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Decarbonising EU Steel: Trade & Policy Implications

Alexander Jülich (Wuppertal Institute, Germany)

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Decarbonising EU Steel – Motivation

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High climate relevance

- **7%** global/ **5**% EU GHG emissions
- Up to **2 t CO2/t of steel** via coal based Blast Furnaces (BF)
- Steel = **backbone** of EU industry

Low-carbon technologies available

- **Low-carbon steel:** DRI, direct electrolysis
- steel via **scrap EAF** already much cleaner (0,3 t CO2/t steel)

Strong incentives

- Rising **EU CO2 prices +** phase-out of **free allowances**
- High **public funding**

Risks w/o action

- Risk of **Carbon leakage**
- High **energy prices** in the EU
- **Overcapacity**

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Overarching research question (Study 9):

*„How do **policies** shape the pathways towards a decarbonised EU steel industry and its impacts on **energy demand** and **CO_2 emissions**, considering **spatial relocation** globally and within the EU?"*

Underpinned by more fine-grained questions:

a) Analysis of dynamics on the sub-EU level such as the Member state level;
b) the role of imports of intermediate products;
c) policy instruments for supporting green steel and their effects
d) energy demands of a decarbonised EU steel industry.

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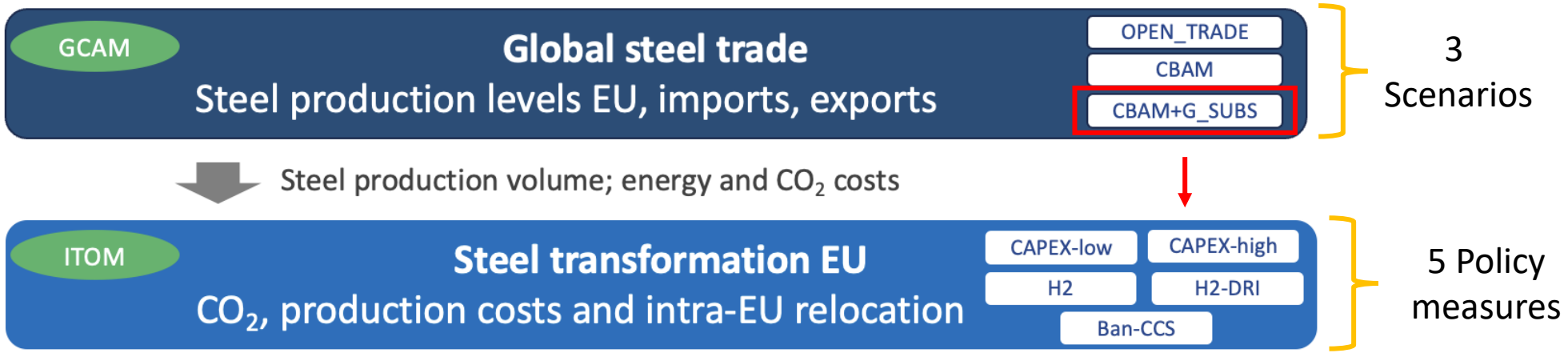
Workflow and Scenarios analysed

Models used:

- **GCAM –** global, partial equilibrium IAM
- **ITOM-steel –** sectoral bottom-up linear optimization model



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Three policy scenarios for EU Steel decarbonisation

Context: NDCs until 2030 + long term net-zero targets (SSP2) → 1.7-1.8°C

OPEN-TRADE

No steel-specific policies

- **Global market** decides location of production & techs used
- Regional different CO_2/energy prices → **relocation of steel?**

CBAM

EU introduces **CBAM**

- Level playing field
- Represented **by 3 steel Categories**: low/medium/high carbon
- Low-carbon: **no CBAM charge**

CBAM+G_SUBS

CBAM + **subsidies**

- **Lower CAPEX** for low-carbon steel
- Cost reduction: **30%** by 2030, **20%** by 2035, **10%** by 2040

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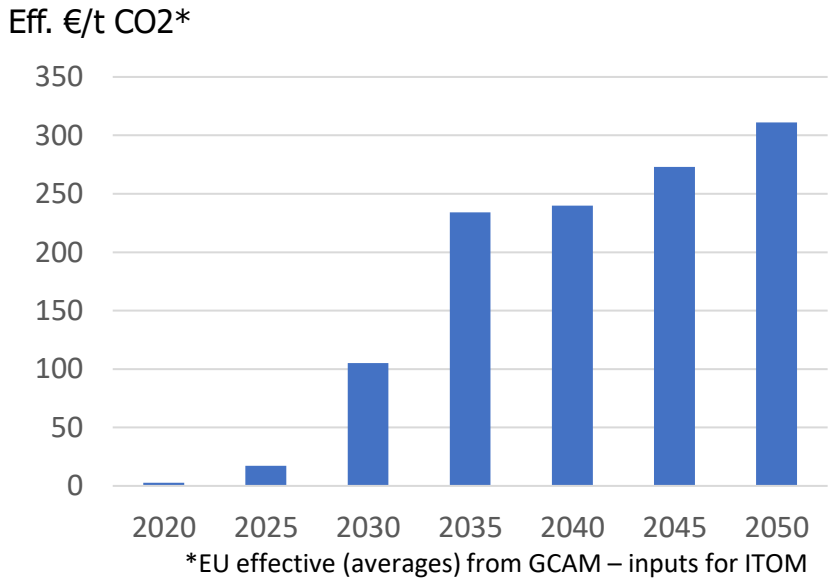
Key drivers: Energy & CO_2 prices

CO2 price as key driver

- CO_2 prices are **skyrocketing in the EU:** >311 €/t CO2 in 2050)
- **Phase-out of free allowances + phase in of CBAM**
- Other world regions face lower CO_2 prices or later increases → **competitiveness gap**



*EU effective (averages) from GCAM – inputs for ITOM

Energy prices falling long term

- Electricity: >100 €/MWh today → ~60 €/MWh by 2050
- Green H_2: costs halve between 2030 and 2050

Technology shift in the 2030s

- Electrification, hydrogen-based DRI, and secondary steel expand
- CO_2-intensive routes are phased out

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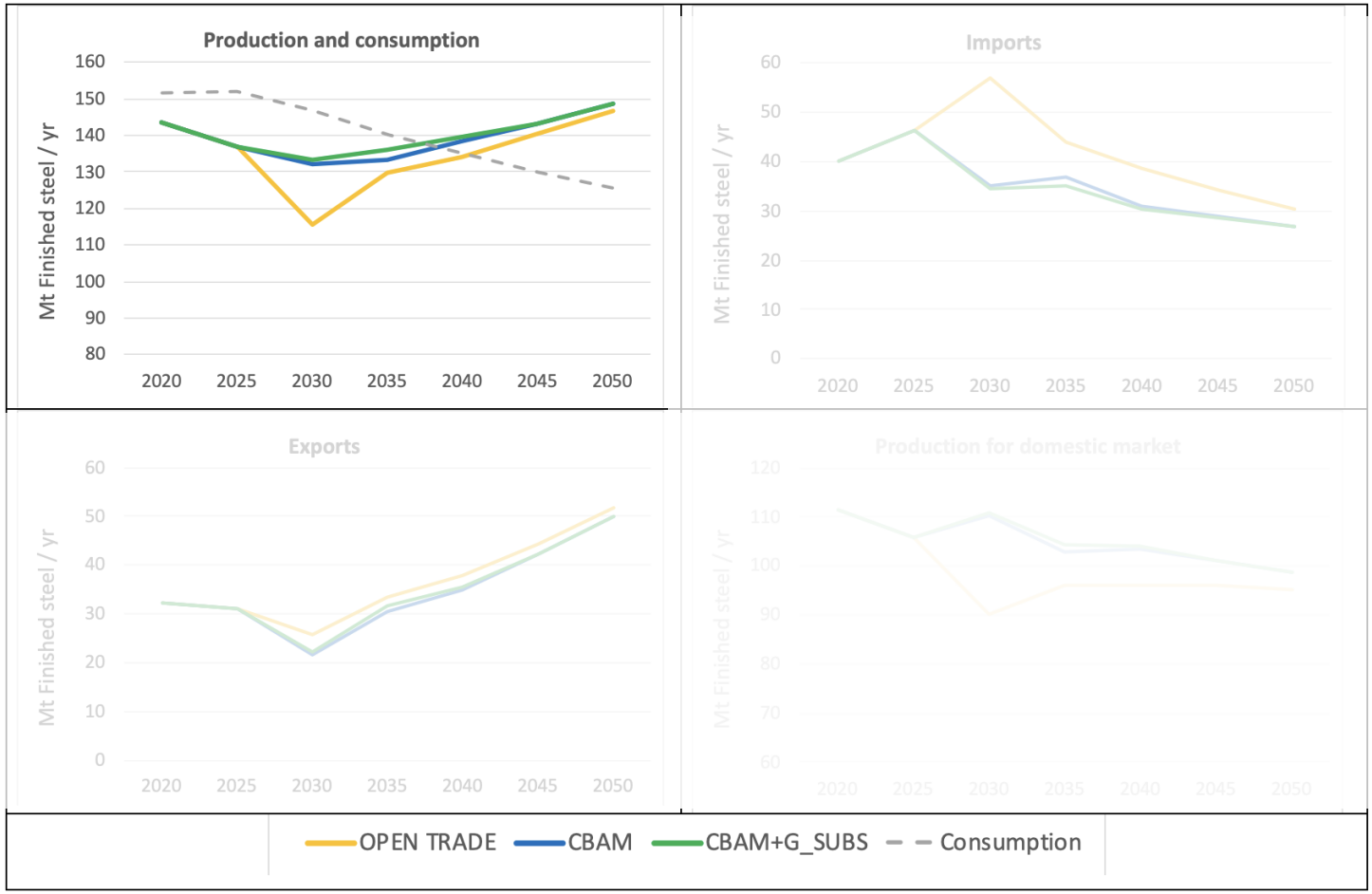
GCAM – EU27 Steel Production Levels & trade



(Note: production for domestic market = Production – Exports)

Production

- Sharp **decline** until 2030 without support (OPEN-TRADE).
- CBAM **protects** domestic production
- With CBAM+G_SUBS, EU industry **recovers** faster

Trade

- **Imports** surge under OPEN-TRADE but stabilise under CBAM.
- **Exports** recover strongly after 2040 as EU becomes cost-competitive.
- EU shifts from net importer to exporter in long term.

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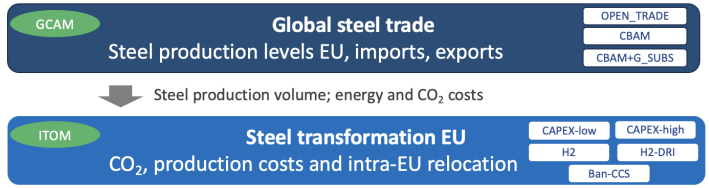
ITOM – EU Steel Transformation Pathways (CBAM+G_SUBS)



Production

- Shift **from BF** to **secondary steel & low-carbon DRI/electrolysis** by 2035.
- **Iron production** drops **~40%**, decoupled from steel demand.

Emissions

- CO_2 emissions: near-neutral by 2035, net negative by 2045.

Steel costs

- Costs rise mid-term but stabilise long-term (+20% vs 2020).

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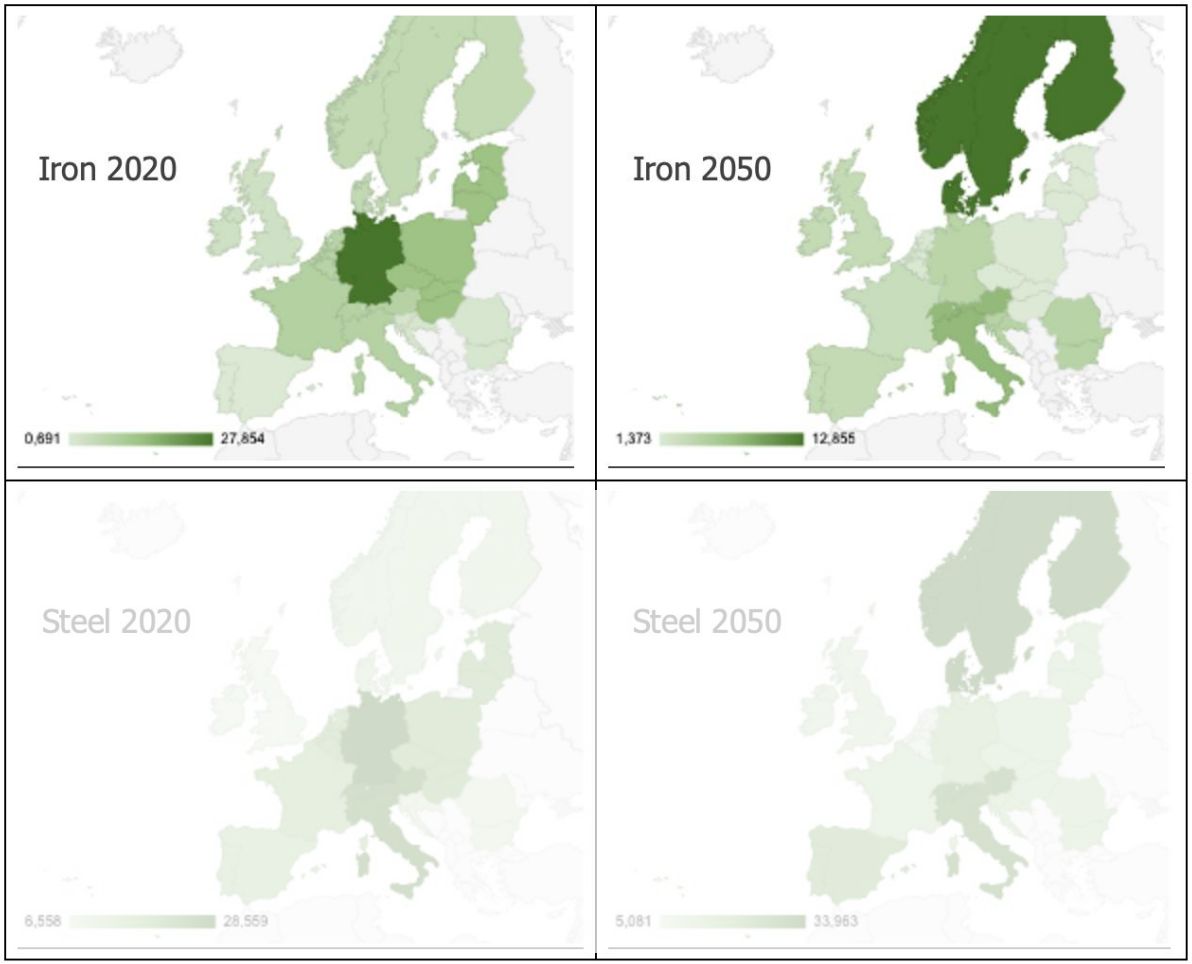
ITOM – Relocation of Iron and Steel Production



2020: Production concentrated in **DE, BeNeLux, East Europe** (BFs).

2050:
Shift to **North & South Europe**

Relocation within the EU due to regional differences in **energy prices (elec.; H2)** resulting from better RE conditions

Iron production:

- relocates more strongly
- decoupling of iron-/steelproduction → **DRI routes**

Steel production

- relocation less pronounced → use of **scrap**, imports of **HBI**, **electrolysis** (MOE) steel.

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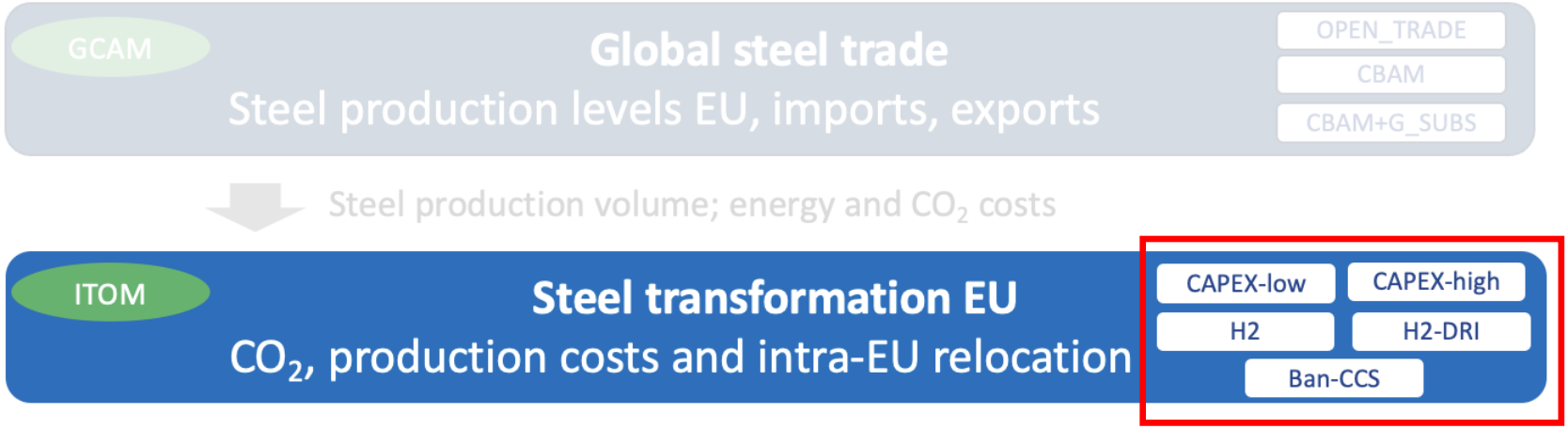
"How do policies shape the pathways towards a decarbonised European steel industry?"



CBAM+G_SUBS

Baseline

► transformation already underway and EU steel competitive again in long run

► **But**: recent news from the EU steel industry shows that the current **transformation dynamics are unstable!**

Policy measures

►Could policy measures **accelerate** and **shape** the transition?

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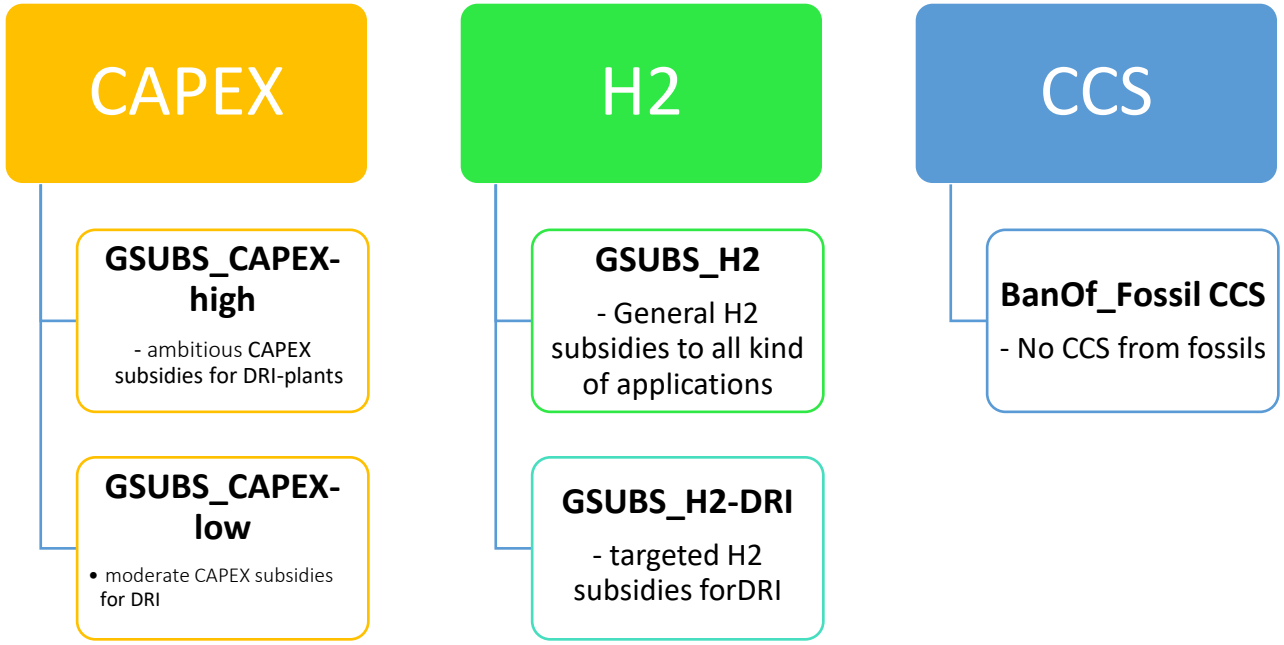
5 policy measures are investigated with **ITOM** (based on the CBAM+G_SUBS)



- ► Accelerating uptake of low-carbon technologies
- ► Reducing reliance on fossil CCS
- ► Shaping transformation according to policy preference

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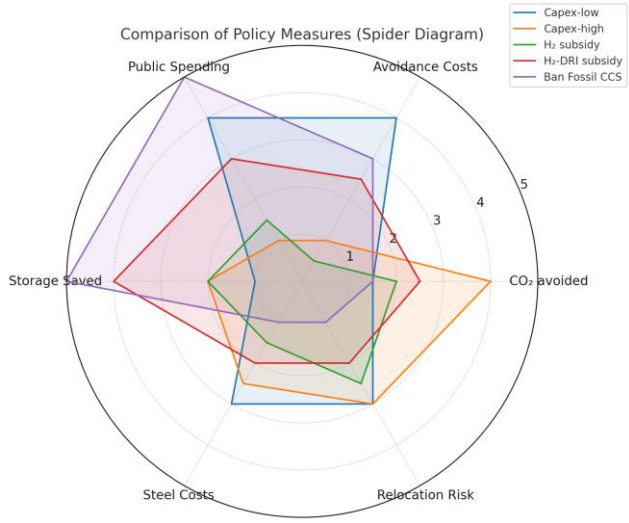
No single Policy Measure is the best!

CAPEX-high = most effective in CO2 avoidance, but costly in subsidies and avoidance cost

H2 = efficient and good for CO2 abatment, also costly

Ban on fossil CCS = storage benefit and no subsidies needed, but higher steel cost & relocation risk



	Direct CO2 Emissions avoided (Mt CO2)	Upstream Emissions avoided (Mt CO2eq)	CO2 storage capacity saved (Mt CO2)	CO2 avoidance costs (€/t CO2)	Costs of steel (relative to baseline)	Subsidies in EU 27 (Mio €)	Iron relocation (% of production)	Steel relocation (% of production)
GSUBS_Capex-low	40	2.6	45	83	-0.7%	3'316	25%	24%
GSUBS_Capex-high	116	7.1	72	145	-1.0%	16'773	26%	23%
GSUBS_H2	67	10.9	34	226	-0.6%	15'115	27%	23%
GSUBS_H2-DRI	47	24.4	159	115	0.5%	5'843	37%	24%
GSUBS_BanOfFossilCCS	41	12.3	350	0	2.7%	0	51%	25%

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Policy measures shape (more than accelerate) the pathway

► **CBAM is effective** to limit carbon leakage – but only **partly protects** exports.

► **Competitive renewable energy** is crucial for long-term EU steel competitiveness – but requires **coordinated EU action** on energy infrastructure and hydrogen deployment.

► **Rising CO_2 prices** and **falling electricity costs** drive the shift to low-carbon steel (EAF/DRI/electrolysis).

► **Scrap use is key** – reduces energy demand, CO_2 storage needs and import dependency.

► **Complementary policies** can guide the transition and ensure alignment with EU priorities.

► **Intra-EU relocation** of steel production is cost-effective, following regional energy-price advantages.

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Steel decarbonisation is unavoidable

► it is central to achieving EU climate targets.

Strong policies decide

► Europe can be a frontrunner – without them, risks of relocation and leakage rise.

Coherent strategy needed

► CBAM + industrial support must go hand in hand to secure a climate-neutral and competitive steel sector.

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Thank you!

Alexander Jülich

alexander.juelich@wupperinst.org

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