ITEM 12. FACILITATING STEEL COMPANIES' TRANSITION TO LOW-CARBON STEEL

FINAL REPORT: A DEEP DIVE INTO STEEL COMPANIES' DECARBONISATION STRATEGIES

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PWB 2023-24 – Decarbonisation Workstream Overview

Output Result 4 (OR 4)

March 2023 | Sept.2023 | December 2023 | May 2024 | December 2024

- **Indicators on Decarbonisation Progress** (IOR 4.1)
  - December 2023
  - December 2024
- **The Steel Industry & the Low-carbon Transition** (IOR 4.2)
  - Interim Report DSTI/SC(2023)13
  - Final Report DSTI/SC(2024)06
- **The Circular Economy & Scrap** (IOR 4.3)
  - Interim Report DSTI/SC(2023)14
  - Final Report DSTI/SC(2024)5
- **Hydrogen as a new Strategic Input** (IOR 4.4)
  - Final Report
- **Workshop on Technological Solutions** (IOR 4.5)

Outline of the Report

Steel companies & decarbonisation: The **state of play**

- ✓ Companies' decarbonisation strategies, pathways, projects
- ✓ Scope: top steel producers for each region

Identifying **patterns** in companies' decarbonisation strategies

- ✓ Groups of companies with similar approaches
- ✓ Drivers shaping these strategies

Policy mapping & policy insights

- ✓ Decarbonisation challenges
- ✓ Mapping of policies enabling steel decarbonisation
- ✓ Policy insights to facilitate the steel industry's transition

Why is this important?

- **Steel Decarbonisation is a central theme in discussions incl. trade, markets, production, and beyond.**
- Decarbonisation is a prevalent topic of discussion in the steel sector since the emergence of low to zero carbon technologies
- Decarbonisation is imperative shaping the landscape of **both business strategies and policymaking to reach the Paris Agreement**
- Close coordination of value chains, i.e. government-companies & upstream-downstream, is a key enabler for the steel industry decarbonisation

Methodology: Identifying challenges from Companies' Decarbonisation Strategies & Policy mapping

Company's challenges & low-carbon projects

- ✓ Identifying challenges:
  - Interim report, company's annual report, white papers, articles, etc.
- ✓ A total of **229** low-emission projects
- ✓ Targeted Technologies: Energy efficiency, Hydrogen, H-DR, CCUS, Scrap, Emergent technologies,
- ✓ Investment size
- ✓ Source: World Steel Dynamics, Company's annual report, Green Steel Tracker

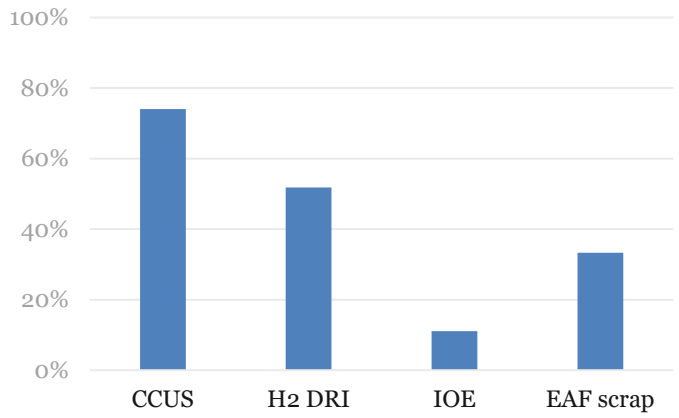
Policy mapping

- ✓ **11** jurisdictions, a total of **87** policies
  - Policy instruments: Regulation, R&D, funding, plan….
- ✓ Targeted Technologies: Energy efficiency, Hydrogen, H-DR, CCUS, Bioenergy, Scrap, Emergent technology, Not technology specific
- ✓ Supply-side VS Demand-side
- ✓ Phase-in VS Phase out
- ✓ Which challenges addressed?
- ✓ Source: Climate Club policy database, Gov. policy briefings, etc.

Key Challenges for Decarbonisation

1) Technology scale-up

- ✓ Rapid technological maturity is a key but technological readiness is limited
  - 74% CCUS (TRL 5)
  - 52% H2-DRI-EAF (TRL 6)
  - 11% Iron Oxide Electrolysis (TRL 4-6)



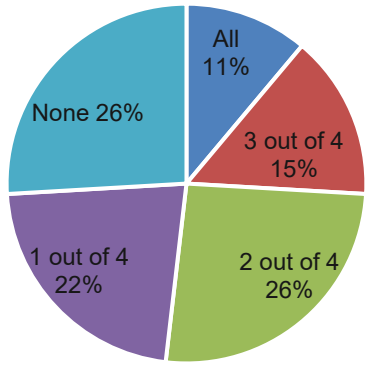


Figure 1 & 2. Share of low-carbon breakthrough technologies selected by the sample companies' decarbonisation strategy

- ✓ Low-emission technologies must be compatible with long-term net zero goals

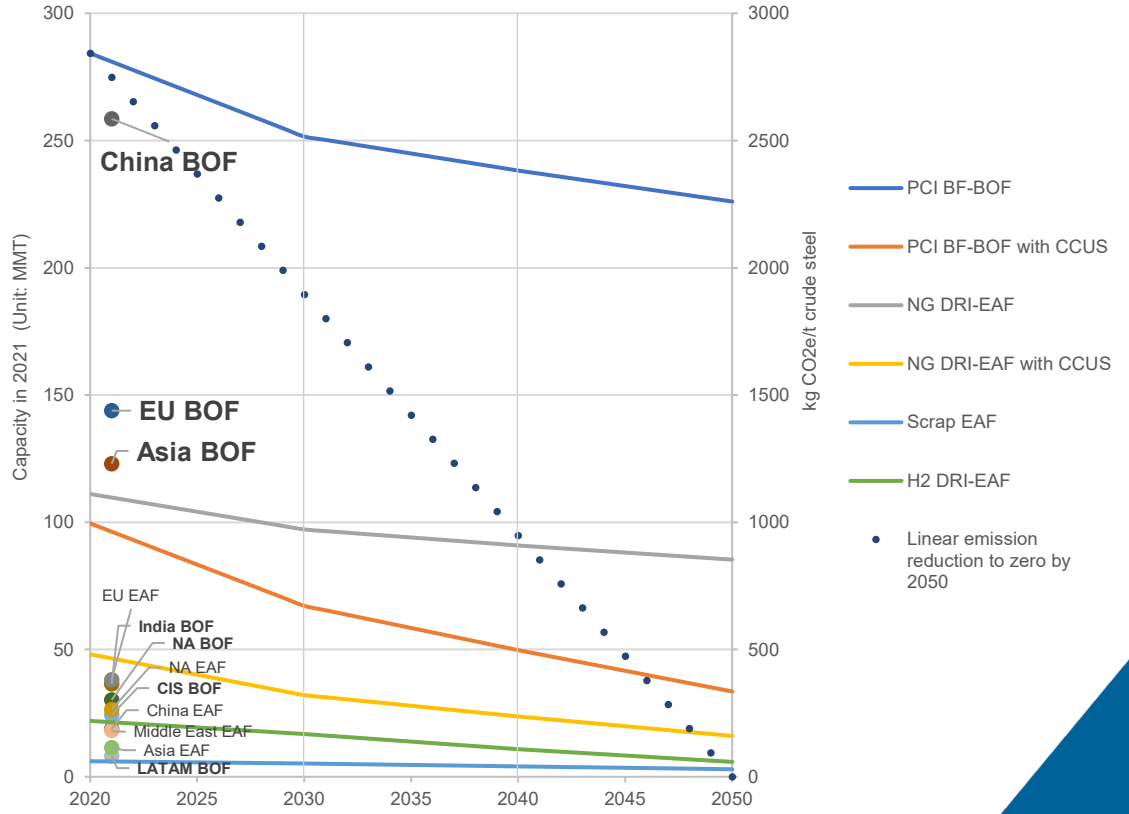


Figure 3. Emission intensity of selected technologies (IEA (2023), Vogl and Åhman (2019).

Key Challenges for Decarbonisation

2) Finance

- ✓ Low- to near zero-carbon innovative technologies are capital-intensive
- ✓ Investment costs for **Development up to TRL 9 + Production plants + Auxiliary facilities** + OPEX + electricity +…. (per 1 MTPA crude steel)
  - **H2-DRI**: € 250 million for TRL 9 + € 250 million Full industrial plant + € 100 million Water electrolysis
  - **CCUS**: €450 million for TRL 9 + €1000 million for Full industrial plant + € 200 million CO2 capture

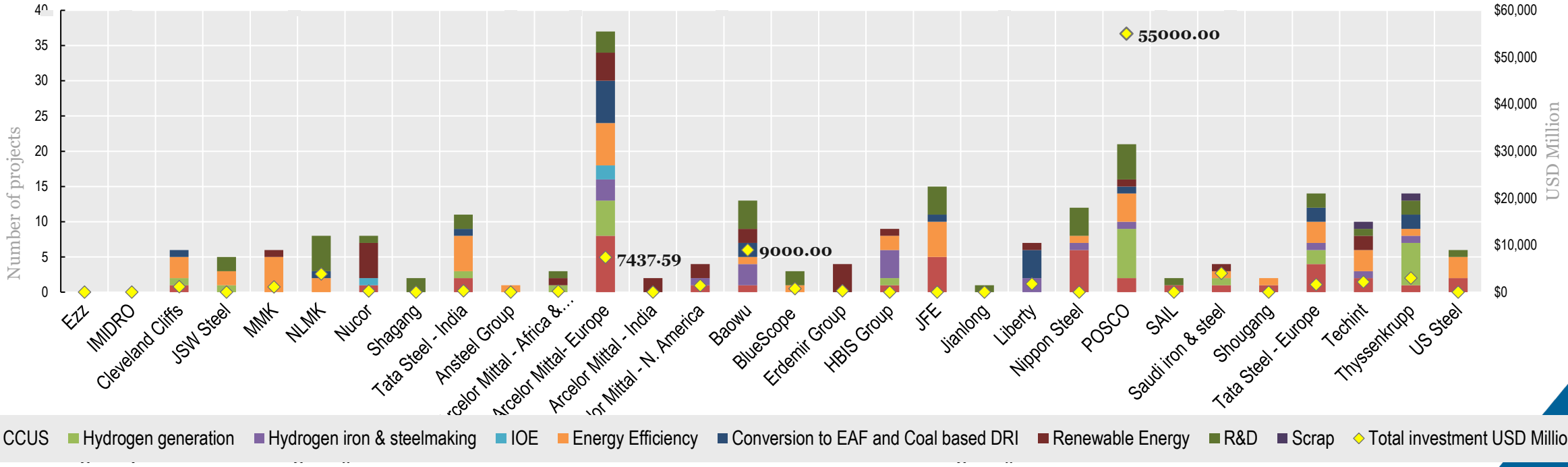


Figure 4. Investment size and the number of low-emission projects announced by the sample companies (World Steel Dynamics (2023))

Key Challenges for Decarbonisation

3) Resources

- ✓ **Steel decarbonisation depends on significant limited resources**
- ✓ Key resources for technology route types**:**
  - CCUS: carbon storage sites & carbon transportation
  - H2-DRI-EAF: availability of green hydrogen
  - DR-grade pellets & iron ore with high iron content
  - Scrap

4) Demand / Market for low-emission steel

- ✓ **10-50%** cost increase per tonne of low-emission steel
- ✓ High demand-signal from downstream industries esp. automotive industry to reach their scope 3 emissions

  -> **Voluntary commitments**

5) Barriers to exit

- ✓ By 2050, steelmaking based on
  - **44% electrolytic hydrogen**,
  - **37% CCUS-equipped facilities,**
  - **14% IOE**
- ✓ By 2050, steel production will grow from 1880 Mt (2022) to 1960 Mt (2050) (IEA, 2023)

  -> **4.3 % increase** (IEA, 2023)

Policy mapping: the status quo in selected jurisdiction

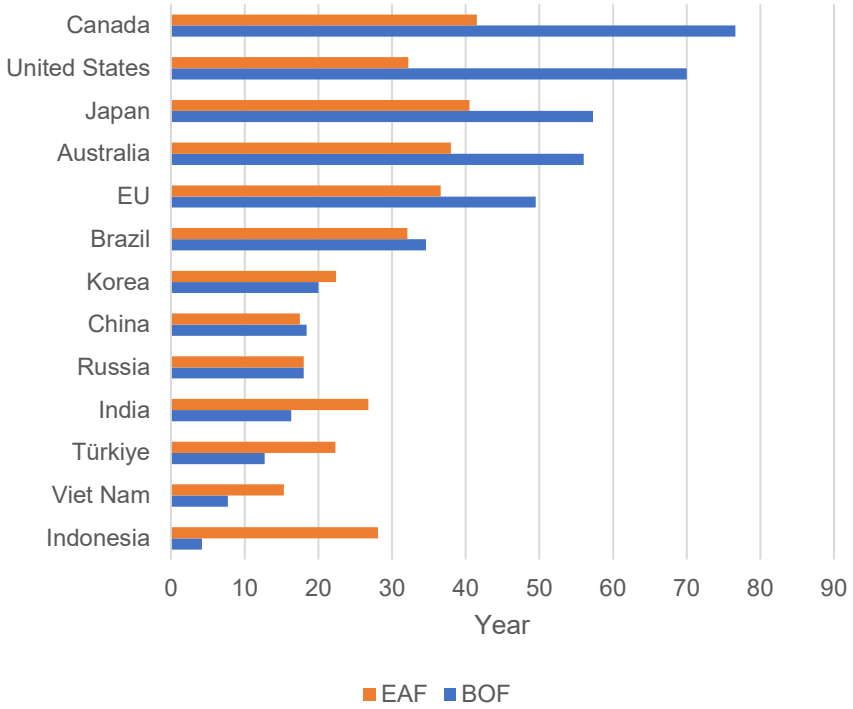


Figure 5. Average age of steelmaking capacity by types of asset

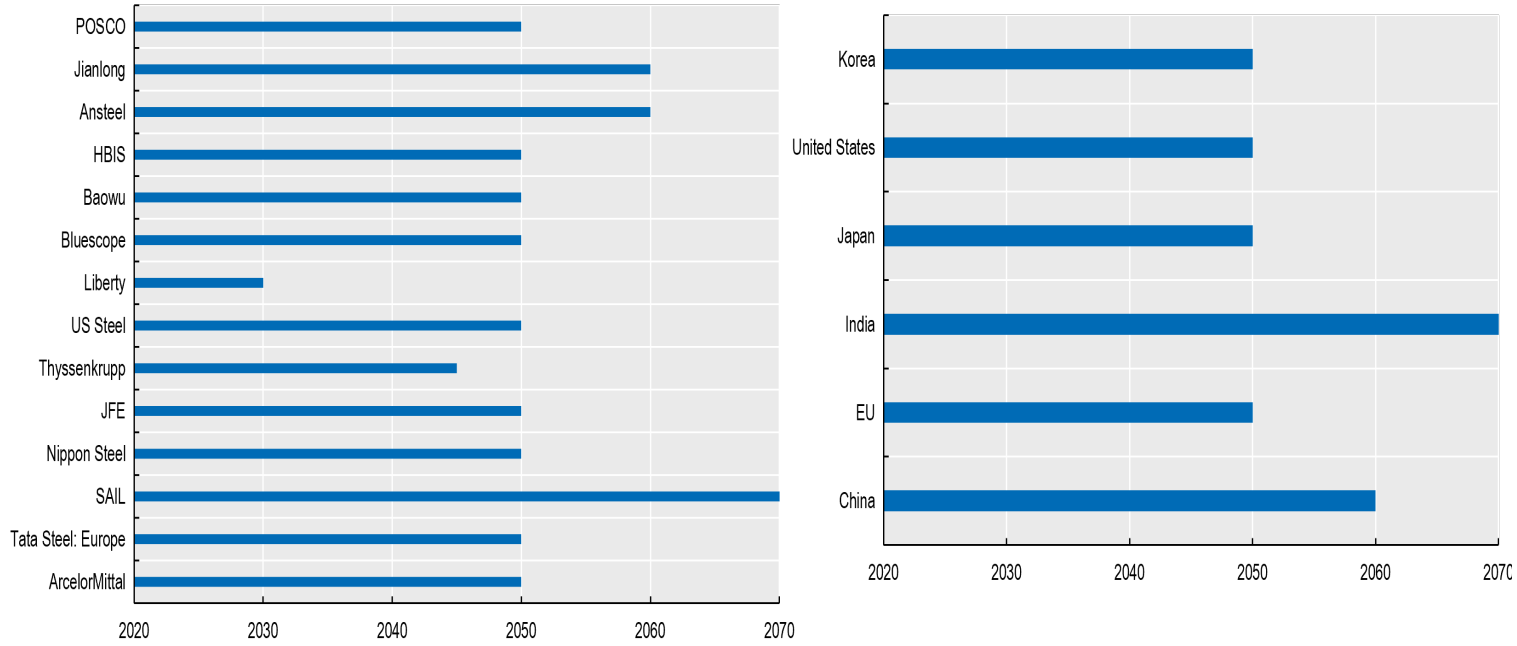
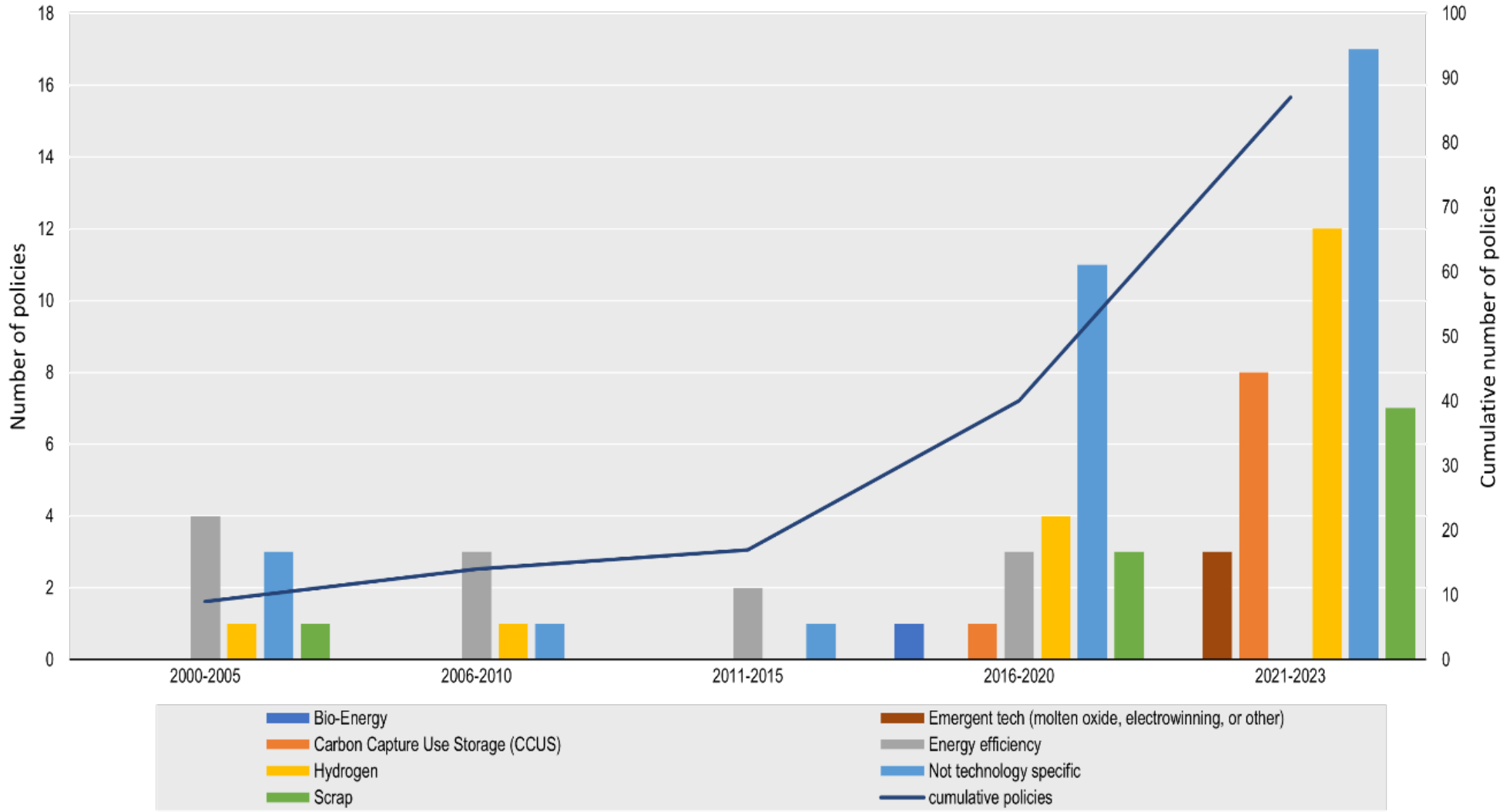


Figure 6. Net zero target years in company strategies and net zero target years set by government

Key findings: Timeline of policy announcements and their target technologies (Figure 7.)



Key findings: Comparing focus areas between company decarbonisation strategies & policies

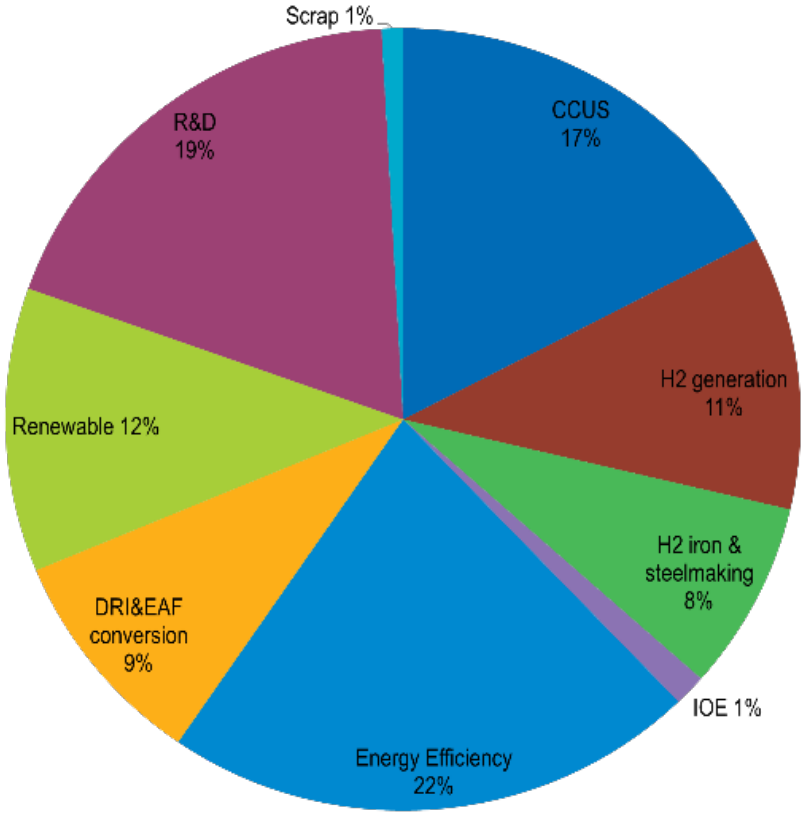


Figure 8. Technology profiles of low-emission projects from the sample companies (World Steel Dynamics (2023))

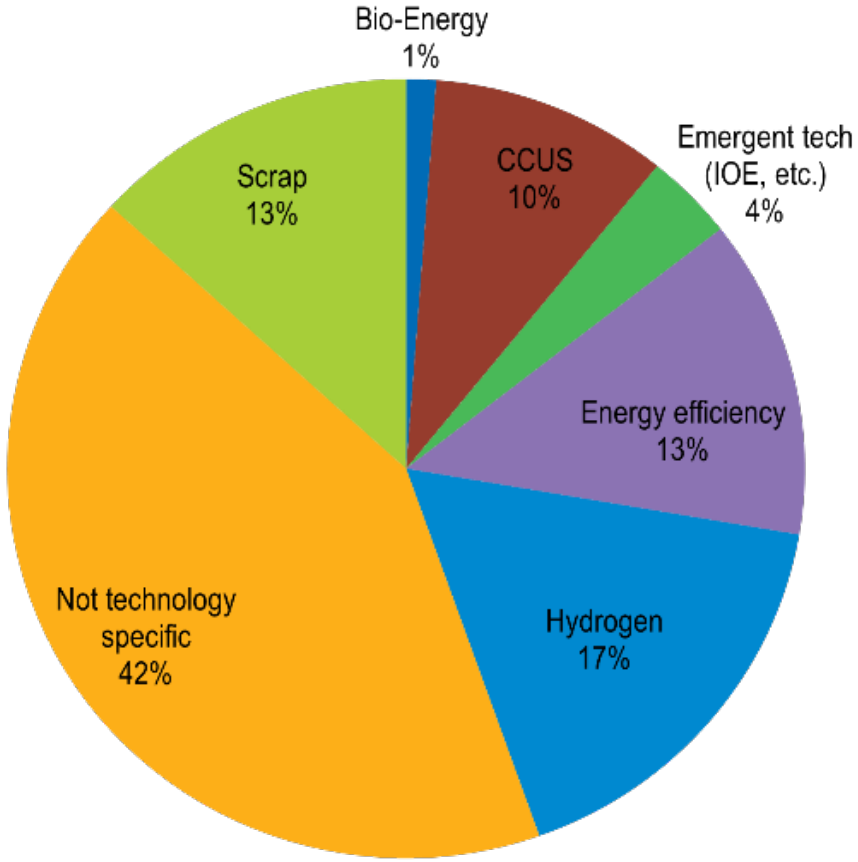


Figure 9. Technology profiles from policies in selected jurisdiction

Policy focus: Where are we paying attention?

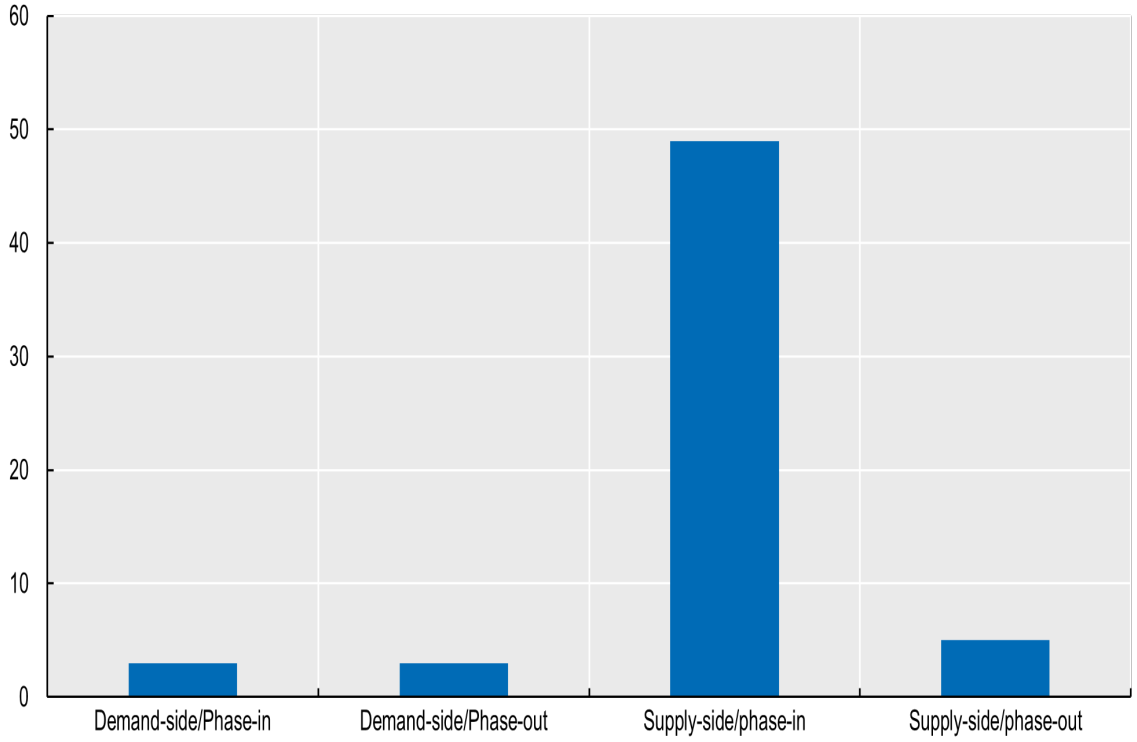


Figure 10. Orientation of policies in the selected jurisdictions

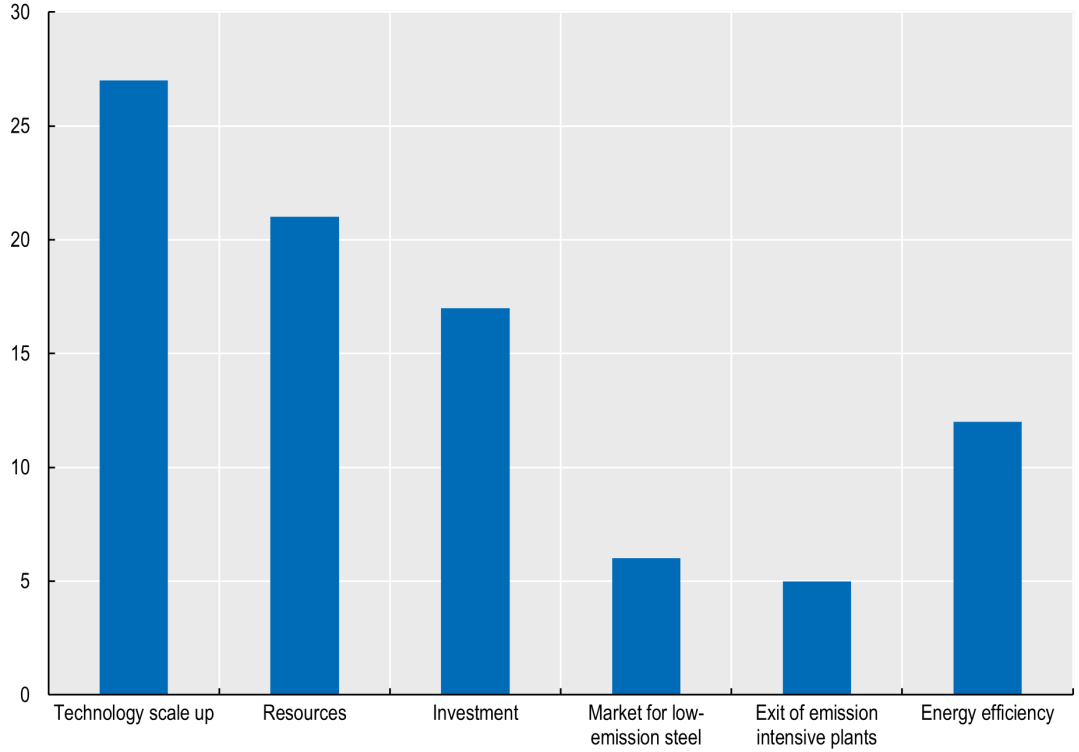
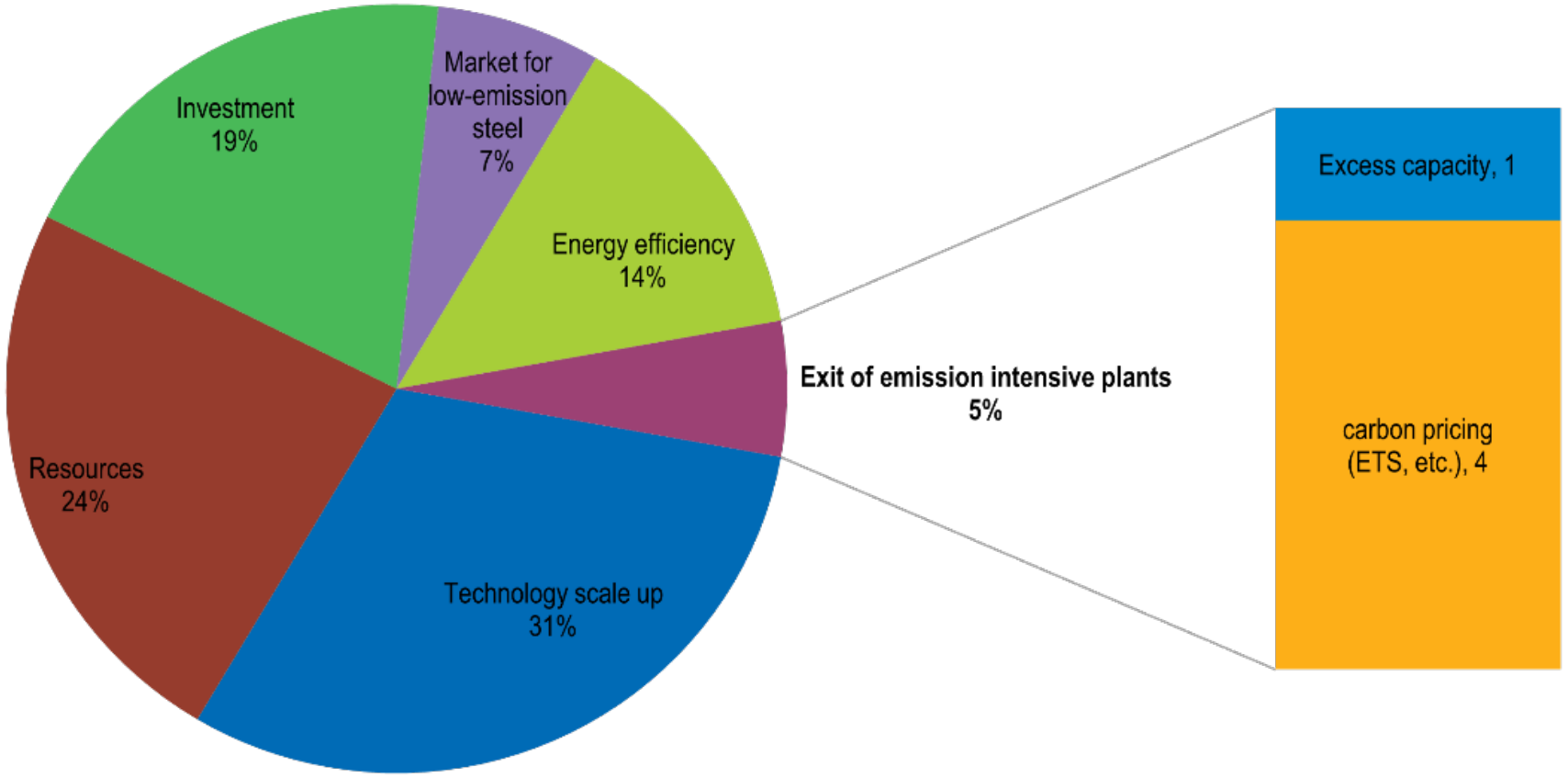


Figure 11. Challenges addressed by policies

Key findings: Distribution of policies addressing identified challenges (%) (Figure 12.)



Summary of key findings & policy insights

Company's strategies:

- The vast majority of steel companies have set ambitious decarbonisation objectives with a decarbonisation roadmap

Policy-mapping:

- Much focus on supply-side/phase-in, **with insufficient focus on demand-side/phase-out**
- Policy approaches will have to adapt with rapid advances in low-carbon steelmaking
- Competitiveness of low-carbon steel as well as rapid exit of emission-intensive plants require **carbon pricing** and/or **direct market-shaping**

Correlations between company's strategies & policy frameworks:

- the more ambitious a country's net-zero target, the more ambitious its companies' targets, often even more so
- An increasing number of steel companies and jurisdictions have engaged in the steel decarbonisation with the roadmap, **yet details are lacking**
- **Energy Efficiency** has been and continues to be an important part in both company strategies and policy perspectives partly due to the still prevalent of BF-BOF
- Close coordination of value chains is needed
- Limited attention to **just transition** both from company's strategies (5) and the policy perspective (7)

THANK YOU

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