Achieving climate-neutral steel by 2050

How the steel sector can shift from coal-based to clean production

Agora Industry

November 2025

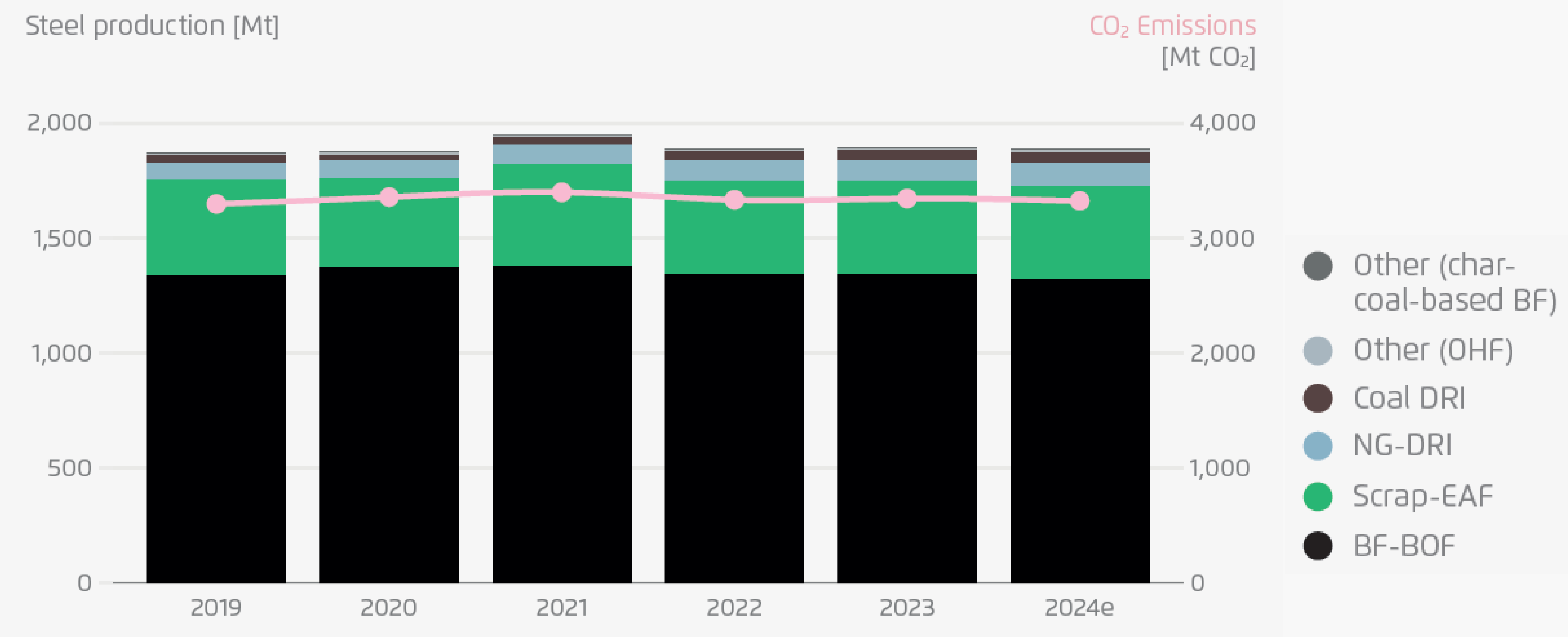
Agenda

- → 2030 steel emissions projection
- → Next generation steel making
- → Bottlenecks in the DRI supply chain
- → Policy mix and international collaboration

2030 steel emissions projections

Peak emissions: we might already be beyond peak emissions in the steel sector – where do we go from here?

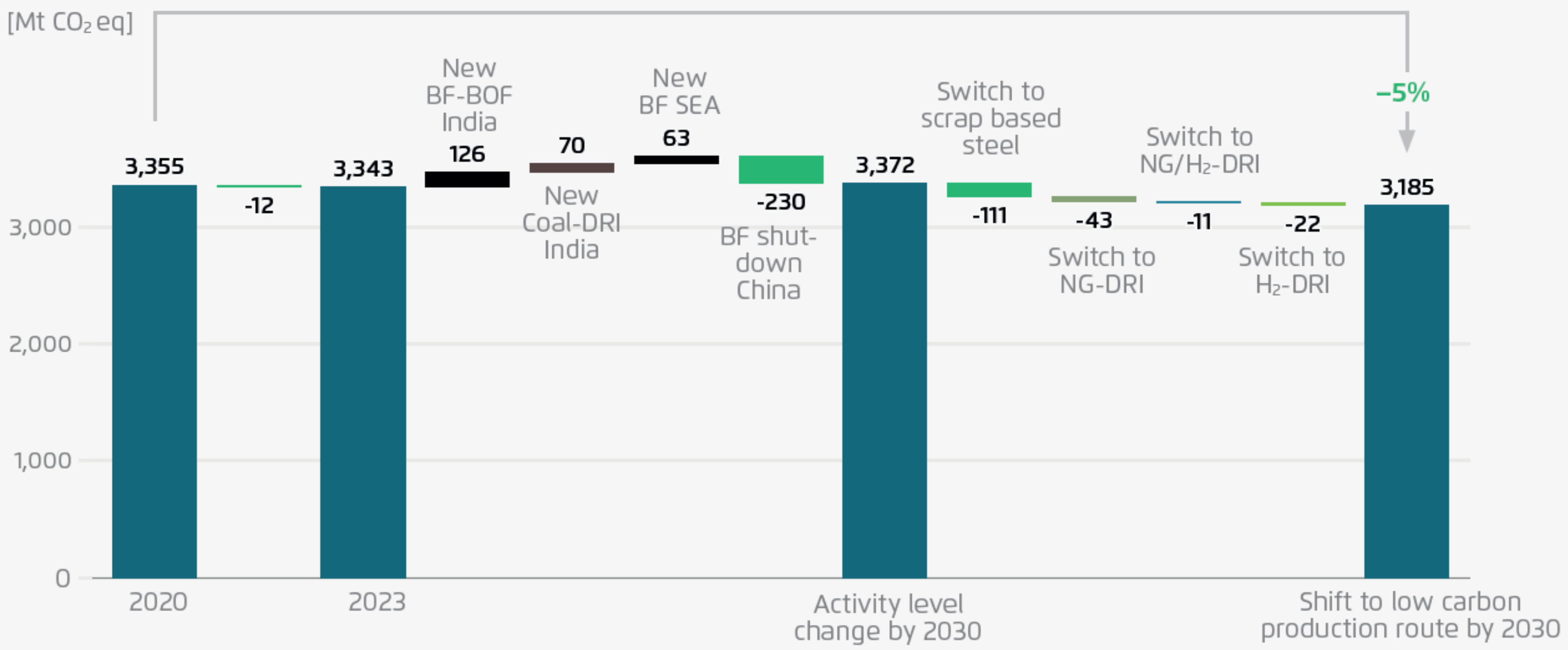
Global crude steel production by production route and steel sector CO_2 emissions (2019–2024)



Agora Industry (2025) based on Agora Industry (2023). From 2019 to 2024, BF-BOF route contributes ~90% of total CO_2 emissions annually.

2030 outlook: Where could we land by 2030? A lot is assumption-driven, yet three main factors will determine where we land

2030 outlook: Projected CO_2 emissions development of the steel sector



Assumptions vs. 2023 production

1.) Activity change coal-based production:

- New BF-BOF India: +60 Mt prod
- New Coal DRI India: +25 Mt
- New BF-BOF SEA: +30 Mt
- BF Shutdown CHN: -100 Mt

2.) Switch to Secondary Steel

- BF Switch to scrap-EAF: -50 Mt

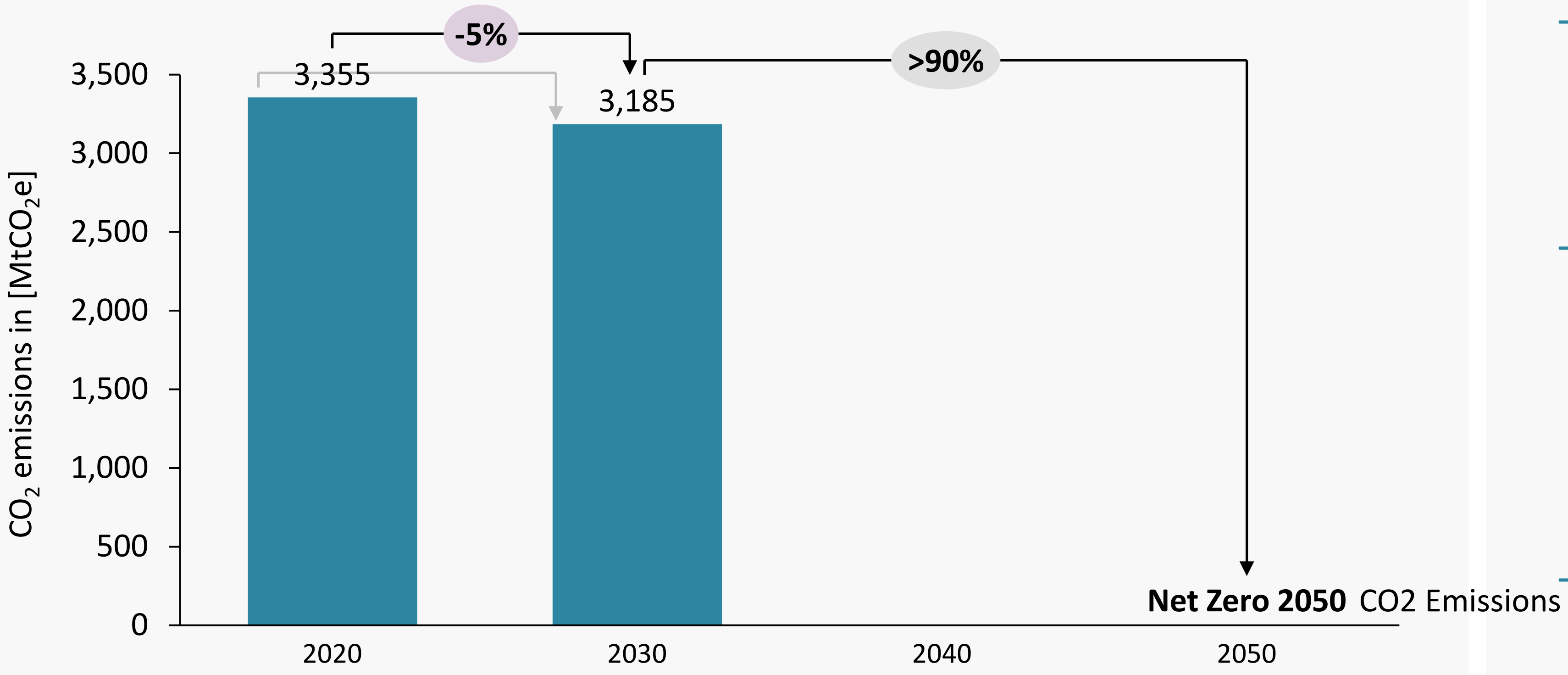
3.) Switch to lower-carbon iron:

- BF Switch to NG-DRI-EAF: -30 Mt
- BF Switch to NG->H2-DRI: -10 Mt
- BF-Switch to H2-DRI: -10 Mt

 Agora Industry (2025) based on perceived trends in key regions regarding coal-based steel production as well as in depth analysis of he low carbon steel announcement pipeline.

Net Zero by 2050 requires a significant acceleration of the global steel transition. The foundations for this acceleration must be laid out now.

Steel sector: projected CO2 emissions 2030 and Net Zero by 2050



How to accelerate the global steel transition?

→ **Unlock scrap-based steel production:** Increase the share of scrap-based steel production through policy incentives

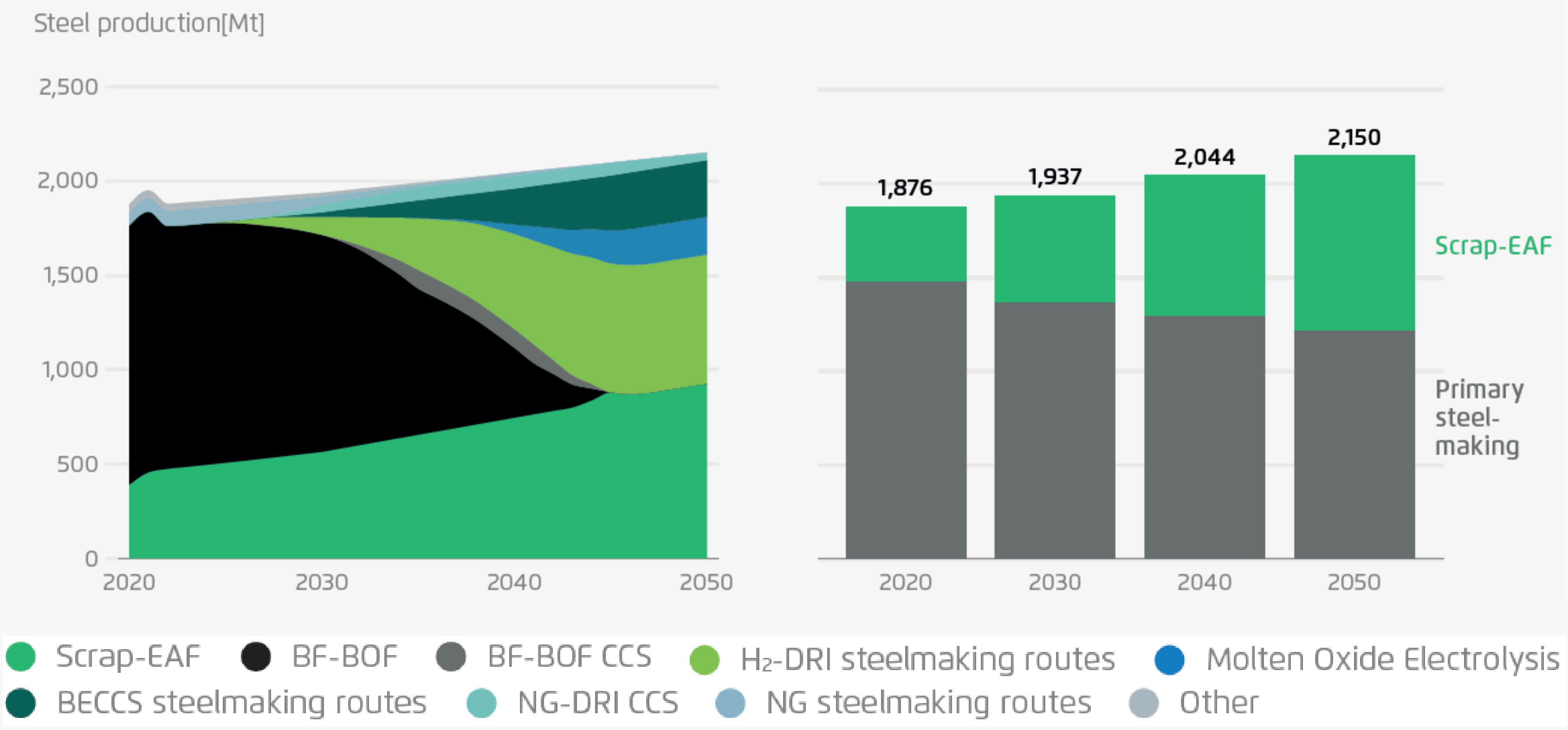
→ **Low-carbon iron production:** Which technologies for NZE-iron production can be ramped up to deliver at the speed required to reach Net Zero 2050?

→ **Policy framework:** Which policy framework is required to unlock RES and low-carbon H_2 for steel as well as offtake markets?

Next generation steel making

There's broad consensus emerging that scrap-based steel can supply 40–50% of NZE-steel by 2050, the rest needs to be low-carbon primary steel

Steel sector pathways to Net Zero: Technology Mix and global steel → Fig. 3 production by route, 2020–2050



The role of scrap-based steel for Net Zero by 2050

There's broad consensus across several studies that the share of scrap-based steelmaking can increase and deliver around 40–50% production by 2050 (i.e. Agora, IEA, MPP, NZI.org).

Clean primary steel production will have to deliver at least 50% of production by 2050

This translates into more than 1000 Mt production. Which tech-nologies can help to deliver that?

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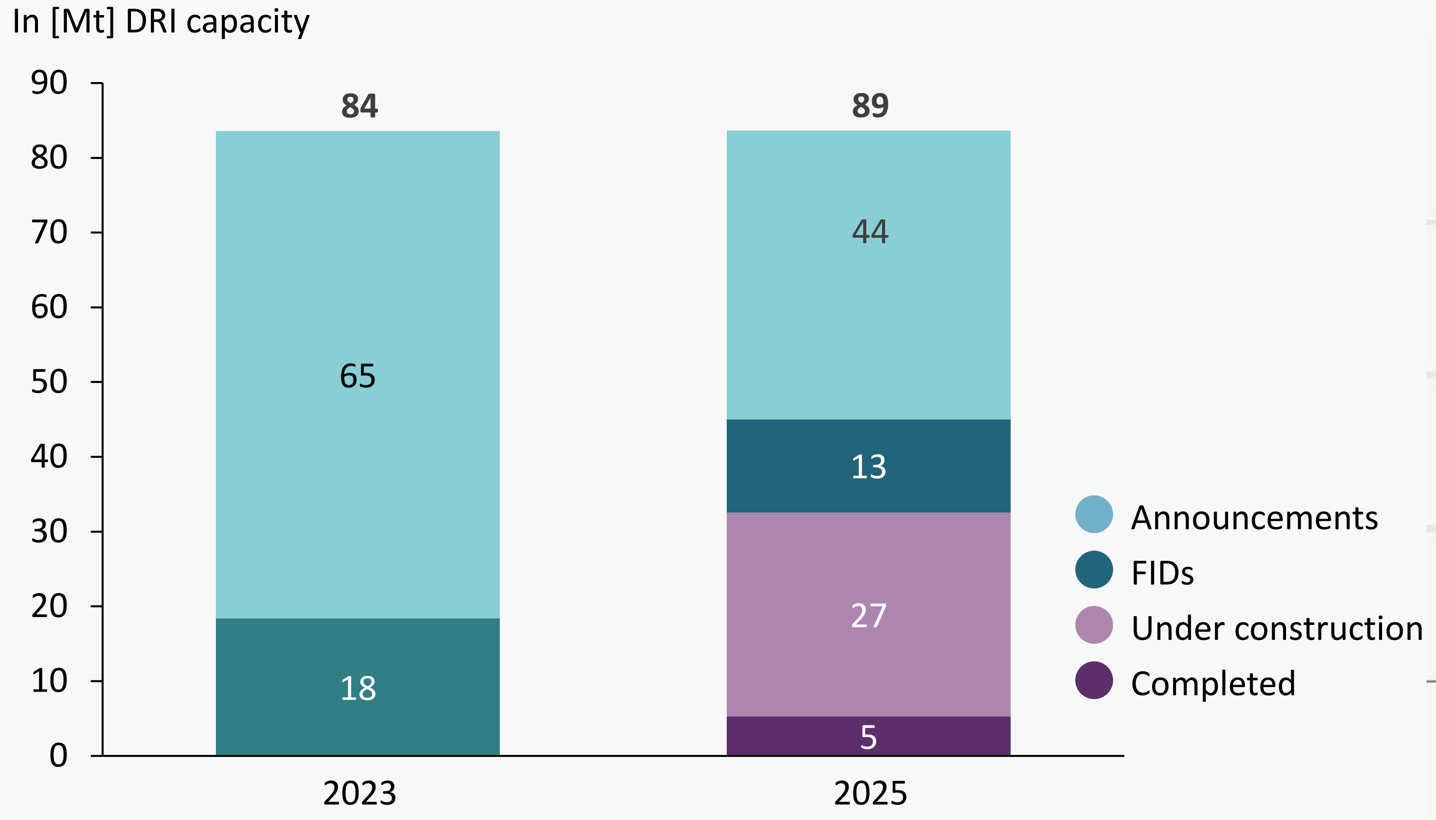
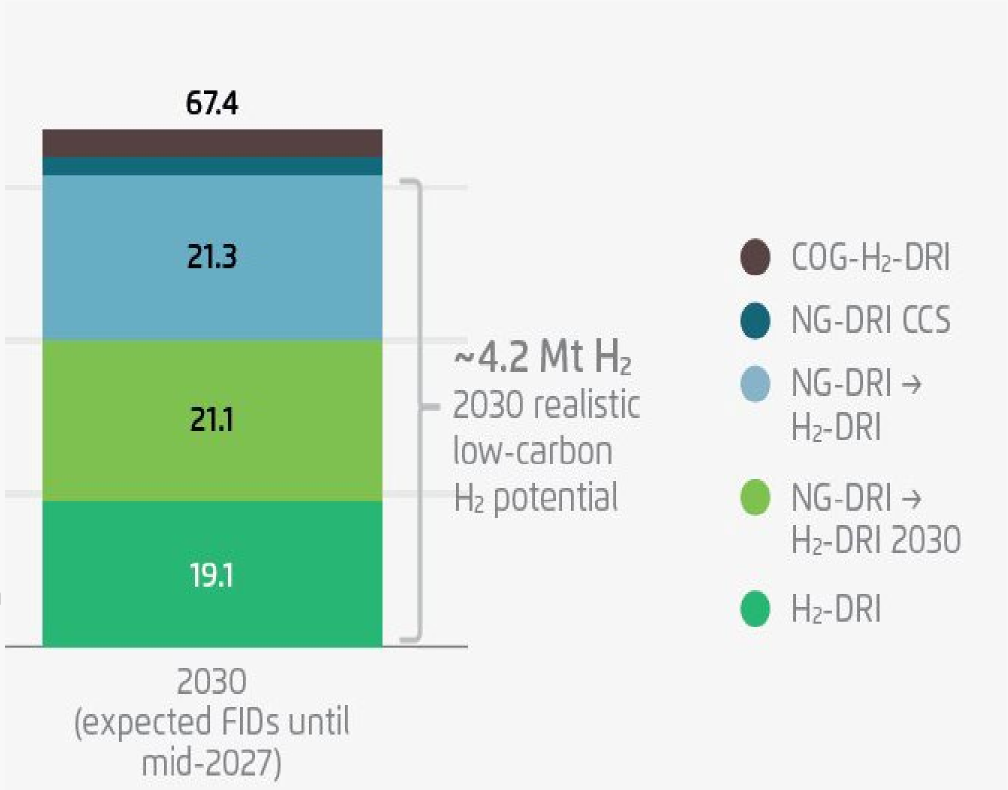
The number of projects that has reached at least FID stage has increased significantly, but few are H_2-DRI

The 2030 low-carbon steel announcement pipeline in 2023 and 2025 and intended fuel use by those projects that have reached at least FID

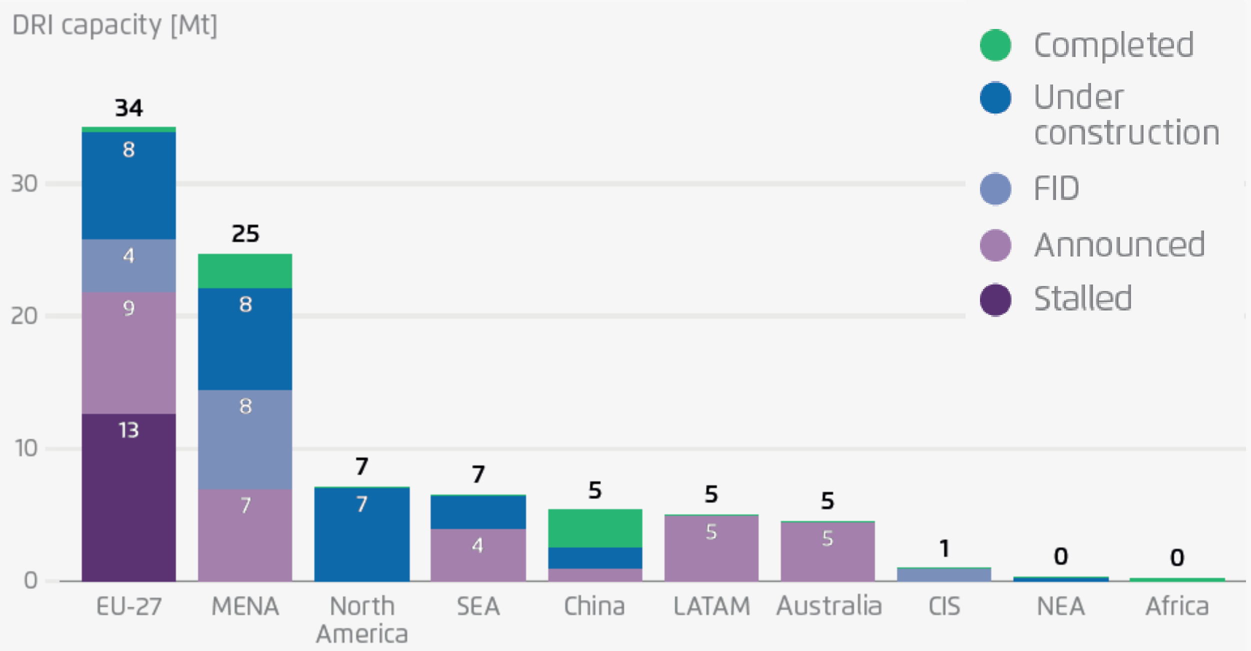


Realistic outlook: 45-62 Mt new DRI capacity will come online by 2030, but not all will use clean H2 by 2030

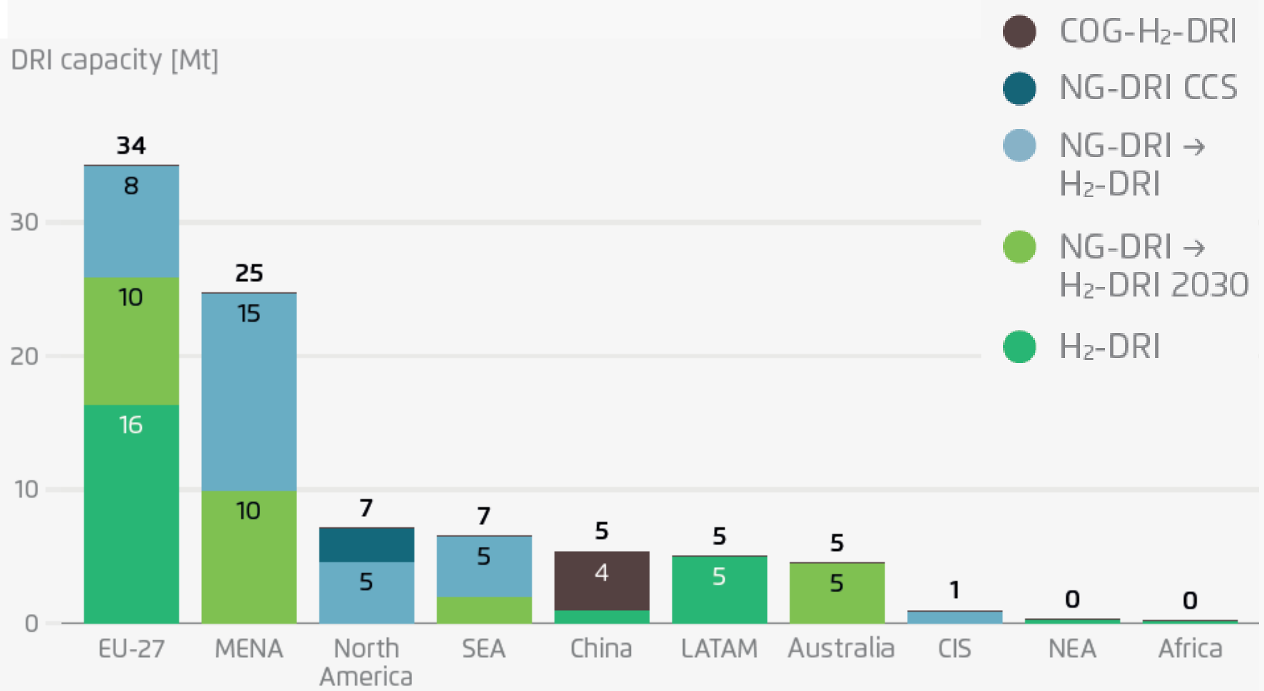


Regional Breakdown: The EU and MENA can lead DRI/HBI production – boosting low-carbon H_2 supply is key

The DRI project pipeline: by project status



The DRI project pipeline: by fuel type



Agora Industry (2025) based on Global Steel Transformation tracker, GEM and SEI (2024). The data Includes all projects that are near zero emissions compatible. SEA = Southeast Asia; NEA = Northeast Asia without China; CIS = Commonwealth of Independent States; NG-DRI = H2-DRI 2030 covers projects that will start operation of their DRI plants with natural gas, but have publicly communicated the intention to use either 100% low-carbon H2 or a significant share of low-carbon H2 by 2030. COG-H2-DRI refers to coke oven gas H2-DRI and refers to projects in China that are using H2-rich coke oven gases from the blast furnace. NG-DRI = H2-DRI projects refer to projects that mention the possibility to use low-carbon H2 in he future without a concrete objective to do so by 2030

Today, there are 10mt of H2 ready DRI under construction in the EU. Another 15mt is in the permitting stage awaiting FID

DRI-based steel project pipeline in the EU

Country	Start of production	DRI [Mt]	Steel [Mt]	Status	2030: DRI inputs [1]	2035: DRI inputs [1]
Finland	2029–30		2.5 Mt	2.5 Mt permitting, awaiting FID	H_2	H_2
France	2029	2.0 Mt	4.0 Mt	4.0 Mt permitting, awaiting FID	H_2	H_2
Germany	2027–2029	6.6 Mt	7.3 Mt	7.3 Mt under construction, partially completed	20% H_2 30% Fossil gas	70% H_2 30% Fossil gas
Netherlands	2029		2.5 Mt	2.5 Mt permitting completed, partial funding secured, awaiting FID	Fossil gas	H_2
Spain	2028–29		1.5 Mt [2]	1.5 Mt permitting, awaiting FID	H_2	H_2
Sweden	2027	3.4 Mt	7.5 Mt	2.5 Mt under construction, 5.0 Mt permitting, awaiting FID	H_2	H_2
Total			25.3 Mt			

Agora Industry (2026) • [1] fuel type for input; [2] based on 70% scrap, 30% procured DRI

→ FIDs are reliant on these projects managing to de-risk the investment with a mid to long term offtake agreement. **Projects need long-term buyers locked in before investors will commit to funding them.**

→ **Automotive Sector in Europe** is being considered as a potential **major demand sector** with an **annual demand of 15 million tonnes**.

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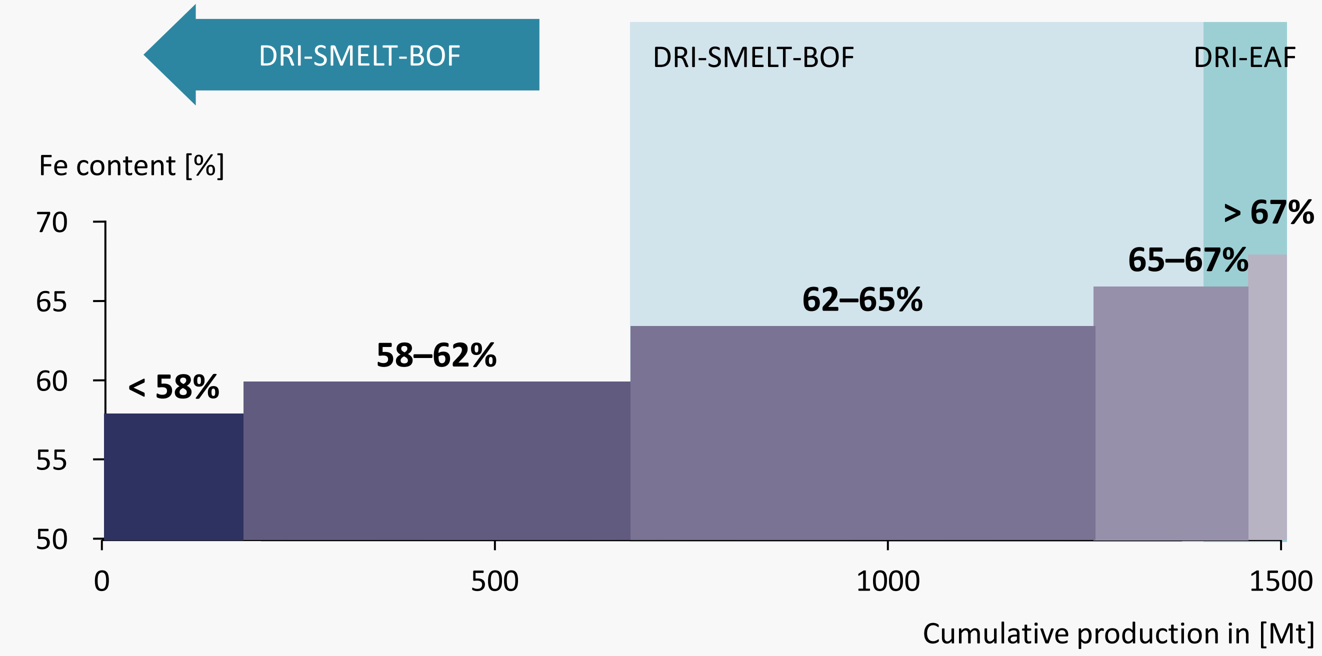
Bottlenecks in the DRI supply chain

High grade iron ore - Since 2023, there are new pilot and demonstration projects to make lower-grade iron ore accessible for the DRI route

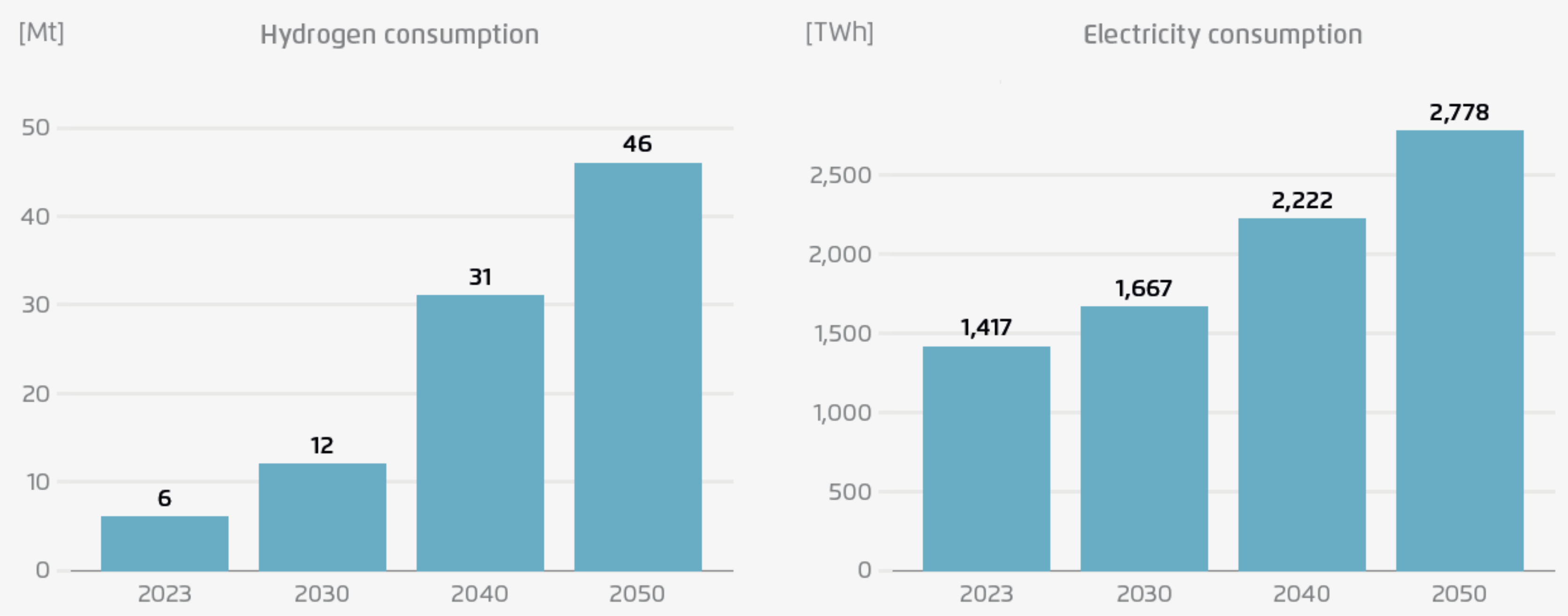
Status quo seaborne iron ore freight by grade



1. Develop new iron ore mining projects with >66% iron content
2. Build more DRI-SMELT-BOF plants
3. Beneficiate more iron ore with lower iron content to supply DR-grade level

Decarbonising steel will require huge new renewables resources to be built out

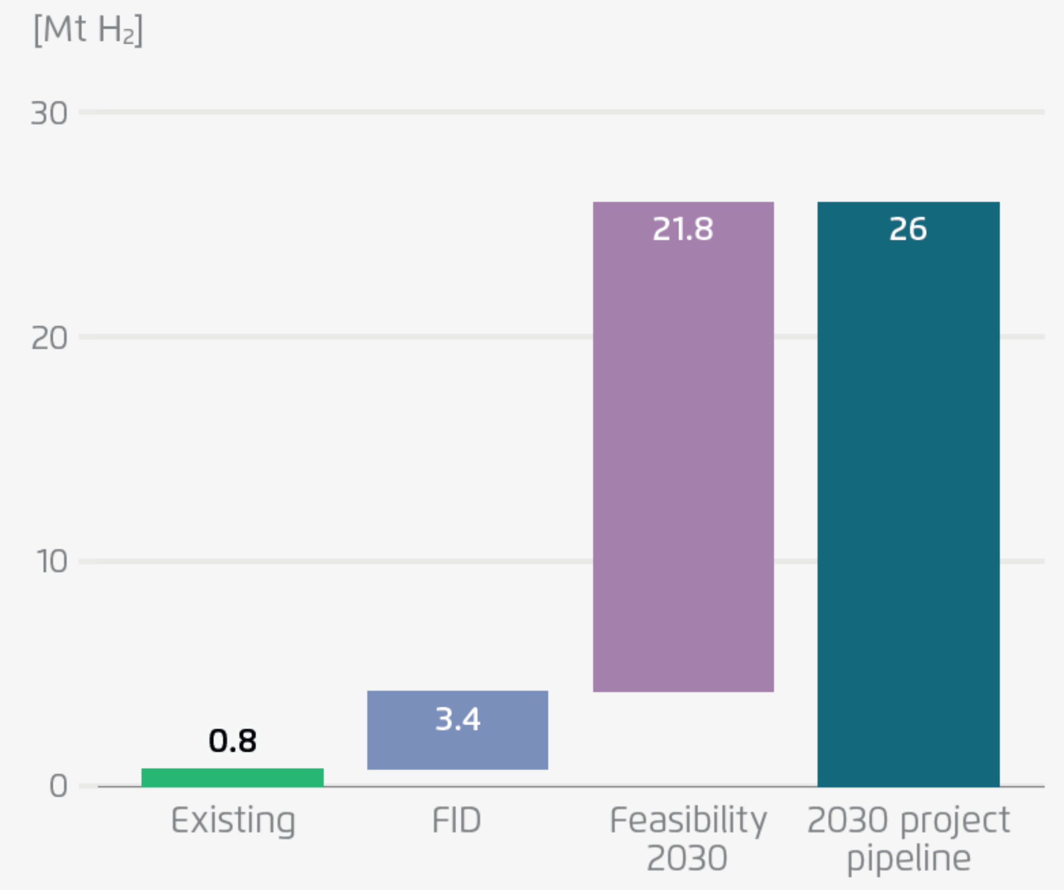
Global steel sector H_2 and electricity demand in the IEA's NZE 2050 Scenario, 2023-2050



- → Rapid clean-steel deployment requires parallel investment in renewable electricity, grids, and H_2 infrastructure (production, transport, storage).
- → Supporting infrastructure build-out have long lead times: early and co-ordinated planning is essential.
- → Natural gas–based DRI production needs a clear pathway to access RES and clean H_2 to avoid stalling at a 50% transition.

Low-carbon H2 project pipeline: We‘re not lacking announcements, but we‘re lacking FIDs. Why is that?

2030 low-carbon H_2 project pipeline

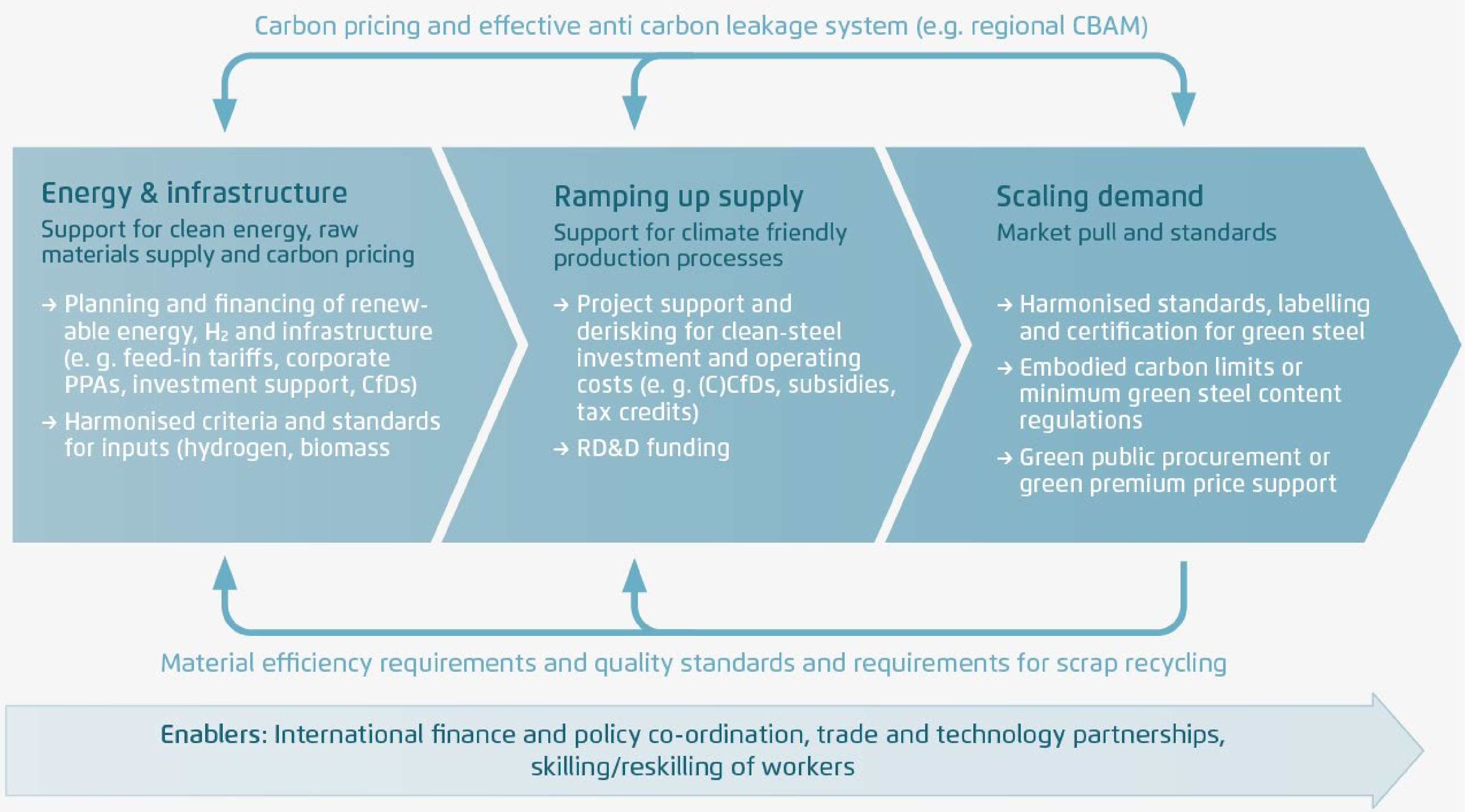


Reasons:

1. Globally low-carbon hydrogen production costs are higher than most studies previously expected 2 years ago.
2. Transporting hydrogen via ship adds a significant amount of cost which makes interregional H_2 trade more costly, unless it is transported as embodied H_2 (HBI)
3. The policy framework to incentivize FIDs for low-carbon H_2 is not fully fit for purpose yet.

Policy mix and international collaboration

Policy Toolbox for the Steel Transformation: A smart policy mix along the whole value chain is needed



Co-ordinated international action along the entire value chain is needed

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Key Takeaways

1 **Lead the decarbonisation of heavy industry**
Iron ore, iron, and steel producers are positioned to be global leaders in transforming energy-intensive industries. By setting and delivering on clear pathways to climate neutrality—underpinned by existing net-zero commitments—they will demonstrate that transforming the **steel sector is both possible and commercially viable.**

2 **Accelerate deployment of clean primary steel technologies**
Hydrogen-based Direct Reduced Iron (DRI) is the main technology pathway for climate-neutral primary steel production. Its large-scale global uptake requires a **concerted, coordinated effort across the entire technology value chain**—from technology providers and engineering firms to steelmakers and investors—to rapidly expand capacity and deployment.

3 **Secure renewable energy and green hydrogen supply**
Climate-neutral steel requires **reliable access to affordable renewable electricity, clean hydrogen, and supporting infrastructure.** Companies will actively work with energy partners and governments to unlock these resources for iron and steel production.

4 **Strengthen governance and trade frameworks across the value chain**
Transformation at scale depends on robust governance, fair and transparent trade rules, and coordinated global action in technology and investment. Joint efforts by international bodies, governments, industry actors, and downstream customers are needed to align standards, reduce trade barriers, and foster cross-border cooperation that supports a competitive, climate-neutral steel industry.

5 **Call for supporting policies and enabling regulatory environments**
Governments need to support this transformation by enacting supportive policy frameworks along the iron & steel value chain. Measures that accelerate investment, reduce risk and stimulate demand are needed to create a viable business case for climate-neutral steel.

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Thank you for your attention

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Agora Think Tanks gGmbH
Anna-Louisa-Karsch-Straße 2, D-10178 Berlin
T +49 (0) 30 7001435-000

www.agora-industry.org
info@agora-industry.org