

CFM-Traction Project

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# Carbon Contracts for Differences: a cost-effective instrument for the decarbonization of the basic materials sector

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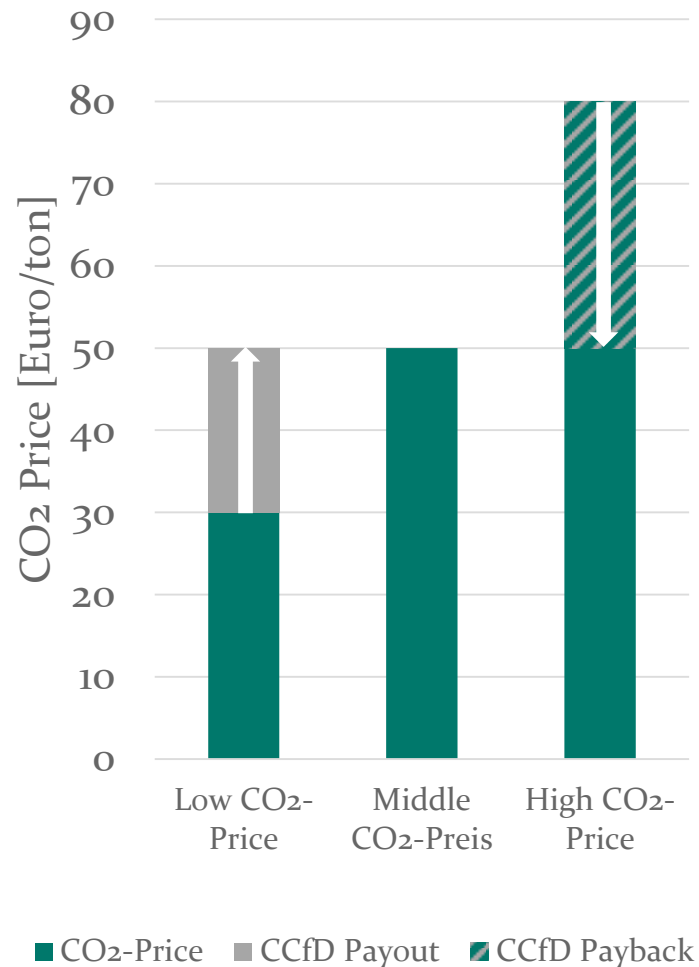
Olga Chiappinelli (DIW Berlin)

European Dialogue - Policy Toolkit for Net-Zero Industrial Innovation, 11.01.2021

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1. Description of CCfD
2. Estimation of impact of CCfDs on financing costs
3. Estimation of CCfD reference price
4. Estimation of government cash flows from CCfDs

## How do Carbon Contracts for Difference work?

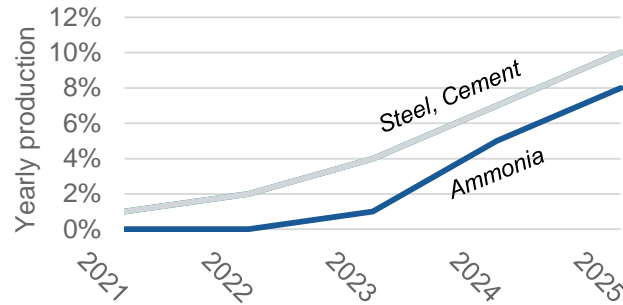


- Contract between government and company developing an innovative low-carbon project
- Pay the difference between EUA price and contract reference price for emissions savings below benchmark level
- Guarantee a fixed revenue for emissions savings
- Hedge against regulatory and market risks thereby reducing financing cost
- Reduce public funding needs

Source: Richstein (2017)

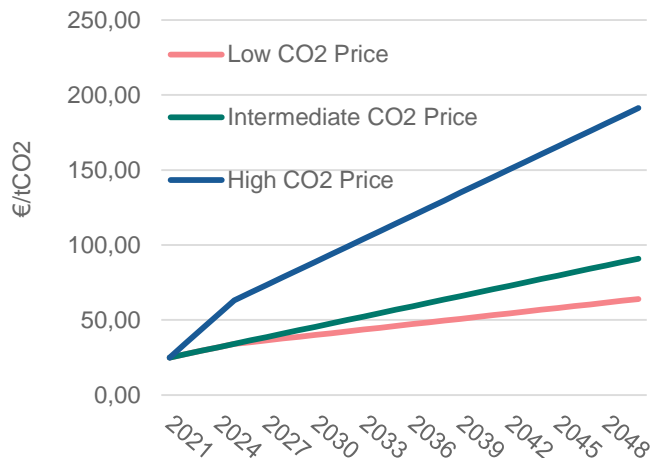
# CCfD cost-assessment analysis - description of the scenarios

## Decarbonization paths (Germany):



**Emissions reduction:**  
 Yearly 7,4 Mt CO<sub>2</sub> (from 2025),  
 Total 158 Mt CO<sub>2</sub> (until 2044)

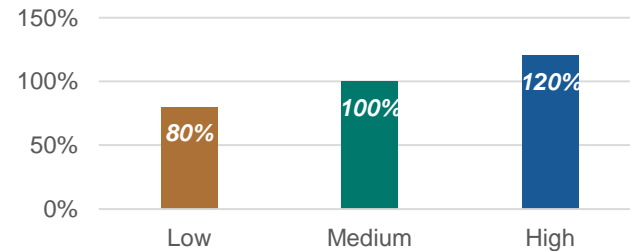
## CO2 price developments:



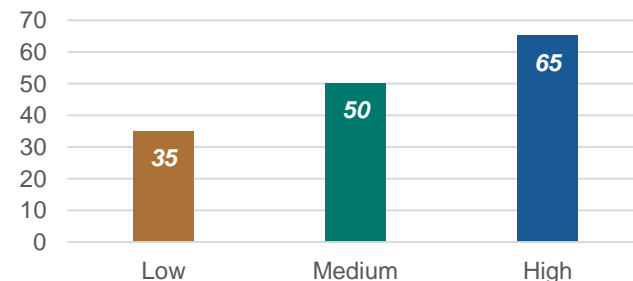
## Technologies:

	Conventional	“Green”
<b>Steel</b>	Blast furnace	Hydrogen direct reduction
<b>Cement</b>	Rotary kiln	CCS + Oxyfuel
<b>Ammonia</b>	Steam cracker	Hydrogen electrolysis

## Investment costs:



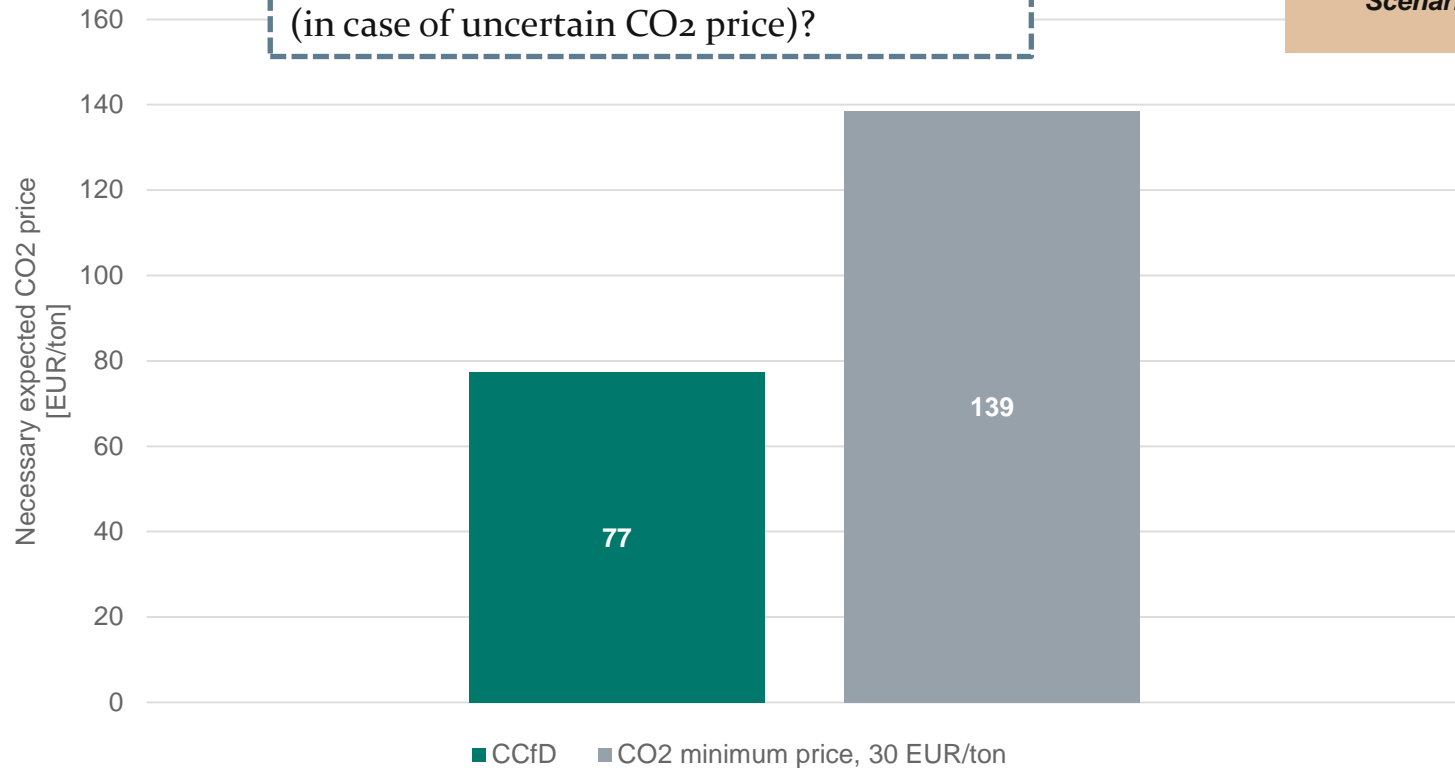
## Electricity price (Germany):



# Impact of CCfD on financing cost at the example of steel (blast furnace → hydrogen direct reduction)

What average level of expected market price would be necessary to realize an investment (in case of uncertain CO<sub>2</sub> price)?

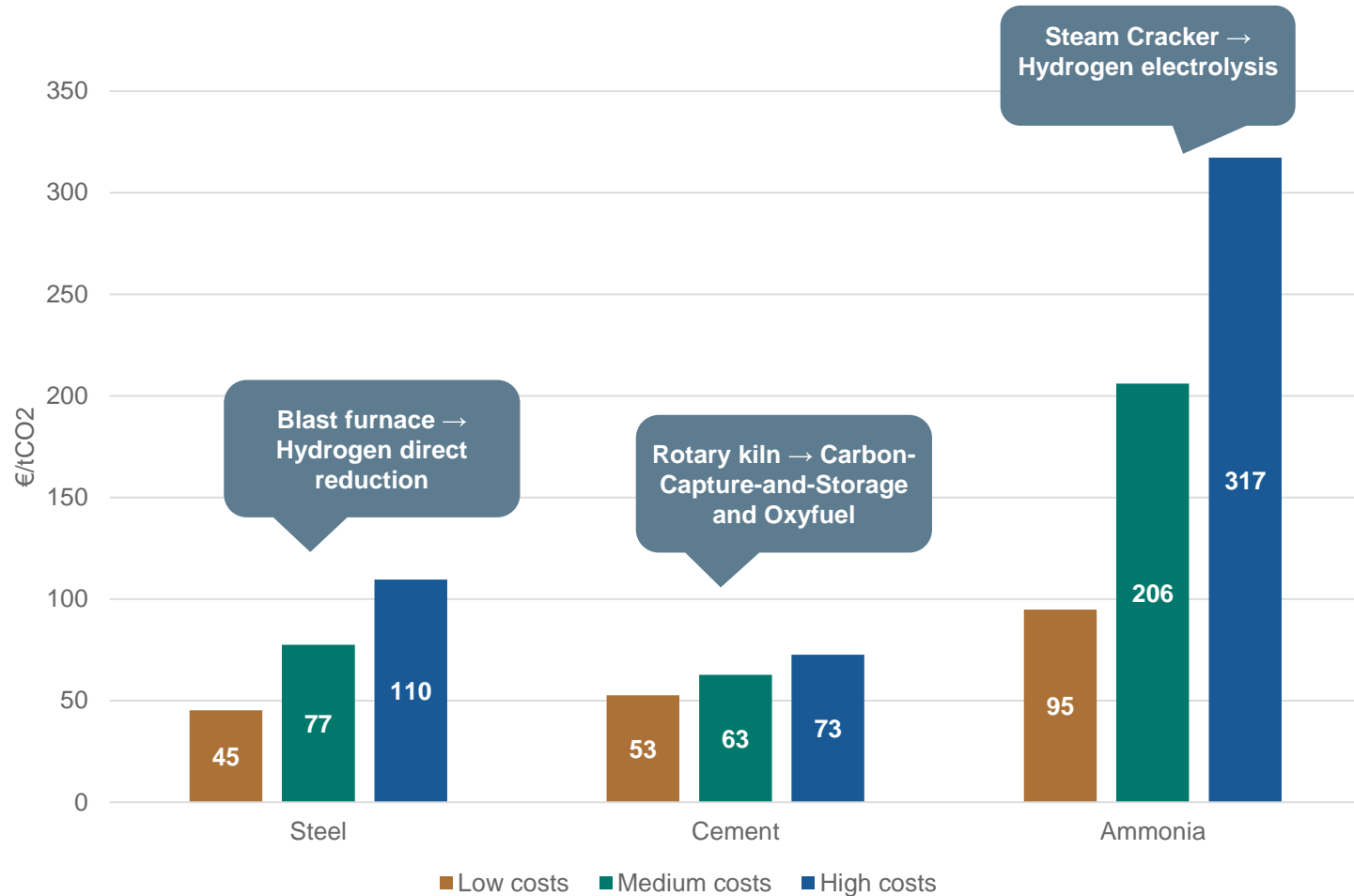
Medium Cost Scenario



## CCfDs induce investment in clean technologies at lower carbon price levels

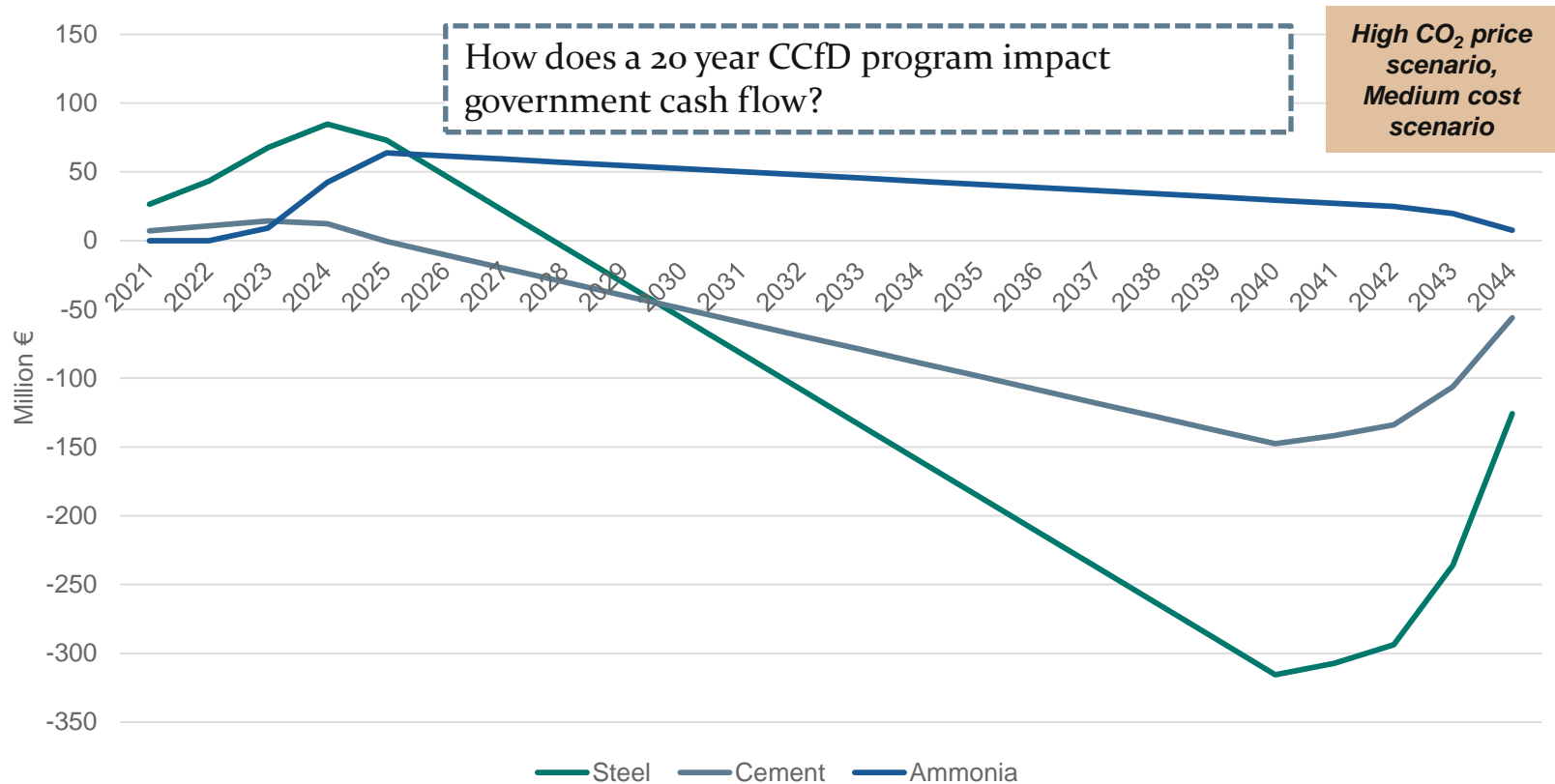
*Assumptions:* Comparison with “Brownfield” investment; electricity prices (Low: 35 €, Medium: 50 €, High: 65 €); investment costs (Low: 80%, Medium: 100%, High: 120 %); CO<sub>2</sub> price developments based on IEA World Energy Outlook 2016 and own calculations; 100% free Allocation, Discounting rate 0.8%.

CCfD reference price covering investment costs per sector and cost scenario: Germany



*Assumptions:* Comparison with „Brownfield“ investment; electricity prices (Low: 35 €, Medium: 50 €, High: 65 €); investment costs (Low: 80%, Medium: 100%, High: 120 %); CO<sub>2</sub> price developments based on IEA World Energy Outlook 2016 and own calculations; 100% free Allocation, Discounting rate 0.8%; CCfD duration (20 years)

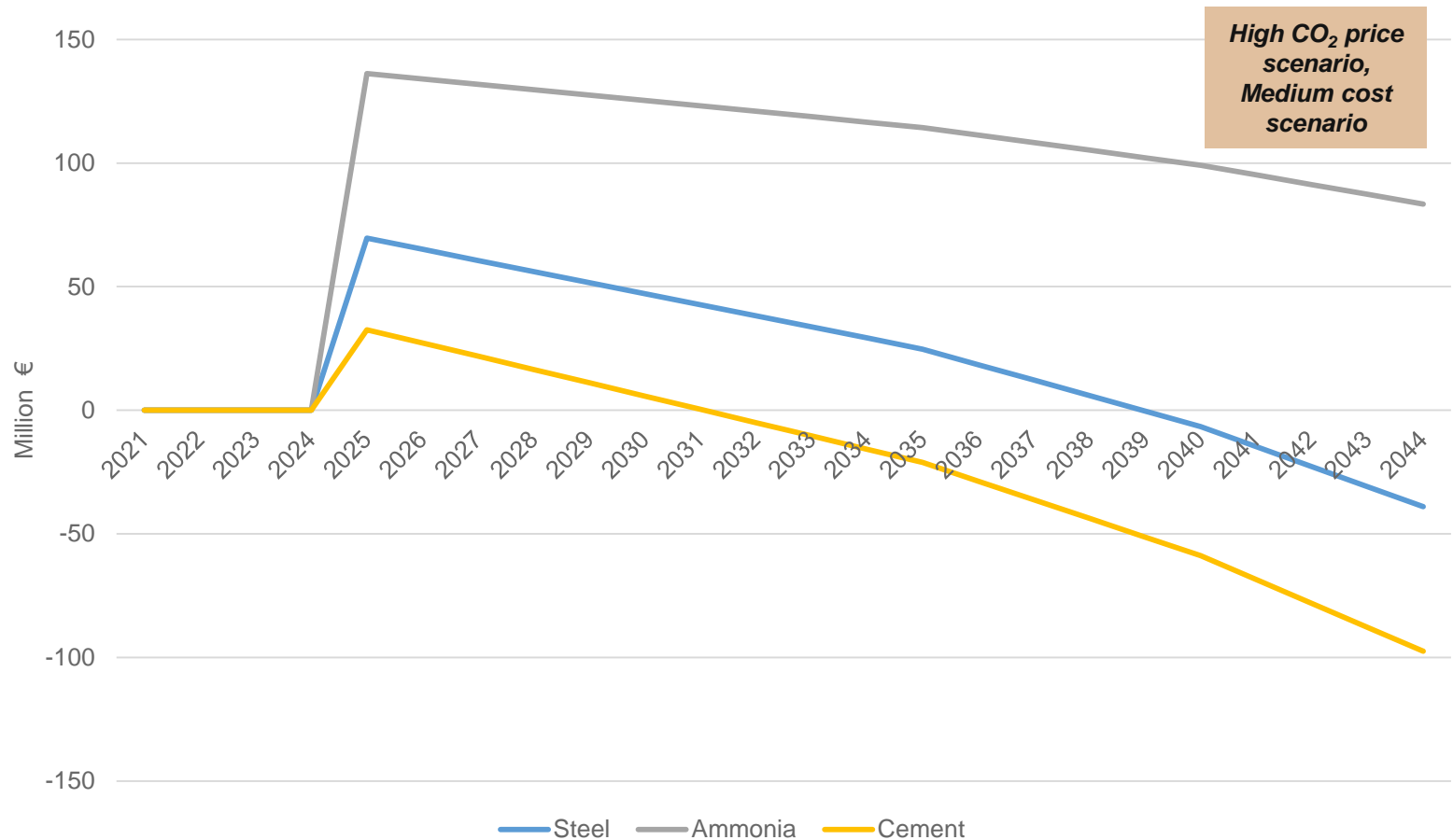
# Time evolution of CCfD payments - expansion path to 2025 (10% production): Germany



With high CO<sub>2</sub> price the government has revenues from CCfDs

*Assumptions:* Comparison with “Brownfield” investment; electricity prices (Low: 35 €, Medium: 50 €, High: 65 €); investment costs (Low: 80%, Medium: 100%, High: 120 %); CO<sub>2</sub> price developments based on IEA World Energy Outlook 2016 and own calculations; 100% free Allocation, Discounting rate 0.8%; CCfD duration (20 years)

# Time evolution of CCfD payments - expansion path to 2025 (10% production): Poland



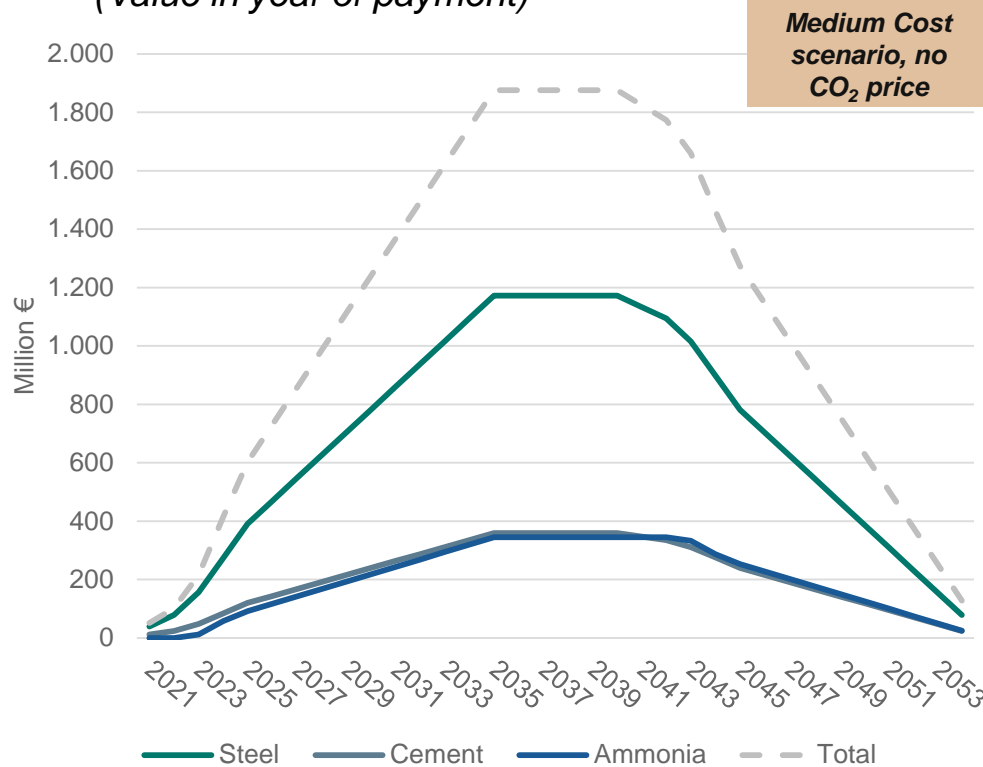
**Assumptions:** Comparison to a “Brownfield” investment; electricity prices (low: 55€, medium: 70€, high: 85€); investment costs (low: 80%, medium: 100%, high: 120%); CO<sub>2</sub> price paths based on WiseEuropa forecast; risk-free interest rate: 3.1%; interest rate on debt: 7%.



Estimation of CCfD payment – expansion path until 2035 (30% of production): Germany

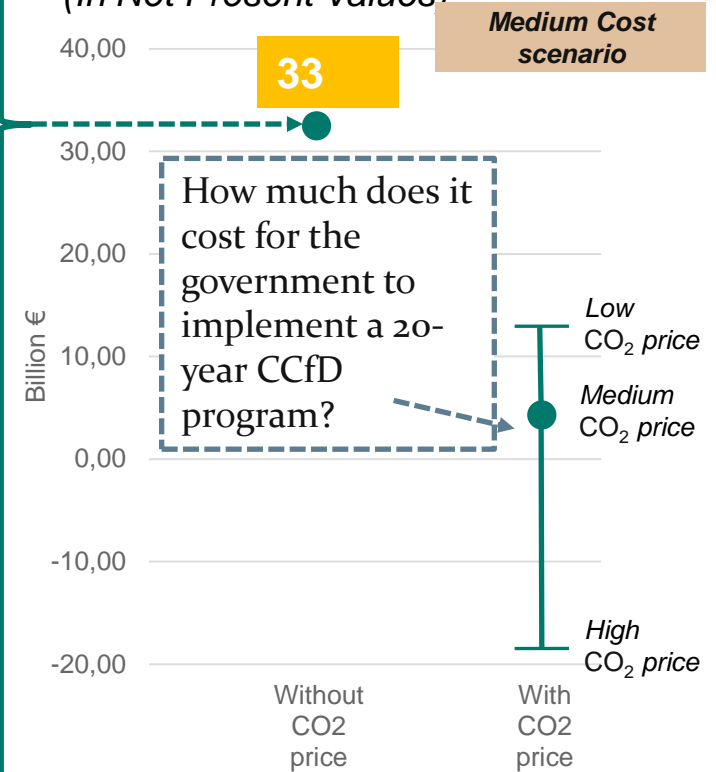
**a) Payments over time without CO2 price**

(Value in year of payment)



**b) Comparison of total payment**

(In Net Present Values)

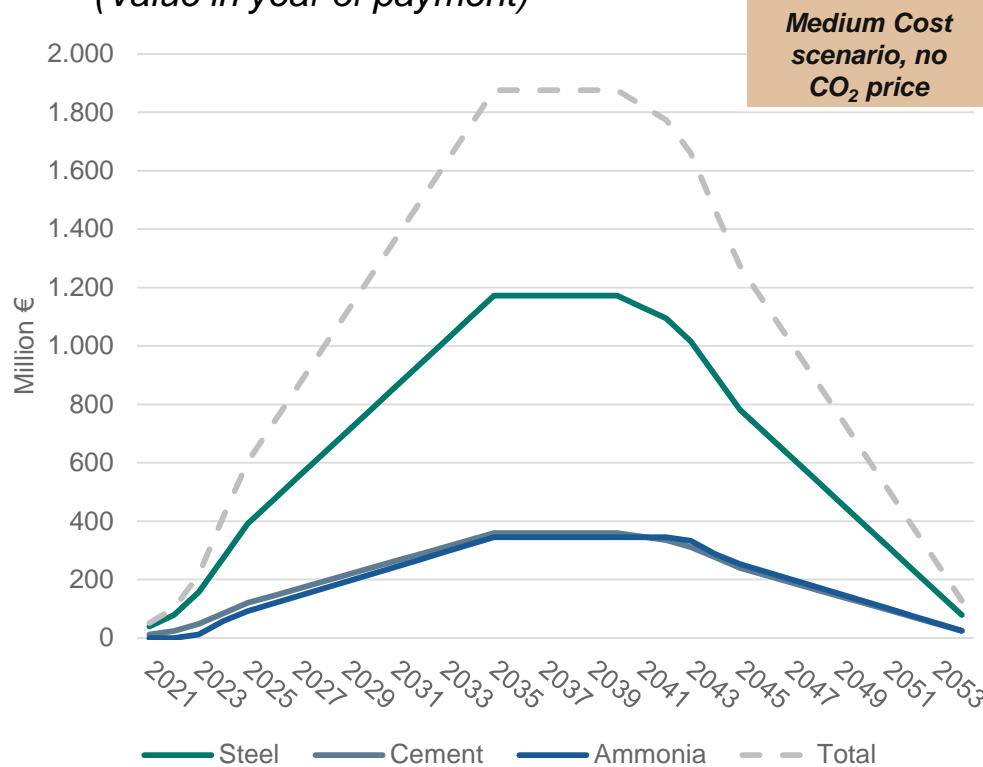


**Assumptions:** Comparison with “Brownfield” investment; electricity prices (Low: 35 €, Medium: 50 €, High: 65 €); investment costs (Low: 80%, Medium: 100%, High: 120 %); CO<sub>2</sub> price developments based on IEA World Energy Outlook 2016 and own calculations; 100% free Allocation, Discounting rate 0.8%; CCfD duration (20 years)

Estimation of CCfD payment – expansion path until 2035 (30% of production): Germany

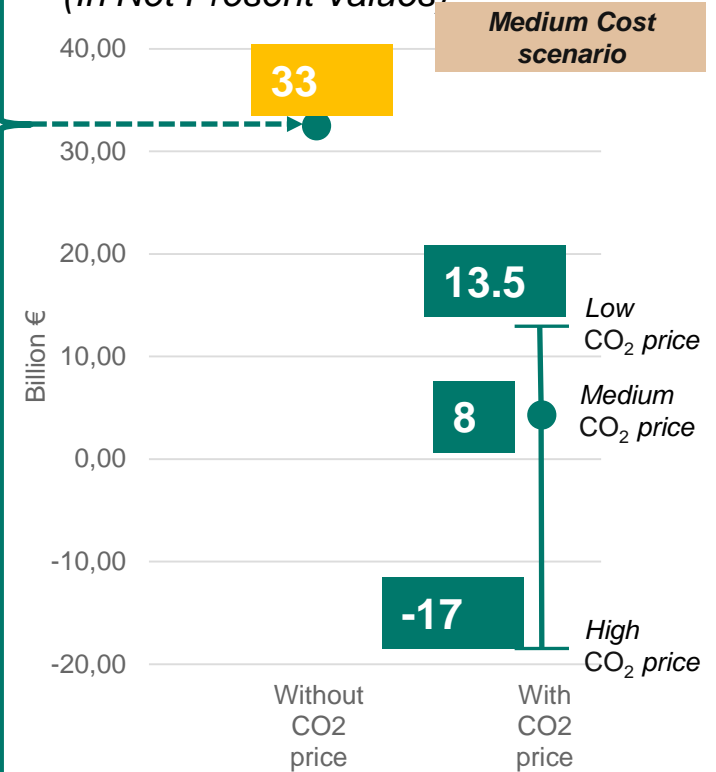
**a) Payments over time without CO2 price**

(Value in year of payment)



**b) Comparison of total payment**

(In Net Present Values)



**CO2 price plus CCfDs substantially reduce funding needs for government**

*Assumptions:* Comparison with “Brownfield” investment; electricity prices (Low: 35 €, Medium: 50 €, High: 65 €); investment costs (Low: 80%, Medium: 100%, High: 120 %); CO<sub>2</sub> price developments based on IEA World Energy Outlook 2016 and own calculations; 100% free Allocation, Discounting rate 0.8%; CCfD duration (20 years)

*CCfDs as hedging instrument:*

- Reduce the level of CO<sub>2</sub> price required to make investments in low-carbon technologies viable
- Reduce the level of public funding required for the transformation
- Need support from Renewables policies / complementarity with RES-CfDs to hedge against electricity price volatility

Vielen Dank für Ihre Aufmerksamkeit.



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## References

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# Backup-Slides

## Cost assumptions overview

Technology	Operational costs (Electricity price: 50 €/MWh) [€/t product]	Investment costs [€/t Yearly capacity]	Type of investment
Cement - conventional	41	85	Brownfield
Cement – Oxyfuel CCS	72	332	Greenfield
Ammonia – conventional (Steam cracker)	337	329	Brownfield
Ammonia - Hydrogen electrolysis	665	910	Greenfield
Steel – conventional (Blast furnace)	304	170	Brownfield
Steel – H-DRI	414	631	Greenfield
Hydrogen electrolysis	3235	800 (€/kW)	Greenfield

Further Assumptions: Depreciation period (20 years), Utilization of facilities (full capacity), Efficiency of Electrolysis (66% or 50 MWhel/t H2)