Kickstarting the global steel transformation: a bottleneck analysis

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According to the IEA, for a 1.5°C steel decarbonization pathway, by 2030 at least 100 Mt of near-zero primary steel and 30% emission reductions are required. Is that feasible?

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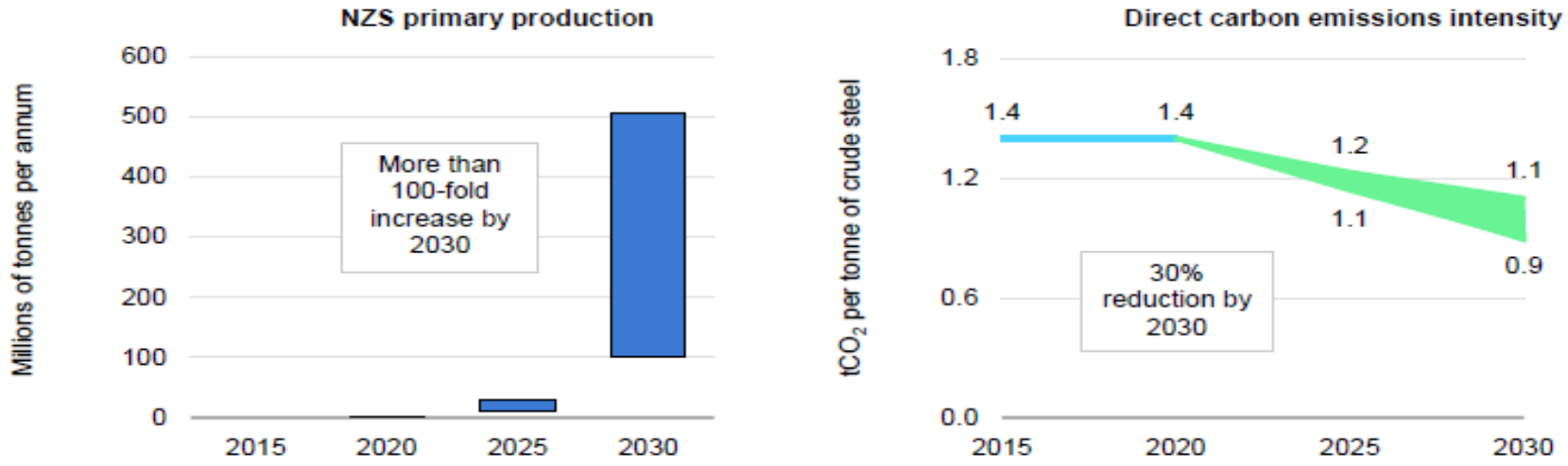
Figure 5.1. Change in direct carbon emissions intensity and NZS primary production needed to meet climate goals, 2015-2030

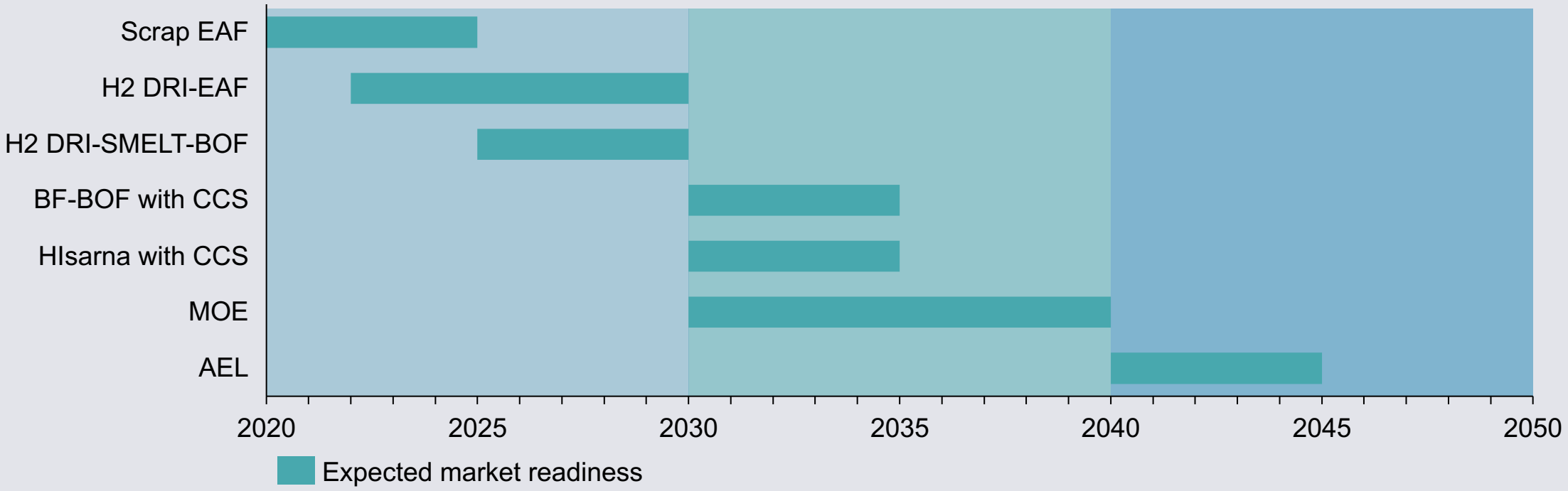


Notes: The change in the direct carbon emissions intensity includes process emissions, and exludes Scope 2 and 3 emissions.
Sources: IEA, 2021; Bataille, Stiebert and Li, 2021; E3G & PNNL, 2021; MPP, 2021; and Agora Industry, 2021.

Source: Breakthrough Agenda Report 2022 by IEA, IRENA and UN High Level Champions

We expect that before 2030 there will be only three technologies that can contribute to significant emission reductions: scrap-EAF and NG- or H2-based DRI technologies

Expected market readiness of different breakthrough technologies for steelmaking



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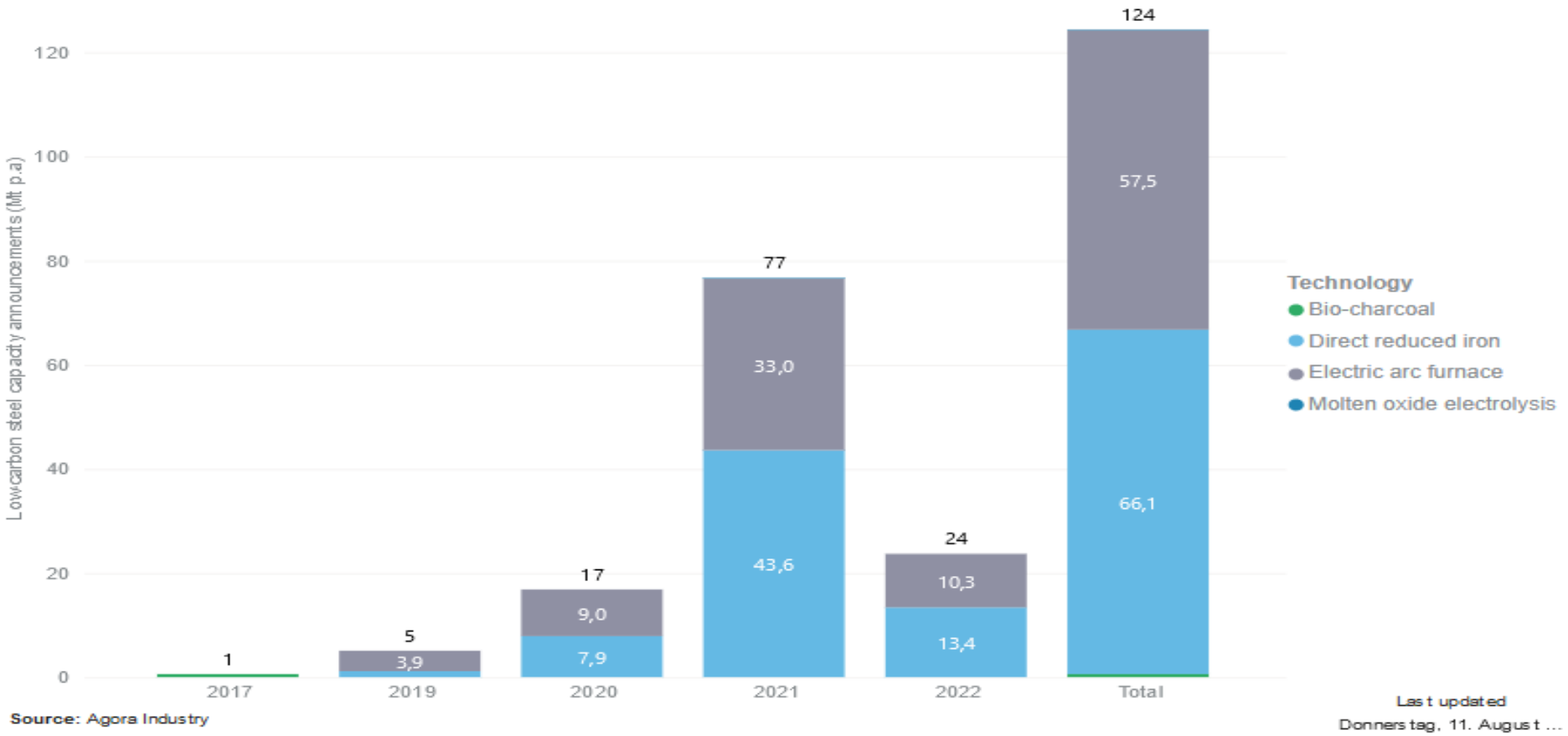
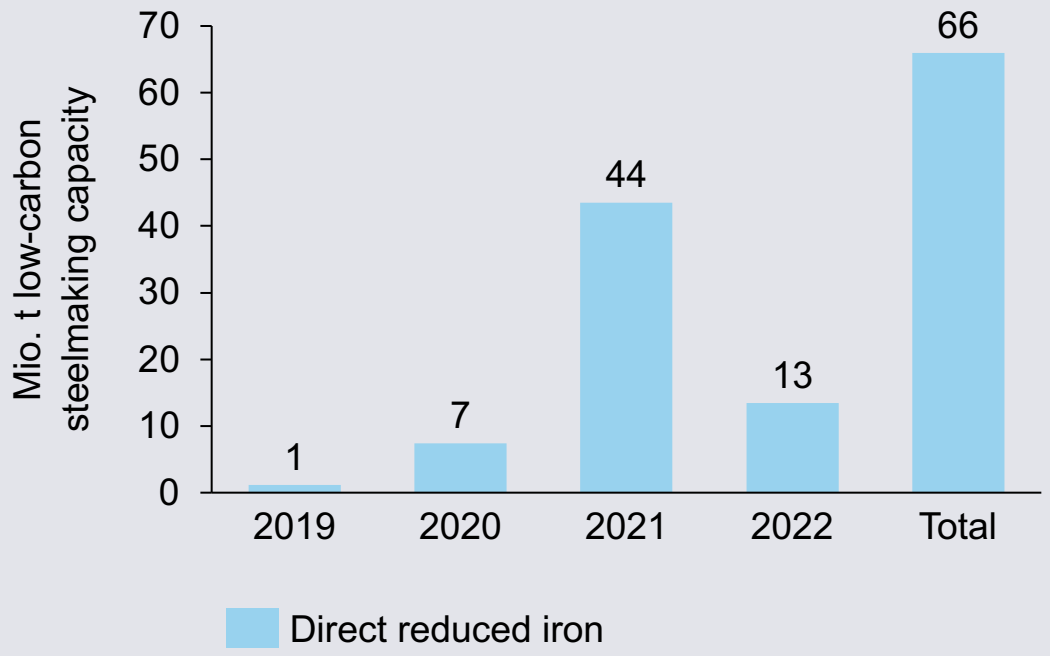
To date, steel companies have announced to replace 124 Mio. t of blast furnace capacity with low-carbon technologies: these are dominated by a switch to scrap-EAF and DRI-based routes



Source: Agora Industry

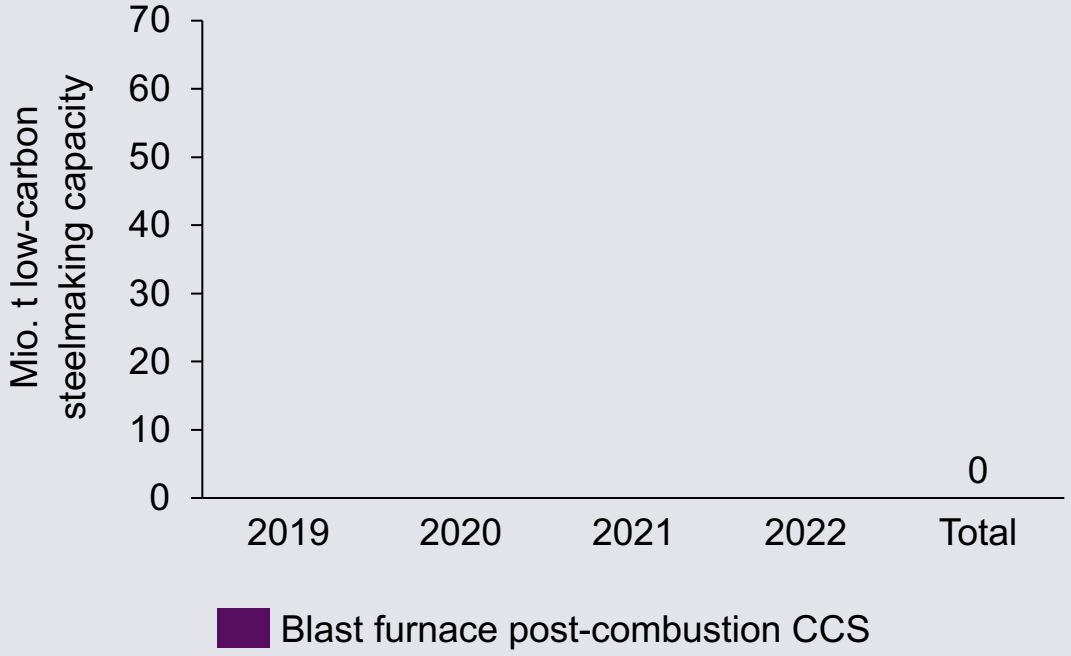
Betting on retroactive CCS for blast furnaces is a risky bet: few steel companies are working on the commercialization of CCS on coal-based blast furnaces

2030 low-carbon steel announcements: DRI



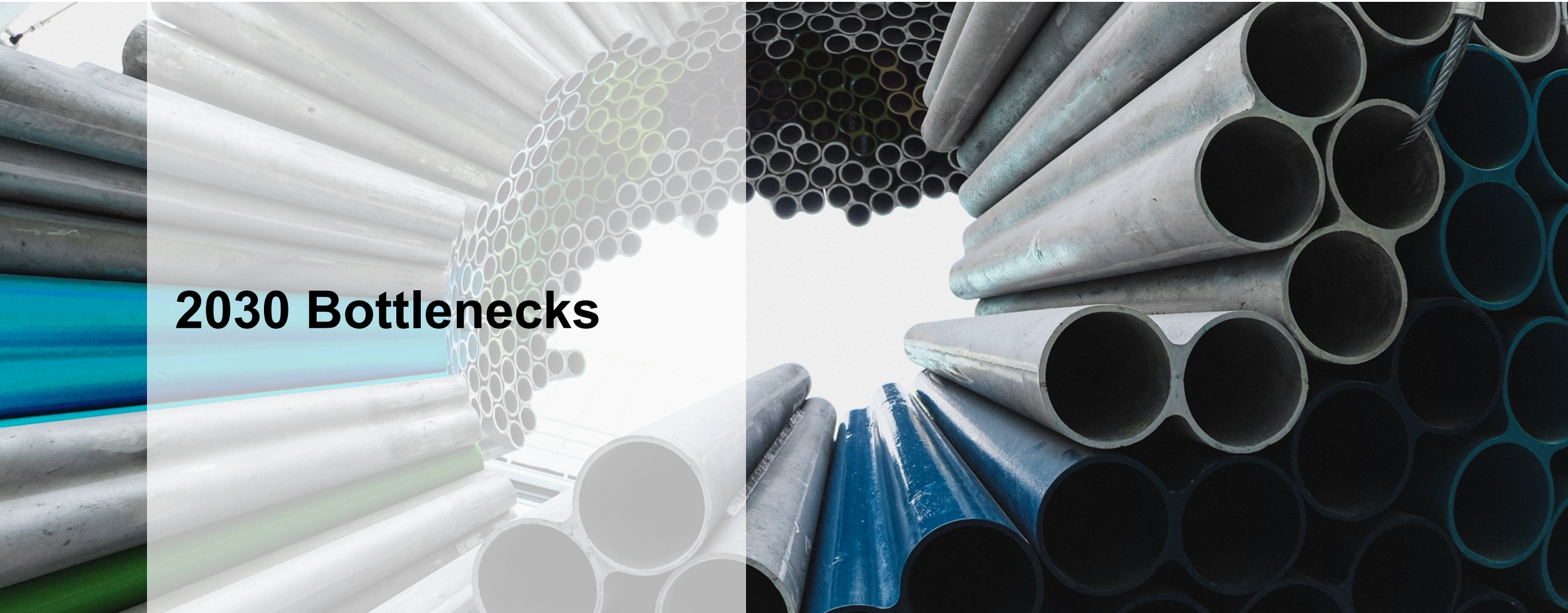
Agora Industry, Global Steel Transformation Tracker 2022

2030 low-carbon steel announcements: CCS in combination with coal-based blast furnaces



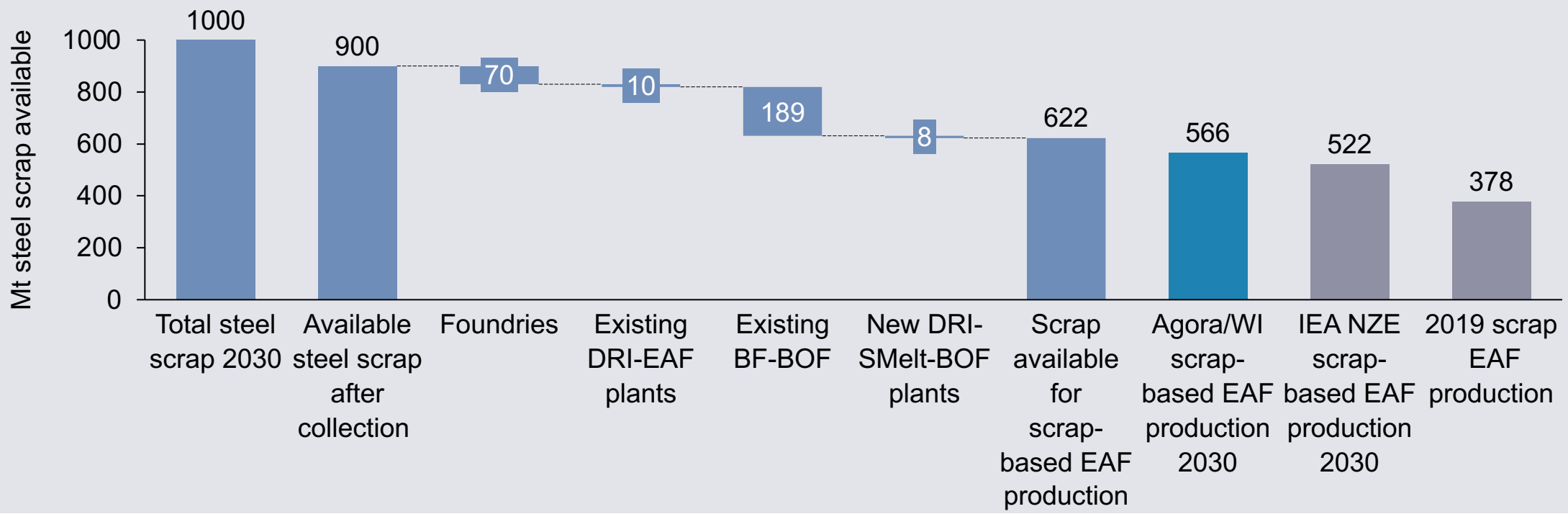
Agora Industry, Global Steel Transformation Tracker 2022

2030 Bottlenecks



Steel scrap: scrap supply will increase but is nonetheless limited. While the scrap-EAF route will grow significantly, low-carbon primary steel technologies will also be needed

Maximum potential of scrap-based EAF steel production based on 2030 steel scrap forecast



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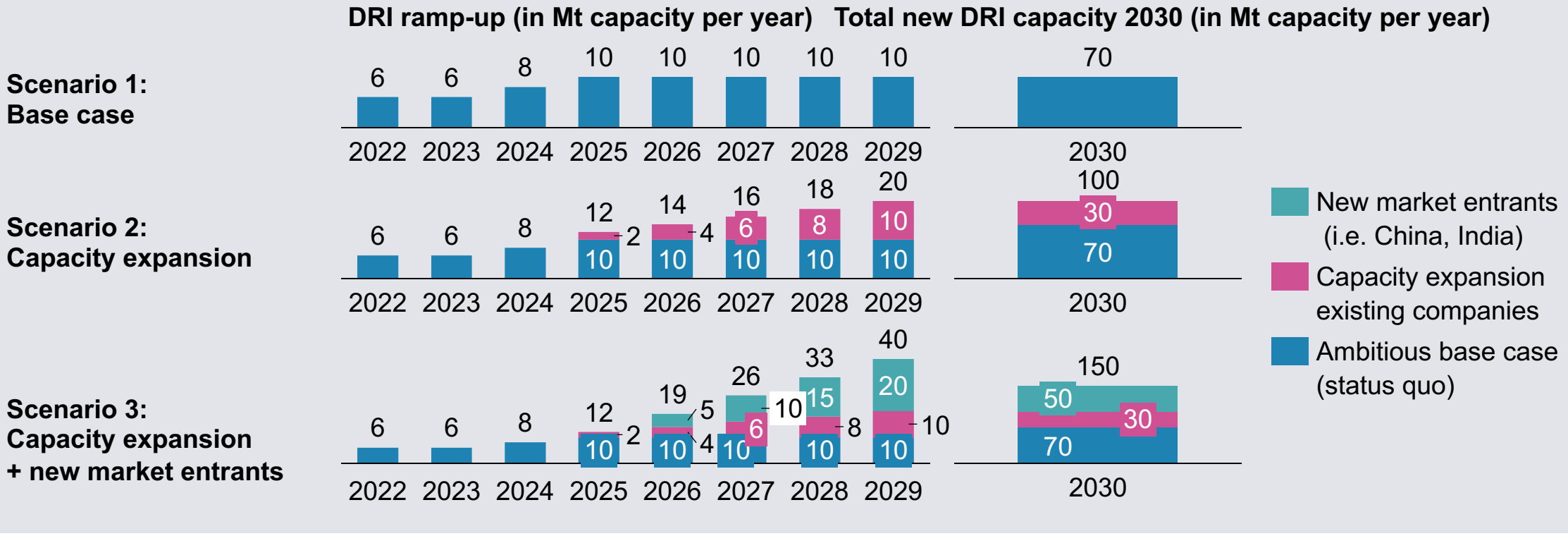
DRI engineering capacities: with current DRI engineering capacities, it won‘t be possible to reach the 2030 targets. Urgend action is required to remove this bottleneck

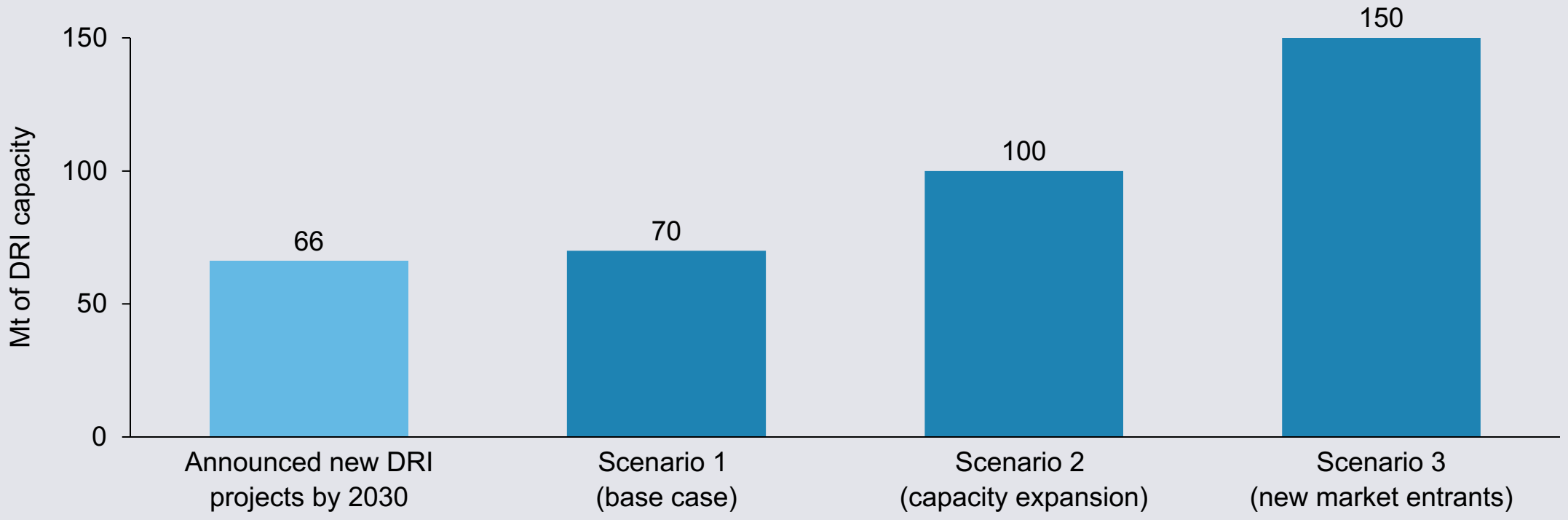
Three scenarios of DRI engineering capacity



Agora Industry, Wuppertal Institute, Lund University own analysis 2022

DRI engineering capacities: if more than 100 Mt of near-zero primary steel will be needed by 2030, more than 100 Mt of DRI capacity will be required

Overview of announced DRI capacity by 2030 and scenarios for ramp-up of DRI in various engineering capacity scenarios



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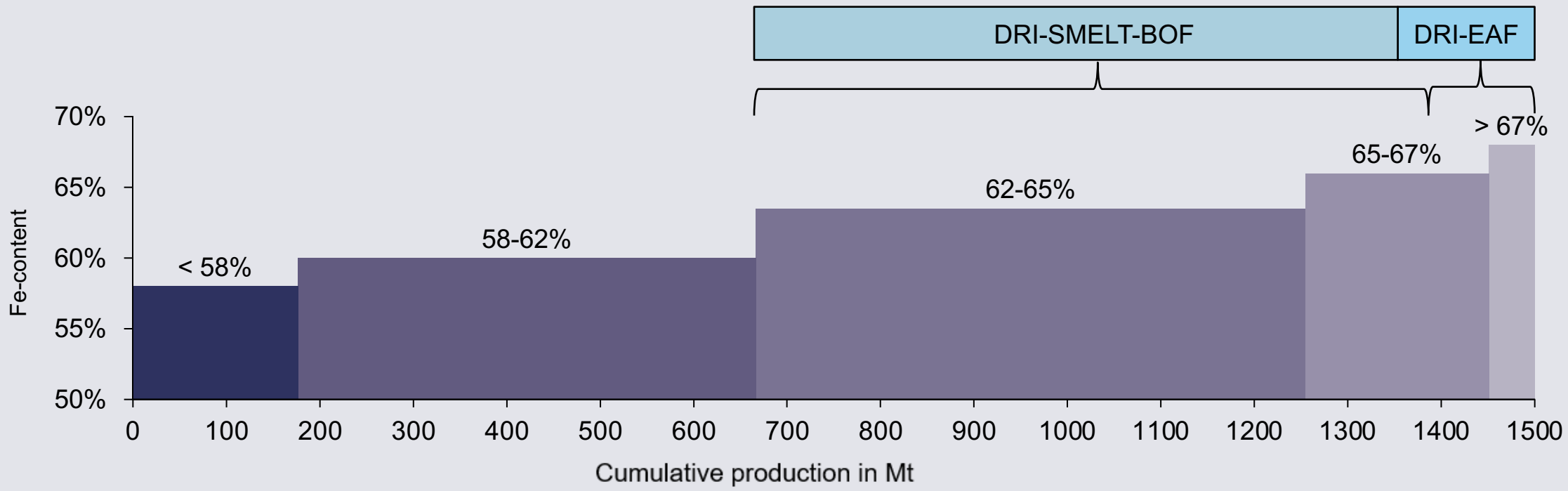
DR-grade pellets: many studies indicate that DRI-grade pellets will be a bottleneck for DRI deployment. But the DRI-SMELT-BOF route will enable the use of 50% of all iron ore qualities

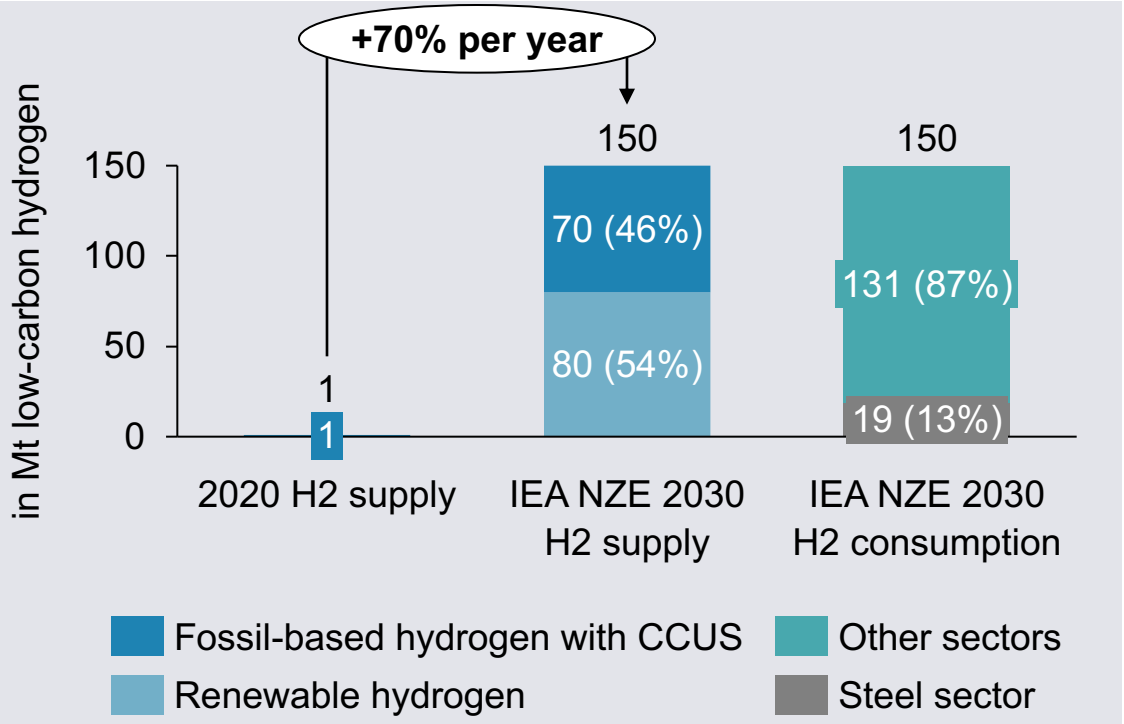
Iron Ore Seaborne freight by grade



Agora Industry and Wuppertal Institute based on Mission Possible Partnership 2021

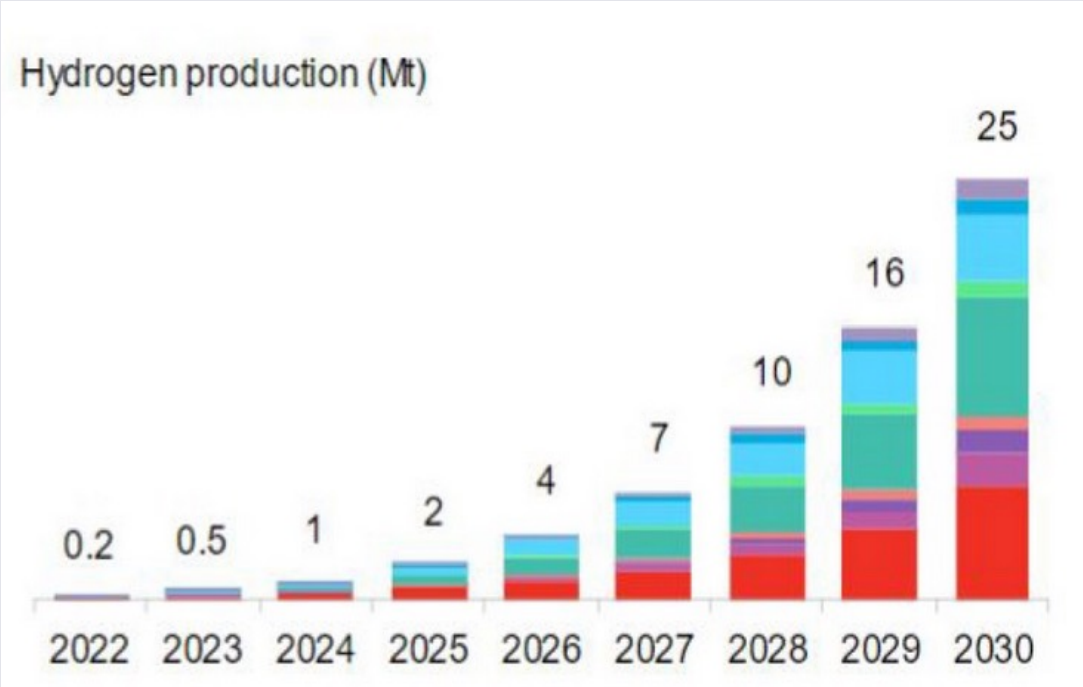
H2 supply and infrastructure: the supply of low-carbon H2 needs to be ramped up significantly, but over the last years the project pipeline has seen fast growth

Breakdown of low-carbon H2 supply and consumption in IEA NZE



Agora Industry based on IEA 2021 and IEA 2022

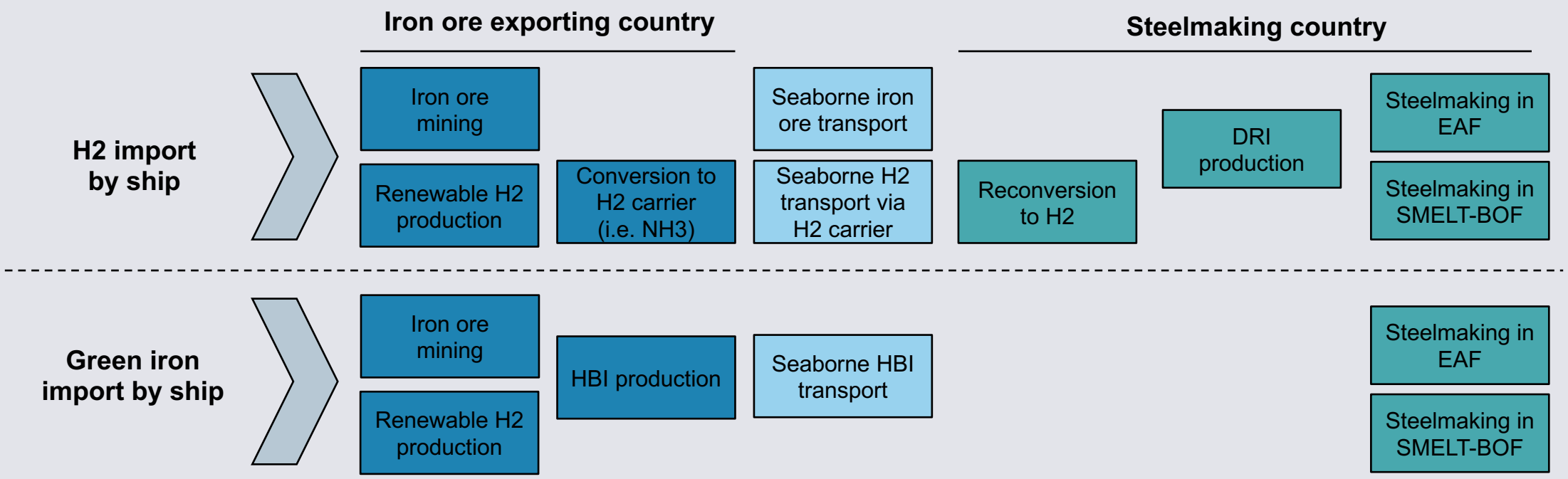
Current estimates of renewable H2 supply by 2030



BNEF, 2022

H2 supply and infrastructure: Shipping green iron instead of H2 and its derivatives minimises the energy losses in reconversion processes and H2 infrastructure demand

Comparison of two potential routes for cross-country low-carbon steelmaking value chains



Agora Industry and Wuppertal Institute, 2022

Summary

- According to the IEA, for a 1.5°C compatible steel decarbonization pathway, by 2030 the steel industry needs to reduce its emissions by 30% and produce more than 100 Mt of near-zero emission primary steel.
- The most important technologies will be an increase of scrap-based EAF production and the fast ramp-up of DRI-based steelmaking technologies.
- DRI engineering capacities will be the most important bottleneck until 2030. Urgent action is required to expand this capacity.
- Limited DR-grade pellet supply will likely be less of a short-term bottleneck. The DRI-SMELT-BOF routes allows the use of blast furnace pellets and thus the use of 50% of the global iron ore supply
- Low-carbon H2 supply needs to be ramped up quickly, but DRI plants can also be initially operated with natural gas. Low-carbon H2 can be blended in later as it becomes available. For oversea trade, transporting green iron instead of H2 and its derivates will likely be cheaper and reduce H2 infrastructure demand.

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