

GREEN PUBLIC PROCUREMENT FOR DECARBONIZING INDONESIA'S STEEL INDUSTRY



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Abbreviations

3R	: Reduce, Reuse, Recycle
Bappenas	: Ministry of National Development Planning/National Development Planning Agency
BF-BOF	: Blast Furnace–Basic Oxygen Furnace
BPS	: Central Statistics Agency
CAPEX	: Capital Expenditure
CCS/CCUS	: Carbon Capture and Storage/Carbon Capture, Utilization, and Storage
COGS	: Cost of Goods Sold
CREA	: Centre for Research on Energy and Clean Air
EAf	: Electric Arc Furnace
EAf-DRI	: Electric Arc Furnace-Direct Reduce Iron
EPD	: Environmental Product Declarations
EU CBAM	: European Union Carbon Border Adjustment Mechanism
GEM	: Global Energy Monitor
GDP	: Gross Domestic Product
GHG	: Greenhouse Gas
GPP	: Green Public Procurement
GWP	: Global Warming Potential
IEA	: International Energy Agency
IPCC	: The Intergovernmental Panel on Climate Change
IPPU	: Industrial Processes and Product Use
ISO	: International Organization for Standardization
LCA	: Life Cycle Assessment
LCC	: Life Cycle Costing
LKPP	: National Public Procurement Agency
LTS-LCCR	: Long-Term Strategy for Low Carbon and Climate Resilience
MEAT	: Most Economically Advantageous Tender
MOE	: Molten Oxide Electrolysis
NDC	: Nationally Determined Contributions
NZE	: Net Zero Emission
OPEX	: Operational Expenditure
PLN	: State Electricity Company
PPK	: Commitment-Making Officials
PPA	: Power Purchase Agreement
RPJMN	: National Medium-Term Development Plan
RPJPN	: National Long-Term Development Plan
TQM	: Total Quality Management
SDGs	: Sustainable Development Goals
SIH	: Green Industry Standard
SNI	: Indonesian National Standards
SPP	: Sustainable Public Procurement
WACC	: Weighted Average Cost of Capital



Foreword

» **Dr.-Ing. Ilham Akbar Habibie, M.B.A**

Chair of The Board of Trustees
The Habibie Center

We express our deepest gratitude to Almighty God for His blessings and grace, which have enabled the completion and publication of this research report titled “Green Public Procurement for Decarbonizing Indonesia’s Steel Industry.” This publication is the result of an in-depth study conducted with diligence and dedication, representing The Habibie Center’s contribution to advancing the transition toward sustainable industrial development in Indonesia.

The iron and steel industry is one of the strategic sectors in Indonesia’s economy, yet it is also a significant contributor to carbon emissions within the national industrial value chain. Amid Indonesia’s commitment to addressing global climate change and the broader global push toward industrial decarbonization, innovative and transformative policy approaches are needed to drive emissions reductions in this sector.

Green Public Procurement (GPP) emerges as a policy instrument with strong potential to stimulate demand for environmentally friendly products and industrial processes. Leveraging the government’s substantial purchasing power, GPP can act as a catalyst for transforming the steel industry toward low-carbon production practices. This research comprehensively examines how public procurement mechanisms can be designed, implemented, and optimized to

support the decarbonization of Indonesia’s steel industry.

This study presents a thorough analysis, including a review of green procurement policies in Indonesia and their associated challenges, along with evidence-based policy recommendations. It is hoped that all stakeholders can work together to strengthen the governance foundations of the iron and steel industry, enabling more effective and accelerated decarbonization efforts. I also hope that the findings and recommendations in this publication will serve as a valuable reference for stakeholders, particularly government institutions, industry actors, academics, and development partners committed to Indonesia’s sustainability agenda.

I extend my highest appreciation to all researchers, experts, and resource persons who have contributed their knowledge, time, and critical insights throughout this research process. I also thank our institutional partners, relevant ministries, industry associations, and other organizations for their support and collaborative spirit during the course of this study.

May this publication provide meaningful benefits and contribute to Indonesia’s long journey toward a greener, more competitive, and sustainable industrial future.

Jakarta, 5 May 2026

Executive Summary

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Executive Summary

Indonesia's steel sector faces a dual imperative: supporting infrastructure-driven economic growth while meeting its greenhouse gas emissions reduction targets. Achieving this balance requires a transition toward low-carbon steel production, particularly through electric arc furnaces (EAF) and hydrogen-based direct reduced iron (DRI) pathways. However, progress is constrained by significant challenges, notably the lack of stable demand signals needed to justify the high capital investments associated with these technologies.

In this context, Green Public Procurement (GPP) could be a vital policy for creating a stable and clear domestic market for low-carbon steel. Nevertheless, implementing this policy also presents considerable challenges that hinder its execution. This study therefore examines these challenges and the policy recommendations that should be implemented to accelerate the adoption of GPP as a game changer to promote the use of green steel in Indonesia. Furthermore, the study investigates the

impact of decarbonizing the iron and steel industry on Indonesia's greenhouse gas (GHG) emission reduction targets.

To accomplish the aims of this research, the conceptual framework is based on the five pillars of GPP implementation most relevant to developing countries. These pillars are: Policy and Legal Framework; Technical Foundations and Green Classification; Capacity Building and Human Resources; Supplier Selection Strategy; and Demand-Side Innovation. Furthermore, this research employs qualitative and quantitative approaches to analyze the GPP policy pillars in practice and assess the effect of GPP on GHG emissions using four decarbonization scenarios: the Scrap-EAF scenario; the Natural Gas DRI-EAF scenario; the Hydrogen DRI-EAF scenario; and the Hydrogen + Renewable EAF scenario.

As a result of this study, implementing GPP for green steel can significantly reduce emissions compared to the business-as-usual scenario. The result is as follows:

Comparative Scenario for a Decarbonized Iron and Steel Plant in Indonesia

Type of Technology	Total Emissions (tCO ₂)	Carbon Intensity (tCO ₂ /t steel)	Emission Reduction vs BAU
Business as Usual (BF-BOF)	48,021,312	1.46	-
Scenario 1: Scrap-EAF	12,558,132	0.38	-74%
Scenario 2: Natural Gas DRI-EAF	21,536,480	0.66	-55%
Scenario 3: Hydrogen DRI-EAF	2,495,080	0.09	-94%
Scenario 4: Hydrogen + Renewable EAF	~0	0.00	-100%

Source: Author modelling based on Global Energy Monitor plant data and ISO 14404 emission methodology.

Meanwhile, GPP in the ground faces some challenges that hinder the implementation of the policy. As stated by several key stakeholders, here are the challenges of GPP implementation according to the five pillars that are utilized as the framework for this research, as follows:

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PILLAR 1

POLICY AND LEGAL FRAMEWORK



The legal framework exists normatively but remains flexible and voluntary; there is no leading sector; absence of an operational mandate and incentives directly linked to procurement. This condition has prevented the GPP from creating a credible demand signal for the iron and steel industry, making the industry reluctant to invest in low-carbon technologies for the production of iron and steel.

PILLAR 2

TECHNICAL FOUNDATION AND GREEN CLASSIFICATION



No emission-intensity-based classification for iron and steel is available. Ecolabel and Green Industry Standard (SIH) have not been integrated into the procurement system. As a result, green standard claims cannot be used as a basis for technical evaluation.

PILLAR 3

CAPACITY DEVELOPMENT AND HUMAN RESOURCES



GPP training for government officials is voluntary and not tiered. On the other hand, the capacity of PPK and Working Groups (Pokja) is limited, while the high audit risk of implementing GPP in each ministry makes procurement officials reluctant to include green steel criteria in the procurement process.

PILLAR 4

SUPPLIER SELECTION STRATEGY



Supplier selection is still dominated by the lowest-price paradigm. Furthermore, the green certification (e.g: SIH) is only an additional attribute, and the LCA/LCC are not used systematically as a vital criterion for selecting suppliers. As a result, there is no economic incentive for steel producers to meet green procurement standards, making them reluctant to invest in low-carbon technologies, as they will face economic risks if they continue to invest in technologies that comply with green procurement.



No green demand targets or long-term purchasing commitments. Demand for green steel is fragmented across ministries/agencies and regions, and regional governments face limited fiscal space, which is making green procurement of green steel a priority. Thus, producers perceive that the government procurement is not a reliable source for making a clear demand for green steel.

To operationalize GPP, Indonesia should prioritize the establishment of a clear and coherent regulatory framework. A critical step is to embed mandatory minimum thresholds for green steel within key policy instruments, including the RPJMN and the Presidential Regulation on Public Procurement—particularly those governing the Domestic Component Level (TKDN). These mandates can be piloted through major national strategic projects, such as the Nusantara Capital City (IKN) and the 3 Million Housing program, to demonstrate feasibility and build market confidence.

Moreover, effective implementation of such policies would benefit from coherent coordination, with the leading actor to align cross-sectoral priorities, synchronize regulatory frameworks across relevant ministries, and ensure that decarbonization commitments are embedded within

broader infrastructure planning and regional industrial development strategies, which embed the GPP of green steel as a key tool to comply with green commitments.

In parallel, integrating existing certification schemes, such as the Green Industry Standard (SIH), into procurement criteria will be essential to ensure credibility, standardization, and accountability. Equally important is strengthening institutional capacity and human resources to support effective implementation and long-term sustainability. By aligning regulatory frameworks, market incentives, and institutional readiness, GPP can serve as a powerful lever to stimulate demand, mobilize investment, and position Indonesia as a frontrunner in low-carbon steel production.

CHAPTER 1

INTRODUCTION



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1.1.

Background

Indonesia's iron and steel industry has experienced rapid growth in recent years. In 2023, Indonesia became the world's fourth-largest exporter of iron and steel, with export values reaching approximately USD 27.5 billion—3.5 times higher than in 2019 and more than twelve times higher than in 2015 (CREA, 2024). This growth resulted in the iron and steel industry contributing nearly 40% of Indonesia's national trade surplus in 2023 (CREA, 2024). Investment in the iron and steel sector has also increased significantly, reaching USD 37.7 billion in 2023, up from USD 14.8 billion in 2020, driven by both domestic and foreign financing (CREA, 2024).

Iron and steel are vital materials for global infrastructure and the clean energy transition. Within heavy industry, the iron and steel sector is collectively responsible for around 6–7% of global CO₂ emissions (Åhman et al., 2023). The sector also accounts for approximately one-third of emissions associated with construction materials (around 1.2 gigatons of CO₂ per year), making it one of the most emissions-intensive industrial sectors.

The most dominant steel production pathway today is the Blast Furnace–Basic Oxygen Furnace (BF-BOF) process. The BF-BOF route involves reducing iron ore into pig iron in a blast furnace and subsequently refining it into steel in a basic oxygen furnace. This process is highly carbon-intensive. On average, the BF-BOF route emits about 2.3 metric tons of CO₂ per ton of steel produced (Fan & Friedmann, 2021). Globally, the BF-BOF route dominates crude steel production, accounting for around 71% of total output. This route produces primary steel from iron ore, which constitutes about 70% of global steel production overall (Åhman et al., 2023).

In addition to accounting for the majority of CO₂ emissions, the potential for emission reductions within the BF-BOF route remains limited, even with technological improvements and operational optimization (Fan & Friedmann, 2021). To meet the targets of the Paris Agreement, the iron and steel sector must achieve net-zero emissions between 2050 and 2060. Therefore, substantial efforts are required to decarbonize the sector, particularly in

the steelmaking process—especially at the stage of smelting iron ore into primary steel.

Public procurement plays a strategic role in driving industrial decarbonization due to its capacity to shape market demand and create incentives for production transformation. As a demand-side policy instrument, public procurement can influence industrial behavior through standardized and measurable environmental criteria, thereby accelerating the adoption of low-carbon technologies in emissions-intensive sectors (Krieger & Zipperer, 2022; SEI, 2023).

Moreover, the sustainable public value perspective emphasizes that government spending decisions generate not only economic outputs but also long-term social and environmental value (Li & Cao, 2023). Amid growing global commitments to emission reduction targets, public expenditure—which accounts for 10–20% of GDP in many countries—serves as a powerful catalyst in creating markets for green steel and cement, strengthening low-carbon supply chains, and reducing investment risks for clean technologies (Chiappinelli, 2020). Thus, the systematic, data-driven, and verifiable integration of green procurement principles is a key prerequisite to ensuring a just and measurable industrial transition toward a low-carbon economy (Hasanbeigi & Sibal, 2024).

As the largest purchaser of goods and services, the government holds a strategic position in influencing markets and promoting sustainable production practices through public procurement policies. Indonesia has initiated the implementation of Sustainable Public Procurement (SPP). In Indonesia, SPP is designed to integrate economic, social, and environmental considerations into government spending

decisions (Amalia et al., 2024). This effort aligns with the country’s commitment to sustainable development and the need to ensure that public budget utilization generates broader public value—not only in terms of cost efficiency but also in contributing to long-term sustainability (Maulana et al., 2024). Although Indonesia has demonstrated regulatory progress and increasingly recognizes the strategic role of SPP in driving industrial transformation, its implementation remains uneven and faces various structural and institutional capacity challenges (Wirahadikusumah et al., 2020).

The legal and policy framework governing SPP is stipulated in Presidential Regulation No. 16/2018 and its amendment under Presidential Regulation No. 12/2021. These regulations mandate that government procurement must take into account sustainability aspects encompassing economic, social, and environmental dimensions. The regulations also refer to ISO 20400:2017 on sustainable procurement guidance, which emphasizes principles of accountability, transparency, and stakeholder engagement (Wirahadikusumah et al., 2020).

This research focuses specifically on the environmental dimension of public procurement, namely Green Public Procurement (GPP). GPP is explicitly designed to reduce environmental impacts, particularly greenhouse gas (GHG) emissions generated throughout the life cycle of goods or services (Testa et al., 2016). This focus enables governments to establish measurable and science-based technical requirements, such as carbon intensity thresholds, clean energy certification, or Life Cycle Assessment (LCA) methodologies (Tarantini et al., 2011).

Although Indonesia already has a legal foundation to mainstream sustainability

aspects within its national procurement system, there is currently no specific regulation explicitly governing sustainable procurement for iron and steel materials in national policy. Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No. 5/2019 (Permen LHK 5/2019) on Procedures for Implementing Eco-Labeling covers only six categories of environmentally friendly goods and services and does not yet include iron and steel products.

In the construction sector—one of the largest contributors to emissions—the application of green criteria remains at an early stage (Al Fath et al., 2024; Puspitasari & Glennardo, 2021). Limited awareness and understanding among project managers regarding sustainability standards have

resulted in low energy efficiency and suboptimal environmental performance in government buildings (Sukardi & Abduh, 2019; Willar et al., 2020).

These challenges are further compounded by limited human resource capacity, particularly among procurement officials who have not received adequate training on green procurement practices. In fact, factors such as improved sustainability literacy, continuous training for procurement practitioners, and active engagement in professional associations have been shown to positively contribute to GPP performance by strengthening understanding of best practices and collaborative networks (Sukardi & Abduh, 2019; Suliantoro & Fitriani, 2022; Willar et al., 2020).

Integrating iron and steel into Indonesia's national GPP policy will play a crucial role in supporting the country's decarbonization targets, including achieving Net Zero Emissions by 2060 or earlier, as outlined in the Long-Term Strategy for Low Carbon and Climate Resilience (LTS-LCCR 2050) document issued by the Ministry of Environment and Forestry (2021). The government has significant potential to leverage public spending power as a catalyst to stimulate demand for low-carbon products. This aligns with the United Nations Environment Programme (UNEP, 2021), which views GPP not merely as a procurement tool but as a strategic policy instrument to accelerate market transformation toward a green economy.

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1.2.

Research Questions



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1

What are the emission levels of the iron and steel decarbonization following the pathways: (i) Business As Usual, (ii) DRI-EAF with Natural Gas, (iii) DRI-EAF with Green Hydrogen, and (iv) DRI-EAF with Green Hydrogen and Renewable Electricity?

2

What is the applicable regulatory framework for the procurement of green iron and steel goods and services?

3

How can green iron and steel materials be integrated into the national public procurement policy framework?

1.3.

Previous Research

Several previous studies have underscored the importance of decarbonization as a strategic effort to achieve net-zero emission targets, particularly in energy-intensive industries such as iron and steel. A 2024 study by the Centre for Research on Energy and Clean Air (CREA) reveals that approximately 80% of Indonesia's iron and steel industry still relies on the highly carbon-intensive Blast Furnace–Basic Oxygen Furnace (BF-BOF) technology as the core production process. This dependence constrains the global competitiveness of the national industry. The study recommends the development of an industrial decarbonization policy framework to restore the trade balance and ensure a fair and competitive market.

A study by the Center of Economic and Law Studies (Celios) (2025) also states that Indonesia's steel industry remains heavily dependent on fossil fuel-based production processes, particularly the Blast Furnace

(BF), which contributes significantly to the carbon footprint, including emissions from steel transportation as a global commodity. This research focuses on two major players in the national steel industry: PT Krakatau Steel and PT Krakatau Posco. Decarbonization challenges are further complicated by the long lifespan of industrial assets (spanning decades) and price volatility, both of which hinder resource mobilization for decarbonization initiatives. Among its recommendations are the development of a decarbonization roadmap for the steel industry, the acceleration of carbon tax implementation, and the establishment of a just transition framework for industrial workers.

In the context of strengthening sustainable industrial supply chains, various studies have also begun to highlight sustainable public procurement mechanisms as policy instruments capable of driving upstream transformation. A 2024 report by the

International Institute for Sustainable Development (IISD) indicates that Indonesia has established a relatively strong policy framework for sustainable public procurement, with provisions integrated into national development plans and procurement regulations. However, the availability of environmentally friendly products and services in the market, as well as the additional costs associated with green products, remain significant constraints.

Although previous research has explained the need for decarbonization in the iron and steel industry and acknowledged the existence of sustainable procurement provisions within national development policies, an analytical gap remains regarding sustainable public procurement—particularly in relation to the iron and steel sector. Therefore, research conducted by The Habibie Center seeks to fill this analytical gap.

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CHAPTER 2

LITERATURE REVIEW

2.1. Conceptual Framework

2.1.1. Green Public Procurement

According to the European Commission (2016), Green Public Procurement (GPP) is a process whereby public authorities procure goods, services, and works with a lower environmental impact compared to goods, services, and works with the same primary function that would otherwise be procured without such a policy.

GPP is a key component and pillar of the broader concept of Sustainable Public Procurement (SPP). The main objective of SPP is to achieve an optimal balance among the three core pillars of sustainable development—economic, social, and environmental aspects—at every stage of the procurement process.

As a pillar of SPP, GPP focuses on reducing negative impacts on health, air quality, soil, and water, while ensuring that natural resources are used in accordance with

prevailing legal regulations. Specifically, GPP integrates green guidelines into public tenders as a mechanism to encourage the production and use of sustainable products and services (Lăzăroiu et al., 2020).

GPP functions as an instrument through which governments leverage their substantial purchasing power—averaging around 12% of GDP in OECD countries—to stimulate markets to shift toward more sustainable practices (Pouikli, 2021). GPP requires the evaluation of environmental impacts of products, services, or works throughout their entire life cycle, from raw material extraction to final disposal. According to Singh et al. (2024), two key components within the GPP concept are Life Cycle Costing (LCC) and Life Cycle Assessment (LCA). These are explained as follows:

1 Life Cycle Costing (LCC): A method that measures the financial impact of an investment throughout the product's life cycle, including acquisition costs, operational costs (e.g., energy, water), maintenance costs, and end-of-life costs (disposal or recycling). LCC is designed to position sustainable procurement at the center of purchasing decisions.

2 Life Cycle Assessment (LCA): An approach governed by international standards such as ISO 14040/44:2006, which measures the energy burden and potential environmental impacts of a product.

In principle, GPP selection criteria are based on the Most Economically Advantageous Tender (MEAT). This means that purchasing decisions are not based solely on the lowest upfront price, but rather on the optimal combination of quality, risk, timeliness, and total cost from a life-cycle perspective (Sönnichsen & Clement, 2020).

Furthermore, GPP utilizes ecolabels (in Indonesia established by the Kementerian Lingkungan Hidup dan Kehutanan) and other sustainability standards to verify that goods or services meet the environmental criteria required by local authorities. The use of these standards assists procurement authorities in identifying products that are inherently low-carbon, energy-efficient, and recyclable (Orfanidou et al., 2023).

2.1.2. Green Iron and Steel

The concept of green iron and steel has emerged as an alternative solution to transform the global steel industry toward sustainable and carbon-neutral production. Green iron and steel are manifested through the adoption of technologies that avoid the direct use of carbon (carbon direct avoidance) and utilize clean energy sources (Teixeira, 2025). The concept serves as a compass, guiding industry players away from fossil fuel dependence and toward the production of essential infrastructure materials that respect environmental boundaries. This represents a systemic shift that requires synergy

between technological advancement, infrastructure investment, and supportive government policies (Bălașa & Sandberg, 2025).

Approaches to decarbonization primarily center on technological strategies. Iron and steel decarbonization focuses on carbon direct avoidance by eliminating carbon-based reducing agents. This can be achieved through innovation in the main production routes for green steel. Referring to Ellersdorfer et al. (2024), there are three main production pathway scenarios to achieve green iron and steel:

1 Hydrogen-Based Direct Reduction (EAF-DRI)

This pathway is considered the most promising route to achieve carbon neutrality in primary steel production. The process replaces carbon-based reducing agents (typically natural gas or coke) with hydrogen. The chemical reaction produces water vapor instead of CO₂. The process yields Direct Reduced Iron (DRI), which can then be compressed into Hot Briquetted Iron (HBI), enabling safe and efficient transportation. The DRI/HBI is subsequently processed in an Electric Arc Furnace (EAF) to produce final steel.

2 Scrap Recycling Utilization (EAF Route)

Steel can also be produced through a secondary route using recycled steel scrap in an Electric Arc Furnace (EAF). Scrap-based steel production inherently generates significantly lower carbon emissions—around 0.07 tons of CO₂ per ton of steel—compared to the primary Blast Furnace–Basic Oxygen Furnace (BF-BOF) route. However, the sustainability of iron and steel production through this pathway heavily depends on the availability and quality of scrap needed to meet global steel demand.

3 Electrification with New Technologies

A more revolutionary approach involves the use of pure electricity as both the energy source and reducing agent to produce primary iron. One example is Molten Oxide Electrolysis (MOE), which aims to produce steel without any carbon emissions. Nevertheless, this route remains at a low level of technological readiness and still requires further research and development.

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Table 1. Types of Decarbonization Technologies and Their Emission Reduction Potential

Technology/Strategy	Emission Reduction Potential	Key Considerations
Hydrogen-Based DRI + EAF	Up to 95–100% (long term)	Requires renewable energy, high cost
CCS/CCUS in BF-BOF	35–90%	Retrofit challenges, high cost
Scrap-Based EAF	50–99%	Limited by scrap availability
Energy Efficiency Improvements	15–20% (short term)	Best available technology, modernization

Source: Ellersdorfer et al., 2024

2.1.3. The Pillars of GPP Planning

A fundamental and relevant set of principles is required for developing countries to implement GPP (Green Public Procurement) in a way that is adapted to existing institutional, economic, and structural challenges. These principles are synthesized from various references

(Singh et al., 2024; Victor Slavesescu et al., 2022; Sönnichsen & Clement, 2020). These principles are formulated into five pillars, each consisting of specific aspects and indicators (see Table 2).

Table 2. 5 Pillars of GPP

Pillar	Aspect	Indicator
Pillar 1: Policy and Legal Framework	Vertical & Horizontal Policy Integration	Translate national policies (such as NZE) into clear operational guidelines for ministries/agencies and local governments in green public procurement.
		Build collaboration among ministries of environment, finance, industry, infrastructure, and the national public procurement agency (LKPP).
	Regulatory Optimization and Synergy	Prioritize evaluation criteria that consider Life Cycle Cost (LCC), environmental impact, and social value rather than the lowest price alone.

Pillar	Aspect	Indicator
Pillar 1: Policy and Legal Framework	Incentives and Enforcement	Design fiscal and non-fiscal incentive/disincentive schemes for ministries/agencies and suppliers demonstrating strong green performance.
		Provide incentives and support (e.g., financing schemes) for suppliers innovating in green products.
Pillar 2: Technical Foundations and Green Classification	Taxonomy and Standardization	Develop a classification system for goods/services based on emission intensity (Near-Zero vs. Low Emissions).
		Ratify and promote the use of recognized standards (such as ISO and Environmental Product Declarations/EPD) to ensure credibility.
Pillar 3: Capacity Building and Human Resources	Policy Focus Shift	Procurement should prioritize goods derived from the core 3R principles (reduce, reuse, recycle) and MEAT (Most Economically Advantageous Tender).
	Tiered Professional Training	Provide specialized training for government procurement staff on environmental criteria, use of LCA (Life Cycle Assessment), LCC (Life Cycle Costing), and MEAT evaluation.
		Develop training modules tailored to sector-specific needs.
Pillar 4: Supplier Selection Strategy	Business Capacity Enhancement	Encourage supplier companies (local, national, global) to invest in green innovation and implement environmentally oriented Total Quality Management (TQM).
		Provide guidance to businesses and potential suppliers to meet GPP standards and criteria.
	Specific GPP Criteria	Develop practical GPP implementation guidelines for each ministry/agency, including a priority product list.
	Life-Cycle-Based Evaluation Tools	Emphasize LCA traceability aspects in procurement documents to fully understand environmental impacts.
Pillar 5: Demand-Side Innovation	Selection Strategy	Integrate clear environmental criteria into supplier qualification and selection processes.
		Use government purchasing power to create a guaranteed market for low-emission products.

Source: Various sources (edited by authors)

2.1.3.a. *Pillar 1: Policy and Legal Framework*

Many developing countries face challenges in the form of fragmented regulations and voluntary GPP arrangements (Pouikli, 2021). Policy and legal frameworks constitute the main pillar in the implementation of Green Public Procurement (GPP) as the operational foundation. Without an operational regulatory basis, there is no driving force compelling the transition from conventional practices toward sustainability. Without a clear legal mandate, government organizations tend to perpetuate lowest-price procurement methods, which often overlook long-term environmental costs (Singh et al., 2024). Pillar 1 consists of several aspects that form the foundation of the role of policy and legal frameworks, including:

1 Vertical and Horizontal Policy Integration

National commitments such as Net Zero Emissions (NZE) and the Paris Agreement often lose their “momentum” when translated into technical-level implementation without clear technical guidelines. The legal framework acts as a bridge to translate these visions into concrete working instructions for ministries/agencies and local governments. In many developing countries, the lack of collaboration and synergy among ministries/agencies represents a major obstacle to GPP implementation (Pouikli, 2021). A binding legal framework can enable cross-sector collaboration and ensure consistently coordinated policies.

2 Regulatory Optimization

Regulation needs to shift from the “lowest price” paradigm toward MEAT (Most Economically Advantageous Tender) criteria that identify the best value for money. MEAT allows buyers to consider a balance between technical quality, environmental impact, and social value in tender evaluations. Therefore, incorporating Life Cycle Costing (LCC) into regulations is essential to assess the true cost of a product’s production. Although green products often involve higher upfront capital costs, their long-term effectiveness—through minimizing negative environmental impacts—demonstrates more cost-efficient outcomes over time.

3 Incentives and Enforcement

A strong legal policy framework enables the establishment of incentive schemes for suppliers that innovate. Incentives may include tax reductions, simplified business licensing procedures, and improved access to financing for companies that comply with green standards. Conversely, suppliers that fail to comply with green standards may be subject to disincentives.

Photo: magnific.com

2.1.3.b. *Pillar 2: Technical Foundations and Green Classification*

The pillar of technical foundations and green classification is crucial in the implementation of Green Public Procurement (GPP). Technical foundations and classification function to ensure that every procurement activity truly delivers positive environmental impacts. Furthermore, the presence of technical standards helps to prevent misleading environmental claims such as greenwashing and shifts the paradigm toward considering long-term costs (Szilagyi et al., 2022). Pillar 2 consists of the following aspects that form the basis of technical foundations and green classification:

1 Taxonomy and Standardization

Developing a classification of goods based on emission intensity enables governments to strategically stimulate demand for innovative low-carbon technologies. This is particularly crucial when discussing IPPU sectors such as iron and steel, which are difficult to decarbonize. Clear emission classifications help mitigate environmental impacts in a measurable way (Pouikli, 2021).

The credibility of such classifications can be ensured through the use of globally recognized standards such as ISO 14024 or ISO 14021. In addition, it is important to promote Environmental Product Declarations (EPD), as these documents provide transparent data on the life-cycle impacts of products. The benefit is that buyers can compare different offers on a strong empirical basis (LKPP, 2024).

2 Policy Focus Shift

The core 3R principles (reduce, reuse, recycle) form the foundation of the circular economy. Their objective is to decouple economic growth from the consumption of limited natural resources. By prioritizing 3R principles, governments can significantly reduce waste at its source and extend the lifespan of materials.

Moreover, in many developing countries, conventional procurement systems are often trapped in the “lowest price” paradigm, which neglects long-term quality and ecological impacts. MEAT (Most Economically Advantageous Tender) enables stricter evaluation by incorporating Life Cycle Costing (LCC). The LCC system calculates the total cost of a product, including costs of use, maintenance, and end-of-life disposal. As a result, green products are often perceived as premium-priced because they internalize all these cost components—something that conventional products typically do not account for (Singh et al., 2024).

Photo: magnific.com

2.1.3.c. *Pillar 3: Capacity Building and Human Resources*

Procurement staff often lack experience in evaluating complex environmental criteria and tend to work in silos (Singh et al., 2024). Investment in human resources through specialized training is required to integrate the green paradigm into the procurement system (Sönnichsen & Clement, 2020). Therefore, the pillar of capacity building and human resources development becomes fundamental in the implementation of Green Public Procurement (GPP). This is because the success of GPP depends not only on regulations but also on the competence of the individuals operating the system. Pillar 3 consists of aspects that form the basis for capacity building and human resource development, including:

1 Tiered Training

Tiered training is the most effective solution for mastering procurement evaluation tools and applying MEAT criteria. Training on environmental criteria, Life Cycle Assessment (LCA), and Life Cycle Costing (LCC) is essential to shift procurement staff's mindset toward quality, long-term value, and energy efficiency. Without these skills, green products are often rejected because their initial capital costs are perceived as too high (Orfanidou et al., 2023).

Through tiered training, staff can apply the MEAT method objectively. Training programs should also be tailored to the specific needs of each sector. Contextualized modules and training ensure that national policies can be translated into concrete operational actions in practice.

2 Business Capacity Enhancement

In addition to strengthening the capacity of government procurement staff, it is equally important to enhance the capacity of business actors to foster green innovation and environmentally oriented Total Quality Management (TQM), provide guidance on meeting GPP standards, and reduce associated risks.

Governments in developing countries often have significant purchasing power and demand, yet the market may not be ready to supply green products. Encouraging suppliers to invest in green innovation and implement environmentally oriented TQM can significantly improve their environmental performance (Acquah et al., 2023). Suppliers often face technical difficulties in meeting strict GPP criteria. Through guidance and support, governments can help suppliers understand technical specifications and environmental labeling criteria.

Photo: magnific.com

2.1.3.d. *Pillar 4: Supplier Selection Strategy*

The rigid “lowest-price” bidding system often benefits only large companies and reduces opportunities for local suppliers that are innovating (Singh et al., 2024). Therefore, a supplier selection strategy is needed in the implementation of Green Public Procurement (GPP) to break dependence on the “lowest-price” system. Shifting the paradigm toward MEAT (Most Economically Advantageous Tender) enables governments to assess social and environmental aspects in addition to merely the cost of goods sold (COGS). Without a structured selection strategy, small suppliers lack sufficient incentives to upgrade their production standards toward greater sustainability.

1 *GPP Criteria and Operational Guidelines*

Developing a priority list of products—from those with the greatest to the least environmental impact—is essential for determining key focus areas (Orfanidou et al., 2023). In addition, practical guidelines that are easy to implement for each ministry/agency help reduce procurement barriers, particularly those related to staff knowledge in adopting GPP. These guidelines ensure that national policies can be translated into concrete technical and operational actions.

2 *Life-Cycle-Based Evaluation Tools*

Green products are often perceived as more “premium” compared to conventional products. This perception can be challenged through the use of Life Cycle Costing (LCC) (Orfanidou et al., 2023). LCC can demonstrate whether green products are more cost-efficient by calculating all life-cycle components—operational, energy, maintenance, and end-of-life disposal costs—and comparing them with conventional products using the same calculation components.

3 *Supplier Selection and Qualification Strategy*

Integrating green criteria from the selection stage is crucial to screen suppliers that are genuinely committed to environmental sustainability. Therefore, strategies that require compliance with environmental criteria during the qualification stage and incorporate green value into bid evaluation weighting become decisive factors in ensuring sustainability as a primary consideration in procurement (Sönnichsen & Clement, 2020).

To conduct LCC properly, a thorough understanding of product traceability is required. Emphasizing traceability in procurement documents is essential to fully understand environmental impacts through Life Cycle Assessment (LCA). This aspect enables tracking of carbon footprints and environmental impacts from raw material extraction to end-of-life waste. As a result, procurement decisions can be made by comparing various bids based on objective scientific data.

Furthermore, applying MEAT criteria enables public authorities to select bids not solely based on the lowest price, but also by considering quality, energy efficiency, and social value. For complex projects, supplier selection strategies should be complemented with early dialogue and partnership schemes. These approaches play an important role in managing and sharing risks between the government and suppliers, while also ensuring that the domestic market is prepared to meet the specified green requirements (Adjei-Bamfo et al., 2023).

Photo: magnific.com

2.1.3.e. *Pillar 5: Demand-Side Innovation*

The private sector is often reluctant to invest in environmentally friendly technologies due to high costs and the absence of market certainty (Singh et al., 2024). Therefore, the pillar of demand-side innovation is highly important in the implementation of Green Public Procurement (GPP) in developing countries. This pillar leverages the government's substantial purchasing power to create market certainty, particularly for green products that are perceived as high-risk by the private sector (Adjei-Bamfo et al., 2023). Demand-side innovation provides clear signals of purchasing commitment and future policy direction to suppliers. This enables domestic suppliers to undertake long-term investments in sustainable production processes without fear of losing market demand.

Photo: magnific.com

CHAPTER 3

METHOD

This study employs both qualitative and quantitative approaches. The quantitative approach is used to analyze the dynamics and trends of greenhouse gas emissions, including identifying the contribution of the industrial sector and evaluating emission changes associated with the implementation of specific policy instruments (Rissman et al., 2020). This analysis provides measurable empirical evidence regarding the effectiveness of GPP policies in reducing industrial emissions.

Meanwhile, the qualitative approach is used to analyze aspects of GPP policy and its implementation in practice, including policy formulation, instrument design, implementation mechanisms, as well as the responses and capacities of the actors involved, both at the institutional and industrial levels (Åhman et al., 2017). Through in-depth IDI, policy document analysis, and case studies, this approach enables researchers to understand the context, barriers, and enabling factors of policy implementation that cannot be adequately captured through quantitative data alone (Dawadi et al., 2021).

3.1. Qualitative Approach

According to Hennink et al. (2020), a qualitative approach allows researchers to examine the experiences of individuals or groups in detail using a range of specific research methods such as in-depth IDI, focus group discussions, content analysis, and life histories or biographies. This approach is used because it enables a more contextual understanding of GPP

implementation in Indonesia, particularly in the iron and steel industry, especially from the perspective of parties involved in procurement. Thus, the experiences, perceptions, and actions expressed by various stakeholders can provide insights and recommendations for the future development of GPP in Indonesia.

3.1.1. Data Collection Techniques

This study conducted in-depth IDI to further explore the experiences, perceptions, and views of parties involved in the implementation of GPP in Indonesia, particularly within the iron and steel industry. The selection of interviewees was

carried out purposively to obtain detailed information related to specific topics, considering that the selected participants have direct experience and relevance to the research topic (Etikan, 2016).

Photo: magnific.com

Table 3. List of In-Depth Interview Informants¹

Institution	Affiliation of Informant (Division/Directorate/Field)	Informant Code
<i>Lembaga Kebijakan Pengadaan Barang/Jasa Pemerintah (National Public Procurement Agency (NPPA))</i>	Strategy and Policy Development Division	N1
<i>Kementerian Lingkungan Hidup (Ministry of Environment)</i>	Centre for Environmental Impact Control and Business Activities	N2
<i>Kementerian Pekerjaan Umum (Ministry of Public Works)</i>	Directorate of Construction Services Procurement	N3
<i>Kementerian Perindustrian (Ministry of Industry)</i>	Head Green Industry Centre	N4
<i>Kementerian Perencanaan Pembangunan Nasional/ Badan Perencanaan Pembangunan Nasional (Ministry of National Development Planning/ National Development Planning Agency)</i>	Directorate of Environment	N5
<i>Kementerian Dalam Negeri (Ministry of Think-Tank Organization)</i>	Directorate General of Regional Financial Development Researcher	N6 N7
<i>Responsible Steel</i>	Director of Development and Innovation	N8
<i>Indonesian Chamber of Commerce and Industry</i>	Deputy Chairman for the Development of Downstream Processing of Iron and Steel Commodities	N9
<i>The Indonesian Iron & Steel Association</i>	Executive Director	N10

In conducting the IDI, the researcher used a semi-structured interview guide (King & Horrocks, 2010). Although the IDI were conducted in a semi-structured format, the discussions were carried out adaptively, allowing the researcher to conduct probing based on the responses of the informants. This was done to obtain more in-depth information in specific areas of discussion,

clarify ambiguities, and explore particular topics that were not included in the interview guide questions. The questions in the discussion guide were developed from the conceptual framework. In addition to IDI, the study also used secondary data sources such as policy documents, journals, articles, and mass media reports.

¹ For information, the researchers sent interview request letters to the BP BUMN, Social and Environmental Responsibility Division, but did not receive a response until this research was published.

3.1.2. Data Analysis Techniques

After the interview data were collected, the researcher conducted a thematic analysis to identify patterns or themes within the discussion transcript data (Maguire & Delahunt, 2017). This process involved several steps, including familiarizing oneself with the data, generating initial codes, identifying potential themes, reviewing and defining those themes, and then writing up the findings (Maguire & Delahunt, 2017). The codes were aligned with the analytical framework used in this study.

In the thematic analysis—particularly in the coding of in-depth IDI—this study employed both deductive and inductive approaches. The deductive approach was used to guide the analysis of findings based on the research questions and the predetermined GPP framework, while the inductive approach helped explore new findings emerging from the informants.

3.2. Quantitative Approach

E mission accounting exercise is developed to assess the two primary production pathways:

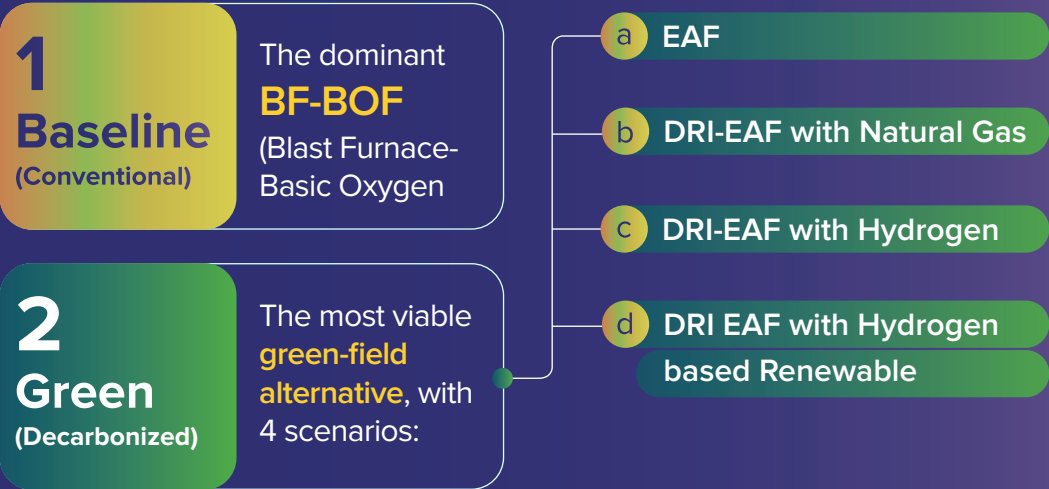


Photo: magnific.com

3.2.1. Data Collection

a. Data Stratification (What to Collect)

Before defining the techniques, the data is stratified into three core quantitative pillars to feed the integrated model:

1

TECHNO- OPERATIONAL DATA

(Mass & Energy
Balance)

- **BF-BOF**
Iron ore consumption, coking coal/PCI rates, limestone requirements, and typical blast furnace energy intensities
- **BF-BOF**
DR-grade pellet requirements, green hydrogen consumption (kg H₂/ ton\$ steel), and electricity intensity for the EAF melting phase.

2

ECONOMIC & FINANCIAL DATA

(CAPEX &
OPEX)

- **Capital Expenditure**
Greenfield investment costs (ton capacity) for both routes, including hydrogen electrolyzers for the green pathway.
- **Operational Expenditure**
Commodity prices, grid electricity tariffs, renewable energy Power Purchase Agreement (PPA) estimates, and labour/maintenance fixed costs.
- **Financials**
Discount rate (WACC/Weighted Average Cost of Capital), plant economic life, and depreciation schedules.

3

ENVIRONMEN- TAL DATA

(Carbon
Footprint)

- **Emission factors**
for Scope 1 (direct process emissions) and Scope 2 (grid electricity emissions).
- **Projected carbon tax rates**
or carbon credit pricing
(e.g., EU CBAM or Indonesian carbon tax).

b. Data Collection Methodologies (How to Collect It)

To ensure the model is grounded in reality, a multi-tiered data collection approach should be utilized:

A

SECONDARY DESKTOP RESEARCH & BENCHMARKING

(PRIMARY METHOD)

1.39 Since building a steel plant model relies heavily on established thermodynamic and economic benchmarks, secondary data will form the baseline.

- **Industry Standards & Guidelines**

Extracting mass-balance and energy-intensity baselines from authoritative bodies such as the International Energy Agency (IEA), World Steel Association (WSA), and the EU Best Available Techniques (BAT) Reference Documents.

- **Market Intelligence Platforms**

Gathering historical and projected commodity pricing (Iron Ore 62% Fe, DR-grade pellets, Premium Hard Coking Coal, Scrap) from platforms like S&P Global Platts, Argus Media, or BloombergNEF.

- **Academic & Think-Tank Literature**

Utilizing recent peer-reviewed techno-economic assessments (TEAs) focusing specifically on green hydrogen LCOS and DRI-EAF transition pathways.

B

REGULATORY & POLICY DOCUMENT REVIEW

To accurately model the localized context (e.g., if modeling for Indonesia or a specific region):

- **Energy Tariffs**

Collecting industrial electricity tariffs from local utilities (e.g., PLN in Indonesia) and assessing national renewable energy pricing.

- **Carbon Regulations**

Reviewing national NDC (Nationally Determined Contributions) documents and carbon pricing roadmaps to input accurate carbon penalty variables into the financial model.

C

PROXY DATA & VENDOR SPECIFICATIONS

(TARGETED PRIMARY DATA)

For the emerging H2-DRI-EAF pathway, historical data is scarce.

- **Equipment Vendor Estimates**

Sourcing CAPEX intensity approximations from public feasibility studies or press releases of major technology providers (e.g., Midrex, Tenova, SMS group) and electrolyzer manufacturers.

- **Case Study Extrapolation**

Analyzing data from early-mover green steel projects (e.g., HYBRIT or H2 Green Steel in Sweden) to establish realistic cost-reduction curves and operational assumptions.

c. Data Validation & Harmonization Technique

Raw data collected from various sources will often have different boundaries or units. The following techniques will be applied before feeding the data into the model:

Unit Standardization Converting all energy inputs to a uniform metric (e.g., GJ or MWh per ton of crude steel) and financial inputs to a single currency and base year (e.g., Real 2024 USD).	Boundary Synchronization: Ensuring that the CAPEX for both BF-BOF and H2-DRI-EAF covers the exact same “gate-to-gate” boundaries (e.g., both including raw material handling and casting, but separating the hydrogen production facility if treated as a Levelized Cost of Hydrogen input).
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3.2.2. Emissions Analysis

Emissions Estimation		
The potential GHG savings are quantified.		
Baseline Established emission factors for the BF-BOF pathway (approx. 2.33 tonnes CO₂/tonne steel) will be used. This will be further refined by incorporating emission sources unique to Indonesia’s production, including IPPU (Industrial Processes and Product Use) and Direct Energy emissions from coke production [4].	Green Pathway Emissions for the natural gas-based DRI-EAF pathway (approx. 1.37 tonnes CO₂/tonne steel) and the near-zero H2-DRI-EAF pathway will be modelled.	The output of this model—a verified GWP (Global Warming Potential) per tonne value—is not merely an estimate. It is the technical specification [17] that can be written directly into GPP tender documents, thus “informing the necessity” of GPP by creating its core technical mechanism.

Calculating greenhouse gas (GHG) emissions for steel production is complex because it involves not just burning fuel (combustion) but also chemical reactions (process emissions) where carbon is used as a reducing agent to strip oxygen from iron ore.

a. Primary Methodologies

There are three main frameworks used globally. The choice depends on whether you are reporting for a national inventory, a specific facility, or a corporate carbon footprint.

Table 4. Main frameworks for Iron and Steel GHG Calculation

Framework	Target Audience	Key Characteristic
IPCC Guidelines	National Inventories	Uses a Tiered approach (Tier 1, 2, 3) based on data availability.
ISO 14404 (Part 1 & 2)	Steel Facilities	The industry standard for intensity (tCO ₂ /tsteel). Focuses on site-specific efficiency.
GHG Protocol	Corporations	Breaks emissions into Scope 1, 2, and 3. Standard for corporate sustainability reporting.
Best Available Technology	Steel Technology	Used as benchmark the parameter for Iron and Steel Emission

b. Core Calculation Approaches

There are two fundamental ways to calculate the emissions [18]:

● Carbon Mass Balance Approach

This is the preferred method for integrated steel plants (Blast Furnace route). Instead of measuring every smokestack, you measure all carbon entering the site and subtract all carbon leaving the site (in products or by-products). The difference is assumed to be released as CO₂.

$$E_{CO_2} = \left[\sum (M_{in} \times C_{in}) - \sum (M_{out} \times C_{out}) \times \frac{44}{12} \right]$$

Where,

- E_{CO_2} : Emissions of CO₂ (tonnes)
- M_{in} : Mass of carbon-bearing inputs (ore, coal, coke, limestone, electrodes)
- C_{in} : Carbon content fraction of inputs
- M_{out} : Mass of carbon-bearing outputs (steel, slag, exported gas, dust)
- C_{out} : Carbon content fraction of outputs
- $\frac{44}{12}$: Conversion factor from Carbon (C) to Carbon Dioxide (CO₂)

● Emission Factor Approach

Used when detailed material balance data is missing (often Tier 1).

$$E_{CO_2} = \text{Activity Data} \times \text{Emission Factor}$$

Where,

- Activity Data : Amount of fuel consumed (e.g., tonnes of coal) or steel produced.
- Emission Factor : Standard coefficient (e.g., 1.85 tCO₂/tsteel for global average BF-BOF).

C. Calculation by Process Route

● Integrated (BF-BOF)

This route produces primary steel from iron ore and accounts for ~70% of global production.

• Key Sources

Coke Ovens, Sinter Plant, Blast Furnace (BF), Basic Oxygen Furnace (BOF).

• Major Emission Driver

Chemical reduction of iron ore using coke/coal

• Equation Focus

You must account for the carbon entering via **Coking Coal** and **Limestone** (CaCO₃ releases CO₂ when heated).

● Electric Arc Furnace (EAF)

This route recycles scrap steel or uses Direct Reduced Iron (DRI).

• Key Sources

Electricity generation (Scope 2), Graphite electrode consumption (Scope 1), Natural gas for burners.

• Major Emission Driver

Electricity grid intensity.

• Equation Focus

$$E_{total} = (E_{electricity} \times EF_{grid}) + (M_{electrodes} \times EF_{electrodes}) + E_{combustion}$$

d. Categorizing Emissions (GHG Protocol)

Two of the three GHG Protocol emission classifications (direct emissions, indirect energy emissions, and value chain emissions) are used in this calculation:

- **Scope 1: Direct Emissions**

Emissions from sources owned or controlled by the company.

- **Process Emissions**

CO₂ released during the chemical reaction in the Blast Furnace or DRI shaft.

- **Combustion Emissions**

Burning natural gas, coke oven gas, or blast furnace gas for heat.

- **Flux Emissions**

Decomposition of limestone (CaCO₃) and dolomite.

- **Scope 2: Indirect Energy Emissions**

- Emissions from the generation of purchased **electricity** and **steam**.

- **Crucial for EAF plants**

If the grid is coal-heavy, Scope 2 will be massive. If the grid is green, Scope 2 is near zero.

e. Critical Accounting Details (ISO 14404)

The ISO 14404 standard introduces the concept of “Credits” to allow for fair comparison between plants.

The Net Emissions Equation:

$$E_{net} = E_{direct} + E_{indirect} - E_{credit}$$

- E_{direct} : Represents the greenhouse gas emissions that are generated physically inside the boundary of the steel plant. In standard greenhouse gas accounting (such as the GHG Protocol), this is classified as Scope 1 emissions.

- $E_{indirect}$: Represents the greenhouse gas emissions that are generated outside the physical boundaries of the steel plant, but occur directly as a result of the plant’s energy consumption classified as Scope 2 and 3 emission.

- E_{credit} : If a steel plant sells by-products (like Blast Furnace Gas used to power a local town, or Slag used in cement), they get a “credit” deducted from their total to reflect that they prevented emissions elsewhere.

CHAPTER 4

THE EFFECT OF IRON AND STEEL DECARBONISATION ON EMISSION REDUCTION



Photo: imip.co.id/PT Dexin Steel Indonesia

4.1.

Steel and Iron Business As Usual (BAU) Emission Analysis

Based on Global Energy Monitor (GEM), the total steel and iron production capacity in Indonesia is 20,770 TTPA and 12,060 TTPA, respectively [24]. The chart which shown in Figure 1 reveals a significant disparity in production capacity across Indonesia's steel industry players, with Dexin Steel Morowali Plant emerging as the dominant market leader. Located in Morowali, this facility records the highest capacity, reaching the 7,000 TTPA (thousands of tons per annum),

which far surpasses the traditional steel industrial cluster in Cilegon. In comparison, Krakatau Steel and KS Posco in Cilegon maintain stable but lower capacities, hovering between the 3,000 and 4,000 range. This suggests a major expansion or shift in heavy steel production centers towards Sulawesi, likely driven by proximity to raw material sources and mineral downstreaming initiatives.

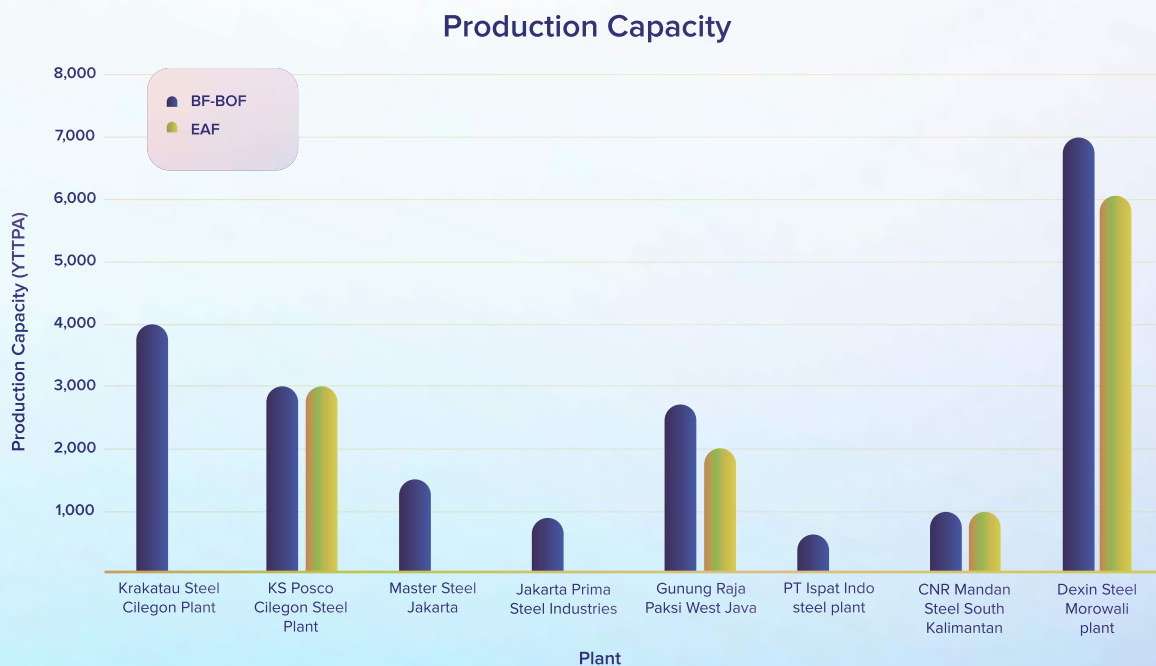


Figure 1. Production Capacity of Steel and Iron Plant in Indonesia (2025)

There is considerable variation among private producers located in Java and Kalimantan. Gunung Raja Paksi holds a strong middle position with capacity ranging from 2,000 to nearly 3,000, though notable fluctuations exist across different data series. Meanwhile, other plants such as Master Steel, Jakarta Prima Steel, PT Ispat Indo, and CNR Mandan Steel operate on a smaller

scale, averaging below 1,500. The data also highlights differing consistencies; KS Posco and CNR Mandan show highly uniform capacity across all series, whereas other plants have missing data points in certain series, potentially indicating differences in annual realized production or specific operational focuses.

In calculating emissions from the plant, consultants first use reference data on how much energy is required to produce 1 ton of steel and iron. For BF-BOF, the following energy is required:

- ✓ **Coke:** ~380 kg (0.38 t) [25]
- ✓ **PCI Coal:** ~160 kg (0.16 t) [26]
- ✓ **Limestone/Flux:** ~150 kg (0.15 t) [25]
- ✓ **Electricity:** ~150 kWh (0.15 MWh)² [26][26]

Table 5. Emission factor for BF-BOF plant

BF-BOF	Emission Factor (tCO ₂ /t)	References
Coke	3.1 ³	[27] IPCC, "IPCC Chapter 4: Metal Industry Emissions METAL INDUSTRY EMISSIONS," 2006.
PCI Coal	2.8	[27] IPCC, "IPCC Chapter 4: Metal Industry Emissions METAL INDUSTRY EMISSIONS," 2006.
Limestone/Flux	0.44	[27] IPCC, "IPCC Chapter 4: Metal Industry Emissions METAL INDUSTRY EMISSIONS," 2006.
Electricity	0.76 (tCO ₂ /MWh) ⁴	[28] 0.76 is value for Operation Margin in JAMALI Grid. The OM represents the emission factor of the existing fleet of power plants whose electricity generation would be displaced by a new green energy project or efficiency measure

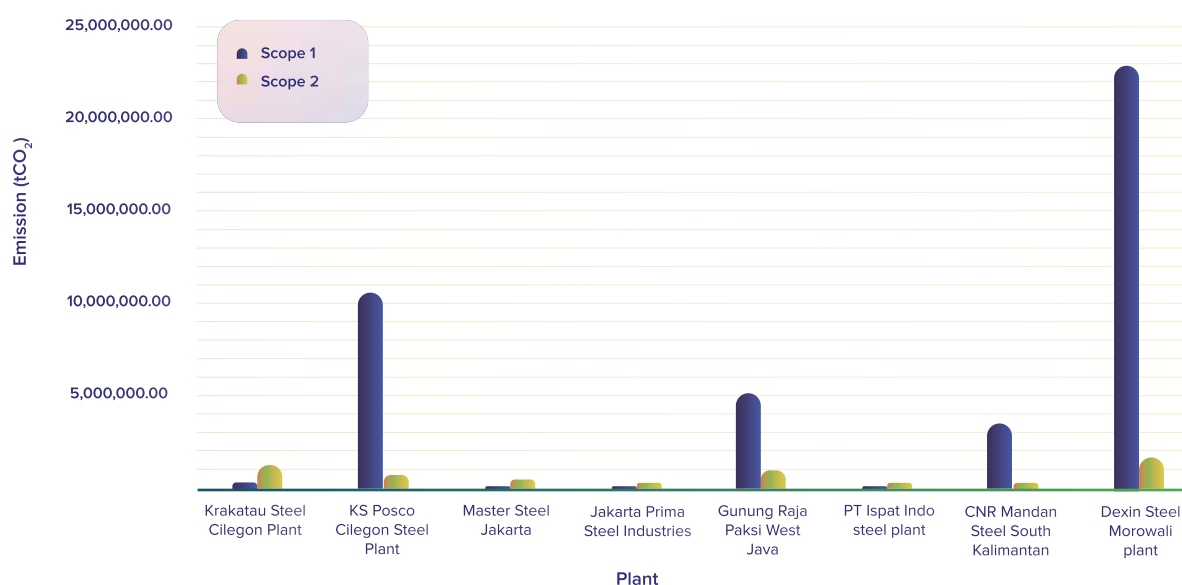
² Integrated plants often generate their own electricity from waste gas, but we will assume grid import for a conservative Scope 2 estimate.

³ IPCC, "IPCC Chapter 4: Metal Industry Emissions METAL INDUSTRY EMISSIONS," 2006.

⁴ Keputusan Menteri Energi dan Sumber Daya Mineral (Kepmen ESDM) No. 163/K/HK.02/MEM.S/2021

Table 6. Emission factor for EAF-Plant

EAF	Emission (tCO ₂ /t)	References
Natural Gas	0.002 (tCO ₂ /m ³) ⁵	[29] L. Herlina et al., "Indonesia's country-specific CO ₂ emission factor based on gas fuels for greenhouse gas inventory in the energy sector," <i>Environmental Pollution</i> , vol. 368, p. 125749, Mar. 2025, doi: 10.1016/J.ENVPOL.2025.125749.
PCI Coal	2.8	[27] IPCC, "IPCC Chapter 4: Metal Industry Emissions METAL INDUSTRY EMISSIONS," 2006.
Limestone/Flux	0.44	[27] IPCC, "IPCC Chapter 4: Metal Industry Emissions METAL INDUSTRY EMISSIONS," 2006.
Electrodes	3.66	[27] IPCC, "IPCC Chapter 4: Metal Industry Emissions METAL INDUSTRY EMISSIONS," 2006.
Electricity	0.76 (tCO ₂ /MWh)	[28] 0.76 is value for Operation Margin in JAMALI Grid. The OM represents the emission factor of the existing fleet of power plants whose electricity generation would be displaced by a new green energy project or efficiency measure

**Figure 2. Scope 1 and 2 CO₂ Emission of Steel and Iron Plant in Indonesia (2025)**

⁵ L. Herlina et al., "Indonesia's country-specific CO₂ emission factor based on gas fuels for greenhouse gas inventory in the energy sector," *Environmental Pollution*, vol. 368, p. 125749, Mar. 2025, doi: 10.1016/J.ENVPOL.2025.125749



Photo: REUTERS/Stringer

Based on Figure 2, here is a clear distinction in emission profiles between plants that produce Iron and those that only list Steel production.

● High Scope 1 Emitters

Plants like Dexin Steel Morowali, KS Posco, Gunung Raja Paksi, and CNR Mandan show massive Scope 1 (direct) emissions. This is visually represented by the tall blue bars in the chart.

● Root Cause

This correlates directly with the "Iron" column in the table. These facilities likely operate Blast Furnaces (BF) or similar smelting technologies that use coal or coke as a reductant to convert ore into iron, a process that inherently releases massive amounts of CO₂.

Dexin Steel Morowali is the dominant source of emissions in the cohort, contributing a majority share (approx. 50%) of the total volume. The plant's Scope 1 emissions are particularly elevated, surpassing the second-ranked KS Posco by a margin of over 100%.

Plants that show no "Iron" production in this dataset—specifically Krakatau Steel, Master Steel, Jakarta Prima, and PT Ispat Indo—have a completely different emission structure.

● Scope 2 Dominance

These plants have Scope 2 (indirect emissions from electricity) figures that are often higher than or comparable to their Scope 1 emissions. In the chart, their orange bars are more prominent relative to their blue bars.

● Operational Context

This suggests these facilities utilize Electric Arc Furnaces (EAF) or focus on downstream processing (rolling/finishing), which are energy-intensive but do not require the heavy on-site combustion of coal found in ironmaking.

● Key Comparison (KS Posco vs. Krakatau Steel)

This contrast is most visible between the two Cilegon plants. Despite Krakatau Steel having a higher listed steel capacity (4,000) than KS Posco (3,000), KS Posco's total emissions (11.1 million) are nearly 7 times higher than Krakatau Steel's (1.5 million). This highlights that primary ironmaking is significantly more carbon-intensive than steel processing/recycling.

The steel industry's carbon footprint in this dataset is heavily skewed by primary iron production. While electricity consumption (Scope 2) is a factor for all, the massive direct emissions (Scope 1) from the top producers—particularly Dexin Steel—indicate that significant decarbonization will depend heavily on technological shifts in the ironmaking stage (e.g., moving away from coal-based smelting) rather than just greening the electrical grid.

4.2. Transition Scenario

4.2.1. Scenario 1: Transition BAU Technology to EAF

The emission profile exhibits a characteristic EAF signature, defined by the inversion where Scope 2 (Indirect Emissions) significantly exceeds Scope 1 (Direct Emissions). In this EAF scenario, on-site coal combustion (Scope 1) is drastically minimized, offset by a substantial surge in specific electrical energy consumption required for the melting process. Data for Dexin Steel Morowali (~7,000 TTPA capacity) illustrates this shift, with Scope 2 emissions approaching 4 MtCO₂ versus

approximately 1 MtCO₂ for Scope 1. This implies that a full national transition to EAF shifts the decarbonization vector away from plant-level process technology and places it entirely on the Grid Emission Factor (GEF). Consequently, if the power generation mix remains coal-heavy, net global emissions will not significantly decrease; the carbon load is merely displaced from the steel plant's stack to the power generation facility.

Table 7. Transition BAU Technology to EAF Emission

No	Plant	Scope 1 (tCO ₂)	Scope 2 (tCO ₂)	Total Emission (tCO ₂)
1	Krakatau Steel Cilegon Plant	314,080.00	1,216,000.00	1,530,080.00
2	KS Posco Cilegon Steel Plant	471,120.00	1,824,000.00	2,295,120.00
3	Master Steel Jakarta	117,780.00	456,000.00	573,780.00
4	Jakarta Prima Steel Industries	70,668.00	273,600.00	344,268.00
5	Gunung Raja Paksi West Java	370,614.40	1,434,880.00	1,805,494.40
6	PT Ispat Indo steel plant	51,038.00	197,600.00	248,638.00
7	CNR Mandan Steel South Kalimantan	157,040.00	608,000.00	765,040.00
8	Dexin Steel Morowali plant	1,025,471.20	3,970,240.00	4,995,711.20
Total		2,577,811.60	9,980,320.00	12,558,131.60

Referencing the inventory data and capacity charts, a "Full EAF" scenario necessitates a fundamental restructuring of the national feedstock hierarchy. BF-BOF critical inputs such as Coking Coal and PCI Coal would become largely obsolete—relegated to minor roles as charge carbon—while demand for Ferrous Scrap and Graphite Electrodes would experience an exponential surge. The primary

engineering and logistical challenge lie in securing feedstock throughput for massive capacities like Dexin (7,000 TTPA) and Krakatau Steel (4,000 TTPA) under an EAF configuration. Given that domestic scrap generation is likely insufficient to meet this load, the industry would be compelled to rely on heavy scrap imports or pivot to Gas-based Direct Reduced Iron (DRI) to bridge the material deficit.

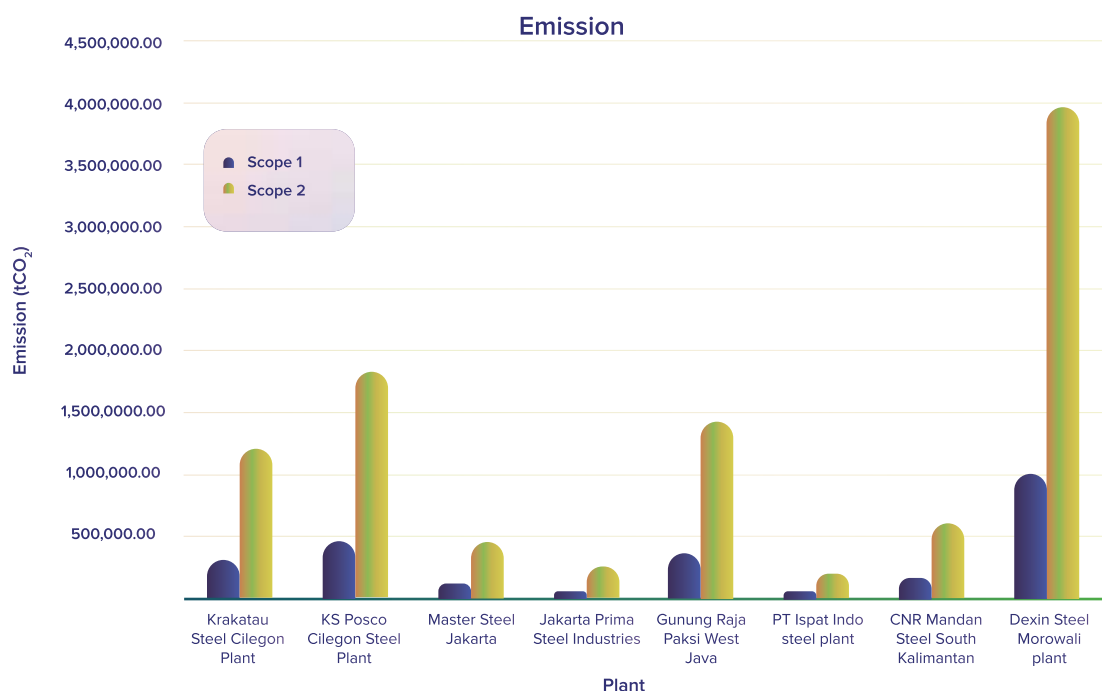


Figure 3. Scope 1 and 2 Emission for Transition BAU Technology to EAF Emission

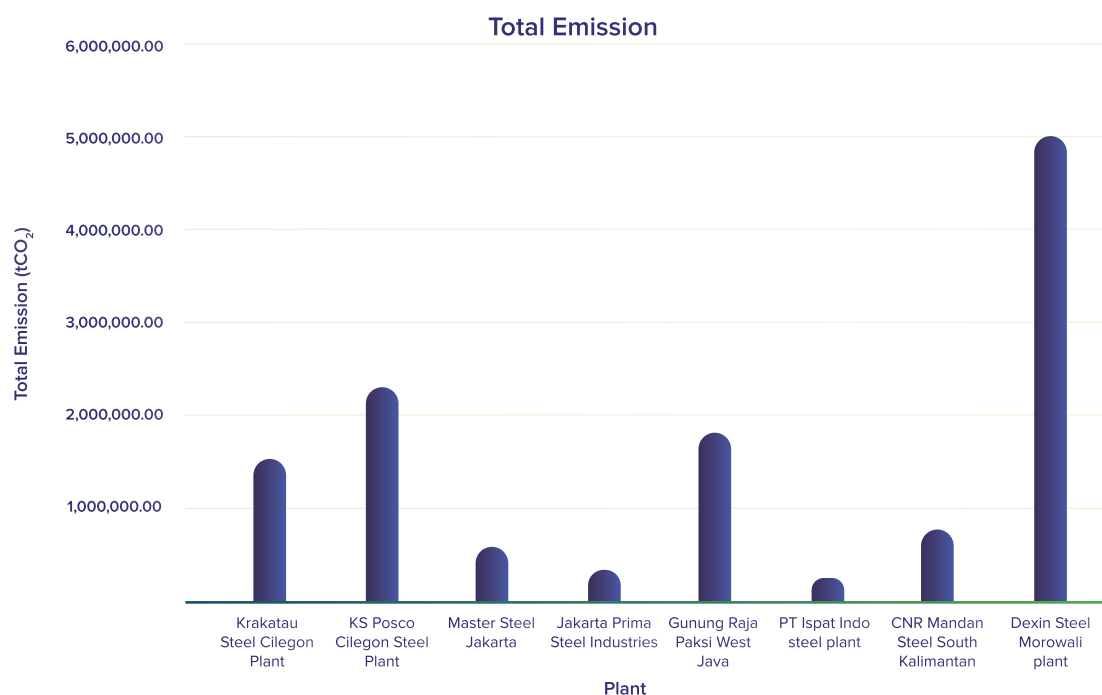


Figure 4. Total Emission for Transition BAU Technology to EAF Emission

The data illustrates a distinct "Emission Inversion" characteristic of the Electric Arc Furnace (EAF) scenario, where Scope 2 (Indirect Emissions) significantly dominates over Scope 1 (Direct Emissions). This trend is clearly visible in the emission chart, particularly for major producers like Dexin Steel Morowali (capacity ~7,000 TTPA), where Scope 2 emissions approach 4 MtCO₂ while Scope 1 remains near 1 MtCO₂. This implies that under a full EAF adoption scenario, the primary driver of the Indonesian steel sector's carbon footprint shifts from on-site coal combustion (typical of BF-BOF) to the carbon intensity of the external electricity grid. Consequently, effective decarbonization becomes less about plant-level technology and more about the "greening" of the national power grid; if the electricity source remains coal-heavy, the industry effectively just displaces emissions from the steel plant to the power plant rather than eliminating them.

Secondly, a transition to an EAF-dominant landscape would necessitate a fundamental restructuring of the national raw material supply chain, creating a stark contrast with the current inventory list. The decarbonization of Indonesia's steel sector cannot rely exclusively on the highly efficient Scrap-EAF route (Scenario

1) due to a severe domestic scrap deficit. With national demand projected to reach 60 million tons per year by 2060, domestic scrap generation can realistically only support 15% to 20% of total production. Attempting to bridge the resulting 55+ Mt shortfall through global imports would expose operators to extreme price volatility and massive import bills, effectively erasing the economic advantage of the recycling pathway and proving that virgin steel production (from iron ore) must remain the dominant, structural backbone of the industry.

Inputs that are critical for Blast Furnaces, such as "Coking Coal" and "PCI Coal," would become largely obsolete, while the demand for "Scrap Steel" and "Graphite Electrodes" would surge exponentially. The capacity chart highlights the magnitude of this logistical challenge: sustaining massive production capacities like Dexin (~7,000 TTPA) and Krakatau Steel (~4,000 TTPA) solely via EAF would likely overwhelm domestic scrap availability. This deficit would compel the industry to either rely heavily on scrap imports or integrate Direct Reduced Iron (DRI) facilities to bridge the feedstock gap, thereby reshaping the sector's economic and operational infrastructure.

4.2.2. Scenario 2: Transition BAU Technology to DRI-EAF with Natural Gas

Unlike the Scrap-EAF scenario where emissions are driven by the power grid, the DRI-EAF scenario depicted in the chart shows a return to Scope 1 (Direct Emissions) dominance, albeit at a lower intensity than coal-based methods. For the largest facility, Dexin Steel Morowali (7,000 TTPA), Scope 1 emissions surge to approximately 7.5 MtCO₂ (blue bar), while Scope 2 (Indirect Emissions) remains moderate at around 1.0 MtCO₂ (orange bar). This profile indicates that the carbon

footprint is primarily generated on-site through the chemical reforming of natural gas (CH₄) into reducing gases (CO and H₂) within the shaft furnace, rather than from coal combustion. While this route significantly lowers the carbon intensity to approximately ~0.66 tCO₂/tsteel (compared to ~1.4-1.8 for BF-BOF), it confirms that "Gas-based Transition" still leaves the industry heavily reliant on fossil fuel inputs, keeping the majority of emissions within the plant's direct operational boundary.

Table 8. Transition BAU Technology to DRI-EAF with Natural Gas Emission

No	Plant	Scope 1 (tCO ₂)	Scope 2 (tCO ₂)	Total Emission (tCO ₂)
1	Krakatau Steel Cilegon Plant	2,320,000.00	304,000.00	2,624,000.00
2	KS Posco Cilegon Steel Plant	3,480,000.00	456,000.00	3,936,000.00
3	Master Steel Jakarta	870,000.00	114,000.00	984,000.00
4	Jakarta Prima Steel Industries	522,000.00	68,400.00	590,400.00
5	Gunung Raja Paksi West Java	2,737,600.00	358,720.00	3,096,320.00
6	PT Ispat Indo steel plant	377,000.00	49,400.00	426,400.00
7	CNR Mandan Steel South Kalimantan	1,160,000.00	152,000.00	1,312,000.00
8	Dexin Steel Morowali plant	7,574,800.00	992,560.00	8,567,360.00
Total		19,041,400.00	2,495,080.00	21,536,480.00

While Scope 1 is the primary driver, the chart also highlights a non-negligible Scope 2 component, which is notably higher than in integrated BF-BOF plants (which typically generate their own electricity). Processing DRI in an Electric Arc Furnace is more energy-intensive than processing scrap because the DRI pellets still contain gangue (impurities) that require significant electrical energy to melt and slag off. For

a 4 Mtpa plant like Krakatau Steel, the Scope 2 emissions sit at approximately 0.3 - 0.5 MtCO₂. This demonstrates that while replacing BF-BOF with DRI-EAF reduces the "Coal" dependency, it increases the "Grid" dependency; therefore, the full decarbonization potential of this route remains capped unless the natural gas is eventually substituted with Hydrogen and the EAF is powered by a renewable grid.

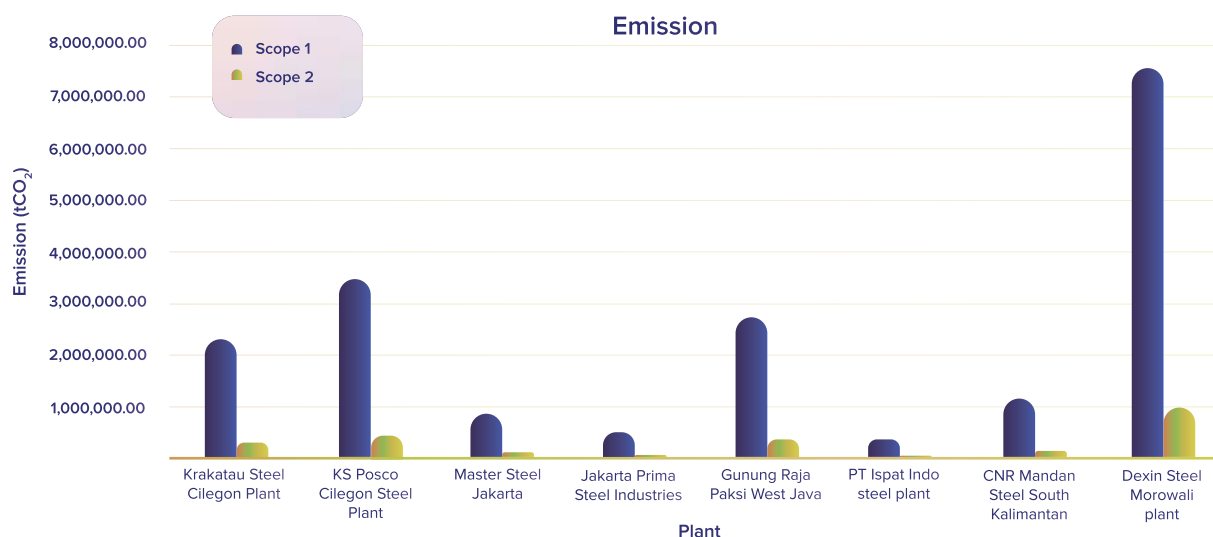


Figure 5. Scope 1 and 2 Emission for Transition BAU Technology to DRI-EAF with Natural Gas Emission

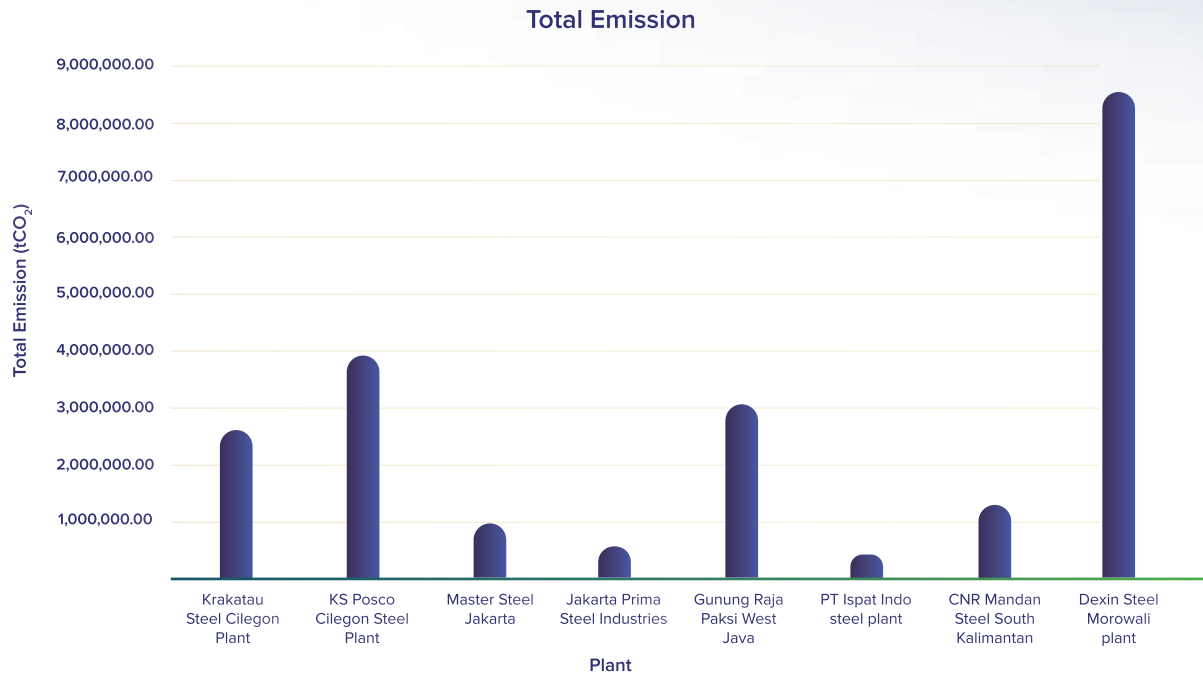


Figure 6. Total Emission for Transition BAU Technology to DRI-EAF with Natural Gas Emission

Based on the total emission projection, the Gas-based DRI-EAF scenario results in a substantial aggregate carbon footprint, with the largest facility, Dexin Steel Morowali, reaching a total annual output of approximately 8.56 MtCO₂. This high absolute figure—alongside roughly 3.94 MtCO₂ for KS Posco Cilegon—indicates

that while the DRI route reduces reliance on coking coal, the chemical reforming of natural gas still generates significant Scope 1 emissions, proving that without the integration of green hydrogen or carbon capture technologies, this transition pathway remains a major source of atmospheric carbon.

4.2.3. Scenario 3: Transition BAU Technology to DRI-EAF with Green Hydrogen

Based on the emission profile presented in the chart, the Green Hydrogen DRI-EAF scenario represents the theoretical "end-state" of deep decarbonization, characterized by the complete elimination of Scope 1 (Direct Emissions). The chart displays a total absence of blue bars across all facilities, signifying that the chemical

reduction of iron ore is achieved purely via electrolytic hydrogen (H₂), releasing water vapor instead of carbon dioxide. This technological shift effectively removes the carbon intensity associated with the ironmaking phase, which is traditionally the largest source of emissions in both BF-BOF and Gas-DRI routes.

Table 9. Transition BAU Technology to DRI-EAF with Green Hydrogen Emission

No	Plant	Scope 1 (tCO ₂)	Scope 2 (tCO ₂)	Total Emission (tCO ₂)
1	Krakatau Steel Cilegon Plant	-	304,000.00	304,000.00
2	KS Posco Cilegon Steel Plant	-	456,000.00	456,000.00
3	Master Steel Jakarta	-	114,000.00	114,000.00
4	Jakarta Prima Steel Industries	-	68,400.00	68,400.00
5	Gunung Raja Paksi West Java	-	358,720.00	358,720.00
6	PT Ispat Indo steel plant	-	49,400.00	49,400.00
7	CNR Mandan Steel South Kalimantan	-	152,000.00	152,000.00
8	Dexin Steel Morowali plant	-	992,560.00	992,560.00
Total		-	2,495,080.00	2,495,080.00

However, the scenario is not zero-carbon, as evidenced by the persistence of Scope 2 (Indirect Emissions) represented by the orange bars. The data indicates that Dexin Steel Morowali still generates approximately 1.0 MtCO₂ annually, while KS Posco Cilegon contributes roughly 450,000 tCO₂. This residual footprint is attributed to the substantial electrical energy required

by the Electric Arc Furnace to melt the DRI sponge iron. Therefore, even with a carbon-neutral reductant (Green Hydrogen), the final environmental performance remains contingent on the "greening" of the electrical grid powering the EAF; without a renewable power source for the melting phase, the process retains a significant indirect carbon penalty.

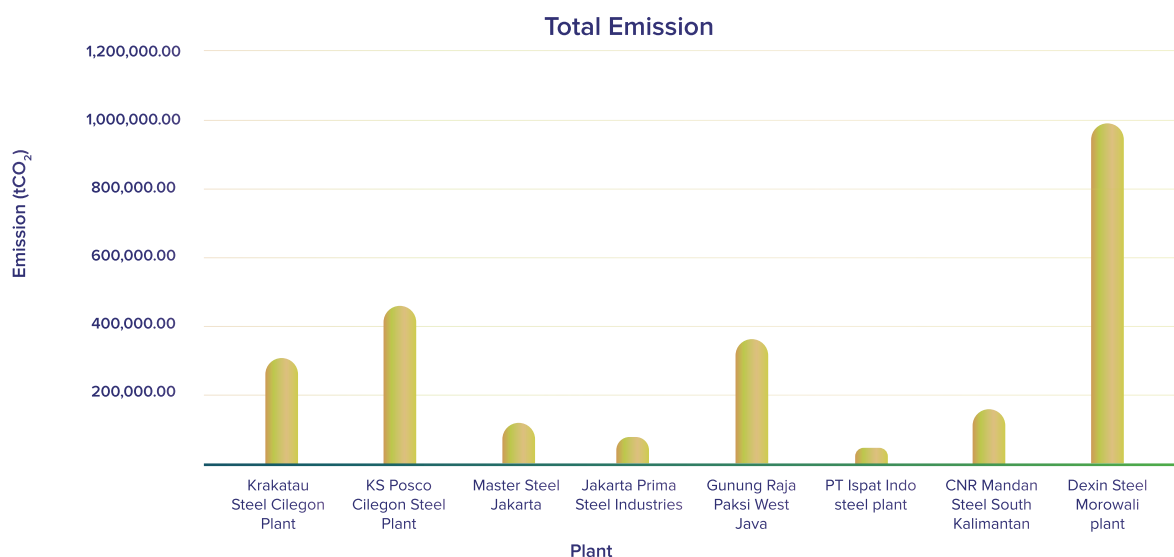


Figure 7. Scope 1 and 2 Emission for Transition BAU Technology to DRI-EAF with Green Hydrogen Emission

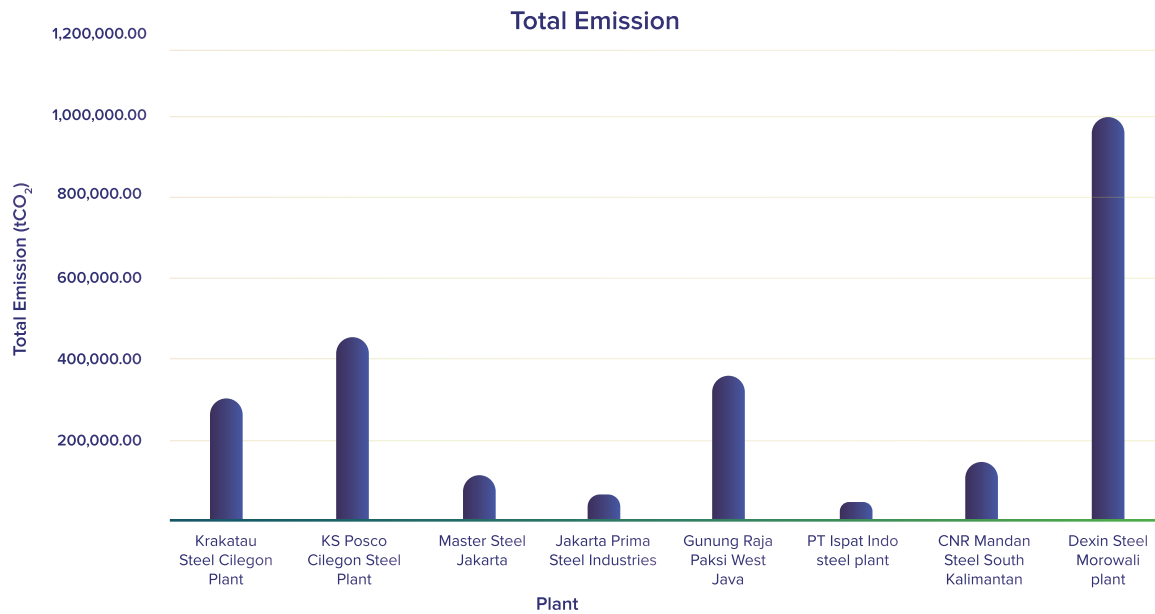


Figure 8. Total Emission for Transition BAU Technology to DRI-EAF with Green Hydrogen Emission

Based on the total emission projections, the Green Hydrogen DRI-EAF scenario achieves the deepest decarbonization, reducing the annual aggregate carbon footprint of the largest producer, Dexin Steel Morowali, to approximately 990,000 tCO₂, and KS Posco Cilegon to roughly 450,000 tCO₂. This drastic reduction is driven by

the complete elimination of direct process emissions (Scope 1), as the chemical reduction of iron ore with green hydrogen yields only water vapor, thereby leaving a residual carbon footprint that is exclusively comprised of Scope 2 emissions derived from the electrical grid intensity required to power the Electric Arc Furnaces.

4.2.4. Scenario 4: DRI-EAF with Green Hydrogen and Renewable Electricity

Based on the chart provided, the DRI-EAF with Green Hydrogen and Renewable Electricity scenario represents the achievement of "True Net Zero" steelmaking, characterized by the complete elimination of the carbon footprint. The graph displays an empty field with no visible bars, indicating that Scope 1 (Direct Emissions) have dropped to zero because the chemical reduction of iron ore using green hydrogen releases only water vapor (H₂O) instead of CO₂. Similarly, Scope 2 (Indirect Emissions) are also reduced to zero (or negligible levels), as the energy-intensive Electric Arc Furnace is powered entirely by renewable sources (such as geothermal, hydro, or solar), removing the grid-based carbon penalty seen in previous scenarios.

This total "wipeout" of emissions signifies the absolute decoupling of production capacity from carbon output. For massive industrial complexes like Dexin Steel Morowali (7 Mtpa) and Krakatau Steel (4 Mtpa), which generated millions of tons of CO₂ in the Coal and Gas scenarios, the aggregate emissions in this scenario effectively flatline to near 0 tCO₂. This confirms that the only pathway to fully decarbonize the Indonesian steel industry is a synchronized dual-transition: adopting hydrogen for the chemical ironmaking phase while simultaneously securing a dedicated renewable power supply for the melting phase.

4.3. Comparative Scenario

The data reveals a stark contrast between the Business-as-Usual (BAU) trajectory and all alternative technological scenarios. The BAU baseline, driven primarily by coal-intensive BF-BOF routes, results in a massive aggregate carbon footprint of approximately 48.0 million tCO₂, with the colossal Dexin Steel Morowali plant alone accounting for roughly half of this load (~24.4 million). The visual disparity between the towering Dark Blue bars (BAU) and the other scenarios in

the chart confirms that the current reliance on coking coal is unsustainable for climate targets. Implementing Scenario 1 (Scrap-based EAF) offers the most immediate radical reduction, slashing total emissions by roughly 74% down to 12.6 million tCO₂. This demonstrates that shifting from "reducing ore" to "recycling scrap" is currently the most effective method for carbon abatement, provided sufficient scrap feedstock is available.

Table 10. Comparative scenario for a decarbonized Iron and Steel Plant in Indonesia

No	Plant	Current	Scenario 1: EAF	Scenario 2: DRI EAF with Natural Gas	Scenario 3: EAF DRI with Hydrogen	Scenario 4: EAF DRI with Hydrogen and Renewable
1	Krakatau Steel Cilegon Plant	1,530,080.00	1,530,080.00	2,624,000.00	304,000.00	0.00
2	KS Posco Cilegon Steel Plant	11,178,000.00	2,295,120.00	3,936,000.00	456,000.00	0.00
3	Master Steel Jakarta	573,780.00	573,780.00	984,000.00	114,000.00	0.00
4	Jakarta Prima Steel Industries	344,268.00	344,268.00	590,400.00	68,400.00	0.00
5	Gunung Raja Paksi West Java	6,036,186.40	1,805,494.40	3,096,320.00	358,720.00	0.00
6	PT Ispat Indo steel plant	248,638.00	248,638.00	426,400.00	49,400.00	0.00
7	CNR Mandan Steel South Kalimantan	3,726,000.00	765,040.00	1,312,000.00	152,000.00	0.00
8	Dexin Steel Morowali plant	24,384,360.00	4,995,711.20	8,567,360.00	992,560.00	0.00
Total		48,021,312.40	12,558,131.60	21,536,480.00	2,495,080.00	0.00

The Levelized Cost of Steel (LCOS) and emission data illustrate the fundamental economic challenge of industrial decarbonization. Under the Business as Usual (BAU) baseline, the industry produces massive emissions totaling over 48.02 million tCO₂ while maintaining a highly competitive market LCOS of 589.21 USD/ton. Transitioning to Scenario 1 (Scrap-based EAF) presents a rare economic and environmental advantage, slashing total emissions by roughly 74% down to 12.55 million tCO₂ while slightly lowering the production cost to 582.98 USD/ton. However, because this highly efficient recycling route is structurally constrained by the limited domestic availability of scrap metal, the industry must inevitably rely on virgin steel production to meet aggressive long-term infrastructure demands.

Moving beyond scrap recycling into virgin steel production via Direct Reduced Iron (DRI) exposes a steep "Green Premium" that penalizes commercial viability. Scenario 2 utilizes natural gas as a transitional bridge, which successfully cuts emissions to 21.53 million tCO₂ but drives the LCOS up to 721.33 USD/ton. Achieving true deep decarbonization through Scenarios 3 and 4 requires the integration of hydrogen electrolyzers, which forces the cost up drastically to 901.95 USD/ton and ultimately peaks at 912.95 USD/ton when paired exclusively with dedicated renewable energy. While Scenario 4 represents the necessary net-zero endgame by eliminating CO₂ emissions entirely, the massive 323 USD/ton price gap compared to the BAU baseline dictates that robust carbon market mechanisms and tax structures will be essential to equalize the market.

Table 11. Comparative LCOS for a decarbonized Iron and Steel Plant in Indonesia

Scenario	Total Emission (tCO ₂)	LCOS (USD/ton)
Business as Usual	48,021,312.40	589.21
Scenario 1: EAF	12,558,131.60	582.98
Scenario 2: DRI-EAF with Natural Gas	21,536,480.00	721.33
Scenario 3: DRI-EAF with Hydrogen	2,495,080.00	901.95
Scenario 4: DRI-EAF with Hydrogen and Renewable	-	912.95

A critical engineering insight from the comparison is that Scenario 2 (Gas-based DRI)—represented by the Green bars—actually results in higher emissions (21.5 million tCO₂) compared to the Scrap-EAF route. This illustrates the "energy penalty" of producing virgin iron; even when using cleaner natural gas, the chemical reduction of iron ore generates significantly more Scope 1 emissions than simply melting existing scrap.

Consequently, for producing new virgin steel (essential for high-grade applications where scrap cannot be used), the industry must look toward Scenario 3 (Hydrogen-based DRI). The Light Blue bars for this scenario are barely visible on the chart, representing a collapse in total emissions to just 2.5 million tCO₂. This confirms that while Natural Gas (Scenario 2) acts as a transitional bridge, only Green Hydrogen (Scenario 3) combined

with renewable power (Scenario 4, effectively zero) can deliver the deep decarbonization required to approach Net Zero.

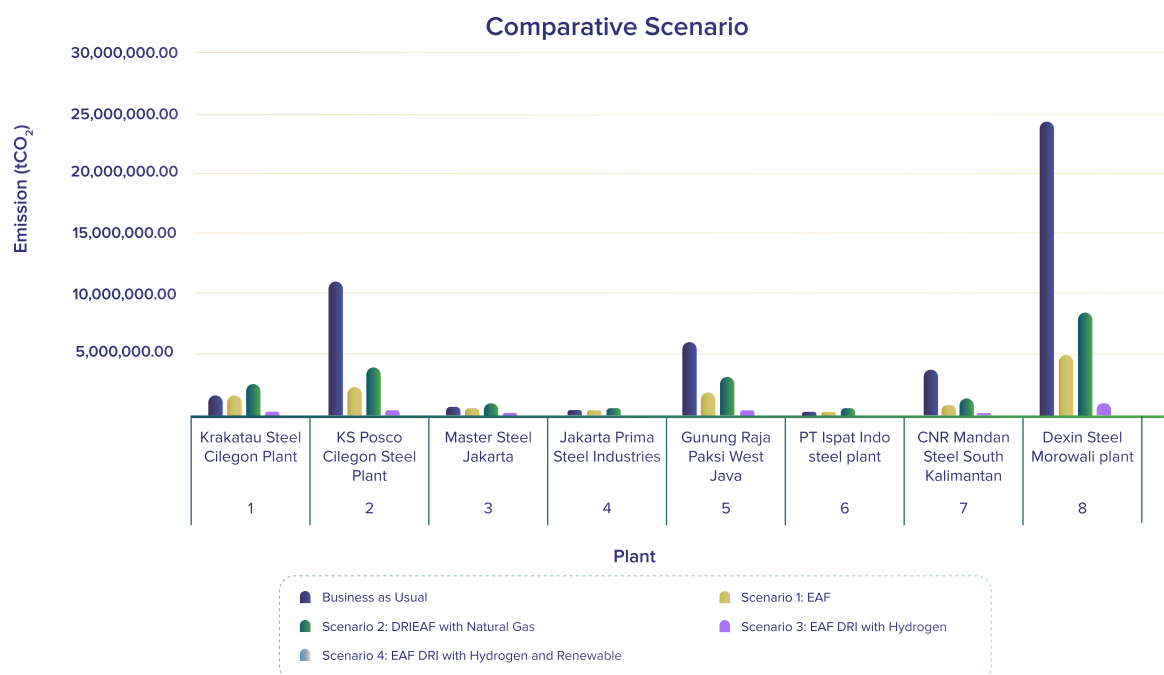


Figure 9. Comparative scenario for a decarbonized Iron and Steel Plant in Indonesia

Table 12. Comparative scenario of Carbon Intensity for a decarbonized Iron and Steel Plant in Indonesia

Scenario	Total Emission (tCO ₂)	LCOS (USD/ton)
Current	48,021,312.40	1.46
Scenario 1: EAF	12,558,131.60	0.38
Scenario 2: DRI-EAF with Natural Gas	21,536,480.00	0.66
Scenario 3: DRI-EAF with Hydrogen	2,495,080.00	0.09
Scenario 4: DRI-EAF with Hydrogen and Renewable	0.00	0.00

Photo: envanto.com

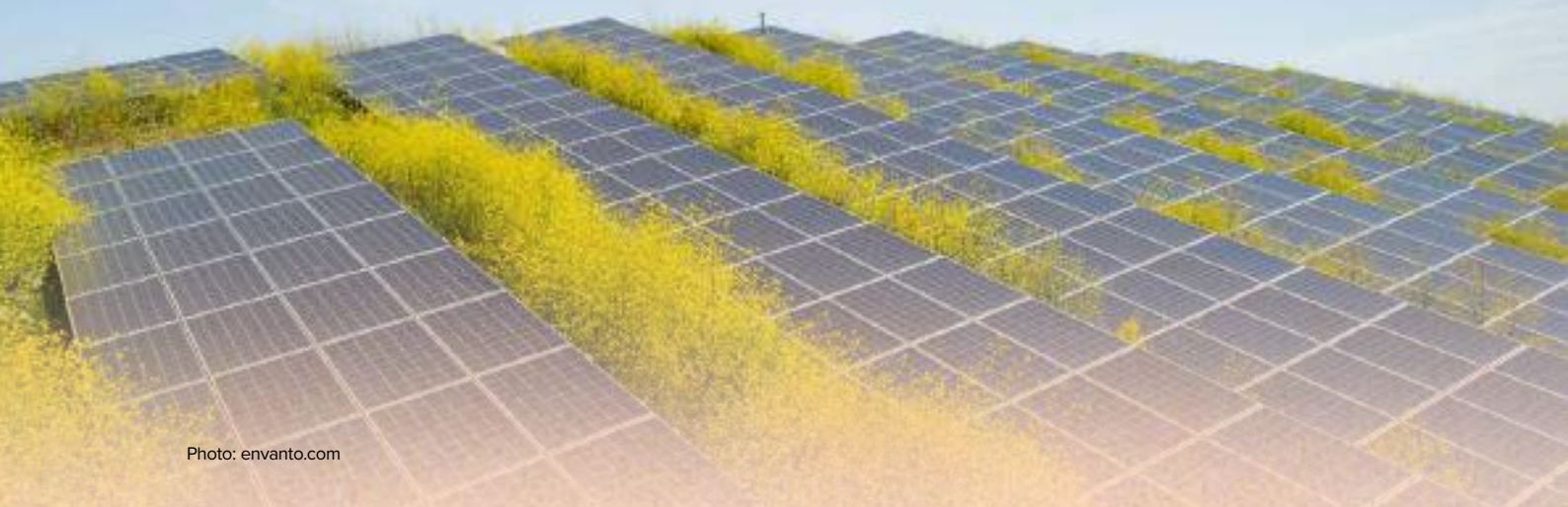


Photo: envanto.com

The data reveals a significant efficiency hierarchy where Scenario 1: EAF (Scrap-based) currently offers the most immediate intensity reduction, dropping from the BAU baseline of 1.46 tCO₂/tsteel&iron down to 0.38 tCO₂/tsteel&iron. This 74% reduction validates the thermodynamic advantage of secondary steelmaking (recycling), which bypasses the energy-intensive chemical reduction of iron ore. Notably, Scenario 2: DRI-EAF with Natural Gas—while significantly cleaner than the coal-based BAU—records an intensity of 0.66 tCO₂/tsteel&iron. This highlights the "energy penalty" of producing virgin steel; even with cleaner natural gas, chemically reducing iron ore results in a carbon intensity nearly double that of simply melting scrap, limiting the decarbonization potential of the natural gas transition to a "medium-carbon" rather than "low-carbon" status.

To breach the "low-carbon" threshold (typically defined as <0.5 tCO₂/tsteel&iron), the industry must transition to Scenario 3: DRI-EAF with Hydrogen, which slashes intensity to a negligible 0.09 tCO₂/tsteel&iron. This dramatic drop represents a 94% reduction from the BAU baseline, confirming that replacing carbon reductants with hydrogen is the only viable engineering pathway for producing virgin steel with an environmental footprint comparable to scrap recycling. Finally, Scenario 4 achieves a theoretical 0.00 tCO₂/tsteel&iron intensity, demonstrating that the final 0.09 delta depends entirely on Scope 2 emissions; thus, True Net Zero is only achievable by coupling Green Hydrogen with a fully renewable power supply for the EAF melting phase.

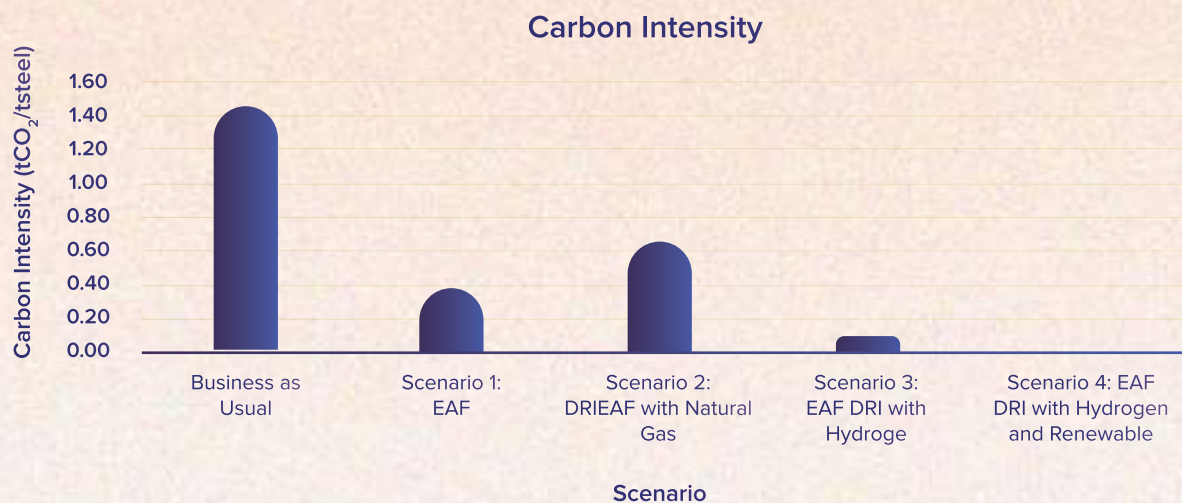


Figure 10. Comparative scenario of Carbon Intensity for a decarbonized Iron and Steel Plant in Indonesia

4.4.

Contribution to the Second NDC of IPPU

In 2025, the Current Policy Scenario (CPOS), serving as the BAU baseline for all national IPPU sectors, is projected at approximately 74.65 million tCO₂. The BAU scenario for the iron and steel sector alone contributes 48.02 million tCO₂. In absolute terms, the iron and steel industry accounts for nearly 64% of the total national IPPU emissions.

Consequently, any failure to decarbonize the steel sector automatically guarantees a failure to achieve the overall SNDC targets, as the remaining carbon budget (roughly 26 million tCO₂) must be distributed among all other heavy industries, such as cement and petrochemicals.

Table 13. IPPU Emission in SNDC

IPPU SNDC	2025	2030	2035	2035
SNDC CPOS (tCO ₂)	74,658,000	79,465,000	93,580,000	93,580,000
SNDC LCCP_L	68,042,000	74,147,000	73,115,000	34,243,000
SNDC LCCP_H (tCO ₂)	70,656,000	78,960,000	78,304,000	34,375,000

Indonesia aims to reduce IPPU emissions from the CPOS baseline (~79.46 million tCO₂) down to approximately 74.14 million tCO₂ under the Low Carbon Compatible Pathway (LCCP_L) by 2030. Shifting the steel industry to Scenario 1 (EAF) drastically drops emissions to 12.55 million tCO₂, yielding a massive abatement of ~35.4 million tCO₂ against the BAU. Alternatively, utilizing Scenario 2 (Gas-DRI) reduces emissions to 21.53 million tCO₂, saving ~26.4 million tCO₂.

Adopting scrap-based EAF or Gas-DRI routes will instantly secure Indonesia's 2030 LCCP targets. Furthermore, the surplus emissions abatement generated by these pathways could be utilized to offset emission growth in other "hard-to-abate" industrial sectors.

By 2060, the CPOS baseline is projected to skyrocket to ~109.39 million tCO₂. However, the LCCP target demands radical abatement, capping total IPPU emissions at just 34.24 million tCO₂. If the steel industry persists with the coal-fired Blast Furnace route (BAU), its standalone emissions of 48 million tCO₂ would exceed the entire national IPPU quota for 2060 (34.24 million tCO₂). Transitioning to Scenario 3 (Green Hydrogen) compresses steel emissions to a marginal 2.49 million tCO₂. Scenario 4 (Hydrogen + Renewables) effectively eradicates them entirely to 0.00 tCO₂. Approaching 2060, Scenarios 3 and 4 transitions from "alternative options" to mathematical prerequisites. Without the migration to pure hydrogen reduction in the steel sector, the 34.2 million tCO₂ national carbon budget is mathematically unattainable.

Photo: envanto.com

4.5. Steel and Iron Emissions Projection based on Decarbonization Scenario

Based on the Steel and Iron Emission Projection in Indonesia chart, the long-term environmental trajectory of the industry presents a stark divergence between unrestrained growth and deep decarbonization. The Business as Usual (BAU) scenario, represented by the orange line, illustrates an alarming and unsustainable path. Starting from a baseline of approximately 48,000 units (representing 48

million tCO₂) in 2025, BAU emissions nearly triple to an astonishing 140,000 by 2060. This aggressive upward slope mirrors the anticipated surge in national steel demand, clearly demonstrating that continuing with conventional coal-based Blast Furnace technology will generate a carbon footprint that easily breaches Indonesia's Net Zero limits.

Steel and Iron Emission Projection in Indonesia

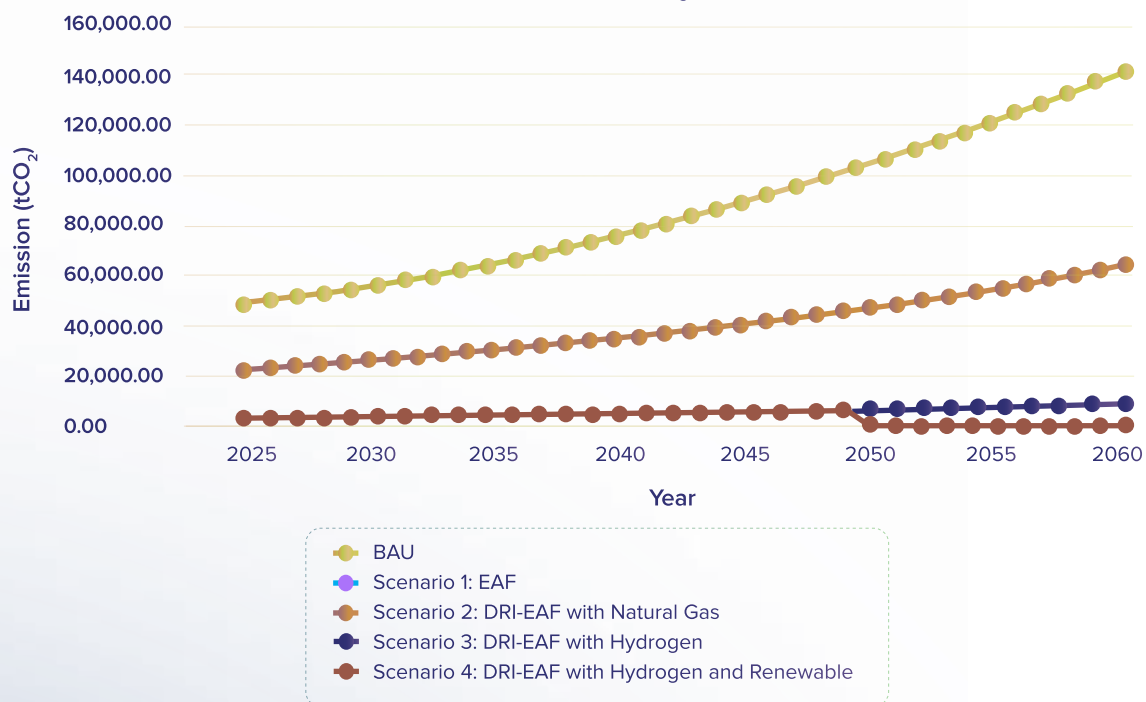


Figure 11. Steel and Iron Emission Projection in Indonesia

The blue line representing Scenario 2 (DRI EAF with Natural Gas) highlights the limitations of utilizing fossil gas as a permanent climate solution. While it offers a significant initial reduction—starting at roughly 21,000 in 2025 compared to BAU's 48,000—it still follows a steep, linear growth trajectory as production capacity scales up over the decades. By 2060, emissions from this natural gas route are projected to reach approximately 60,000, which is noticeably higher than the industry's entire BAU carbon footprint in 2025. This visually confirms that Scenario 2 is merely a transitional bridge that delays the carbon crisis rather than solving it.

Clustered at the bottom of the graph, Scenario 1 (Scrap-based EAF) demonstrates a highly effective, albeit constrained, mitigation pathway. Represented by the dark green line, emissions remain remarkably flat and subdued throughout the entire 35-year projection, registering only a tiny fraction of the BAU footprint. While the carbon intensity of this recycling route is incredibly low, its flat trajectory also reflects its limited scalability. Because the domestic supply of high-quality scrap steel cannot match the exponential demand curve of a developing nation, this low-emission route cannot single-handedly absorb the country's projected production burden toward 2060.

The true paradigm shift required for the 2060 Net Zero target is visualized by the trajectories of Scenarios 3 and 4, which represent the integration of Green Hydrogen. These pathways flatline at the very bottom of the y-axis, indicating an absolute decoupling of industrial growth from greenhouse gas emissions. Notably, the light green line representing Scenario 4 (Hydrogen combined with Renewable energy) visibly drops to an absolute zero point around the year 2050 and maintains that flatline through 2060. This visualizes the ultimate technological endgame: producing massive volumes of virgin steel without contributing a single ton of CO₂ to the atmosphere.

Ultimately, the defining feature of this projection chart is the progressively widening chasm between the BAU and the decarbonization scenarios over time. In 2025, the abatement gap between the worst-case (BAU) and best-case (Scenario 4) options is approximately 48,000 units; by 2060, that delta expands exponentially to a staggering 140,000 units. This expanding "jaws" shape indicates that the longer the industry delays its capital transition toward hydrogen and renewable-powered EAFs, the more insurmountable the accumulated carbon debt will become.

Shifting the industry from the top trajectory to the bottom is a strict mathematical necessity for Indonesia's long-term climate commitments.

Photo: envanto.com

CHAPTER 5

PORTRAIT OF GPP IN INDONESIA

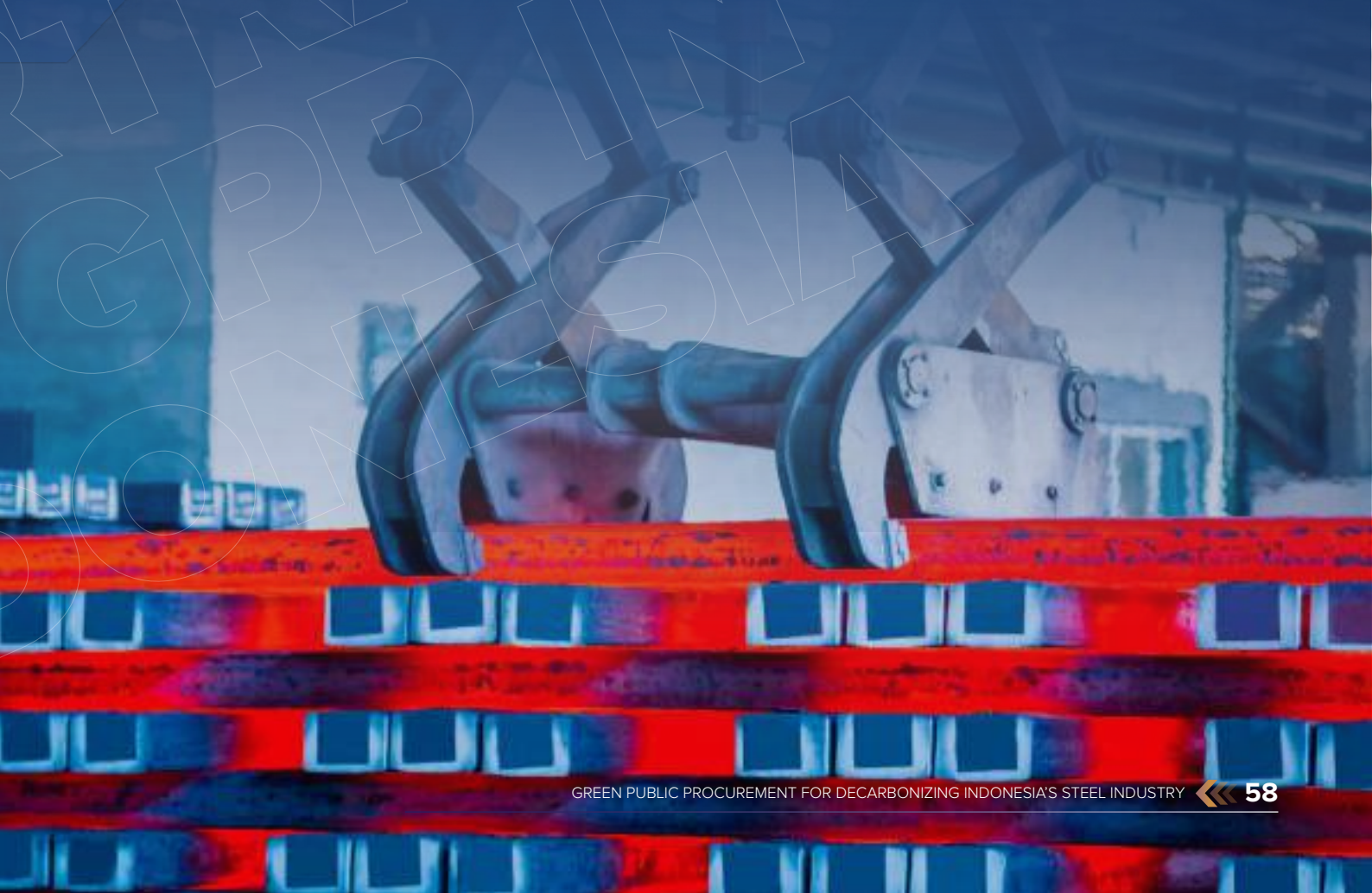


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5.1.

Regulations on GPP

5.1.1. Laws

Law Number 59 of 2024 on the National Long-Term Development Plan (RPJPN) 2025–2045 serves as the main foundation for integrating green principles into procurement policies. This law explicitly positions the circular economy as the direction of national development, with the objective of reducing dependence on natural resource–based materials and realizing a zero-waste vision through the implementation of the 9R principles. These principles focus on five priority industries—food and beverages, electronics, textiles, construction and building materials, and packaging—which have direct implications for government procurement.

Furthermore, the RPJPN 2025–2045 emphasizes a low-carbon development pathway through energy efficiency policies, waste management, circular economy practices, and the development of green industries. In the procurement context, this policy direction opens opportunities for the government to prioritize products and services that meet energy efficiency, low-emission, and environmentally friendly

standards. Infrastructure development is also directed to adopt a green, sustainable, and resilient approach, so that public procurement of goods and services is not only oriented toward economic value but also toward balancing social and environmental impacts.

Another relevant regulation is Law Number 6 of 2023 on Job Creation. Although this law primarily focuses on job creation and improving the ease of doing business, it contains provisions relevant to green procurement. Article 97 requires central and regional governments to allocate at least 40 percent of public procurement to domestic Micro, Small Enterprises, and Cooperatives. This provision has the potential to strengthen green procurement when combined with policies that support MSMEs in transitioning toward sustainable production. In addition, Article 117 emphasizes the obligation for industrial companies to comply with green industry standards. Furthermore, Article 57 paragraph (4) stipulates that the implementation of Indonesian National

Standards (SNI) as a requirement for goods traded domestically must consider several aspects, including environmental considerations.

Subsequently, Law Number 2 of 2017 on Construction Services provides a more operational legal basis for applying green principles in construction sector procurement. This law consistently emphasizes the obligation to protect and preserve the environment in the implementation of construction services. Through the concept of Safety, Health, and Sustainability Standards (SMK3L), environmental aspects become an integral part of material quality standards,

environmental management, and construction contract clauses. Compliance with these standards applies to both service users and service providers, with clear administrative sanctions in cases of violations.

Currently, target indicators related to public procurement of green goods (including green iron and steel) have been included in several policy documents, such as the National Medium-Term Development Plan (RPJMN) 2025–2029 and the Circular Economy Roadmap and National Action Plan 2025–2045. The relevant indicators and targets are detailed in Table 13 below.

Table 14. Indicators and Targets Related to Green Industry

Regulation	Indicator	Target
Presidential Regulation (Perpres) Number 12 of 2025 on the National Medium-Term Development Plan 2025–2029	Number of products applying sustainable principles	- Target: 70 environmentally certified products (cumulative) by 2025 - Target: 150 environmentally certified products (cumulative) by 2029
	Number of industrial companies certified as green industries (by location)	Target 2029: 200 company
	Ratio of circular material usage in the industrial sector	Target 2029: 15%
	National green-based steel industry development policy	Target: 1 policy recommendation in 2025
	Study on Cooperation Opportunities and Harmonization of Green Industry Standardization for international recognition	Target: 1 policy recommendation in 2029

Regulation	Indicator	Target
Presidential Regulation (Perpres) Number 12 of 2025 on the National Medium-Term Development Plan 2025–2029	Draft Green Industry Standards	- Target 2025: 3 NSPK (Norms, Standards, Procedures, Criteria) - Target 2029: 7 NSPK
	Draft Government Procurement Regulations for Environmentally Friendly/Sustainable Products (for LKPP)	Target: 2 draft regulations in 2025 and 10 draft regulations in 2029
	Environmentally friendly/sustainable products included in the government procurement system (LKPP)	Target: 2 products in 2025 and 4 products in 2029
	Implementation of government procurement for environmentally friendly/sustainable products (LKPP)	Target: 2 institutions in 2025 and 5 institutions in 2029
Circular Economy Roadmap and National Action Plan 2025–2045	Target percentage of minimum criteria for eco-labeled products used in projects	- Regulatory framework for minimum eco-labeled product usage under Sustainable Construction criteria (2025–2029) 10% of project products (2030–2034) 15% (2035–2039) 20% (2040–2045)
	Target percentage of eco-labeled construction products listed in the LKPP Construction Catalog	- Regulation on the use of eco-labeled products in public procurement (2025–2029) 20% of construction products eco-labeled in the LKPP Construction Catalog (2030–2034) 30% (2035–2039) 50% (2040–2045)
	Number of Green Industry Standards (SIH) in the construction sector	2025–2029: SIH for 50% of products under KBLI 46631 (metal goods for construction materials) or 46634 (cement, lime, sand, and stone)

Regulation	Indicator	Target
		• 2030–2034: SIH for 100% of products under KBLI 46631 or 46634 • 2035–2039: SIH for 50% of products under KBLI 46632 (glass), 46633 (roof tiles, bricks, tiles, and similar products), and/or 46636 (wood) • 2040–2045: SIH for 100% of products under KBLI 46632, 46633, and/or 46636, and 50% for other KBLIs (paint, porcelain, etc.)
	Recycled or alternative material content used in construction material production	• 2030–2034: 10% recycled content in all construction materials • 2035–2039: 30% recycled content • 2040–2045: 50% recycled content

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5.1.2. Presidential, Government, and Ministerial Regulations

Presidential Regulation of the Republic of Indonesia Number 46 of 2025 is the second amendment to Presidential Regulation Number 16 of 2018 concerning Government Procurement of Goods/Services (PBJP). This regulation serves as the main reference for the government in conducting the procurement process of goods/services. This regulation has stated that green and sustainable principles are important in the entire process of government procurement of goods and services. For example, Article 5 letter (i) stipulates that one of the procurement policies includes the implementation of sustainable procurement. In addition, Article 68 paragraphs (1) and (2) explicitly regulate that the implementation of procurement of goods/services must pay attention to sustainability aspects, which include environmental, social, economic, and/or institutional aspects.

Presidential Regulation No. 46/2025 also elaborates in more detail on the intended environmental aspects. In Article 68 paragraph (2a), it is explained that environmental aspects include efforts to reduce negative impacts on health, air quality, soil, and water, as well as the use of natural resources in accordance with statutory regulations. Furthermore, these environmental considerations need to be translated into technical specifications of goods/services, among others through the use of Environmentally Friendly Products or the application of technical criteria that consider environmental aspects verified using environmental labels.

Furthermore, Presidential Regulation No. 46/2025 Article 68 paragraph (3) emphasizes the multi-actor role in the implementation of sustainable procurement. The roles possessed by these actors include:

- **Budget User (PA)/Budget User Authority (KPA):**
Planning and Budgeting of Green/Sustainable Procurement;
- **Commitment-Making Official**
Preparation of technical specifications/terms of reference and contract drafts in green/sustainable procurement of goods/services;
- **Selection Working Group, Procurement Official, or Procurement Agent**
Ensuring that these aspects are reflected in the selection documents.

In addition, Presidential Regulation Number 59 of 2017 concerning the Implementation of Sustainable Development Goals (SDGs) serves as the basis for mainstreaming SDG values into national development policies and practices. In this context, government procurement of goods and services is positioned as a strategic instrument to support the achievement of SDG Goal 12, namely ensuring sustainable consumption and production patterns. One of the global targets of this goal is the increase of sustainable public procurement practices, in line with national policies and priorities.

Following up on this global target, Indonesia established a national target in the form of developing environmentally friendly products through the establishment of product categories and criteria registered in the GPP system until 2019 or adjusted to the targets listed in the RPJMN 2015–2019.

To stimulate the development of the green iron and steel industry, the government through several Government Regulations provides several fiscal incentives (see Table 14 below).

Table 15. Government Regulations Related to Fiscal Incentives

No	Regulation	Facility
1	Government Regulation (PP) No. 78 of 2019 on Income Tax Facilities for Investment in Certain Business Sectors and/or Regions	- Provides income tax reduction facilities for investments in the basic iron and steel industry and steel rolling industry using Electric Arc Furnace (EAF) technology. - The facility includes a net income reduction of 30% of the total investment value in tangible fixed assets (including land) used for core business activities, allocated over six years at 5% per year.
2	Government Regulation (PP) No. 49 of 2022 on VAT Exemption or Non-Collection for Certain Imports and/or Deliveries of Taxable Goods and Services	Provides VAT exemption on the import of strategic goods, including iron ore derived from mining or taken directly from its source.

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To implement green procurement policies, the government through several agencies makes technical regulations as part of efforts to achieve development targets related to green procurement. For example, the Ministry of Environment and Forestry (KLHK) stipulates Minister of Environment and Forestry Regulation (Permen LHK) Number 5 of 2019 concerning Procedures for Procurement of Environmentally Friendly Goods and Services as a technical basis that strengthens the environmental dimension in government procurement. This regulation defines the criteria for goods and services classified as environmentally friendly and establishes a labeling system, including Type I, Type II Ecolabel and Environmentally Friendly Technology Verification. The articles in this regulation explain the function of labeling as a verification tool for products that meet the principles of resource efficiency, emission reduction, and sustainable waste management. Thus, Permen LHK 5/2019 provides technical standards that serve as a reference for LKPP in determining products that meet green criteria.

The Type I and Type II Ecolabel systems have differences. Type I Ecolabel is granted to products that meet the Indonesian National Standard (SNI), taking into account environmental impacts throughout the product life cycle. Certification is carried out by an accredited third-party body, with approval from KLHK. Meanwhile, Type II Ecolabel is known as the Indonesian Self-Declared Ecolabel, related to certain environmental claims made by producers. Although the term “self-declared” is used, these claims still go through a structured verification process. Producers begin this process by submitting their environmental claims to an environmental label verification institution to be evaluated, followed by registration at KLHK. This system ensures that even though producers declare their own environmental claims, there is still a



strict verification and approval mechanism, so that the credibility of Type II Ecolabel in Indonesia is maintained. Until 2023, procurement institutions of several national ministries have used both types of Ecolabel (IISD, 2024). In addition, these labeled products are included in the e-Catalogue, which facilitates procurement in the public procurement process and increases the potential for GPP implementation.

On the other hand, there is the Green Industry Standard (SIH) from the Ministry of Industry which serves as a reference to encourage industries to apply green principles based on the Indonesian Industrial Classification (Regulation of the Statistics Indonesia [BPS] Number 19 of 2017). This standard is developed in collaboration with related ministries, industry associations, and companies. Although compliance with SIH is voluntary, this standard provides a framework for implementing green industry practices. SIH certification mainly applies to companies as a whole, assessing production processes and management systems comprehensively. SIH covers efficient use of raw materials, renewable energy, optimized production processes, product quality, effective management systems, and waste management technology. Companies can apply for certification through green industry certification bodies that meet SNI ISO 17065 standards, with more than 16 recognized bodies available (Minister of Industry Regulation Number 14 of 2020). Certification involves document review and compliance audits, allowing certified companies to use the Green Industry logo

for 4 years.

Specifically for the iron and steel industry, SIH certification is regulated in Minister of Industry Regulations such as Permenperin No. 12 of 2023 for coated steel sheets, Permenperin 41 of 2024 for steel bars, and Permenperin No. 45 of 2024 for the steel sheet industry in general (slabs, steel plates, etc.). These three regulations establish similar technical and management requirement aspects, with the note that there are differences in specification requirements that must be fulfilled to achieve SIH and the standards of these three regulations are voluntary. The intended technical requirement aspects are explained in the annex.

To stimulate the development of the green iron and steel industry, the government through Minister of Finance Regulation Number 130/PMK.010/2020 concerning the Provision of Corporate Income Tax Reduction Facilities prepares several fiscal incentive schemes that can be used which include:

1

reduction of corporate income tax on new investment for pioneer industries such as upstream basic metal industry (iron steel), where the entity must obtain a score of 80% of the pioneer industry criteria eligible to apply for the tax reduction facility; and

2

one of the quantitative criteria of pioneer industries eligible to obtain corporate income tax reduction is the use of environmentally friendly technology with a score of 10%.

Meanwhile, LKPP as a Non-Ministerial Government Institution (LPNK) directly responsible to the President to develop and establish government procurement policies in Indonesia, issued Head of LKPP Decree Number 157 of 2024 concerning Sustainable Government Procurement Guidelines, which is the most specific regulation in operationalizing the concept of green procurement. In this document, it is stated that sustainable procurement includes three main dimensions: economic, social, and environmental, with the environmental focus directed at the use

of environmentally friendly products or services. One concrete form of support for green procurement is found in the clause stating that procurement of goods/services may prioritize products with environmental labels or ecolabels regulated by KLHK.

LKPP provides space for procurement agencies to prioritize products proven to meet environmentally friendly criteria, for example energy-efficient products, made from recycled materials, or with high resource efficiency.

On the other hand, the regulation underlines the importance of integrating sustainable criteria at every stage of government procurement which includes (IISD, 2024):

- **Planning Stage**

At this stage, the use of the procurement planning system called the General Procurement Plan Information System (SIRUP) is mandatory for all procurement, including sustainable or green procurement equipped with green or sustainability tagging for each planned procurement package. This is intended to facilitate easier identification and assessment in measuring the performance of green/sustainable procurement from each institution or ministry.

- **Preparation Stage**

This stage includes defining technical requirements and procurement specifications, including green aspects of certain goods. Officials conducting procurement also consult with parties from LKPP who understand green/sustainable procurement mechanisms if needed. There are several requirements and specifications that can be considered by procurement officials, for example the official may use a checklist to ensure that the procurement carried out has met green/sustainable aspects.

- **Procurement Stage**

This stage requires the use of an e-procurement system which allows procurement tenders to be conducted online, e-catalogue, and online purchasing. The E-Catalogue can provide information regarding green/sustainability aspects of certain goods such as the imposition of Ecolabel. KLHK also has a similar online procurement portal but specifically offering green goods called Sibarjasramling.

- **Evaluation Stage**

At this stage, officials conducting public procurement assess the technical capability of suppliers, especially regarding compliance with green/sustainable goods requirements, for example whether the goods offered have been granted green or sustainable certification.

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5.2. GPP Policy Gaps

The results of the literature study and IDI with a number of stakeholders indicate that GPP in Indonesia is still treated as an administrative and compliance instrument, rather than as a market-creation tool. This orientation is reflected in the dominance of a voluntary approach, the flexibility of legal mandates, and the tendency of procurement to adhere to the lowest-price paradigm. Within the demand-side innovation framework, this condition limits the state's ability to provide credible and long-term demand signals to industry, particularly in capital-intensive and emission-intensive sectors such as iron and steel.

Furthermore, the weak technical foundation, limited capacity of procurement actors, and supplier selection strategies indicate that the GPP issue is not merely a lack of commitment, but rather a systemic unpreparedness to operationalize green demand. The absence of traceable standards, limited

understanding of LCA/LCC, and the administrative concerns of Commitment-Making Officials (PPK) indicate the presence of structural buyer failure. Without policy interventions that explicitly address these barriers, public spending risks continuing to fail to function as a driver of innovation and industrial decarbonization.

In addition, contextualizing the five pillars of GPP with existing regulations shows that the effectiveness of GPP is highly dependent on alignment between procurement policy, industrial policy, and climate policy. As long as existing regulations operate in parallel without a clear orchestration mechanism, public procurement will struggle to play its strategic role as a policy mix. This explains why various industrial decarbonization initiatives and green certifications have not automatically been translated into real preferences in government spending.

5.2.1. Pillar 1: Policy and legal framework

Interview results show that the national policy framework for GPP in Indonesia is normatively available and relatively coherent, without significant regulatory overlap among ministries/agencies. Recognition of GPP is manifested in Presidential Regulation 16/2018 in conjunction with Presidential Regulation 12/2021 concerning Government Procurement of Goods/Services, Government Regulation 46/2017 concerning Environmental Economic Instruments, as well as various derivative policies within LKPP. Bappenas explained that the initial phase of GPP development was indeed focused on strengthening policy at the macro level, with the Ministry of Environment and Forestry (KLHK) acting as the implementing institution and involving cross-institutional discussions:



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“At the initial stage, efforts were more focused on strengthening policy at the macro level. In that context, KLHK acted as the implementing institution, involving cross-institutional discussions, including with LKPP. This process then contributed to the issuance of Presidential Regulation Number 12 of 2021, as well as the adoption of environmentally friendly procurement principles in Government Regulation Number 46 of 2017 concerning Environmental Economic Instruments.”

(N5, IDI, 5 December 2025)

A central constraint in advancing GPP within Indonesia's steel sector lies in the absence of an operational and enforceable policy and legal framework. While decarbonization is increasingly recognized at the strategic level, stakeholders consistently emphasize that this recognition has not translated into market-shaping regulatory instruments, as decarbonization *“has not had any impact on the domestic market”* due to the absence of regulations affecting sales and financial performance (N9 IDI, 20 February 2026).

From the perspective of industry actors, the most immediate gap is the lack of policies that directly affect commercial outcomes and market behavior. This regulatory vacuum results in the absence of effective demand signals for green steel, leaving the market entirely undeveloped,

where *“there is no market for green steel in Indonesia”* (N10, IDI, 19 February 2026) and even public procurement is not willing to absorb price premiums, as *“there isn't” any willingness to pay 10% more for green steel”* (N10, IDI, 19 February 2026). These statements indicate that without mandatory procurement frameworks or public demand creation, green steel remains commercially non-viable in the domestic context.

However, respondents agreed that the main challenge of Pillar 1 lies not in the absence of regulation, but in the absence of binding operational mandates. LKPP explicitly highlighted that the norms in sustainable procurement regulations remain general and flexible, and therefore are not strong enough to encourage consistent implementation:

“In the currently applicable Presidential Regulation, sustainable procurement covers three main aspects, namely environmental, economic, and social aspects. However, normatively, the legal formulation uses the phrase ‘and/or’, meaning that fulfillment of only one aspect can already be categorized as sustainable procurement.”

(N1, IDI, 24 November 2025)

This flexible normative character reflects weak coercive pressure within the institutional framework, so that GPP has not yet functioned as a demand-side innovation policy instrument capable of creating credible and long-term demand

signals. In this context, the Ministry of Industry emphasized that the obligation to use green standards cannot be imposed unilaterally from the production side, but must be pulled through public procurement demand mechanisms:

“The Green Industry Standard is still voluntary. If it is to be made mandatory, it must be done gradually and pulled from the demand side, not by forcing industry unilaterally because it could affect competitiveness.”

(N4, IDI, 5 January 2026)

The lack of economic incentives embedded in the policy framework further reinforces this condition. Stakeholders highlight that Indonesia does not provide fiscal or financial mechanisms to support the transition, where *“there are no incentives from the Indonesian government”* (N10, IDI, 19 February 2026) and *“green products are not paid at a higher price”* (N10, IDI, 19 February 2026). As a result, the policy framework fails to internalize environmental value into price signals, leaving producers exposed to higher costs without compensatory mechanisms.

The weakness of policy design is exacerbated by the absence of a leading sector explicitly tasked with overseeing cross-ministerial and central–regional GPP implementation. From a central–

regional relations perspective, the Ministry of Home Affairs emphasized that local governments are still waiting for direction and designation of a national lead actor: *“The Ministry of Home Affairs does not act as the leading sector, but rather waits for initiatives from the technical ministry responsible.”* (N6, IDI, 14 November 2025)

This pattern of mutual waiting was also confirmed by technical ministries and procurement institutions. The Ministry of Public Works (PU), LKPP, and Bappenas all stated that the absence of a designated lead actor causes GPP coordination to run partially and ad hoc, without formal mechanisms such as a steering committee or national directing structure:

“ *The challenge in coordinating is... because no one has been appointed.* ”

(N3, IDI, 24 November 2025)

“ *Currently, there is no leading sector specifically leading the implementation of green public procurement at the national level.* ”

(N3, IDI, 24 November 2025)

“ *LKPP itself... cannot be the leading sector, so there must be someone who can connect everything.* ”

(N5, IDI, 5 December 2025)

Another major issue lies in weak regulatory protection and enforcement, particularly in trade governance. Indonesia is perceived as having relatively weak trade protection, making it “*a major export destination*” for foreign steel (N9, IDI, 20 February 2026), while enforcement gaps persist, where imports may evade compliance, including tax obligations (N9, IDI, 20 February 2026). This weak enforcement environment not only undermines industrial competitiveness but also dilutes the effectiveness of any potential green policy instruments, as low-cost, carbon-intensive imports continue to dominate the market.

In addition, stakeholders point to institutional and policy fragmentation, particularly the absence of coordinated planning tools, where “*there is no commodity balance system for steel*” unlike in other sectors (N10, IDI, 19 February 2026). This highlights the lack of integrated policy coordination across sectors, which is essential for translating national commitments into operational mechanisms.

In terms of regulatory synergy, interview results show that procurement assessment based on life cycle costing (LCC), environmental impacts, and social value fully depends on budget users within each ministry/agency. The absence of cross-sector technical guidelines makes

sustainability integration highly dependent on individual discretion, making it difficult to shift from a lowest-price paradigm. LKPP emphasized that green criteria in procurement evaluation remain voluntary and are not substantively regulated in core regulations:

“ In the context of green procurement, there is currently no mandatory obligation... The determination of environmental criteria for certain materials depends heavily on the budget user. ”

(N1, IDI, 24 November 2025)

From an implementation perspective, the Ministry of PU highlighted limitations in technical instruments and emission

measurement methodologies that could burden working groups and create evaluation uncertainty:

“ Measuring carbon emissions in the procurement process still requires significant effort... the instruments and calculation methodologies have not been fully prepared. ”

(N3, IDI, 24 November 2025)

Regulatory credibility is further weakened by the misalignment between domestic standards and international frameworks, where *“green industry standards are not recognized internationally”* (N10, IDI, 19 February 2026). Without international recognition, domestic regulatory

instruments fail to provide export incentives or compliance motivation, limiting their strategic value.

Furthermore, the weakness of Pillar 1 is also reflected in the absence of integrated fiscal and non-fiscal incentive

and disincentive schemes linked to the public procurement system. Sustainable procurement practices remain voluntary, without concrete incentives for innovative suppliers:

“Sustainable procurement has so far been voluntary.”

(N3, IDI, 24 November 2025)

“There are no incentives for green iron and steel GPP.”

(N7, IDI, 14 November 2025)

Although the Ministry of Environment indicated that reward mechanisms exist through PROPER—such as licensing facilitation for businesses with good environmental performance—this scheme is not directly connected to public procurement policy and practice:

“Actually, in terms of regulatory context, it already exists... one of the rewards is facilitation in environmental licensing processes.”

(N2, IDI, 14 November 2025)

Finally, stakeholders underscore the broader issue of policy uncertainty and lack of strategic direction, particularly in the context of evolving global dynamics, where the transition *“cannot be treated as a race”* and requires stronger policy certainty and coordination (N9, IDI, 20 February 2026).

Overall, the challenges of Pillar 1 of GPP in Indonesia are structural. GPP has been normatively recognized and is relatively coherent, but the absence of a leading

sector, weak operational mandates, low regulatory synergy, weak enforcement, lack of incentives, and absence of demand-side instruments directly linked to procurement systems cause GPP to stop at the policy level. From the perspective of innovation systems theory and demand-side innovation, this condition indicates the state’s incapacity to utilize public procurement as a market-creation instrument to simultaneously drive innovation and green industrial transition.

5.2.2. Pillar 2: Technical foundation and green classification

Within the demand-side innovation framework, the technical foundation functions to translate policy commitments into clear market specifications that can be responded to by industry. However, the interview results indicate that Pillar 2 of GPP in Indonesia still faces structural weaknesses in the aspects of standardization and green classification. To date, there has been no development of an emission-intensity-based classification of goods and services—particularly for the iron and steel sector—that can be directly operationalized within the public procurement system. This condition is reinforced by industry perception that

“there is no differentiation in the market between green and non-green steel” (N10, IDI, 19 February 2026), indicating the absence of a formal taxonomy that distinguishes products based on carbon performance. Bappenas emphasized that the policy approach remains focused on the upstream side of production, while emission performance-based regulation at the procurement stage has not yet been built systemically. As a result, although relatively credible labels such as ecolabels are already available, a standardized and ready-to-use emission classification mechanism for public procurement is still absent.

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From a policy and implementation perspective, Indonesia already has the KLHK Ecolabel (Permen LHK No. 5/2019), the Green Industry Standard (SIH) of the Ministry of Industry, as well as various international references such as ISO and Environmental Product Declaration (EPD). However, interview findings reveal that these instruments have not yet been integrated into the LKPP procurement system. LKPP stated that in the latest version of the e-catalogue, environmentally friendly label information remains descriptive in nature, and green procurement is implemented gradually without making it a binding basis for technical evaluation.

This condition reflects that widely recognized standards have not yet been formalized as mandatory references to ensure the credibility of green products in procurement, compounded by the fact that *“our green industry standards are not recognized internationally”* (N10, IDI, 19 February 2026), which further weakens their function as credible market signals.

The Ministry of Industry explicitly emphasized that without clear and verifiable technical parameters, green product claims are difficult to use in the procurement process:

“Without the measurement of embodied emissions, credible MRV, and traceable standards, green product claims are difficult to use in the procurement system.”

(N4, IDI, 5 January 2026)

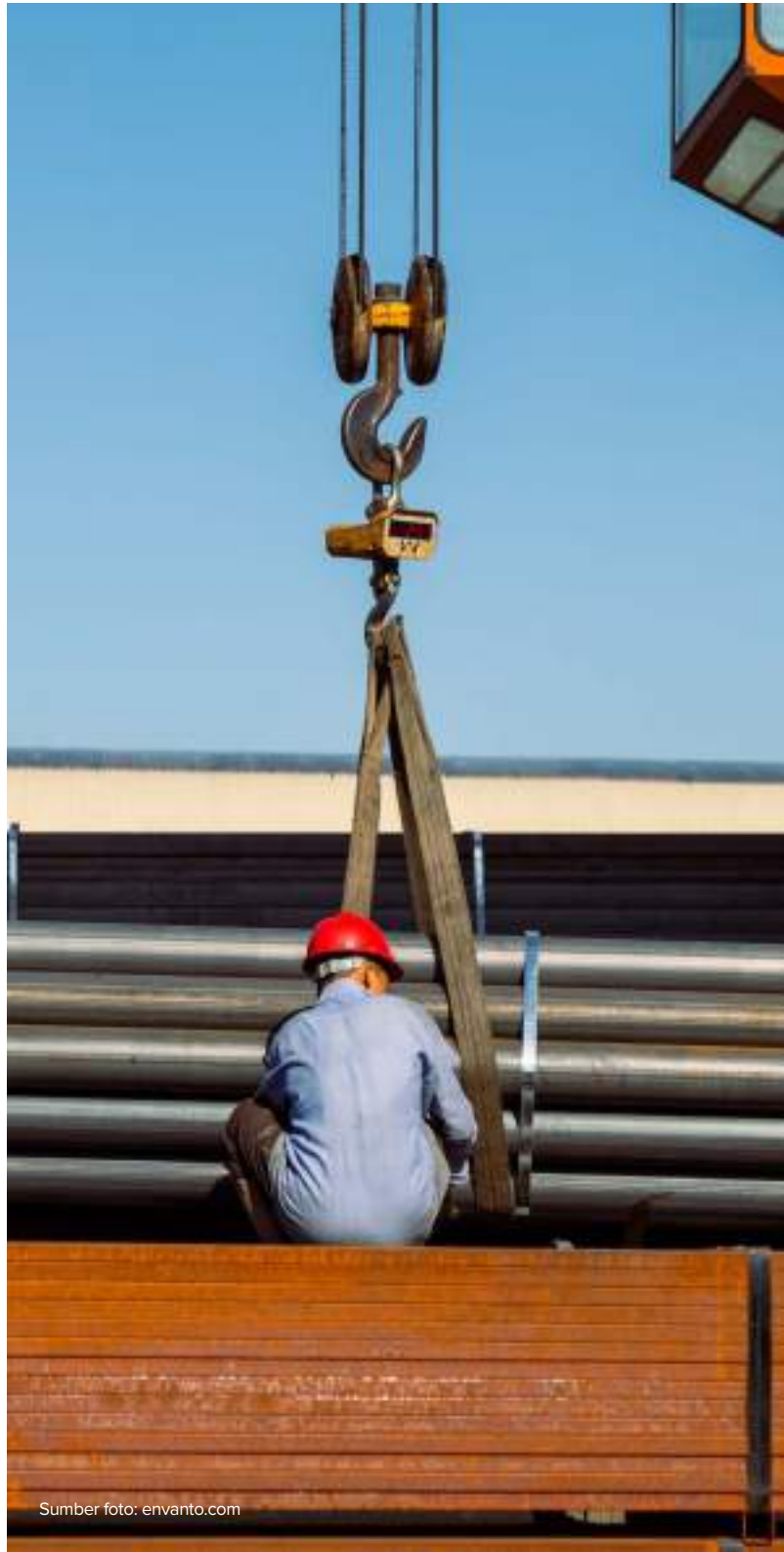
Photo: magnificent.com

The absence of this technical foundation not only increases the risk of greenwashing, but also hampers the shift in procurement paradigm from lowest price to most economically advantageous tender (MEAT) and long-term value for money. This is reflected in market realities where *“green products are not paid at a higher price”* (N10, IDI, 19 February 2026), indicating that environmental value is not yet internalized into procurement evaluation mechanisms.

From the implementor’s perspective, the Ministry of Public Works highlighted the technical and market implications if green product certification, such as SIH, were to be made mandatory, including concerns regarding bias toward local producers and the readiness of material quality. Nevertheless, in principle, the Ministry of PU expressed readiness to translate policy into sectoral technical guidelines, provided that clearer operational guidance is issued by LKPP. Without such guidance, the implementation of GPP in the construction sector risks miscoordination, given that the sector involves many ministries and actors with differing characteristics.

This weakness in the technical foundation is intertwined with the lack of institutionalization of the shift in policy focus from a lowest-price approach toward long-term sustainability value. Interview results indicate that the principles of 3R and MEAT have not yet been systematically mainstreamed in public procurement policy. Bappenas noted that in several countries, good GPP practices are supported by the establishment of procurement value thresholds or minimum spending quotas that must meet green criteria. In contrast, in Indonesia, such an approach remains voluntary and is not supported by mandatory provisions. This condition is

further reflected in industry perception that decarbonization currently *“does not create demand—it only clusters the market”* (N10, IDI, 19 February 2026), highlighting the disconnect between classification systems and actual procurement incentives.



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LKPP emphasized that the application of sustainability aspects in procurement packages still largely depends on the capacity and discretion of Commitment-Making Officials (PPK), Working Groups (Pokja), and procurement human resources (SDM PBJ) within each ministry/agency. From a technical standpoint, the Ministry of PU stressed that the limited availability of carbon emission measurement instruments and environmental efficiency tools constitutes a significant barrier to operationalizing the 3R and MEAT principles in practice. Without clear and standardized measurement tools, procurement officials lack a technical basis to assign evaluation weight to environmental benefit aspects. This situation explains why the shift in policy focus from lowest price to sustainability value remains at a conceptual stage and has not yet materialized in binding policy design.

Another key constraint lies in the limited development of supporting technical ecosystems, particularly in relation to low-carbon inputs such as scrap-based production, where *“scrap-based steel... still relies heavily on imports”* and requires domestic processing capacity to ensure quality (N10, IDI, 19 February 2026). This indicates that technical foundations are not limited to standards alone but also include supply chain readiness and material traceability, both of which are essential for credible green classification and Life Cycle Assessment (LCA) implementation.

In addition, stakeholders highlight technological transition challenges, noting that *“one of the key challenges is how to transform existing technologies into environmentally friendly technologies”* (N10, IDI, 19 February 2026). This suggests that, in the absence of clear technology-neutral emission thresholds or classification criteria, industries face

uncertainty regarding what qualifies as “green,” thereby weakening compliance incentives.

From the perspective of Institutional Theory, this condition reflects the weak manifestation of coercive pressures in the implementation of GPP. Regulations that recognize green procurement lose their binding force because they are not supported by a solid technical foundation and clear operational standards. Meanwhile, from the perspective of Market Failure Theory and Innovation Systems, the absence of technical tools such as LCC and LCA integrated into the procurement system hinders the evaluation of long-term environmental benefits. Without credible technical evidence, green products continue to be perceived as expensive and risky, thereby preventing the government from performing its strategic function as a market creator in driving green innovation.

Finally, the broader structural issue is the lack of an integrated technical framework that links standards, classification, and procurement systems. Without such integration, technical instruments remain fragmented and ineffective, as decarbonization itself *“is still at an early stage... the roadmap already exists, but implementation is still limited”* (N10, IDI, 19 February 2026).

Thus, Pillar 2 of GPP in Indonesia has not yet functioned as an operational foundation, but rather remains at a conceptual level. Strengthening emission-intensity-based classification, establishing mandatory standards integrated with the procurement system, and mainstreaming LCC/LCA are crucial prerequisites for GPP to function effectively as a demand-side innovation instrument that drives the transition toward a low-carbon and sustainable economy.

5.2.3. Pillar 3: Capacity development and human resources

The development of procurement human resource capacity is a primary prerequisite for GPP effectiveness. However, interview results show that capacity strengthening in the context of green procurement in Indonesia remains fragmented, voluntary, and highly dependent on individual or technical ministry initiatives. Although LKPP regulations have established the strategic roles of PA/KPA, PPK, and Working Groups in the procurement process, there is no mandatory, tiered, and nationally integrated GPP technical training obligation, particularly related to environmental criteria, the use of LCA, LCC, and MEAT. This institutional limitation is compounded by broader industrial

capacity constraints, where the transition toward green steel requires substantial capability upgrading and remains at an early stage, with decarbonization *“still at an early stage... the roadmap already exists, but implementation is still limited”* (N10, IDI, 19 February 2026) .

LKPP consistently emphasized that its institutional mandate is limited to regulating procurement methods and procedures, while technical and environmental substance is entirely delegated to budget users in each ministry/agency. This condition results in uneven competencies across ministries/agencies and between central and regional governments:

“ LKPP in principle does not regulate the technical specifications of products to be purchased, but focuses on procurement procedures and methods, such as the use of e-catalogues and auction mechanisms. The determination of criteria for certain materials, including mandatory commitments to use green iron or steel, depends entirely on the budget user.”

(N10, IDI, 19 February 2026)

The absence of a standardized professional training framework directly affects the low analytical capacity of procurement implementers in translating environmental criteria into procurement documents and processes. At the technical implementation level, such as within the Ministry of PUPR, the lack of training reinforces resistance among PPKs in applying green criteria. Concerns about potential audit findings, uncertainty regarding the quality of green materials,

limitations in ecolabel supply chains, and perceptions of higher prices reflect that existing training has not equipped PPKs with LCA/LCC-based capabilities to demonstrate the economic and technical value of green products. This perception is reinforced by industry realities where *“green products are not paid at a higher price”* (N10, IDI, 19 February 2026), making procurement actors more risk-averse in adopting sustainability criteria.

“*Green buildings currently calculate carbon only during the operational phase, not during the construction phase... that is what we are currently developing.*”

(N3, IDI, 24 November 2025)

From a policy planning perspective, Bappenas acknowledged that global practice shows the effectiveness of mandatory GPP policies—such as through tender value thresholds requiring green criteria. However, in Indonesia, such an approach remains voluntary and has not become a near-term capacity development priority. Consequently, the urgency of developing and implementing systematic and tiered green procurement training remains low, so GPP continues to be perceived as a normative initiative rather than a mandatory practice.

From an industrial perspective, one of the most critical capacity challenges lies in the technological transformation required to shift toward low-carbon production, where *“one of the key challenges is how to transform existing technologies into environmentally friendly technologies”* (N10, IDI, 19 February 2026). This reflects a broader issue of technical capability gaps, where existing production systems are not designed for decarbonization pathways such as hydrogen-based steelmaking or advanced electric arc furnace (EAF) technologies. The transition is therefore not incremental, but structural, requiring new knowledge, skills, and operational competencies.

This capacity gap is even more apparent at the local government level. The Ministry of Home Affairs and the Ministry of Environment noted that limited human resources cause GPP to be narrowly understood, even reduced merely to the

use of electric vehicles. In such conditions, the absence of simple guidelines, priority product lists, and contextual training modules makes it difficult for local governments to implement GPP more substantively:

“ **Zero Emission is being encouraged through official vehicles... some regions have indeed implemented it.** ”

(N6, IDI, 14 November 2025)

Closely linked to this is the limited readiness of supporting industrial ecosystems, particularly in the supply of low-carbon inputs. For instance, stakeholders highlight constraints in the domestic scrap industry, where *“scrap-based steel... still relies heavily on imports”* and requires domestic processing capacity to ensure quality (N10, IDI, 19 February 2026). This indicates that capacity gaps extend beyond individual firms to the broader industrial value chain, including material processing, quality control, and logistics systems required to support green production.

Although LCA and LCCA principles are recognized within industrial environmental policy—such as through the PROPER mechanism—this technical knowledge remains confined to environmental policy domains and has not been internalized as practical competence within general public procurement. The absence of cross-sector training modules bridging environmental

policy and procurement practice reinforces fragmentation of capacity among actors.

At the same time, stakeholders emphasize that capacity limitations are closely tied to the absence of enabling conditions, particularly in terms of incentives and market signals that would justify investment in skills and capability development. Industry actors stress that *“what is needed is simple: lower costs, market access, and price incentives”* (N10, IDI, 19 February 2026), highlighting that capacity development is structurally linked to economic viability rather than purely technical training.

On the supplier side, capacity development challenges are also evident. Interview results indicate that efforts to encourage suppliers to invest in green innovation are constrained by market uncertainty and weak demand signals from public procurement. Bappenas acknowledged that strengthening supplier capacity for

GPP has not yet become a policy priority, while LKPP's position is limited because procurement mechanisms often select contractors rather than directly purchasing materials. Consequently, demand for green products—such as green iron and steel—depends heavily on the technical design of sectoral ministries, particularly the Ministry of PU.

From a strategic perspective, stakeholders also highlight the lack of practical experience and benchmarking in accessing green financing and implementing decarbonization projects, where *“none of our members have successfully accessed funding”* (N10, IDI, 19 February 2026). This reflects a capacity gap in navigating financial instruments and international funding mechanisms, which are critical components of the global green transition. The absence of successful cases further limits knowledge diffusion and institutional learning.

The Ministry of PU emphasized that transitioning to green material production requires significant investment, while the voluntary nature of GPP policy exposes businesses to high investment risks. Concerns also arise regarding failed tenders if ecolabel or SIH requirements are made mandatory before producers

are ready, limiting supplier participation. This condition shows that the absence of technical assistance schemes and policy–industry readiness misalignment hampers supplier capacity enhancement within GPP. This risk perception is further reinforced by industry concerns that *“producers who move too quickly risk losing competitiveness”* if policy and market compensation are not aligned (N9, IDI, 20 February 2026).

Overall, the weakness of Pillar 3 creates buyer failure, where public buyers lack sufficient technical capacity, professional confidence, and learning frameworks to formulate sophisticated, long-term value-oriented demand. From an Institutional Theory perspective, policy pressure alone is insufficient without professionalization and capacity strengthening of implementers. From a Market Failure Theory perspective, minimal technical guidance and demand certainty discourage suppliers from investing in green innovation. Thus, human resource capacity development—on both the public buyer and supplier sides—is the key bridge between GPP policy targets and field implementation. Without tiered, contextual, and mandatory training, GPP will continue to be understood as normative guidance rather than a normal and effective procurement practice.

Photo: magnific.com

5.2.4. Pillar 4: Supplier selection strategy

Supplier selection strategy is a crucial point in GPP because at this stage the state's demand signal is directly translated into market decisions. However, interview results indicate that green supplier selection strategies in Indonesia have not yet functioned optimally as a demand-pull instrument. The absence of sectoral, simple, and cross-actor agreed GPP implementation guidelines causes environmental criteria to not be consistently internalized in supplier qualification and evaluation processes. As a result, supplier selection practices depend heavily on the individual capacity of procurement staff in each ministry/agency, thereby limiting GPP's potential as a market-creation instrument for green products. This condition is further shaped by market pressures, where Indonesia has become *“a major destination for steel exports because its trade protection is relatively weak”* (N9, IDI, 20 February 2026), reinforcing price-based competition in supplier selection.

In terms of specific criteria, findings show that no guideline explicitly establishes green material criteria, particularly for iron and steel, as supplier selection prerequisites. The absence of a leading sector to formulate and coordinate such criteria reinforces implementation fragmentation. From a procurement governance perspective, LKPP emphasized that construction procurement focuses more on selecting contractors rather than directly purchasing materials, so environmental criteria for green products fully depend on how budget users formulate technical specifications in procurement documents. Without clear guidance, environmental criteria are not systematically internalized

in qualification and supplier evaluation stages. This is compounded by the absence of market differentiation, where *“there is no differentiation between green and non-green steel”* (N10, IDI, 19 February 2026), limiting the incentive to embed such criteria in procurement.

This condition is reinforced by weak integration among existing standards and schemes. N7 highlighted that the Green Industry Standard (SIH), KLH ecolabel, and Ministry of Energy efficiency labels have not been positioned as a single operationally connected ecosystem within public procurement. Although substantively products meeting SIH or ecolabel standards can be categorized as green products, such recognition does not automatically provide added value in bidding processes, as *“green products are not paid at a higher price”* (N10, IDI, 19 February 2026). Limited sectoral coverage and the absence of automatic compliance mechanisms prevent optimal utilization of existing standards.

A primary issue is the dominance of low-cost imports, which undermines the ability of domestic suppliers—especially those transitioning toward greener production—to compete within procurement systems. This includes the penetration of imported finished products at very low prices that *“come ready to install”* (N9, IDI, 20 February 2026), reflecting a procurement environment where supplier selection is indirectly shaped by global price competition rather than structured evaluation criteria incorporating environmental performance or long-term value.

Regarding life-cycle-based evaluation tools, traceability of environmental impacts through LCA remains at an early stage and has not become standard practice in supplier selection. From a policy planning perspective, Bappenas has not prioritized LCA usage nationally and still positions it as voluntary. Meanwhile, LKPP reiterated that its mandate is limited to procurement methods and systems, while LCA technical substance and specification formulation are delegated to technical ministries. At the sectoral implementation level, the Ministry of PUPR described real challenges in applying LCA due to limited data, methodology, and technical capacity. Currently, emission calculations are mostly conducted at pre-construction or operational phases, even though the construction phase contributes significant environmental impacts but is not fully integrated into procurement evaluation.

Relatedly, stakeholders emphasize that existing procurement and trade governance systems lack effective filtering mechanisms, allowing imports to enter the domestic market with minimal scrutiny, where imports *“go straight into the kitchen”* without filtering (N9, IDI, 20 February 2026). This metaphor highlights the absence of a tiered supplier qualification system, where products and suppliers should ideally be screened

based on compliance with technical, environmental, and economic criteria before entering procurement processes.

On the other hand, the Ministry of Environment embeds LCA more strongly within environmental policy through the PROPER mechanism, where LCA preparation forms part of business environmental performance assessment. However, the linkage between LCA obligations in environmental policy and supplier selection processes in public procurement remains weak and not systematically connected. Thus, although LCA principles are normatively recognized, environmental impact traceability has not been optimally utilized as a binding evaluation tool in supplier selection strategies.

In addition, weak enforcement and regulatory loopholes further distort supplier selection outcomes, where imports may evade compliance, including tax obligations (KADIN), and mechanisms such as the master list allow even finished goods to enter with zero import duties (KADIN). Such conditions create an uneven playing field, where domestic suppliers are disadvantaged not only by cost structures but also by inconsistent regulatory enforcement, ultimately discouraging investment in green production.

The accumulation of weaknesses in specific criteria and evaluation tools prevents supplier selection strategies from functioning as effective demand-pull mechanisms. In this context, the Ministry of Industry firmly emphasized that recognition

of green certification must be positioned as a selection criterion rather than merely an additional attribute, in order to create economic incentives for industry to invest in green innovation:

“If SIH is only an additional attribute, industry has no strong incentive to invest.”

(N4, IDI, 5 January 2026)

Furthermore, stakeholders highlight the need for stronger domestic supplier prioritization mechanisms, particularly in public infrastructure and strategic projects, where national strategic projects *“should prioritize domestic producers”* (N9, IDI, 20 February 2026), ensuring that procurement supports domestic capacity building while gradually integrating green criteria.

From a strategic standpoint, stakeholders also call for more assertive trade remedies and protective measures to rebalance supplier competition, emphasizing the need for *“stronger safeguard and trade remedy instruments”* (N9, IDI, 20 February 2026). Such measures are seen as essential to create a level playing field, particularly in the early stages of the green transition, where domestic producers face higher costs.

Finally, the findings point to the need for a more structured and transparent supplier selection framework, supported by improved governance and verification mechanisms, including the need for

verification of domestic production capacity before allowing imports (N9, IDI, 20 February 2026). This suggests that supplier selection should be based on data-driven assessment of capacity, compliance, and environmental performance, rather than ad hoc or price-driven decisions.

The main challenge of Pillar 4 lies in the absence of explicit, cross-sectoral, and binding integration of environmental criteria in supplier qualification and selection processes. From a market failure theory perspective, this explains why green supplier selection in Indonesia has not generated sufficiently strong demand signals to encourage supplier investment in green innovation. Meanwhile, from an institutional theory framework, weak legal mandates and the absence of green procurement quotas or thresholds reflect low coercive pressure on procurement actors and industry. Without clear and integrated policy certainty, GPP fails to function as a transformational instrument linking procurement policy with industrial decarbonization objectives simultaneously.



Photo: magnific.com

5.2.5. Pillar 5: Demand-side innovation

Many stakeholders view government purchasing power as the main lever for creating demand for green products. In the macro policy context, the RPJMN and circular economy roadmap recognize public procurement as a supporting instrument for transition toward a low-carbon economy. However, interview results indicate that this normative recognition has not been translated into clear and binding green demand targets at the procurement level. As a result, Indonesia's public spending has not fully functioned as a demand-side innovation instrument, because existing policy signals are not yet strong enough to shape long-term market expectations. This is reflected in industry perceptions that *“there is no market for green steel in Indonesia”* (N10, IDI, 19 February 2026), indicating the absence of a domestically anchored demand base.

From a planning perspective, Bappenas views procurement policy as an instrument to encourage upstream adjustments, particularly in production standards, green certification, and emission reduction. However, these incentives have not been comprehensively operationalized

by each ministry/agency in the form of spending commitments or green procurement quotas. At the policy and implementation level, LKPP indicated that strengthening the demand side has begun through socialization, pilot projects, and roadmap preparation. Nevertheless, this process remains at an early stage and has not generated sufficient demand volume to broadly alter market behavior, consistent with the observation that public procurement is not yet willing to absorb price premiums, as *“there isn't”* willingness to pay 10% more for green steel (N10, IDI, 19 February 2026).

This limited strength of demand signals was confirmed by the Ministry of PUPR, which emphasized that businesses are fundamentally ready to transition toward green production if there is certainty of absorption through public procurement. Without such guarantees, investment risk—particularly in capital-intensive sectors such as iron and steel—is perceived as too high, especially in a market context where *“green products are not paid at a higher price”* (N10, IDI, 19 February 2026).

“Industry is basically ready. But if there is no guarantee of absorption through procurement, the risk is too large.”

(Ministry of PU, IDI, 24 November 2025)

From a fiscal governance perspective, the Ministry of Home Affairs highlighted limited fiscal space of local governments due to budget efficiency pressures and high personnel expenditure. This condition limits local governments' ability to actively use public spending as a green market-creation instrument. Meanwhile, N7 and other non-government actors noted that demand signals for products such as green iron and steel are beginning to emerge, but remain fragmented and insufficiently consolidated to form a stable and certain market. This fragmentation is further reinforced by the absence of price differentiation, where *“there is no differentiation between green and non-green steel in the market”* (N10, IDI, 19 February 2026).

Overall, demand-side innovation through government spending remains at an early stage. Public purchasing power has not been effectively utilized to reduce the commercial risks faced by businesses investing in green innovation. Although policy signals and discourse on green procurement transition exist, industry does not yet perceive public spending as a credible and sustained demand signal. For capital-intensive sectors, certainty of volume and continuity of orders is a primary prerequisite before undertaking

technological transformation. This is consistent with stakeholder views that *“what is needed is simple: lower costs, market access, and price incentives”* (N10, IDI, 19 February 2026), highlighting the importance of predictable demand and economic viability.

Importantly, stakeholders challenge the assumption that decarbonization alone can generate demand, emphasizing instead that *“decarbonization does not create demand—it only clusters the market”* (N10, IDI, 19 February 2026). This insight highlights a fundamental limitation: without policy-driven demand creation, green products will not gain market share regardless of technological readiness.

From a macroeconomic perspective, demand for steel in Indonesia is also highly dependent on government spending, particularly infrastructure investment, where declining infrastructure budgets directly reduce steel absorption capacity, as stakeholders note that infrastructure spending reductions *“directly affect steel demand”* (N10, IDI, 19 February 2026). This suggests that public expenditure is a key lever for demand-side innovation, yet it is not currently aligned with green procurement objectives.

From a strategic standpoint, KADIN highlights the critical role of government intervention in creating demand and reducing investment risk, emphasizing that *“the government’s role is vital as an anchor of transformation”* (N9, IDI, 20 February 2026), particularly because “the transition cannot be left to market mechanisms alone” (N9, IDI, 20 February 2026). This underscores the need for active state intervention in the early stages of market formation.

Furthermore, stakeholders propose concrete demand-side policy instruments, including mandatory procurement and market guarantees, where green procurement *“should mandate the use of green steel in strategic national projects”* (N9, IDI, 20 February 2026) and where mechanisms such as green premiums are needed to ensure viable returns on investment (N9, IDI, 20 February 2026). These recommendations reflect a shift toward state-led market creation, where

public procurement is used to de-risk investment and accelerate adoption.

Finally, stakeholders emphasize that demand-side innovation must be complemented by broader industrial policy measures, including protection against carbon leakage and alignment with global market trends, highlighting the need for *“protective trade instruments”* to prevent low-cost imports from undermining domestic industry (N9, IDI, 20 February 2026).

Thus, the weak function of GPP as a demand-side innovation instrument reflects a lost strategic opportunity for the state to leverage its purchasing power in shaping a green market ecosystem. Without translating macro policy targets into clear, measurable, and long-term demand commitments, public spending will continue to fail in performing its role as a market creator driving innovation and industrial transition toward a low-carbon economy.

Photo: envanto.com

Table 16. Policy Gaps on GPP Based on Five Pillars

GPP Pillar	Ideal Function within the GPP Framework	Key Findings in Indonesia	Implications for Green Iron & Steel
Pillar 1: Policy and Legal Framework	Provides a binding legal mandate, clarity of actors' roles, and cross-ministry/agency and central–local orchestration	The legal framework exists normatively but remains flexible and voluntary; there is no leading sector; absence of an operational mandate and incentives directly linked to procurement	GPP has not created a credible demand signal for the iron and steel industry; industry is reluctant to invest due to the absence of market certainty
Pillar 2: Technical Foundation and Green Classification	Establishes product classification based on measurable and verifiable environmental performance	No emission-intensity-based classification for iron and steel is available; ecolabel and Green Industry Standard have not been integrated into the procurement system; high risk of greenwashing	Low-carbon steel products are difficult to distinguish from conventional steel in tenders; green claims cannot be used as a basis for technical evaluation
Pillar 3: Capacity Development and Human Resources	Enhances the capacity of procurement actors and suppliers to consistently apply LCA, LCC, and MEAT	GPP training is voluntary and not tiered; limited capacity of PPK and Working Groups (Pokja); high audit risk concerns; understanding of GPP is often narrowly reduced	Procurement officials are reluctant to include green steel criteria; green products are perceived as expensive and administratively risky
Pillar 4: Supplier Selection Strategy	Integrates environmental criteria as prerequisites and determining factors in supplier selection and evaluation	Supplier selection is still dominated by the lowest-price paradigm; green certification is only an additional attribute; LCA/LCC are not used systemically	No economic incentive for steel producers to meet green standards; low-carbon technology investment is not rewarded in tenders
Pillar 5: Demand-Side Innovation	Uses public spending to create early markets (anchor demand) and reduce investment risk	No green demand targets or long-term purchasing commitments; demand is fragmented across ministries/agencies and regions; limited fiscal space at the local level	Public spending fails to function as a market creator; industry does not view government procurement as a reliable source of demand for green steel

Source: In-depth IDI with LKPP, Bappenas, Ministry of PUPR, Ministry of Industry, Ministry of Environment, Ministry of Home Affairs, and a think-tank organization (2025–2026); authors' analysis.

CHAPTER 6

GREEN PUBLIC PROCUREMENT PRACTICES IN CANADA AND INDIA



Photo: canadiansteel.ca

6.1. GPP in Canada

6.1.1. Profile of the Canadian Steel Industry

The Canadian steel industry is one of the strategic industrial sectors that supports the development of public infrastructure, construction, automotive, energy, and national manufacturing. Based on data from the Canadian Steel Producers Association (CSPA), Canada produces approximately 13 million tons of primary steel per year, as well as more than 1 million tons of steel pipe and tube products, with production facilities distributed across various regions of the country (Canadian Steel Producers Association [CSPA], 2023). The industry directly employs around 23,000 workers and supports more than 100,000 indirect jobs throughout its supply chain (CSPA, 2023).

From the consumption side, steel in Canada is primarily absorbed by public infrastructure and construction projects, the automotive sector, energy (including renewable energy), and general manufacturing. The government's position as a major steel purchaser—particularly through infrastructure projects—makes the public procurement sector a strategic instrument for shaping anchor demand

in the national steel market (International Institute for Sustainable Development [IISD], 2022).

Although Canada has significant domestic production capacity, it still relies on imports to meet part of its national steel demand. IISD policy modeling indicates that approximately 18% of Canada's steel needs are met through imports, mainly from the United States and other countries with relatively higher production emission intensities (IISD, 2022). This condition strengthens the policy argument that import substitution through sustainable public procurement can provide dual benefits, namely emission reductions and strengthening of domestic industry.

A structural advantage of the Canadian steel industry also lies in its contribution to the circular economy. Steel is a material that is 100% recyclable without losing its mechanical properties, and a significant proportion of Canada's steel production is based on the use of recycled scrap, which substantially reduces greenhouse gas emissions throughout the product life

cycle (CSPA, 2023). Thus, on average, steel produced in Canada has lower emission intensity compared to imported steel,

especially that originating from countries with fossil fuel-intensive energy mixes (IISD, 2022).

6.1.2. Canadian GPP Practices

GPP practices in Canada are not implemented as a single sectoral policy, but rather as part of an integrated policy architecture that connects public procurement, climate policy, and national industrial strategy. The Government of Canada explicitly positions GPP as an instrument to address demand-side market failure (buyer failure), particularly for low-carbon products that are technologically available but not yet price-competitive (IISD, 2022).

The IISD report emphasizes that GPP in Canada has been implemented through the integration of sustainability criteria and life-cycle-based approaches in the procurement of buildings, infrastructure, cement, and steel. In the steel sector, this approach is realized through the use of life-cycle costing (LCC), consideration of energy efficiency in production processes, and preference for lower-carbon domestic steel in strategic public projects (IISD, 2022).

Quantitatively, IISD policy modeling shows that sustainable public procurement scenarios can generate significant greenhouse gas emission reductions, while simultaneously improving the economic performance of the steel sector in the medium to long term. The sustainable plus domestic production scenario even demonstrates the potential for increased industry revenues and job creation, despite higher initial production costs resulting from stricter sustainability standards (IISD, 2022). These findings reinforce the argument that GPP can function as an industrial transition instrument, not merely an environmental policy.

From the industry perspective, the CSPA has declared an aspirational commitment to achieve net-zero CO₂ emissions by 2050. The decarbonization roadmap of Canada's steel industry emphasizes five main pillars:

- (i) development and adoption of breakthrough technologies such as hydrogen, process electrification, and carbon capture;
- (ii) improvement of operational efficiency based on advanced technologies;
- (iii) utilization of low-carbon electricity from Canada's energy grid;
- (iv) strengthening of circular economy practices; and
- (v) public procurement policies that explicitly recognize the carbon advantage of Canadian domestic steel (CSPA, 2023).

Photo: canadiansteel.ca

Within this framework, GPP is positioned as a crucial demand-pull policy to reduce investment risk in low-carbon technologies. The CSPA explicitly calls for public procurement policies—both at the federal and provincial levels—to be used to provide preference for low-carbon domestic steel, while simultaneously preventing carbon leakage through the entry of imported steel with looser emission standards (CSPA, 2023). This approach is also linked to discussions on carbon burden equality in international trade, including the exploration of carbon border adjustment mechanisms.

Thus, GPP practices in Canada demonstrate that public procurement is treated not merely as an administrative function, but as a strategic tool for industrial transformation, simultaneously pursuing decarbonization goals, national industrial competitiveness, and long-term economic value creation.

These findings are reinforced by interview results with Shivakumar N8 (Director of Development and Innovation, ResponsibleSteel), who provided direct insight into GPP practices in Canada. He

emphasized that the role of the Canadian government as an institutional buyer is highly significant, with approximately 25% of national steel demand originating from government projects, particularly large-scale public infrastructure and construction projects (N8, IDI, 2026).

N8 also confirmed that Canada has implemented embodied carbon standards for high-value public construction projects, including requirements for approximately 30% reduction in embodied carbon emissions for structural steel and reinforcing steel. These standards have been applied gradually since 2022 and are periodically updated to expand material coverage and tighten emission thresholds (N8, IDI, 2026).

In this context, GPP functions not only as a procurement selection instrument but also as a mechanism to create long-term demand certainty for the low-carbon steel industry. As stated by N8, *“these standards provide long-term certainty for the industry to begin investing in low-carbon steel technologies, because they know that public demand will continue to exist”* (N8, IDI, 2026).



Photo: canadiansteel.ca

6.1.3. Structural Asymmetry: Market-Selection vs Technology-Transition Contexts

Canada's steel industry operates with a structurally low-carbon baseline, where approximately 70% of production is based on scrap recycling through EAF technology. As a result, Green Public Procurement (GPP) in Canada primarily functions as a market-selection mechanism, where procurement policies differentiate between relatively low-carbon products and reinforce the competitiveness of already decarbonized production pathways.

In contrast, Indonesia's steel industry remains dominated by primary steel production via BF–BOF, accounting for the majority of emissions-intensive output. This creates a fundamentally different policy challenge. Rather than selecting among existing low-carbon alternatives, Indonesia must use GPP as a technology-transition instrument to stimulate the emergence and scaling of low-carbon production pathways—such as scrap-based EAF and hydrogen-based DRI.

This distinction has important implications. In a market-selection context (Canada), GPP operates by:

- **Rewarding existing low-carbon producers**
- **Differentiating products based on marginal emission differences**
- **Reinforcing competitiveness of domestic industry**

Whereas in a technology-transition context (Indonesia), GPP must:

- **Create initial demand for technologies not yet widely deployed**
- **Support capital-intensive industrial transformation**
- **Reduce first-mover investment risk**
- **Enable structural shifts in production pathways**

Therefore, the transferability of Canadian lessons is inherently limited if interpreted as direct policy replication. Instead, the Canadian case should be understood as illustrating the end-state of a mature GPP system, while Indonesia's challenge lies in designing GPP as a transition-enabling policy mix.

This interpretation aligns with the findings in Chapter 4, where decarbonization pathways such as scrap-based EAF and hydrogen-based DRI require substantial structural transformation of Indonesia's

industrial base. In this context, GPP must go beyond product-level selection and function as a strategic instrument to induce technological change at the production level.

However, it is important to note that the effectiveness of this approach is partly conditioned by Canada's existing industrial structure, where low-carbon production pathways are already dominant, reducing the transition burden compared to countries such as Indonesia.

6.2. GPP in India

6.2.1. Profile of the Indian Steel Industry

India is the world's second-largest steel producer, and the steel sector plays a strategic role in national economic development. The iron and steel industry contributes approximately 2.5% to India's Gross Domestic Product (GDP) and provides employment to more than 2.5 million people, both directly and indirectly (JMK Research & Analytics, 2024). In fiscal year 2023–2024, India's crude steel production reached approximately 144.3 million tons, while finished steel production was recorded at 138.5 million tons (JMK Research & Analytics, 2024).

From the consumption perspective, steel is a key input for the construction and infrastructure sector, which absorbs nearly 70% of total national steel consumption, followed by manufacturing, automotive, and engineering sectors (RMI, 2024). Domestic steel consumption in FY2024 reached approximately 135.9 million tons, in line with the Indian government's large-scale infrastructure development agenda (JMK Research & Analytics, 2024). Nevertheless, India's per capita steel consumption remains relatively low, at

approximately 81 kg per capita, far below the global average, indicating long-term demand growth potential (JMK Research & Analytics, 2024).

India is also actively integrated into global steel trade. In FY2024, India exported approximately 7.46 million tons of finished steel, with European countries such as Italy, Belgium, and Spain as major destinations. On the other hand, finished steel imports reached approximately 8.3 million tons, with nearly 80% of imports originating from China, South Korea, and Japan (JMK Research & Analytics, 2024). This partial dependence on imports, particularly for certain steel products, constitutes an important consideration in formulating public procurement policies oriented toward strengthening domestic production while simultaneously reducing emissions.

From an environmental perspective, the steel sector is one of the largest emission contributors in India. In FY2023, the sector generated approximately 357 million tons of CO₂, equivalent to 13–14%



Photo: manufacturingtodayindia.com

of total national carbon emissions, with an average emission intensity of around 2.55 tCO₂ per ton of crude steel, higher than the global average (JMK Research

& Analytics, 2024). This emission profile makes the steel industry a priority sector in the national decarbonization agenda and GPP policy.

6.2.2. Indian GPP Practices



Unlike Canada, India does not yet have a comprehensive and binding national GPP policy. However, various policy initiatives and procurement instruments have gradually and sectorally developed, forming an initial foundation for GPP implementation, including for strategic materials such as steel (IISD, 2024).

From the procurement policy framework perspective, the General Financial Rules (GFR) 2017 and various procurement manuals provide a legal basis for integrating value for money principles, life-cycle costing (LCC), and environmental considerations into public procurement. Although not explicitly mandating GPP, these regulations create space for the application of environmental criteria and life-cycle costs in government tenders (IISD, 2024). In addition, the Government of India has developed the Government e-Marketplace (GeM) platform, which gradually integrates sustainability criteria

and environmental labels for certain products.

In the steel industry context, an important development occurred through the launch of the Green Steel Taxonomy for India by the Ministry of Steel in 2024. This taxonomy defines green steel based on CO₂ equivalent emission intensity per ton of finished steel, with a primary threshold of 2.2 tCO₂/tfs, as well as a star rating system to classify the level of greenness of steel (Ministry of Steel, 2024). The taxonomy is designed as a common language to distinguish low-carbon steel from

conventional steel, as well as a prerequisite for public procurement, financial support, and other policy incentives.

A critical analytical implication of India's Green Steel Taxonomy emerges when benchmarked against Indonesia's emission profile. The taxonomy defines green steel using a threshold of approximately 2.2 tCO₂ per ton of finished steel, which serves as the baseline for classification. However, as shown in Chapter 4 (Table 12), Indonesia's current Business-as-Usual (BAU) emission intensity is already approximately 1.46 tCO₂ per ton, significantly below India's baseline threshold.

Furthermore, under a scrap-based Electric Arc Furnace (EAF) scenario, Indonesian steel plants such as Krakatau Steel can achieve emission intensities of approximately 0.38 tCO₂ per ton, which would qualify not only as "green" under India's taxonomy but likely fall within its highest performance tier.

This comparison reveals that adopting India's taxonomy threshold without adjustment would result in limited differentiation between conventional and low-carbon steel in Indonesia, thereby weakening its effectiveness as a policy instrument. Instead of driving decarbonization, such a threshold risks labeling a large portion of existing production as already "green," reducing the incentive for further technological transition.

Therefore, Indonesia requires a more ambitious and context-specific emission classification, calibrated to its national decarbonization targets and technological pathways. This reinforces the argument that taxonomy design must be aligned not only with international benchmarks but also with domestic emission baselines and transition objectives.

In addition, India is actively engaged in the international heavy industry decarbonization agenda, including through its leadership in the Industrial Deep Decarbonisation Initiative (IDDI). Through IDDI, India positions public procurement as a strategic instrument to create early demand (demand creation) for low-carbon materials such as steel and cement, particularly in large-scale public infrastructure projects (RMI, 2024).

Several policy studies indicate that GPP in India is positioned as a demand-side innovation policy aimed at addressing buyer failure and investment risks in low-carbon technologies. RMI analysis estimates that the implementation of a moderate GPP scenario—for example, a 25% emission intensity reduction—could significantly reduce emissions from construction materials with a relatively limited green premium, approximately 2–8% for steel, thus remaining within a range affordable for public expenditure (RMI, 2024).

Nevertheless, the IISD report emphasizes that GPP implementation in India still faces various structural challenges, including the absence of a strong legal mandate, limited capacity of procurement actors, limited availability of green steel products in the domestic market, and weak monitoring and evaluation systems (IISD, 2024). Therefore, GPP policy in India currently remains incremental and experimental in nature, focusing on taxonomy development, pilot projects, and policy learning before moving toward a more binding and nationally scaled implementation.

This interpretation is reinforced by N8, who emphasized that to date India does not yet have a binding GPP policy for the steel sector, although it has developed the Green Steel Taxonomy as an initial technical foundation (N8, IDI, 2026).

According to N8, India's green steel taxonomy—with its emission intensity threshold-based classification—functions more as a market preparation instrument rather than an operational procurement policy. He stated that the policy remains at the discussion stage for elevation into formal regulation in the coming years (N8, personal interview, 2026).

In this context, the main limitation of GPP implementation in India is the absence of long-term demand visibility from the government. As stated by N8, *“without long-term demand visibility from the government, the industry will not dare to invest at the scale required for decarbonization”* (N8, IDI, 2026).

Photo: magnific.com

Table 17. Differences in GPP Approaches in Canada and India

Comparison Aspect	Canada	India	Learning Implications for Indonesia
Status of GPP Policy	Relatively mature and integrated with climate policy and industrial strategy	Incremental and sectoral; no binding national GPP policy yet	Indonesia needs to move beyond a voluntary approach toward a selective and operational mandate
Position of GPP in Public Policy	Strategic instrument for market creation and investment de-risking	Market-enabling instrument (market preparation)	GPP must be positioned as a market-creating tool, not merely administrative compliance
Approach to Green Steel	Embodied carbon standards applied in high-value public projects ($\pm 30\%$ reduction)	Green Steel Taxonomy based on emission intensity thresholds and star rating	Combination of performance standards (Canada) + taxonomy (India) is relevant for the Indonesian context
Strength of Public Demand Signal	Strong and credible; $\pm 25\%$ of steel demand originates from government projects	Weak and inconsistent; no long-term public purchasing commitment yet	Certainty of demand volume and duration is key to driving industrial investment
Integration with Industrial Policy	Very strong; GPP aligned with the national steel decarbonization roadmap	Emerging; linkage between taxonomy and procurement still limited	Harmonization of procurement–industry–climate policies needs to be explicitly orchestrated
Technical Instruments Used	LCA and LCC institutionalized in public construction procurement	Green steel taxonomy as an initial common language	Indonesia needs a ready-to-use technical foundation within the procurement system
Implementation Approach	Gradual but binding for strategic projects	Pilot projects and policy learning	Gradual implementation reduces market risk and actor resistance
Impact on Industry	Reduces investment risk for low-carbon technologies; encourages adoption	Impact still limited to discourse and early-stage industry readiness	Without a demand signal, industry tends to delay investment

Comparison Aspect	Canada	India	Learning Implications for Indonesia
Main Weakness	Potential increase in initial costs and fiscal resistance	Absence of legal mandate and demand visibility	Policy design must balance climate ambition and fiscal capacity
Key Lesson	Procurement mandate + demand certainty = market transformation	Taxonomy is important but insufficient without procurement	Indonesia needs to combine demand certainty with a solid technical foundation

Source: Case study analysis based on IISD (2022; 2024), RMI (2024), Ministry of Steel India (2024), and stakeholder IDI (2025–2026).

CHAPTER 7

STRATEGIC DIRECTION TO INTEGRATE GREEN STEEL INTO PUBLIC PROCUREMENT

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7.1.

Pillar 1: From Normative Recognition to Operational Mandate

Strengthening Pillar 1 is focused on closing the policy gaps identified in Section 5.2.1, namely the weak operational mandate, the absence of a leading sector, and the lack of integrated incentives and enforcement mechanisms within Indonesia's GPP framework. Interview findings and lessons learned from the case studies of Canada and India show that the success of GPP as a demand-side innovation instrument depends heavily on the clarity of legal mandates, cross-sectoral orchestration, and the consistency of demand signals from the state.

First, strengthening an operational and binding legal mandate. Interview results indicate that sustainable procurement regulations in Indonesia are normatively available, but they use flexible formulations such as the phrase “and/or,” which weakens coercive pressure on procurement implementers (N1, interview, 2025). To address this gap, strengthening derivative regulations is required to explicitly mandate the integration of environmental criteria in certain procurement categories with high emission impacts, including iron and steel. Lessons from Canada show that legal mandates do not always appear in

a single dedicated law but are realized through binding operational standards in high-value public projects, such as the requirement to reduce embodied carbon by approximately 30% in structural steel and reinforcing steel since 2022 (IISD, 2022; N8, interview, 2026). This approach provides legal certainty while maintaining flexibility for gradual implementation.

Meanwhile, India's experience demonstrates the limitations of relying solely on voluntary policies. Although India has developed a Green Steel Taxonomy based on emission intensity thresholds, the absence of a binding procurement mandate makes the taxonomy function more as a market preparation instrument rather than a driver of real demand (Ministry of Steel, 2024; IISD, 2024). This confirms that Indonesia needs to move beyond a voluntary approach toward measurable selective obligations.

Second, the appointment of a leading sector and coordination mechanisms across ministries/agencies and between central–regional governments. Cross-ministerial IDI confirm a pattern of mutual waiting due to the absence of a national

lead institution for GPP. This condition hampers the integration of industrial, climate, and procurement policies (N5; N1; N3; N6, IDI 2025, 2026). Lessons from Canada show the importance of policy orchestration, where public procurement is positioned in alignment with industrial decarbonization strategies and climate policies, so that procurement standards, industrial roadmaps, and emission targets reinforce each other (IISD, 2022; CSPA, 2023).

Based on this, Pillar 1's strategy in Indonesia needs to include the designation of a coordinating institution—such as through a presidential decree—with authority to coordinate cross-sectoral GPP, set priority materials (including iron and steel), and ensure consistency of implementation at central and regional levels. Without a clear steering structure, GPP will continue to operate partially.

Third, harmonization of procurement regulations with industrial and climate policies. The policy gap identified in Section 5.2.1 shows that various instruments—such as the Green Industry Standard, PROPER, and fiscal incentives—are not yet directly linked to the procurement system. The Canadian case study demonstrates that procurement preferences for low-carbon domestic steel are designed simultaneously to reduce carbon leakage and strengthen national industrial competitiveness (CSPA, 2023). In India, although procurement mandates

are not yet strong, the linkage between the green steel taxonomy, the Industrial Deep Decarbonisation Initiative (IDDI), and public procurement discourse is beginning to form an integrated policy framework (RMI, 2024). Thus, Indonesia needs to harmonize procurement regulations with green industrial policy and national climate targets, so that industrial certification or environmental performance does not stop at administrative recognition but becomes the basis for real preference in government spending.

Fourth, integrating incentives directly linked to procurement. IDI show that GPP practices in Indonesia remain voluntary and are not supported by incentives directly connected to the procurement system (N3; N7, IDI 2025). Lessons from Canada emphasize that certainty of public demand is the strongest incentive for industry to invest in low-carbon technologies because it reduces long-term market risk (IISD, 2022). Conversely, India's experience shows that without long-term demand visibility, industry tends to delay investment even if a taxonomy framework is available (N8, interview, 2026). Therefore, Pillar 1 needs to link green procurement with existing fiscal and non-fiscal incentive schemes—such as tender prioritization, evaluation weighting, or easier access to financing—alongside disincentive mechanisms for procurement that ignores sustainability criteria in priority sectors.

Strengthening Pillar 1 requires a shift from normative recognition toward a binding operational mandate, supported by institutional orchestration, policy harmonization, and incentives directly linked to public spending. Lessons from Canada show the effectiveness of a gradual and measurable mandatory approach, while India's experience serves as a reminder that without legal pressure and clear demand signals, GPP will struggle to function as a market-creation instrument. Integrating these lessons into the Indonesian context is a prerequisite for GPP to truly drive the systemic and sustainable decarbonization of the iron and steel industry.

7.2.

Pillar 2: Building a Technical Foundation and Emission Classification

Strengthening Pillar 2 is directed at addressing the gap identified in Section 5.2.2, namely the absence of a standardized, integrated, and operational technical foundation to mainstream GPP, particularly for iron and steel materials. Interview findings and lessons from Canada and India show that without clear green classification, traceable measurement tools, and technical standards recognized within the procurement system, GPP will remain at a normative level and be vulnerable to greenwashing.

First, developing sector-specific green classification based on emission intensity.

Interview results show that Indonesia does not yet have a goods/services classification based on emission intensity that can be directly used in procurement documents, especially for the iron and steel sector. Existing instruments—such as the Ministry of Environment’s Ecolabel and the Ministry of Industry’s Green Industry Standard (SIH)—remain general, are not directly linked to emission thresholds, and are not integrated into LKPP’s e-procurement system (N1; N4, IDI 2025–2026).

Lessons from India show the relevance of developing a Green Steel Taxonomy that classifies steel based on CO₂ emission intensity per ton of steel and is complemented by a star rating system (Ministry of Steel of India, 2024). Although not yet mandatory in procurement, this taxonomy provides a common language among government, industry, and financial institutions. Meanwhile, Canada does not use a single formal national taxonomy but applies embodied carbon standards based on emission reduction thresholds (around 30%) in large public projects, which functionally act as an operational green classification (IISD, 2022; N8, interview,



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2026). Based on these lessons, Indonesia needs to develop a green iron and steel classification based on emission intensity (for example, near-zero, low-emission, and conventional steel) aligned with domestic technological conditions and national decarbonization targets. This classification must be designed from the outset to be compatible with LKPP’s procurement system and usable as a basis for technical evaluation.

Second, technical standardization and integration of credible verification instruments. The main gap in Pillar 2 lies in the lack of integration of standards and verification instruments such as LCA, LCC, and Environmental Product Declaration (EPD) into procurement practice. Without credible measurement, reporting, and verification (MRV), green product claims are difficult to justify in the tender process (N4, interview 2026). On the other hand, the Ministry of Public Works highlighted limitations in data, methodology, and technical capacity as major barriers to implementing LCA in construction procurement (N3, interview 2025).

The Canadian case study shows that the use of LCA and LCC approaches has been gradually institutionalized in public building and infrastructure procurement, allowing environmental aspects to be assessed objectively and auditable (IISD, 2022). In India, although LCA is not yet mandatory in procurement, policy discourse through IDDI and the green steel taxonomy is beginning to drive the need for standardized emission data as a prerequisite for policy support and financing (RMI, 2024). For Indonesia, Pillar 2's strategy needs to position LCA/ LCC and EPD as key technical instruments recognized in iron and steel procurement, using a gradual approach. In the initial stage, recognition can be given to established international standards (ISO 14040/44, ISO 14404, EPD) before developing more contextual national standards.

Third, integrating the technical foundation into the national procurement system. Information related to green labels in the current e-catalogue remains descriptive and is not used as a binding evaluation

basis (N1, interview 2025). This condition causes available standards to fail as market signals. Lessons from Canada show that technical standards become effective when directly linked to tender requirements and evaluation weighting, rather than functioning merely as additional attributes (IISD, 2022).

Thus, Indonesia needs to integrate green classification and technical standards into LKPP's e-procurement and e-catalogue systems so that iron and steel products can be grouped based on emission performance. This integration will facilitate procurement officials in objectively comparing bids and reduce the burden of individual discretion that has hindered implementation.

Fourth, mitigating greenwashing risks and strengthening market trust. Without a strong technical foundation, the risk of greenwashing increases and reduces procurement actors' trust in green products. This concern is one of the main reasons for resistance among commitment-making officials (PPK) in applying environmental criteria (N3; N1, IDI 2025). The Canadian case study shows that clear standards and independent verification increase procurement and industry trust in low-carbon claims (CSPA, 2023). In India, the development of a green steel taxonomy is also intended to avoid ambiguous environmental claims in the market (Ministry of Steel of India, 2024). Therefore, Pillar 2 in Indonesia must emphasize independent verification, data transparency, and emission traceability as key prerequisites for green procurement, so that green product claims are technically and legally accountable.

Strengthening Pillar 2 requires a transformation from a conceptual approach toward an operational technical foundation. Lessons from Canada show the effectiveness of performance-based emission standards directly linked to procurement, while India's experience underscores the importance of taxonomy as a common language even if not yet mandatory. Integrating both approaches into the Indonesian context—through clear emission classification, credible technical

standardization, and procurement system integration—is a prerequisite for GPP to function as a demand-side innovation instrument that drives measurable and tangible decarbonization of the iron and steel industry.

Unlike India, Indonesia's relatively lower baseline emission intensity requires the development of a more stringent taxonomy threshold to ensure meaningful differentiation and avoid policy dilution.

Based on Table 12, Indonesia's steel production exhibits the following indicative emission intensities:

- | | |
|---|---|
| <ul style="list-style-type: none"> ● BF–BOF (conventional primary steel)
~1.8–2.3 tCO₂/t | <ul style="list-style-type: none"> ● EAF (scrap-based)
0.3–0.8 tCO₂/t |
| <ul style="list-style-type: none"> ● Current national average (BAU)
~1.46 tCO₂/t | <ul style="list-style-type: none"> ● Best-case EAF (e.g., Krakatau Steel)
~0.38 tCO₂/t |

These values suggest that Indonesia already operates below Indian baseline thresholds (2.2 tCO₂/tfs), but still exhibits a wide dispersion across production technologies, which can be leveraged for policy differentiation.

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7.3.

Pillar 3: Professionalization of Procurement Actors and Suppliers



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Strengthening Pillar 3 is aimed at closing the gap identified in Section 5.2.3, namely the weak technical and professional capacity of procurement actors and business actors in operationalizing GPP. Capacity limitations—not merely regulatory absence—are the determining factor explaining why GPP in Indonesia is still perceived as a normative and administratively high-risk initiative. Lessons from Canada and India emphasize that systematic investment in capacity development is a prerequisite for translating policy mandates into consistent and credible procurement practices.

First, institutionalizing mandatory and tiered training for procurement actors. Currently, there is no mandatory tiered technical training on GPP for Budget Users (PA/KPA), Commitment-Making Officials (PPK), and Procurement Working Groups (Pokja). As a result, understanding of LCA, LCC, and MEAT varies significantly across ministries/agencies and between central and regional governments and depends on individual initiative (N1; N3, IDI 2025). Concerns about audit findings and uncertainty regarding green material quality further reinforce implementation resistance.

The Canadian case study shows a more institutionalized approach, where procurement capacity is strengthened through technical guidance, toolkits, and learning-by-doing in high-value public projects. The application of embodied carbon standards in public construction projects is supported by improved professional competence of procurement officials and technical consultants, enabling administrative risks to be managed (IISD, 2022).

In contrast, India's experience confirms that without capacity investment, the introduction of new instruments—such as the Green Steel Taxonomy—risks remaining conceptual. IISD (2024) notes that low procurement actor capacity is one of the main barriers to GPP implementation in India, even though an initial policy framework is available.

Based on these lessons, Indonesia needs to institutionalize mandatory and tiered GPP training, including basic modules (GPP concepts and audit risks), technical modules (LCA, LCC, MEAT), and sectoral modules (construction, iron and steel).

Also, a certificate must be provided to officials who complete the training.

Second, developing contextual and sector-based training modules. Interview findings indicate that existing training is not contextualized to sectoral needs, particularly construction and iron and steel materials (N3; N5, IDI 2025). As a result, GPP principles are often narrowly reduced—for example, only to electric vehicle procurement—without addressing embodied emissions during the construction phase.

Lessons from Canada show that training and technical guidelines are designed sectorally so procurement actors understand the technical and economic implications of applying low-carbon standards to specific materials such as structural steel (CSPA, 2023; IISD, 2022). In India, policy discourse through IDDI also emphasizes sectoral capacity building to support the adoption of taxonomy and new standards (RMI, 2024).

Therefore, Pillar 3's strategy in Indonesia needs to prioritize the development of simple, applicable, and sector-aligned training modules consistent with the green classification and technical standards developed under Pillar 2, so that policy can be translated into operational procurement specifications.

Third, strengthening supplier capacity through technical assistance. Capacity gaps exist not only on the public buyer side but also on the supplier side. IDI indicate that business actors are reluctant to invest in green innovation due to demand uncertainty and limited technical support

in meeting GPP criteria (N3; N5, IDI 2025).

The Canadian case study shows that public demand certainty combined with technical guidance encourages industry to invest in low-carbon technologies because market risk becomes predictable (IISD, 2022; CSPA, 2023). In India, limited technical assistance and lack of long-term demand visibility are major barriers to steel industry readiness to meet green standards (IISD, 2024; N8, interview 2026).

In Indonesia, Pillar 3's strategy needs to include technical assistance programs for suppliers—especially iron and steel producers—to understand technical requirements, certification, and emission measurement methodologies. This approach will reduce the risk of market exclusion and expand the supplier base ready to meet GPP criteria.

Fourth, establishing communities of practice and continuous learning mechanisms. Interview findings indicate fragmentation of knowledge across ministries/agencies and limited cross-sectoral learning space (N1; N5, IDI 2025). Lessons from Canada emphasize the importance of communities of practice that enable experience exchange among procurement actors, consultants, and industry in applying green standards (IISD, 2022). Thus, Indonesia needs to build continuous learning mechanisms—such as a national technical GPP forum—that function as spaces for knowledge consolidation, standard updates, and dissemination of best practices, so that capacity development does not stop at one-off training.

Strengthening Pillar 3 requires shifting from a voluntary approach toward professionalizing the procurement system. Lessons from Canada show that strong capacity allows green standards to be applied without excessively increasing administrative risk, while India's experience confirms that lack of capacity

can hinder implementation even when policy frameworks are available. The integration of mandatory training, sectoral modules, supplier technical assistance, and continuous learning mechanisms is a prerequisite for GPP in Indonesia to function effectively as a demand-side innovation instrument.



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7.4.

Pillar 4: Supplier Selection as a Green Demand-Pull Instrument

Strengthening Pillar 4 is directed at closing the gap identified in Section 5.2.4, namely the failure of supplier selection strategies to function as an effective demand-pull mechanism within GPP. Interview findings show that supplier selection in Indonesia remains dominated by administrative and lowest-price paradigms, with environmental criteria treated as additional (nice to have), non-binding, and highly dependent on budget user discretion. Lessons from Canada and India show that supplier selection strategies are the key point for translating policy and technical standards into real demand signals for industry.

First, establishing green criteria as selection prerequisites rather than merely additional attributes. IDI with LKPP and the Ministry of Industry confirm that green certifications—such as the Green Industry Standard (SIH) and ecolabels—are not yet positioned as gatekeeping criteria in supplier selection processes. As a result, industry lacks strong economic incentives to invest in green innovation because compliance with environmental standards does not determine tender success (N1; N4, IDI 2025–2026).

The Canadian case study shows a firmer approach, where embodied carbon standards and emission reduction requirements are applied as part of technical requirements in high-value public projects. In practice, only suppliers capable of meeting certain emission thresholds can effectively participate in tenders, making green criteria a selection prerequisite (IISD, 2022; N8, interview, 2025).

Conversely, India's experience demonstrates limitations when green criteria are not institutionalized as prerequisites. Although the Green Steel Taxonomy has been developed, IISD (2024) notes that it is not yet systematically used to screen suppliers in public procurement, limiting its impact on industry behavior. For Indonesia, Pillar 4's strategy needs to shift green criteria from voluntary attributes to gradual selection prerequisites for priority procurement categories such as iron and steel, while considering domestic market readiness.

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Second, integrating environmental criteria into supplier qualification and evaluation stages. The main gap identified in Pillar 4 is the absence of explicit integration of environmental criteria into supplier qualification and evaluation stages. IDI show that construction supplier selection focuses more on contractor choice, while material aspects—including steel—are often not thoroughly evaluated in terms of environmental performance (N1; N3, IDI 2025).

Lessons from Canada show that supplier evaluation is conducted not only on price and technical capacity but also on life-cycle environmental performance, which is integrated into evaluation weighting (most economically advantageous tender/MEAT) (IISD, 2022). In India, policy discourse through IDDI and RMI (2024) emphasizes the importance of incorporating environmental criteria from the early stages of selection to reduce green premium risks and clarify supplier expectations. Therefore, Indonesia needs to redesign supplier selection stages by explicitly incorporating environmental criteria from qualification stages and assigning clear weighting in bid evaluation, so that green criteria genuinely influence tender outcomes.

Third, utilizing life-cycle-based evaluation tools to strengthen supplier selection. The use of LCA and LCC in supplier selection remains very limited due to capacity constraints and absence of operational guidance (N3; N5, IDI 2025). As a result, green products continue to be perceived as more expensive and risky.

The Canadian case study shows that applying LCC and life-cycle approaches enables the government to compare bids more objectively, so products with higher upfront costs but lower environmental impacts can be economically justified (IISD, 2022). In India, although LCA is not yet mandatory in procurement, the development of the green steel taxonomy is beginning to drive the need for life-cycle data as a future basis for supplier selection (RMI, 2024).

For Indonesia, Pillar 4's strategy needs to position life-cycle-based evaluation tools as a core component of supplier selection, starting with pilot projects in high-value procurement and high-emission materials.

Fourth, expanding supplier participation and mitigating market exclusion risks. IDI with the Ministry of Public Works and Bappenas reveal concerns that overly strict green criteria may limit supplier numbers and increase failed tender risks, particularly if domestic industry readiness is uneven (IDI 2025). Lessons from Canada show that such risks are mitigated through gradual implementation, early market engagement, and clear standard roadmaps allowing industry adaptation time (CSPA, 2023; IISD, 2022). In India, incremental approaches are also adopted through pilot projects and policy learning before broader binding implementation (IISD, 2024).

Thus, supplier selection strategies in Indonesia need to be designed adaptively: applying green criteria gradually, opening space for supplier dialogue, and combining minimum requirements with evaluation weighting so that market transformation remains inclusive.

Strengthening Pillar 4 requires repositioning supplier selection from an administrative mechanism into an active policy instrument that creates demand for green products. Lessons from Canada show that green criteria positioned as prerequisites and reinforced with life-cycle-based evaluation can drive low-carbon industrial investment. Meanwhile,

India's experience confirms that without integration of green criteria in supplier selection, standards and taxonomies risk failing to influence the market. Integrating these lessons into Indonesia's context is a prerequisite for supplier selection strategies to function effectively as leverage for the iron and steel industry's transition toward a low-carbon economy.



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7.5. Pillar 5: Public Spending as a Demand-Pull Instrument

Strengthening Pillar 5 is directed at closing the gap identified in Section 5.2.5, namely the failure of government spending to function as a demand-side innovation instrument capable of creating credible, measurable, and long-term market signals for green iron and steel products. Although the strategic role of public procurement has been normatively recognized in national planning documents, such recognition has not yet been translated into real and consistent demand commitments. Lessons from Canada and India show that demand-side innovation becomes effective only when the state explicitly uses its purchasing power to reduce investment risk and shape market expectations.

First, establishing clear and measurable demand signals through public spending commitments. Interview findings show that Indonesia does not yet have quantitative targets or clear green demand commitments in public procurement, especially for emission-intensive materials such as iron and steel. As a result, industry does not view government spending as anchor demand for long-term investment planning (N3; N5, IDI 2025).

The Canadian case study shows a contrasting approach. The Canadian government leverages large-scale public infrastructure projects as a primary demand source, with approximately 25% of national steel demand originating from government projects. The application of binding embodied carbon standards provides medium- to long-term demand visibility, enabling industry to invest in low-carbon steel technologies (IISD, 2022; N8, interview, 2026).

In India, limited demand signals remain a major obstacle. Although the Green Steel Taxonomy has been developed, IDI and IISD (2024) analysis confirm that without clear public purchasing commitments, the steel industry is reluctant to undertake large-scale decarbonization investments.

Thus, Pillar 5's strategy in Indonesia needs to include green demand commitments—such as spending quotas, minimum targets for low-carbon steel use, or high-value pilot green procurement projects—so that public spending functions as a credible market signal.

Second, using public procurement as an investment risk de-risking instrument.

Interview findings show that Indonesian business actors perceive investment in green iron and steel technologies as high risk due to large upfront costs and uncertain market absorption (N3, interview 2025). Without demand-side intervention, such risks are borne entirely by industry.

Lessons from Canada show that GPP is explicitly positioned as a de-risking instrument. With demand certainty from public projects and integration of green criteria into tenders, the government reduces commercial risk faced by industry, allowing the green premium to be gradually absorbed (IISD, 2022).

In India, RMI (2024) analysis shows that even a moderate GPP scenario—such as a 25% emission intensity reduction—can be achieved with relatively limited cost increases (around 2–8%), provided there is government demand certainty.

Therefore, Pillar 5 in Indonesia needs to be designed to shift part of investment risk from industry to the state through medium-term contracts, framework agreements, or offtake commitments in strategic public projects.

Third, using pilot projects and innovative procurement as market learning tools.

Interview findings indicate that incremental approaches are more acceptable to procurement actors and industry than immediately broad binding policies (N1; N5, IDI 2025). The Canadian case study shows that low-carbon standards were initially applied in high-value public projects and gradually expanded as market readiness improved (IISD, 2022). In India, a similar approach is adopted through pilot projects and participation in international initiatives such as IDDI, positioning public procurement as a policy and market learning tool before scaling



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nationally (RMI, 2024).

In Indonesia, Pillar 5's strategy needs to prioritize pilot procurement projects for green iron and steel in strategic public construction sectors (for example, transport infrastructure or government buildings), aiming to build track records, reduce uncertainty, and strengthen market confidence.

Fourth, consolidating demand across ministries/agencies and central–regional governments.

The policy gap identified in Pillar 5 shows that green demand in Indonesia remains fragmented and uncoordinated across ministries/agencies and regional governments. The Ministry of Home Affairs emphasized that limited fiscal space and budget efficiency pressures make regional governments reluctant to pioneer green procurement without national support (N6, interview 2025). Lessons from Canada show that demand consolidation—both at federal and provincial levels—strengthens government bargaining power and increases market scale for green products (CSPA, 2023). In India, lack of demand consolidation is one reason why GPP market signals remain weak (IISD, 2024).

Thus, Pillar 5 in Indonesia needs to include mechanisms for consolidating green demand across ministries/agencies and between central and regional governments—a cross-ministry task force may be an option—, so that procurement volumes become sufficiently large to influence industrial investment decisions. Strengthening Pillar 5 requires repositioning government spending from an administrative function into a strategic market-creation instrument. Lessons from Canada show that public demand certainty

reduces investment risk and drives industrial decarbonization, while India's experience confirms that without long-term demand visibility, technical policies and green taxonomies are insufficient to change market behavior. Integrating these lessons into Indonesia's context is a prerequisite for GPP to function truly as a demand-side innovation instrument that drives the sustainable and measurable transition of the iron and steel industry toward a low-carbon economy.



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Table 18. Strategy for Integrating Green Iron and Steel into GPP in Indonesia

GPP Pillar	Key Problem	Strategic Objective	Proposed Policy Instruments	Lessons from Canada and India
Pillar 1: Policy and Legal Framework	The GPP mandate is normative and voluntary; there is no leading sector; incentives are not linked to procurement	Shift GPP from normative recognition to a binding operational mandate.	• Designation of priority sectors/materials (iron & steel) in derivative PBJP regulations • Appointment of a national coordinating actor across ministries/agencies • Integration of GPP with fiscal/non-fiscal incentives	Canada: binding embodied carbon standards in large public projects; India: limitations of the voluntary approach
Pillar 2: Technical Foundation and Green Classification	No steel classification based on emission intensity; standards not yet integrated into the procurement system	Provide a measurable, verifiable, and operational technical foundation	• Development of green steel classification based on emission intensity • Recognition of LCA, LCC, and EPD as evaluation bases • Integration of the classification into the LKPP e-catalogue	India: Green Steel Taxonomy as a common language; Canada: emission-based
Pillar 3: Capacity and Human Resource Development	Limited capacity of PPK/Pokja; non-tiered training; high audit risk.	Improve the professionalism of procurement actors and supplier readiness.	• Mandatory and tiered GPP training (basic–technical–sectoral) • Specific modules for construction and steel • Technical assistance for steel suppliers	Canada: learning by doing through public projects;

GPP Pillar	Key Problem	Strategic Objective	Proposed Policy Instruments	Lessons from Canada and India
Pillar 4: Supplier Selection Strategy	Green criteria are only additional attributes; selection is based on the lowest price.	Make environmental criteria decisive selection factors.	- Gradual establishment of green criteria as prerequisites - MEAT- and LCC-based evaluation weighting - Pilot projects for green supplier selection	Canada: emission criteria as gatekeeping; India: taxonomy has not yet influenced selection
Pillar 5: Demand-Side Innovation	No green demand targets; fragmented demand; high investment risk.	Use public spending as a market-creation instrument for green steel.	- Establishment of minimum targets for low-carbon steel use - Medium-term public contracts/offtake - Consolidation of demand across ministries/agencies and central–regional levels	Canada: public spending as anchor demand; India: lack of demand visibility

Source: Synthesis of interview results (2025–2026), analysis in Chapter 5, and lessons from the Canada and India case studies.

CONCLUSION

CONCLUSION



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This study shows that decarbonizing the iron and steel sector is a crucial prerequisite for achieving Indonesia's GHG emission reduction targets, given the high emission intensity of this sector and its strategic role in national infrastructure and industrial development. Emission modeling indicates that shifting from the conventional BF–BOF production route toward low-carbon pathways—such as hydrogen-based DRI–EAF, increased scrap utilization, and electrification—has the potential to significantly reduce emissions to near zero in the long term. However, this technological transformation is capital-intensive, high-risk, and will not occur at scale without strong and long-term demand signals.

In this context, GPP holds a strategic position as a demand-side policy instrument capable of bridging climate objectives, industrial policy, and public procurement practices. The research findings show that Indonesia already has a relatively adequate GPP regulatory framework normatively, but its implementation remains constrained by structural weaknesses. GPP is still treated as a voluntary and administrative instrument and has not functioned as a market-creation

tool. The absence of a binding operational mandate, the lack of a leading sector coordinating across ministries and between central and regional governments, the weak technical foundation based on emission classification, limited procurement actor capacity, and supplier selection strategies still oriented toward the lowest price have caused public spending to fail in providing credible demand signals for the green iron and steel industry.

The analysis of the five GPP pillars confirms that the main challenge is not merely a lack of policy commitment, but systemic unpreparedness to operationalize green demand. The policy and legal framework pillar is available but has not been translated into measurable selective obligations. The technical foundation pillar remains weak due to the absence of emission classification and ready-to-use integration of LCA/LCC within the procurement system. The capacity development pillar reveals buyer failure, where procurement actors lack professional competence and confidence to apply green criteria. The supplier selection pillar has not functioned as a demand-pull mechanism because

environmental criteria have not become prerequisites influencing tender outcomes. The demand-side innovation pillar shows that Indonesia's public spending has not yet been utilized as anchor demand to reduce industrial investment risk.

The case studies of Canada and India provide relevant contrasting lessons. Canada demonstrates that GPP can function effectively as an industrial transformation instrument when linked to binding emission performance standards, life-cycle approaches, and demand certainty from large-scale public projects. In contrast, India's experience shows the limitations of a voluntary approach: developing a green steel taxonomy is important as a technical foundation, but without procurement mandates and long-term demand visibility, its impact on industrial behavior remains limited. This comparison confirms that the success of GPP depends on a combination of legal mandates, technical foundations, actor capacity, and consistent demand signals.

Based on these findings, this study concludes that integrating green iron and steel into

Indonesia's GPP will only be effective if a paradigm shift occurs: from compliance- and lowest-price-based procurement toward procurement as a strategic instrument for green market creation. The five proposed strategic pillars—strengthening operational mandates, building an emission-classification-based technical foundation, professionalizing procurement actors and suppliers, repositioning supplier selection as a demand-pull instrument, and utilizing public spending as a market-creation tool—must be viewed as an integrated policy package rather than partial interventions.

Thus, GPP has the potential to become a key lever for decarbonizing Indonesia's iron and steel industry while simultaneously strengthening national industrial competitiveness in the global transition toward a low-carbon economy. However, this potential can only be realized if the state actively uses its purchasing power to provide certainty, reduce investment risk, and consistently orchestrate cross-sectoral policies. Without such structural change, GPP will remain at a normative level and Indonesia risks losing strategic momentum in the transformation toward a green industrial economy.

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