Carbon Contracts for Difference for the industrial transformation

Considerations on concept & design

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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.

Overview of development of GHG emissions by sector

- 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$_2$e, 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.

Prognos, Öko-Institut, Wuppertal-Institut (2021)
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 CO₂ reductions in the basic materials industry until 2030.

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

Contribution to the definition and design of CCfDs with three transformative technology examples:
→ NG & H₂-based DRI for steel production
→ Renewable H₂ for ammonia production
→ CCS- & BECCS for cement production

As a result:
→ Industry as anchor for infrastructure (H₂ & CO₂)
→ Potential for CO₂ reductions of 21 Mt & CO₂ 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.

<table>
<thead>
<tr>
<th>1) Technology-specific free allocation</th>
<th>2) Product-specific free allocation</th>
<th>3) No free allocation</th>
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</thead>
<tbody>
<tr>
<td>Cost of reference plant</td>
<td>Cost of reference plant</td>
<td>Cost of reference plant</td>
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<tr>
<td>Cost gap to be covered</td>
<td>Cost gap to be covered</td>
<td>Cost gap to be covered</td>
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<tr>
<td>Cost of low-carbon plant</td>
<td>Cost of low-carbon plant</td>
<td>Cost of low-carbon plant</td>
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<tr>
<td>No free allocation</td>
<td>Equivalent free allocation</td>
<td>No free allocation: costs rise</td>
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<tr>
<td>ETS CO₂-costs</td>
<td>CCFD-payment</td>
<td>CCFD-payment</td>
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<tr>
<td>Operational costs</td>
<td>Additional costs</td>
<td>Additional costs</td>
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<tr>
<td>Reference costs</td>
<td>Reference costs</td>
<td>Reference costs</td>
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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.

- 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

Assumptions

<table>
<thead>
<tr>
<th></th>
<th>2025</th>
<th>2030</th>
<th>2040</th>
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<tbody>
<tr>
<td>CO₂-price [€/EUA]</td>
<td>60</td>
<td>70</td>
<td>90</td>
</tr>
<tr>
<td>H₂-price [€/kg]</td>
<td>4,4</td>
<td>3,7</td>
<td>2,0</td>
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</table>

→ 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 CO₂ prices & decreasing H₂ costs we expect:
1. falling additional costs for natural gas & H₂ steel;
2. that demand for low-CO₂ 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 CO₂ reduction creates supply and a reference price for green steel products.

Interplay of CCfDs and green lead markets

- 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.

Agora Industrie, FutureCamp, Wuppertal Institut und Ecologic Institut (2022)
The refinancing requirement for CCfDs differs significantly – depending on the effective reform of the EU ETS.

<table>
<thead>
<tr>
<th>Transformation costs of primary steel production without EU ETS reform in billions of euros</th>
<th>Transformation costs of primary steel production with EU ETS reform in billions of euros</th>
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</thead>
<tbody>
<tr>
<td><strong>Reference scenario</strong></td>
<td><strong>Reference scenario</strong></td>
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<tr>
<td><strong>Opex</strong></td>
<td><strong>Opex</strong></td>
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<td><strong>Capex</strong></td>
<td><strong>Capex</strong></td>
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<td>27</td>
<td>19</td>
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<td>8</td>
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<tr>
<td>35</td>
<td>35</td>
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<tr>
<td><strong>H₂ cost reduction</strong></td>
<td><strong>H₂ cost reduction</strong></td>
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<td>8</td>
<td>8</td>
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<tr>
<td><strong>Green lead markets</strong></td>
<td><strong>EU-ETS reform</strong></td>
</tr>
<tr>
<td>linear ramp-up to 9 Mt in 2040</td>
<td>linear ramp-up to 11 Mt in 2036</td>
</tr>
<tr>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td><strong>Residual costs for CCfDs</strong></td>
<td><strong>Green lead markets</strong></td>
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<tr>
<td>8</td>
<td>5</td>
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<tr>
<td>10</td>
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<td>2</td>
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Agora Industry, FutureCamp und Wuppertal Institut (2022)
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.

- 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.
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. Company submits project outline with operating concept and estimate of additional costs
2. Company submits formal project-specific application
3. 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

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

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.

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

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

Agora Industry (2022)
Thank you for your attention!

Questions or comments? Feel free to contact me:
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