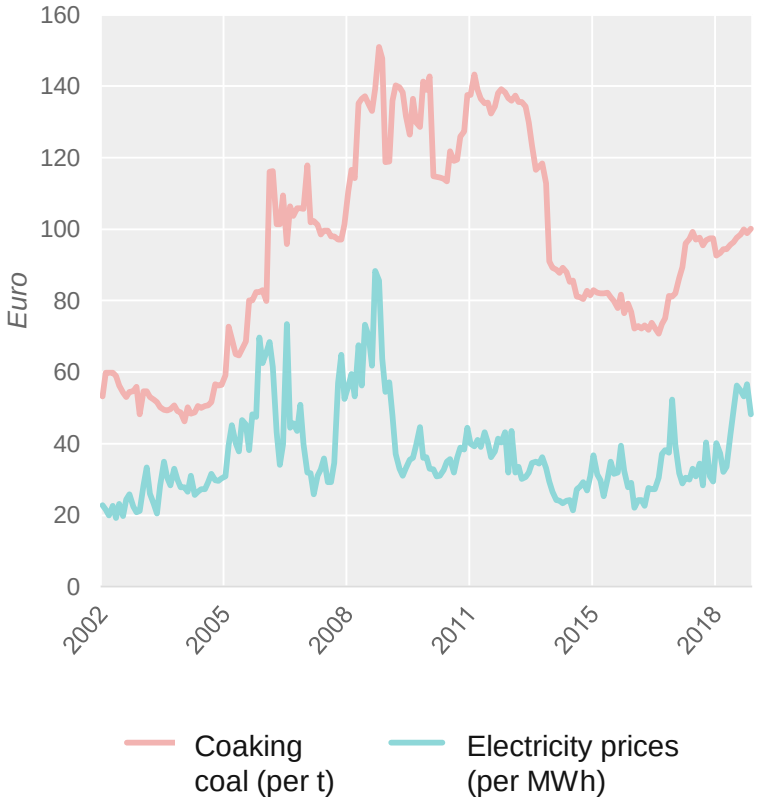


- CCfDs lead to lower financing costs as revenue streams are secured – enabling debt financing, and lower equity premiums
- CCfDs also allow for a continuous operation of assets – avoiding investment ruins due to volatile carbon prices
- Price floors would need to be nearly the same level as CCfDs (due to the high incremental OPEX of clean processes) – without the payback to governments

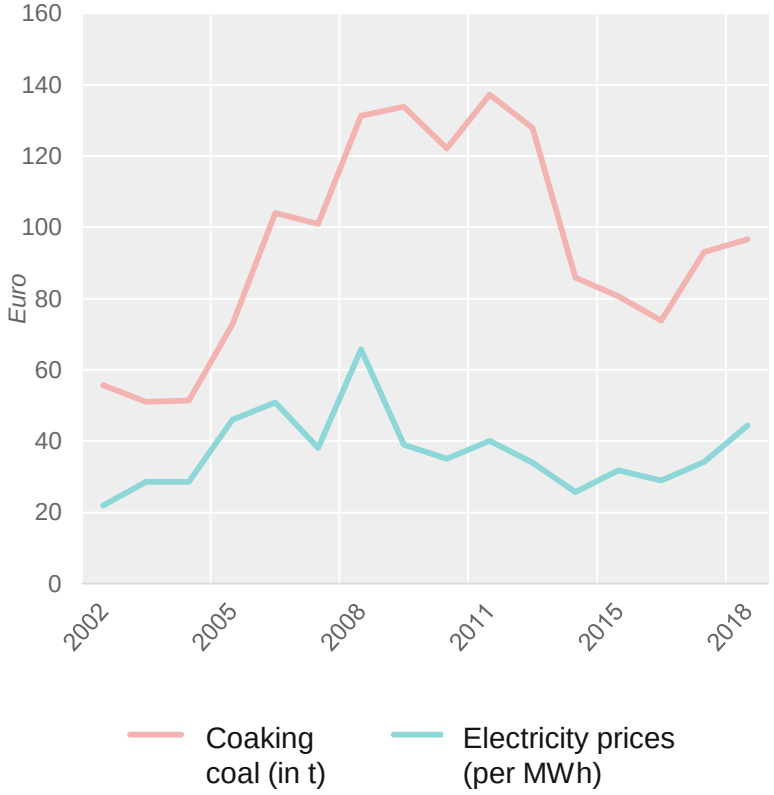
[1] following Ehrenmann and Smeers (2011)'s approach of working with risk-free discounted NPV cash-flows.

But are CO_2 prices the only novel risk for clean technologies? Historical development of electricity and coking coal prices

a) Monhtly development



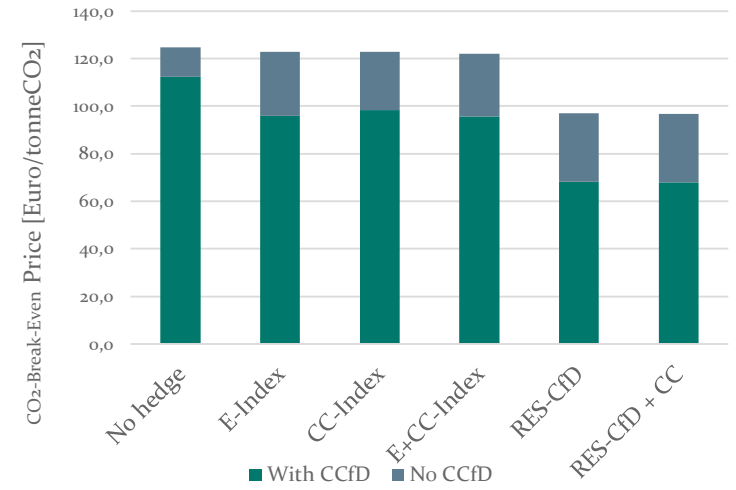
b) Yearly development

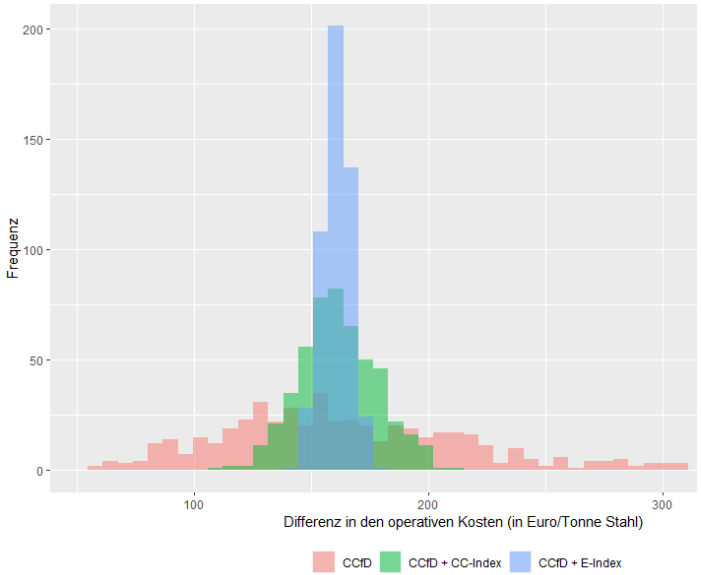


- The two input factors coking coal and electricity are correlated over the observation period (Monthly: 0.47, Annual: 0.56).

Carbon price and other risks

- Incumbent technologies set the market price (for now up to long-term)
- Carbon price risks, but also new input factors (electricity, hydrogen) affect new (non-price-setting) technologies more[1]
- For many industrial processes input factor risks as big (or bigger) than CO2 price risks → significant risk premia if not hedged[2]
- These risks can be included in CCfD design
- Or can these risks be hedged otherwise (e.g. gov-secured electricity CfDs)





[1] Gross, Robert, William Blyth, and Philip Heptonstall. 2010. "Risks, Revenues and Investment in Electricity Generation: Why Policy Needs to Look beyond Costs." *Energy Economics* 32 (4): 796–804. https://doi.org/10.1016/j.eneco.2009.09.017.

[2] Richstein, Jörn C., Mats Kröger, Karsten Neuhoff, Olga Chiappinelli, and Frederik Lettow. 2021. "Carbon Contracts for Difference. An Assessment of Selected Socio-Economic Impacts for Germany." Climate Strategies. https://climatestrategies.org/publication/carbon-contracts-for-difference-an-assessment-of-selected-socio-economic-impacts-for-germany/.

DIW BERLIN

Conclusions

- Market failures exist that warrant a regulatory approach with regard to CO_2 price (and energy price risks) when supporting decarbonisation technologies
- (C)CfDs well suited to address policy (and price) risks in presence of incomplete risk markets
- Reduction of risk premia via CCfDs can be significant – as high risk of processes not running due to incremental OPEX
- Energy price risks for new industrial processes often have similar size to CO_2 price risks
- CCfDs can be introduced without CO_2 prices (being just Carbon Contracts), potentially also other risks - but open to later CO_2 price introduction.

References

- Richstein (2017), Project-based carbon contracts for difference, DIW Discussion Papers 1714
- Neuhoff et al. (2019), “Building Blocks for a Climate-Neutral European Industrial Sector”, Climate Strategies Report
- Richstein & Neuhoff (2019), “Carbon Contracts for Difference – an overview”, in “Industrial Innovation: Pathways to deep decarbonisation of Industry, Part 3: Policy implications” 2020
- Richstein, Jörn C., and Karsten Neuhoff. 2022. “Carbon Contracts-for-Difference: How to de-Risk Innovative Investments for a Low-Carbon Industry?” *IScience* 25 (8): 104700. https://doi.org/10.1016/j.isci.2022.104700.
- Vogl, V., Åhman, M., & Nilsson, L. J. (2018). Assessment of hydrogen direct reduction for fossil-free steelmaking. *Journal of Cleaner Production*, *203*, 736-745.

Vielen Dank für Ihre Aufmerksamkeit.

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

Redaktion