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ASSERTING CLIMATE CHANGE LEADERSHIP IN ASEAN:

Carbon Pricing for the Malaysian Steel Industry

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Executive Summary

In recent years, Malaysia has attracted significant investment in its steel sector. While the inflow of capital and technology are welcome, they are also accompanied by large increases in greenhouse gas (GHG) emissions. By 2030, Malaysia is projected to triple its steel production capacity and to quadruple GHG emissions from the steel sector. This increase in total emissions and in emissions intensity run counter to global trends, and make it more difficult for Malaysia to reach its GHG reduction commitments under the Paris Agreement. To address this concern, the government has implemented a moratorium on new steel production capacity expansion, but it has yet to announce a comprehensive policy to address the rapid emissions growth of the sector.

There is a global consensus that carbon pricing is one of the most effective tools to reduce carbon emissions. Carbon pricing provides economic incentives for businesses to reduce their carbon emissions by internalising the costs of GHG emissions, which encourages investment in cleaner technologies, energy efficiency measures, and renewable energy sources. Additionally, carbon pricing can generate revenue for governments, which can be used to fund climate adaptation and mitigation efforts, investment in renewable energy infrastructure, or providing rebates to low-income groups.

Presently, Malaysia has no carbon pricing framework and no binding laws on climate change or decarbonisation, which limits the government's abilities to reduce the national GHG emissions. While implementation of carbon pricing has been announced in the Twelfth Malaysia Plan (12MP) 2021-2025, currently there are no concrete public plans for its implementation. A study on the impact of carbon pricing in Malaysia is currently being carried out with the support from the World Bank and will likely be released sometime in 2025.

While the reduction of carbon emissions is a societal imperative and should be adopted by all segments, some industries are more intensive in emissions than others. One case in point is the steel industry. In Malaysia, as well as globally, the steel industry plays an important role in the transition to a low-carbon economy. Steel is both a significant and hard-to-abate source of GHG emissions. Additionally, it is a crucial material for manufacturing wind turbines, electric vehicles, bioenergy refineries, and green buildings, all of which contribute to a low-emissions economy. The rapid growth of GHG emissions from the steel sector is a matter of great concerns, as these emissions are very difficult and costly to reduce.

While a number of policy documents have been presented to the public, the Malaysian government has yet to present a climate change law that would create legally binding targets or basic carbon pricing infrastructure, such as a national carbon register and compliance rules. Due to the urgency of this issue, this report aims to: a) understand current trends and future drivers of investment and GHG emissions in the Malaysian steel industry; b) examine the needs of carbon pricing for the manufacturing sector and the steel sub-sector specifically and the available types of carbon pricing that are feasible to be implemented in the Malaysian context, including a Carbon Border Adjustment Mechanism (CBAM); and c) recommend policies that can ensure that the Malaysian steel industry supports national GHG emission reduction targets.

The study employs secondary data sources collated from Malaysia Steel Institute (MSI) and other publicly available data sources and publications. Additionally, interviews with key stakeholders in Malaysia and abroad were also undertaken to ensure that a comprehensive understanding of the research focus can be achieved. The list of interviewees is highlighted in the Appendix.

Firstly, the study highlighted that the construction of new large-scale blast furnace steel mills has exacerbated overcapacity concerns and led to a rapid increase in GHG emissions. The increase in production capacity in Malaysia has led to some technological upgrading, as well as increased exports, but is primarily being driven by foreign investment from China. Chinese steel producers have been increasing their investments in ASEAN due to excess capacity and falling demand inside China (Tham & Yeoh, 2020).

Secondly, the study highlighted the different technological options for reducing emissions in the sector. The Malaysian steel industry has two primary production processes: Blast Furnace-Basic Oxygen Furnace (BF-BOF) and Electric Arc Furnace (EAF). The GHG emissions from BF-BOF are roughly 240% higher than those from EAF (World Steel Association, 2021). While Carbon Capture Utilisation and Storage (CCUS) has been suggested as a way to reduce BF-BOF emissions, this is not deemed to be technologically or economically feasible. Instead, solutions may be found in coupling EAF technology to new electrolysis or hydrogen steel making technologies. In theory, provided that these plants are fed with renewable energy, this can enable the production of zero-emissions steel.

Thirdly, the study emphasised that the key market mechanisms to curb emissions rely either on setting a price for carbon and allowing the total emissions to vary, or establishing the total quantity of emissions, and letting the price fluctuate according to transactions between economic actors. The first approach is a carbon tax and the second is a cap-and-trade or emissions trading system (ETS).

While a carbon tax directly sets a price on carbon by levying a fee on GHG emissions, charged by a given government, a cap-and-trade introduces a limit for firms on overall emissions and market participants trade unused emission allowances as credits, thereby creating a carbon market. A comparison between a carbon tax and cap-and-trade system is presented below. Presently, most countries choose to adopt a hybrid approach, combining a tax and cap-and-trade system.

	Carbon Tax	Cap-and-Trade
Advantages	• Predictable carbon price • Simpler implementation	• Predictable emissions volume • Allows sale of excess emissions rights • Politically less controversial
Disadvantages	• Emissions volume uncertain • Politically unpopular	• Carbon price uncertainty • Difficult implementation

A carbon import tax (CBAM) mechanism should be considered alongside the imposition of carbon pricing, as it would avoid carbon leakages and protect Malaysian producers from foreign producers who are not subject to carbon taxes.

Fourth, the study notes that Malaysia's major trading partners, along with most of its ASEAN neighbours, are all in the process of implementing carbon pricing. Singapore and Indonesia have already imposed carbon pricing, Brunei, Thailand and Vietnam are expected to do so before 2028. Malaysia is therefore facing the risk of lagging behind regional peers.

Lastly, based on the examination of the pros and cons of the carbon tax and the cap-and-trade models, coupled with the examination of existing policies implemented by the ASEAN peers and the international community, the authors propose a timeline and a step-by-step implementation plan for carbon pricing measures for the local steel industry. The timeline emphasises the need for urgent action, given the increase in high emissions steel production capacity in Malaysia, by suggesting a temporary tax on coking coal. This policy measure buys time to develop the necessary regulatory infrastructure for carbon pricing and carbon import taxes (MY-CBAM). By 2026, Malaysia could impose mandatory measurement, by 2027 Malaysia could introduce carbon pricing (and remove the temporary coking coal tax). In 2030, assuming a national carbon pricing scheme is operational, the steel pricing scheme can become part of a national scheme.

Proposed Timeline for Policy Implementation

Year	Actions
2025	Impose a temporary tax on coking coal to account for the implicit high GHG emissions of blast furnace steel production.
	Prepare regulatory infrastructure needed for carbon pricing.
	Prepare regulatory infrastructure needed for a Malaysian carbon import tax (MY-CBAM).
2026	Require at-source measurement of GHG emissions and reporting of GHG emissions for imported steel products
2027	Impose carbon pricing and MY-CBAM, and remove the temporary coking coal tax. The government's excess emissions charge could be based on a trade-weighted basket of carbon prices from major trading partners.
2030	Creation of a national carbon pricing framework which would absorb the steel sector carbon pricing pilot scheme.

1. Introduction

In Malaysia, as well as globally, the steel industry plays an important role in the transition to a low-carbon economy. Steel is both a significant and hard-to-abate source of greenhouse gas (GHG) emissions and an important economic input used in manufacturing, construction, infrastructure and defence. It is also an essential material used for the production of wind turbines, electric vehicles, bioenergy refineries, and green buildings, all of which contribute to a low-emissions economy.

Globally, steel production accounts for approximately 8% of GHG emissions (International Energy Agency, 2023), whereas in Malaysia the sector contributes only 4.5% to anthropogenic emissions in 2020 (Malaysian Iron and Steel Industry Federation, 2022). However, GHG emissions from the iron and steel sector are Malaysia's fastest-growing source of emissions. If recent trends persist, emissions from the steel sector in Malaysia will exceed the global average, both in relative and absolute terms (for detailed figures, see appendix). As new large-scale blast furnace steel mills become operational, emissions from steel production could increase to 12% of national emissions by 2030, and 57% of Malaysia's national manufacturing emissions (Industrial Processes and Product Use, IPPU). At the same time, the average emissions intensity of Malaysian steel will exceed the global average due to the increased usage of blast furnace-based production. Blast furnaces have much higher emissions than alternative steel production technologies.

In effect, the steel industry in Malaysia is racing ahead in the wrong direction, by rapidly increasing production capacity using highly polluting blast furnace technology, while the rest of the world is working to drastically scale-back emissions. Japan, the European Union, and the United States have all announced multi-billion dollar research grants and co-funding for the development and construction of low-emissions steel mills that can replace blast furnace technology (World Economic Forum, 2023).

Given this development trajectory, there is an urgent need to adjust Malaysia's industrial and environmental policies in ways that ensure that the steel sector contributes positively to Malaysia's GHG emission reduction commitments.

Therefore, this report has the following objectives:

1. To understand current trends and future drivers of investment and GHG emissions in the Malaysian steel industry.

2. To examine the needs of carbon pricing for the manufacturing sector and the steel sub-sector specifically and the available types of carbon pricing that are feasible to be implemented in the Malaysian context, including CBAM.

3. To recommend policies that can ensure that the Malaysian steel industry supports national GHG emission reduction targets.

The report consists of five sections. Section 1 provides an introduction to Malaysia's climate change policies, as well as recent developments in the Malaysian steel sector. Section 2 begins with an analysis of recent trends in steel production and related GHG emissions in Malaysia. This is then followed by Section 3 where a discussion of the challenges of abating GHG emissions in the steel industry, the already available and emerging technological pathways for doing so, and current policy responses in foreign countries to meet these challenges are presented.

The report then moves to Section 4 where a discussion on the role of carbon pricing in the steel industry, the underlying theoretical perspectives, as well as the political-economic considerations of relevant stakeholders are highlighted.

The report concludes with Section 5 where a summary of policy options for Malaysia with regards to carbon pricing in the steel sector are presented for policy consideration.

1.1. Malaysia's Climate Change Policies

As a party to the 2015 Paris Agreement, Malaysia has committed itself to achieve net-zero GHG emissions by 2050 in order to play its part in limiting anthropogenic global warming to 1.5 degrees Celsius.

As part of the Paris Agreement, Malaysia has set GHG emission reduction targets under its Nationally Determined Contribution (NDC). Malaysia has set a target for 2030 to reduce the GHG emissions intensity of its economy by 45% relative to 2005 levels, which were 0.34 kg CO_2 eq/RM GDP at that time. By 2050, Malaysia aims to achieve net-zero emissions (Ministry of Natural Resources, Environment and Climate Change, 2022).

The 2030 target means that Malaysia can still increase its emissions in absolute terms, as long as its economy grows more rapidly than its emissions. From 2005 to 2019, the GHG emission intensity of Malaysia was reduced by 35.9%, from 0.34 kg/RM to 0.22 kg/RM, while total emissions more than doubled, increasing by 32% from 250 million ton to 330 million ton (Ministry of Natural Resources, Environment and Climate Change, 2022). While Malaysia appears to be on-track to achieve its 2030 NDC commitments, its 2050 target requires a rapid decrease in GHG emissions, including from the steel industry.

The timeline of achieving net-zero emissions by 2050 was reaffirmed in the Twelfth Malaysia Plan (12MP) 2021-2025 under the Ismail Sabri administration, which also stated the government's intention to introduce carbon pricing. Since then, the government has initiated a study on carbon pricing, which is expected to be published in 2025 (Bernama,

2023). The government has also launched, the National Energy Transition Roadmap (NETR) and the New Industrial Master Plan (NIMP) 2030. These documents outline policies aimed at reducing greenhouse gas emissions, although they do not offer any details about carbon pricing.

While a number of policy documents have been presented to the public, the Malaysian government has yet to present a climate change law that would create legally binding targets or basic carbon pricing infrastructure, such as a national carbon register and compliance rules. It is also not clear how current policies will lead to Malaysia achieving net-zero emissions.

With regards to the steel sector, a "Green Transition Roadmap for the Iron and Steel industry" is currently under development (Liew, 2023b). As an economically important and a hard-to-abate industry, understanding the growth prospects of the steel industry in Malaysia - in terms of production volume and technological choices - is critical to evaluate the challenges for Malaysia to meet its environmental commitments.

1.2. Developments in the Malaysian Steel Industry

In recent years the Malaysian steel industry has faced a number of challenges related to overcapacity and trade issues.

The construction of new large-scale blast furnace steel mills has exacerbated overcapacity concerns, but it has also enabled Malaysia to start domestic production of new products, such as hot rolled coil steel (HRC). HRC is an important input for the downstream iron and steel, automotive, electrical and electronics, oil and gas, and shipbuilding sectors (Liew, 2023a).

Overcapacity concerns extend beyond Malaysia. According to the South East Asian Iron and Steel Institute (SEAISI), production capacity in ASEAN is projected to double from 75.3 Mt/year to 151.9 Mt/year by 2030, based on current announcements and ongoing construction. Malaysia's production capacity is to see the largest increase, rising by 32.8 Mt/year from 16.1 Mt/year in 2023 to 48.9 Mt/year by 2030, a more than 200% increase (South East Asia Iron and Steel Institute, 2023).

Yet, in recent years, a number of Malaysian steel producers have ceased production, including Perwaja/Kinsteel, Antara Steel and Megasteel, citing adverse market circumstances (lack of demand, competition) and overcapacity concerns.

During the last decade, the increase in production capacity in Malaysia is primarily being driven by foreign investment from China. Chinese steel producers have been increasing their investments in ASEAN due to excess capacity and falling demand inside China. The increasing cost of environmental regulation and taxes, and restrictions on new steel investment in China have also made ASEAN countries more attractive due to their less stringent environmental regulations. While these investments may generate some employment and opportunities for technology transfer, it will also increase GHG emissions and could harm local producers who lack scale or technological expertise (Tham & Yeoh, 2020). Malaysia has traditionally maintained a positive stance towards Chinese investments, which is not the case in all ASEAN countries. Countries such as Vietnam, The Philippines and Indonesia have faced protests against Chinese investment in recent years (Blanco Pitlo, 2024; Deasy & Lin, 2023; Tuc, 2018).

Regarding the steel trade, Malaysia is both a significant importer and a notable exporter of steel. Malaysia has tended to import coil steel (typically used in manufacturing), while exporting long steel (typically used in construction). Local producers of coil steel have claimed unfair trade practices by countries such as China, South Korea, Vietnam and Japan, arguing that their steel products are sold at below-market cost (dumping). They have asked the Malaysian government to impose countervailing duties. In several instances, the Malaysian government has imposed anti-dumping tariffs on imported coil steel (Bernama, 2021; Skrine, 2023).

2. Production and Emissions Trends of the Steel Industry in Malaysia

Until 2019, Malaysia was a net importer of steel, with export volumes exceeding imports only from 2020 onwards. The growth in steel exports has been accompanied by the construction of new large-scale blast furnace production capacity starting in 2017, with further expansion taking place in 2024, and additional expansion scheduled for 2026. These changes in production patterns have been accompanied by changes in technology, ownership, and GHG emissions.

Before discussing issues related to domestic production (Section 2.2) and international trade (Section 2.3), a brief timeline of key developments in the steel industry is discussed first (Section 2.1). This section will end with an analysis of the impact of these changes on GHG emissions (section 2.4).

2.1. Introduction: Brief History and Timeline

Until the 2010s, Malaysia's steel industry mainly consisted of domestically-owned producers of long steel products (mainly used in construction), who tended to use relatively small-scale low-emissions Electric Arc Furnace (EAF) mills to produce steel from scrap. However, the industry generally suffered from overcapacity, with only a 21% utilisation rate in 2016 (Malaysia Steel Institute, 2023). As a result, the industry faced consolidation and also closures.

Table1 is a non-exhaustive overview of key developments within the steel industry based on a review of news reports. The 2014-2018 period marked a time during which several steel plants stopped production, adding up to a reduction in capacity of 6.45 Mt/year. However, from 2017 until now, 6.2 Mt/year in new capacity has come online, with 21.7 Mt/year planned for the coming years.

Steel plants that have closed have tended to be smaller EAF facilities which rely on steel scrap. New capacity has mainly come from large Blast Furnace-Basic Oxygen Furnace (BF-BOF) mills.

Table 1: Timeline of Key Developments

Year	Key developments
1982	Government sets up Perwaja Steel in Terengganu, a joint-venture between Heavy Industries Corp of Malaysia, Terengganu state government, and Nippon Steel (Japan)
2006	Kinsteel acquires loss-making Perwaja Steel
2011	An Joo Resources opens 0.5 Mt/year hybrid BF-EAF in Penang
2014	Establishment of Alliance Steel in Pahang by Guangxi Beibu Gulf Port (China) and Guangxi Shenglong (China)
	Perwaja/Kinsteel stops production at 1.65 Mt/year EAF in Terengganu
2015	Antara Steel stops production at 0.9 Mt/year EAF in Johor
	Masteel starts production at 0.3 Mt/year rolling mill in Selangor
2016	Megasteel stops production at 3.2 Mt/year EAF in Selangor
2017	Alliance Steel starts production at 3.5 Mt/year BF-BOF in Pahang
2018	Beijing Jianlong (China) acquires stake in stalled Eastern Steel in Terengganu
	Kinsteel stops production at 0.7 Mt/year bar mill in Kedah
2020	Eastern Steel starts production at 0.7 Mt/year BF-BOF in Terengganu
2023	Eastern Steel expands production using 2 Mt/year BF-BOF
2025	Esteel (Singapore) to start production at 2.5 Mt/year DRI in Sabah
2026	Alliance Steel to expand production using 6.5 Mt/year BF-BOF
Later	Eastern Steel to expand production using 2 Mt/year BF-BOF
	Wenan Steel (China) to start production at 5.7 Mt/year BF-BOF in Sarawak (possibly up to 10 Mt/year)
	Esteel (Singapore) to expand production using 5 Mt/year DRI

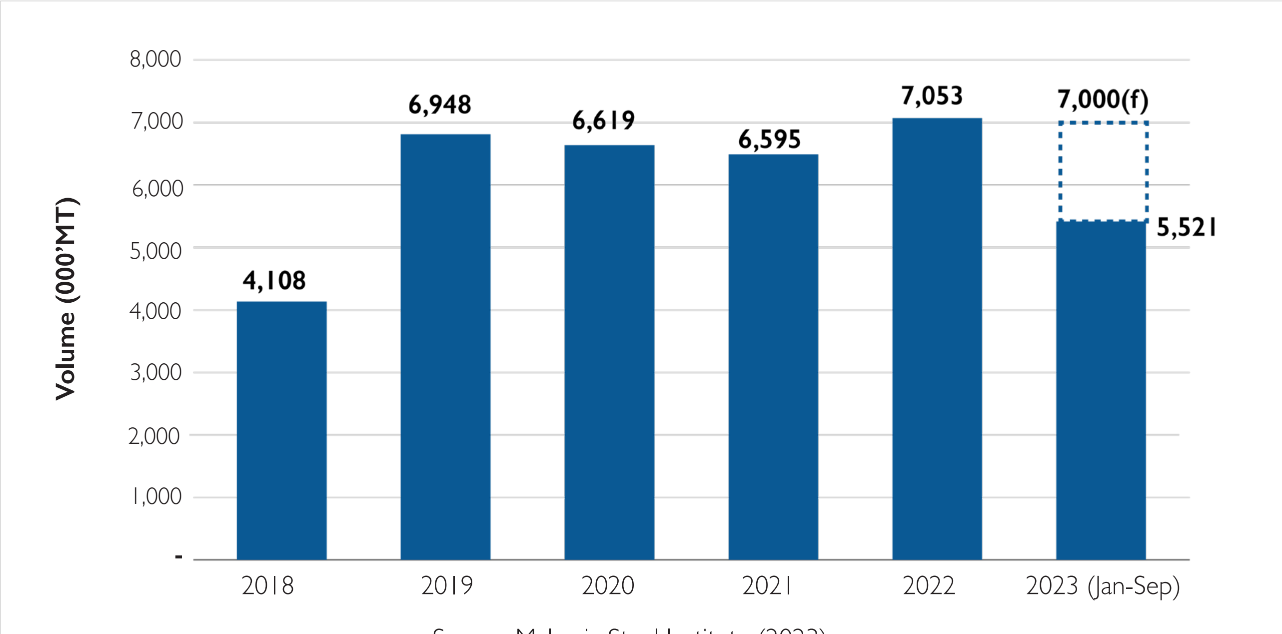
Source: News reports compiled by the authors, including from *The Star, The Edge, New Straits Times* and *Daily Express.*

2.2. Domestic Production Capacity and Output

Based on the Figure 1, Malaysia's steel production experienced a significant increase from 2018 to 2019, rising by 69% (+2.84 Mt). This increase follows the start of steel production at Alliance Steel from late 2017 onwards. Alliance Steel has a production capacity of 3.5 Mt/year.

While steel production has remained relatively stable from 2019 to 2023, at approximately 7 Mt/year, new capacity from Eastern Steel which came online in August 2023, and Alliance Steel, which is due to come online in 2026, will add 8.5 Mt to annual production capacity. The increase in production capacity, even if not fully utilised, could lead to a doubling in steel output within the next few years.

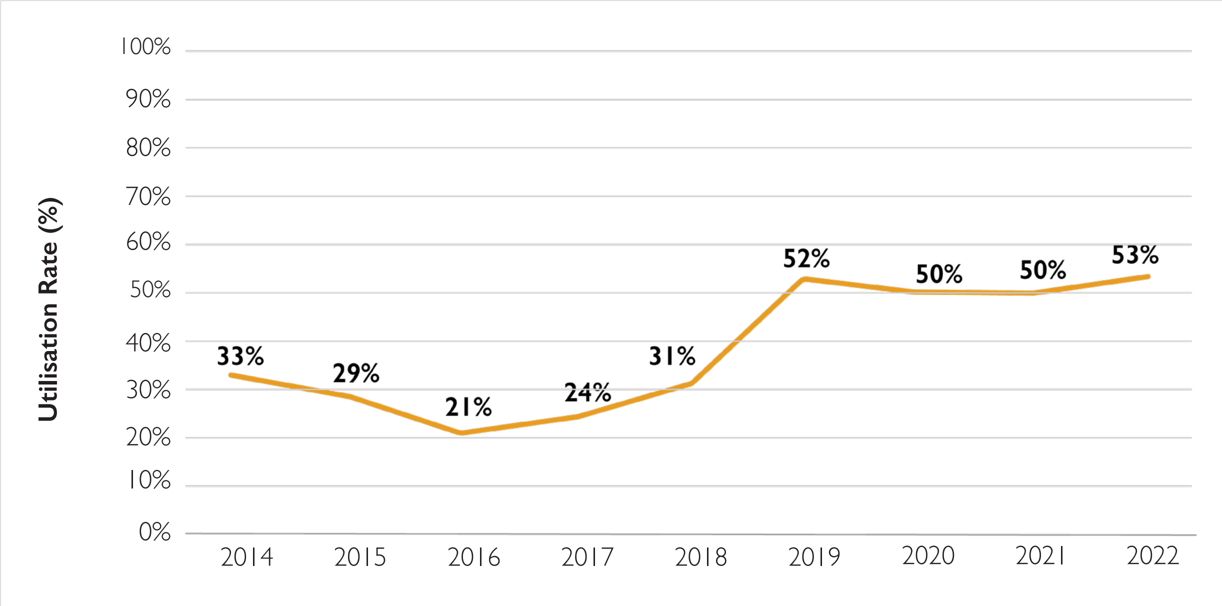
Figure 1: Steel Production in Malaysia



Source: Malaysia Steel Institute (2023)

Based on Figure 2, it is noted that although steel production capacity has increased in recent years, Malaysia has seen a relatively low utilisation rate of between 21-53% from 2014-2022. Globally, steel production capacity utilization was between 75-79% in 2021-2022 (Organisation for Economic Co-operation and Development, 2023). Overcapacity concerns within the broader ASEAN region have also been noted. Overcapacity is attributed to the rapid increase in domestic production capacity, rather than declining demand (South East Asia Iron and Steel Institute, 2023).

Figure 2: Steel Production Capacity Utilisation Rates in Malaysia



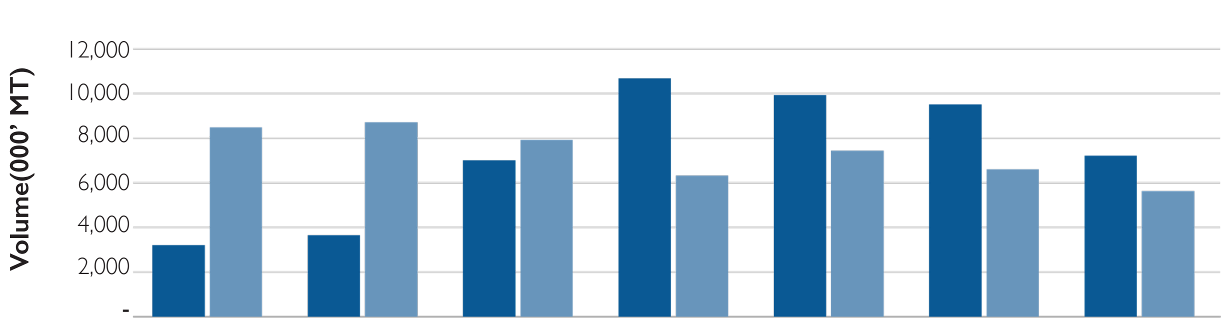
Source: Malaysia Steel Institute (2023)

2.3. International Trade and Investment

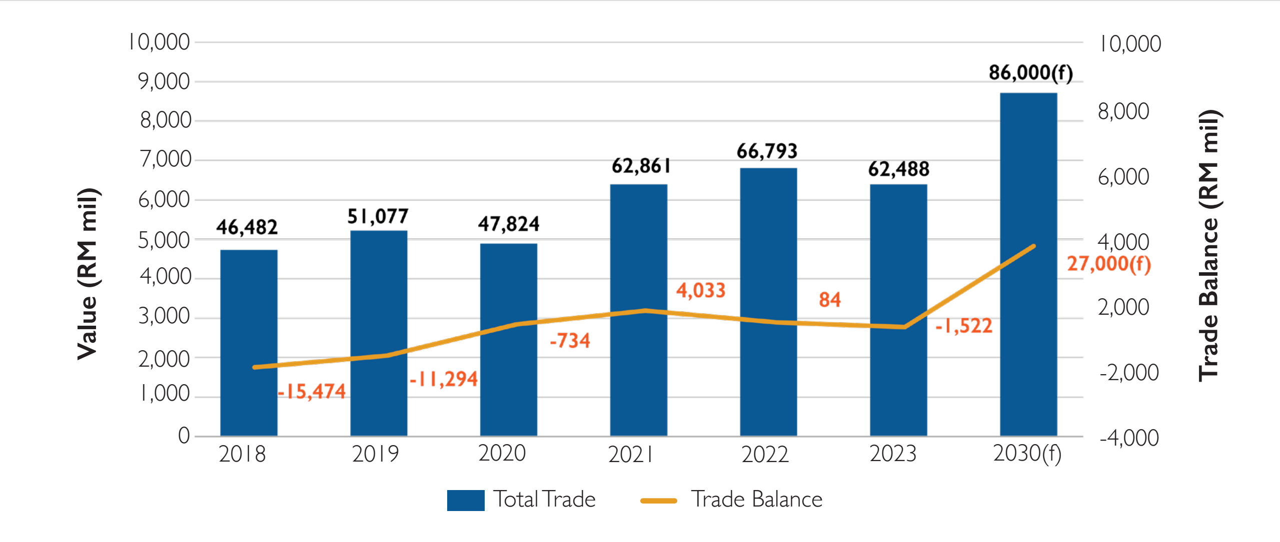
As noted in the introduction, Malaysia has recently become a net exporter of steel in volumetric terms (since 2019), while also being a net steel exporter in value terms in 2021 and 2022. Based on the Figure 3, the year 2023 once again saw a trade deficit of RM1.5 billion despite a surplus in volumetric terms.

The divergence between net export volume (surplus) and net export value (deficit) suggests that Malaysia generally exports lower-value steel, while importing higher value-added products. This is also confirmed by industry players, who observe a local oversupply and export of long steel (typically used in construction) and the continued need to import coil steel (typically used in manufacturing).

Figure 3: International Steel Trade of Malaysia



	2017	2018	2019	2017	2021	2022	2023(Jan -Sept)
Export	3,094	3,443	6,641	10,031	9,378	8,966	6,789
Import	8,005	8,210	7,511	5,988	7,018	6,328	5,321



Source: Malaysia Steel Institute (2023)

Although new investments in steel production are aimed at moving Malaysian steel manufacturing up the value chain, the new blast furnace steel production capacity that was added during the last decade has primarily focused on the production of long steel. Malaysian steel producers have claimed that this has exacerbated overcapacity problems in the domestic market.

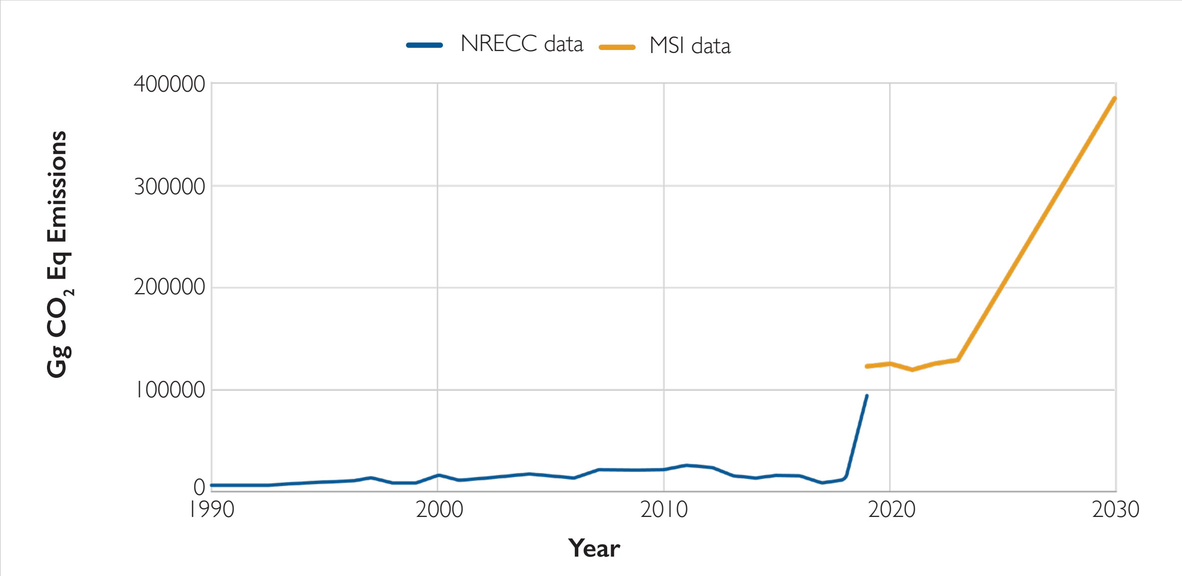
Investment in steel production is primarily from China and tends to be directed at developing new BF-BOF capacity. A notable exception is the proposed natural gas-fired Direct Reduced Iron (DRI) mill in Sabah, which is being developed by Esteel (Singapore). Natural gas-based DRI production generates lower GHG emissions, reportedly in the range of 0.77–1.37 tons of CO_2 per ton of steel, which is approximately 40-70% lower than BF-BOF production (Sohn, 2020; World Steel Association, 2021).

2.4. GHG Emissions

As a result of capacity expansion and the increasing use of blast furnace technology, the GHG emissions from steel production in Malaysia are rapidly increasing.

Based on historical data and recent updates and projections from the Malaysia Steel Institute (MSI) highlighted in the Figure 4, GHG emissions reached 12,228 Gg CO_2 eq in 2019, which is 370% higher than the previous peak of 2,593 Gg CO_2 eq emissions in 2011. By 2030, MSI projects emissions from the steel industry to reach 38,695 Gg CO_2 eq, which would account for roughly 12% of national GHG emissions (as compared to 3.7% in 2019).

Figure 4: Emissions from Steel Production (Malaysia)



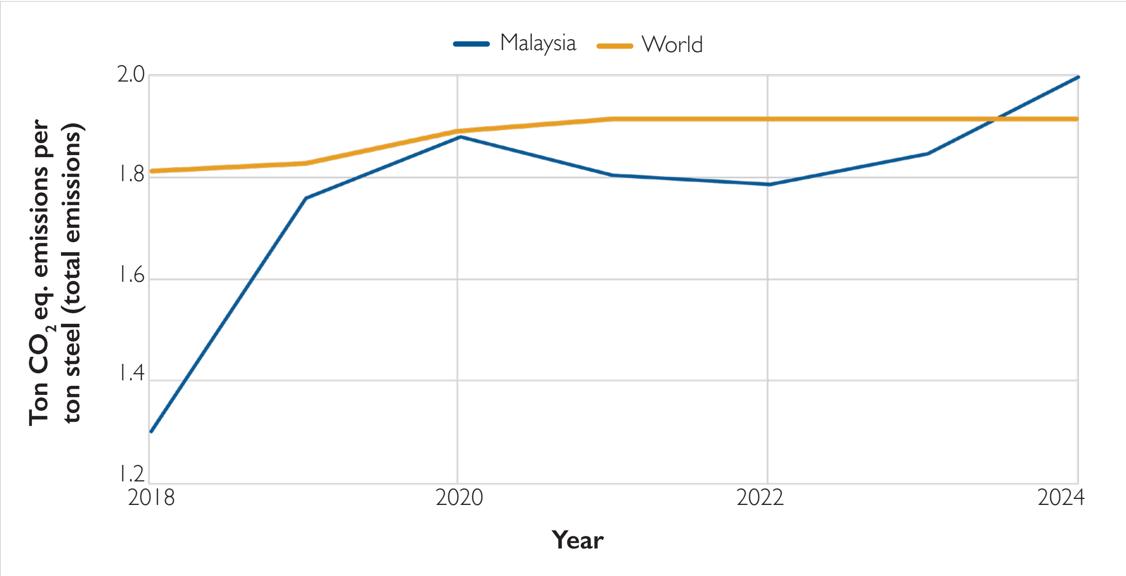
Source: Ministry of Natural Resources, Environment and Climate Change (2022) and Malaysia Steel Institute (2023). See appendix for details.

While Malaysia is allowed to increase GHG emissions until 2030 under its NDC commitments, it is supposed to reduce the emissions intensity of its economy. However, the emissions intensity of the steel industry appears to be increasing, based on the latest available data.

Based on Figure 5, the total emissions per ton of steel production has risen from 1.42 Mt CO_2 eq in 2018, significantly below the global average, to 2.20 Mt CO_2 eq in 2024 (projected), which is above the global average of 1.91. Causing this increase is the addition of new BF-BOF capacity. Blast furnaces produced 20% of steel in Malaysia in 2018, increasing to around 60% in 2024.

The rapid increase in emissions from steel production has raised concerns among industry bodies, the environment ministry, and academics (Fan et al., 2023), and is seen as a threat to Malaysia's ability to meet its GHG reduction targets.

Figure 5: Steel Production Carbon Emissions Intensity



Source: Malaysia Steel Institute (2023), World Steel Association (2021) and author calculations. See appendix for details

2.5. Policy and Regulatory Framework

GHG emissions are a negative externality as they contribute to climate change, a pressing economic and environmental issue. For this reason, the standard policy prescription to deal with it is to make economic actors internalise the costs of their emissions, with carbon pricing being a favoured policy option.

Malaysia currently has no carbon pricing framework and no binding laws on climate change or decarbonisation, which limits the government's abilities to reduce GHG emissions from the steel industry. While implementation of carbon pricing has been announced in the Twelfth Malaysia Plan (12MP) 2021-2025, there are currently no concrete public plans for its implementation.

A study on the impact of carbon pricing in Malaysia is currently being carried out with the support from the World Bank and will likely be released sometime in 2025. With Malaysia's next general election scheduled no later than February 2028, it remains unclear whether the government would be willing to implement carbon pricing before that date, considering its potential inflationary effects. It is also unclear if the steel sector would be included in the carbon pricing framework.

The only way in which the Malaysian government is able to indirectly control emissions from the steel sector is through its manufacturing licensing requirements. In 2023, the Ministry of Investment, Trade and Industry (MITI) placed a moratorium on new manufacturing capacity in the steel industry (The Sun Daily, 2023). This moratorium will likely affect several new steel projects and expansions planned after 2026.

The moratorium is intended for the government to refine its steel industry policy, which aims to address both concerns of overcapacity, and to develop frameworks that encourage lower-emissions steel production (The Sun Daily, 2023).

3. The Challenges of GHG Emissions Reductions for the Steel Industry

The steel sector currently accounts for a relatively small, but rapidly increasing share of GHG emissions in Malaysia. The increasing GHG emissions are especially concerning because steel production, like the production of cement, fertiliser and chemicals, emit GHGs as part of their core production process. Even if energy is obtained from renewable or near-zero emissions sources, the production process would still cause significant GHG emissions.

In order to successfully transition towards a low-emissions profile, the steel industry needs to globally reduce emissions by 93% (International Energy Agency, 2023). Such a large reduction would require the retrofitting, conversion or new construction of large amounts of steel production capacity during the next 25 years. This is a relatively short timeline, given the growing demand for steel and the typical lifetime of a steel plant, which is 40 years (International Energy Agency, 2020). New blast furnace capacity coming online in 2025 would therefore remain operational until approximately 2065 under normal circumstances. To reach net-zero emissions by 2050, the Malaysian steel sector requires advance planning and investments into new technologies to reduce emissions.

In this section, the sources of steel industry emissions and demand for green steel are discussed (Section 3.1), then followed by a review of emerging technological options (Section 3.2). The section concludes with a brief survey of national policy responses aimed at encouraging the production of low-emissions steel.

3.1. Steel Industry Emissions and Demand for Green Steel

Currently, the steel industry has two primary production processes: Blast Furnace-Basic Oxygen Furnace (BF-BOF) and Electric Arc Furnace (EAF). The GHG emissions from BF-BOF are roughly 240% higher than those from EAF (World Steel Association, 2021).

The BF-BOF process involves the conversion of iron ore and coking coal into steel. The coking coal is used both as an energy source, a reducing agent and a source of carbon to produce steel. However, during this process, large amounts of CO_2 are released.

The EAF process involves the melting down of steel scrap into new steel products using electricity. In theory, provided that the EAF is fed with renewable energy, this can enable the production of zero-emissions steel. It should be noted that there are some emissions associated with the collection of steel scrap, so a zero-emissions scenario is unlikely, but that process would be part of a greener circular economy.

Based on global total emissions data, BF-BOF are estimated at approximately 2.33 ton CO_2 eq per ton steel. By comparison, emissions from EAF emit approximately 0.68 ton CO_2 eq per ton. Emissions from the new DRI-EAF, which is being planned in Sabah are much lower than BF-BOF, yet higher than scrap-EAF. The DRI-EAF would enable iron ore to be used as feedstock, instead of scrap metal. A comparison of the three technologies, their production and their emissions profile is shown in the Fgure 6 and Table 2.

Figure 6: Overview of current steel-making technologies and their use and emissions in Malaysia

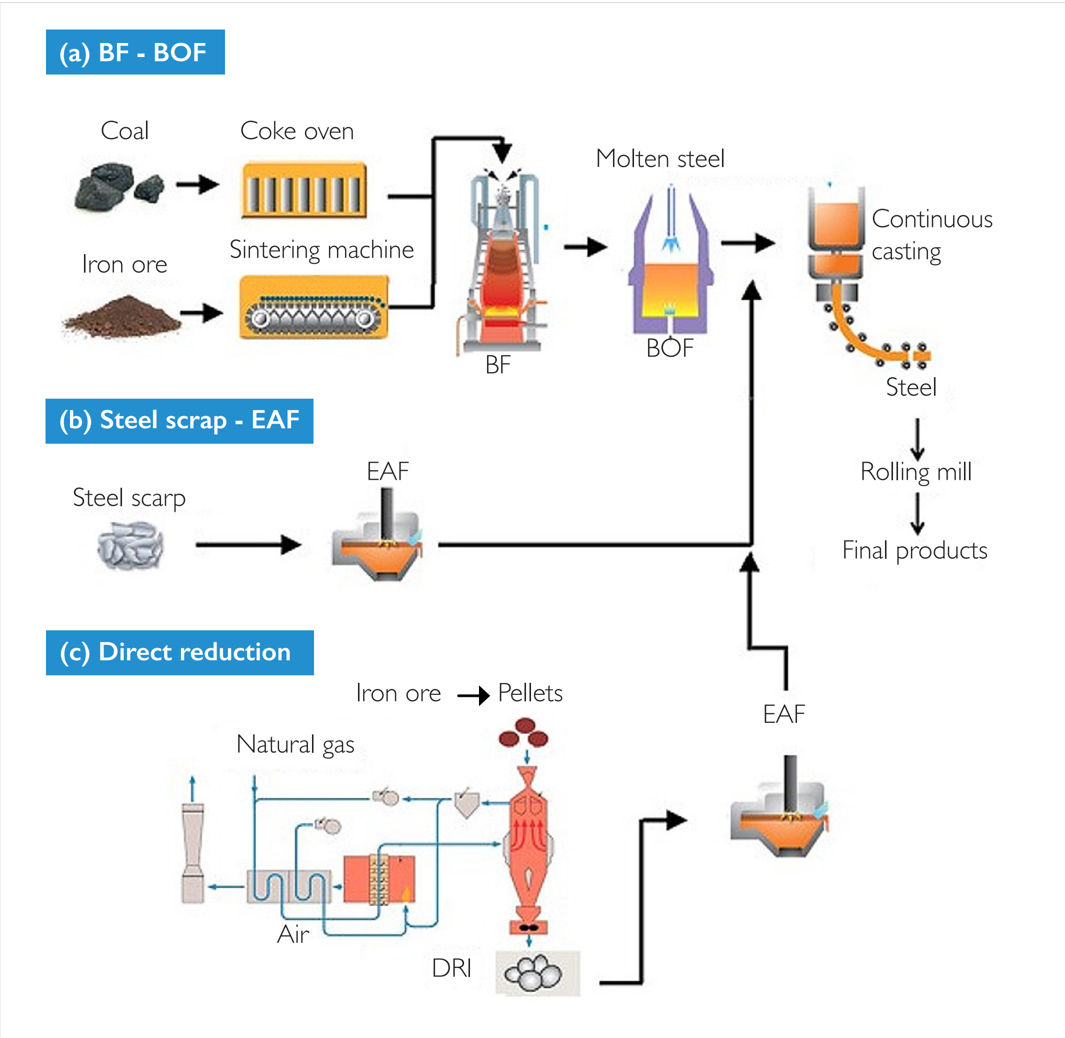


Image source: Perpiñán (2023)

Table 2: Current steel-making technologies and their production and emissions profile in Malaysia

	BF-BOF	Scrap-EAF	DRI-EAF
Feedstock	Iron ore, coking coal	Scrap, electricity	Iron ore, natural gas
Total emissions per ton of steel	2.33	0.68	0.77–1.37
Malaysian production (2022)	4,074 Mt (56%)	3,216 Mt (44%)	0
Malaysian emissions (CO_2 eq, 2022)	9,492 Mt (81%)	2,187 Mt (19%)	0

Source: Malaysia Steel Institute (2023), World Steel Association (2021), Sohn (2020) and author calculations. See appendix for details.

The decarbonisation of the steel industry is driven by both 'push-' and 'pull'-factors. The main push factor, which would encourage lower emissions, is carbon pricing. Carbon pricing would raise the cost of high-emissions steel production and therefore make competing low-emissions technologies more cost competitive. Without carbon pricing, low-emissions technologies which might require more expensive renewable energy and scrap inputs, may struggle to be cost competitive with blast furnace steel plants.

The main pull factor for green steel is the demand from consumers and downstream manufacturers. If automobile, construction and other large steel users are able to charge a premium for low-emissions steel, this can offset higher steel production costs. For example, updated green building standards could include a requirement for low-carbon emissions steel.

3.2. Technological Solutions and Their Limitations

There are a number of technologies that offer potential solutions for the production of low- or zero-emissions steel. While scrap-EAF and DRI-EAF offer lower emissions, new technologies such as hydrogen steel-making (HDRI) and novel electrolysis processes offer a path towards zero-emissions steel production. While Carbon Capture, Utilisation and Storage (CCUS) for BF-BOF has been suggested by some industry players in Malaysia (and by the International Energy Agency in the past), it is currently uneconomical and lacks technological feasibility.

CCUS has a history of over-promising and under-delivering (Sani, 2024). The lack of modularity and the complexity of the technology has resulted in limited learning rates over time, unlike solar PV or wind energy. CCUS project costs have failed to significantly come down and has been of minimal use in the steel industry – to this date, there is only one plant, Emirates Steel, in Abu Dhabi, which operates with this solution. Instead of implementing CCUS for existing BF-BOF facilities, the replacement of these facilities with cleaner steel plants, such as HDRI-EAF, appears to be the most economical and technologically viable path towards reducing emissions in the steel industry.

The main technological pathway for the production of low-emissions steel focuses on replacing the blast furnace process, which utilises iron ore and coking coal, with a Direct Reduced Iron (DRI) process that does not emit GHGs. The DRI process can then be linked to an EAF, which could in turn be powered by renewable energy.

While the replacement of coking coal with natural gas is a way to reduce emissions, it is also possible to use hydrogen as a reducing agent, in a process called HDRI. If hydrogen is also generated from renewable energy sources (green hydrogen), then a zero-emissions steel plant becomes possible. Currently, the world's first HDRI plant is under construction in Boden, Sweden by H2 Green Steel. The HDRI process requires a steady supply of hydrogen, and so for the Boden plant, off-peak North Sea wind power is used for hydrolysis, with hydrogen being stored in underground caverns. The HDRI plant is being financed through a combination of subsidies, loans from the European Investment Bank and loans backed by future steel purchase agreements. Similar projects are being planned in Germany and Austria (Gordon, 2023).

An alternative to HDRI is electrolysis technologies. In aqueous electrolysis (AE), iron ore is reduced by submerging it in acid with an electric current running through. In molten oxide electrolysis (MOE), electrodes are placed in powdered iron ore and a high current is run through it until it melts, causing the oxygen to separate. Both of these technologies are not yet ready for commercial deployment. A potential advantage of electrolysis is that it can be deployed at a smaller scale, making it more suitable to be coupled to existing EAF mills. However, electrolysis requires a constant and very high voltage power supply, which may be difficult to obtain from renewable energy (Gordon, 2023).

While CCUS from BF-BOF has been proposed as a pathway to produce zero-emissions steel and to extend the lifetime of existing BF-BOF capacity, it does not appear realistic at the moment. BF-BOF plants have many different point sources of emissions and CO_2 capture is both technically difficult and relatively costly (Perpiñán et al., 2023). ThyssenKrupp, a large German steel producer, has opted to replace a BF-BOF mill with HDRI, rather than implementing CCUS (Gordon, 2023).

Another concern regarding CCUS is that it does not address the Scope 2 (electricity consumption from the grid) and Scope 3 (supply chain and end use) emissions involved in coal mining and transportation, which would also have to be captured in some way for the production of zero-carbon steel (Adams, 2022).

3.3. Existing Domestic Policy Responses

The challenges of transitioning towards net-zero emissions in the steel industry has triggered a number of policy responses, especially in the European Union. These policy responses encompass support for R&D and technological innovation, sourcing renewable energy, and carbon pricing.

In Europe, the aforementioned HDRI plant in Boden, Sweden was realised with a combination of government support and private funding in order to gain experience in scaling the technology and to prove its commercial viability. In the United States, under the Inflation Reduction Act (IRA) there is a US$ 6.3 billion (RM 30 billion) allocation for the Industrial Demonstrations Program, which could potentially support the development of green steel technologies (Kim, 2023). In South Korea, as well as elsewhere, industry players have asked for the government's support to help phase out blast furnaces and to replace them with HDRI and EAF plants.

Aside from investments in new technologies, there is also a recognition of the need to improve renewable energy access. Green steel can only be produced if the electricity needed for EAF and hydrolysis (or electrolysis) originates from low-carbon sources. Hence, renewable energy planning and green steel policies need to be closely coordinated.

Finally, carbon pricing has been introduced in a number of countries, including in the European Union and South Korea. However, until recently, these sectors benefited from large free allowances of emission rights. These free emission rights were granted in part to avoid international carbon leakages. Carbon leakage occurs when production is moved to a foreign country (without carbon taxes), and products are then imported back into the home country. In this case, producers avoid the tax, but still contribute to global GHG emissions. In order to address these leakages, carbon import taxes (CBAM) are now due to be introduced.

3.4. International Trade Policy Responses

While Australia, Canada and the United States are all considering legislation to address carbon leakages, the European Union is the first jurisdiction to implement a carbon import tax. The Carbon Border Adjustment Mechanism (CBAM) is currently in its initial phase of implementation, by which importers are mandated to provide detailed information about the carbon content of imported products – this tax will initially apply to steel, cement, fertiliser and certain related products (European Commission, 2024).

In 2026, CBAM will move to the next phase and importers will need to pay import taxes that are commensurate with the carbon content of their products. While the precise impact of CBAM is somewhat uncertain, including the calculations and measurements to be used, it is estimated to act like an 8.1% tax on steel products imported from outside the EU (Kim, 2023). Importers will be able to deduct carbon taxes that have already been paid outside the EU, subject to terms and conditions.

An important question related to international trade and carbon pricing is the implementation of export rebates. In order to keep exports competitive, industry organisations and the European Parliament have argued that steel producers should be able to obtain a rebate for the carbon taxes paid on goods that are exported. This approach has been rejected by the European Commission and many scholars alike. This is because the provision of a carbon export rebate is seen as undermining the intent of the carbon pricing regime as it still allows large scale carbon emissions if they are tied to products that are being exported. Thus, emissions could still rise along with exports, making EU net-zero emissions goals difficult to achieve. Additionally, the export rebate would violate WTO rules against export subsidies. Therefore, while export rebates have also been proposed in other countries, including Canada, they may not be viable due to environmental objections and violations of international trade law (Leonelli, 2022)

4. Carbon Pricing for the Steel Industry

The urgency of addressing climate change has brought carbon pricing to the forefront of policy discussions worldwide. With approximately 23% of global GHG emissions now under carbon pricing schemes, governments are increasingly exploring mechanisms to internalise the costs of carbon emissions. This section delves into the intricacies of carbon pricing, examining its models and political feasibility, particularly within the context of the steel industry in Malaysia.

4.1. Introduction to Carbon Pricing, Models, and Political Feasibility

Climate change, an effect of the accumulation of GHG emissions on the Earth's atmosphere, has sparked calls for meaningful actions to limit the rate of temperature increase associated with human activities since the industrial age. Among the policy instruments available for governments to reduce carbon emissions is to put a price on carbon, thereby forcing economic actors to internalise the cost of their actions and technological choices. About 23% of the world's emissions are now covered by a carbon pricing scheme, with revenues approaching US$ 95 billion (World Bank, 2023), although carbon pricing policies are far from uniform in design and effectiveness. It is technically hard to cover all economic activities, perfectly monitor their emissions, and impose a cost on carbon. It is, however, much easier to focus on high emitting sectors, which includes the steel and cement industry, power plants, among others.

The key market mechanisms to curb emissions rely either on setting a price for carbon and allowing the total emissions to vary, or establishing the total quantity of emissions, and letting the price fluctuate according to transactions between economic actors. The first approach is a carbon tax and the second is a cap-and-trade or emissions trading system (ETS).

A carbon tax directly sets a price on carbon by levying a fee on GHG emissions, charged by a given government. It has the benefit of providing a clear price signal but at the cost of not guaranteeing a specific amount of emissions reduction. The tax creates an incentive for companies to reduce emissions to avoid paying the tax, although the exact reduction will depend on the response of firms to the carbon price. Economists tend to favour the adoption of carbon taxes because it is easier to administer and is transparent (Metcalf, 2021). Yet, it has failed to gain traction worldwide due to political reasons (Rabe, 2018). Carbon taxes are notoriously unpopular and, because of that, have generally been set at a level which is only marginally effective and insufficient to address the ambitious goals of drastically decarbonising the global economy. Carbon taxing can range from close to US$ 0 per t/CO_2 eq, as in Poland and Ukraine, to above US$ 120 per t/CO_2 eq as found in Uruguay, Liechtenstein, Switzerland, and Sweden (World Bank, 2023, p. 21). Depending on the precise design and implementation of a carbon tax measure, its overall inflationary effects can be minimised.

Furthermore, cap-and-trade is an alternative to a government-determined direct price on carbon. In this system, firms face a limit on overall emissions and market participants trade emission allowances, thereby creating a carbon market. This mechanism ensures a predefined environmental outcome (because total emissions are capped) but results in variable carbon pricing. Implementing a cap-and-trade system can be complex, requiring a robust administrative framework to monitor, report, and verify emissions, and to enforce the cap. Yet, it is less politically sensitive as prices are not set directly by bureaucrats and politicians. Furthermore, depending on how allowances are allocated, a cap-and-trade system can reward some companies by allowing them to sell permissions to pollute in the market, based on their previous emissions (Metcalf, 2021).

A very simple comparison between a carbon tax and cap-and-trade system is provided below. In reality, most countries choose to adopt a hybrid approach, combining a tax and cap-and-trade system.

	Carbon Tax	Cap-and-Trade
Advantages	• Predictable carbon price • Simpler implementation	• Predictable emissions volume • Allows sale of excess emissions rights • Politically less controversial
Disadvantages	• Emissions volume uncertain • Politically unpopular	• Carbon price uncertainty • Difficult implementation

The unequal introduction of carbon pricing by varying countries, and at different rates, raises the risk of investments moving away from jurisdictions where the price of carbon and other environmental obligations have a more serious effect on the cost of doing business. In this scenario, polluters would shift production to less environmentally stringent host countries, resulting in loss of jobs and fiscal revenues in places with carbon pricing, while not affecting total global emissions.

The phenomenon described above is termed carbon leakage and a mechanism to limit it is to set an import tax that takes into account the carbon footprint of the product where it was manufactured - essentially the CBAM proposal. CBAM is technically complex to implement, but it achieves two important goals: it tackles the issue of carbon leakages after a government adopts carbon pricing and it also reduces the domestic political resistance to it, as it eliminates one source of competitive advantage of other exporting countries which have not set the same environmental restrictions. One key takeaway of the reviews about carbon pricing adoption (e.g., Metcalf 2021; Blanchard, Gollier, Tirole 2023) is that political support matters for its effective implementation. Therefore, carbon pricing may need to be sequenced to build a supporting political coalition (Colgan & Hinthorn, 2023) and complemented by other policies which can reduce the resistance to it. This can include redirecting revenue collected from polluters to green upgrading support grants for the affected sectors and other forms of revenue recycling.

4.2. Carbon Pricing Strategies for the Steel Industry: International Examples

A number of economies have implemented or are planning to implement carbon pricing for the steel industry. A brief overview of their policies by major steel producers (and exporters) is presented in the Table 3.

Table 3: International Examples of Carbon Pricing Strategies

China Carbon pricing for steel from 2025 onwards	China has an ETS, but it currently does not include steel. China intends to bring the steel industry into its ETS by 2025, increasing pressure on the steel industry to decarbonize. China has earlier taken administrative measures to reduce steel productions and related GHG emissions (Coroneo-Seaman, 2023).
European Union Carbon pricing for steel since 2005	Steel is part of the EU ETS although steel producers have typically been allocated large allowances free of charge due to concerns over carbon leakage. The implementation of CBAM aims to address this problem and will lead to a gradual phasing out of free emission allowances for steel producers in the EU after 2026 (European Commission, 2024)
India Carbon pricing after 2024	India has not yet implemented an explicit carbon pricing scheme, although announcements about a national compliance and offset carbon market are expected in 2024. Current government policies require the steel industry to purchase a certain share of its energy from renewable energy sources (Singh, 2023).
South Korea Carbon pricing for steel since 2015	In South Korea, 40% of GHG emissions are from the steel sector and a large part of its manufacturing sector, including automotive and shipbuilding, has high steel content. The steel sector is part of the Korean ETS, but has typically benefited from free emission allowances, which have in some cases, been sold on to other sectors. South Korea is currently not considering a CBAM mechanism. There is concern that a high carbon price will erode the economic competitiveness of its steel sector (Kim, 2023).
Turkiye No carbon pricing yet	Turkey does not have a carbon price and currently lacks a comprehensive climate change policy. However, it would likely benefit from implementing carbon pricing due to the high share of its exports, including steel, bound for the EU and thus subject to CBAM. Turkey does have an implicit carbon tax through a 30% excise duty on fuels, which effectively acts as a carbon pricing for its transportation sector (Organisation for Economic Co-operation and Development, 2022).

Source: Collated by authors from various sources

Many ASEAN economies are moving ahead with carbon pricing schemes, with Singapore launching mandatory carbon pricing in 2022 and Indonesia in 2023. Thailand and Vietnam are expected to follow suit sometime between 2026 and 2028.

Table 4: Carbon Pricing Strategies of Selected ASEAN Countries

Brunei Carbon pricing from 2025 onward	Under its National Climate Change Policy (2020), Brunei has imposed mandatory carbon emissions reporting from 2024. Brunei will implement carbon pricing from 2025, which will apply to all industries which emit a significant amount of GHG. Note that Brunei does not have a large domestic steel industry; it exports steel scrap (International Monetary Fund, 2023).
Indonesia Carbon pricing since 2023, excludes steel	Indonesia launched its carbon market in September 2023 with a national trading platform and carbon register, but a sector-based regulatory approach (and restrictions on inter-sector carbon credit trading). Emissions from coal power plants and forestry (land use change) are the initial focus of the market. It is expected that the steel sector and other high-emission industrial sectors will eventually be covered by the carbon pricing scheme in the coming years. Current carbon prices in Indonesia are very low (Mulyana, 2023).
Singapore Carbon pricing since 2022, includes steel	Singapore has implemented a carbon tax in 2022, with a limited number of allowances for high emissions and trade-exposed industries. The tax is currently S$ 25/ton (RM 88) and will rise to S$ 45/ton (RM 158) in 2026. The target for 2030 is a tax of S$ 50-80/ton (RM 176-281), depending on international carbon price developments (National Climate Change Secretariat Singapore, 2024).
Thailand Carbon pricing from 2026-2028 onward	Thailand presented a draft climate change bill for public consultation in February 2024. The bill includes provisions for a national Emissions Trading System (ETS), national carbon register and carbon import taxes, and would also cover the steel industry. Legal experts suggest that the law will be implemented within 1-3 years (Vanikieti, 2024).
Vietnam Carbon pricing from 2028 onward	Vietnam is currently developing its legal framework for a carbon market, a process supported by the World Bank and multiple ministries. A pilot carbon market is set to launch in 2025, with carbon pricing starting from 2028 onwards, when firms, including the steel sector, would face emissions charges (Truong, 2023).

Source: Collated by authors from various sources

5. Policy Options for Carbon Pricing in the Malaysian Steel Industry

There is an urgent need to address the rising GHG emissions from the Malaysian steel industry. In this section, we outline the policy options for introduction of carbon pricing in Malaysia. We consider the positions of different stakeholders, relevant international developments, carbon pricing mechanisms (including measurement and taxation), and propose a possible implementation timeline.

5.1. Urgency of Carbon Pricing for the Steel Industry

Due to the rapidly increasing amount of GHG emissions in the steel industry, from 4.5% in 2020 to 12% in 2030 (Malaysian Iron and Steel Industry Federation, 2022), it is important for Malaysia to rapidly adopt measures that can stop the growth in emissions from the sector and to develop policies that support the transition towards a low-emissions green steel industry.

A lack of policy actions could lead to increasing overcapacity in steel production in Malaysia. While excess production can be exported, Malaysia would have to bear the consequences of hard-to-abate GHG emissions from large-scale steel exports. By allowing an increase in emissions from the steel industry, Malaysia may need to impose additional emission-reduction measures on other sectors of the economy to reach its net-zero goals. Sectors such as energy generation, cement, fertilisers, petrochemicals, and transportation may have to reduce their emissions further and faster to accommodate the growth of steel emissions within Malaysia's "carbon budget". By spending its carbon budget on the steel sector now, Malaysia has fewer options to support other sectors in the future.

Furthermore, China's plans to include the steel sector in its ETS by 2025 could mean that more Chinese steel companies would want to move their high emission blast furnaces to Malaysia, to take advantage of the lack of carbon pricing here. As mentioned earlier, while this development may generate some employment and opportunities for technology transfer, it will also increase GHG emissions rapidly and could harm local producers who lack capital and the technological expertise to compete effectively with large and well-funded new entrants in the long run.

Overall, Malaysia is falling behind its top trading partners, all of which have implemented some form of carbon pricing. Singapore, China and the EU have already implemented national carbon pricing schemes, while the US has implemented a more complex mix of state-level taxes and federal subsidies. While Malaysia's lack of carbon pricing could provide some short-term benefits, it could strain trade relations with its main trading partners in the long run. Trade partners could follow the EU's example of imposing a carbon import tax. Green procurement and production rules could lock Malaysian producers out of low-emissions supply chains in favour of neighbouring countries, such as Singapore and Indonesia, who have already implemented carbon pricing. Addressing emissions now could be costly, but being excluded from supply chains and liable to carbon import taxes will be even more costly in future.

5.2. Coalition Building for Carbon Pricing

With regards to carbon pricing in the Malaysian steel industry, there are multiple views to consider, including those of steel producers, downstream steel buyers, and the government. Malaysia is in a unique position, whereby a majority of steel producers support the imposition of carbon pricing in order to drive a low-carbon transition in the industry. This approach aligns with the government's own policy goals, although it would appear that Malaysian steel producers want to move along an accelerated timeline compared to the government.

However, the downstream industry does not appear to support carbon pricing, citing the likely inflationary effects of even relatively small price increases. Interviews with downstream industry players suggested that they will pass on costs to end-users. Some interviewees also noted that Malaysia is a "developing country", and that the problem of climate change should not be a policy priority for the Malaysian government at this time.

The most affected industries of steel price increases are construction and the automotive sector. Real estate developers suggest that steel accounts for 25-35% of construction costs in high rise buildings and for around 6% in landed property (Tan, 2021), which is not an insignificant part of their total cost. This is also the case for the automotive industry. On average, a car contains about 900 kg of steel. Materials, including steel, account for between 40-70% of a vehicle's production costs (World Steel Association, 2019). Although firms can adjust their designs to use less steel, price increases in steel can cause significant inflationary effects in the short-run. This potential inflationary effect can be moderated by a gradual increase in carbon prices.

One way to temper the inflationary effects of carbon pricing on the steel sector could be to use the revenue raised from carbon pricing to either cross-subsidise green steel production, or to establish a green steel investment or transition fund. These could also align with the goals of the NIMP 2030, which aims to move the Malaysian manufacturing industry up the value chain.

While a majority of steel producers favour carbon pricing, steel producers with large new BF-BOF capacity may oppose the measure as their higher GHG emissions means that they will see increased production costs. EAF producers with lower GHG emissions may likely favour carbon pricing, as the impact on their production costs will be lesser.

5.3. Suitable Carbon Pricing Model and CBAM

Malaysia should rapidly develop a comprehensive policy to reduce GHG emissions from the steel industry. This policy can be framed as a carbon pricing pilot scheme aimed at developing the capacity needed to implement a national carbon market, or as a specific sectoral policy – whereby Malaysia can announce a sequenced approach to implementing carbon pricing. An integral component of such an approach would be the implementation of a CBAM-like carbon import tax.

It is important to note that while targeted at the steel industry, the policy can also be used to support national institutions, including the development of the Bursa Carbon Exchange (BCX) and the Malaysian Sustainable and Responsible Investment (SRI) bond and sukuk markets. Green steel also requires green energy; therefore, the low-carbon transition may support investments into new renewable energy generation capacity and the trading of Renewable Energy Certificates (RECs) on BCX. Local quality assurance and audit bodies, such as SIRIM (technical standards), RAM/MARC (ratings agencies), and the Malaysian Institute of Accountants (auditors), may also contribute. Carbon pricing for the steel industry may also provide an impetus to setup a Malaysian or ASEAN Validation and Verification Body (VVB) for carbon credits, and could support the creation of Malaysian carbon auditors and technical solutions providers.

Regardless of the exact path chosen, Malaysia should consider the adoption of a carbon pricing model with the following characteristics:

1. Implement a cap-and-trade scheme, whereby emission rights are allocated to steel manufacturers based on their current production capacity and the lowest emissions technology currently available in the domestic market. This approach would incentivise steel production at low-emissions plants, while discouraging production at high-emissions plants, and encouraging investments in low-emissions technologies. Depending on how it is implemented, the scheme could be designed in a way that minimises the inflationary effects of carbon pricing. The government can gradually reduce the number of emission rights issued to the steel sector in order to meet its 2050 net-zero emissions commitments and encourage investments in state-of-the-art green steel plants.

2. Firms with excess emissions would have four choices to acquire the necessary emissions rights:

    - Reduce emissions by purchasing RECs on BCX (limited to 5% of electricity consumption),
    - Purchase carbon credits on BCX (limited to 5% of emissions),
    - Purchase excess emission rights from other manufacturers (possibly via BCX),
    - Pay a carbon tax to the government (or purchase additional emission rights on BCX issued by the government).

3. Carbon taxes collected by the government could be utilised as matching grants for SRI bonds and sukuk issued by the steel industry to finance new or refurbished low-emissions steel production capacity and R&D.

4. Given the highly competitive nature of the steel industry, Malaysia should also consider adopting a CBAM-like carbon import tax to avoid carbon leakage to foreign countries without carbon pricing. However, Malaysia should refrain from offering a carbon tax-rebate to firms that export, as it could undermine the effectiveness of carbon pricing in reducing domestic GHG emissions and would violate WTO rules and other trade agreements.

In the short term, the above measures may lead to an increase in domestic steel prices and may harm the export competitiveness of Malaysian steel in markets without a carbon import tax. However, these measures would make low-emissions Malaysian steel producers more competitive in the domestic market, and in foreign markets with a carbon import tax, such as the European Union, the United Kingdom and Thailand, where a carbon import tax will soon take effect. Therefore, the long-term effects for the Malaysian industry are likely to be positive.

The above policy recommendations should be implemented within a short time frame in order to stop the rapid growth of steel sector emissions in Malaysia.

5.4. Regulatory Framework and Implementation Timeline

Given the urgency of Malaysia's rapidly increasing carbon emissions, the following timeline is proposed for implementing the necessary policies and regulatory framework. This process may be coordinated by the MSI, which could establish a special task force with representatives from other government branches, including the customs department, tax department, Ministry of Natural Resources and Environmental Sustainability, and energy regulators, potentially chaired by the Prime Minister directly.

As some time is needed to develop the necessary regulatory infrastructure for explicit carbon pricing, Malaysia could begin by imposing an implicit carbon price on coking coal (metallurgical coal). This would follow the examples of India and China, which have at various points in time imposed import duties on metallurgical coal (Reuters 2007, 2024).

Malaysia may also draw on offers from the EU to provide technical assistance in developing the needed regulatory frameworks and consult with its ASEAN neighbours on common standards and capacity building.

Table 5, is the proposed timeline. The timeline emphasises the need for urgent action, given the increase in high emissions steel production capacity in Malaysia, by suggesting a temporary tax on coking coal. This policy measure buys time to develop the necessary regulatory infrastructure for carbon pricing and carbon import taxes (MY-CBAM). By 2026 Malaysia could impose mandatory measurement, by 2027 Malaysia could introduce carbon pricing (and remove the temporary coking coal tax). In 2030, assuming a national carbon pricing scheme is operational, the steel pricing scheme can become part of a national scheme.

Table 5: Proposed Timeline for Policy Implementation

Year	Actions
2025	Impose a temporary tax on coking coal to account for some of the implicit carbon emissions of BF-BOF steel production.
	Prepare regulatory infrastructure needed for carbon pricing, such as rules for installing measurement equipment and calculating the carbon emissions related to electricity use.
	Prepare regulatory infrastructure needed for a Malaysian CBAM (MY-CBAM), including calculation methods and certification of foreign emissions taxes.
2026	Require at-source measurement of GHG emissions in the steel industry and the reporting of GHG emissions in the production of imported steel and selected steel products.
2027	Impose carbon pricing and MY-CBAM, and remove the temporary coking coal tax. The government's excess emissions charge could initially be set at 50% of EU carbon prices, gradually moving up to 100% by 2030. The government could also establish a carbon price based on a trade-weighted basket of carbon prices from major trading partners, such as Singapore, the EU, China, South Korea, and California.
2030	Creation of a comprehensive national carbon pricing framework (which includes the steel sector), replacing the steel sector carbon pricing pilot scheme.

6. Conclusion

The challenges posed by GHG emissions in the steel industry demand urgent action and innovative solutions. This research has shed light on the significant role of carbon pricing in mitigating emissions and steering the industry towards a sustainable future.

The steel sector, a vital component of Malaysia's economy, faces a critical juncture. Without intervention, the rapid growth in GHG emissions could jeopardise Malaysia's climate commitments and hinder its transition to a low-carbon economy.

Fortunately, carbon pricing offers a promising pathway forward. By internalising the true cost of carbon emissions, we can incentivise investments in cleaner technologies, drive innovation, and promote responsible production practices.

Malaysian policymakers should consider seizing the opportunity and lead the charge towards a greener steel industry, which would include:

1. Implementing Carbon Pricing: Initiate a phased approach to carbon pricing in the steel industry, starting with a temporary tax on coking coal and transitioning to a comprehensive cap-and-trade scheme. This will create economic incentives for emissions reduction and drive the adoption of sustainable practices.

2. Fostering Collaboration: Forge partnerships between government agencies, industry players, and civil society to facilitate the transition to low-emissions steel production. Collaboration is key to overcoming barriers, sharing knowledge, and maximising impact.

3. Investing in Innovation: Allocate resources to research and development efforts aimed at advancing low-carbon technologies in the steel sector. Investing in innovation will accelerate progress towards Malaysia's climate goals and enhance the competitiveness of Malaysian steel products in the global market.

4. Leading by Example: Demonstrate Malaysia's commitment to sustainability by setting ambitious GHG emissions reduction targets and adhering to international best practices. By leading by example, Malaysia can inspire other nations to follow suit and collectively address the climate crisis.

There is a real opportunity for the Malaysian society to move ahead with its low-carbon development aspirations and build the necessary regulatory framework to incentivize the adoption of greener technologies and environmentally sustainable investments. Given the steel industry's trajectory of rising emissions and its overall impact in the country's carbon budget, policymakers should consider starting carbon pricing regulations in this sector.

Appendix

Author Calculations

Indicator	2018	2019	2020	2021	2022	2024
Scrap consumption (1000 MT, source: MSI)	3542	3502	2911	3000	3216	
Iron ore consumption (1000 MT, source: MSI)	1564	5939	5760	6097	7129	
Steel from scrap (Scrap-EAF, 1000 MT)*	3542	3502	2911	3000	3216	$3216_{(est)}$
Steel from iron ore (BF-BOF, 1000 MT) (1)*	894	3394	3291	3484	4074	$5074_{(est)}$
Total steel production (2)*	4436	6896	6202	6484	7290	$8290_{(est)}$
Total steel production (source: MSI)	4108	6948	6619	6595	7053	
Discrepancy between MSI and author calc*	+328	-52	-417	-111	237	
Emissions from Scrap-EAF (3)*	2409	2381	1979	2040	2187	$2187_{(est)}$
Emissions from BF-BOF (3)*	2082	7907	7669	8118	9492	$11822_{(est)}$
Total emissions (Gg CO_2 eq) (4)*	4491	10289	9649	10158	11679	$14009_{(est)}$
Total emissions (Gg CO_2 eq, source: BUR-4)	1110	9461				
Total emissions (Gg CO_2 eq, source: MSI)		12228	12421	11887	12599	12886 (year 2023) 38695 (forecast 2030)
Steel production emissions intensity for Malaysia (MT CO_2 eq per MT steel, source: MSI) (5)*	1.29	1.76	1.88	1.90	1.79	1.84 (2023) 1.99 (2024)
Steel production emissions intensity for world (MT CO_2 eq per MT steel, source: WSA)	1.81	1.82	1.88	1.91	1.91	

*** Author calculations of emissions, with the following assumptions:**

1. 1 ton of scrap produces 1 ton of steel; 1.75 ton of iron or produces 1 ton of steel. Estimate for 2024: additional 1,000,000 MT in steel production from BF-BOF based on announced capacity increases.
2. Add steel from scrap + steel form iron ore
3. For BF-BOF, 2.33 MT of CO_2 eq total emissions per MT of steel produced; for Scrap-EAF, 0.68 MT of CO_2 eq total emissions per MT of steel produced
4. Add emissions from EAF + emissions from BF-BOF. Note that MSI's emissions data is on average 18% more than author-estimated emissions. When estimating emissions intensity with MSI data, for 2018 and 2024, author calculations + 18% is used – see also note 5.
5. Total emissions divided by total production, based on MSI data, except for 2018 and 2024, which uses author calculations – see also note 4.

Please note: calculations are based on total emissions, which include direct emissions and emissions involved in energy generation.

Interviewees

Representatives from the following organisations were interviewed or provided feedback on this report. Several others were also consulted, but they preferred to remain anonymous.

- Australian High Commission, Kuala Lumpur
- European Commission, Brussels
- Malaysia Steel Institute (MSI)
- Malaysia Steel Works (Masteel)
- Ministry of Investment, Trade and Industry (MITI)
- Ministry of Natural Resources and Environmental Sustainability (NRES)

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