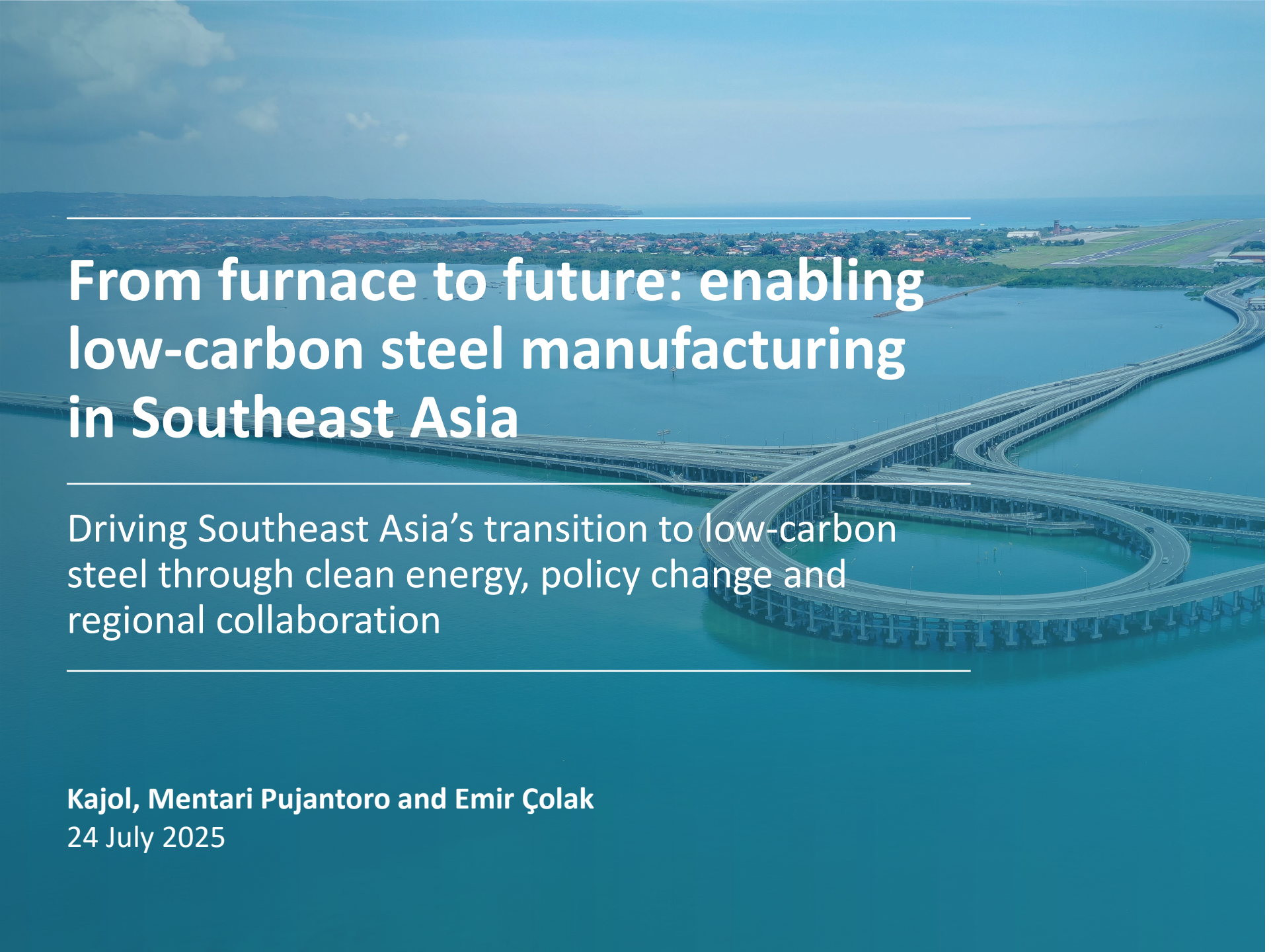

From furnace to future: enabling low-carbon steel manufacturing in Southeast Asia

Driving Southeast Asia’s transition to low-carbon steel through clean energy, policy change and regional collaboration

Kajol, Mentari Pujantoro and Emir Çolak

24 July 2025

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Agora Energiewende

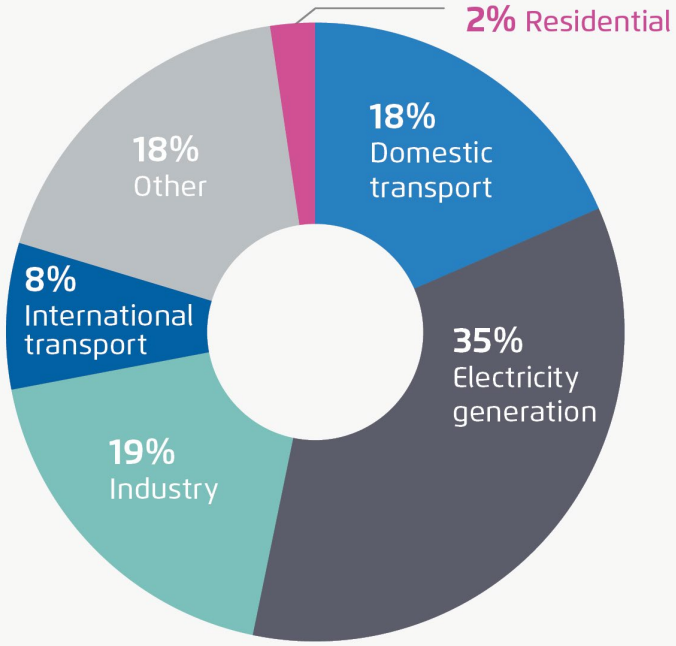
Content

→ Southeast Asia steel production and growth
→ Challenges in the steel sector
→ Pathways and enabling conditions

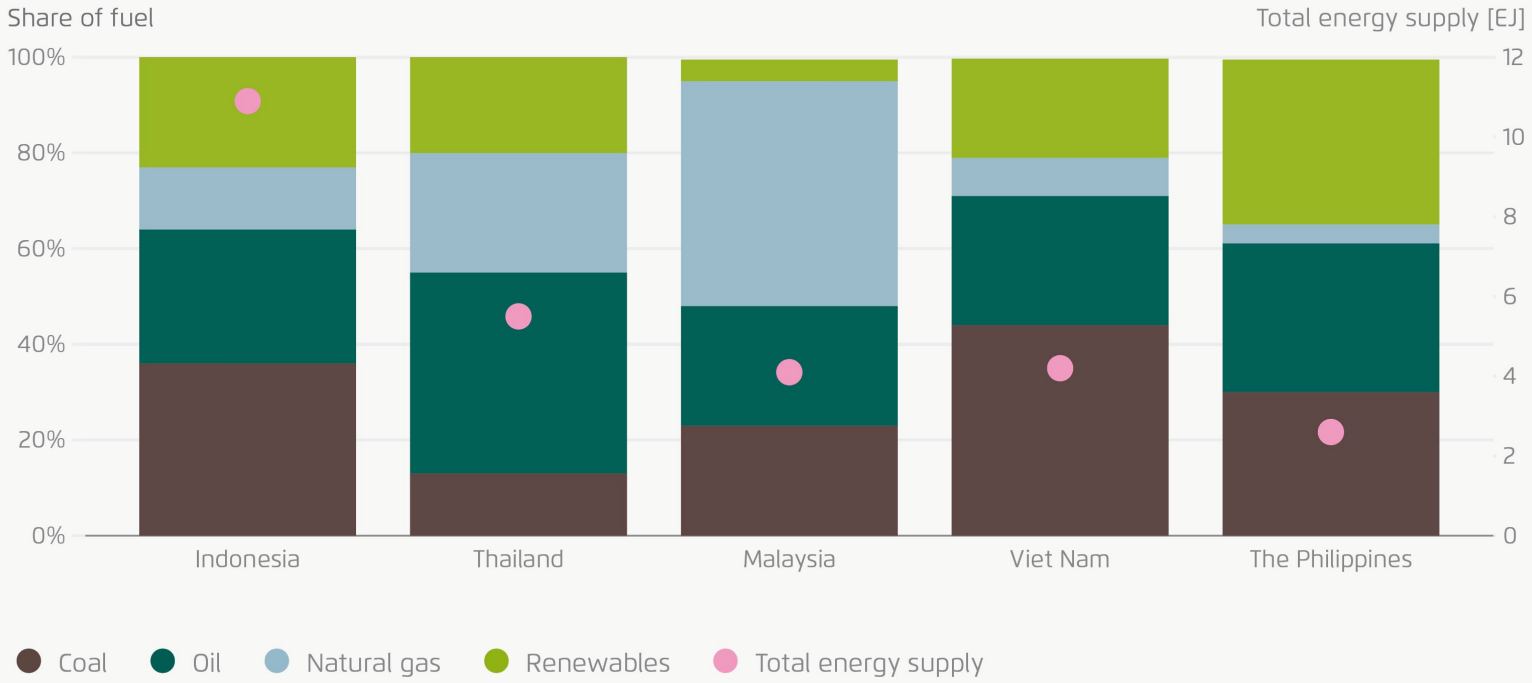
Southeast Asia steel production and growth

Energy landscape in Southeast Asia

Greenhouse gas emissions by sector in Southeast Asia, 2022



Energy demand by fuel in Southeast Asia, 2022



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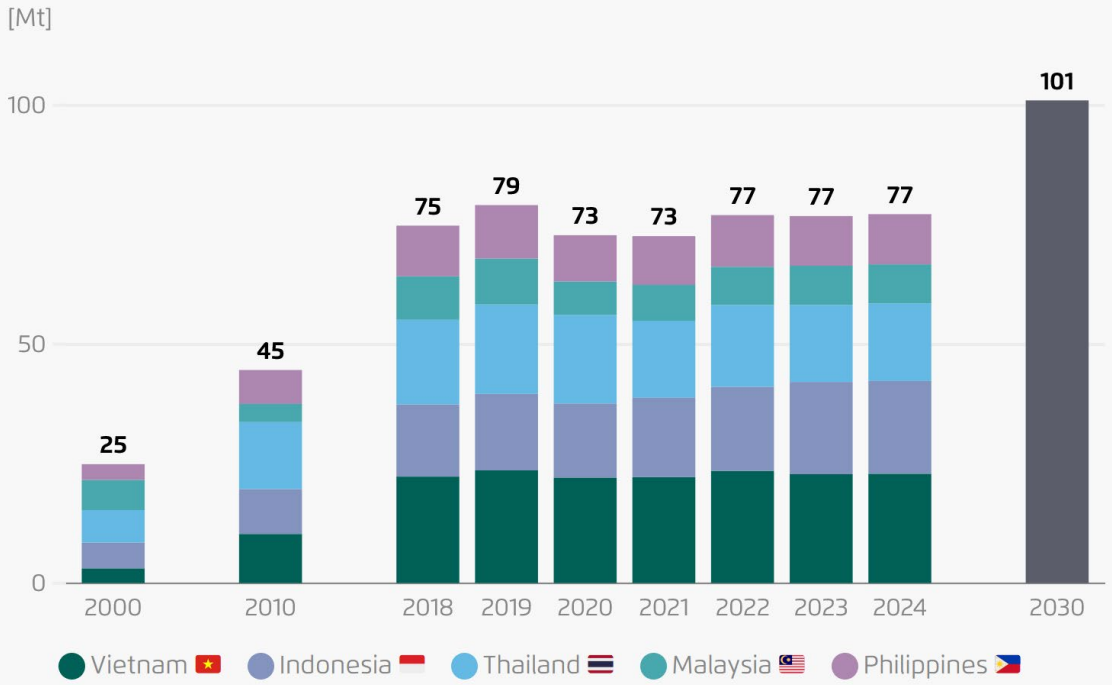
Steel demand in Southeast Asia is projected to reach 101 Mt by 2030

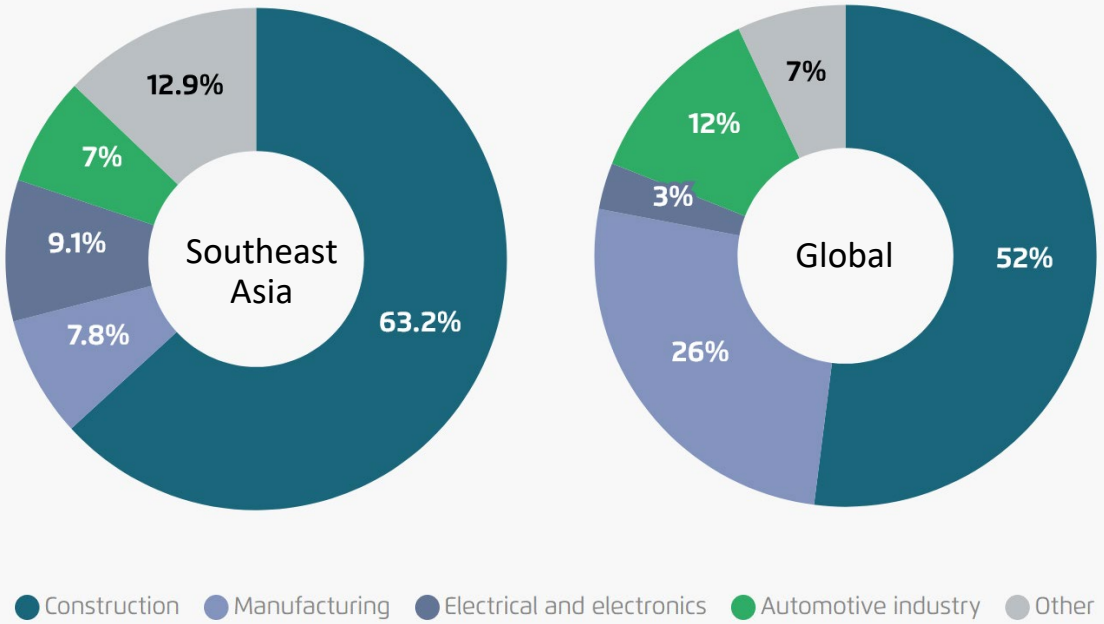
Steel demand is growing, driven by urbanisation and infrastructure projects

Historical and forecasted steel demand in Southeast Asia



The construction sector is driving the growth of steel consumption (2024)

Steel consumption by sector in Southeast Asia and globally



 | Source: SEAISI (2022) and World Steel Association (2024)

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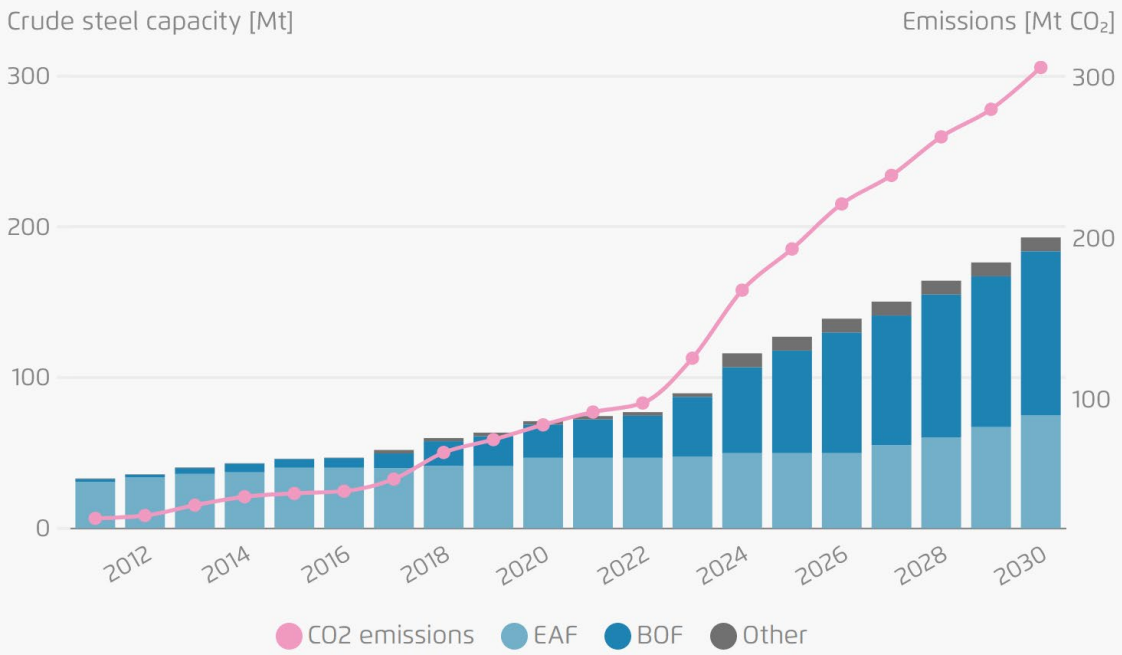
Historically dominated by EAF, the region has now shifted towards BF-BOF route

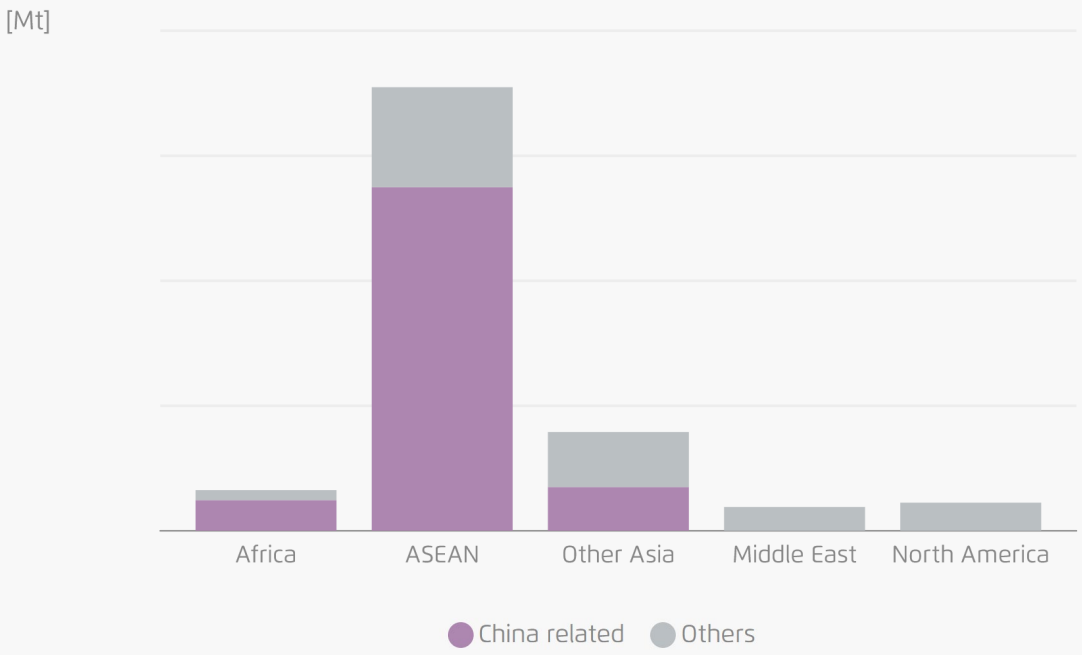
BF-BOF share in SEA crude steel capacity rose from 6% to 30% between 2011–2020, adding ~20 Mt capacity

Historical and forecasted crude steel capacity vs emissions in Southeast Asia



Investment from Chinese companies and domestic policy have driven BF development pipeline in ASEAN-5

Announced foreign investment in steel production capacity (2023)

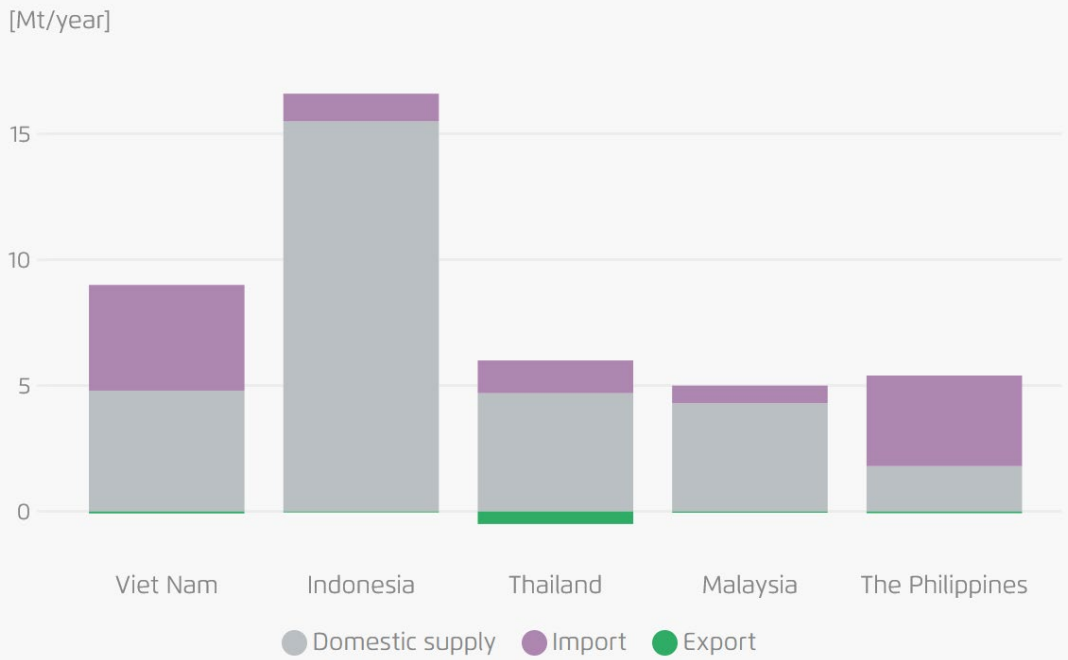


 Source Agora Industry based on SEAISI (2022) , GEM (2024) and OECD (2024)

The evolving steel trade landscape in Southeast Asia

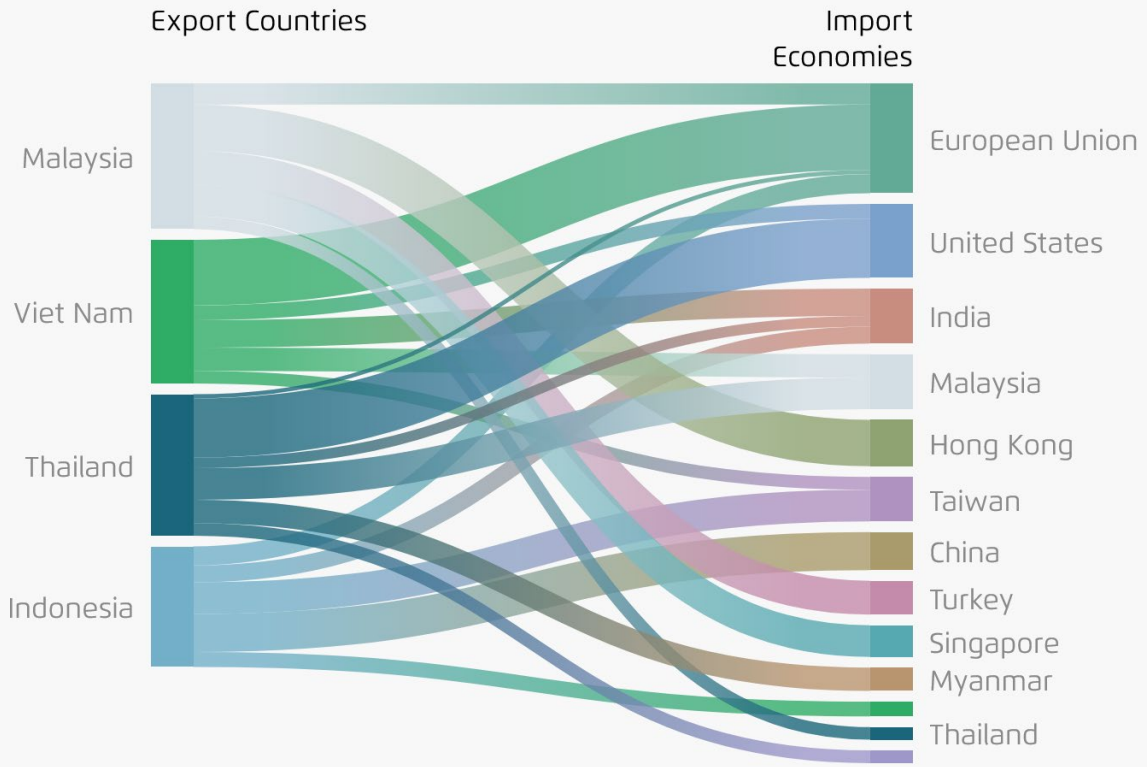
Southeast Asia's rising scrap demand highlights the need for investments in improved recycling practices

Scrap demand in Southeast Asia (2023)



The challenge lies in remaining competitive

Steel exports from Southeast Asia (2023)



 Source: US Department of Commerce, Enforcement and Compliance (2024) and SEAISI (2022)

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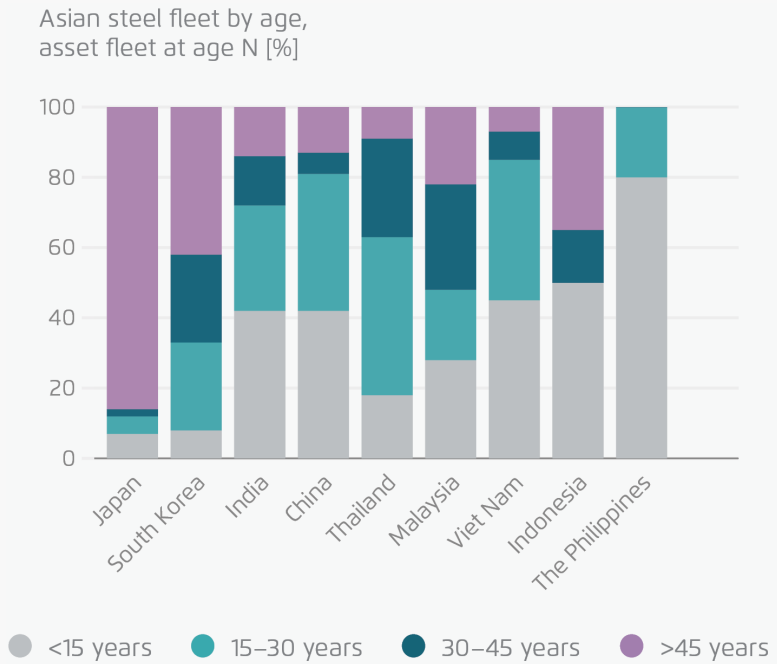
Steel sector challenges in Southeast Asia

Challenge 1: Young, carbon-intensive fleet and overcapacity risk long-term emissions lock-in

The young steel fleet poses a structural challenge for transitioning to greener technologies



Overcapacity issue and further investment in carbon-intensive fleet threatens flexibility in a changing market

Steel production and installed capacity in Southeast Asia

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Challenge 2: Availability of technology and cost of green steel

Feasibility analysis of net-zero technologies for Southeast Asia

Technology available by 2030

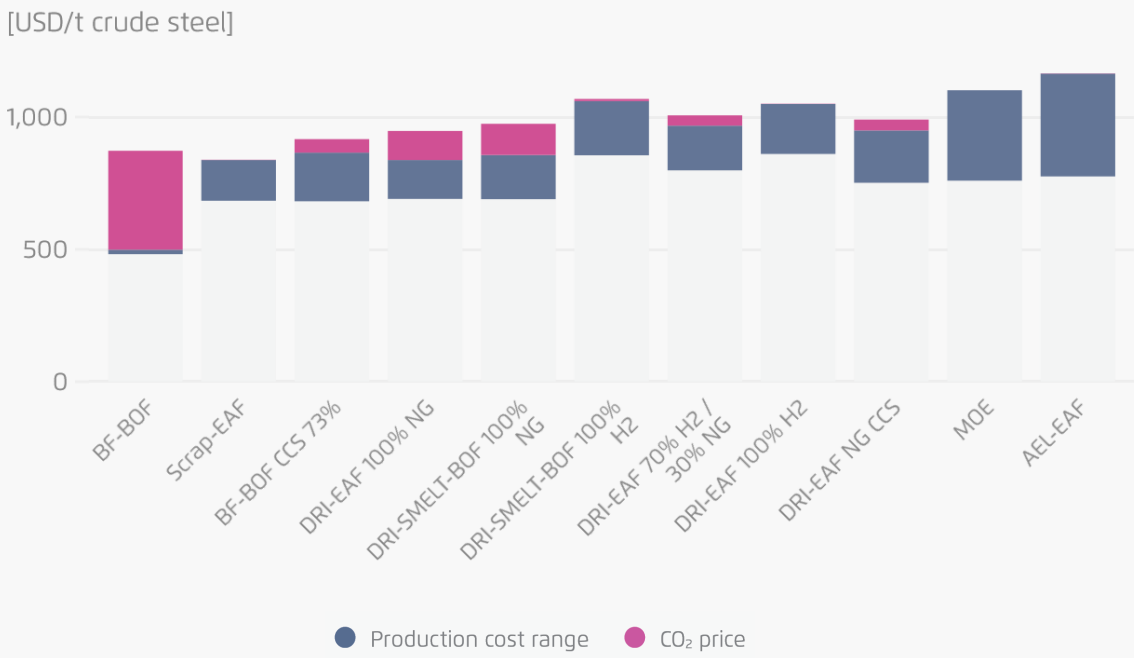
Low-carbon technology	CO_2 reduction	Residual emissions	Energy consumption	Challenge in Southeast Asia	Additional factors	Global production cost (2050)
NZE Scrap-EAF	100%	0.01 t CO_2/t CS	2.8 GJ/ t CS	Access to high quality scrap	Access to renewable energy	630–840 USD/t CS
DRI-EAF 100% H2	100%	0.007 t CO_2/t CS	10.8 GJ/ t CS	Additional steps/ assets needed for lower quality iron ore	→ Allows for flexible hydrogen uptake → Requires access to renewable energy and green hydrogen	720–950 USD/t CS
DRI-SMELT-BOF 100% H2	98%	0.04 t CO_2/t CS	11.9 GJ/ t CS	Lower quality iron ore possible	→ Allows for flexible hydrogen uptake → Requires access to renewable energy and green hydrogen → Access to renewable carbon input	720–950 USD/t CS

Technology available beyond 2030

MOE	100%	0 t CO_2/ t CS	14.8 GJ/ t CS	Lower quality iron ore possible	Requires large amount of continuous renewable electricity	600–1,100 USD/t CS
AEL-EAF	100%	0.01 t CO_2/ t CS	13.7 GJ/t CS	Lower quality iron ore possible	Requires large amount of continuous renewable electricity	600–1,100 USD/t CS
BF-BOF CCS 73%	73%	1.362 t CO_2/t CS	22.8 GJ/ t CS	Lower quality iron ore possible	→ Requires access to extensive CO_2 transport and storage infrastructure → Low technology development activity	600–950 USD/t CS

The carbon price mechanism can play a pivotal role for green steel production

Production cost analysis for different steel technologies in Southeast Asia, 2050



Left: Agora Industry (2025). Note: The technologies were chosen based on their technological maturity, potential for deep CO_2 reduction, and relevance to regional resource and infrastructure conditions. Production costs represent estimated ranges in USD per tonne of crude steel based on global trends. The challenges specific to Southeast Asian adoption are colour-coded: red indicates high challenge, yellow indicates medium, and green indicates low challenge. Right: Agora Industry (2025). CO_2 price: USD 200 per t CO_2, based on IEA (2024) data. The price of natural gas is assumed to be USD 12.5–18.7 per GJ (EREA & DEA, 2024). The price of renewable hydrogen is assumed to be USD 38–46 per GJ (Agora Energiewende and Agora Industry, 2024).

Challenge 3: Policy and regulatory support

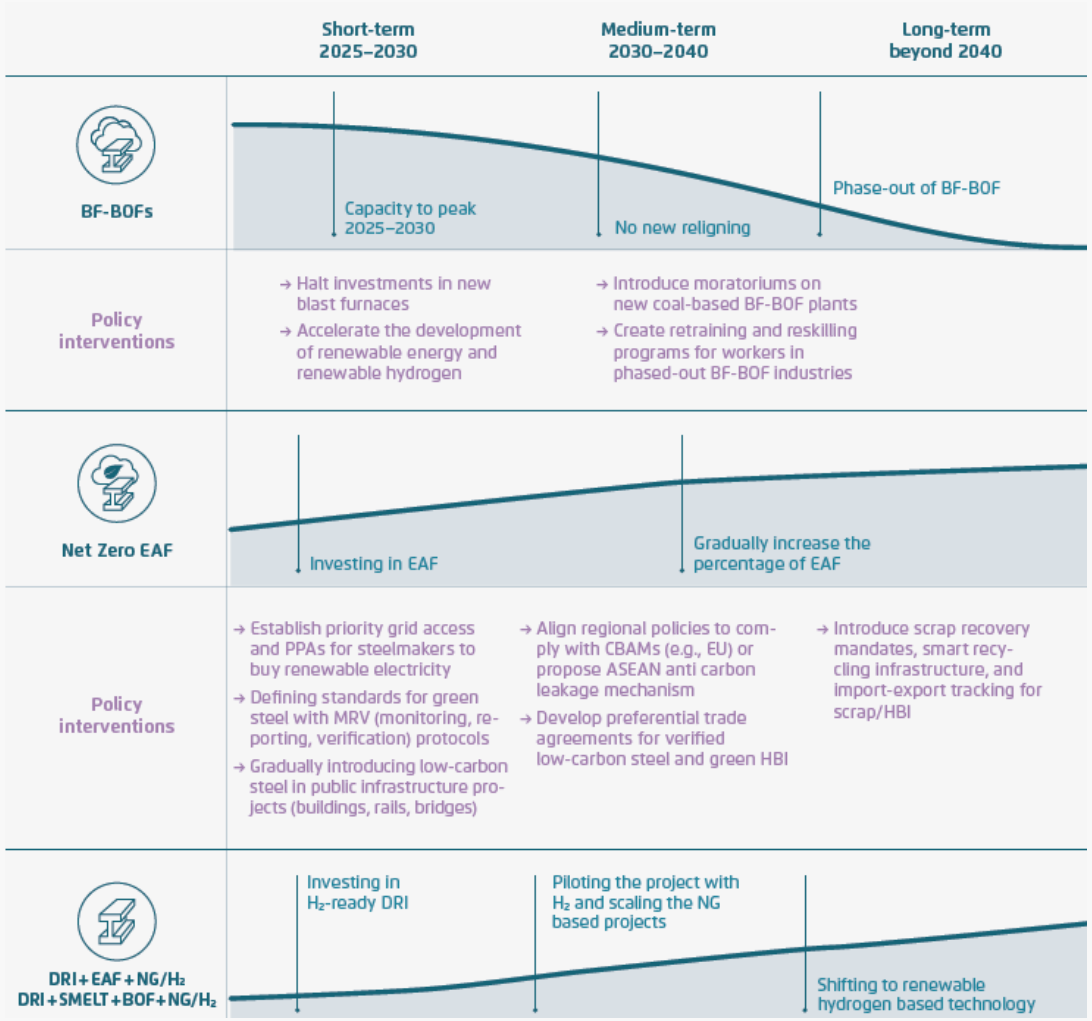
Upstream, midstream and downstream policies across Southeast Asia

	Country	Viet Nam	Indonesia	Thailand	Malaysia	The Philippines
Upstream	Steel decarbonisation roadmap	Drafting a strategy for green steel development until 2030	Ministry of Industry is developing roadmap	N/A	Green steel in New Industry Master Plan 2030	N/A
Upstream	Hydrogen policy	The hydrogen energy development strategy (2024) aiming to replace fossil hydrogen in fertiliser and petrochemical sector, and use in green steel	The national hydrogen strategy (2023) focuses on replacing the use of fossil-based hydrogen in fertilisers and ammonia production – some pilot projects for green hydrogen from solar and geothermal	Hydrogen strategy in the making. The recent power development plant focus on mixing hydrogen in the gas pipeline from 5% in 2030 to 20% in 2050	Hydrogen Economy and Technology Roadmap (2023) aims to replace fossil based hydrogen in the fertiliser, chemical and methanol sector and 20% of blending with fossil gas in power generation	Hydrogen strategy in the making, with discussions around hydrogen uses as long-term storage and alternative fuel
Upstream	Renewable electricity policy	Stop and go policy on RE and currently moving towards auction-based procurement system. Corporate PPA has been introduced (2024) in two mechanisms (private wire or through wholesale electricity market)	Feed-in tariffs capped at the local average costs of electricity generation. Corporate PPA / green energy as service (GEAS) is limited	Feed in tariff scheme. Considering the creation of a national framework for corporate PPA as previously only approved on a case-by-case basis	Various policies like solar auction programme. Corporate Renewable Energy Supply Scheme (CRESS) allows for direct RE purchase from generators via national grid	Various policy instruments available: Green Energy Auction Program, Renewable Portfolio Standards. Green Energy Option Program available for corporate PPA
Midstream	Carbon pricing & trading system	Pilot carbon trading programme launching in 2025 for steel, full rollout by 2029	Carbon pricing mechanisms planned under Law 7/2021 (ETS + carbon tax) are limited to power station	No dedicated carbon market for steel yet, but private initiatives like Meranti Green Steel aim to fill the gap	Carbon tax planned by 2026 for steel, leading to an internal carbon market	N/A
Midstream	Derisking instrument for investments	N/A	N/A	Available incentives and funding for green steel, like Thai Climate Initiative Fund	Available incentives for green technology adoption in steel production	Tax incentives available for low-carbon industries
Midstream	Other supporting regulations	Energy efficiency and emissions reduction regulations in heavy industries, including steel	Energy efficiency limits exist for coated steel	N/A	Two-year moratorium on new steel expansion, encouraging green transition	Green Metals Initiative promotes green steel practices
Downstream	Green building requirements	Several voluntary green building rating systems encourage the selection of materials with recycled content, such as steel, but do not explicitly mandate the use of green steel or focus on embodied carbon	There are general guidelines and standards (like the SNI and GBRS) that encourage sustainable material choices, but not explicitly steel. This is a voluntary programme.	Recycled content in steel in construction must be 25% if there is no information available from suppliers (part of TREES)	Promotes the use of green materials, including steel, as part of its efforts to enhance the sustainability of the construction industry	Building for Ecologically Responsive Design Excellence program doesn't include steel. Voluntary programme
Downstream	Public procurement requirements	Viet Nam has issued some policies related to green public procurement but has not enacted a Green public procurement law	Green public procurement doesn't include steel as part of its product category	Green public procurement was announced in 2024, but lacks implementation framework	Coated flat steel product is part of the government's public procurement	Green public procurement implementation is integrated into the public procurement process supervised by the Government Procurement Policy Board but steel is not part of the list
Downstream	Scrap recycling standards	The Ministry of Natural Resources and Environment has issued national technical regulations on imported scrap materials for production inputs (Q1 2025)	Informal sector; no dedicated regulations for steel scrap	Scrap recycling and waste management, but no specific technical regulations for imported scrap for production inputs	Leading in steel scrap recycling, but needs to standardise scrap quality	Regulate scrap imports under general environmental laws, but do not have specific technical regulations

Agora Industry (2025). Note: The policy status for each country is color-coded to indicate progress: green represents policies that are on track or well-developed, yellow reflects emerging or partially implemented policies, and red denotes limited action or policies not yet in place. Information is based on the latest publicly available government documents and policy statements as of April 2025.

Pathways and enabling conditions

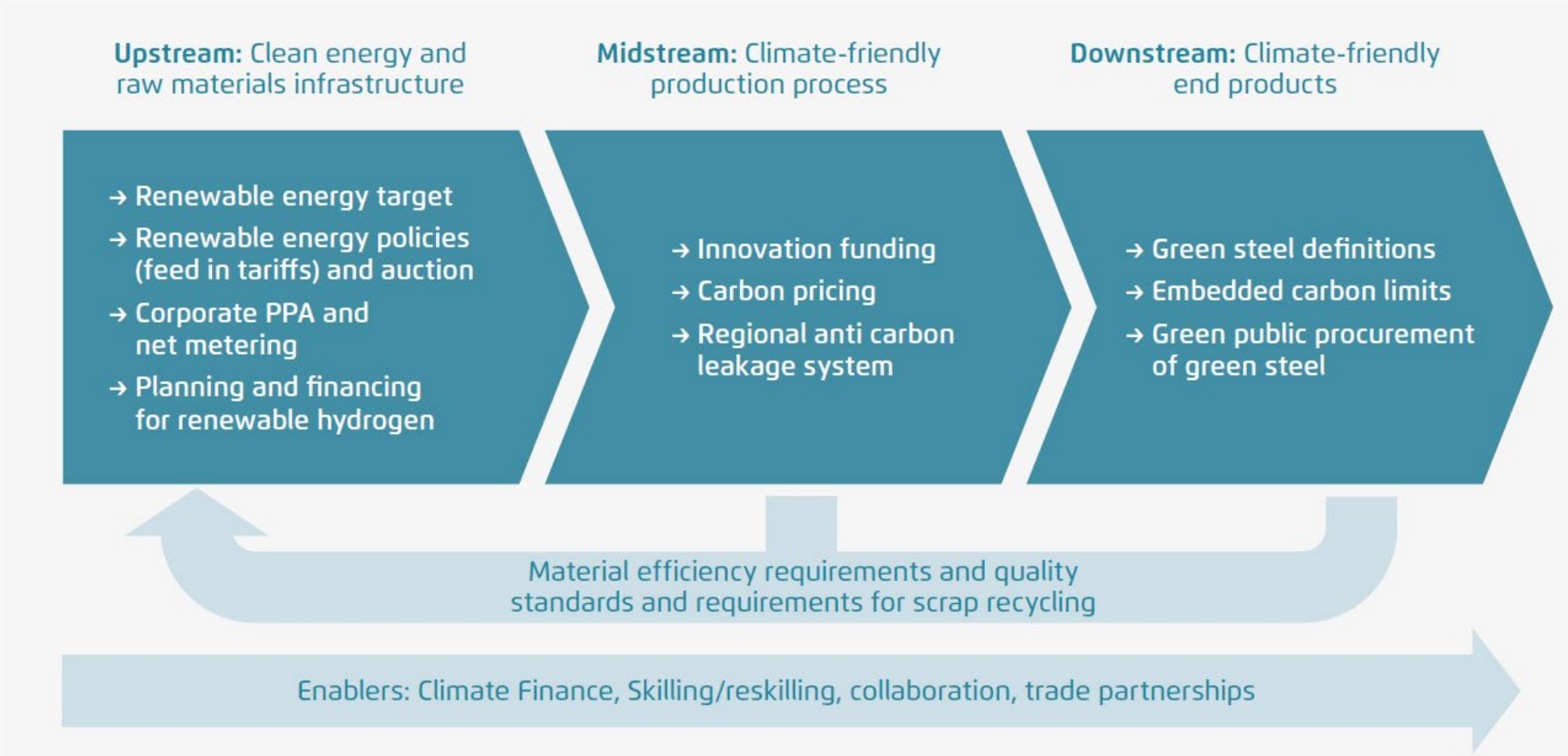
Southeast Asian countries must make decisive and ambitious commitments to phase out blast furnaces within the next ten years



Enabling conditions:

- → Halt investment in any new blast furnaces
- → Scale up gas DRI as a transition technology before full adoption of hydrogen-based DRI
- → Phase out BF-BOF
- → Shift to hydrogen-based DRI and renewable-powered EAF since advancements in green hydrogen and renewables will make this transition both technologically viable and cost-effective

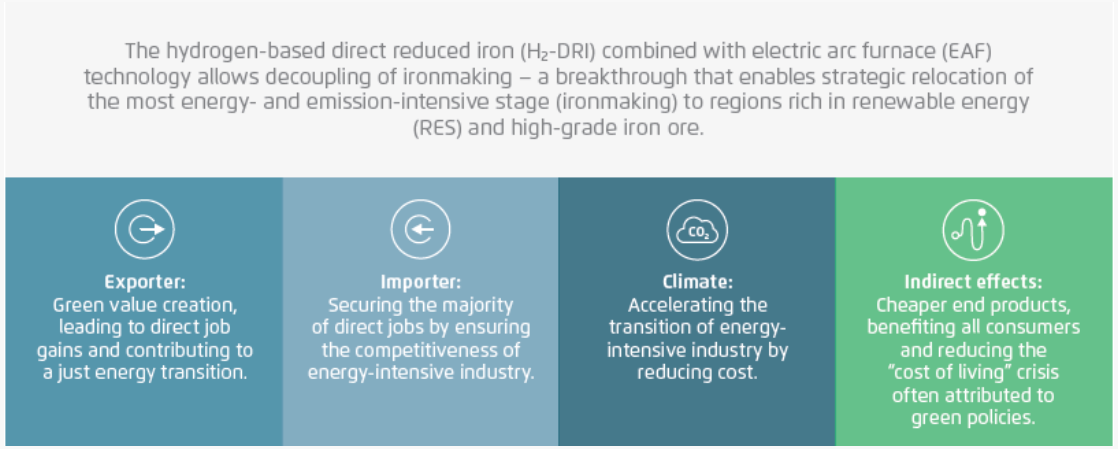
Policy mix for steel transformation: steel transformation needs smart policies along the whole value chain



Strategic alignment on green iron trade and regional cooperation can unlock new export markets

Assessing the emerging green iron trade rather than adding new production capacity

Potential benefits of green value chain trade partnerships



Regional Comprehensive Economic Partnership (RCEP)

- → Establish an ASEAN-level steel decarbonisation working group to boost coordination beyond existing efforts
- → Deepen ASEAN+3 cooperation to align infrastructure, green hydrogen and clean standards, supporting CBAM compliance
- → Under RCEP, explore anti-carbon leakage mechanisms to harmonise standards, reinvest revenue and fund decarbonisation

Tap into emerging sectors such as electric vehicles (Evs) through joint ventures between steel and automotive industries

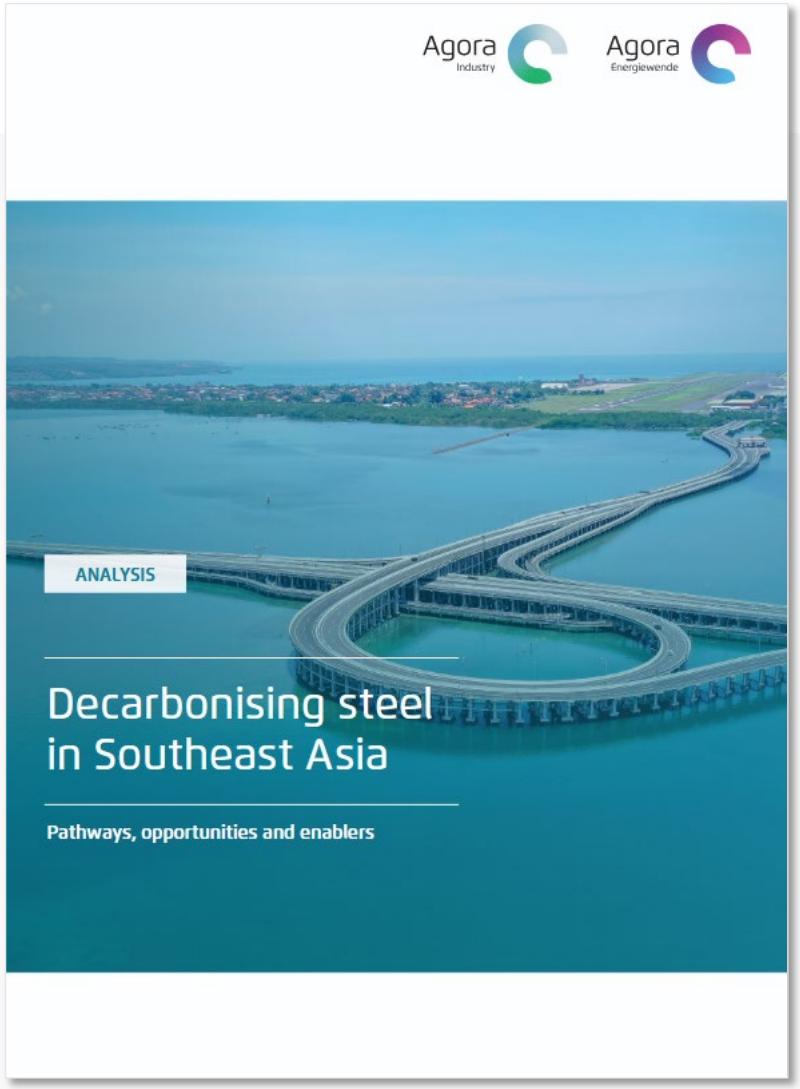
Key takeaways

1 **Southeast Asia is emerging as a key player in the global steel value chain**, driven by domestic demand and exports. With over 90 percent of blast furnaces needing reinvestment by 2040 and emission set to double to over 300 Mt CO2 by 2030, the region has a critical window to shift to low-emission steel.

2 **Southeast Asia's steel sector can transition to low-carbon production through gradual investments in clean technologies.** This path would avoid 120 Mt CO_2 by 2040 and strengthen local industrial resilience while enhancing competitiveness against low-cost imports and carbon border tariffs.

3 **Joint efforts between governments and industry are key to building a competitive low-carbon steel sector in Southeast Asia.** A value chain approach can establish the region as a global hub for low-carbon steel production, driving economic growth and attracting global investment.

4 **A unified ASEAN strategy is vital to support the region's development amid geopolitical and market pressures.** Deeper engagement with China, Japan and South Korea through ASEAN+3 can address shared infrastructure and investment challenges, aligned with climate goals.



The publication is available for download here:

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Thank you for your attention!

Do you have any questions or comments?

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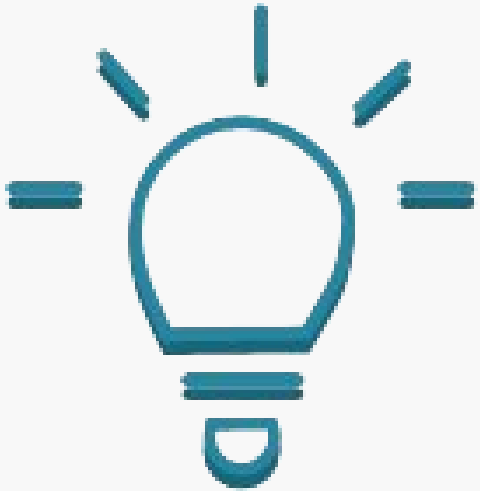
Reflections and questions



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Panel discussion

Wrap-up