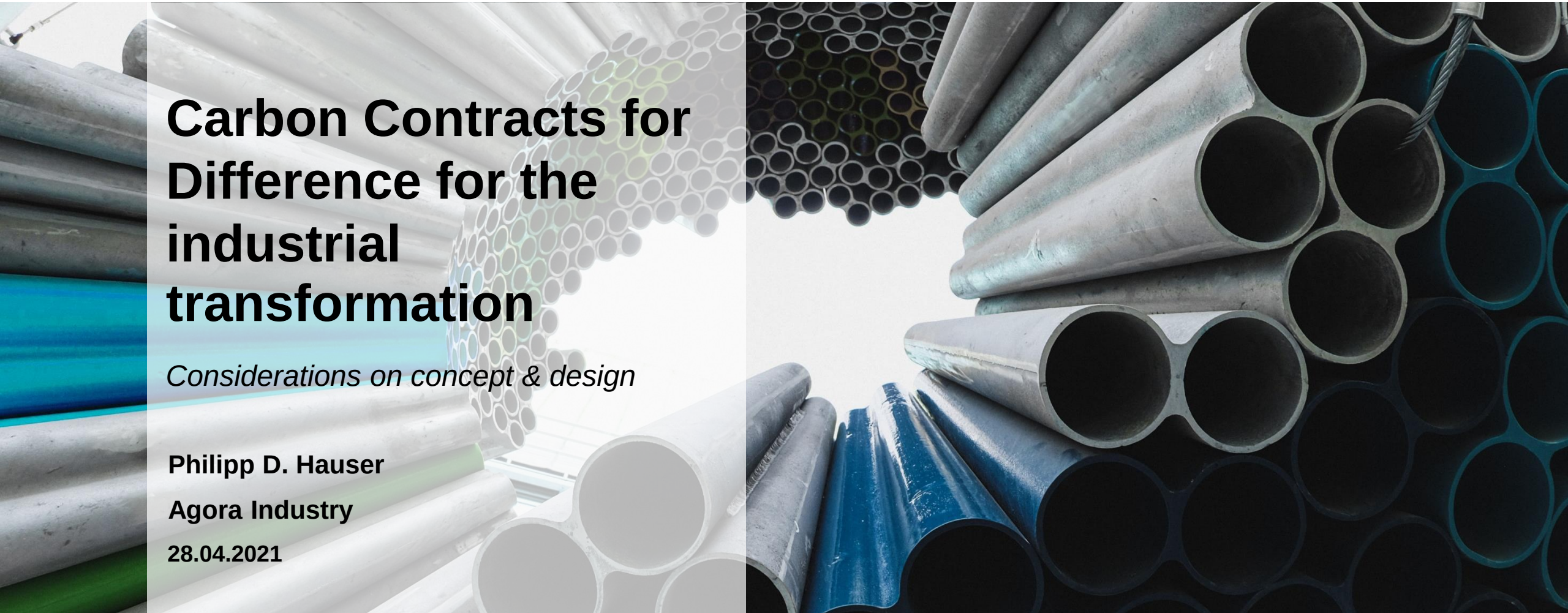

Carbon Contracts for Difference for the industrial transformation

Considerations on concept & design

Philipp D. Hauser

Agora Industry

28.04.2021

To achieve a climate-neutral Germany 2045 and -65% until 2030, the industry sector needs to transform. Here is where Carbon Contracts for Difference come into play.

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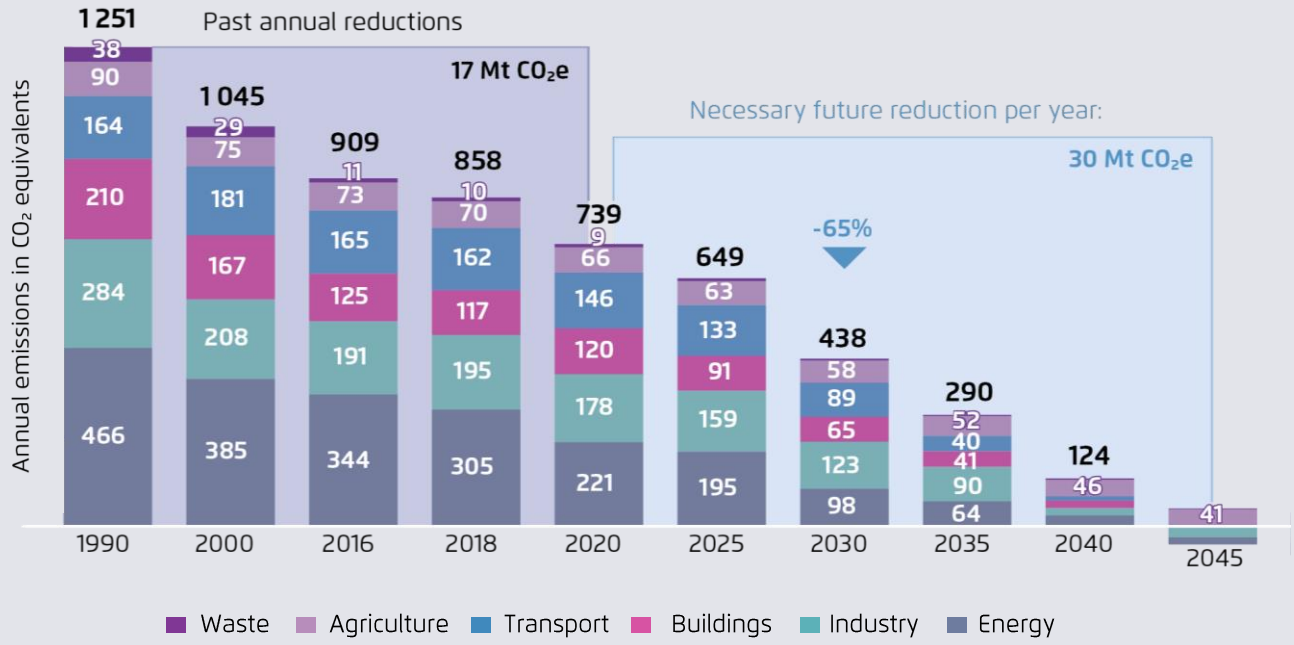
Overview of development of GHG emissions by sector



Prognos, Öko-Institut, Wuppertal-Institut (2021)

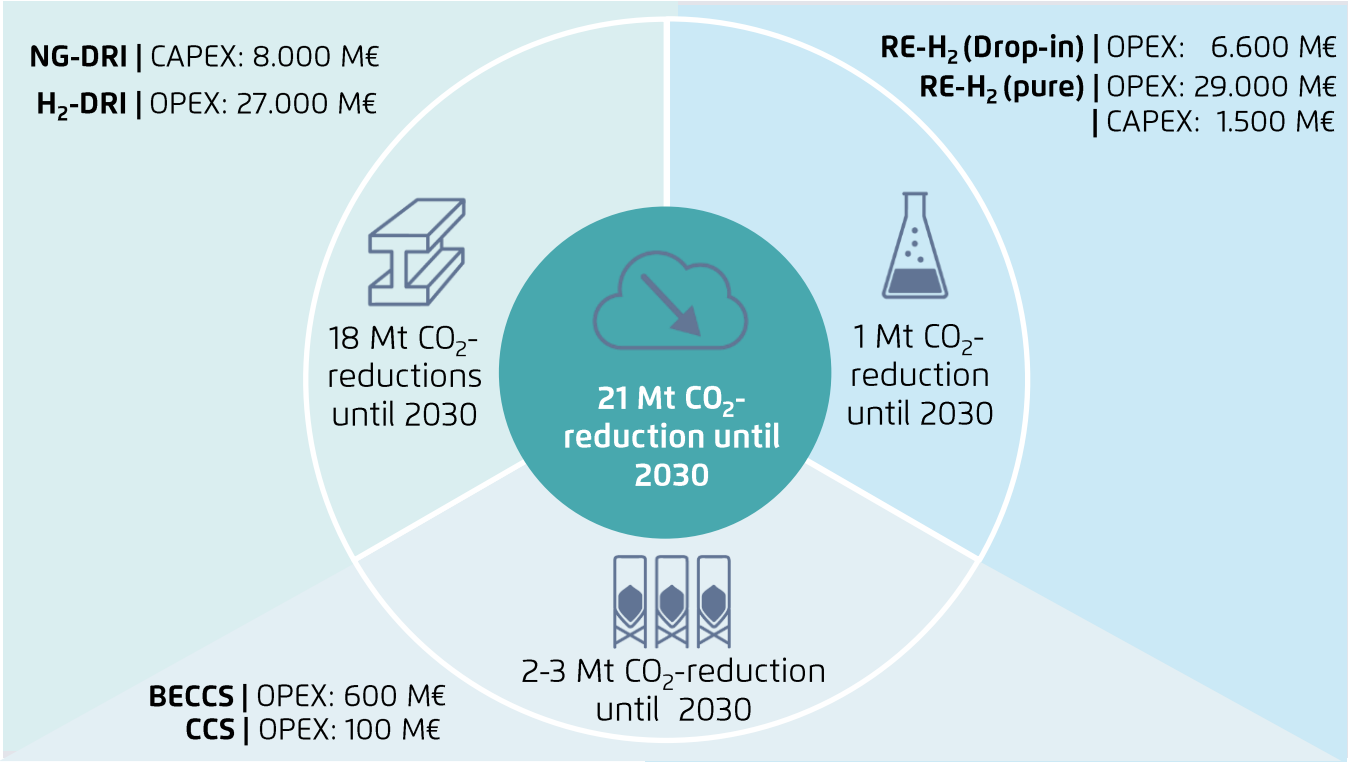
- → Constitutional court requested review of Germany's Climate Law (2019) to ensure intergenerational justice (April '21)
- → Government revised Climate Law with a linear path to climate neutrality by 2045 (June '21)
- → Industry is 2nd largest and stagnating source of emissions. A transformational strategy is needed to abate 68 Million t of CO_2e, as required by the Climate Law (2021).
- → CCfDs are featured by the coalition treaty of Germany's new government as an instrument to support the industrial transformation.
- → Details for the design of CCfDs expected for the Summer Package 2022
- → Our upcoming study addresses key design questions for CCfDs and provides input for their implementation in the German context.

Our study shows that CCfDs can play a crucial, multifaceted role for the transformation of industry and provides impulses for implementation.

1	**Industry transformation must start now** to use reinvestment cycles and avoid stranded assets**. CCfDs cover additional costs** of building and operating low-carbon production plants **until regulation and markets have adjusted to the goal of climate neutrality.**
2	**Low-carbon production provides an anchor for building and operating infrastructure for hydrogen and CCS.** CCfDs for industries must be designed to support the development of an utilization of infrastructure that is critical for the decarbonisation of other sectors.
3	**CCfDs accelerate industry transformation,** allow **substantial emission reductions before 2030** and prepare industry and infrastructure for climate neutrality. **Initially high costs of the transformation can be reduced by smart policy design.**
4	**CCfDs need to be combined with other policy instruments** such as the reform of the EU ETS, effective carbon leakage protection and the development of green lead markets **to secure the transition to a market-based system.**

CCfD offer the possibility to enable significant CO_2 reductions in the basic materials industry until 2030.

Overview of the content and results of the study CCfDs for industrial transformation



Agora Energiewende, FutureCamp, Wuppertal Institut und Ecologic Institut (2022)

Contribution to the definition and design of CCfDs with three transformative technology examples:

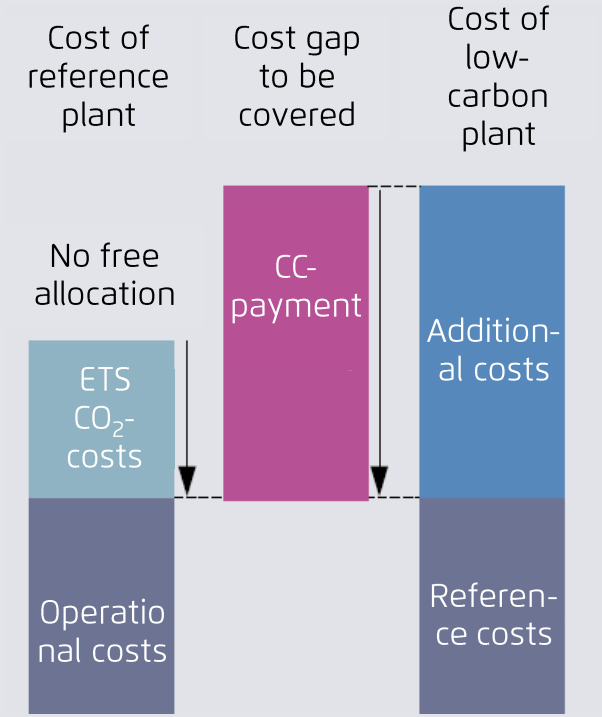
- → NG & H_2-based DRI for steel production
- → Renewable H_2- for ammonia production
- → CCS- & BECCS for cement production

As a result:

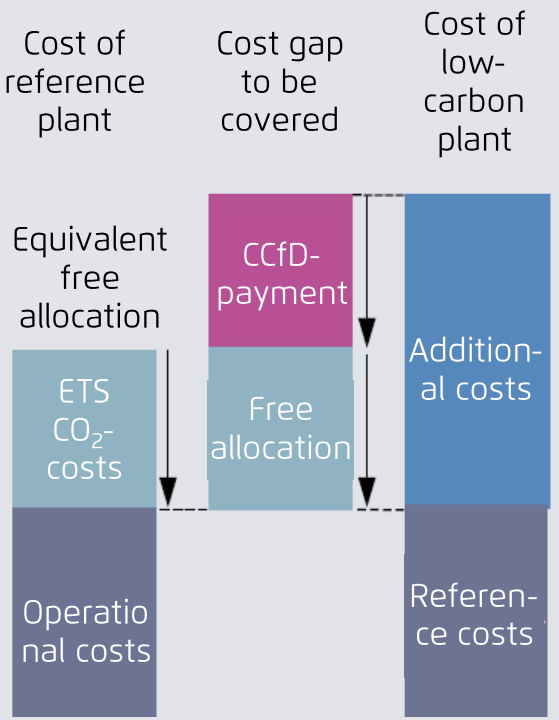
- → Industry as anchor for infrastructure (H_2 & CO_2)
- → Potential for CO_2 reductions of 21 Mt & CO_2 sinks of 1 Mt tons by 2030
- → Synergies for promoting strategies of circularity and resource efficiency
- → Refinancing under different scenarios
- → Discussion of CCfD design in interaction with a possible CBAM, expected ETS reform and development of green lead markets

CCfDs must work under the given regulatory framework and support the evolution of Europe's ETS &Carbon leakage policies.

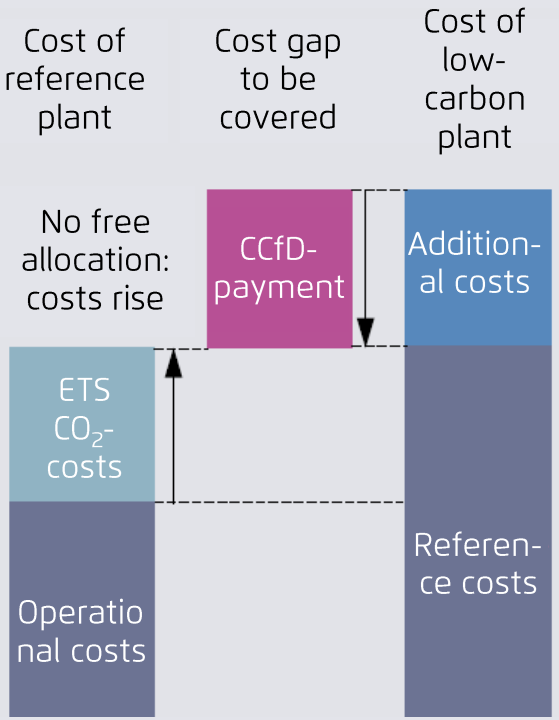
1) Technology-specific free allocation



2) Product-specific free allocation



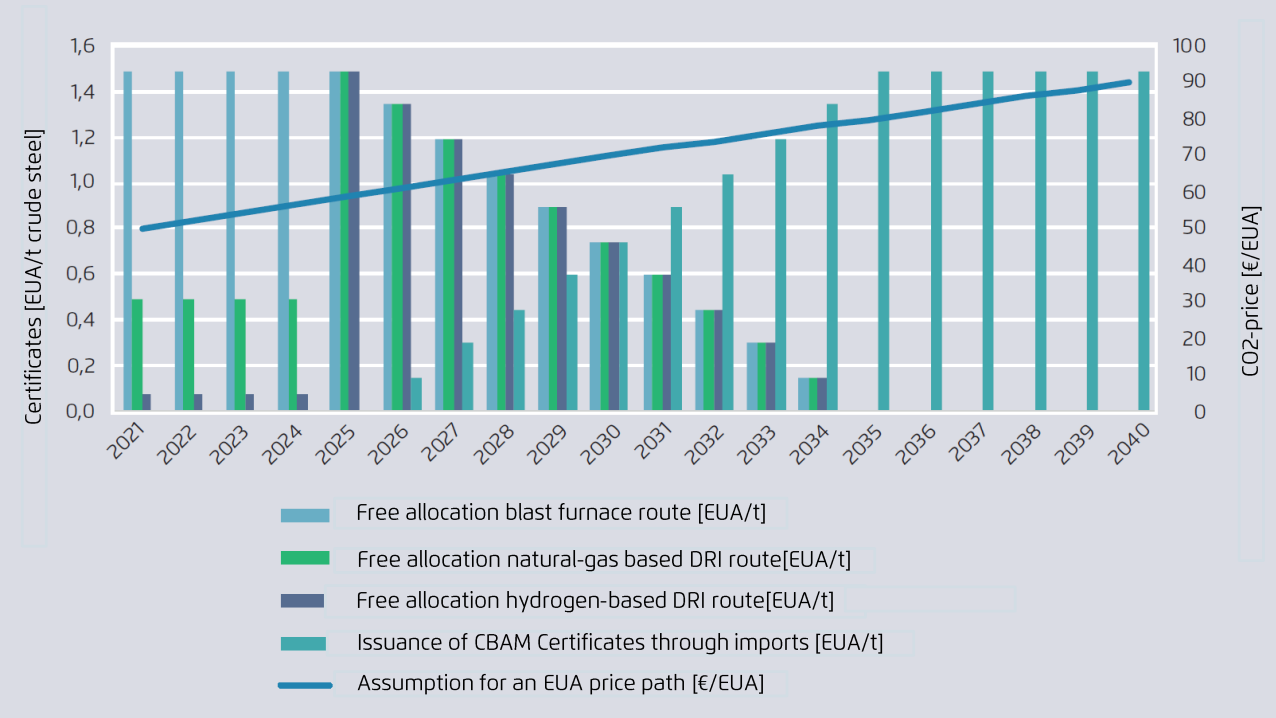
3) No free allocation



Agora Energiewende, FutureCamp, Wuppertal Institut und Ecologic Institut (2021): Klimaschutzverträge für die Industrietransformation. Analyse zur Stahlbranche

CCfDs need to be implemented in the short term despite and because of the still uncertain reform of the ETS and its carbon-leakage regulations.

Conversion of carbon leakage protection from free allocations to CBAM using the steel sector as an example

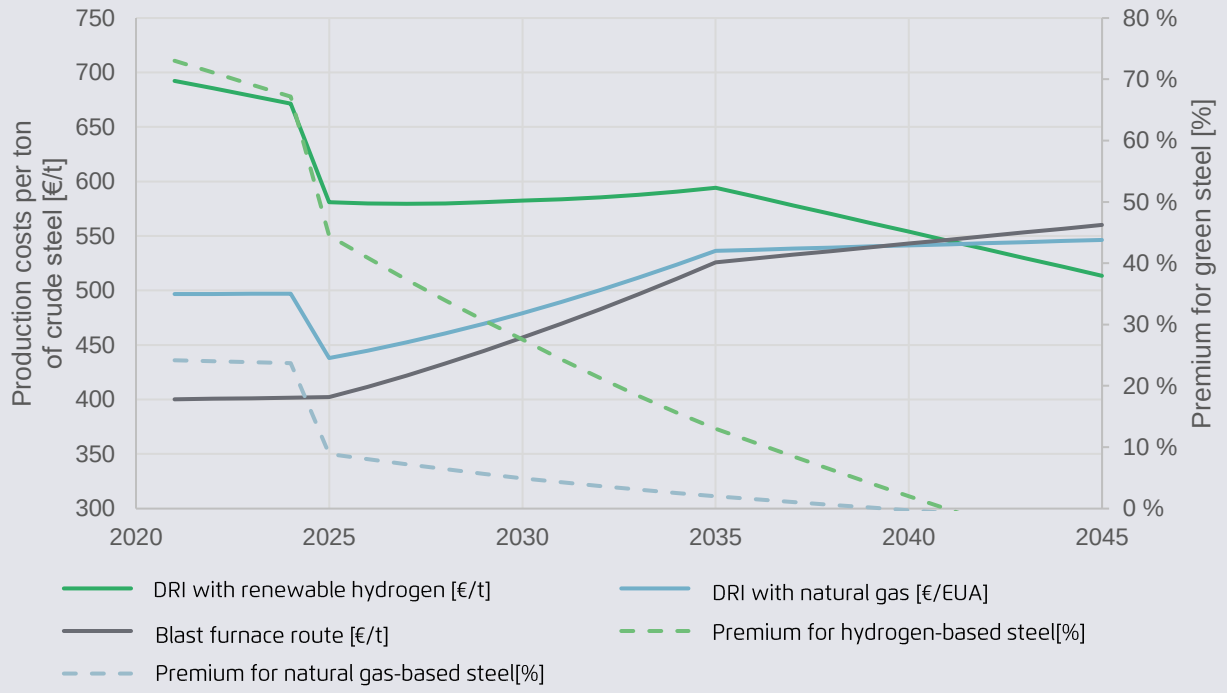


Agora Industry, FutureCamp, Wuppertal Institut und Ecologic Institut (2022)

- → At present, coal-, natural gas- and hydrogen-based steelmaking receive different levels of free allocations. Low-carbon production is disadvantaged.
- → As part of the Fit-for-55 package, the EU Commission announced to adjust the practice to avoid distortive effects between reference and low carbon processes & alternatives.
- → From 2026 onwards, the volume of free allocations is to be gradually reduced. In return, a CBAM is to be introduced.
- → The equivalence of the free allocations must be maintained throughout the entire process.

As part of the reform of the Fit-for 55 package, we expect the additional costs for low-carbon steel products to fall and demand to increase accordingly.

Production costs (CAPEX and OPEX) of different technologies



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Assumptions

	2025	2030	2040
CO_2-price [€/EUA]	60	70	90
H_2-price [€/kg]	4,4	3,7	2,0

→ Starting in 2026, all routes will receive an equivalent amount of free allocations: The additional costs of DRI steel decreases.

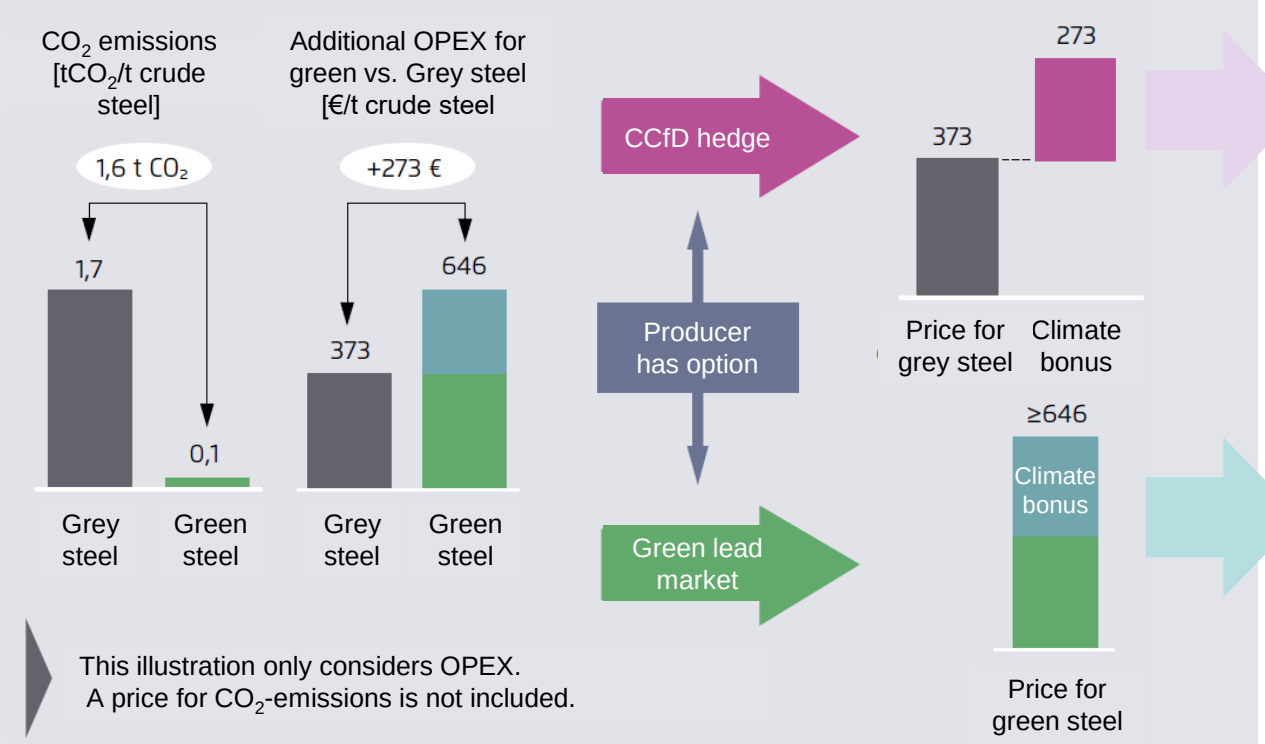
→ Between 2026 & 2035, free allocations are phased out and CBAM is introduced: Reference costs increase.

→ Due to EU-ETS reform, increasing CO_2 prices & decreasing H_2 costs we expect:

1. falling additional costs for natural gas & H_2 steel;
2. that demand for low-CO_2 steel will increase and it will move from being an initial premium product to the new standard.

Looking at the benefits of CCfDs for developing green lead markets, clear hedging and crediting of CO_2 reduction creates supply and a reference price for green steel products.

Interplay of CCfDs and green lead markets



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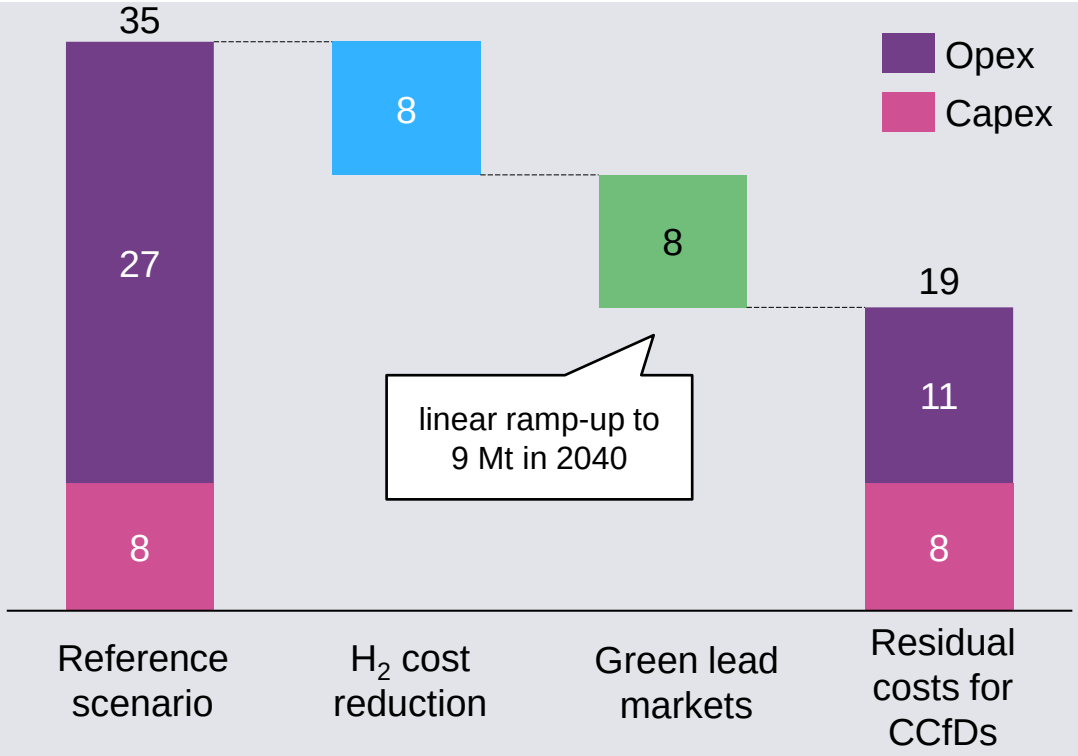
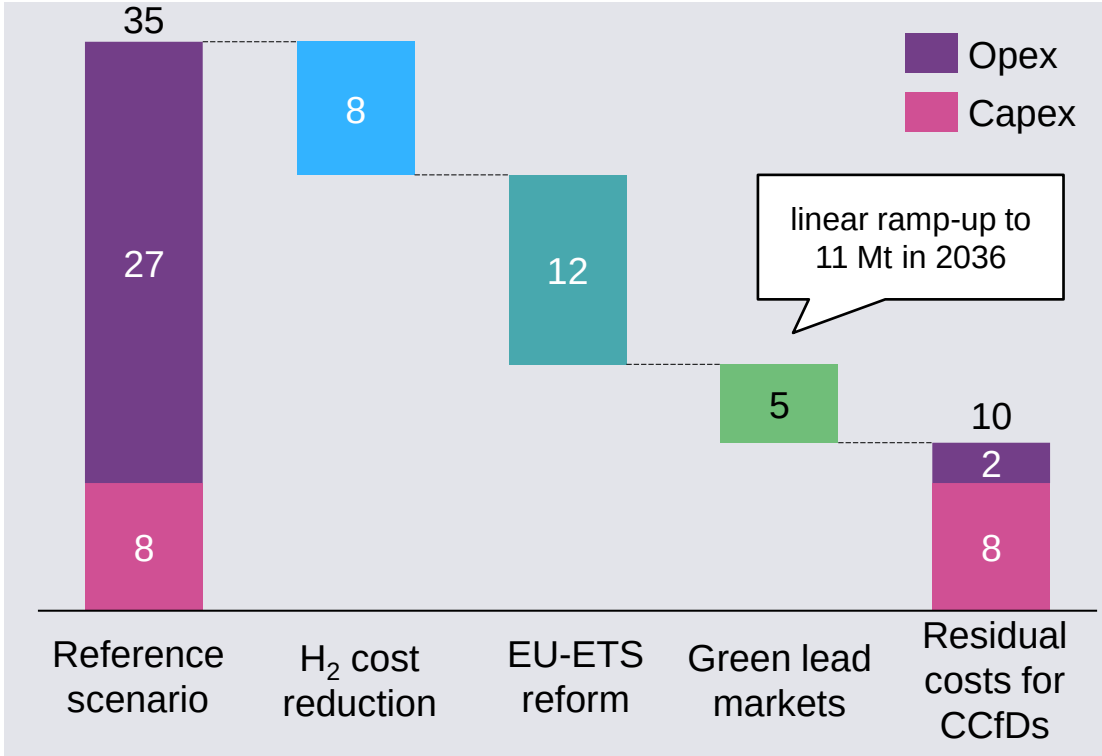
- → The climate benefit of green steel is remunerated via the CCfD.
- → Steel is sold at the GHG intensity of the conventional steel benchmark.
- → Green steel is sold to customers who pay a price premium that is higher than the CCfD premium.
- → Volumes sold as green steel are excluded from support under the CCfD.

The refinancing requirement for CCfDs differs significantly – depending on the effective reform of the EU ETS.

Transformation costs of primary steel production without EU ETS reform in billions of euros



Transformation costs of primary steel production with EU ETS reform in billions of euros



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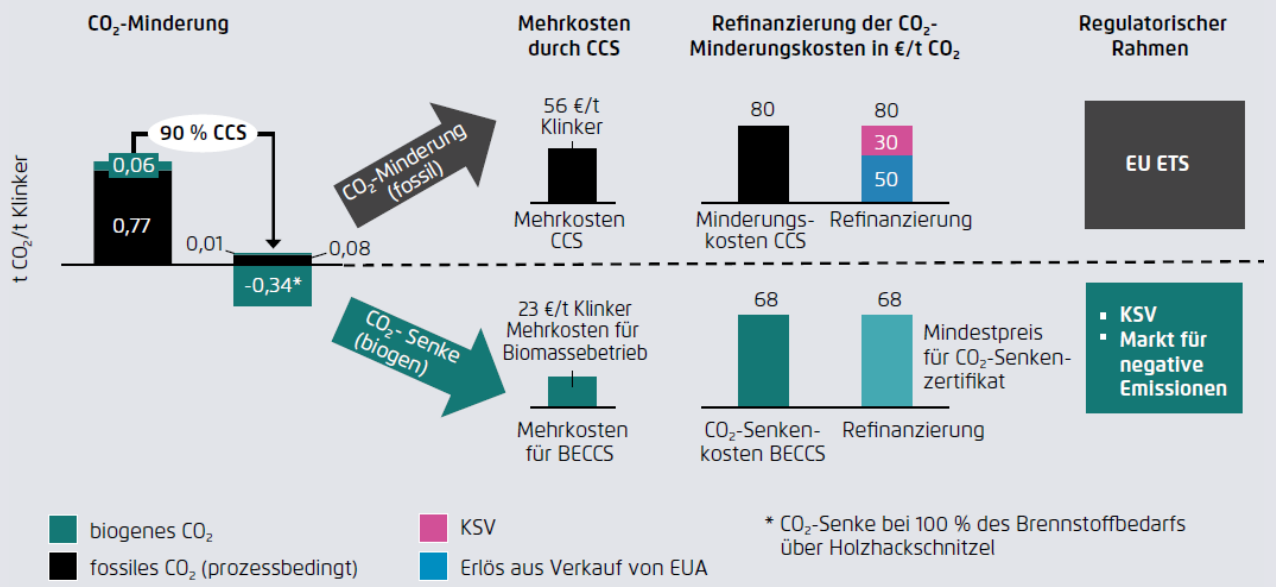
Carbon Contracts for BECCS in cement production to mobilize negative emission potential

Separate consideration of mitigating process emissions and generating negative emissions by BECCS in the case of an oxyfuel plant.



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- → Cement plants equipped with CCS are suitable as vectors for BECCS.
- → By replacing fossil fuels with biogenic fuels, CO2 sink capacities of up to 0.34 t CO2/t clinker can be achieved.
- → The use of wood chips results in higher operating costs, but the use of the existing CCS plant results in relatively favorable costs for negative emissions.
- → Costs are reduced within the framework of a sensible biomass cascade use.
- → Under the current regulations, negative emissions are not recognized in the EU ETS and must be remunerated elsewhere.

Upstream | Midstream | Downstream

CCfDs as project-specific funding to compensate for the additional costs of building and operating low-carbon plants

High Δ CAPEX additional costs:
Combination of grants and CCfD to compensate for additional costs in operation (Δ OPEX).

Moderate Δ CAPEX additional costs:
Δ CAPEX can be allocated to production and compensated with the additional costs in operation (Δ OPEX) within the framework of the CCfD.

Tender and selection process

	1	2	3
	Company submits project outline with operating concept and estimate of additional costs	Company submits formal project-specific application	Company commits to implement the project under the conditions of CCfD
	Public sector makes pre-selection on the basis of competitive criteria	Public authority undertakes business audit as a basis for defining the contract price and other parameters	Public authorities deposit the CCfD with a commitment authorization

Designing CCfDs with the goal of supporting the development of the upstream supply chain (Building H2, CCUS, and supply of biogenic waste and fuels infrastructure).

Green lead markets establishment via stimulation of demand and willingness to pay through supply of climate-friendly basic materials created via CCfD. Monitoring & crediting of products sold as climate-friendly in the definition of the premium.

Settlement of a grant by CCfD
(contract period: 10 years)

Dynamic funding based on the agreed contract price

Regular advance payment of the climate protection payment on the basis of the agreed expected values

Dynamic ex-post settlement of the effective premium at the end of the agreed settlement periods

Aspects for consideration on the interaction of the EU regulatory framework with CCfDs

Scenarios for Carbon Leakage Protection and Refinancing of CCfDs

Scenario	3: Fit for 55	1 & 2: Continued free EUA
Carbon Leakage Protection	- Phase-out of free EUA - Phase-in of CBAM	1) Continued free EUA for reference technology 2) Equivalent free EUA for all production technologies
CCfD refinancing needs	- Low due to effective internalisation of carbon price	1) High 2) Medium, depending on the level of equivalent allocations
Refinancing Options	High revenues from auctioning of EUAs	Climate surcharge

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Aspects for discussion

- → **CCfDs and their refinancing in different scenarios for reform of ETS and Carbon Leakage Protection**
- → **Sequence of implementation as well as aspects of scope and interaction**
- → **Possibilities of evolving to auctioning on a European level**
- → **Combination and accounting of EU & MS support mechanisms along the value chain**
- → **Reform and application of state aid regulation**
- → **Definition of common rules for the definition and trade of “green products”**

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Thank you for your attention!

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