

2025 AEER Year-End Report

STEEL INDUSTRY DECARBONIZATION:

**"Greening Indonesia's Steel Industry,
Steeling the Collective Green Determination"**

by: Timotius Rafael & Yuyun Hikmatul Uyun



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AEER
AKSI EKOLOGI & EMANSIPASI RAKYAT

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About Aksi Ekologi dan Emansipasi Rakyat (AEER)

AEER is an Indonesian environmental organization founded in 2017, dedicated to addressing ecological and social justice issues, particularly those exacerbated by unsustainable industrial practices. AEER's mission is to rescue communities impacted by environmental degradation and promote policies that support sustainability. The organization actively campaigns to reduce the country's dependence on fossil fuels, especially coal, while encouraging a transition to low-carbon energy alternatives. This commitment is reflected in their target to help reduce Indonesia's carbon emissions by 446 million tons of CO₂ in the energy sector by 2060.

The organization collaborates with local and international partners, including community groups, government agencies, and other NGOs, to conduct research and advocacy campaigns. AEER's work is crucial in the context of Indonesia's growing nickel industry, which, while playing a crucial role in the global transition to electric vehicles, also poses significant environmental and social challenges. By raising awareness, producing detailed research reports, and engaging in policy dialogue, AEER strives to mitigate the negative impacts of mining and other industrial activities. The organization also emphasizes the importance of biodiversity conservation and the protection of vital ecosystems, working to ensure that economic development does not compromise environmental integrity.

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EXECUTIVE SUMMARY

1. The steel industry serves as the development foundation of the economy, infrastructure, manufacturing, and energy transition, positioning itself as a priority sector in the National Mid-Term Development Plan (Rencana Pembangunan Jangka Menengah Nasional/RPJMN) and the Vision of Golden Indonesia 2045. However, the domination of coal-based technology causes this sector to be one of the largest contributors to the national greenhouse gas emissions. Without any changes in the direction of technology and energy, the steel industry expansion risks locking in high emissions in the long term and hindering Indonesia from achieving the net zero emissions target.
2. Steel decarbonization is interrelated with climate, human rights, and just transition issues. The impact of the steel industry not only reflects on the rising carbon emissions, but also on water and air pollution, public health problems, degradation of living spaces, and workforce conflicts around the industrial parks. This emphasizes that the decarbonization policy must be placed within the framework of business and human rights, as well as just transition, so that the emission reduction works hand in hand with protecting the right to a good and healthy environment, and the well-being of the affected communities.
3. The decarbonization policy framework has existed, but it is still weak in its integration and implementation. RPJMN 2025-2029, Presidential Regulation Number 110 of 2025 on Carbon Economic Value, and the Industrial Decarbonization Roadmap outline the policy direction towards a low-carbon steel industry. However, the decarbonization agenda has not yet become an explicit goal and has not been integrated into industrial policy. It is still a normative agenda, and not yet supported by binding sectoral targets, operational roadmaps, and strong monitoring mechanisms. The gap between plans and their implementation is the main challenge.
4. The dominance of China's steel production, developed countries' protectionist policy, and the implementation of the European Union's Carbon Border Adjustment Mechanism (CBAM) has weakened the competitiveness of high-emission domestic steel. At the same time, Indonesia's steel industry is still dependent on raw material imports and fossil energy, making it vulnerable to global rate fluctuation and international trading policy. Without decarbonization, the industry is prone to losing market access, facing high carbon prices, and experiencing a long-term decline in competitiveness.

5. Steel decarbonization is a strategic opportunity to strengthen the competitiveness and resilience of domestic industry. The transition towards low-carbon steel opens an opportunity to develop clean technology, increase the energy efficiency, utilize the renewable energy, and differentiate the sustainable standard-based products. With the support of consistent regulation, transition financing, and green energy infrastructures, decarbonization will become an instrument to advance the domestic steel industry, decrease the economic and social risks, and also ensure the development of a sustainable and fair industry.

Therefore, the government is advised to:

- a. Stipulate a firm, binding, and long-term steel decarbonization regulation framework. Additionally, there must be a measured technology transition roadmap up to 2050. The certainty of policy direction, including emission standards, reporting obligations, and integration with the Carbon Economic Value instrument, is important to signal strong and foreseeable investment to industry actors.
- b. Strengthen the support toward transition financing and mitigation of investment risk. The access to fiscal and non-fiscal incentives combination, such as tax deduction, limited and targeted subsidies, blended finance schemes, and the utilization of international climate financing, is used to lessen the initial cost of low-carbon technology adoption. Some schemes like Industrial Decarbonization and Competitiveness Fund (IDCF) need to be ensured as operational, easily accessible by the industry, and connected to the national financing institutions.
- c. Accelerate the provision of clean energy infrastructures and low-carbon raw materials. The development of new renewable energy (NRE) power plants, the advancement of green electricity grids, and the establishment of green hydrogen ecosystem and steel recycling, especially in the strategic industrial parks.
- d. Encourage technology transformation gradually and fairly. The government should propel technology transition from coal-based Blast Furnace to the low-carbon production route, such as green electricity-based Electric Arc Furnace, increased recycling, and other innovative technologies.
- e. Integrate the protection of the environment, health, and human rights within steel industrial policies. Decarbonization must include the improvement of environment, work safety, and public health standards in the surrounding industrial parks. The government should ensure strict supervision, transparency of emission and environmental quality data, and the establishment of complaint and recovery mechanisms for affected communities.

1.1 Background

The steel industry is often called the “mother of all industries” due to its role as a foundation in the development of the economy and other industries. Steel is commonly used as the main raw material for infrastructure, manufacturing, and transportation. Not only for construction, steel is also an important material in developing clean energy infrastructure, which is the center of energy and new renewable energy (NRE) transition--such as the structure of wind turbines and solar power plants (*Pembangkit Listrik Tenaga Surya/PLTS*), electric vehicle transportation, and the materials for critical mineral downstreaming. This is because steel offers high strength, durability, and recyclability.¹

In the 2025 national economy and development, the steel industry as part of the Metal, Machinery, Transportation Equipment, and Electronic Industries (ILMATE), made a significant contribution, accounting for 4.3% in the National Gross Domestic Product (GDP). This number came from Indonesia's non-oil and gas manufacturing industry sector, which in total contributes 17.3% to the National GDP.² This elevated the steel industry to a strategic sector in the RPJMN and the Vision target of Golden Indonesia 2045.³ On the other hand, the steel industry was responsible for the emission of greenhouse gas (GHG) as much as 430 million tons of carbon dioxide in 2022, which equals 4.9% of the total industrial emissions and approximately 9% of the global emissions. This large number of GHG emissions is due to the dominance of coal-consuming technologies.⁴

¹ <https://app-arcelormittal-cm-uat.azurewebsites.net/media/case-studies/steel-is-the-power-behind-renewable-energy?>

² <https://ilmate.kemenperin.go.id/statistik/kontribusi-pdb>

³ <https://money.kompas.com/read/2025/06/01/204439126/industri-baja-dinilai-jadi-fondasi-strategis-menuju-indonesia-emas-2045?>



Figure 1. Suralaya Steam Power Plant in Merak, Banten Primarily Fueled by Coal as One of the Energy Resources for the Steel Industry in Cilegon

Source: AEER Documentation, 2025

As a result, the government regarded the steel industry as part of the important decarbonization action to achieve the Net Zero Emissions target by 2050 and support the green economy.⁵ Thus, a decarbonization roadmap is required, such as for energy efficiency, renewable energies, low-carbon fuels, and new technologies in the steel sector. Without any technology transition, the expansion of the extractive industry can cause high emissions for the next decade and hinder the climate goals.⁶

⁵ <https://ekonomi.bisnis.com/read/20231023/257/1707071/kemenperin-andalkan-industri-baja-capai-target-nol-emisi-karbon?>

⁶ <https://wri-indonesia.org/en/news/ministry-national-development-planning-ppnbappenas-and-wri-indonesia-ensure-integration-nickel?>

The policy of steel decarbonization and transition towards a low-carbon industry is not only related to the climate. It also aims to actualize the government's and the company's responsibilities towards the environment, health, and welfare of the affected communities. As stated in the 1945 Constitution of the Republic of Indonesia, the right to a good and healthy environment is recognized as part of human rights. Without a clean and healthy environment, fundamental rights such as living and health rights cannot be fully achieved.

Several examples of violations in the steel industry affecting the environment and surrounding communities include complaints from the residents of Cilegon Municipality, especially from Tegal Ratu Village and Kubangsari Village of Ciwandan Sub-district. Some complaints include flu/cough symptoms and shortness of breath which causes the Acute Respiratory Infection (ARI) cases to increase every year. Further complaints include the disruption of water flow due to the construction of the industrial area boundary wall, land reclamation, and sand mining activities that damage water absorption and led to a major flood that submerged hundreds of residents' homes in Ciwandan in early January 2026.⁷

1.2 Goals and Scope of CATAHU

CATAHU (*Catatan Tahunan*/Annual Report) of industrial decarbonization aims to document, analyze, and evaluate the impacts of industrial decarbonization policies and practices in relation to human rights and the environment, particularly in the steel industry. CATAHU also serves as a policy advocacy tool to urge the government and business leaders in ensuring the industrial decarbonization agenda is in line with the business and human rights principles and does not put vulnerable groups at risk.

The scope of CATAHU covers all industrial value chains, starting from processing and refining activities up to manufacturing and distribution processes of industrial products. CATAHU also highlights the environmental impacts of industrial decarbonization, such as increased heavy industry emissions, water and air pollution, and ecosystem degradation. Other scopes include the analysis of national and global policies related to the climate and industry, including the commitment to the Second Nationally Determined Contribution (SNDC), Net Zero Emission (NZE) target by 2050, as well as the global green trade policy such as CBAM which impacted the domestic industry.

⁷ <https://cilegon-parlemen.com/cilegon-hari-ini/pagar-industri-menutup-drainase-dprd-nilai-banjir-ciwandan-citangkil-akibat-salah-tata-ruang>



CHAPTER 2. PROGRAM AND POLICY ANALYSIS

The following are national and global policies on steel decarbonization that are also relevant to Indonesia's climate commitment.

2.1 RPJMN 2025-2029

Based on the National Mid-Term Development Plan (RPJMN) of 2025–2029 and the Vision of Golden Indonesia 2045, the steel industry is positioned as a priority sector with an important role in the development of the national economy and infrastructure. The steel industry, categorized under the “iron and steel basic metals” industry, reflects that the sector is a focus of manufacturing industry development and resource downstreaming, as described in the priority industry framework.⁸

In the steel industry decarbonization context, RPJMN has not yet explicitly placed the emission reduction as the main goal for the steel industry transformation. The decarbonization agenda is still implicit and dispersed, especially through the narration of energy efficiency, green industry development, and support towards general energy transition.

Other than that, RPJMN's approach towards the steel industry continues to prioritize national economic growth and resilience, instead of the social and environmental impact mitigation. The issues of the impact on public health, air quality, living space, and workforce safety and welfare around the industrial parks are not yet firmly integrated within the industrial policy framework. It shows that the RPJMN's decarbonization agenda is not yet fully aligned with just transition, business, and human rights principles.

⁸ <https://steel-mining-policy.id/saatnya-industri-baja-menjadi-prioritas-pembangunan-nasional/>

However, the Ministry of Industry (*Kementerian Perindustrian/Kemenperin*) highlights the supporting policies for the steel industry, which are considered in accordance with RPJMN, such as:

- *Trade remedies and import control to protect the domestic steel industry.*
- *Mandatory SNI implementation for steel products to increase the quality and competitiveness.*
- *Fiscal incentive for the steel industry investment.*
- *The increase of Local Content Requirements (LCRs) to strengthen the involvement of local companies in the steel industry.*
- *Energy supply security through certain natural gas pricing (*harga gas bumi tertentu/HGBT*) scheme so the industry can operate efficiently.*⁹

2.2 Presidential Regulation No. 110 of 2025

Steel is recognized for its high emissions, which were then regulated by the government through Presidential Regulation No. 110 of 2025 on the Implementation of Carbon Economic Value (CEV) Instruments and Greenhouse Gas (GHG) Emission Control. This regulation supersedes Presidential Regulation No. 98 of 2021 and expands the scope of the carbon policy as the main instrument in the decarbonization strategy.

The key substance in this Presidential Regulation 110/2025 is the national implementation of Carbon Economic Value (CEV) instruments and GHG emission control, which shall be enacted in several phases. Among them are carbon allocation, formulation and establishment of SNDC, the governance of CEV instruments implementation, transparency framework, monitoring and evaluation, coaching and financing, as well as the establishment of a steering committee.¹⁰

⁹ https://perpustakaan.bappenas.go.id/e-library/file_upload/koleksi/dokumenbappenas/konten/Dokumen%202025/Konten/Relayout%20Narasi%20RPJMN%20Tahun%202025-2029%20%282%29.pdf

¹⁰ <https://peraturan.bpk.go.id/Details/334733/perpres-no-110-tahun-2025>



2.3 Regulation of the Minister of Industry on the Industry Decarbonization Roadmap

In August 2025, the Ministry of Industry collaborated with the World Resources Institute (WRI) Indonesia and the Institute for Essential Services Reform (IESR) to formulate the roadmap of industrial decarbonization which includes 9 sectors, one of which is the steel sector. The formulation of this roadmap aims to establish a competitive national industry that operates with net zero emissions by 2050, faster than the national target at 2060.¹¹

Presidential Regulation 110/2025 and the Decarbonization Roadmap place the policy focus to not only on emission reporting, but also on real emission reduction through investment and clean technology in the steel industry sector. Furthermore, the planned follow-ups are the issuance of the Regulation of the Minister of Industry on the implementation of decarbonization in the industrial sector in June 2026, and the issuance of the regulation on the Industrial Decarbonization Roadmap in phases for each sub-sector in September 2026.

This Decarbonization Roadmap is necessary to ensure it does not focus solely on industrial and national interests at the central level. Instead, it takes into consideration the inputs and involvement of the surrounding communities to make it more inclusive.



¹¹ <https://www.antaranews.com/berita/4537670/kemenperin-wri-iesr-kolaborasi-susun-peta-jalan-dekarbonisasi>

2.4 The Initiative of GISCO and IDCF

IDCF, or Industrial Decarbonization Competitiveness Facility, is a financing platform created by the Ministry of Industry, which serves as the bridge between industry's small to medium investment needs and the availability of large-scale funding from international funding entities. IDCF is included in the blue book, or List of Medium-Term Planned External Loans (RPPLN) 2025-2029 with a maximum amount of 600 million USD or 9 trillion IDR, with the loan from the World Bank.



Figure 2. Scheme of Green Industry Services Company (GISCO)

Source: AIGIS Event, 2025 ¹²

¹² <https://www.instagram.com/p/DOqujQWCTCG/>

Meanwhile, GISCO, or the Green Industry Service Company, is a business model created by the Ministry of Industry to be a solution for the industry in increasing the decarbonization efforts using investment costs as low as possible, and pays back the investment through the savings earned from green technology. GISCO's scope as a green industrial service company includes the provision of technology, implementation, operation, maintenance, measurement, and verification of emissions.

Both initiatives are good efforts in showing that decarbonization is not a burden, but an opportunity for national industries that want to reduce emissions to address their main challenges--capital constraints and high investment risks. However, the implementation have to be supported by establishing the regulation and platform that are well interconnected with the industry. Some great examples, such as the Electronic Environmental Reporting Information System (*Sistem Informasi Pelaporan Elektronik Lingkungan Hidup/SIMPEL*) or Company Performance Rating Assessment Program (*Program Penilaian Peringkat Kinerja Perusahaan/PROPER*) by the Ministry of Environment, can serve as references to ensure both initiatives by the Ministry of Industry move beyond concepts and planning. On the other hand, the industry needs to follow the existing concept to gain the investment opportunities for a faster green energy transition.

2.5 Human Rights Bill and Due Diligence in one of the biggest steel production countries in the world

South Korea is the world's 6th biggest steel-producing country. It is also the location of Pohang Steel Company (Posco), which is Krakatau Posco's parent company. Until the end of 2025, South Korea was processing a *Legislative Bill for the Act on the Protection of Human Rights and the Environment for Sustainable Business Management* (shortened as *Corporate Human Rights and Environmental Due Diligence Act/mHREDD*). The Bill obliges companies to carry out due diligence to proactively identify and solve potential human rights and environmental violations across global supply chains.

The Bill defines the supply chain comprehensively, starting from raw material provision to end-user consumption, including direct and indirect business relationships. The Bill obliges companies to adjust their action plan based on the nature and extent of their business relationships and impacts.

mHREDD refers to the company's process of identifying, preventing, and lessening negative impacts on human rights and the environment, as well as transparently disclosing relevant information.

This Bill has been proposed by the South Korean parliament since September 2023. It was repropoed on 13 June 2025. Jung Tae-ho, a parliament member from the Democratic Party (Gwanak-eul, Seoul), together with the Korean Transnational Corporations Watch (KTNC Watch), Korean Confederation of Trade Unions (KCTU), and Federation of Korean Trade Unions (FKTU), urged the National Assembly of South Korea to pass the bill as a form of commitment towards international standards.

The Bill also sets mandatory due diligence towards human rights and the environment, which applies to the companies with over 500 employees or an annual income of around USD 150 million. Small and medium enterprises (Usaha Kecil dan Menengah/UKM) are excluded.

Looking at South Korea's policy, as one of Asia's leading steel producers, Indonesia can also adopt and implement similar obligations for human rights protection and due diligence for the steel industry. Indonesia's steel companies, such as Krakatau Posco, subsidiary of Posco Korea, could become Asia's second leader in implementing human rights and due diligence practices. It goes beyond following the rules, but also about protecting human rights and the surrounding environment, from upstream to downstream across the entire steel supply chain.



CHAPTER 3. STEEL INDUSTRY DEVELOPMENT (PAST – PRESENT – FUTURE)

3.1 Steel Industry Technology Transformation

In the early development of the steel industry, the technology used was the Electric Arc Furnace (EAF) at PT Krakatau Steel (PTKS), the pioneer of the steel industry in the early 1970s. Initially, the electricity and energy usage was supplied with gas. Other than PTKS, another steel industry in the 1970s was PT Ispat Indo in Surabaya. Over the years, the development mainly occurred in the Jakarta area (Tata Steel, etc.), followed by Surabaya (Gunawan Djaya Steel), and South Kalimantan with the existence of Meratus Jaya Iron and Steel. However, over the past 13 years, steel development has been focused on nickel-based stainless steel, driven by the downstream agenda, especially in Sulawesi and North Maluku.

Unfortunately, electricity-based technologies were then replaced by coal-based technologies. This is demonstrated by the utilization of coal in the Blast Furnace technology process. Companies like PT Krakatau Posco and PT Dexin Steel Indonesia are the main actors, while PT Krakatau Steel and PT Gunung Raja Paksi have similar technology but are not operational. As of early 2026, there are at least four steel companies utilizing technology fueled by coal fossil. Other companies, such as PT Ispat Indo and PT Krakatau Steel for example, are using electricity-based technology, although with way smaller capacities than the fossil-based ones. Roughly, their mix is 80% for the BF-BOF route and 20% for the EAF route at the national scale (Hasan and Swastika, 2024).¹³ It indicates the domestic steel industry does not really pay attention to the impact of technology usage on the climate and the surrounding environment, because they still use fossil fuel for massive steel production.

¹³ <https://energyandcleanair.org/publication/indonesia-iron-and-steels-full-potential-hinges-on-low-carbon-technologies/>

IRON AND STEEL SMELTING INDUSTRY IN INDONESIA

Iron Ore/Scrap raw materials

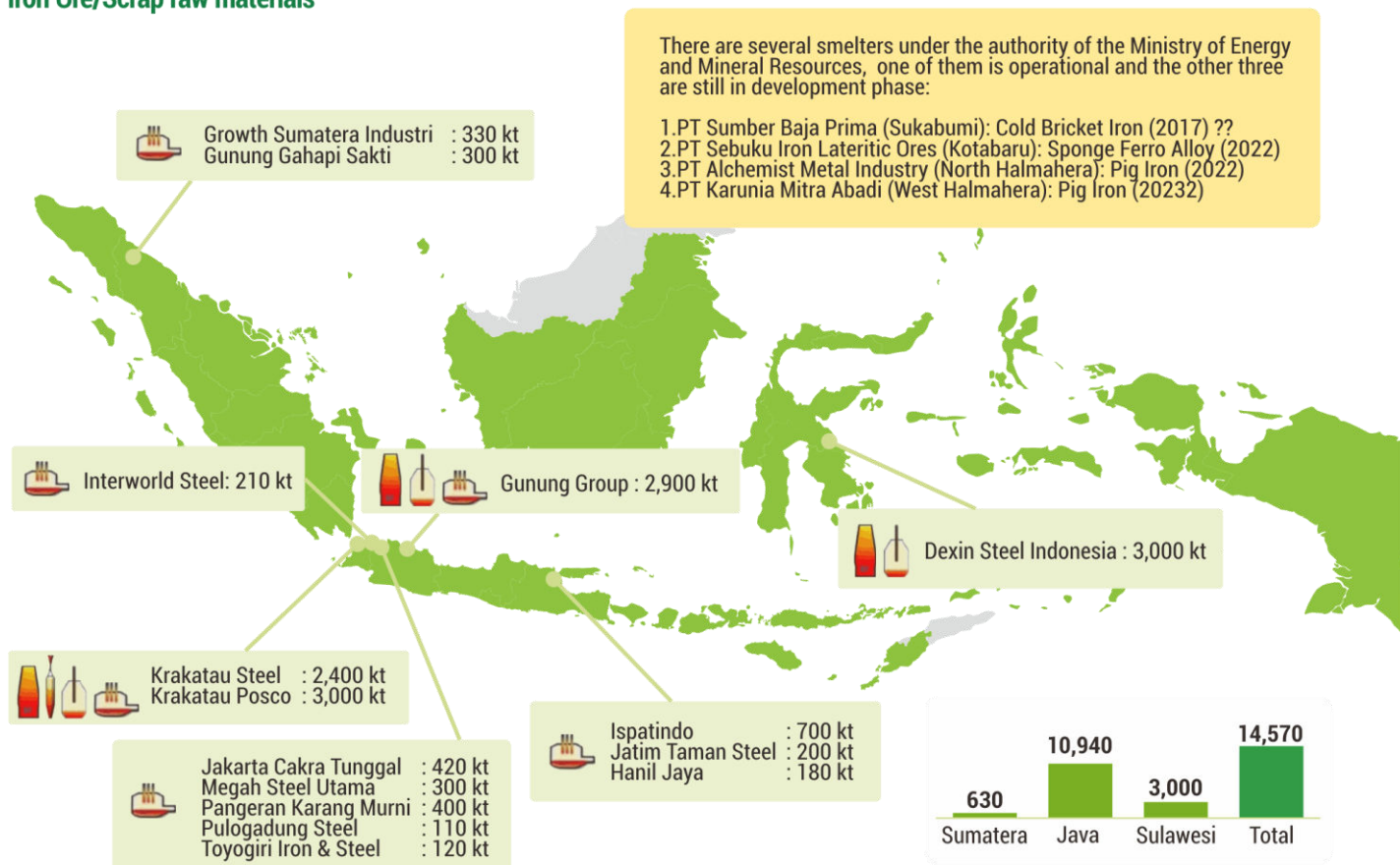


Figure 3. The list of iron and steel smelter industry in Indonesia

Source: Prometindo, 2025 ¹⁴

Reclaim Finance, an NGO based in Paris, stated that the steel making process via coal-based blast furnace remains dominant and is counterproductive to the industry's decarbonization goals.¹⁵ This is a huge warning because blast furnace steel processing is dominating up to 80% of the domestic steel production. It is also the biggest CO₂ emitter in Indonesia, with around 2 tons of CO₂ emission for each ton of raw steel. Furthermore, we must also consider the demand and production of domestic steel, which are predicted to increase 12 times from 2023 until 2060.

¹⁴ https://drive.google.com/drive/folders/130Zsbh87PDW6_4IMewuuvbX75ypT5nyA

¹⁵ https://reclaimfinance.org/site/wp-content/uploads/2024/03/Steeling-our_future_March_2024.pdf?

Table 1. The Projection of Iron and Steel Industry Production in Indonesia until 2060

Steel Demand-Supply (millions of ton)	2023	2030	2050	2060
Indonesia	16.0	33.0	125.0	207.0
KS Holding	2.4	-	-	-
KS Affiliation	3.0	13.7	52.5	87.0
Others	10.6	19.3	72.5	120.0
KS Group Steel Supply	34%	42%	42%	42%

Source: PT Krakatau Steel, 2025 ¹⁶

In addition, the iron and steel industry is predicted to increase its CO₂ emissions by 11.7 times in 2060, compared to 2023. If the data above is compared to the Current Policy Scenario (CPOS) of net national emission data in the SNDC which projects 1,886,905 million tons of CO₂ in 2060, the steel industry emissions would account for a 31% portion of national emissions. Thus, the steel industry emission rate should become a shared concern that urges immediate implementation of decarbonization plans. The KS Group (Krakatau Posco included) itself is projected to become a major player with 42% market share in 2030, 2050, and 2060, making it another shared concern.¹⁷

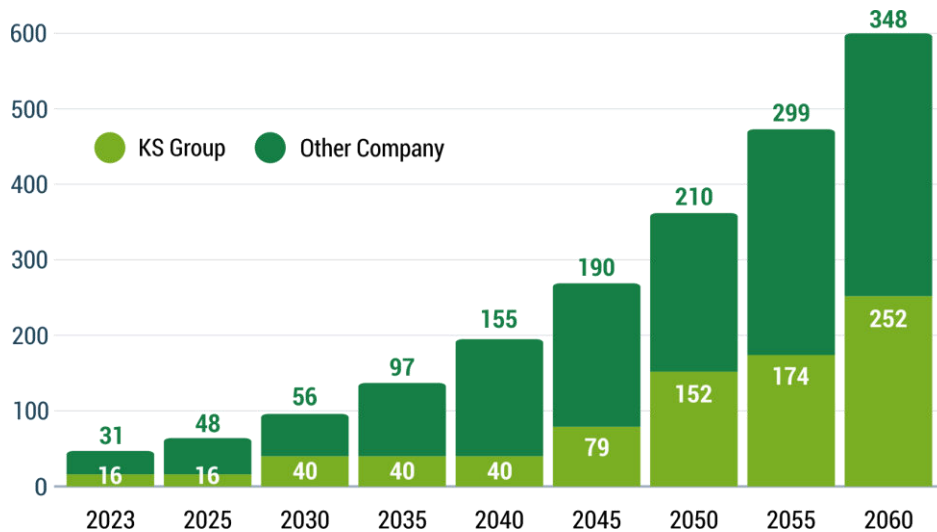


Figure 4. Projected Increase in Emissions in the National Steel Industry (in million tons of CO₂)

Source: PT Krakatau Steel, 2025

Given this fact, if the Business as Usual (BaU) scenario is not combined with an emission reduction scenario, achieving the NZE will become even more difficult in the next few years.

¹⁶ Environmental Study Discussion at PT Krakatau Steel – Action for Ecology and People's Emancipation (AEER)

¹⁷ *Ibid*

3.2 Global Pressure: China's Domination and Protectionism

The US President, Donald Trump, has implemented the protectionist policy by imposing a 25% import tariff on steel and 10% on aluminum, which had a significant impact on global trade, particularly by creating pricing pressures. Excessive steel imports from China--up to 118 million tons globally in 2024--that are driven by government subsidies,¹⁸ plummeting domestic demand, high US steel import tariffs, and carbon trading restrictions in the European Union, have led to Indonesia's market being flooded with imported steel from China. These imports are cheaper, turning Indonesia into a dumping ground.¹⁹ This has weakened the competitiveness of the domestic steel industry, forcing producers to lower their production volume to reduce costs, and indirectly slows down steel industry decarbonization efforts.

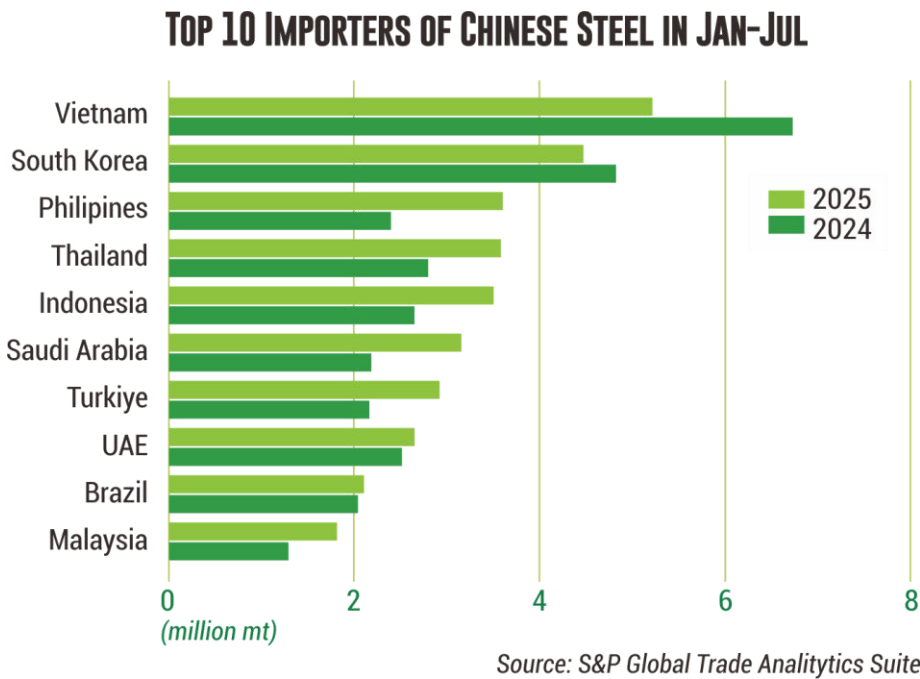


Figure 5. Steel Importer Countries from China in Q1-Q2 within the last two years

Source: S&P Global Trade Analytics Suite, 2025²⁰

¹⁸ <https://steel-mining-policy.id/sminsights-berita-baja-mingguan-minggu-iii-oktober-2025/>

¹⁹ <https://www.cnbcindonesia.com/news/20251003134401-4-672613/bos-ks-wanti-wanti-banjir-baja-china-bakal-makin-parah-bmad-tak-cukup>

²⁰ <https://www.spglobal.com/energy/en/news-research/latest-news/metals/082225-chinas-steel-exports-on-track-to-exceed-2024-level-despite-possible-drop-in-oct>

On the other hand, the European Union has issued the CBAM policy, which implements a carbon price on imported goods across the energy sectors of all supply chains to prevent “carbon leakage” for products like steel, aluminum, fertilizer, hydrogen, electricity, and cement. The CBAM’s plan implementation has been running since 1 January 2026. Even though the European export share for domestic steel is not significant (only around 7% in 2022), the exported steel products, such as semi-finished products, flat and long products, pipes, and stainless steel are still affected by the tariff increase in the Indonesia-Europe trading protection mechanism via CBAM.

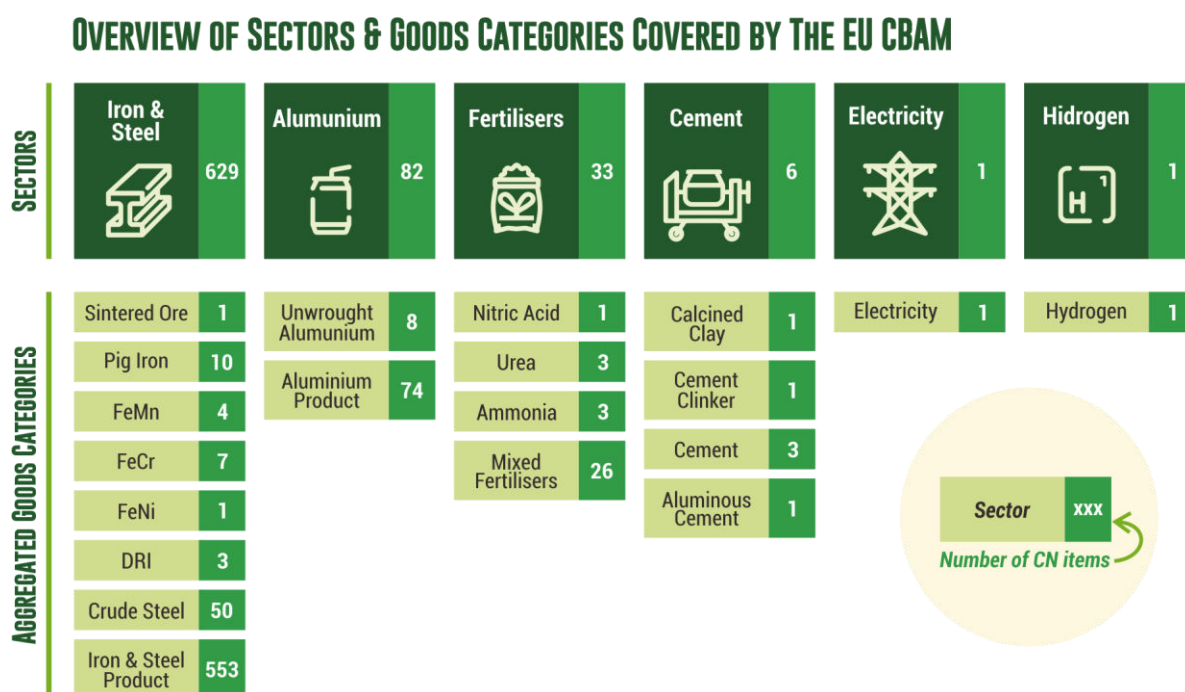


Figure 6. General overview of the sectors and categories of goods included in the European Union CBAM.

Source: CBAM Reports and Consulting, 2025 ²¹

CBAM implementation is carried out by purchasing a CBAM certificate as a financial obligation. The certificate fee is calculated by multiplying carbon emissions on the products and the European Trading System (ETS) benchmark, with free allocation factors in current year re-multiplied with the CBAM certificate cost, directly linked to the ETS carbon price. Based on calculations, the certificate for coal (BF-BOF technology) will cost around €40-90/ton of steel. This is more expensive than for the EAF route, which is €15-36/ton of steel.²² It will definitely weaken the competitiveness of the steel industry in Europe and trigger a domino effect, not only for the steel industry itself but also for other trading commodities between Europe and Indonesia.

²¹ <https://cbamreports.com/aboutcbam>

²² <https://steel-mining-policy.id/dampak-struktural-cbam-terhadap-kinerja-ekspor-baja-nasional-2026/>

3.3 Dependence and Fragility of National Supply Chain

Low availability of raw materials is one of the problems in the domestic steel industry. Even though Indonesia is rich in minerals, the steel industry relies heavily on imported goods, primarily for scrap or iron ore. Indonesia has available iron ore raw materials, but their average Fe concentration is only 47%²³. Meanwhile, at least 67% Fe concentration is required for the refining process by the DRI-EAF²⁴, and 65% for BF-BOF.²⁵ Thus, Indonesia has to import iron ore from countries like Brazil and Australia, where the Fe content exceeds 70%.

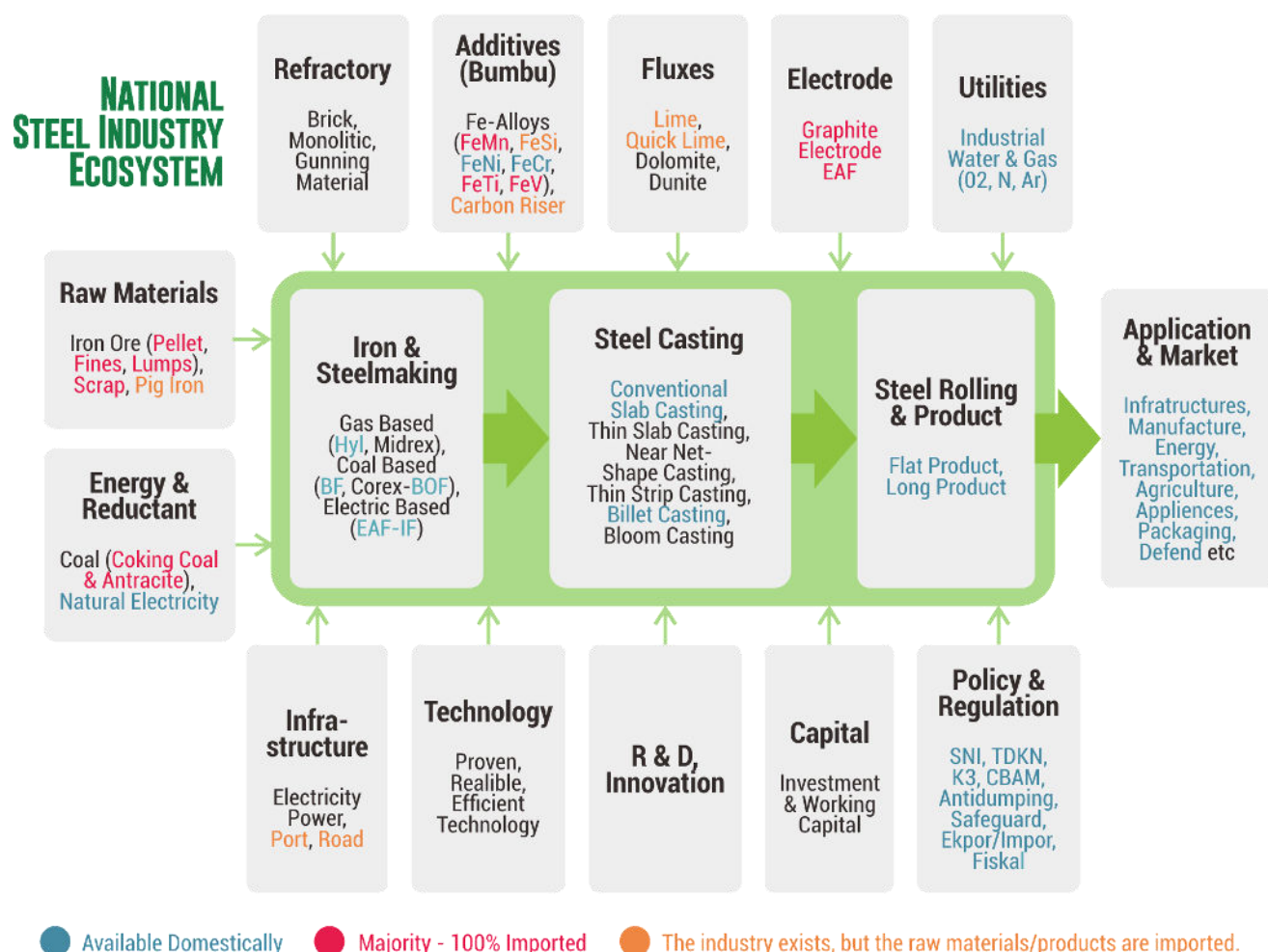


Figure 7. Domestic Steel Industry Ecosystem

Source: The Association of Indonesian Mining Professionals, 2025²⁶

²³ <https://elibrary.unisba.ac.id/files2/10.1129.pdf>

²⁴ <https://www.midrex.com/tech-article/the-iron-ore-challenge-for-direct-reduction-on-road-to-carbon-neutral-steelmaking/>

²⁵ <https://www.nature.com/articles/s41467-023-38123-2>

²⁶ https://www.youtube.com/watch?v=tusLIU_Sr44

Government data shows that 55% of domestic steel product demands are met by imports, primarily from China.²⁷ The condition implies that national production has not yet sustainably met half of the domestic market demand. Key raw materials like iron ores and coking coals still depend on imports (up to 92% for iron ore and 81% for coking coal).²⁸ This condition demonstrates the vulnerability in the upstream of the steel industry supply chain. Dependence on imported materials also makes the domestic steel industry vulnerable to global price fluctuations, international trade policies, and geopolitical crises. Other than China, Indonesia also relies on raw material imports from Australia, India, and Brazil.

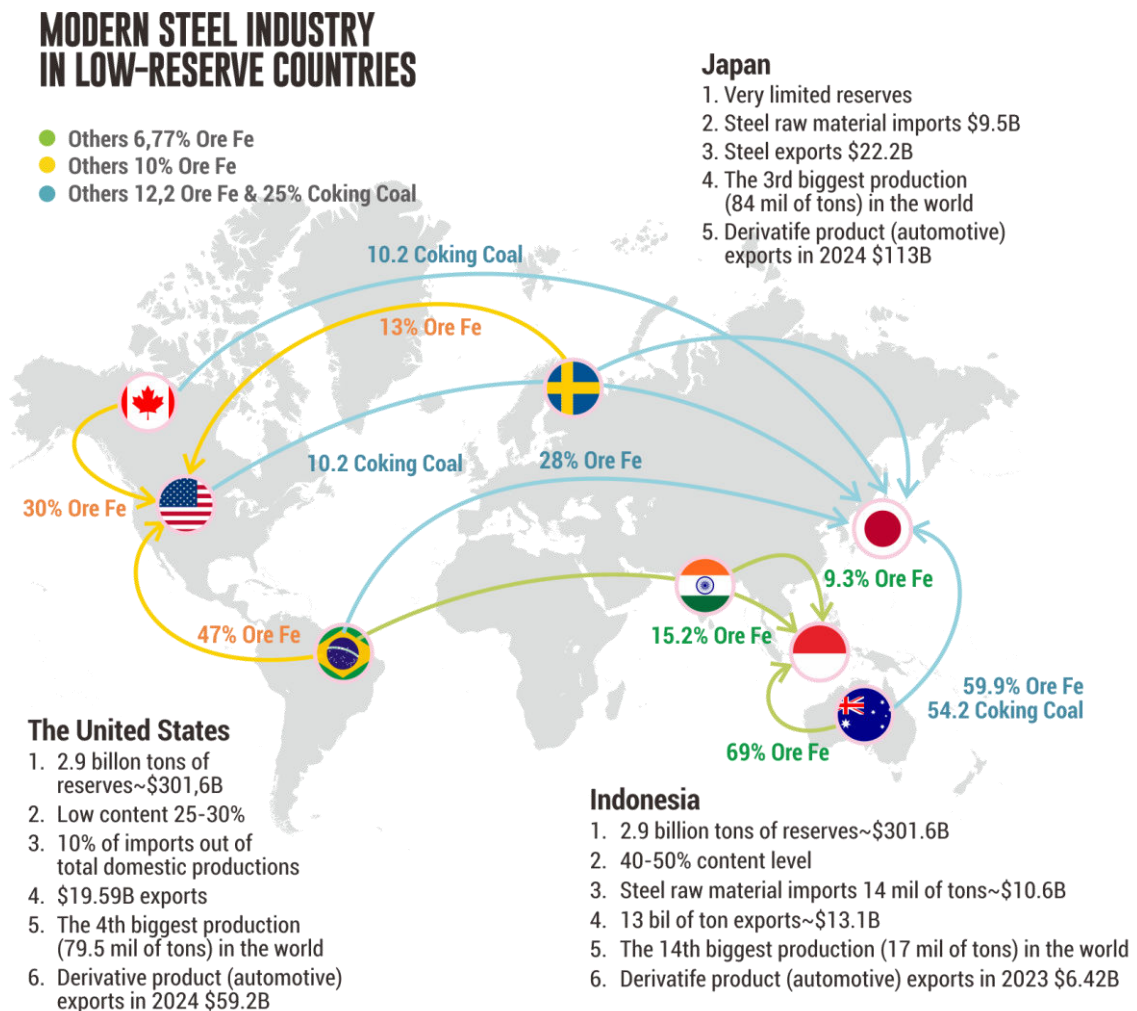


Figure 8. Map of Global Steel Making Raw Material Supply Chain

Source: Geological Engineering ITB Alumni Association, 2025²⁹

²⁷ <https://www.tempo.co/ekonomi/55-persen-kebutuhan-baja-domestik-dipenuhi-dari-impor-2088135>

²⁸ <https://asia-pacific-solidarity.net/news/2025-11-10/imports-supply-55-percent-of-indonesias-steel-demand.html?>

²⁹ https://www.youtube.com/watch?v=tusLIU_Sr44

An alternative that enables Indonesian companies to meet their own domestic steel demand has yet to be found. One of the alternatives is modifying the refining and smelting processes in national companies so that Indonesian iron ore can still be processed, despite its low Fe content. Geopolitical pressures and domestic market protection in developed countries further increase Indonesia's dependence on imported steel. Meanwhile, those countries could stop their exports at anytime, threatening domestic steel stability.

3.4 The Gap between National Demand and Supply

The utilization of Indonesian steel industry capacity is still below 57%, far from the ideal standard of 80%. It indicates that imported steel products can actually be produced domestically.³⁰ The demand for the automotive, manufacturing, and construction industries are high, but they are not met by domestic production. Activating the factories of inactive companies, such as Meratus Jaya Iron and Steel and PTKS, could be an option, although it's challenging.

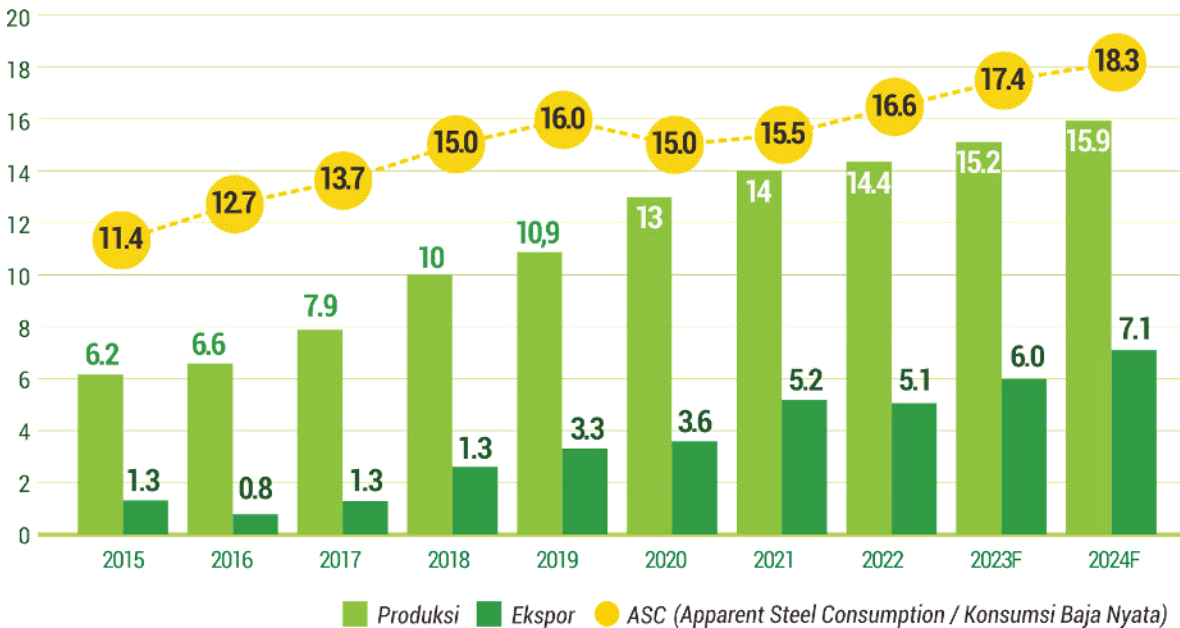


Figure 9. The Projection of Consumption, Production, and Export of Domestic Steel

Source: IISIA, 2025 ³¹

³⁰ <https://bcasekuritas.co.id/en/latest-news/news/dihadang-impor-dan-oversupply-global-krakatau-steel-paparkan-strategi-bangkit-di-dpr>

³¹ <https://iisia.or.id/news/proyeksi-kinerja-baja-nasional-2024>

The automotive, manufacturing, and construction industries are the main market of steel consumption in Indonesia. The high demand for gasoline, electric, and hybrid vehicles encourages investors to enter the domestic automotive market. Moreover, the development of spare part industries also increases the demand for iron and steel as the main raw materials. Manufacturing, other than for spare parts, can also be found in the mineral downstream sectors, such as nickel, bauxite, copper, and gold. These sectors require steel, whether for the smelting construction or as raw material. The construction sector is the largest consumer of steel, especially for the development of transportation accesses like roads and railways, buildings, and renewable energy power plants. Essentially, steel becomes the “mother of the industry”.

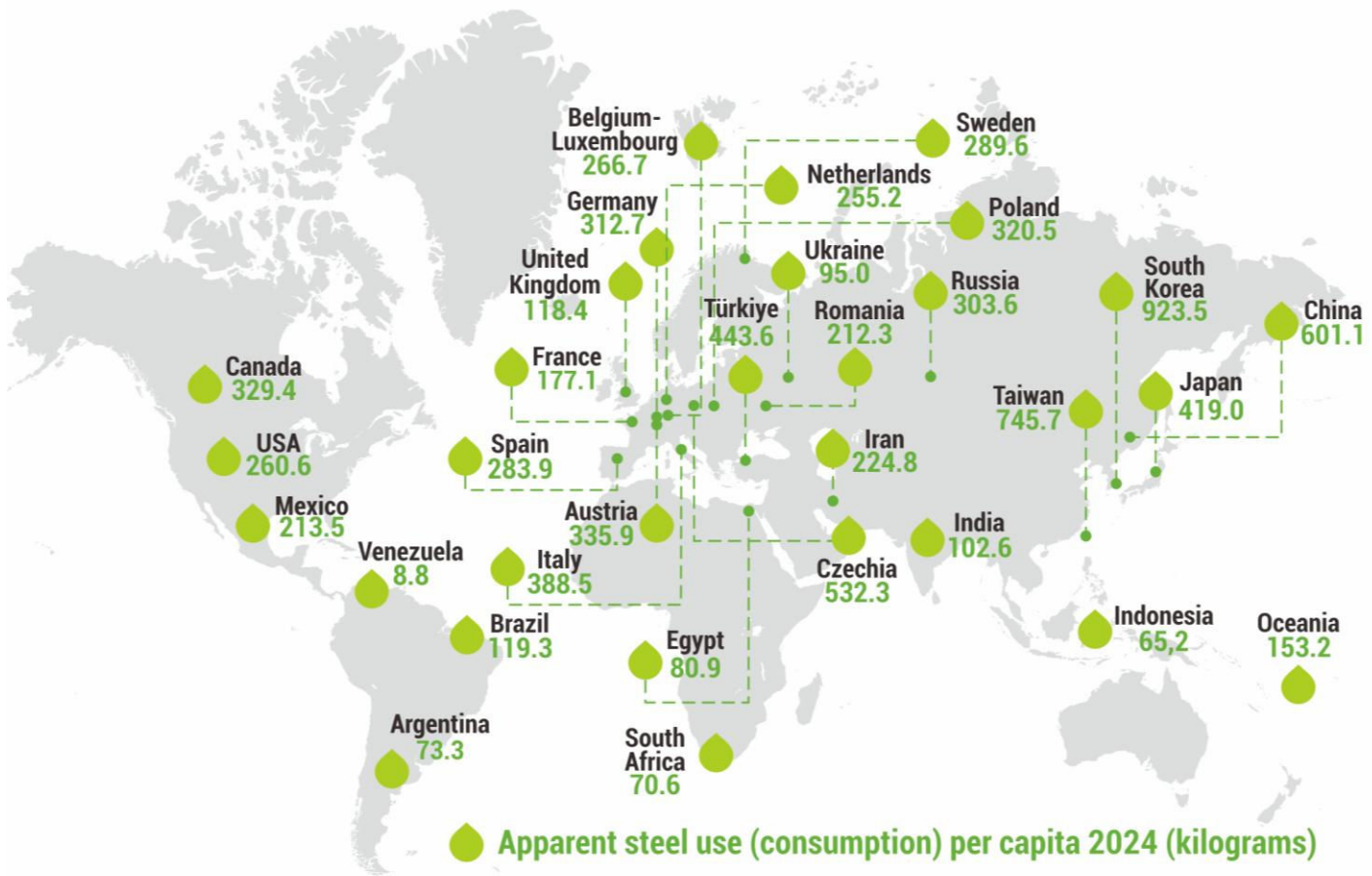


Figure 10. Steel Consumption Map for Each Country in 2024

Source: Worldsteel, 2025 ³²

³² [World Steel in Figures 2025 - worldsteel.org](https://worldsteel.org)

However, the domestic steel industry had not yet met domestic demand, as reflected by steel consumption reaching 19.3 million tons in 2025, while production was only around 16.5 million tons. The steel consumption in Indonesia is only 65 kilograms per capita, compared to the global average, which is 214 kilograms per capita, and Asia's 283 kilograms per capita.³³ It reflects the need for massive development of the steel industry to create an independent steel industry capable of withstanding the protectionist strategies from developed countries, while also boosting national economic growth. However, it must be noted that clean and renewable energy must be utilized as part of industrial decarbonization to tackle the climate crisis.

3.5 Future Opportunities and Challenges

The steel industry will tap into a huge opportunity in the future, motivated by the increasing demand for steel as the key material in economic growth and energy transition. The steel demand for infrastructure, construction, transportation, and renewable energy development (including for power plants, transmission grids, wind turbines, and solar panel structures) is projected to keep growing. Highly volatile steel price, encouragement of NRE utilization, increasing steel consumption, and supply chain sustainability are the main concerns of the industrial decarbonization era.



³³ *Ibid*

Indonesia has the potential to develop iron and steel industry as the foundation for an industry, but several challenges must be addressed, including project eligibility, high number of steel imports from China, and pressure from European environmental standard.

1

Integration Potential between Iron Steel Industry and Railways

Home > Ekonomi

Prabowo Bakal Bangun Kereta Trans Sumatera, Kalimantan, dan Sulawesi

04 November 2025, 14:25 | Tim Redaksi

KAI Tambah 54 Lokomotif Baru untuk Perkuat Angkutan Batu Bara, Beroperasi Juli 2025

15 Apr 2025 • 16:29 WIB

Investasi Rp100 Miliar, Indonesia Perkuat Hilirisasi Industri Baja

Dani Jumadil Akhir, Jurnalis - Kamis, 12 Juni 2025 11:023 WIB0:23 WIB

Senin, 05 Mei 2025 22:27 WIB

Gubernur Riau Wahid Usulkan Pembangunan Rel Kereta Batubara Dumai - Inhu ke Menteri Investasi

KAI Terima 14 Lokomotif Baru Tipe CC 205 dari AS untuk Angkutan Barang

KAI menerima 14 lokomotif baru dari AS untuk memperkuat angkutan barang di Sumatra, mendukung target pertumbuhan logistik dan transisi energi bersih.

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2

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Kelompok iklim mengajukan keluhan terhadap raksasa baja global ArcelorMittal | kastra.co

By Ratu Rina Windarty - December 17, 2025 49 0

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3

The Eligibility of Iron and Steel Smelting Projects are Questioned

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Opsi Penyelamatan Krakatau Steel (KRAS): Disuntik Danantara hingga Rombak Bisnis

Krakatau Steel (KRAS) menghadapi krisis keuangan dan membutuhkan suntikan modal dari Danantara serta restrukturisasi bisnis untuk bertahan.

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Ini Biang Kerok Utang Krakatau Steel (KRAS), Danantara Angkat Bicara

Krakatau Steel (KRAS) menghadapi utang besar akibat proyek blast furnace yang gagal. Danantara menyarankan restrukturisasi dan pemberian modal kerja untuk pemulihan.

Dionisio Damara Tonce - Bisnis.com
Sabtu, 15 November 2025 | 07:41

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Figure 11. Challenges and Issues in Indonesia's Steel Industry in 2025

Source: Petromindo, 2025³⁴

³⁴ https://www.youtube.com/watch?v=tusLIU_Sr44

Major projects, such as railways, industry downstreaming, and energy transition, will increase the steel demand. However, it requires domestic industry to be prepared in terms of technology, raw materials, and sustainability so we can avoid dependence on imports.

The transformation towards low-carbon steel also creates new value-added opportunities through the development of more efficient production technologies, increased steel recycling, and product differentiation based on sustainability standards. For countries and companies that are able to adapt earlier, green steel has the potential to become a source of competitive advantages and provide access to high-value global markets.

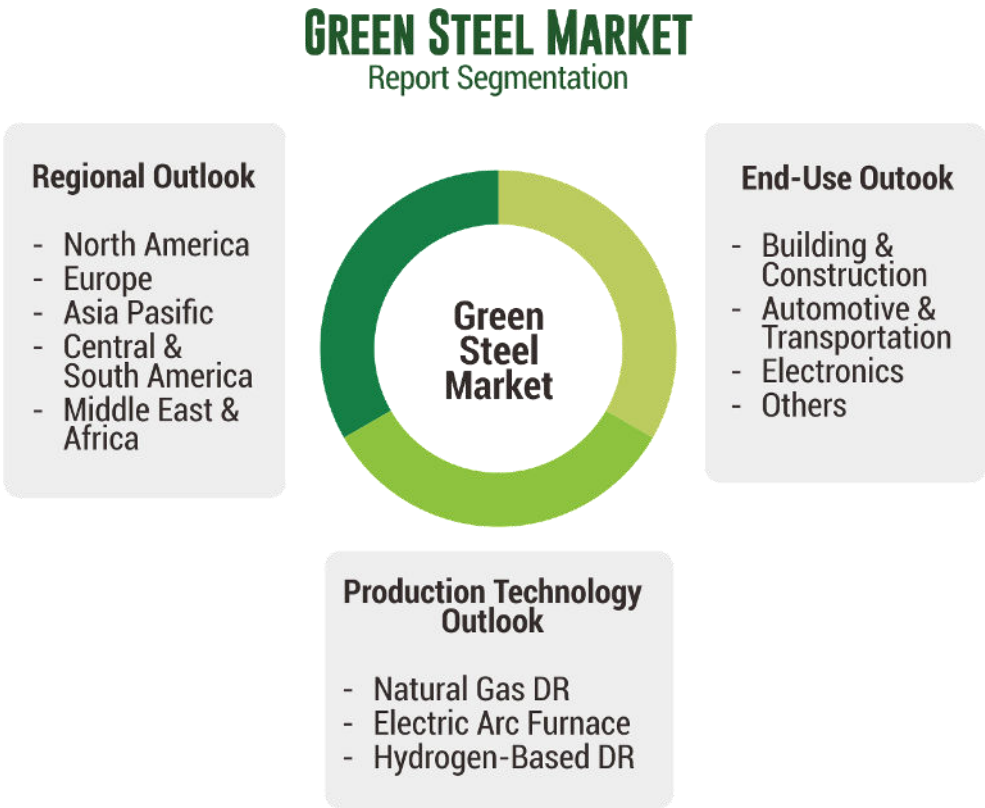


Figure 12. The Segmentation of the Green Steel Market

Source: Grandview Research, 2025 ³⁵

³⁵ <https://www.grandviewresearch.com/industry-analysis/green-steel-market-report>

CHAPTER 4.

CARBON EMISSIONS AND INDUSTRY IMPACTS

4.1 High CO₂ as the Byproduct of Steel Processing

The steel industry is one of the industrial sectors that is very energy-intensive and carbon-intensive due to its traditional production process using fossil fuel (coking coal) to reduce iron ore into steel. During this process, the carbon from the coal reacts with the oxygen and produces CO₂ as the main byproduct released to the atmosphere. Globally, this industry produces almost two billion tons of raw steel annually, with the average emissions approximately between 1.85 and 2.33 tons of CO₂ for each ton of steel. It contributes around 7-9% of the total CO₂ emissions in the world.³⁶

The calculation of CO₂ or carbon emissions produced by this steel industry depends on the technology and energy sources used. If using the BF-BOF technology, it will produce around 1.8-2.3 tons of CO₂ for every 1 ton of steel produced. Meanwhile, if using the EAF technology that utilizes steel scraps as the main material, it will produce around 0.06-0.5 tons of CO₂ per ton of steel. However, combining the technology between Direct Reduced Iron (DRI) and EAF can produce around 1.37 tons of CO₂ per ton of steel, which is lower than the BF-BOF.



³⁶ <https://globalcarbonfund.com/carbon-news/steels-heavy-carbon-burden-is-arcelormittal-pulling-back-on-its-net-zero-climate-pledge/>

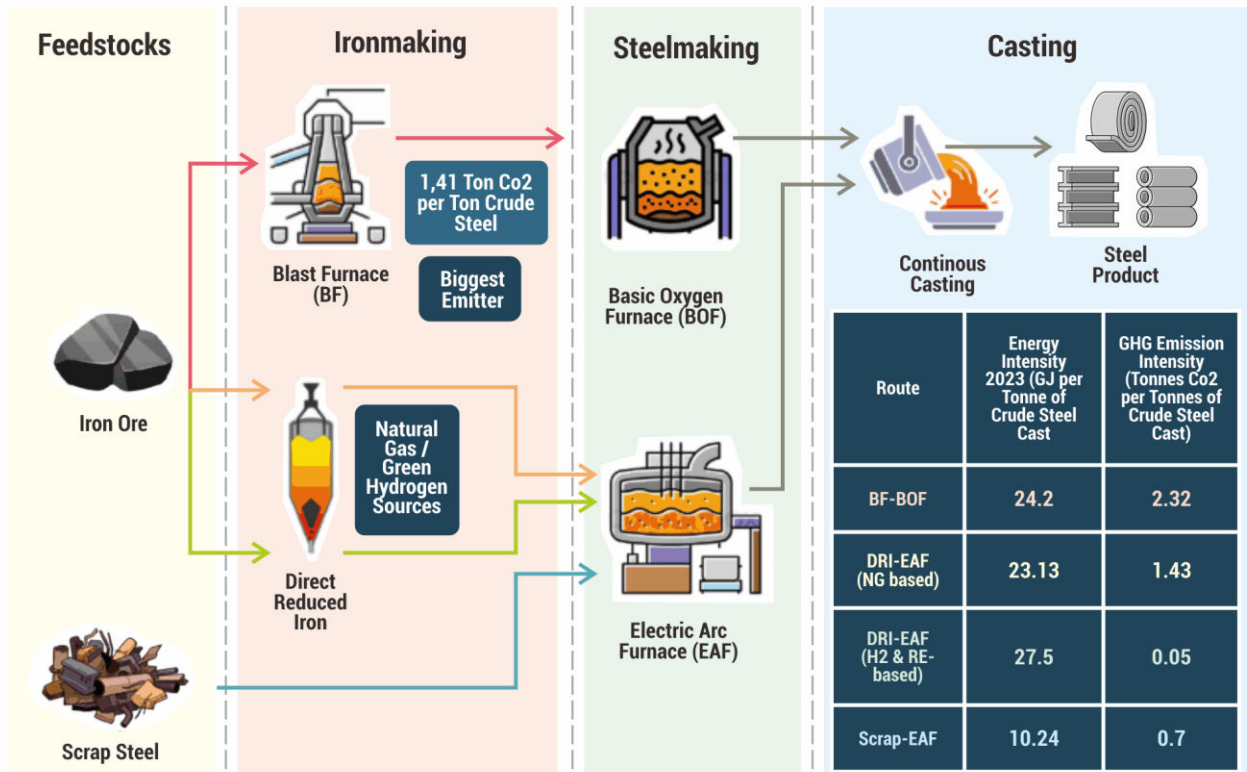


Figure 13. Steel Production Processes based on the Technology, Energy, and GHG Emissions Produced

Source: Wang et al, 2021 ³⁷

Without technological and policy transformations, domestic steel emissions may continue to grow alongside domestic demand, which is estimated to exceed 24 million tons of CO₂ annually by 2030. If not handled immediately, CO₂ emissions from the steel industry will significantly impact global climate change, air pollution, and the population. Thus, the urgency of decarbonization becomes the primary target of future projections. The International Energy Agency (IEA) and several international agencies aim to reduce emission intensity to around 0.6 tons of CO₂ per ton of steel in 2050 (from the current ~2 tons), in line with the 1.5 °C global climate goal.

³⁷ Wang, P., Ryberg M., Yang Y., Feng, Kuishuang., Kara, S., Hausc, M., & Cheng, WQ. 2021. Efficiency Stagnation in Global Steel Production Urges Joint Supply-and demand Side Mitigation Efforts. Nature Communications. 12 (1): 2066. doi: 10.1038/s41467 021-22245-6.

4.2 The Social, Economic, and Health Impacts

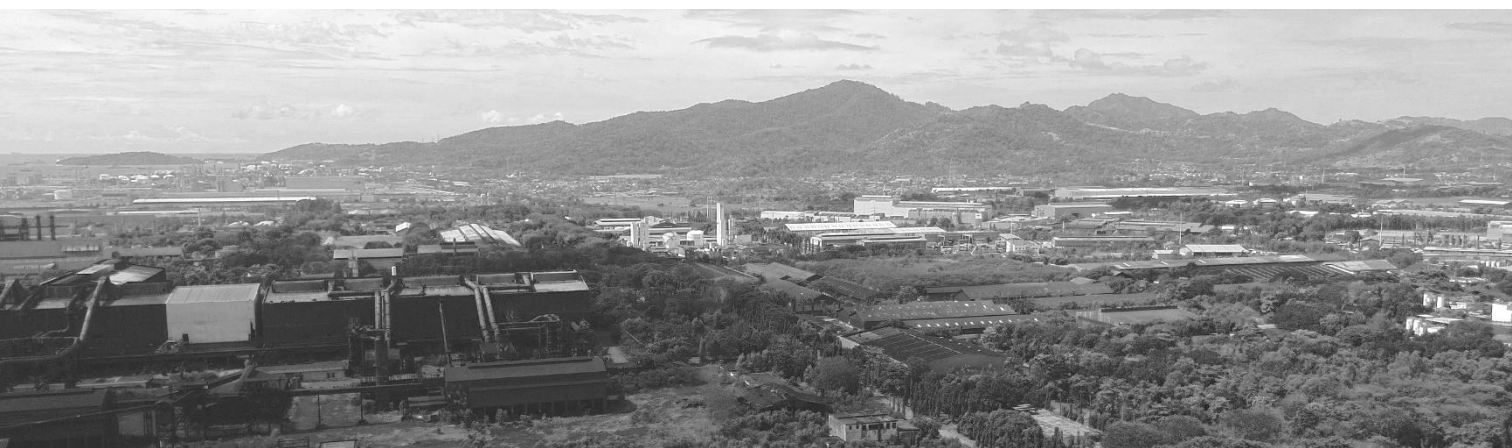
The steel industry keeps developing rapidly and is often claimed as the driving force of national economic growth by the government. On the other hand, this industry sadly does not sustain the welfare of the surrounding communities. Instead, the surrounding communities has to bear the adverse impacts on the economy and the unevenly distributed long-term welfare. The steel industrial park in Cilegon, where PT Krakatau Posco and PT Krakatau Steel were established, and the center of the domestic steel industry, has become a real example.

A study by the Indonesian Center for Environmental Law (ICEL) stated that the local unemployment rate in Cilegon is still high even with a huge steel industry in the area. It shows a disproportion between industry development and local employment absorption. The open unemployment rate (*tingkat pengangguran terbuka/TPT*) in Cilegon Municipality in 2023 reached 7.25%. The number is considered high compared to the national average of 5.45% in 2023. In January 2023, the Youth Alliance for Industrial Advocacy (*Aliansi Pemuda Peduli Industri/APPI*) protested against PT Krakatau Posco, raising their concerns about the small number of recruitment for local workers, especially those from nearby communities (Tegal Ratu, Kubangsari, and Samangraya Villages).³⁸

Table 2. TPT Data of Cilegon Municipality and National of 2019-2023

Indicators	2019	2020	2021	2022	2023
Cilegon Municipality's Level of Open Unemployment Rate (TPT)	9.68	12.69	10.13	8.10	7.25
National's Level of Open Unemployment Rate (TPT)	4.98	4.94	6.26	5.83	5.45

Source: ICEL, 2025 ³⁹



³⁸ <https://faktabanten.co.id/cilegon/dinilai-kurang-serap-pekerja-dari-pribumi-krakatau-posco-didemo-massa/#:~:text=Dinilai%20Kurang%20Serap%20Pekerja%20Dari,Massa%20%C2%B7%20Faktabanten.co.id>

³⁹ https://icel.or.id/media/pdf/comprs-ICELIndustriBajadiCilegon_ID-.pdf

Meanwhile, in PT Gunung Raja Paksi (PT GRP) industrial park in Bekasi, hundreds of employees were laid off, on the grounds of efficiency.⁴⁰ Several former employees have not yet received their severance pay, up to hundreds of millions of rupiah, leading them to sue the company.⁴¹ In addition to the cases mentioned above, steel industry activities also harm other traditional livelihoods, such as agriculture and fisheries. Water pollution and the loss of fish habitats have reduced fishermen's productivity, resulting in lower incomes.⁴²

The steel industry also has a significant impact on public health. This is reflected in the increasing number of acute respiratory infection (ARI) cases and skin conditions among residents of surrounding communities. Based on the data from Statistics Indonesia of Cilegon Municipality, ARI has been the number one disease in Cilegon Municipality since 2023. There were 41,779 recorded ARI cases in Cilegon in 2023, followed by 38,010 cases in 2024. Ciwandan Sub-district, where the two biggest steel companies in Indonesia were located (PTKS and PTKP), had 6,514 cases in 2023 and 5,091 in 2024. This is a major concern, because these ARI cases represented 9–12% of the total population in Ciwandan Sub-district.

In addition to that, data retrieved by AEER from Ciwandan Community Health Center (*Puskesmas*) show an increase of ARI cases from 2023 to mid-2025 in Tegal Ratu Village, the community closest to the industrial parks.



⁴⁰ <https://www.koranperdjoeangan.com/150-pekerja-diduga-alami-phk-sepihak-ratusan-buruh-pt-gunung-baja-konstruksi-berunjuk-rasa-spontan/#:~:text=Bekasi%2C%20KOnline%20E2%80%93%20Ratusan%20pekerja%20PT,PHK%2C%20dali%20perusahaan%20melakukan%20efisiensi.&text=Mendengar%20informasi%20tersebut%20massa%20aksi,buruh%20yang%20ikut%20berunjuk%20rasa.&text=Berkat%20gerak%20cepat%20tim%20advokasi,dan%20kembali%20bekerja%20seperti%20biasanya>

⁴¹ <https://liputancikarang.com/eks-pekerja-pt-gunung-raja-paksi-tbk-gugat-pesangon-rp-173-juta-tegaskan-tetap-pada-perjanjian-phk/#:~:text=Eks%20Pekerja%20PT%20Gunung%20Raja,Pada%20Perjanjian%20PHK%20%2D%20liputancikarang.com>

⁴² https://icel.or.id/media/pdf/ICEL-Industri-Baja-di-Cilegon_EN_.pdf?

Table 3. ARI Data in Tegal Ratu Village in 2023-2025

Mounth	Year		
	2023	2024	2025
Januari	78	63	98
Februari	69	85	120
March	53	78	39
April	22	53	34
May	40	80	51
June	53	54	72
July	59	78	132
Augusts	78	126	153
September	65	126	-
October	54	84	-
November	56	120	-
December	38	118	-
Total	665	1,065	699

Source: Ciwandan Community Health Center, 2025

According to AEER's research, the residents of Tegal Ratu Village, Ciwandan Sub-district, the village closest to the steel industry, expressed that their lives were disturbed by dust, noise, and odor pollution. They also complained about health problems, such as cough, influenza, itchiness, and skin irritation. PM_{2,5} pollutants in the village also surpassed the quality standards, directly contributing to declining air quality and numerous cases of respiratory problems among the local residents.⁴³



⁴³ <https://www.aeer.or.id/analisis-dampak-industri-baja-terhadap-kondisi-sosial-dan-kesehatan-masyarakat-di-era-dekarbonisasi/>



Figure 14. Air Pollution in the Form of Black Dust from the Industry, Flying into Residents' Houses

Source: Facebook/@AniSumiyati

4.3 The Impacts on the Climate, Ecological Disasters, and Environmental Damages

The steel industry is one of the main contributors to the global CO₂ emissions, representing around 7-11% of the total global carbon emissions. Meaning, it is the most carbon-intensive industry sector.⁴⁴ In 2023, the total global GHG emission footprint from the steel industry was estimated at 4.43 billion tons of CO₂. This number is higher than all passenger car emissions worldwide combined.

Aside from carbon emissions, the steel industry is also responsible for complex environmental crises, including air pollution, groundwater and marine contamination, and ecosystem damage in surrounding villages. At the end of December 2025 until early January 2026, Cilegon Municipality was hit by major floods. The worst case was in Ciwandan Sub-district, near the steel industry. Thousands of residents' houses in several villages were submerged, forcing hundreds of residents to evacuate and seek aid.⁴⁵ According to AEER's data, there were around 929 residents of Tegal Ratu Village from 335 families impacted by the flood. The main road, including the Southern Ring Road (*Jalan Lingkar Selatan/JLS*) between Cilegon and Anyer was temporarily cut off

⁴⁴ <https://www.globalefficiencyintel.com/steel-industrys-energy-and-co2-benchmarking>

⁴⁵ https://wilip.id/banjir-ciwandan-rendam-ribuan-rumah-dprd-cilegon-soroti-pagar-kawasan-industri/#:~:text=%20Home.%20*%20Pemerintahan.



Figure 15. The Flood Near the Steel Industrial Park, in Ciwandan Sub-district

Source: Instagram/@intanrizkynandasari, 2026

This systemic flood occurred due to the loss of water infiltration, coastal reclamation, and mangrove forest degradation which is supposed to function as a carbon absorber. Heads of the neighborhood association (RT) and neighborhood council (RW) of Tegal Ratu Village, Ciwandan claimed that there used to be many lush trees. They could even travel to Anyer on foot or by bicycle. However, with the growing industry, the air quality has worsened and pollution is everywhere.⁴⁶

Several residents of Ciwandan Sub-district, especially from Kubangsari and Tegal Ratu Villages, broke down the fences of PT Krakatau Steel that they claimed had blocked the flow of floodwaters. The Chief of Commission I of the Regional House of Representatives of Cilegon Municipality, Ahmad Hafid, assessed that the development of the factories in the industrial parks had disrupted natural water flow pathways and infiltration areas. Rainwater drainage was removed, and discharge into the sea was blocked. Consequently, water lost its natural pathway and flooded the residential areas.⁴⁷ On the other hand, the Head of Cilegon Municipality, Robinsar, assessed that the flooding of the Southern Ring Road of Ciwandan

⁴⁶ <https://www.aeer.or.id/laporan-analisis-dampak-industri-baja-terhadap-kondisi-sosial-dan-kesehatan-masyarakat-di-era-dekarbonisasi-2/>

⁴⁷ <https://faktabanten.co.id/cilegon/2menghambat-jalur-air-warga-korban-banjir-ciwandan-bongkar-pagar-ks/>

Sub-district and some other areas surrounding it was caused by heavy rainfalls, exacerbated by the high tide.⁴⁸

The steel industry also has an impact on issues of living space and criminalization of the local residents. In August-September 2024, Al-Khairiyah Student Movement (GEMA Al-Khairiyah), together with the Cilegon's residents, staged a protest and voiced strong criticism. They suspected that PT Krakatau Posco had manipulated the property tax (*Pajak Bumi dan Bangunan/PBB*), harming regional finances and the community by lowering Regional Own-Source Revenue (*Pendapatan Asli Daerah/PAD*). They also suspected several Korean business owners were being racist by dominating 80% of the economy and business revenues around Cilegon, resulting in discrimination towards local business owners.⁴⁹



Figure 15. PT Dexin Steel Indonesia, Located in Indonesia Morowali Industrial Park (IMIP), Central Sulawesi

Source: TikTok/@dexinsteel, 2025

⁴⁸ <https://www.bantennews.co.id/walikota-cilegon-sebut-banjir-di-ciwandan-diperparah-akibat-air-laut-pasang/>

⁴⁹ <https://faktabanten.co.id/cilegon/digeruduk-mahasiswa-krakatau-posco-diminta-selesaikan-persoalan-ini/>

A different situation is seen at Indonesia Morowali Industrial Park (IMIP) in Central Sulawesi, where attention is drawn to the high number of workplace accidents involving the steel industry workers. In October 2024, an explosion and a massive fire happened at PT Dexin Steel Indonesia (DSI), killing 2 Indonesian workers and a foreign worker from China.⁵⁰ In February 2025, a worker of PT DSI from Bombana, Southeast Sulawesi, lost three of their fingers, allegedly due to obsolete working tools.⁵¹

On top of that, a harassment case occurred in October 2025, committed by a Chinese worker against a local worker. The perpetrator was allegedly being protected by the company. It prompted a strong criticism from the National Trade Union (*Serikat Pekerja Nasional/SPN*).⁵² Indonesian Forum for the Environment (WALHI) also protested the high number of workplace accidents, linking them to the poor OSH (Occupational Safety and Health) standards and weak safety supervision, which harmed the workers' livelihood and the local community.



⁵⁰ <https://chinalaborwatch.org/two-fatal-incidents-at-pt-dexin-steel-indonesia-highlight-urgent-need-for-improved-worker-safety-standards/#:~:text=Two%20Fatal%20Incidents%20at%20PT,Safety%20Standards%20:%20China%20Labor%20Watch>

⁵¹ <https://www.kabarsulteng.id/2025/02/10/lagi-kecelakaan-kerja-di-kawasan-pt-imip-karyawan-pt-dsi-kehilangan-tiga-jarinya-saat-buang-limbah-cungpao/>

⁵² <https://spn.or.id/serikat-pekerja-nasional-kecam-pt-dsi-dan-imip-atas-penghalangan-proses-hukum-kasus-pelecehan/>



CHAPTER 5. CHALLENGES OF THE STEEL INDUSTRY DECARBONIZATION

5.1 The Planning and Realization of Industrial Decarbonization

The challenges of the steel industry's decarbonization, in terms of the planning and realization, can now be seen in the gap between planning documentation and onsite implementation. Several roadmaps and emission reduction targets have been composed in both national and sectoral policy frameworks. However, its implementation in investment plans, technology preferences, and transition schedules at company's level is still limited. Oftentimes, decarbonization is planned normatively and for the long term without any clear operational stages, measured performance indicators, and strong supervision mechanisms. Thus, it is difficult to ensure that the targets are achieved.

In its realization, the steel industry's decarbonization progress is impeded by structural and technical problems. Limited supporting infrastructure, such as renewable energy availability, reliable electrical grids, and low-carbon raw material supply, hinders the implementation of cleaner production technology. Besides, the uncertainty of the regulation and economic incentives causes industry actors to be more careful in deciding long-term investments. As a result, the decarbonization implementation is progressing more slowly than planned. Plus, the domestic steel industry is still in the early phase of transition, with a higher risk of falling behind if the gap between planning and realization is not addressed.

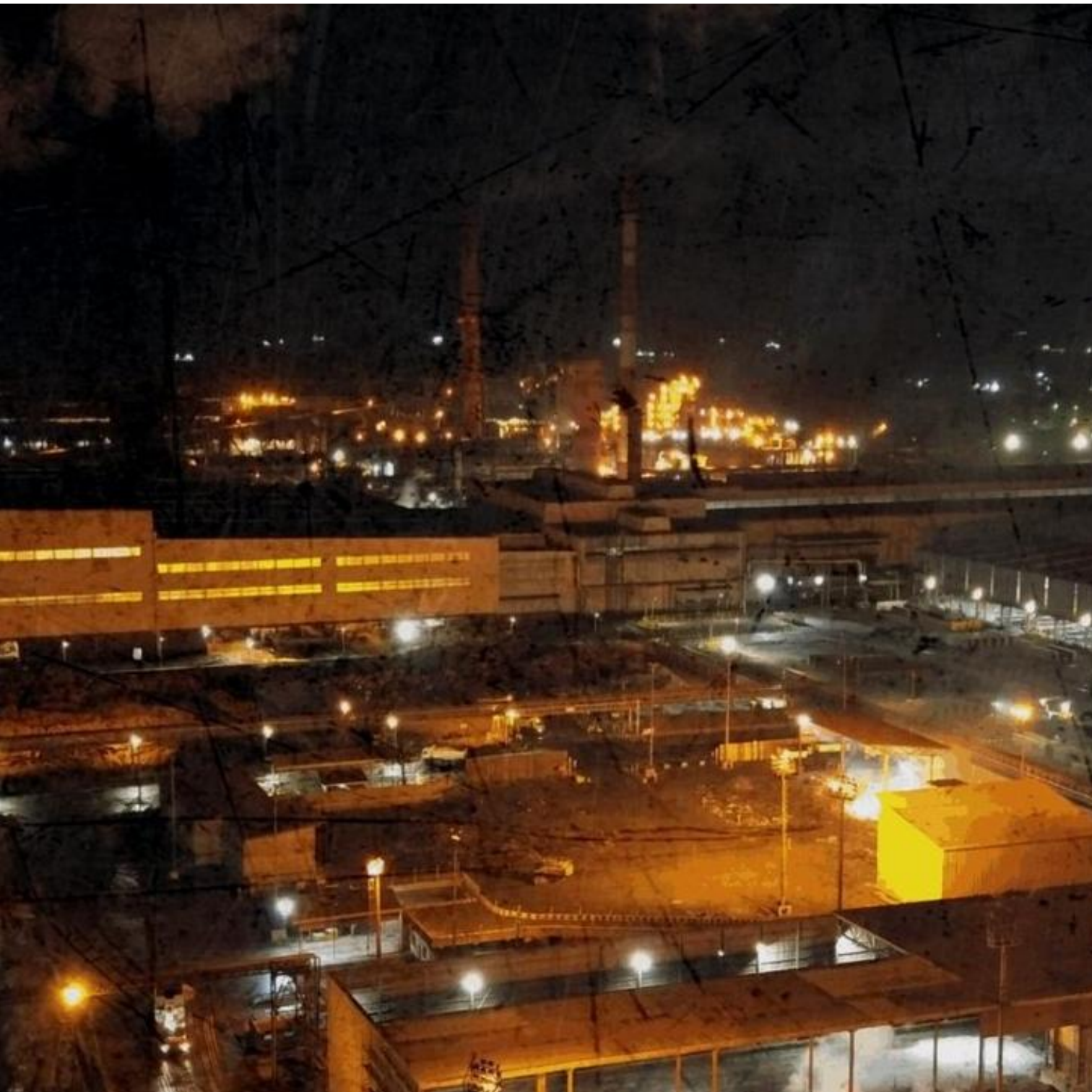


Figure 17. The Landscape of PT Krakatau Posco

Source: AEER Documentation, 2025

5.2 Economic Risks and Potential Loss from the Lack of Decarbonization Efforts

Steel industry decarbonization is a strategic issue closely related to the economic risks and national competitiveness. If left unimplemented, Indonesia's steel industry will fall further behind in the global trade, particularly as carbon emission-based standards and policies become more widely implemented in the international market. Steel produced with high emissions intensity is at risk of incurring additional charges under cross-border carbon trading mechanisms, thereby reducing export competitiveness, lowering foreign exchange earnings, and weakening Indonesia's position in the global supply chain. In the long term, this condition may increase demand for low-carbon steel from other countries, making domestic products less popular.

Meanwhile, in terms of industrial and financial aspects, a transition failure towards low-carbon steel production will escalate financial risk and economic loss. An industry that remains dependent on conventional technology may potentially experience a significant rise in production costs due to tighter regulatory pressures and the obligation to make an abrupt transition. The access to financial support will also become limited because global investors and financial institutions tend to avoid sectors linked to climate risks and high transition. Furthermore, fossil energy-based production facilities risk becoming stranded assets before the end of their technical lifespans, thus reducing company's value and burdening industrial financial stability, including State-Owned Enterprises (Badan Usaha Milik Negara/BUMN). IDC from the Ministry of Industry of the Republic of Indonesia could serve as a national financing scheme based on blended financing, specifically dedicated to the industrial sector decarbonization.

5.3 The Commitment of the Industry

Even though some industry participants have expressed their support for emission reduction and a transition towards low-carbon steel, this commitment has not been put into a clear, measured, and binding investment roadmap. High initial cost to adopt the low carbon technology, the uncertainty of investment return, and limited economic incentives are the reasons many companies halt their real action and maintain their conventional production model, as long as it is profitable in the short term.

In addition to that, the capital-intensive structure of the steel industry, with its long-lived assets, strengthens the tendency to be resistant to change. Companies that have huge investments in fossil energy-based facilities are in a dilemma whether to protect the existing asset values or to meet the decarbonization demand. Without consistent policy signals, firm regulations, and adequate transition support, industry commitments risk being merely declarative and unsustainable. This condition can slow the overall steel sector transformation and increase future economic risks as market pressures and global regulations on carbon emissions intensifies.

5.4 Reinforcing the Availability of Scrap Recycling and Scrap Circulations

The recommended route in the steel decarbonization is the Electric Arc Furnace, which fully utilizes the scrap or recycled iron. The scrap is melted down in the EAF to create new molten steel. This is the route with the lowest carbon emissions, especially if the electricity for EAF comes from renewable energy. The main challenge is supplying high-quality scrap in large amounts, because the global demand for new steel keeps increasing and not all of them can be met from the scrap.

To transition from BF-BOF to Scrap-EAF, up to 15.17 million tons of scrap will be required annually by 2050. However, the limited availability of scrap in Indonesia is a key consideration in the transition of crude steel making raw materials. Moreover, the circulation of scrap to the industry is still insufficient. Plus, its quality varies, mixed with corrosion, non-metal, and residual materials. If the scrap is mixed with heavy metals or dangerous chemical materials, it can seriously harm public health. For high-quality steel products, pure scrap alone is not enough. Thus, a mixture of Direct Reduced Iron (DRI) or pig iron is needed.

Steel recycling is the main component of the “green steel” concept, which is the steel produced with low environmental impacts, especially in terms of carbon emissions. In line with increasing global demand to meet the net-zero emission target, the steel industry is under pressure to decarbonize.⁵³ Utilizing scrap from the recycling process can help reduce carbon emissions and lower production costs by up to 20%.⁵⁴

There are even more advantages, such as:⁵⁵

1. production cost reduction
2. national raw material independence
3. industrial emission reduction
4. job creation
5. natural resources conservation

⁵³ <https://www.smsperkasa.com/blog/steel-recycling-solusi-cerdas-tekan-biaya-jangka-panjang>

⁵⁴ <https://finance.detik.com/industri/d-8203753/kemenperin-ungkap-alasan-industri-baja-ri-masih-pakai-scrap-buat-produksi>

⁵⁵ <https://www.smsperkasa.com/blog/steel-recycling-solusi-cerdas-tekan-biaya-jangka-panjang>



Figure 18. Scrapping Process in Cilincing, North Jakarta

Source: Jakarta Globe, 2018 ⁵⁶

⁵⁶ <https://jakartaglobe.id/eyewitness/where-old-ships-go-to-die/>

The scrap used for steel production are usually classified based on the type and density, which are: Heavy, Medium, Light; with details below:

Table 4. Scrap type used for steel forming process

No	Jenis Scrap	Deskripsi
1	Heavy Melting Steel (HMS)	Industrial or commercial scrap with > 6 mm thickness, such as plates, beams, columns, and channels; including machines or used equipment and specific metal stampings.
2	Car Body	Vehicles, with or without their original interior and wheels.
3	Cast Iron	Cast iron bathtubs, machines, pipes, and engine blocks.
4	Scrap Press	Domestic scrap iron up to ± 6 mm (0.24 inch) of thickness; e.g., "white goods" (refrigerators, washing machines, etc.), roofing iron, water heater, water tanks, and metal sheet scraps.
5	Reinforcing Steel	Used in the construction industry as part of a reinforced concrete structure.
6	Swarf	The remains from drilling or steel forming in the manufacturing process.
7	Manganese Steel	Non-magnetic hard steel for the mining industry, cement mixture, stone crusher, and for environments with high abrasion levels.
8	Rail	Train rails, lorry trails, etc.

Source: Krakatau Jasa Industri, 2021 ⁵⁷

However, the scrap circulation system is not yet well implemented, as indicated in scrap availability, which still relies on imports for around 70% of supply. GRP, as the biggest scrap user in Indonesia, still relies on imports from Japan. Scrap in Indonesia are also commonly produced from low-density steel materials, such as nuts, utensils, and construction tools. Meanwhile, the scraping from old cars, old buildings, and construction waste may be the best solution to improve the density of steel industrial processes.

The existing regulation has not yet obliged business actors, community, and steel companies in Indonesia to promptly recycle iron-rich old goods. A collaboration is needed among the government, business actors, and the community to ensure a better circular economy for scrap in the future and to establish it as a national priority program.

⁵⁷ <https://krakataujasaindustri.com/produk-jasa/trading-manufacture-support/penyediaan-dan-pembelian-scrap-besi-baja>



Figure 19. A picture of factory shutdown by authorities in one of the biggest industrial parks in Indonesia

Source: *Tempo*, 2025⁵⁸

Reinforcement of steel scrap recycling and circulation is also needed. The government reported that PT Peter Metal Technology (PMT), a steel smelter plant in Cikande Modern Industrial Park caused a serious incident of Cesium 137 (Cs-137) radionuclide contamination, detected on the shipping containers of shrimp products that belong to PT Bahari Makmur Sejati (BMS). The containers were located around 3 kilometers from PT PMT's plant location. Cesium-137 radioactive exposure around Cikande Industrial Park has become a clear evidence of weak environmental protection in the supply chain. Improved coordination among stakeholders, reinforcement of safety standards and due diligence within the supply chain and waste management, transparent reporting, and routine industrial supervision should be the main concerns in the steel scrap circulation for decarbonization or environmental protection.⁵⁹

⁵⁸ <https://www.tempo.co/lingkungan/kontaminasi-cesium-137-cikande-aeer-desak-penguatan-due-dilligence-pasokan-scrap-dan-limbah-industri-baja-2075590>

⁵⁹ <https://www.tempo.co/lingkungan/kontaminasi-cesium-137-cikande-aeer-desak-penguatan-due-dilligence-pasokan-scrap-dan-limbah-industri-baja-2075590>

5.5 Dependence on Fossil Energy and Low Utilization of Renewable Energy

To date, most steel facilities still rely on coal and natural gas as the main energy resources, whether for the reduction process or to generate heat and electricity. Energy structures dominated by fossil fuels result in high emissions in the steel industry and significantly complicate efforts to reduce emissions. This is especially the case because conventional production technologies are deeply integrated with fossil energy usage and have long asset lifespan.

At the same time, the utilization of renewable energy in the steel industry is relatively low because of limited supplies, infrastructure, and economics. The availability of a stable renewable energy at a large scale remains a major challenge, while the steel industry requires continuous and highly intensive energy supply. Additionally, initial investment costs, limited access to green electricity grids, and inadequate incentive and regulatory schemes slow down the adoption of renewable energy. This condition broadens the gap between the decarbonization targets and industrial operational reality, amplifying the urgency for energy system transformation as a key prerequisite of steel industry decarbonization.



5.6 The Regulatory and Financing Uncertainty

The regulatory uncertainty becomes the main challenge in pushing the steel industry decarbonization because industry actors need the certainty of long term policy to decide on the capital-intensive and high-risk investments. Changes or inconsistencies to the policies related to carbon prices, emission standards, renewable energy incentives, and transition obligations tend to cause companies to wait. Without any clear and credible regulatory signals, decarbonization is perceived as an additional risk, not a strategic requirement, so that the plan to reduce emissions is often pushed back or is only minimally implemented.

On the other hand, financing uncertainty emerges as a direct consequence of the abovementioned regulatory uncertainty. The financial institution and investors need policy certainty to assess the eligibility of a decarbonization project and its return on investment risks. The World Trade Organization (WTO) recorded more than 20 different decarbonization standards and initiatives in the steel industry that cause rising transaction cost and regulatory uncertainty for the producer in measuring their products' carbon content. Meanwhile, the uncertain policies, such as the carbon pricing mechanism and export limitation, keep changing without any long-term certainty for heavy industry investment.⁶⁰

When the regulation does not give certainty to the market for low-carbon steel products or does not guarantee long term support, financing becomes expensive, limited, or even unavailable. This reciprocal relationship creates a circle of obstacles, where regulatory uncertainty weakens financing interests, while limited financing slows down the realization of steel industry decarbonization



⁶⁰ <https://www.steelorbis.com/steel-news/latest-news/wto-proliferation-of-decarbonization-standards-creates-uncertainty-1272956.htm?>



CHAPTER 6. POLICY RECOMMENDATION

AEER offers several policy recommendations to answer the steel industry decarbonization challenges, relevant for the national policy context:

1. The government should stipulate a clear, consistent, and long-term steel decarbonization regulation framework, including a binding sectoral emission target, technology transition roadmap, and carbon price policy certainty, thereby providing the industry actors with strong and foreseeable investment signals.
2. Financial support for transition is needed through a combination of fiscal and financial instruments, such as tax incentives, limited and focused subsidies, blended finances, and international climate financial utilizations to lessen the risk and initial cost of low-carbon steel technology investment.
3. The government should accelerate the provision of supporting infrastructure for decarbonization, especially by increasing a reliable and affordable renewable energy supply, advancing the green electricity grids, and developing green hydrogen ecosystems and steel recycling as the prerequisites of production process transformation.
4. An industrial policy that pushes technological transformation gradually and fairly is needed, including modernization support for existing facilities, risk management of neglected assets, as well as capacity enhancement and employee reskilling programs to ensure a just transition.
5. The government should strengthen cross-sector coordination and the involvement of industry actors, financial institutions, and international partners in planning and implementing steel decarbonization. This is to ensure that implemented policies are aligned with global market dynamics and international Net Zero Emission regulations by 2060 or earlier, as well as to strengthen domestic steel industry competitiveness.



The steel industry is often called the "mother of all industries" due to its role as a crucial foundation for economic development and other industries. Steel is widely used as a primary raw material for infrastructure, manufacturing, and transportation. Steel is not merely a construction material; it is also a crucial material for building clean energy infrastructure that is central to the energy transition and new and renewable energy (EBT)—such as wind turbine structures and solar power plants (PLTS), electric vehicle transportation, and materials for the downstream processing of critical minerals. This is due to steel's strength, durability, and high recyclability.

In terms of the national economy and development, by 2025, the steel industry, as part of the Metal, Machinery, Transportation Equipment, and Electronics Industry (ILMATE), will contribute significantly, contributing 4.3% of the National Gross Domestic Product (GDP) from Indonesia's non-oil and gas processing industry sector, which in total contributes 17.3% of the National GDP. This makes the steel industry a strategic sector in the National Medium-Term Development Plan (RPJMN) and a target of the Golden Indonesia Vision 2045. However, the steel industry is responsible for greenhouse gas (GHG) emissions of 430 million tons of carbon dioxide in 2022, equivalent to 4.9% of total industrial emissions, or approximately 9% of global emissions. This significant GHG emissions are due to the dominance of coal-consuming technologies.



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