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Green Industry and Trade Assessment (GITA) of Indonesia: A Strategic Guide toward Green Industrial Development

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Green Industry and Trade Assessment (GITA) of Indonesia: A Strategic Guide toward Green Industrial Development

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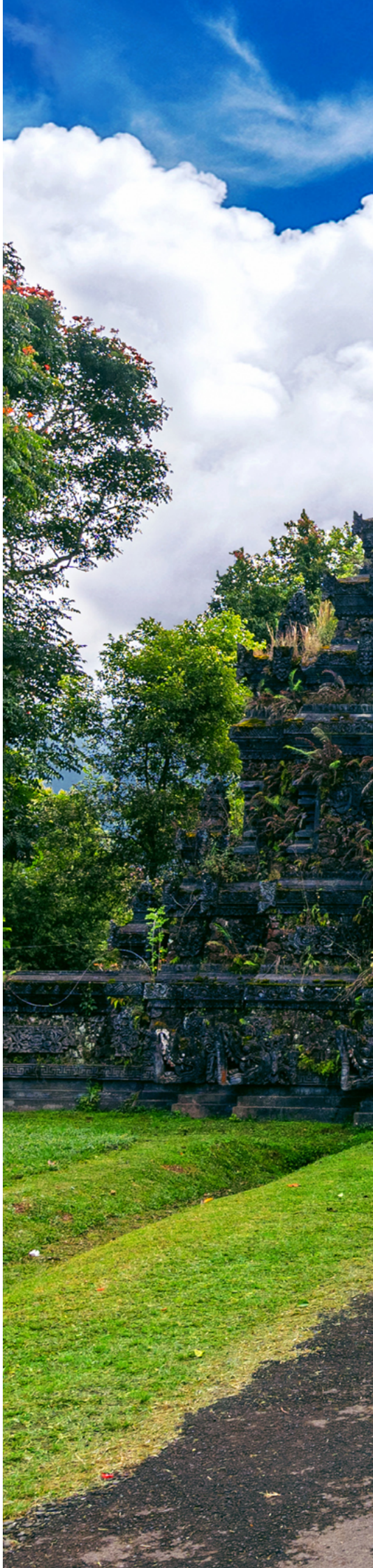


TABLE OF CONTENTS

List of the Figures

List Of Tables

ABBREVIATION

AFOLU	Agriculture, Forestry, and Other Land Use
AEA	ASEAN Energy Award
AMDAL	*Analisis Mengenai Dampak Lingkungan*/Environmental Impact Assessment
APPI	*Asosiasi Produsen Pupuk Indonesia*/Indonesian Fertilizer Producers Association
BAPPENAS	*Badan Perencanaan Pembangunan Nasional*/Ministry of National Development Planning
BAU	Business as Usual
BOD	Biological Oxygen Demand
BPPI	*Badan Penelitian dan Pengembangan Industri*/Industrial Research and Development Agency
BPS	*Badan Pusat Statistik*/National Statistic Agency
CDM	Clean Development Mechanism
CEMS	Continuous Emissions Monitoring System
CER	Certified Emission Reduction
COD	Chemical Oxygen Demand
CPO	Crude Palm Oil
Ditjen PPI	*Direktorat Jenderal Pengendalian Perubahan Iklim*/Directorate Generale of Climate Change
DMC	Domestic Material Consumption
DNA	Designated National Authority
DNPI	*Dewan Nasional Perubahan Iklim*/National Council on Climate Change
EIP	Eco-Industrial Park
EnMS	Energy Management System
EU-ETS	European Emission Trading Scheme
FOLU	Forestry and Other Land Use
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GI	Green Industry
GITA	Green Industry Trade Assessment
GS	Gold Standard

HK	*Hutan Konservasi*/Conservation Forest
HL	*Hutan Lindung*/Protected Forest
HPK	*Hutan Produksi yang Bisa Dikonversi*/Convertible Production Forest
HPT	*Hutan Produksi Terbatas*/Limited Production Forest
IEMP	Industrial Environmental Management Plans
IIoT	Industrial Internet of Things
INDC	Intended Nationally Determined Contribution
INDI 4.0	Indonesia Industry 4.0 Readiness Index
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Process and Product Use
ISIC	International Standard Industrial Classification
JCM	Joint Crediting Mechanism
KBLI	*Klasifikasi Baku Lapangan Usaha Indonesia*/Indonesian Standard Industrial Classification
Komnas MPB	*Komisi Nasional Mekanisme Pembangunan Bersih*/National Comission on Clean Development Mechanism
LCDI	Low Carbon Development Initiative
LC_3	Limestone Calcined Clay Cement
LEDS	Low Emission Development Strategies
LSIH	*Lembaga Sertifikasi Industri Hijau*/Green Industry Certification Body
LUCF	Land Use Change and Forestry
MEPS	Minimum Energy Performance Standard
MoEF	Ministry of Environment and Forestry
MoEMR	Ministry of Energy and Mineral Resources
MoI	Ministry of Industry
MP3EI	Master Plan for Acceleration and Expansion of Indonesia Economic Development
MRV	Measuring, Reporting, and Verification
MVA	Manufacturing Value Added
NAMAs	Nationally Appropriate Mitigation Actions
NCPC	National Cleaner Production Centre
NDC	Nationally Determined Contributions
OECD	Organization for Economic Co-operation and Development

PAGE	Partnership for Action on Green Economy
PROPER	*Program Penilaian Peringkat Kinerja Perusahaan dalam Pengelolaan Lingkungan Hidup*/Public Disclosure Program for Industrial Pollution Control
POME	*Pelaporan Online Manajemen Energi*/Energy Management Online Reporting
RDF	Refuse-Derived Fuel
RECP	Resource Efficient and Cleaner Production
REDD+	Reduce Emission Forest Degradation and Deforestation Plus
RPJMN	*Rencana Pembangunan Jangka Menengah Nasional*/The National Medium-Term Development Plan
RPJPN	*Rencana Pembangunan Jangka Panjang Nasional*/The National Long-Term Development Plan
SDGs	Sustainable Development Goals
SIINAS	*Sistem Informasi Industri Nasional*/National Industrial Information System
SIUP	*Surat Izin Usaha Perdagangan*/Trading Business Permits
SKN	Skema Karbon Nusantara/Nusantara Carbon Scheme
SME	Small Medium Enterprise
SOEs	State-Owned Enterprises
SPPL	*Surat Pernyataan Pengelolaan Lingkungan*/Environmental Management Statement Letter
TDP	*Tanda Daftar Perusahaan*/Company Registration
TFPI	Total Factor Productivity of Industry
TRS	Total Reduced Sulphur
TSS	Total Suspended Solids
toe	Ton of oil equivalent
UKL-UPL	*Upaya Pengelolaan Lingkungan Hidup dan Upaya Pemantauan Lingkungan Hidup*/Environmental Management Efforts and Environmental Monitoring Efforts
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
UNSD	United Nations of Statistical Division
VCS	Verified Carbon Standard
WRI-CAIT	World Resources Institute for Climate Analysis Indicators Tool
WWF	World Wildlife Fund

LIST OF DEFINITIONS

BOD	: The oxygen required by microbes in the stabilization of a decomposable waste under aerobic conditions for a period of five days at 20°C and under specified conditions.
Business as Usual	: An unchanging situation despite difficulties or disturbances.
CDM	: One of the flexible mechanisms defined in the Kyoto Protocol.
COD	: The amount of oxygen required to oxidize chemically the organic and sometimes inorganic matter in water or wastewater.
GDP	: The total value of goods produced, and services provided in a country for one year.
GI Award	: An award program targeting industrial companies which have implemented green industry principals in their production processes.
Green Industry	: Industrial production and development that does not come at the expense of the health of natural systems or lead to adverse human health outcomes.
Green Trade	: (or sustainable trade) refers to trade that does not deplete natural resources, harm the environment or deteriorate social conditions while promoting economic growth.
Greenhouse gas	: Any gaseous compound in the atmosphere that is capable of absorbing infrared radiation, thereby trapping and holding heat.
Hazardous waste	: Waste that is dangerous or potentially harmful to health or the environment.
Industry	: Those activities which are described in Section C (manufacturing) of the International Standard Industrial Classification of All Economic Activities (ISIC), Revision 4, of the Statistics Division of the United Nations Department of Economic and Social Affairs.
Industry 4.0	: A new phase in the Industrial Revolution that focuses heavily on interconnectivity, automation, machine learning, and real-time data.
Inorganic Waste	: Waste material (sand, salt, iron, calcium, and other mineral materials) that is only slightly affected by the action of organisms.
KBLI	: One of the standard classifications published by BPS (Badan Pusat Statistik) for economic activities
LCDI	: A process for identifying development policies that maintain economic growth, alleviate poverty, and help achieve sector-level development targets, while simultaneously helping Indonesia to handle climate change and preserve as well as improve the country's natural resources.

LEDS	: A national development strategy that has a low emission perspective where a country can develop sustainably by separating economic growth from intensive GHG emissions.
Manufacturing	: An economic activity that carries out activities to change a raw material mechanically, chemically, or by hand so that it becomes finished/ semi-finished goods, goods with higher value, and also are closer to the end-user.
MVA	: The total estimate of net-output of all resident manufacturing activity units obtained by adding up outputs and subtracting intermediate inputs.
NDC	: The post-2020 voluntary national climate targets, including mitigation and adaptation, which countries committed to and which will become a binding national determined contribution when a country ratifies the Paris Agreement.
Organic Waste	: Organic matter in waste that can be broken down into carbon dioxide, water, methane or simple organic molecules by micro-organisms and other living things by composting, aerobic digestion, anaerobic digestion, or similar processes.
PROPER	: An assessment of environmental management or company performance rating program
RDF	: Fuel derived from the elimination of non-combustible fractions from municipal solid waste.
RECP	: Resource Efficient and Cleaner Production is the continuous application of preventive environmental strategies to a process, product, and service in order to increase efficiency and reduce risks to humans and the environment.
TSS	: Solids in suspension in a water or wastewater that can be removed by laboratory filtration techniques.

Green Industry and Trade Assessment (GITA) of Indonesia: A Strategic Guide toward Green Industrial Development

Executive Summary

This Green Industry and Trade Assessment (GITA) report produced under the Partnership for Action on the Green Economy is one of several efforts to identify actions supportive of a green economy transition in Indonesia, in this case, through sustainable industry and trade. The assessment starts with a review of the multiple planning and policy regimes that have the potential for the greening of industry, particularly the Low Carbon Development Initiative and PROPER, and for supporting green industry and trade. It proceeds to describe the current pattern of industrial production, trade, and environmental and resource issues, to the extent that the limited data allow. It then proposes a green industrialization strategy that would enhance the greening of Vision Indonesia 2045.

The GITA, complementarity to and supportive of the Low Carbon Development Initiative includes actions recommended in transitioning toward green industrial development in the country. These are identifying the more significant environmental impacts and resource inefficiencies in the industry; enhancing targeted environmental regulations with increased company participation in PROPER; setting CO_2 emission targets for industrial subsectors; expanding waste inventories focused on hazardous generation and disposal; requiring environmental management plans for industrial estates; promoting resource efficiency in energy and water intensive industrial subsectors; strengthening the capacity of cleaner production centers to assist small and medium-size enterprises to identify cleaner techniques and technologies; reducing the need for new palm oil plantations by increasing the yield per hectare of existing plantations; and greening of the supply chain of palm oil and other leading export subsectors by improving the processing efficiency of raw material and using residual biomass where available for energy generation.

1 Introduction

The Green Industry and Trade Assessment (GITA) reinforces and strengthens the implementation of the Indonesian Low Carbon Development Initiative (LCDI) in the sphere of the industrial sector. The GITA evaluates the status of industry toward achieving green industrialization. It describes industrial environmental performance of the country in terms of air pollution, water pollution, and industrial waste; resource efficiency in energy, water, and material use; and cleaner technology applications in industrial production.

1.1 Definitions of Green Industry and Green Trade

UNIDO describes Green Industry as industrial production and development that does not come at the expense of the health of natural systems or lead to adverse human health outcomes. Green Industry is aimed at mainstreaming environmental, climate and social considerations into the operations of enterprises. It provides a platform for addressing global, interrelated challenges through a set of immediately actionable cross-cutting approaches and strategies that take advantage of emerging industry and market forces (UNIDO, 2011a).

For the purposes of this assessment, industry is limited to the manufacturing sector as follows:

Industry comprises those activities which are described in Section C (manufacturing) of the International Standard Industrial Classification of All Economic Activities (ISIC), Revision 4, of the Statistics Division of the United Nations Department of Economic and Social Affairs. Industry, as used in this assessment, refers exclusively to manufacturing activities; the terms industry and manufacturing are herein used interchangeably.

For the purposes of this assessment and in keeping with this strategic approach, **green industry** encompasses four activities:

- Greening industry: This refers to any activity by which the processes of manufacturing industry (1) improve their efficiency of energy, water, and raw materials, (2) reduce pollutant discharges to move towards compliance with environmental norms, and (3) shift to the extent possible to the use of renewable energy.
- Environmental goods and services industry: The manufacturing of pollution control and monitoring equipment. In addition, environmental services, such as environmental engineering and auditing, are included even though they are not a direct part of industry according to ISIC 4. However, as such services are needed for greening industry, they are included within the category of green industry.
- Renewable energy industry: The manufacturing of renewable energy technologies (e.g. solar panels, wind turbines, mini-hydro turbines). They are clearly part of industry, even though there is no specific ISIC subcategory for these technologies.
- Materials recovery and recycling industry: To the extent that these activities include transformation during production, they are part of the manufacturing subsectors where this transformation occurs (e.g. transforming scrap metals into new metals, remanufacturing car engines). If they mainly refer to sorting activities, they are classified under waste management activities or wholesale of waste and scrap. (Note: recycling was previously classified under manufacturing in ISIC 3, but this did not effectively reflect its production

process.)

- Green industry and trade: For the purposes of this assessment, "sustainable or green trade has a key role to play in the interface between international trade and the transition to a green economy. While there is no universally agreed definition of sustainable trade, it broadly refers to trade that does not deplete natural resources, harm the environment, or deteriorate social conditions while promoting economic growth." (UNEP, 2013).

Green trade opportunities for manufactured goods are mostly the export of environmental goods and services and renewable energy technologies, in complying with quality, health and environmental standards (ISO 9000, HASP ISO 1400 and eco-labelling) to enhance export potential, in embedding sustainability as a core business strategy, in promoting the complete disassembly, recovery and re-use of individual product components (re-manufacturing) and in the greening of global supply chains.

1.2 Sustainable Development Goals and Green Industrialization

One approach to monitoring the process of green industrialization in Indonesia is to measure its progress of industry in meeting the UN Sustainable Development Goals (SDGs). Out of 17 SDGs, four address economic development and environmental concerns. Of the 169 targets that constitute the substance of the 17 SDGs, industry can contribute to meeting four goals and their 12 associated indicators, of which seven are environment-related (Table 1). In addition to the seven indicators, one should be added for monitoring industrial air pollution, such as total suspended articulate matter or sulfur dioxide emissions, even though there is no headline indicator for air pollution in the SDGs (IGES, 2016).

Table 1 SDGs and Goals to achieve for Green Industrialization

Goals	Targets	Indicators	Green Industry Goals
6. Ensure availability and sustainable management of water…	6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	6.3.1 Proportion of wastewater safely treated	Proportion of industry wastewater safely treated
	6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	6.4.1 Change in water-use efficiency over time	Industry water-use intensity decreased
7. Affordable, reliable, and modern energy	7.2 By 2030, increase substantially the share of renewable energy in the global energy mix	7.2.1 Renewable energy share in the total final energy consumption	Use of renewable energy as percentage of total industry energy use increased
	7.3 By 2030, double the global rate of improvement in energy efficiency	7.3.1 Energy intensity measured in terms of primary energy and gross domestic product (GDP)	Industry energy-use intensity decreased

Goals	Targets	Indicators	Green Industry Goals
9. Infrastructure, industrialization, and innovation	9.4 By 2030 upgrade infrastructure and retrofit industries to make them sustainable, with increased resource efficiency…	9.4.1 CO_2 emission per unit of value added	Industry CO_2 emission intensity decreased
12. Responsible consumption and production	12.2 By 2030, achieve the sustainable management and efficient use of natural resources	12.2.2 Domestic material consumption (DMC), DMC per capita and DMC per GDP	Industry material consumption intensity decreased
	12.4 By 2020, achieve the environmentally sound management of chemicals and wastes throughout their life cycle …and significantly reduce their release to air water and soil…	12.4.2 Treatment of waste, generation of hazardous waste, hazardous management by type of treatment	Percentage of industry hazardous waste collected and safely treated

Source: UN (2016)

1.3 Linkages of the GITA with the Low Carbon Development Initiative (LCDI) in Indonesia

The target of the Low Carbon Development Initiative (LCDI) is to reduce carbon emissions by nearly 43% in the high scenario through the sustainable utilization of natural resources and reduction of carbon and energy intensities. The scenario also predicts a GDP growth of 6% annually between 2019 - 2045. The LCDI, by using predictions based on System Dynamic Modelling, allows simultaneous assessment of social, environmental, and economic impacts of various development pathways.

The GITA focuses on key industry-related indicators of the LCDI; it provides an analysis of how Indonesia is performing on those indicators and what strategy could assist in further improving progress in reaching LCDI targets.

1.4 Key Issues and Questions

This assessment addresses several key issues that are most relevant to green industry and trade. These are:

- What existing policy regimes have the potential for greening industry, encouraging the manufacturing of environmental and renewable energy technologies, and supporting green industry trade?
- What is the status of industry and trade, with regard to key priorities and environmental performance?
- What is known about industrial environmental pollution and resource use? Can green trade help to mitigate environmental pollution or reduce resource use? What modifications in or effective use of existing industrial policies could contribute to greening industry and industry trade?
- What new initiative(s) might be undertaken to accelerate the greening of industry and trade, or even aspects thereof?
- What new industry segments could offer potential for green industry and trade?
- How could the development of these green industry segments be supported?

This chapter reviews the major policies that have or could influence the greening of industry,

2 Indonesia's Policy Regime For Green Industry Production and Trade

the manufacturing of environmental and renewable energy technologies, and the export of manufactured goods. Before discussing policy instruments and institutions, this chapter presents an economic, environmental and social profile of the country as a basis for assessing the alignment of existing policy regimes with the overall development of the country.

2.1 Country Profile

2.1.1 Geographic

Indonesia is a country in Southeast Asia between the Indian and Pacific oceans. It is the world's largest island country and fourth most populous country in the world. In 2017, the population of Indonesia was estimated to be 261.9 million inhabitants. The country has 34 provinces spreading over five main islands and four archipelagos. Currently, there are a total of 17,504 islands that have been identified and a total of 16,056 islands have been registered with the United Nations.

2.1.2 Economic

Indonesia as the largest economy in Southeast Asia has experienced impressive economic growth since overcoming the Asian financial crisis in the late 1990s. The annual growth rate of GDP averaged 5% from 2000 until 2020, reaching an all-time high of 7.16% in the fourth quarter of 2004. Only in the second quarter of 2020 did it hit a record low of -5.32%. GDP in 2018 was 1.04 trillion current US$ (World Bank, 2020). The GDP increased in all sectors, primarily in other service business fields by 9.9%, company services by 8.9% and health and social activity service by 7.1%.

Its exports and imports were reasonably in balance in early 2019. Its exports in February 2019 reached US$ 12.52 billion, which was a decrease of 11.3% from February 2018. Its imports reached US$ 12.2, which was a decrease of 18.6% from February 2018.

2.1.3 Environmental

Indonesia is an equatorial country that has a large tropical forest. It has a total of 120,635 thousand hectares of forestland. Deforestation and forest degradation are two significant environmental concerns. Deforestation is caused by illegal logging and fires; it not only threatens the extinction of various rare species, but can also directly increase the production of GHG emissions. In Sumatera and Kalimantan, deforestation is mainly caused by oil palm and pulp or paper plantation expansion. Plantation expansion in Kalimantan alone is projected to contribute 18–22% (0.12–0.15 GtC yr–1) of Indonesia's 2020 CO_2-equivalent emissions (Carlson, Curran, Asner, & Pittman, 2012).

The rapid economic growth has also affected GHG emissions, particularly from the two main sources of GHG emissions in Indonesia, i.e. FOLU (forestry and other land use) and the energy sector. As indicated by Indonesia's Second Biennial Updated Report (2018), national GHG emissions in 2016 reached 1,461,367 Gg CO2e for five gases (CO2 , CH4 , N2 O, CF4 and C2F6) and 1,457,774 Gg CO2e for three gases (CO2 , CH4, N2O) (Table 2).The total of 3 main gases increased by 432,153 Gg CO2e (42.14%) from the emission level in 2000. The main sources of GHG emissions for the three gasses are mainly from agriculture, forestry, and other land use (AFOLU), and peat fires, followed by energy, waste and industrial process and product use (IPPU).

Table 2 Main Source of GHG Emissions in 2016

Source	Volume (Gg CO_2e)	Percentage (%)
AFOLU and Peat Fires	752,138	51.59
Energy	538,025	36.91
Waste	112,351	7.71
IPPU	55,260	3.79
Total	1,457,774	100

Source: Ministry of Environment and Forests (2018)

As an archipelagic country, Indonesia's freshwater supplies constitute 6% of the world's freshwater reserves or 21% in all the Asia-Pacific region. About a thousand rivers are spread across its islands. Indonesia also has around 840 lakes and 735 small lakes. However, the large amount of freshwater does not guarantee that all communities can easily access clean water. Indonesians often experience problems with the lack of clean water supplies for daily needs.

Waste management is one of the major environmental problems facing the country. Domestic waste generation is projected to increase annually in line with population growth. Based on an estimation by the Ministry of Environment and Forestry (MoEF), waste generation in Indonesia reached 65.2 million tons in 2016 (BPS, 2018). This number is increasing 2-4% annually. Most of the collected waste is brought to open dumping or controlled landfills.

The rapid growth of the manufacturing sector further aggravates the existing waste problem. According to MoEF and the Ministry of Industry (MoI), industrial hazardous waste managed in 2017 was 60.31 million tons. If accumulated from 2015, the quantity managed is less than 40% of the target for hazardous waste management of 755.6 million tons.

2.1.4 Social

Indonesia's population density in 2017 was 137 inhabitants/km2 with Java having the highest density (1.145 inhabitants/ km2).

In terms of poverty, Indonesia has reduced the poverty rate to 9.7% by the end of 2018, lower than 10.1% in 2017 and the lowest since the 1998 monetary crisis. The highest poverty rate was in Papua (27.4%) and West Papua (22.7%).

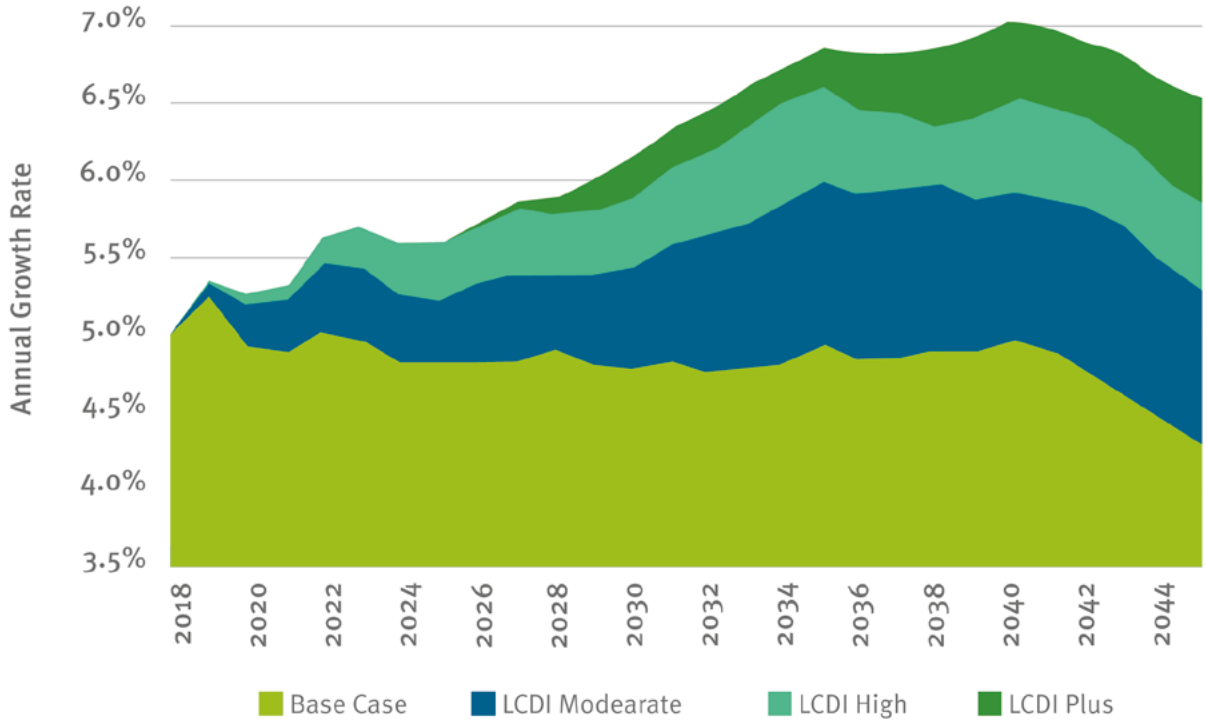
The employment rate of the country's workforce has been improving over the last decade. The unemployment rate was 5.5% in 2017, and 5.3% in 2018 (BPS,2018). Employment is still dominated by three main sectors, i.e. agriculture, forestry, and fisheries with as many as 35.7 million people (28.8%); wholesale and retail trade, car and motorcycle repair and maintenance with 23.1 million people (18.6%); and the manufacturing industry with 18.25 million people (14.7%). Elementary school graduates are the largest population of the labor force (40.7%), followed by junior high school (18.1%), senior high school (18.0%), vocational high school (11.0%), and university (12.2%)

2.2 Low Carbon Development Initiative (LCDI)

The government declared its goal of integrating climate action into the country's development agenda in 2017. The Ministry of National Development Planning (BAPPENAS) launched the LCDI with the aim of explicitly incorporating carbon emission reduction targets into its policy planning exercise, along with other interventions for preserving and restoring the country's natural capital base (Ministry of National Development Planning, 2019). It acknowledged that increasing climate change would result in declining GDP and recognized that there could be significant benefits from

bold climate action (Figure 1). The benefits would come from new job opportunities and better health outcomes between 2019 and 2030 compared to business-as-usual (Ministry of National Development Planning, 2018).

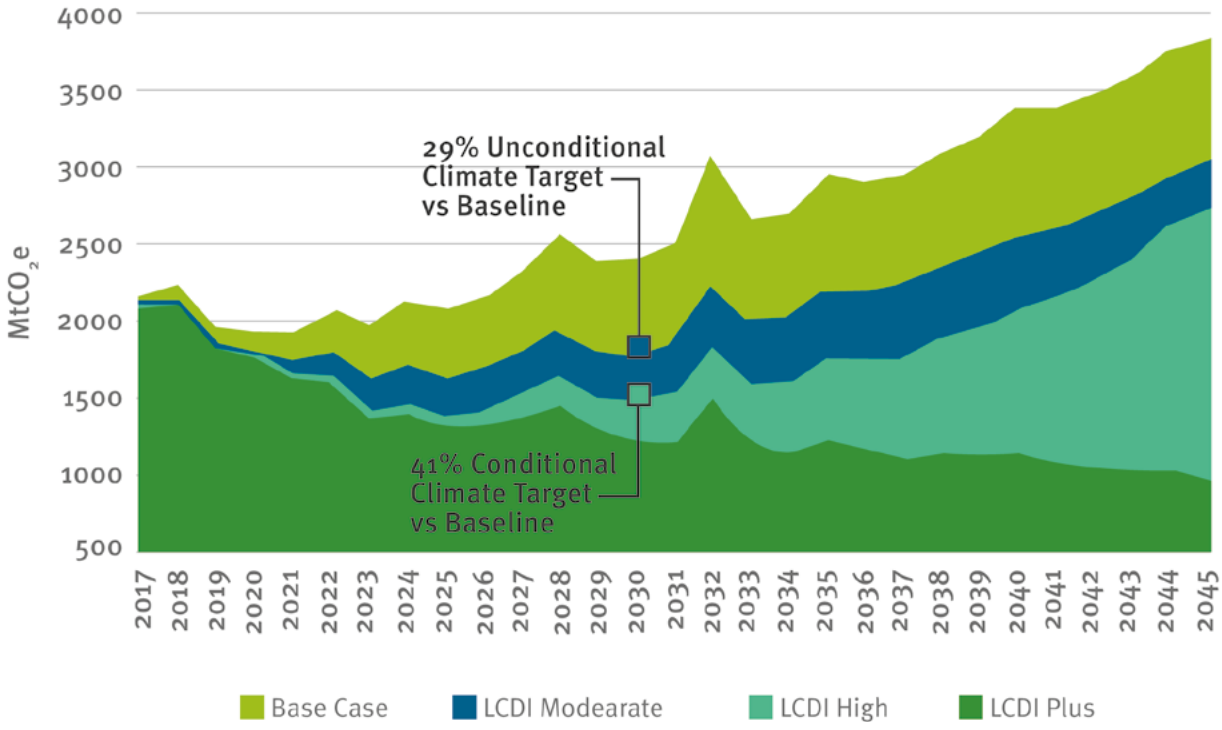
Figure 1 GDP Growth Trajectories for Scenarios Modeled



Source: Ministry of National Development and Planning (2019)

The LCDI modelling exercise analyzed four development scenarios (Figure 2). The first is the LCDI Low Scenario, in which there are no new policies and economic decline continues. It considers the impacts of environmental degradation, including pollution and increased scarcity of environmental goods and services on people and the economy. The second is the LCDI Moderate Scenario, which includes new low carbon policy measures for 2020-2045; it achieves the unconditional nationally determined climate target (NDC) of 29% less emissions in 2030, compared to the baseline. Under this scenario, the required additional investment is estimated at an average of US$ 14.8 billion per year in 2020-2024 (about 1.1% of GDP), and US$ 40.9 billion per year in 2025-2045 (1.4% of GDP) (Ministry of National Development Planning, 2019).The third is the LCDI High Scenario. It includes more ambitious policy measures than LCDI Moderate for 2020-2045 and achieves a conditional NDC target. This scenario leads to 43% less emissions in 2030 compared to the baseline. It is consistent with the Indonesian national climate target, which is a 41% reduction in emissions by 2030. Total GHG emissions are expected to decline from 2.14 $GtCO_2eq$ in 2017 to 1.49 $GtCO_2eq$ in 2030. The average LCDI High investment per year is expected to be US$ 22.0 billion (1.7% of GDP) for the period of 2020-2024, and US$ 70.3 billion (2.3% of GDP) for the period 2025-2045. And finally, the fourth is the LCDI Plus Scenario. It incorporates an extra low carbon policymaking mechanism starting in 2025, with emissions continuing to fall through 2045 and beyond. This fourth scenario requires a set of measures not currently under consideration in Rencana Pembangunan Jangka Menengah Nasional (RPJMN) (National Medium-Term Development Plan), such as i) a price on carbon; ii) higher reforestation targets, and iii) policies for even higher improvements in energy efficiency and reduction of waste.

Figure 2 Emissions Trajectories for Scenarios Modeled under LCDI



Source: Ministry of National Development and Planning (2019)

2.3 Industrial Policy

In addition to the National Medium-Term Development Plan (*Rencana Pembangunan Jangka Menengah Nasional* [RPJMN]) and the National Long-Term Development Plan (*Rencana Pembangunan Jangka Panjang Nasional* [RPJPN]), there are two other documents that form the basis of Indonesia's current industrial policy. The first is the 2008 National Industrial Policy (NIP) and the second is the Master Plan for Acceleration and Expansion of Indonesia Economic Development (MP3EI) launched in 2011. The government also endorsed a new industrial bill in late 2013 and a new trade law in early 2014 but has yet to formulate the necessary implementing regulations.

2.3.1 Presidential Regulation No. 28/ 2008 and Regulation of the Minister of Industry 41/M-IND/PER/3/2010

Improving the Indonesian economy and recovery from the post-crisis conditions are the driving factors for the growth of the industrial sector. Twelve years after the 2008 economic crisis, the annual growth of the industrial sector is still lower than its growth before the crisis. Efforts to accelerate development, build economic independence, equity development, and devolution to regions are supported by Law No. 32 of 2004 concerning Regional Government and Law No. 33 of 2004 concerning balancing finances between the central and regional governments (Tijaja, 2014).

2.3.2 Act No. 3/ 2014 about Industry

Act No. 3/ 2014 describes the objectives of industrial policy for industry to drive the national economy; to strengthen the industrial sector; to create an independent and competitive industry,; to create business certainty; to prevent industrial monopoly; to open new job opportunities; to create an even distribution of industrial development in all parts of the country; to strengthen and affirm national resilience; and to increase living standards. Furthermore, the policy addresses green industry in part two of the Act. As stated in the objectives of the Act, the government would

formulate regulations and strengthen institutional capacity for research and development, testing, certification, and promotion. Regulations would include guidance for raw materials, subsidiary materials, energy, production processes, products, waste management, and business management. To become a contributor to green industry, a company would need to have a green policy, apply an environmental management system, and develop a business web to obtain raw materials, subsidiary materials, and environmentally friendly technologies. Penalties for non-compliance with the regulations include written notices, temporary closure, suspension and/or revocation of industrial business licenses (Ministry of Industry, 2016).

2.3.3 Vision 2045

Indonesia has a long-term industrial development vision, which the government officially launched in 2019 (Ministry of National Development Planning, 2017). The vision is to become an industrialized nation by 2045. To do so, industry would need to change in the following manners to make a significant contribution to the national economy:

- Balanced abilities between Small and Medium Enterprises (SMEs) and large enterprises;
- Strong industrial structures;
- Advanced technology at the forefront of development and market creation;
- Sufficient industrial services to support international competitiveness; and
- Competitive advantage when there is full market liberalization within APEC countries.

Among the targets is the aim to increase contribution of the non-oil and gas industry to GDP from the current 24.0% to 30.0% by 2045. It also aims to raise the contribution of small and medium enterprises to be comparable to those of large industries. To achieve this, the sector needs to grow by 9.4% annually, which is an ambitious target. The policy highlighted seven "strategic outcomes" required to achieve this target, which include increasing manufacturing value-added, market share at home and abroad, innovation and technological capabilities, and broadening industrial development.

2.4 Environmental Governance and Management

The 2009 the Law on Environmental Protection and Management replaced the 1997 Environmental Management Act. The 2009 Law is comprehensive in that it covers environmental inventorying and monitoring, stipulation of eco-regions and formulation of environmental protection and management plans. Regarding industry, the Law requires that business and/or activity with substantial environmental impact must undertake an environmental impact assessment and obtain an environmental permit. The Law makes provisions for management of hazardous and toxic materials. It increased the power of the Ministry of Environment and Forestry (MoEF)to oversee compliance monitoring and enforcement activities by provincial and local governments.

MoEF was formed in 2015 by a merger of the environment and forestry ministries. Indonesia's environmental legislation is primarily sector-based, with several other ministries having important environmental responsibilities. The MoEF's powers are more limited than those of sectoral ministries, and it lacks the financial and human resources to fully exercise its mandate. Four coordinating ministries strive to address policy development fragmentation with limited success. Nevertheless, environmental management, particularly authorizing and compliance assurance, often involves overlapping interests and institutional conflicts. Some regions have initiated inter-jurisdiction collaboration on environmental matters at the local level to help disseminate good practices and build capacity.

The environmental impact assessment (EIA) is the backbone of the country's environmental

regulation. It is undertaken primarily at the local and provincial levels, and its application has improved in recent years due to stricter regulatory requirements and better guidance. However, many projects are still approved without appropriate EIA. If an activity does not require EIA, the operator must submit an Environmental Management and Monitoring Program (EMMP) document. These documents are usually very general, and local authorities review them only superficially. EIA or EMMP approval results in the issuance of an environmental permit that does not cover wastewater discharges or waste management, which are governed by separate permits. Environmental permits rarely contain limits on polluting activities and are valid indefinitely without being subject to periodic review.

Standards for coal-fired power plants and the pulp and paper industry remain significantly less stringent than international standards and the government plans to introduce stricter standards for coal-fired power plants in the future. However, national emission standards for the cement industry were issued in 2017.

The government is stepping up efforts to manage solid waste. The National Solid Waste Management Policy and Strategy aims to reduce waste by 30% by 2025 and effectively manage the remainder. It requires local authorities to develop waste management strategies for 2025 (less than half of the cities and regions have waste strategies) and to regularly report on progress.

2.5 Green Industry Programs

Two government ministries manage green industry programs: The MoI manages the interrelated Green Industry (GI) Award and Certification programs and the MoEF manages the Public Disclosure Program for Industrial Pollution Control (PROPER).

2.5.1 Green Industry Award

The MoI launched the GI Award with regulation No. 18/ M-IND/ PER/3 2016. The award program requires companies to meet several assessment aspects for production processes, waste treatment performance, and management/company commitment. The Green Industry Certificate, and the GI award are open to all national manufacturing companies. As of 2018, there were 877 companies participating in the GI award program, of which 740 companies received higher level four or five scores upon completion of the assessment. In 2018, 153 companies that participated in the green industry award program received level four or five scores. As shown in Table 3, the participation of companies has increased every year except for 2017.

Table 3 Companies receiving GI Award (2015-2018)

Year	Number of Participant (Companies)	Number of Companies that Got GI Award	
		Level 4	Level 5
2015	112	43	59
2016	142	64	65
2017	133	37	87
2018	153	56	87

Source: Ministry of Industry (2018b)

2.5.2 Green Industry Certification

The GI certification procedure is defined by the MoI regulation No. 39/2018. GI certification differs from the GI award in that a certified company is authorized to put the GI logo on its product packaging, product label, letterhead, business card, or promotional media. The certificate has a longer validity period of four years and can be extended – through a re-cer-

tification process – if the company continues to comply with the GI standards. In 2018, 14 companies received GI certificates.

2.5.3 *Program Penilaian Peringkat Kinerja Perusahaan dalam Pengelolaan Lingkungan Hidup* (PROPER)/ Public Disclosure Program for Industrial Pollution Control.

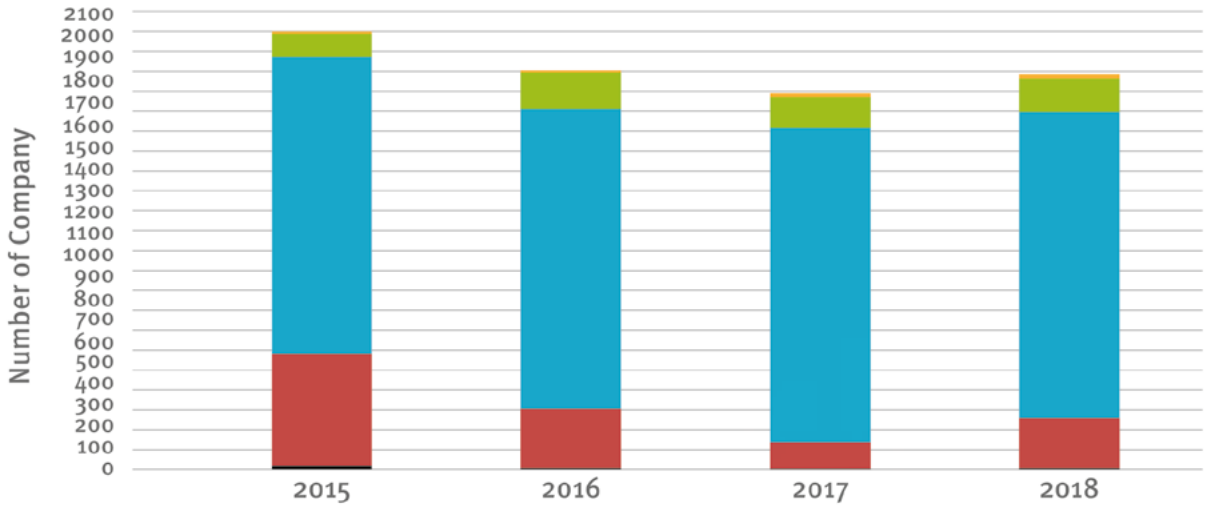
The Company Performance Rating Program (PROPER) (*Program Penilaian Peringkat Kinerja Perusahaan*) under MoEF is an assessment of a company's environmental management performance. It was launched in June 1995 with the objective of reducing pollution with minimum regulatory costs (Garcia et al., 2009 and Ardiansyah, 2014).

The program uses a color-coded rating system ranging from gold for excellent performance, to black for poor performance. The black code means that a company does not meet pollution discharge standards and makes no efforts to reduce pollution discharges. The red code means that a company makes some efforts to comply with environmental standards but fails to successfully meet them and lacks sufficient reporting mechanisms. The blue code means that a company successfully meets pollution discharge standards and has reasonably frequent reporting. The green code is intended for "proactive" companies with a water pollution load of less than 50% of the discharge standard.

The gold code is reserved for companies with air and hazardous waste loads that are 50% less than even green code requirements, use cleaner technology in production, and adopt waste minimization and pollution control measures. PROPER has had a significant effect in shifting factories from noncompliance to compliance in Indonesia.

In 2018, 1,906 companies participated in the program. Out of this number, 905 companies are from the agro-industry sector, 560 from the manufacturing, infrastructure, and service sectors, and 441 from the mineral oil and gas, energy, and mining sectors. The award distribution is as follows: 20 companies have received the gold code with 155 receiving green, 1,454 blue, 241 red, and 2 black (Figure 3).

Figure 3 PROPER Ranking 2013-2018



	2015	2016	2017	2018
Gold	12	12	19	20
Green	108	172	150	155
Blue	1406	1422	1486	1456
Red	529	284	130	241
Black	21	5	1	2

Source: Ministry of Environment and Forestry (2018b)

As shown in Table 4, there are yearly data on the reductions of non-hazardous waste, hazardous waste, and GHGs, and improvements in water and energy efficiency. In 2018, each indicator has increased from the previous year except in non-hazardous waste reduction, which has decreased approximately by 41% compared to the previous year. Over the period from 2015 to 2018, the greatest non-hazardous waste reduction was recorded in 2017 (11.56 million tons), while the greatest hazardous waste reduction was in 2018 (16.3 million tons), and GHG emission reduction was in 2016 (75.7 CO_2 Eq). The greatest improvements in water efficiency were in 2018 (540.4 m^3) and in energy efficiency in 2015 (919.1 million GJ).

Table 4 PROPER Performance

Year	Non-hazardous Waste Reduction (million tons)	Hazardous Waste Reduction (million tons)	Water Efficiency (million m^3)	Energy Efficiency (million GJ)	GHG Emission Reduction (million tons CO_2 Eq)
2015	9.4	4.8	533.1	919.1	48.1
2016	3.2	6.4	447.4	249.8	75.7
2017	11.6	13.6	492.1	230.6	33.6
2018	6.8	16.3	540.4	273.6	38.0

Source: Ministry of Environment and Forests (2018b)

Approximately 2,000 companies have participated in the PROPER initiative but only 6% are large industrial enterprises. PROPER has substantial potential as an incentive for compliance behavior by enterprises. The key driver of PROPER is its public pressure. Government investment in citizen environmental awareness programs would further intensify its impact.

2.6 Policies supporting International Trade Regime

The Act No. 7/2014 about trade includes statements about the foreign trade sector, i.e. exports and imports in Indonesia. It is stated in article 38 in the Act that the government regulates export and import activities through policy and control. The prohibition and restriction of export and import activities are the control aspects of the Act. In order to protect the human, animal, fish, plant, and living environment's health and safety for national security, the government can prohibit or restrict the import or export of a certain good based on this regulation (stated in Article 50 and 54).

Indonesia has implemented free trade agreements with more than 25 countries (Sugiharti et al., 2020). Exports expanded from nearly US$ 100 billion in 2006 to more than US$ 200 billion in 2011, then declined to US$ 145 billion in 2014. More than 50% of total exports consisted of raw materials and intermediate goods (mainly resource-based), which are more volatile in prices and sensitive to changes in global demand. The percentage of trade in Indonesia's GDP decreased from 55% in 2006 to nearly 40% in 2017. This was not only due to increasing local consumption but also because of lower export value. While theoretically an increase in exports may be expected due to a weaker Indonesian Rupiah, exports have not recovered as an overvalued currency has decreased demand and lowered commodity prices (Pino et.al.,2016 and Hegerty, 2016).

2.7 GHG Management Schemes

There are both international and national management schemes for reducing GHG emissions operating in Indonesia.

2.7.1 International

The carbon market scheme has proven to be one of the effective policy instruments in an effort to reduce emissions whether domestically or globally. Indonesia has actively participated in these schemes since 2005 with the formation of *Komisi Nasional Mekanisme Pembangunan Bersih* (Komnas MPB)/ National Commission on Clean Development Mechanism. Market-based mechanisms used as financing alternatives include the Clean Development Mechanism (CDM), Verified Carbon Standard (VCS), Joint Crediting Mechanism (JCM), Gold Standard (GS) and Plan Vivo, and *Skema Karbon Nusantara* (SKN)/ Nusantara Carbon Scheme (PMR Indonesia, 2018).

The CDM has gained significant interest from industries and the business sector, with most projects focused on energy conservation, renewable energy, and waste conversation to energy. The carbon credit or Certified Emission Reduction (CER) includes 32.17 million tons of CO_2 with 46 projects out of 166 projects registered in the UNFCCC (PMR Indonesia, 2018). However, CDM implementation in Indonesia decreased significantly after 2012 when the European Emission Trading Scheme (EU-ETS) declared that only low-income countries' carbon credits are accepted.

As an alternative, a voluntary program such as the Verified Carbon Standard (VCS), has become more viable since 2012, although it does not have as many projects as the CDM. VCS's mechanism is relatively simpler and has lower transactional costs than the CDM. Indonesia has now actively implemented VCS because this scheme is highly preferred by REDD+ and afforestation developers. Its carbon credits reached 14.16 million tons of CO_2 with a total of 13 projects. The two largest REDD+ projects in the world are included in this VCS scheme: PT Rimba Raya Utama with 3.53 million tons of CO_2 and PT Rimba Makmur Utama with 7.45 million tons of CO_2 (PMR Indonesia, 2018).

Beside VCS, the Joint Crediting Mechanism (JCM) is being implemented in Indonesia after the change of policy towards CDM in 2012. JCM is based on bilateral partnerships between Japan and a host country, among which Indonesia is included. A total of two projects (out of 29 JCM projects) in Indonesia have reached carbon credits of 40 tons of CO_2 (PMR Indonesia, 2018). Despite the strict activity requirements, JCM is developing relatively fast in Indonesia. Funding assistance from Japan in the form of subsidies and grants makes it possible for private parties and state-owned-enterprises to implement the emission reduction activities and use recent technologies with affordable costs and sustainable implementation.

The Gold Standard (GS) formed in 2003 by the World Wildlife Fund, and Plan Vivo have developed small-scale projects, especially community-based ones. By having a lower standard than other mechanisms, they make it possible for small developers to implement GHG reduction as the validation and verification have lower transactional costs. In Indonesia, there are six projects based on Plan Vivo and 19 projects on Gold Standard.

2.7.2 Domestic GHG Management Programs

Nusantara Carbon Scheme (Skema Karbon Nusantara [SKN]) is an Indonesia-based mechanism developed by the National Council on Change (DNPI). It aims to facilitate development of a certification program for domestic emission reduction with a carbon market in Indonesia. This mechanism is similar to the CDM and JCM, but its carbon credit is not causally related with any GHG emission reduction policies. However, SKN can still support the emission reduction goal of Indonesia under the UNFCCC. SKN is expected to attract private parties willing to reduce their GHGs through emission trading. Unfortunately, since the dismissal of DNPI in 2015, the government has not developed the scheme further.

Indonesia is considering a market-based carbon pricing policy, including an Emissions Trading Scheme (ETS) for the power and industry sectors to help meet its nationally deter-

mined contributions (NDC) and targets as well as foster low carbon sustainable development to a greater extent. In 2017, Indonesia passed Government Regulation No. 46/2017 on Environmental Economic Instruments; this regulation sets a mandate for an emission and/or waste permit trading system to be implemented by 2024 (within seven years from its passage) (ICAP, 2019).

Some governmental regulations mention that environmental protection should be considered in trading activities. For example, Article 50 and 54 in Act No. 7/2014 state that the government can prohibit and restrict export and import activities for national interests/benefits in order to protect the health and safety of human, animal, fish, plant, and the environment. MoEF Regulation No. 3/2014 can indirectly control GHG emission through PROPER.

2.8 Indonesia Industrial Measurement, Reporting, and Verification Systems

There are two programs for monitoring industrial activities: National Industrial Information System and the Energy Management and Online Reporting.

2.8.1 Sistem Informasi Industri Nasional (SIINAS)/National Industrial Information System

SIINAS is an integrated information system providing data on industry, e.g. market opportunities, regulations, and export-import developments. It is regulated in Article 68 of Act No. 3/2014. This system targets companies, industrial associations, industrial area managers, local governments, related ministries or organizations, communities, and the internal circles of the MoI itself, as its users. The key feature of SIINAS is the online submission of a production report by industrial companies and area managers. As the reports are collected, the system will process the data and present them to users (Ministry of Industry, 2019)

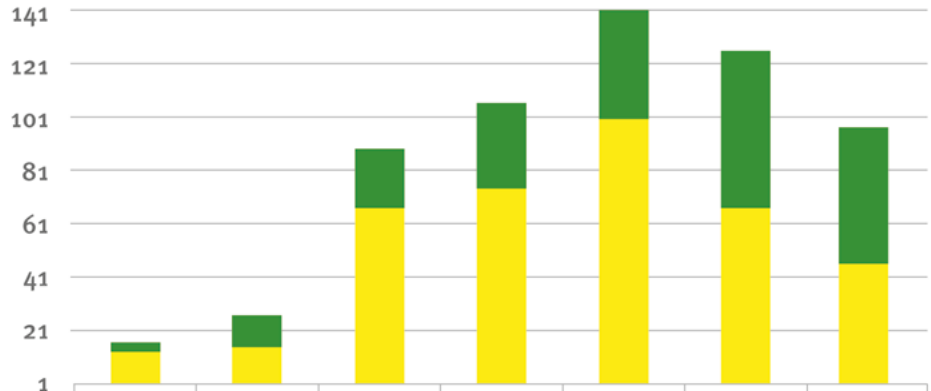
2.8.2 Pelaporan Online Manajemen Energi (POME)/ Energy Management Online Reporting

Energy management is regulated by regulations No. 70/2009 and No. 14/2012. It requires energy users (companies or contractors) using more than 6,000 TOE (ton of oil equivalent) per year to implement energy management systems. The activities of energy management as stated in Article 12 of Government Regulation No. 70/2009 include: (a) appointing a certified energy manager, (b) constructing an energy conservation program, (c) executing an energy audit periodically through a certified auditor, (d) executing an energy audit result recommendation, and (e) reporting energy conservation implementations to the government each year (Djebtke, 2019).

Pelaporan Online Manajemen Energi (POME)/energy management online reporting is an online platform created to facilitate energy companies/users in reporting their energy management implementation to the government. Through this system, the government would be able to know the stated implementation status hence providing a base to construct policies, programs, and benchmarks for energy efficiency. Furthermore, POME can also be used by registered companies to compare the performance and steps taken by other companies with their own (ESDM POME, 2019).

POME reports are categorized as either Green or Yellow. The Green Category refers to users who have implemented all points stated in Article 12 of the Government Regulation No. 70/2009, while the Yellow Category refers to those who have only partially implemented them. Based on the 2019 first semester report of POME, there are 51 users in the Green Category and 44 users in the Yellow category with a total energy savings of 10,321 GWh eq Figure 4). In total, energy savings ranging between 2013 and 2019 consisted of 35,509 GWh eq (Djbetke, 2019)

Figure 4 POME users' achievement year 2013 – 2019's first semester



	2013	2014	2015	2016	2017	2018	2019*
Green Category	3	10	21	29	41	57	51
Yellow Category	12	13	65	75	100	65	44

Source: Djebtke (2019)

2.9 Institutional Capacity for Green Industrialization Programs

Two ministries are responsible for greening industry initiatives. MoI through its Industrial Research and Development Agency (*Badan Penelitian dan Pengembangan Industri* [BPPI]) administers two inter-related programs, the Green Industry (GI) Award and the GI certification. The GI award is managed by the GI center (*Pusat Industri Hijau*) and the GI certification is managed by LSIH (*Lembaga Sertifikasi Industri Hijau)*, while MoEF administers the PROPER program.

2.9.1 Pusat Industri Hijau/GI Center

The GI Center is responsible for administering the GI Award program. In administering the assessment process for the GI award, the GI Center has its own operational team consisting of a secretariat team, a technical team, and an advisory council.

2.9.2 Lembaga Sertifikasi Industri Hijau (LSIH)/GI Certification Body

In assessing a company, the MoI assigns responsibility to a certification body called *Lembaga Sertifikasi Industri Hijau* (LSIH). To be a LSIH, a certification body needs to fulfill the SNI ISO 17065 requirements concerning compatibility assessment of a product, process, and service certification body. In the certification process, LSIH fulfills the role as an auditor which covers most of the scheme's activities from collecting administrative documents to making final decisions regarding the assessment.

2.9.3 Ministry of Environment and Forestry

The PROPER secretariat and technical team of MoEF are responsible for implementing the program.

2.10 Industry 4.0

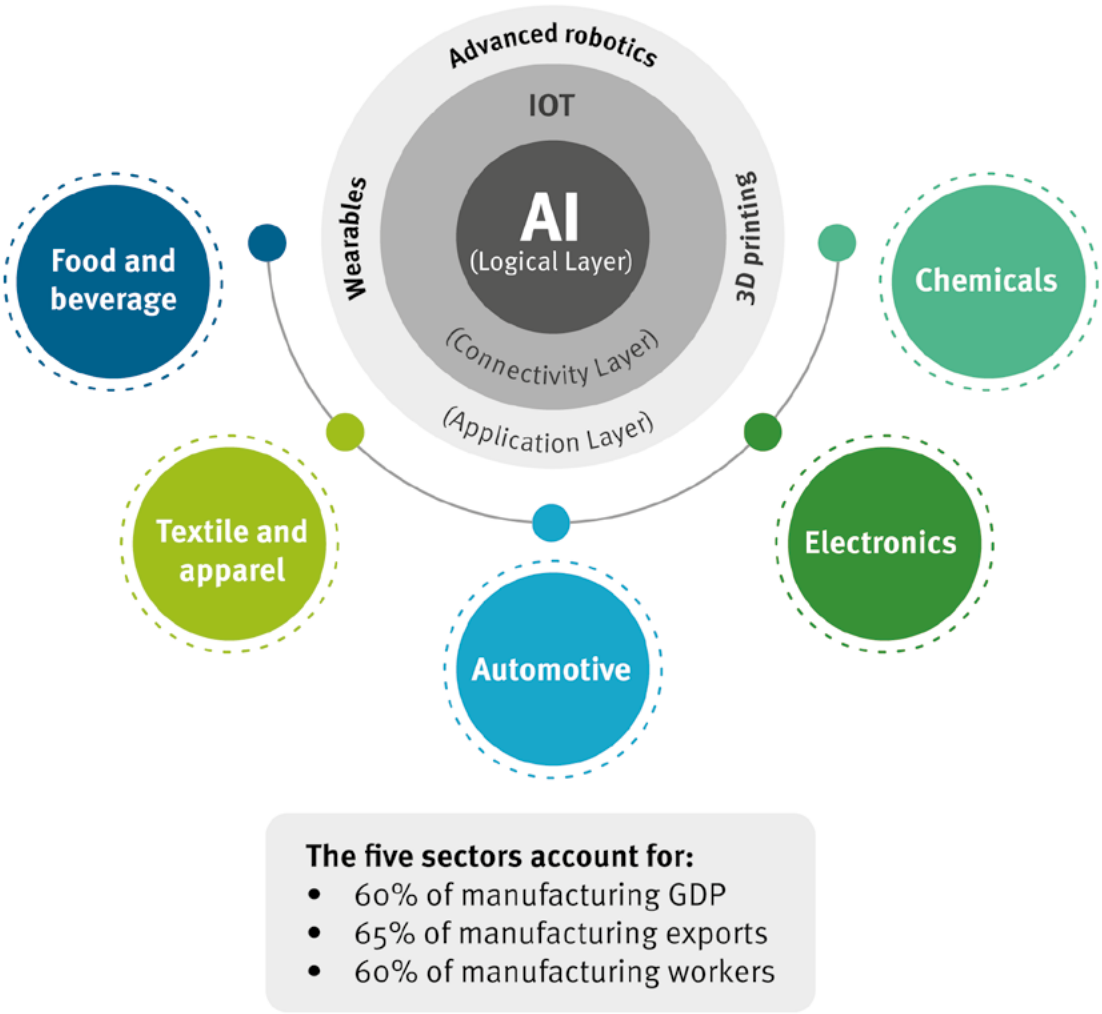
For Indonesia, Industry 4.0 provides opportunities to revitalize the manufacturing sector in order for it to make a significant contribution to Indonesia becoming the tenth largest economy in the world by 2030. In 2018, the MoI designated four strategic methods in which to introduce Industry 4.0:

- Encourage workers to improve their skills, especially in using "internet of things" technology;
- Use digital technology to encourage productivity and competitiveness of SMEs to be able to penetrate the export market through the e-smart IKM programs;
- Utilize digital technology in national industries (Big Data, Autonomous Robots, Cybersecurity, Cloud and Augmented Reality);
- Encourage technological innovation through the development of start-ups so that more technology-based entrepreneurs develop in Indonesia.

2.10.1.Making Indonesia 4.0

MoI launched the "Making Indonesia 4.0" program in April 2018. The program involves key stakeholders including the government, industry associations, business professionals, technology providers, and research and education institutions. There are five technologies that support the development of industry 4.0, which are the (i) Internet of Things, (ii) Artificial Intelligence, (iii) Human-machine Interface, (iv) Advanced Robotics, and (v) 3D Printing (Figure 5).

Figure 5 Five manufacturing sectors which are prioritized for the implementation of making Indonesia 4.0 program



Source: (Ministry of Industry, 2018)

During the program implementation phase, Indonesia will focus primarily on five manufacturing sectors, i.e. (i) food and beverage, (ii) textile and apparel, (iii) automotive, (iv) electronics and (v) chemicals (Table 2.5). The selection is based on the result of an evaluation of economic impacts and implementation feasibility, which includes the contributions to GDP and trade, the potential impact on other industries, the size of investments, and the speed of market penetration. The government will evaluate the strategy of each sector every three years to assess its progress and to review implementation challenges (Ministry of Industry, 2018).

2.10.2 Indonesia Industry 4.0 Readiness Index (INDI 4.0)

MoI initiated the Indonesian Industry 4.0 Readiness Index (INDI 4.0) in 2019 as a standard to measure the level of readiness of companies to incorporate industry 4.0. It is a self-assessment tool to be utilized by each company, and if a company passes the INDI 4.0 assessment, it should be deemed sufficiently competitive to increase production and meet export market requirements.

In 2019, 328 companies conducted online INDI 4.0 self-assessments through the National Industrial Information System/*Sistem Informasi Industri Nasional* (SIINAS) account. These included 39 food and beverage companies, 10 textile companies, 30 chemical companies, 198 automotive companies, 28 electronics companies, 11 metal companies, 11 multi-product companies), and 1 EPC one company. From the results of INDI 4.0 self-assessments conducted, a number of companies were ready to transform into industry 4.0 (Ministry of Industry, 2019).

2.11 Energy

Electricity consumption savings are regulated by the Ministry of Energy and Mineral Resources (MoEMR) under Regulation No. 9/2018, which encourages investments in renewable energy and energy conservation.

2.12 Solid and Hazardous Waste

Act No. 18/2008 requires companies to manage their solid waste and to provide their own waste separation facility, including by putting labels or symbols related to waste reduction and handling on their product packaging.

Regulation No. 101/2014 covers hazardous waste management including classification, reduction, storage, collection, transportation, utilization, treatment/processing, accumulation, dumping/disposal, exception, and border transferring of hazardous waste. In addition, the handling and recovery of environmental pollution, emergency responses towards hazardous waste management, and other aspects are covered. Parties involved in hazardous waste management should have a permit for each of these activities, e.g. a company that stores and collects hazardous waste should have a permit for the storage activity and another permit pertaining to collection activity.

2.13 Summary

Indonesia as the largest economy in Southeast Asia has experienced impressive economic growth since overcoming the Asian financial crisis in the late 1990s. The annual growth rate of GDP averaged 5.0% from 2000 until 2020, reaching an all-time high of 7.2% in the fourth quarter of 2004.

This rapid economic growth has also affected GHG emissions, particularly from the two main sources of GHG emissions in Indonesia, i.e. FOLU (forestry and other land use) and the energy

sector. The government declared its goal of integrating climate action into the country's development agenda in 2017. The Ministry of National Development Planning launched a Low Carbon Development Initiative with the aim of explicitly reducing GHGs. Supporting the Initiative are both international and national carbon management schemes described in section 2.7.

The 2009 Law on Environmental Protection and Management is comprehensive in that it covers environmental inventorying and monitoring, stipulation of eco-regions and formulation of environmental protection and management plans. The MoEF is responsible for implementing the Law. There are other relevant laws and regulations for greening industry, including those for energy and solid and hazardous waste management mentioned above.

Both the interrelated and voluntary Green Industry (GI) Award and Certification programs and the mandatory Public Disclosure Program for Industrial Pollution Control (PROPER) are playing significant roles in greening industry.

MoI launched Industry 4.0 in 2018 with the expectation that a revitalized industrial sector would contribute significantly to Indonesia becoming the tenth largest economy in the world by 2030 as well as transitioning to a greener industry.

3 Indonesia's Manufacturing Sector and Trade in Manufactured Goods

This chapter discusses the current condition of manufacturing industries in Indonesia including the classification of manufacturing industries, manufacture value added and manufacture employment. It describes the current condition of exports and imports, identifying products that demonstrate export potential or face challenges. Lastly, it presents an in-depth characterization of four subsectors that are prioritized in the LCDI, namely the cement, pulp and paper, fertilizer, and food and beverage subsectors.

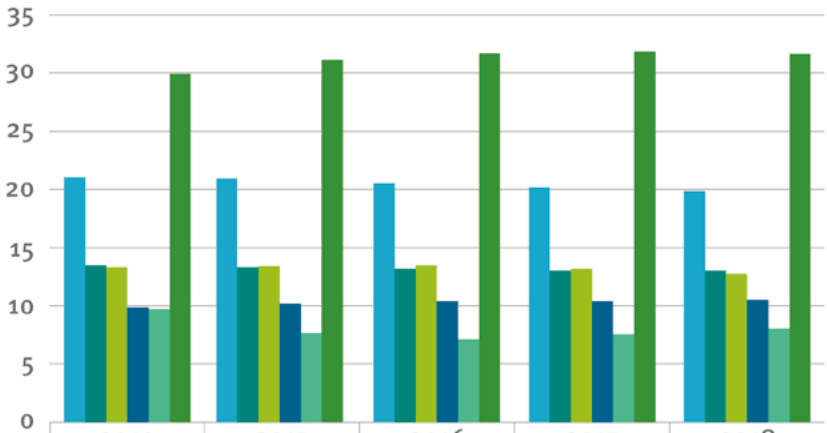
3.1 Current Status of Manufacturing

Manufacturing is an economic activity that transforms raw materials mechanically, chemically, or by hand, so that they become finished or semi-finished goods, which have a higher value, and are closer to the end-user. There are 24 subsectors in the manufacturing sector.

3.1.1 Manufacturing Value Added

The manufacturing sector is the largest contributor to Indonesia's GDP. Based on a National Statistics Agency report in 2018, the manufacturing sector constituted 19.9 % of GDP, followed by large and retail trade, repair and maintenances of cars and motorcycles with 13.0%, and agriculture, forestry, and fisheries with 12.8%. However, data for the past five years and a forecast for the future show its share of GDP is decreasing.

Figure 6 Distribution of the National GDP



	2014	2015	2016	2017	2018
Manufacturing industry	21.08	20.99	20.52	20.16	19.86
Large and trade retail; repair and maintenance of cars and motorcycles	13.43	13.3	13.19	13.02	13.02
Agriculture, forestry, and fiseries	13.43	13.49	13.48	13.15	12.81
Construction	9.86	10.21	10.38	10.38	10.53
Mining and excavation	9.83	7.65	7.18	7.58	8.08
Other business fields	29.97	31.21	31.68	31.86	31.65

Source: BPS (2018)

Out of the 15 countries with the largest shares of manufacturing in GDP, Indonesia ranks fourth, ranking behind South Korea (29%), China (27%), and Germany (23%) (Republic of Indonesia, 2018).

The United Nations Industrial Development Organization (UNIDO) ranked Indonesia tenth in manufacturing value added (MVA) in 2018, worth around US$ 248 billion. China is at the top of the list, followed by United States of America, Japan, Germany and India. Among ASEAN countries, Indonesia is at the top of list, followed by Thailand, Malaysia, Philippines, and Singapore (UNIDO, 2018a).

The annual percentage increase over the period 2007 to 2017 showed considerable variation (Figure 7). In all years it increased more than 4% except for 2008 and 2009, the years of the Asian financial crisis.

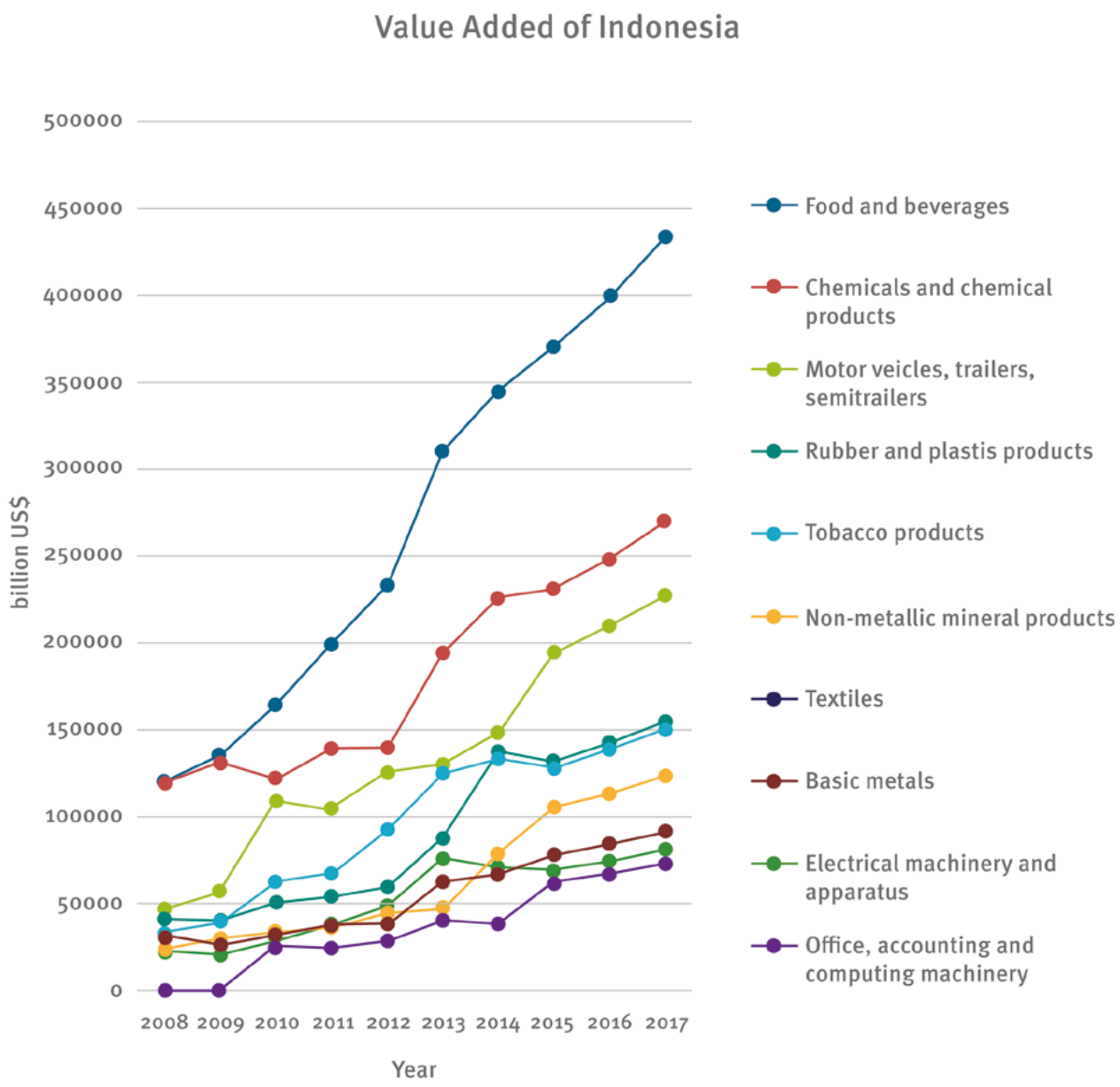
Figure 7 Indonesia's MVA Annual Growth

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2077
Series 1	4.67	3.66	2.21	4.74	6.26	5.62	4.37	4.64	4.33	4.26	4.29

Source: World Bank (2018)

The contributions of the 10 largest manufacturing subsectors to MVA from 2008 to 2017 are displayed in Figure 8. Among all the manufacturing industry subsectors, food and beverage is the leading subsector since 2009, followed by chemicals and chemical products, and motor vehicles, trailers, and semi-trailer. Rubber and plastic products have increased at a faster rate than tobacco products since 2014. The non-metallic mineral products subsector has expanded since 2013, while electrical machinery and apparatus has contracted since 2015.

Figure 8 Manufactured Value Added of Indonesia



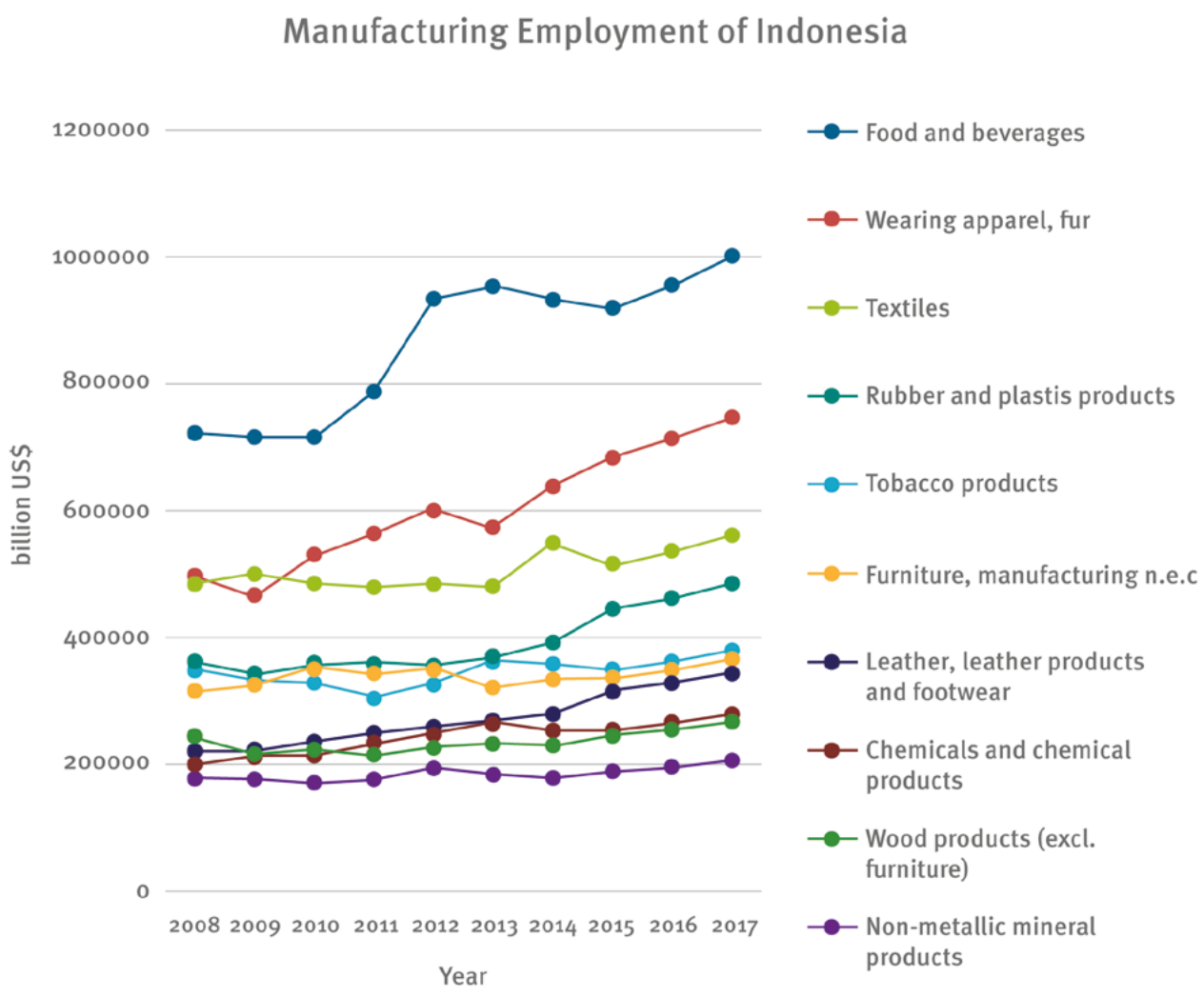
Source: UNIDO (2018b)

3.1.2 Manufacturing Employment

The manufacturing sector employed 14.7% of the workforce in 2018, while the agriculture sector remained the country's primary employer with 28.8% of the total workforce (BPS, 2018). Manufacturing employment in Indonesia grew by an average rate of 3.4% a year between 1991 and 2016 (UNIDO, 2018b).

Figure 9 shows data capturing the 10 largest manufacturing subsectors between 2008 and 2017. The food and beverage sector is leading in terms of number of employees, followed by clothing apparel and textiles. The number of employees in the apparel subsector has increased significantly over this period. However, the non-metallic mineral products sector employs the fewest workers.

Figure 9 Manufacturing Employment of Indonesia



Source: UNIDO (2018b)

3.1.3 Number of Enterprises

The number of enterprises (not necessarily manufacturing) in 2014 was approximately 60 million (Table 5). The agricultural sector accounted for about half of the number of enterprises. The number of medium sized enterprises was about 60,000 and the number of large enterprises about 6,000.

Table 5 Business establishments by firm size in Indonesia, 2006-2014

NUMBER OF ESTABLISHMENTS									
ENTERPRISES	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
A. MSME	49,021,803	50,145,800	51,409,612	52,764,750	54,114,821	55,206,444	56,534,592	57,895,721	59,262,772
Microenterprises	48,512,438	49,608,953	50,847,771	52,176,771	53,504,416	54,559,969	55,856,176	57,189,393	58,521,987
Small enterprises	472,602	498,565	522,124	546,643	568,397	602,195	629,418	654,222	681,522
Medium-sized enterprises	36,763	38,282	39,717	41,336	42,008	44,280	48,997	52,106	59,263
B. Large enterprises	4,577	4,463	4,650	4,676	5,150	4,952	4,968	5,066	4,987
TOTAL (A+B)	49,026,380	50,150,263	51,414,262	52,769,426	54,119,971	55,211,396	56,539,560	57,900,787	59,267,759

Source: Ministry of Cooperatives and SMEs (2016)

3.1.4 Industrial Estates

The country's industrial estate development program began in the 1970s when the national government, in cooperation with the regional governments, set up the country's first industrial estate in Jakarta. This estate became the Jakarta Industrial Estate Pulo Gadung, but due to the limited budget allocated to the program, in 1989 the government issued a decree that opened the industrial estate business to the private sector. This was subsequently followed by the issuance of a series of regulations that formed the legal and technical basis of the industrial estate development program in the country.

According to the latest available data from the Ministry of Industry, there were 172 industrial estates in 2012 located across the Indonesian archipelago, most of which are dominated by manufacturing activities. However, it is difficult to estimate the accurate numbers of industrial estates in Indonesia due to the absence of a unified government body in charge of economic zones. UNIDO suggests that there are 260 industrial estates in Indonesia (UNIDO, 2015).

The revision to the Government Regulation No. 24/2009 along with the issuance of policies targeted at easing investment inside industrial estates, are part of an effort to boost the competitiveness of Indonesia's industrial estates. While these efforts have improved the investment climate in the country, considerable work remains to be done to evaluate and resolve ongoing problems caused by ineffective policies (Octavia, 2016 and Sjaifuddin, 2018).

3.2 Current Status of Exports and Imports

Exports and imports have fluctuated over the past 10 years (Figure 10). Exports slightly decreased between 2011-2016, then increased again in 2017 but did not reach a level which was as high as that of 2011. Imports increased during the period between 2009-2012 and then steadily decreased up to 2016. In 2017-2018 imports increased again, and between 2012-2014 imports were greater than exports resulting in a trade deficit. Following this trend, the level of exports exceeded that of imports until 2018, resulting in a trade surplus.

Figure 10 Export and Import Value in Indonesia (All Sectors)

Source: BPS (2019)

3.2.1 Exports

The value of Indonesian exports in February 2019 was US$ 12.52 billion, which demonstrated an 11.3% decline from February 2018. The steepest decline in non-oil and gas exports between February 2018 and January 2019 occurred in mineral fuels (14.5 %), while the largest increase occurred in jewelry/ gems (53.0%). In the non-oil and gas sector, the value of exports declined by 6.0% between the periods of January 2018 and January 2019 to February 2019. Mining and other exports fell by 13.3%, while export of agricultural products increased by 4.6% (BPS, 2019).

Indonesia ranked 29th in global exports in 2018. The main export destination countries are China (15.1%), Japan (10.8%), the United States of America (10.2%), India (7.6%), and Singapore (7.2%). The five major exports and their destinations in 2018 are listed in Table 6.

Table 6 List of Main Products at the Two Digit Level Exported by Indonesia in 2018

No.	Product	Exported Value (US$ Thousand)	Main Export Destination
1	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes	42,011,767	China (20.9%) Japan (14.2%) India (13%)
2	Animal or vegetables fats and oils and their cleavage products; prepared edible fats; animal or vegetables waxes	20,346,230	India (17.9%) China (16%) Pakistan (7.2%)
3	Electrical machinery and equipment and parts thereof, sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories in such articles	8,855,431	Singapore (19.9%) Japan (17.3%) USA (9.4%)
4	Vehicles other than railway or tramway rolling stick, and parts and accessories thereof	7,552,010	Filipina (25.7%) Thailand (13.6) Vietnam (7.8%)
5	Rubber and articles thereof	6,381,285	USA (25.7%) Japan (13.8%) China (9.1%)

Source: ITC (2019a)

3.2.2 Imports

Indonesia's imports in February 2019 reached US$ 12.20 billion. Compared to January 2019, this was a decrease of 18.6%. The decline in imports occurred in both the oil & gas and non-oil & gas subsectors. Indonesia's trade balance in February 2019 is a surplus with US$ 329.5 million (BPS, 2019).

For world imports, Indonesia ranked 27th in 2018. The main origin countries are China (24.1%), Singapore (11.4%), Japan (9.5%), Thailand (5.8%), and The United States of America (5.4%). The five main imports and their countries of origin are listed in Table 7.

Table 7 List of Main Products at the Two Digit Level Imported by Indonesia in 2018

No.	Product	Imported Value (US$ Thousand)	Main Import Origin
1	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes	31,581,865	Singapore (37%) Saudi Arabia (11.6%) Malaysia (8.1%)
2	Machinery, mechanical appliances, nuclear reactors, boilers; parts thereof	27,197,373	China (36.3%) Japan (17.9%) Thailand (7.1%)
3	Electrical machinery and equipment and parts thereof, sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories in such articles	21,452,748	China (46.9%) Japan (8%) Singapore (5%)
4	Iron and steel	10,246,716	China (21.2%) Japan (18.2%) Republic of Korea (8.3%)
5	Plastic and articles thereof	9,210,567	China (19%) Singapore (14.6%) Thailand (13 %)

Source: ITC (2019a)

3.2.3 Key Sector Industry/Product with Export Potential

Based on international demand and national supply, palm oil (excluding crude) and fraction is the product with the greatest export potential followed by crude palm oil, technically specified natural rubber, newsprint and uncoated paper (-board) and motor vehicles for the transport of persons. Palm oil (excluding crude) and fraction shows the largest difference between potential and actual export in value terms. The gap between potential and actual export value is approximately US$ 10.4 billion. Table 8 shows the top five products with the greatest export potential.

Table 8 Products with the Greatest Potential Export

No.	Product	Potential Export	Indonesia's Export (actual)	Untapped potential
1	Palm oil (excl crude) & fraction	22.4	12	10.4
2	Crude palm oil	9.0	4.7	4.1
3	Technically specified natural rubber	6.4	4.4	2.0
4	Newsprint & uncoated paper (-board)	4.1	2.2	1.9
5	Motor vehicles for the transport of persons	3.9	2.7	1.2

Note: Export Values in US$ billion, Source: ITC, 2019b

3.2.4 Export Challenges

There are several challenges related to Indonesian export:

1. The growth rate of imports is greater than the export growth rate. To support export activities in manufacturing, some subsectors must import raw materials; meanwhile the export value is sometimes below the import value.
2. The product with the greatest export potential is palm oil. However, the environmental impacts of new oil palm plantations are extensive. Deforestation is the major issue that continues to negatively impact this industry. In addition, these plantations degrade soil quality and cause an increase in GHG emissions.
3. Technical requirements and conformity assessment procedures are among the most prominent Non-Tariff Measures affecting exports. Fumigation is the main problem under technical requirements.
4. Many Indonesian exporters appear to be ill-informed about what the export process entails, highlighting the need for better information about export processes including regulations in destination export country, national certificates, and certificate of origin, etc.

3.3 The Prioritized Manufacturing Industrial Subsector in Low Carbon Development Initiative: An overview from an International Trade Perspective

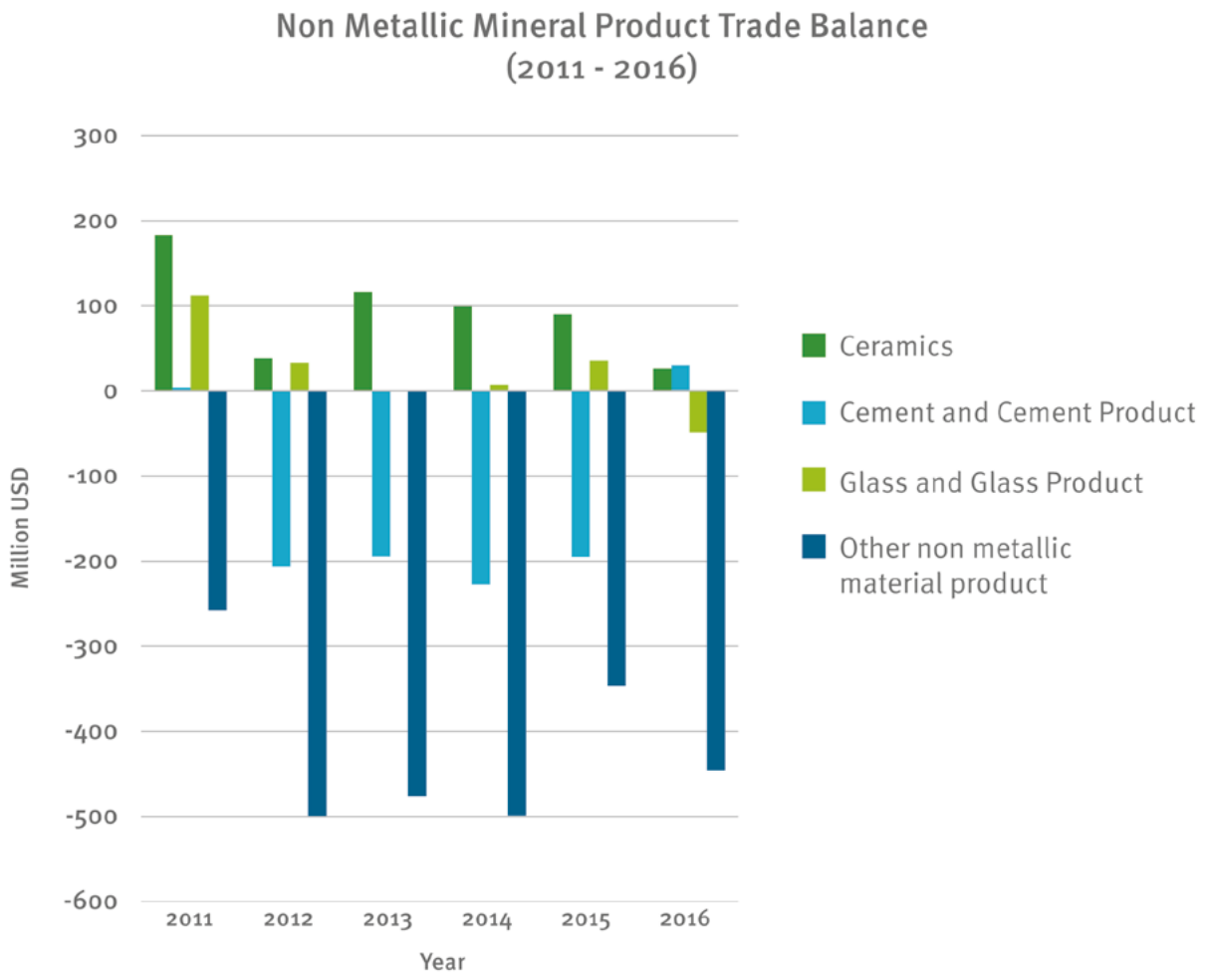
BAPPENAS has developed a modelling approach for Indonesia's LCDI that is currently being used as a basis for the "*RPJMN 2020-2024*". Industry, one of the sectors in the model, has been prioritized to contribute to low carbon development. The eight subsectors which are the key drivers of growth are also the highest energy users and main industry contributors to GHG emissions. The eight subsectors are cement, fertilizer, ceramics and glass, chemical, pulp and paper, textiles, iron and steel, and food and beverage. This section of the assessment examines four of these manufacturing subsectors, i.e. cement, fertilizer, pulp and paper, and food and beverage. These subsectors have shown high growth rates for the past few years and contributed significantly to GHG emissions. Hence, exploring the status of these subsectors will assist in defining a more sustainable development path for the manufacturing sector.

3.3.1 Cement Industry

By 2016, Indonesia became the largest cement producer in East Asia with a total capacity of 92 million tons, followed by Vietnam (78 million tons), Japan (60 million tons), and South Korea (55 million tons).

Figure 11 shows that the cement industry experienced a large trade deficit from 2012 until 2015 because of an increase in infrastructure development and significant growth in the commercial sector. Then in 2016, the cement subsector experienced a surplus again. This was influenced by government policies regarding cement import restrictions and the application of standards for cement production. Currently, cement production in Indonesia is experiencing overcapacity. According to MoI data, the cement industry was estimated to have an excess capacity of 30 million tons in 2017 because several new cement plants came online.

Figure 11 Non-Metallic Mineral Product Trade Balance (2011-2016)



Source: Ministry of Industry (2017)

3.3.2 Fertilizer Industry

Chemicals and chemical products are the second ranking manufacturing subsector in terms of value added. The fertilizer industry is one segment of this subsector sector. Based on data from the Indonesian Fertilizer Producers Association, the total sales of urea fertilizer, including exports, reached 5.17 million tons during the first nine months in 2018 or an average of 574,500 tons per month. In 2019, the fertilizer industry is estimated to grow in the range of 5% per annually along with increasing demand in the agricultural sector. According to MoI data, the growth of the agricultural industry reached 8% per year.

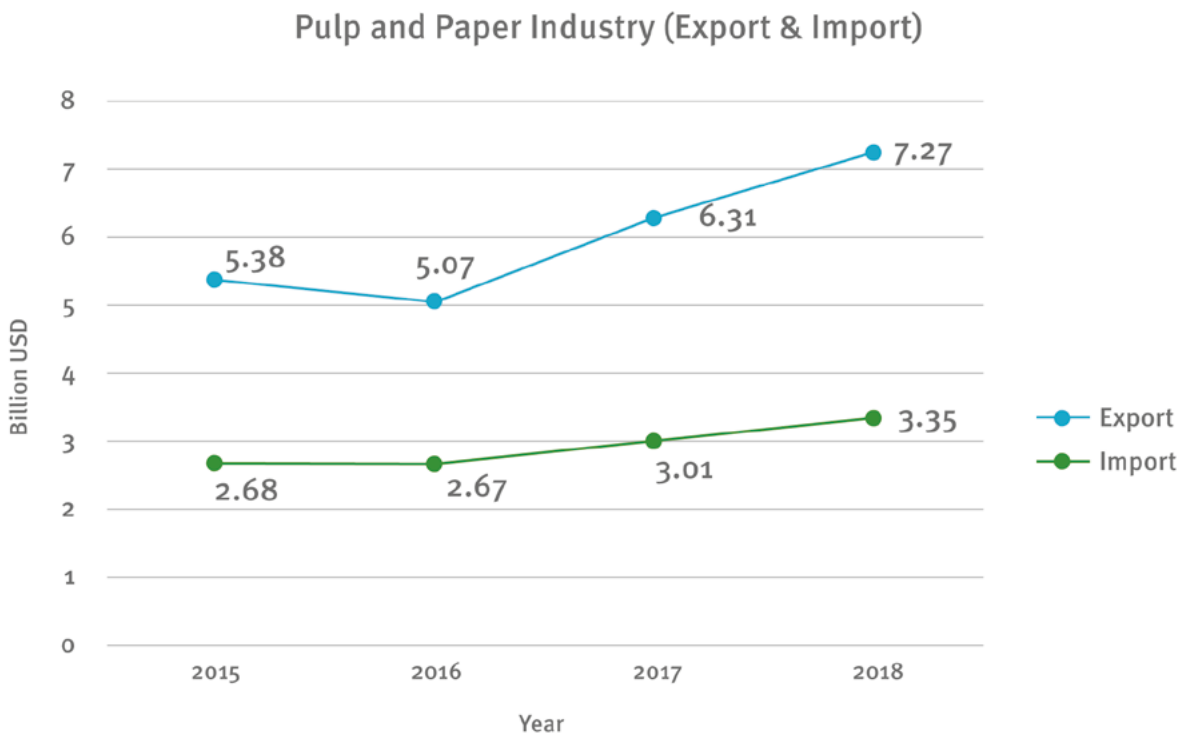
3.3.3 Pulp and Paper Industry

Although it is not included in the top ten manufacturing subsectors in terms of value added, the pulp and paper industry ranks 10th as the biggest pulp producer and ranks 6th as the biggest paper producer in the world. This industry is prioritized for development because Indonesia has a large supply of raw materials because of its tropical climate. The value added of pulp and paper industry is increasing every year. In 2018, it grew 1.1% from the previous year.

It can be seen in Figure 12, the trade balance in the pulp and paper subsector experienced

a surplus for the past five years. In 2018, the pulp and paper subsector reached its highest export surplus (3.92 billion US$). Based on data from the Indonesian Pulp and Paper Association, this industry is expected to grow by 5% because the global and domestic demand continues to increase on average by 2% annually.

Figure 12 Export and Import of Pulp and Paper Industry



Source: (BPS, 2018)

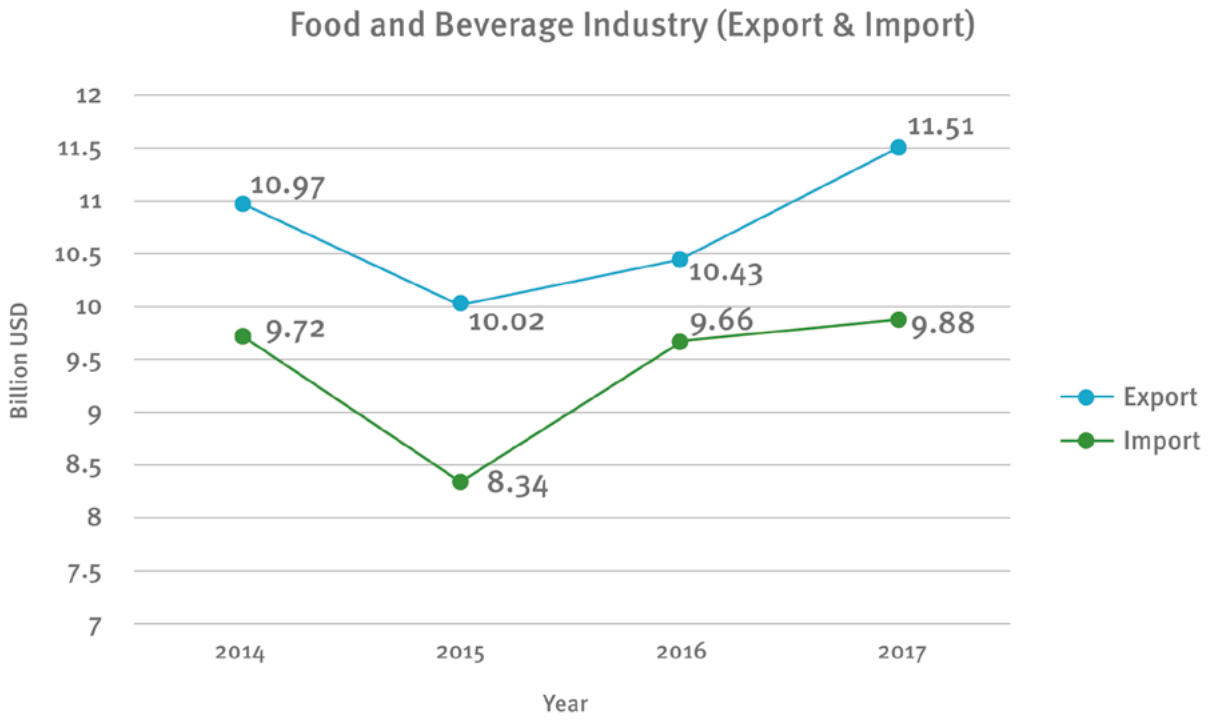
The pulp and paper subsector employs around 131,000 workers (BPS, 2017). It is classified as labor-intensive and export-oriented. As an export-oriented industry, there are several challenges for the pulp and paper industry, mainly economic tensions between the USA and China that push the pulp and paper prices higher as well as dumping allegations from various countries.

3.3.4 Food and Beverage Industry

As mentioned earlier, the food and beverage industry is the leading manufacturing subsector. The value added of the food and beverage industry has significantly increased over the past decade. Based on data from UNIDO, the number of workers in the food and beverage industry reached one million people in 2017 and has consistently increased each year.

The food and beverage industry experienced a trade surplus over the 2014-2017 period (Figure 13), and the surplus was greatest in 2015 with US$ 1.68 billion. The food and beverage industry is projected to be one of the mainstays supporting the growth of the manufacturing sector and the national economy. This is due to the subsector's domestic market size (the largest in the ASEAN region), the country's abundance of agricultural resources, the tendency of consumers to switch to modern pre-packaged foods, and (4) the emergence of players who can compete globally such as PT Indofood and PT Mayoral.

Figure 13 Export and Import of Food and Beverage Industry



Source: BPS, 2018

3.4 Summary

Based on the above analysis, Indonesia's manufacturing sector contributes the most to the country's national GDP. According to a National Statistics Agency report in 2018, the manufacturing sector constituted 19.9% of GDP. Out of the 15 countries with the largest shares of manufacturing in GDP, Indonesia ranks fourth, ranking behind South Korea (29%), China (27%), and Germany (23%). Among ASEAN countries, Indonesia ranks first, followed by Thailand, Malaysia, Philippines, and Singapore. Among all manufacturing subsectors, food and beverage is the subsector that has the highest value added and the greatest number of employees.

Although Indonesia's MVA ranks first in the ASEAN region, the percentage of manufacturing employment in total employment is still below that of Thailand and Malaysia. This is partly due to the fact that employment in Indonesia is still dominated by the agriculture, forestry, and fisheries sectors. However, the number of those employed in the manufacturing sector has increased since 2009. In 2016, manufacture employment accounted for 17% of total employees in Malaysia, and 16.6% in Thailand but only 13.5% in Indonesia.

The number of industrial zones continues to grow in Indonesia with the easing of investment restrictions. There are however several ongoing problems, including adverse environmental impacts due to ineffective policies as well as overlapping mandates between government agencies and private industrial estate associations.

Exports and imports in Indonesia have fluctuated over the past decade. Mineral fuels, mineral oils and products of their distillation, bituminous substances, and mineral waxes still dominate exports. Based on international demand and national supply, palm oil (excluding crude) and its fraction is the product with the greatest export potential with a gap of US$ 10.4 billion. There remain several challenges for expanding exports, mainly related to domestic regulations and the

procedures of importing countries. Expansion of oil palm plantations is also a constraint because of the environmental impact they pose.

Cement, fertilizer, pulp and paper and food and beverage sectors demonstrate high growth rates and make a significant contribution to the GDP, and in the case of the food and beverages sector, also to employment. At the same time, these sectors consume high levels of energy and are amongst high CO_2 emitting sectors which pose some challenges. There is a need for more conducive policy regimes that could accelerate the expansion of export and diversification of Indonesia's international market and that at the same time consider the necessity for greening growth.

4 Industrial Environmental Pollution and Resource Use

4.1 Overview

Probably the best and most current overview of environmental pressures in Indonesia is to be found in the 2020 Environmental Performance Index (EPI) (Wendling et. al, 2020). It ranks 180 countries on 29 performance indicators across 11 issue categories covering threats to human health, natural resources, and ecosystem services. These metrics, with the higher score indicating better performance, provide a gauge at a national scale of how close countries are to established environmental policy goals. The EPI thus offers a scorecard that highlights leaders and laggards in environmental performance, gives insight on best practices, and provides guidance for countries that aspire to be leaders in sustainability.

The EPI score for Indonesia in 2020 is 37.8, ranking it 117th out of 180 countries and 10th out of 25 Asia-Pacific countries. The median score for the 25 countries is 37.3. Some of its neighbors' scores in 2020 are 47.9 for Malaysia, ranking it 103rd out of 180 countries and 6th out of 25 Asia-Pacific countries; 45.4 for Thailand, ranking it 78th out of 180 countries and 7th out of 25 Asia-Pacific countries; and 33.4 for Vietnam ranking it 141st out of 180 countries and 18th out of 25 Asia-Pacific countries.

EPI is a composite of two sub- indices – environmental health and ecosystem viability. On the environmental health index, Indonesia ranks 122 out of 180 countries and 17 out of 25 Asia-Pacific countries with a score of 29.0, which is below the median score of 34.1 for the region. Within this sub-index, it scores below the regional median values on the air quality index (26.8), 143 out of 180 and 23 out of 25; on the sanitation and drinking water index (28.4), 145 out of 180, and 19 out of 25; and on the heavy metals index (34.6), 148 out of 180, and 22 out of 25; but above the regional median value on the waste management index (49.8), 68 out of 180, and 7 out of 25. Waste management is measured as controlled solid waste, which refers to the percentage of household and commercial waste (not toxic materials) generated in a country that is collected and treated in a manner that controls environmental risks.

On the ecosystem vitality score, Indonesia ranks 98 out of 180 countries and 6 out of 25 Asia-Pacific countries with a score of 34.7, which is below the median score of 39.5 for the region. Within this sub-index, it scores above the regional median values on biodiversity (56.3), 107 out of 180, and 11 out of 25; and on the climate change index (54.4), 78 out of 180 and 5 out of 25; but below the regional median values on ecosystem services (20.3), 159 out of 180 and 16 out of 25: on the fisheries index (11.9), 78 out of 180 and 18 out of 25; on pollution emissions index (40.4), 139 out of 180 and 22 out of 25; on the agriculture index (51.8), 45 out of 180 and 7 out of 25; and on the water resources index (0.0), 134 out of 180 and 22 out of 25. Tellingly, the zero score for water resources (estimated by the percentage of municipal wastewater that undergoes at least primary treatment) indicates that there is no municipal treatment for domestic and indirect industry wastewater.

4.2 Pollution and Resource Use

This section presents qualitative information about air, water and hazardous waste pollution, and use of water, material, and energy resources, all taken from OECD (2019). The next section presents quantitative data about CO_2 emissions.

4.2.1 Air Pollution

According to OECD data, 95% of the population was exposed to harmful levels of air pollution (above the WHO guideline value) in 2017. Air pollution caused an estimated 215 deaths

per million inhabitants in 2017. Transport, coal-fired power generation and waste burning are major sources of pollution.

National data on ambient air quality are based on small samples, but efforts are under way to install continuous monitoring equipment in all major cities (estimated to reach 40 cities in late 2018). A new electronic environmental reporting system for industrial facilities should broaden data collection on air emissions and could, in the medium term, help in the establishment of a comprehensive air emissions inventory.

4.2.2 Water Pollution

Freshwater quality is poor and has declined over the past decade. Half of the rivers of Java, the most populated island, are considered polluted or heavily polluted. Wastewater from households (untreated domestic sewage) is the main source of water pollution, followed by solid waste disposal, industrial effluent, mining, agriculture, and urban run-off. Monitoring on wastewater effluent is generally weak and according to estimates, only 14% of wastewater is treated. Various policy initiatives to reduce pollution discharge have achieved encouraging results, but their scale has been too small to significantly improve the quality of the targeted rivers.

4.2.3 Hazardous Waste

More attention needs to be given to hazardous waste management. Indonesia has only one private engineered hazardous waste landfill (located in West Java). Most hazardous waste is temporarily stored by factories on site, subject to licensing provisions under the 2009 Environmental Protection and Management Law. Verification of storage conditions has been challenging due to a general lack of resources, and it is unclear what happens to waste once a storage permit expires. Knowledge on hazardous waste management has improved (the number of companies monitored rose from 39 to 295 over 2012-2016), but continual improvement is needed. Additional hazardous waste treatment infrastructures in other parts of the country could aid in facilitating proper management.

Data on the production of chemicals in Indonesia are also limited. A comprehensive assessment of existing chemicals and data on pollutant releases are lacking, and regulations address only a small subset of hazardous substances among what likely amounts to thousands of chemicals used in the Indonesian market.

4.2.4 Water Utilization in Production

As per the latest data available, Indonesia uses 0.250 m^3 of water to realize one unit of economic output. Indonesia is less water efficient than the Asia-Pacific regional average intensity which is 0.118 (in m^3 per US$) (ESCAP, 2019).

4.2.5 Domestic Material Consumption

Domestic material consumption (DMC) intensity decreased by almost 30% between 2000 and 2016. Indonesia was more resource efficient in terms of usage of material resources compared to the Asia-Pacific regional average. DMC Intensity of Indonesia (kg per 1 US$ [2010 GDP]) in 2016 was 1.81, whereas the average DMC intensity of Southeast Asia (kg per 1 US$ [2010 GDP]) was 2.11 (ESCAP, 2019).

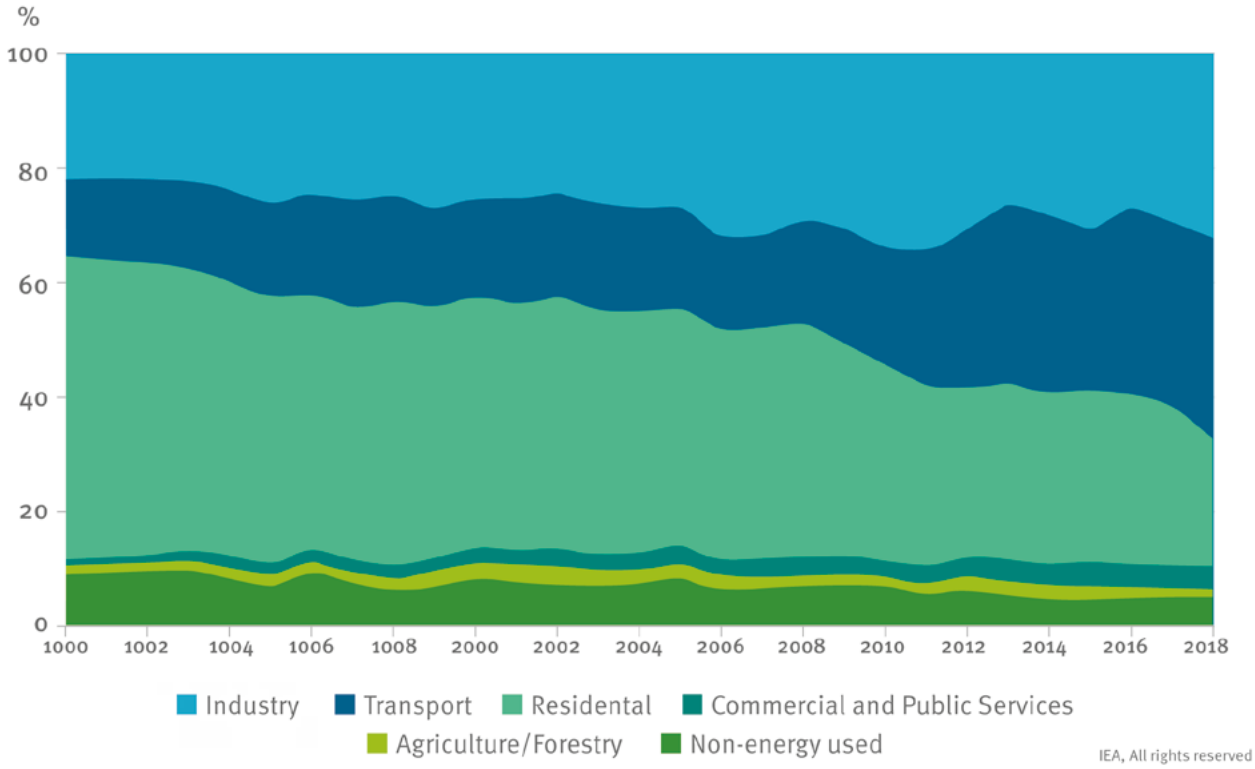
4.2.6 Industrial Energy Use

Energy intensity declined by 33.6 % between 2000 and 2015 compared to 2000. However, relative to China, the declined energy intensity during the period (2009–2013) was much

lower. The yearly decline in China was 9% compared to 4% in Indonesia. In 2015, Indonesia was more resource efficient in terms of energy usage compared to the Asia-Pacific regional average.

Industry is the second largest consumer of energy in Indonesia as illustrated in Figure 14. It consumes 32.14%, with transport consuming 34.84 % and residential 22.55% in 2018.

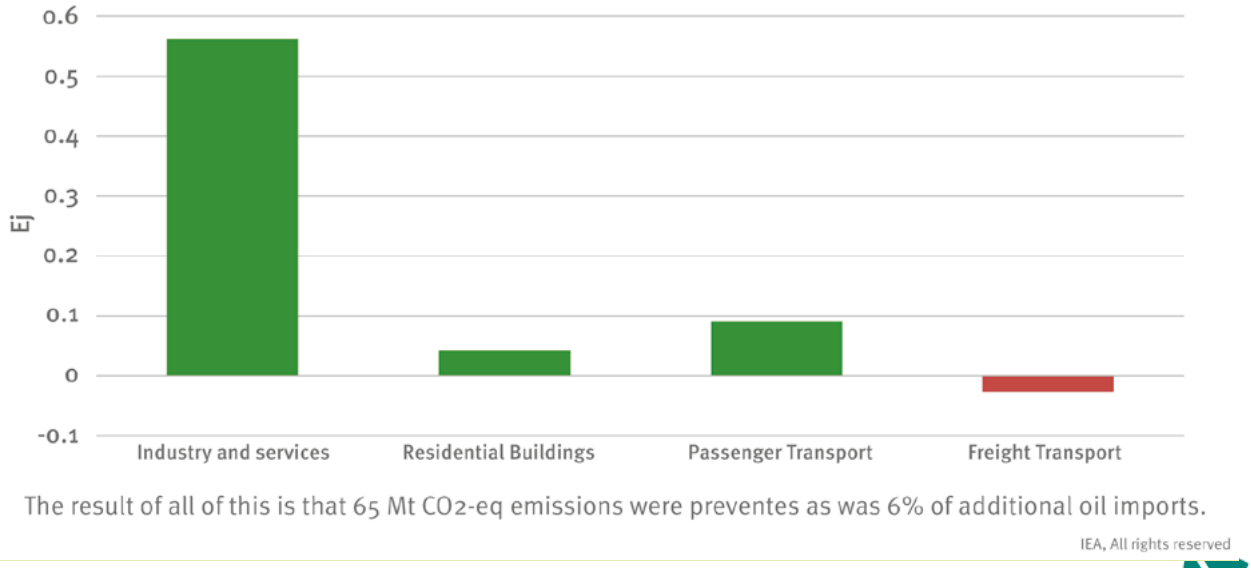
Figure 14 Total Final Consumption (TFC) by Sector, Indonesia 1990-2018, ktoe



Source: World Energy Balances, IEA (2020)

During the 2000s, economic activity shifted from energy-intensive industry sectors to less intensive manufacturing and service sectors and transport. Energy efficiency improvements in Indonesia since 2000 prevented a 9% increase in energy use by 2017 (Figure 15). These improvements prevented the release of 65 MtCO2 eq emissions and reduced oil imports by 6% reduction in additional oil imports.

Figure 15 Energy Saving due to Energy Efficiency in Indonesia (2000-2017)



Source: IEA, 2019

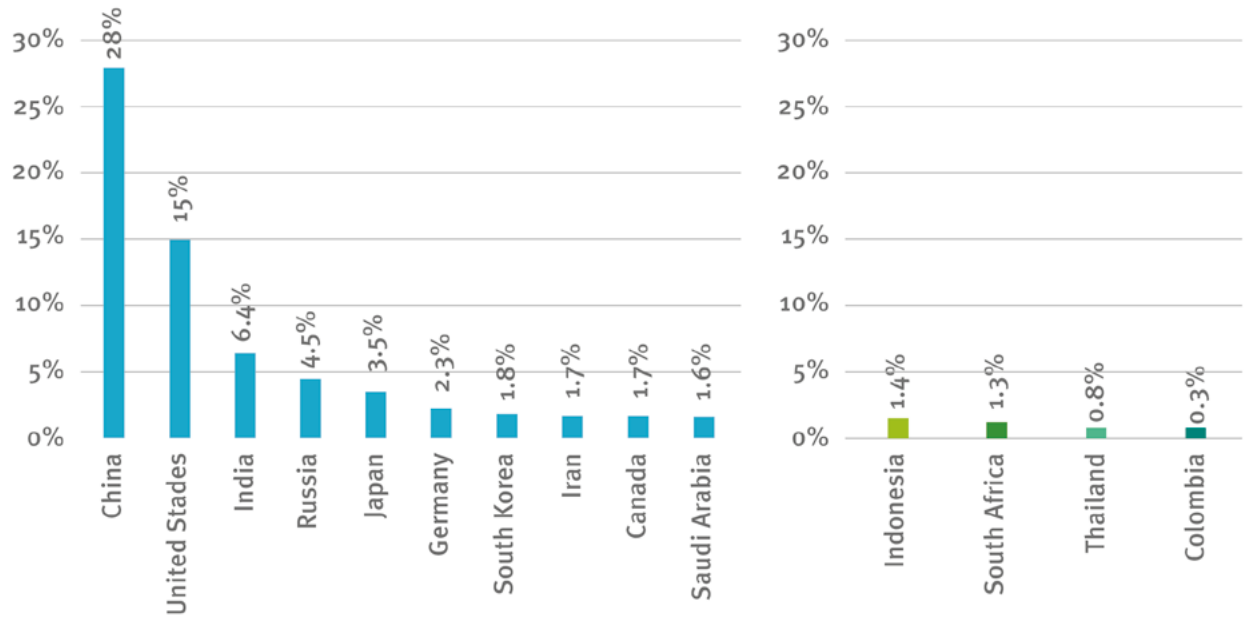
Recent research provides novel evidence on the impact of changes in energy prices on manufacturing performance in two large developing economies—Indonesia and Mexico. It finds that unlike increases in electricity prices, which harm plants' performance, fuel price hikes result in higher productivity and profits of manufacturing plants. The results of instrumental variable estimation imply that a 10 percent increase in fuel prices would lead to a 3.3 percent increase in total factor productivity for Indonesian and 1.2 percent for Mexican plants. The evidence suggests that these effects are driven by the incentives that fuel price increases provide to plants towards replacing inefficient fuel-powered with more productive electricity-powered capital equipment. These results would help to re-evaluate the policy trade-off between reducing carbon emissions and improving economic performance, particularly in countries with large fuel subsidies such as Indonesia and Mexico (Cali et al., 2019).

4.3 Indonesia's CO2 Emissions

Although CO_2 emissions are only one of several GHGs that contribute to climate change, they are the largest pollutants and have the best data available. In 2012, CO_2 emissions were responsible for two-thirds of total GHG emissions (UNIDO, 2019).

Figure 16 shows how much countries' CO_2 emissions contributed to global CO_2 emissions in 2016. The top ten emitters account for 67% of CO_2 emissions. Indonesia is the 11th largest emitter of CO_2 emissions, which constitute 1.4% of global emissions.

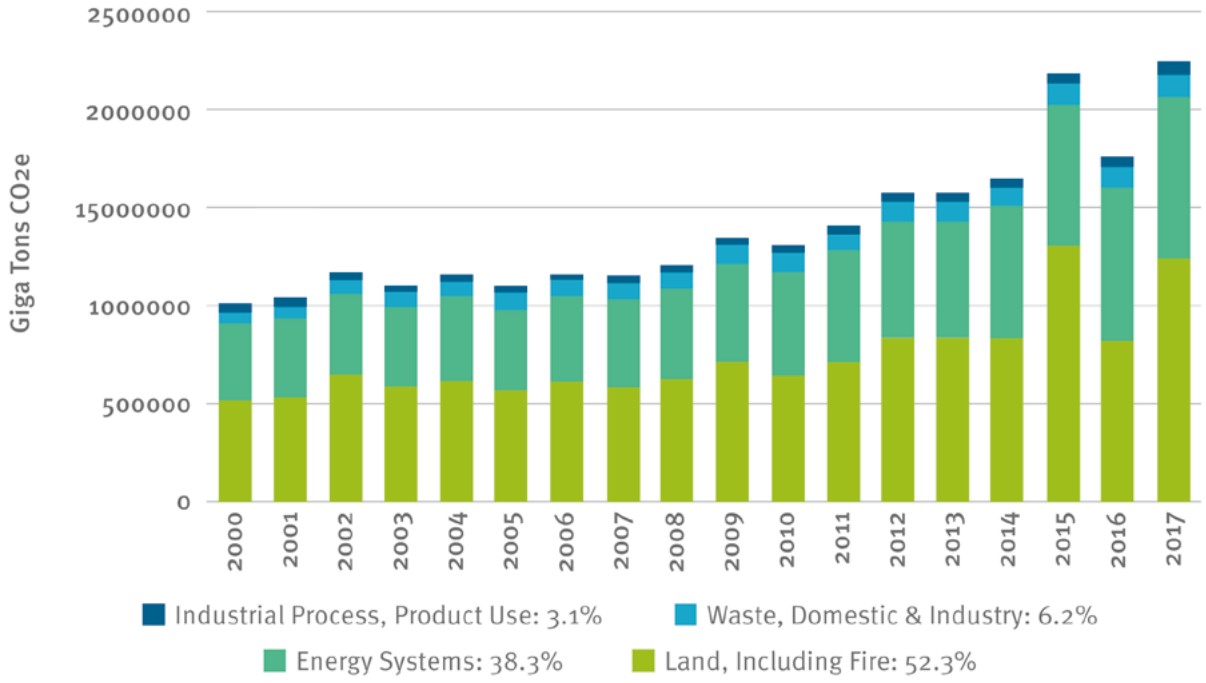
Figure 16 Selected Countries' Shares in World CO2 Emissions, in 2016



Source: IEA, (2018)

The sources of carbon emissions are land, energy systems, waste (domestic and industry) and industrial processes and product use. Most emissions originate from land, accounting for 52.3% of total carbon emissions (Figure 17). Energy systems were responsible for 38.3%, waste for 6.2%, and industrial process and product for 3.1% between 2000 and 2017 (New Climate Economy, 2018).

Figure 17 Total Carbon Emissions in Indonesia by Main Source (2000-2017)

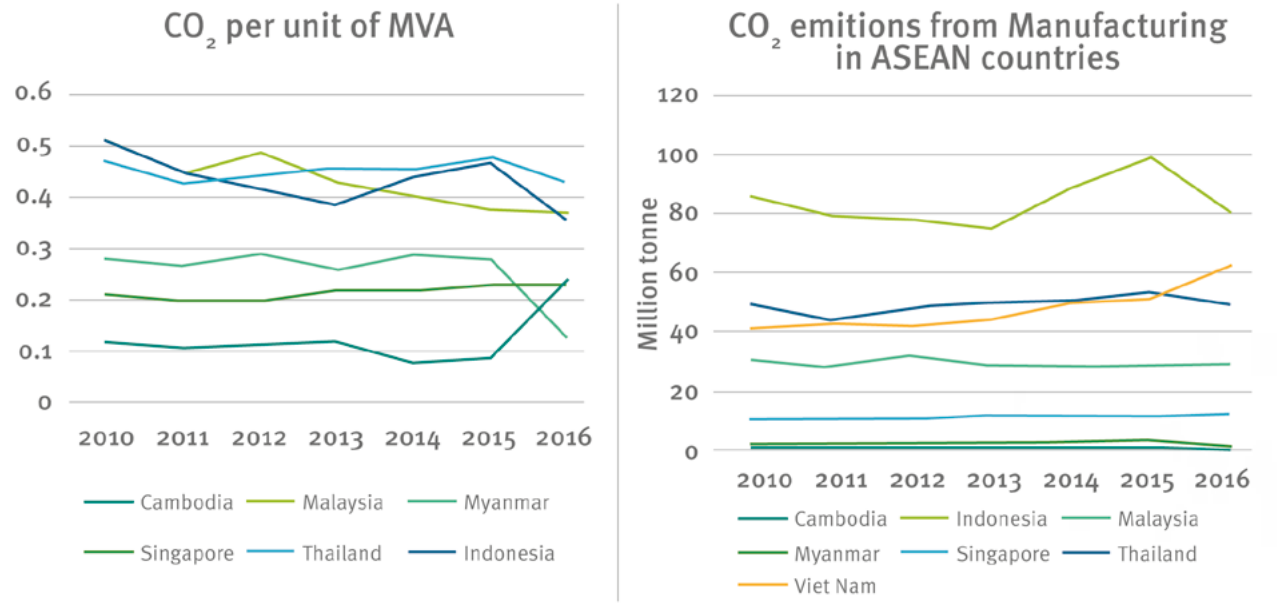


Source: Indonesia emissions by source from BAPPENAS cited in New Climate Economy (2018)

On a global scale, the manufacturing sector contributes to 18.5% of total CO_2 emissions through the combustion of fuels in production processes. However, as this excludes CO_2 emissions from electricity used in the production process, industrial CO_2 emissions are likely to be responsible for an even larger share of total emissions (UNIDO, 2019b). Industrial CO_2 emissions and mitigation potential are related to how industrial production occurs, what they produce, and other factors which occur outside of industry.

Compared to other ASEAN countries, total manufacturing emissions are the highest in Indonesia (Figure 18). Higher emissions in Indonesia are the result of both the size of the manufacturing sector and the rate of economic growth.

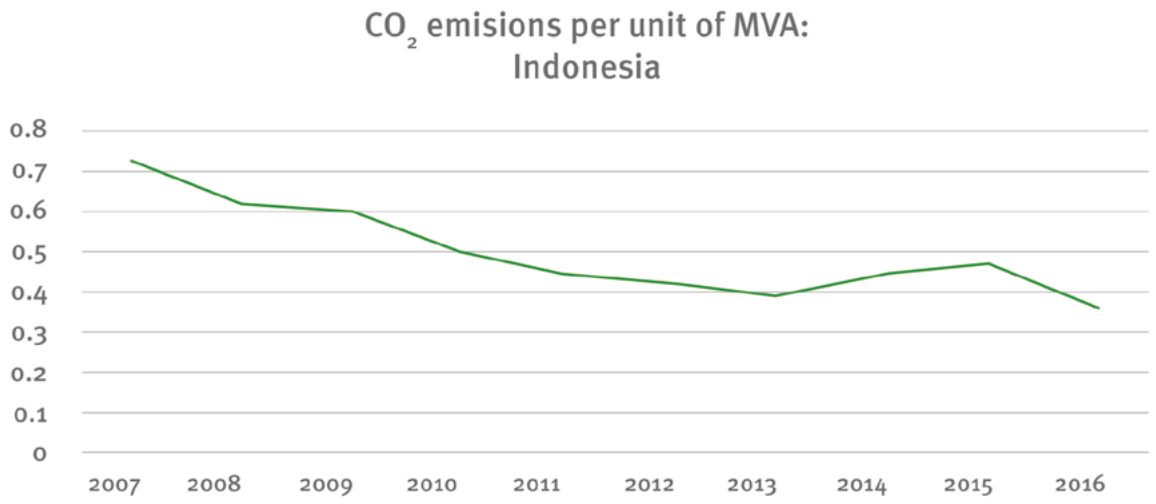
Figure 18 CO2 Emissions from Manufacturing in Indonesia and ASEAN Countries



Source: UNIDO (2018)

On one hand, CO_2 emissions per unit of MVA have been declining over the past ten years in Indonesia (Figure 19). On the other hand, comparison of CO_2 per unit of MVA of Indonesia to other ASEAN countries shows that Indonesia experiences higher CO_2 intensity compared to Cambodia, Malaysia, Myanmar, and Singapore. Thailand follows similar path as Indonesia whereas only Viet Nam's CO_2 emission intensity is higher than Indonesia.

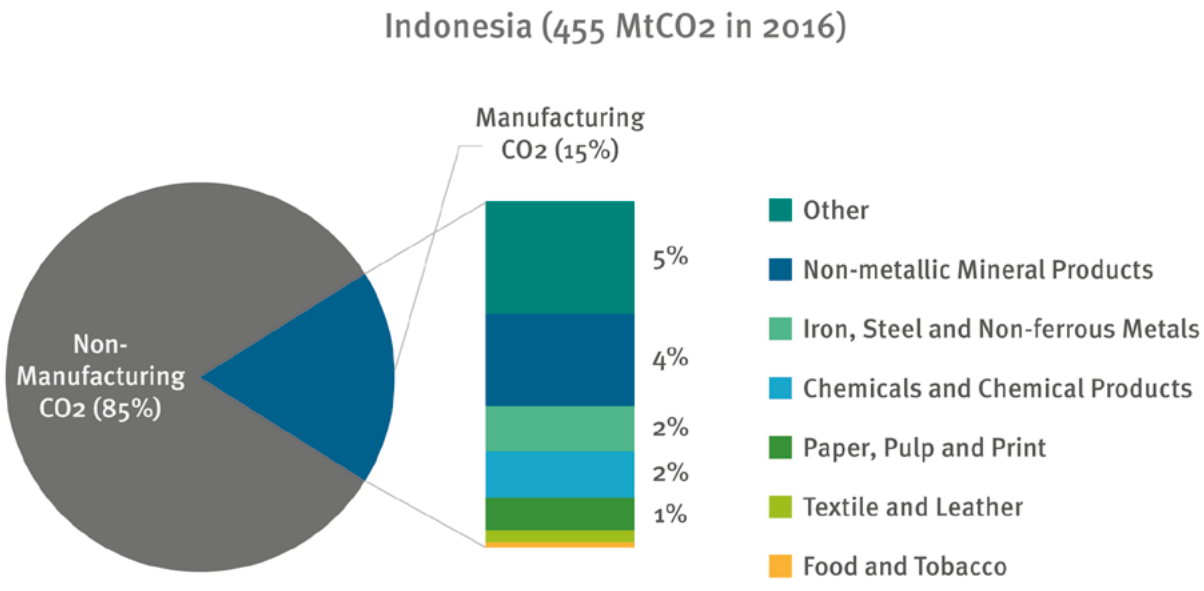
Figure 19 CO2 per unit of Manufacturing Value added



Source: UNIDO (2019b)

Figure 20 shows CO_2 emission composition by the manufacturing subsectors in Indonesia. The bar chart shows the emission contributions from each subsector. Note that the percentage point next to each sector represents the share of the respective subsector in the overall economy-wide emissions, not just manufacturing emissions. Non-metallic mineral products and the iron, steel and non-ferrous metals are the subsectors that contribute most to CO_2 emissions, followed by chemicals and chemical products.

Figure 20 Manufacturing CO2 Emissions in Indonesia by Subsector



Source: UNIDO (2018a)

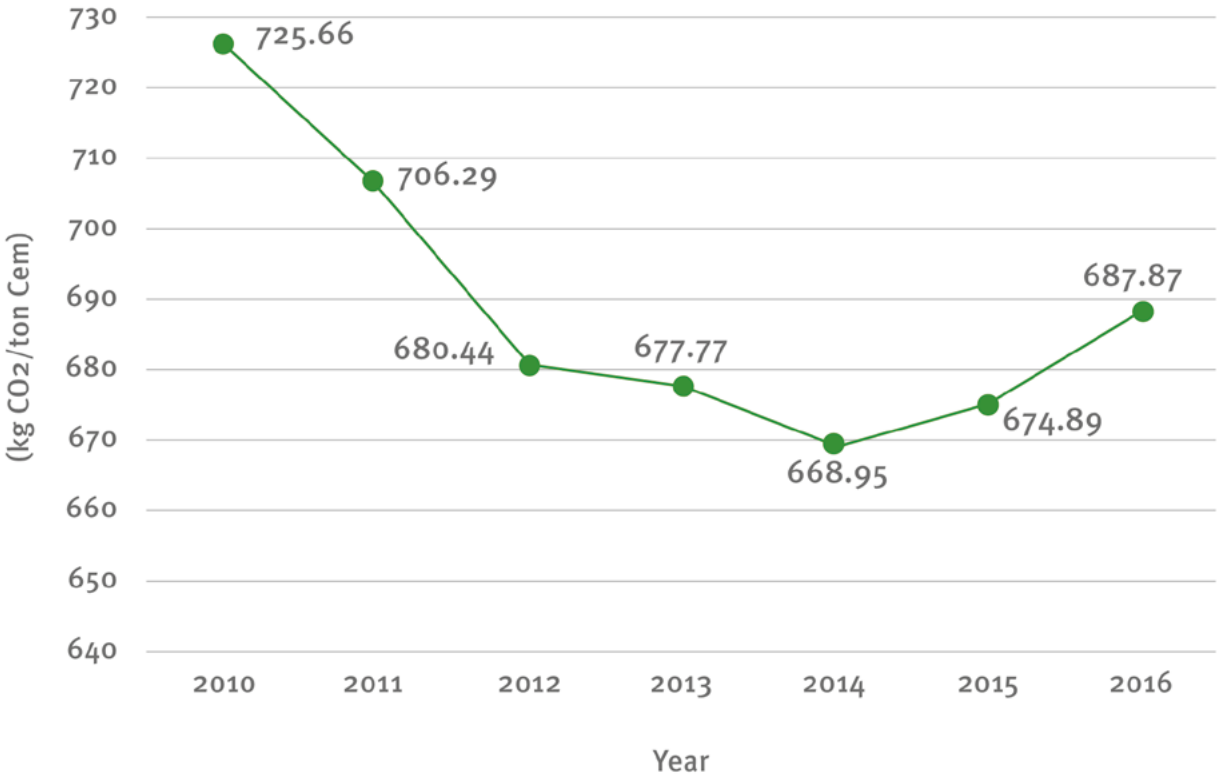
4.4 Analysis of Data for Green Industry and Trade Assessment in Indonesia: Sectoral Perspective

4.4.1 Cement Industry

4.4.1.1 Cement Industry GHG Emissions

The cement industry in Indonesia has 688.83 kg CO_2/ton greenhouse gas emission per year average (Figure 21). In 2016, It became 62 % of the national emissions of Industrial Processes and Product Use (Sianturi, 2018). A number of Cement companies are using innovative technology to reduce emissions.

Figure 21 Total Emission Generated from Cement Industry in 2010-2016



Source: Santoso, 2018

4.4.1.2 Energy Consumption in Cement Industry

The cement industry is the largest energy user in the manufacturing sector in Indonesia. The energy input is dominated by coal that supplies almost 90% of the total energy supply and leaves only 10% of demand to be shared by other types of energy. The energy losses of this industry are relatively high, or approximately 42% of the total energy input. Most of the energy losses are produced by the waste heat of the heating system process, and only 23% of the waste heat that used back by the prime mover of the power plant. Unfortunately, the huge amount of waste heat is still underutilized, which potentially can be used for further energy conservation (Yales Vivadinar, 2016).

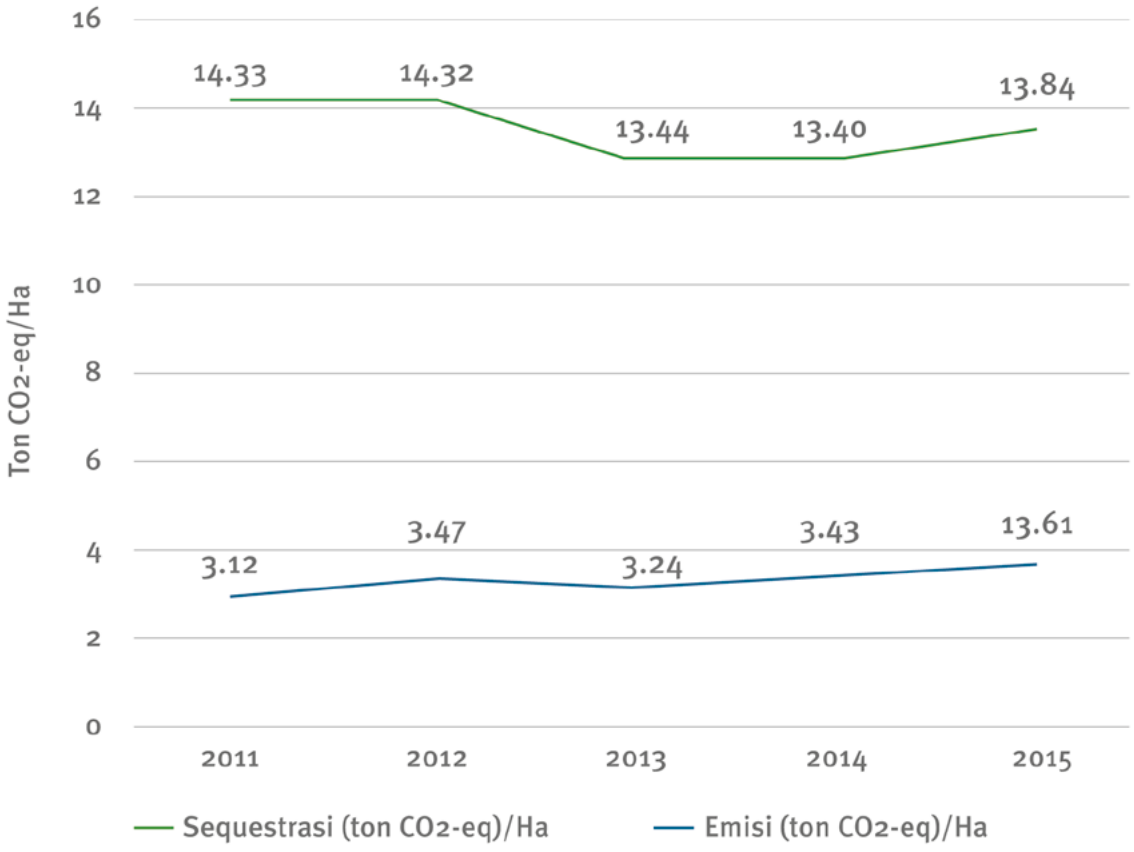
4.4.2 Food and Beverage Industry

The food and beverage industry clusters include Palm oil, mineral water, cacao industry, fruit industry, coconut industry, coffee processing industry, sugar industry, and the tobacco industry.

4.4.2.1 Palm Oil Industry GHG Emission

Based on the GHG emission calculation results in 26 model subsidiaries, results show that the GHG emission in each subsidiary is on average 3.61 tons CO_2/ha in 2015. The important attention point is that the calculation result illustrates that each model subsidiary absorbs an average GHG of about 13.84 tons CO_2/ha (Figure 22). By using a carbon balance, the amount of carbon absorbed by subsidiaries' plantations as calculated is approximately 3 times more than the amount of carbon emission. These results proved that palm oil production could, in fact, absorb more carbon compared to its emission.

Figure 22 Graph on Comparison of Carbon Absorption and Emission per Hectare



There are many steps taken to mitigate GHG emissions in the food and beverages sector. Companies are implementing a "zero burning" policy in an effort to reduce emissions, prohibiting burning for operations in the plantation, for instance through inland preparation for the crop rejuvenation. However, fire risks from other factors need to be anticipated and companies need to prepare fire prevention and fighting facilities such as standard fire trucks and regularly maintaining water pumps, as well as periodic inspections to ensure readiness at any time required. Training on prevention and firefighting is regularly held to improve personnel's preparedness in the event of a fire.

4.4.2.2 Palm Oil Industry Water Consumption

Water intensity in the palm oil sector increased during the 2015-2017 period. In 2015, the ratio of water use was 3.12 m3 per ton of Crude Palm Oil (CPO) produced, whereas in 2016 and 2017, it increased to 3.39 m3 per Ton of CPO.

4.4.2.3 Palm Oil Industry Non-Hazardous Waste

The palm oil industry produces non-hazardous waste from plantations and Palm Oil mills. Non-hazardous waste from plantations is generally in the form of fiber, shell, and Empty fruit bunch. While from the Palm Oil Mill, it produces the Mill Effluent.

Table 9 Non-hazardous waste in Palm Oil

Type of Waste	Total Quantity Produced (tonnes or m^3)	Total Quantity Recycled (tonnes or m^3)	Reused as
Fiber	1,296,027	1,296,027	Fuel
Shell	596,172	596,172	Fuel
*EFB	2,141,151	2,141,151	Organic fertiliser
*POME	5,373,270	5,373,270	Organic fertiliser

Source: (Agri, 2017)

In 2017, the palm oil industry produced 1.2 million tons of fiber and 596,172 Shell from the kernel (Table 9). The recycling rate of waste reached 100% in 2017, whereas the non-hazardous waste was utilized as fuel in the boiler system. Empty Fruit Bunch (EFB) and Palm oil mill effluent (POME) have a 100% recyclability rate and EFB as well as POME are used as organic fertilizers in the plantation.

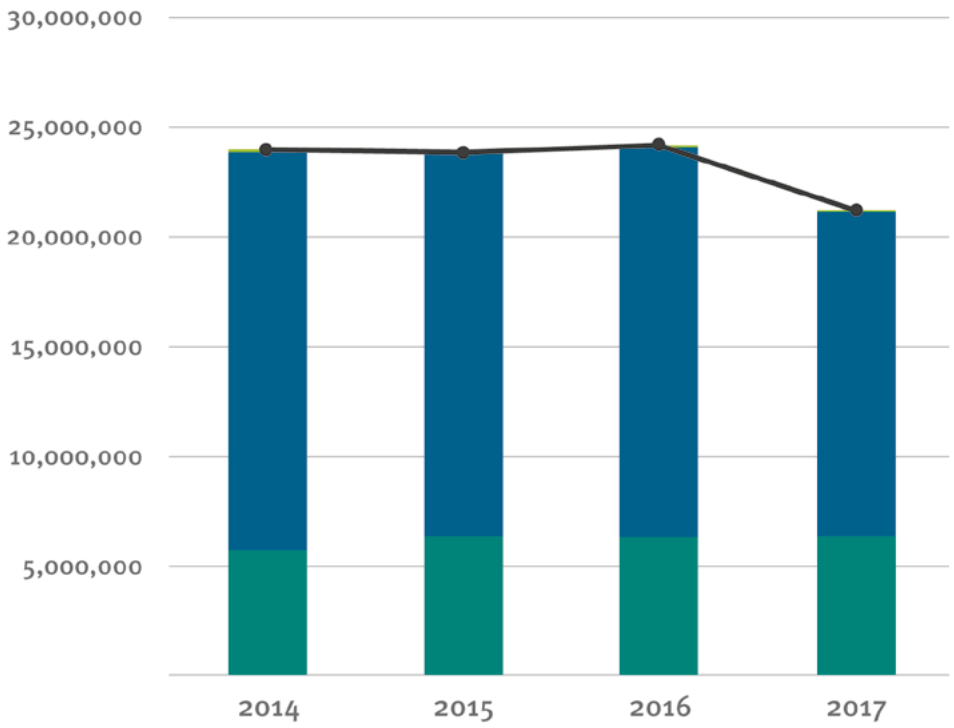
4.4.3 Fertilizer Industry

Pupuk Indonesia Group is the largest fertilizer holding company in Indonesia. As the largest fertilizer producer in Southeast Asia, the Company's main products are fertilizers and soil nutrient additives for agriculture and plantations.

4.4.3.1 Pupuk Indonesia Fertilizer Company Industry Energy Consumption

The use of energy in the Fertilizer Industry consists of electricity, coal thermal energy, and fuel energy and each fuel is used differently for operations depending on energy requirements. Coal is used as an energy source and is gradually being used to replace the use of natural gas for steam and heating. Coal, which is at the top (Figure 23) was chosen because it is more economical than the price of natural gas. Electricity is used for lighting, air conditioner, and engine operation. While energy fuel is used for light transportation and heavy equipment.

Figure 23 Energy Consumption in Fertilizer Industry



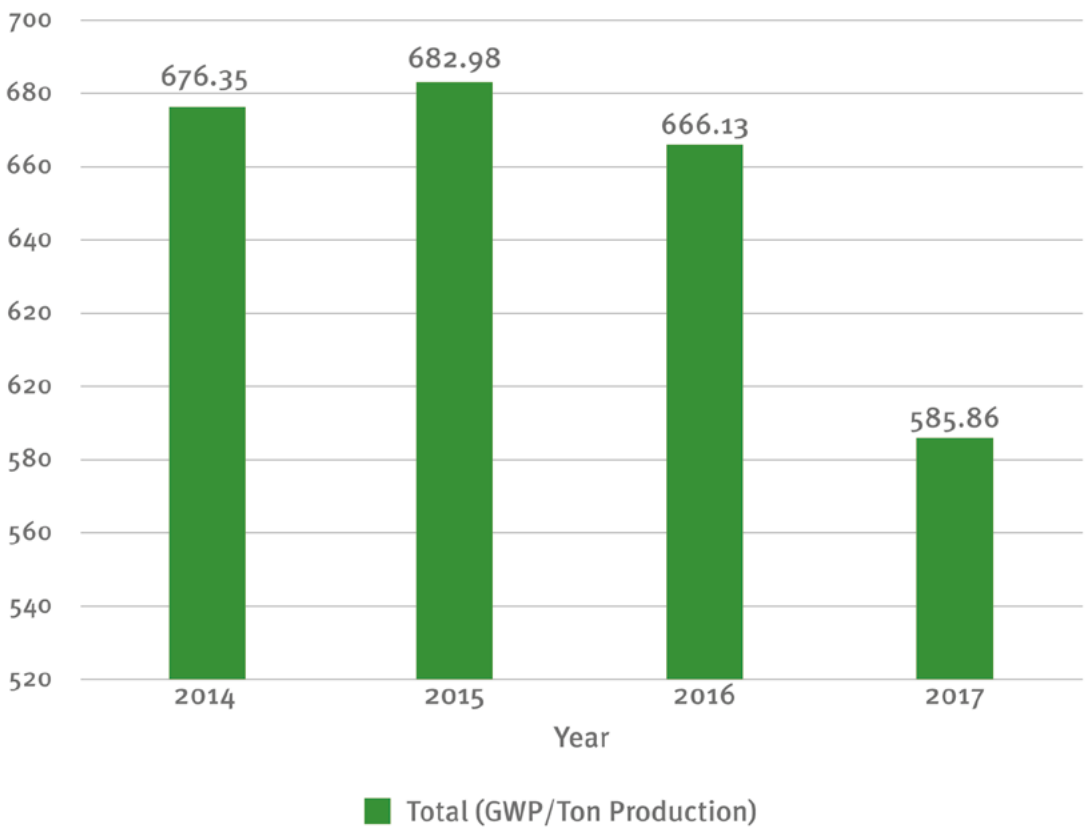
Energy Consumption from Fuel	89225.35	97108.81	78145.8	76924.45
Energy Consumption from Coal	18,194,889	17,006,477	17,742,445	14,769,624
Energy Consumption from Electricity	5,615,523	6,341,452	6,319,110	6,340,667
Total	23,899,637.35	23,445,037,81	24,139,700.80	21,187,215.45

Source: (Pupuk Indonesia, 2017)

4.4.3.2 Pupuk Indonesia Fertilizer Company GHG Emission

GHG emissions are among others generated from fertilizer production and energy use activities. Since 2015, the company Pupuk Indonesia has continued its GHG emission control program by standardizing calculations of GHG emissions and associated measures.

Figure 24 Ratio GHG`s emission compared mass production in 2014-2017



The above figure shows a decrease in GHG emissions during 2014-2017 in Pupuk Indonesia.

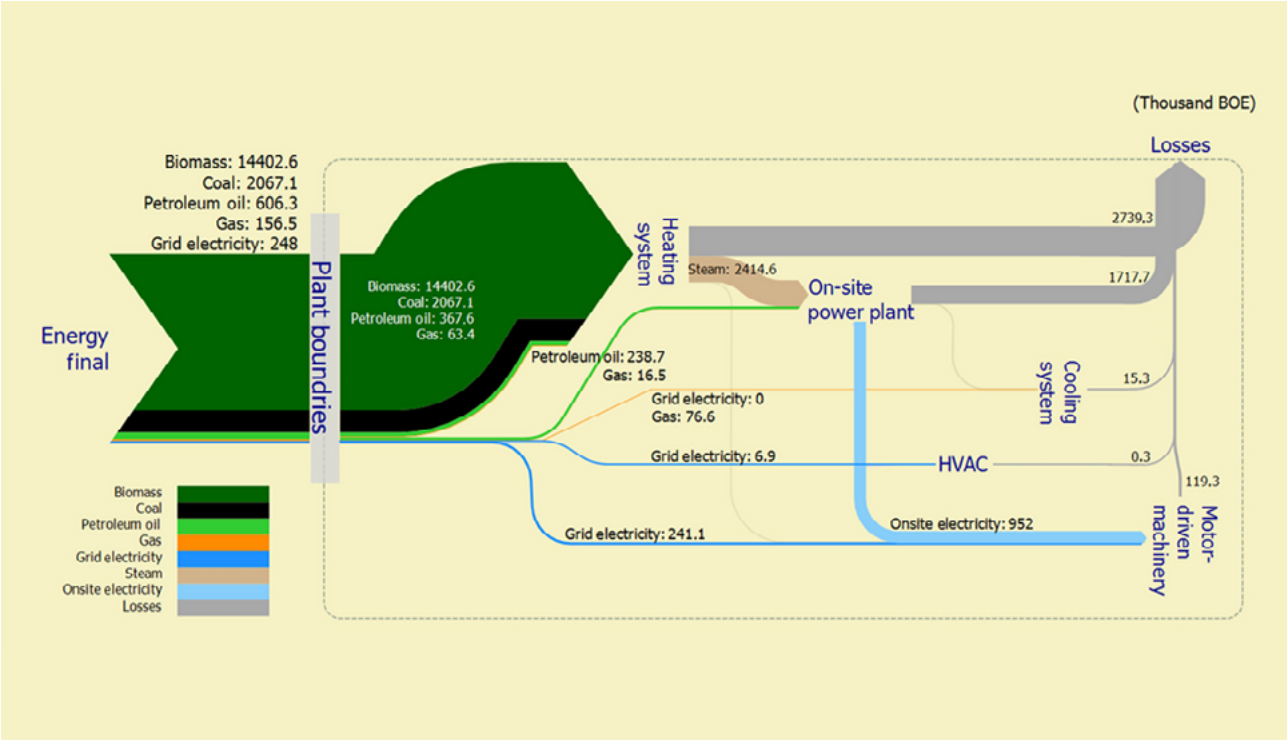
4.4.4.Pulp and Paper Industry

APRIL Indonesia group is one of the largest companies within the pulp and paper sector. APRIL has 11 units located in Sumatera and Java, with emissions in pulp and paper generated through burning fossil fuels and chemical reactions in the pulp and paper making process. The main sources of air emissions are mill operations through recovery and power boilers, fibre lines, bleaching plants, and lime kilns. Recovery and power boilers are used to generate seven steam power turbines that generate approximately 535 MW of electricity. Emission abatement equipment in the form of electrostatic precipitators is fitted in the recovery boiler, power boilers, and lime kilns to reduce the particulate loading of air emissions. Continuous Emissions Monitoring System (CEMS) equipment are installed at main emission sources for capturing data that are assessed at control rooms, the results of which are reported to regulators. In 2017, total particulate treated water emissions fell to 0.55kg / ADT, down from 0.82 kg / ADT. During the same period, sulfur oxide as sulfur treated water emissions fell slightly to 0.45kg / ADT, from 0.47kg / ADT the previous year.

4.4.4.1 Energy Consumption in Pulp and Paper Industry

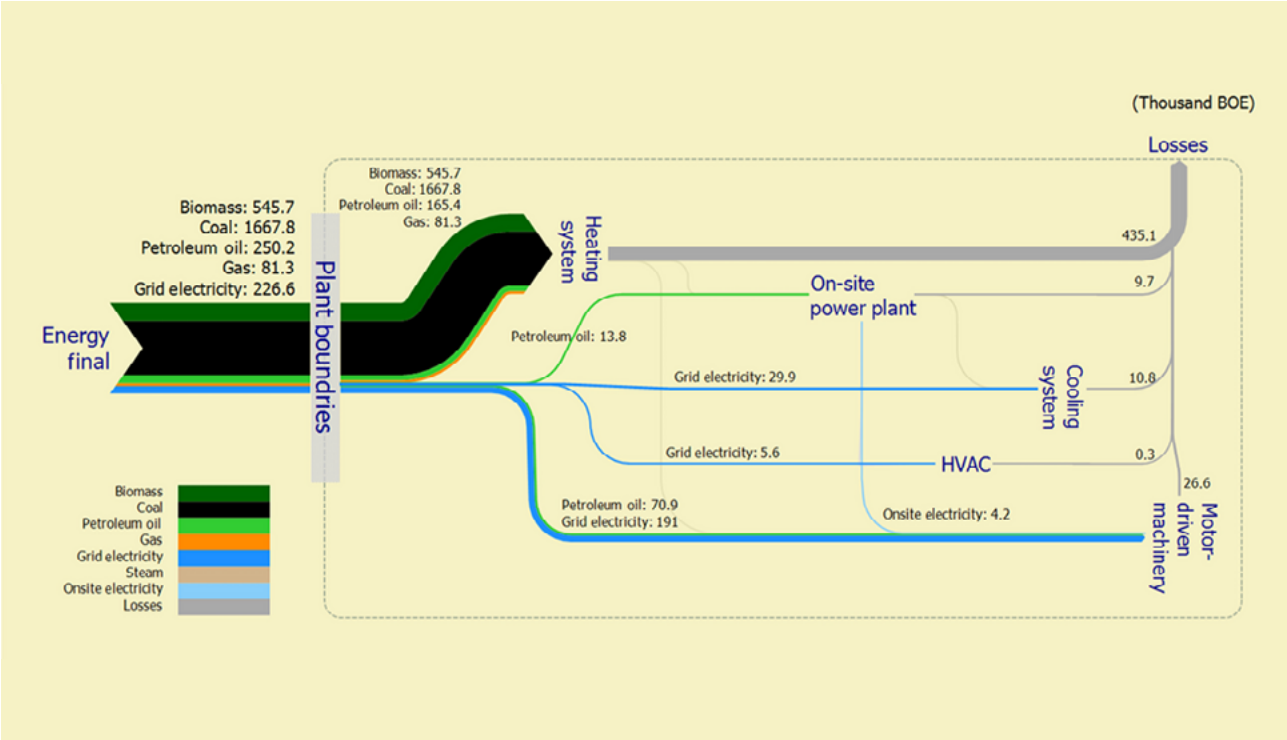
The pulp and paper industry consist of two major branches: the pulp industry and the paper manufacturing industry. The energy supply for the pulp industry mostly comes from the excess wood of the pulp production process with a small number of additional energy sources such as coal, oil, natural gas, and grid electricity. The grid electricity only supplies 20% of the total electricity load, where 80% of the load is satisfied by the on-site power plant that uses almost half of the excess heat from the heating system process.

Figure 25 Energy Flows of The Pulp Industry



Source: Yales Vivadinar, 2016

Figure 26 Energy Flows of The Paper Industry



Source: Yales Vivadinar, 2016

The energy supply for the paper industry is dominated by coal that supplies 60% of the demand and is followed by other types of energy. The heating system utilizes 90% of energy inputs and consists of all energy types except grid electricity. The grid electricity mostly supplies the motor-driven machinery beside the cooling system and HVAC. The paper industry clearly relies much on the grid electricity supply as compared to the pulp industry. Total energy loss from this industry group is approximately 17% and mostly comes from the heating system process. The energy loss from the heating system alone is approximately 18% of the total energy input on this process or higher compared with the energy loss from the heating system of the pulp industry. The large energy consumption for the pulp and paper industry is generally dominated by the pulp industry as opposed to the paper industry.

4.5 Summary

The EPI score for Indonesia in 2020 is 37.8, ranking it 117 out of 180 countries and 10 out of 25 Asia-Pacific countries. The median score for the 25 countries is 37.3. Some of its neighbors' scores in 2020 are 47.9 for Malaysia, ranking it 103 out of 180 countries and 6 out of 25 Asia-Pacific countries; 45.4 for Thailand, ranking it 78 out of 180 countries and 7 out of 25 Asia-Pacific countries; and 33.4 for Vietnam ranking it 141 out of 180 countries and 18 out of 25 Asia-Pacific countries.

For the most part, only qualitative information is available about industrial air, water, hazardous waste pollution, and water, material, and energy consumption.

CO_2 emissions from manufacturing in Indonesia are greater than in any other ASEAN countries, as is the CO_2 emission intensity. Non-metallic mineral products and iron, steel, and non-ferrous metals subsectors are the major sources of manufacturing CO_2 emissions.

5 Industry's Role in Meeting Nationally Determined Contributions

Indonesia's NDC unconditional target for 2030 is a 26% reduction of CO_2 emissions compared to BAU emissions in 2020 (Table 10). According to the BAU scenario, all sectors generated a baseline emission level of 1,971 $MtCO_2eq$ GHG emission in 2020. A 26% reduction of GHG emissions in 2030 would lead Indonesia to a level of about 1.458 $MtCO_2eq$.

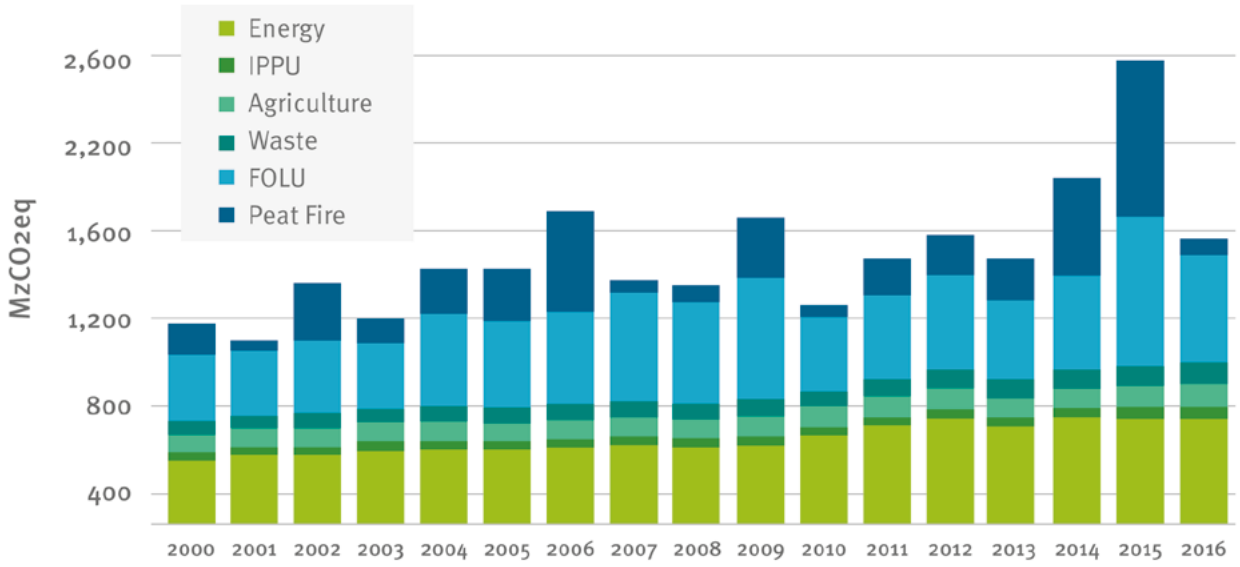
Table 10 Indonesia's Nationally Determined Contribution Targets

Target Year	2020
	2030
Target Type	Reduction compared to Business as Usual Scenario (BAU)
Unconditional Target	2020: -26% compared to BAU (approx. 1.458 $MtCO_2eq$)
	2030: -29% compared to BAU (approx. 2.036 $MtCO_2eq$)
Conditional Target	2020: -41% (approx. 1.162 $MtCO_2eq$)
	2030: -38% (approx. 1.458 $MtCO_2eq$)
Business as Usual Scenario	2020: 1.971 $MtCO_2eq$
	2030: 1.778 $MtCO_2eq$
Industry target	No
GHG Included	CO_2, CH_4, N_2O
Includes LULUCF?	Yes

Source: Climate Watch (n.d.) World Bank (2018), NDC Platform and Indonesia's Third National Communication (2017)

Indonesia appears to be on track to reach its 1.458 $MtCO_2eq$ target equivalent in 2020 based on data from the National Statistics Office. By 2016, it had already mitigated annual emissions by 1.461Mt CO_2 eq by reducing emission related to land use and peat fire. (Figure 28).

Figure 27 Greenhouse gas emissions of Indonesia, 2000 to 2016



Source: Adapted from Second Annual Update. Ministry of Environment and Forests (2018a)

While a specific target for manufacturing is not explicitly specified in the Third National Contribution (TNC) report, a target (measured in MtCO2eq) can be estimated based on Industrial Products and Process use (IPPU) in the 2020 BAU emissions of approximately 65 Mt CO2eq and of energy emissions of 900 MtCO2eq. Meeting the planned target of 1.458 MtCO2 eq in 2020 would require mitigation of 513 MtCO2eq in 2020 compared to its BAU scenario (the difference between 1.971 MtCO2eq and 1.458 MtCO2 eq) (Table 10).

The TNC has detailed information about which sectors will contribute to the 513 $MtCO_2$eq emission reduction. In addition, we calculated how much emission reduction will be generated from IPPU and manufacturing energy reduction but not waste, and compared that to the BAU scenario to establish a target for each of these components:

1. Industry IPPU will account for 0.13% of the reduction target under the unconditional scenario in 2020, which is equivalent to 0.67 MtCO2eq reduction (0.13% of 513 MtCO2eq). The emission of industry IPPU in the 2020 BAU scenario is estimated to be approximately 65 MtCO2eq and it will need to reduce 0.67 MtCO2eq in comparison to this baseline. As a result, an emission target for IPPU in 2025 would be 64 MtCO2eq (65 MtCO2eq minus 0.67 MtCO2eq).
2. Energy will account for 4.95% of the reduction target under the unconditional target scenario in 2020, which is equivalent to 25.4 MtCO2eq (4.95% of 513 MtCO2eq). Energy emissions in the 2020 BAU scenario are expected to be 900 MtCO2eq. As these will need to be reduced by 25.4 MtCO2eq, the target for total energy emissions in 2020 will be approximately 875 MtCO2eq. The next step is to distinguish how much of the emission target mitigation will come from industry-related energy emissions. Manufacturing and construction energy-related emissions in 2014 were about 170 MtCO2eq, while total energy-related emissions were about 569 MtCO2eq. We know therefore, that industry-related energy emissions accounted for 29.8% of energy emissions in 2014. We can also use this ratio to calculate the emission target for 2020, which will be about 260 MtCO2eq (29.8% of 875 MtCO2eq).

Table 11 Emission Reduction Targets and Sector Contributions for Achievement of Target (in Percentage)

Sector	Emission Reduction Target by 2020		Emission Reduction Target by 2030	
	26% (Unconditional)	41% (Conditional)	29% (Unconditional)	38% (Conditional)
Forestry and Peatland	87.62	87.38	59.31	60.15
Waste	6.26	6.56	1.31	2.61
Energy	4.95	4.71	37.93	36.61
Agriculture	1.04	0.93	1.10	0.34
Industry (IPPU)	0.13	0.42	0.34	0.29
Total	100	100	100	100

Source: Ministry of Environment and Forestry (2017)

The total target for manufacturing emissions is the sum of the IPPU and energy targets for manufacturing associated emissions, which is 324 $MtCO_2$eq in 2020 (64 $MtCO_2$eq for IPPU plus 260 $MtCO_2$eq for energy). The 324 $MtCO_2$eq can be used as a reference for marking progress of current emissions compared to the 2020 target. Industry-related emissions in 2014 were 46 $MtCO_2$eq for IPPU and 170 CO_2eq for industry energy-related emissions, a total of 216 $MtCO_2$eq. This is less than the 324 $MtCO_2$eq 2020 target, which indicates that Indonesia appears to be on track in meeting its industry-specific mitigation target.

6 Measures And Priorities For Green Goods Production And Export

To support the implementation of sustainability standards according to priority programs in the Making Indonesia 4.0 road map, MoI is determined to continue encouraging the manufacturing sector to further enhance activities related to circular economy. In the industry 4.0 program, greening industry could be part of the economic digitalization scheme.

Based on green industry principles, green goods are products that use environmentally friendly materials and can be recycled. Also, their production should be energy efficient and not pollute the environment.

6.1 Cement Industry

Green good programs in Indonesia, especially in the cement industry, are closely related to the government's commitment to reduce emissions and energy use during the production process. Some of the cement plants have implemented several innovations for production processes, raw materials, and alternative fuel use that can meet the CO_2 emission reduction targets.

PT Inducement Tunggal Prakarsa is one of cement industries that voluntarily applies the green industry principles. This company has received a green rating from PROPER since 2013. Two Clean Development Mechanism (CDM) projects have been carried out, namely blended cement and alternative fuels. Blended cement is produced using alternative materials to reduce the percentage of clinker during the production process, which reduces CO_2 emissions. The types of hazardous materials include sludge, bottom ash, iron slag, copper slag, etc. Blended cement includes three to 6% of alternative materials. Alternative fuels, such as biomass fuel from rice husks and sawdust, are used because they are considered CO_2-neutral.

6.2 Fertilizer Industry

Green goods in the fertilizer industry are being made using environmentally friendly technologies. These include gasification of coal as an alternative raw material to replace natural gas; installation of a purge gas recovery unit to recover gas resources; and utilization of biodiesel from household waste to fuel forklifts. Furthermore, renewable materials are being substituted for non-renewable materials. For example, PT Petrokimia Gresik (PT Pupuk Indonesia Group) is substituting silica powder with super dolomite and anti-foam with green foam. In addition, the company uses recycled raw materials such as gypsum for fertilizer production.

6.3 Pulp and Paper Industry

The Asia Pulp and Paper Group (APP Sinarmas) produces green products such as multifunctional paper "Bola Dunia" and "Foopak Bionatura Cup" for beverage and food containers. It is optimizing its production processes by using alternative energy and materials, which reducing carbon intensity by 14% in 2017 compared to 2012 (Asia Pulp and Paper Group, 2017).

6.4 Food and Beverage Industry

Many food and beverage companies are switching to environmentally friendly packaging. These include polypropylene-based plastic, bio-foam containers, and edible packaging (Ministry of Industry, 2019).

6.5 Summary

More green goods are being produced and exported due to consumer awareness and competition in the domestic and global markets. The four manufacturing subsectors described above are producing green goods through innovations in technology and the use of alternative raw materials and fuels. The use of the green logo (GI Certification) is also making products more competitive in domestic and global markets.

7 Findings And Recommendation

This chapter summarizes the findings in the above chapters and identifies priority actions for government consideration that have the potential to support green industry development and trade in Indonesia.

7.1 Findings

Despite some significant data gaps in environmental and energy data as well as information about programmatic activities, there are important findings from this assessment.

7.1.1. Programmatic

- The manufacturing sector accounted for 20.2% of GDP in 2017. Among manufacturing subsectors, food and beverage has been the leading subsector since 2009, followed by chemicals and chemical products, and motor vehicles, trailers, and semi-trailers. Food and beverage is also the leading subsector in terms of the number of jobs, followed by clothing apparel, and textiles.
- There are no CO2 emission reduction targets set for industrial subsectors in the Third National Communication.
- The GI Award and Certification programs are excellent initiatives, but their potential is being limited by several factors. For example, both programs are voluntary, thus participants tend to be the same every year and few are SMEs. Moreover, there is confusion about the use and benefits of the GI logo, which undermines its value.
- PROPER is also driving green industrialization particularly because it is a mandatory program. However, PROPER criteria are not sufficiently quantitative, and a facility's PROPER-related evaluation does not systematically entail enforcement measures in cases of serious non-compliance. Moreover, only 6% of the 2000 companies that participate in PROPER are large enterprises.
- MoEF compliance monitoring and enforcement are hampered by low institutional capacity. Inspections are mostly reactive, responding to accidents, complaints, and third-party reports of non-compliance. There is no systematic data available concerning the regulated community, its compliance behavior, or enforcement sanctions. Enforcement approaches vary by jurisdiction and sanctions are inconsistently applied. Written warnings and compliance orders are by far the most commonly used enforcement tools with the only administrative monetary penalties being fines for ignoring compliance orders.
- There is no systematically collected data for conventional pollutants (air, water, waste) and resources (energy, water materials) that constitute the basis of an environmental regulatory program. Without these sets of data, the more serious threats to human health and the environment from industrial pollution will persist. Some data are available from the PROPER program, but they are not being used by MoEF to target its enforcement actions.
- There are only scattered data about ambient air and water quality and none for hazardous waste generation and disposal. Only now is there a limited effort to build a national environmental quality database. Without these data, it is impossible to most effectively use governmental resources to mitigate the more serious environmental insults to human health and critical ecosystems.

7.1.2 CO2 Emissions

- CO2 emissions from manufacturing in Indonesia are greater than any other ASEAN country, as is its CO2 emission intensity.
- Non-metallic mineral products and the iron, steel and non-ferrous metals sectors are the subsectors that contribute most to CO2 emissions.
- Indonesia has managed to decrease manufacturing CO2 emissions in relation to the rest of the economy without decreasing the relative contribution of the manufacturing sector to GDP.

7.1.3 Industrial Energy Use

- Indonesia reduced its economy-wide energy intensity by one-third between 2000 and 2015. However, relative to other developing countries, the decrease in energy intensity during the period was much lower. The yearly average decline of energy intensity in China was 9%, while in Indonesia it was only 4%. In 2015, Indonesia was more efficient in energy usage than the Asia-Pacific regional average.
- Energy efficiency improvements in Indonesia since 2000 prevented a 9% increase in energy use by 2017 (Figure 4.2). These improvements prevented the release of 65 MtCO2 emissions and a 6% reduction in additional oil imports.
- Economic activity moved from energy-intensive industry sectors to less-intensive manufacturing and service sectors, and transport shifted towards more efficient modes.
- Non-metallic mineral products (cement, ceramics, glass, and lime), chemical and petrol chemical, and non-ferrous metals are the largest energy consumers in Indonesia.

7.2 Recommendation for Accelerating Green Industrialization

7.2.1 Enhancing environmental regulation

MoEF can take several actions within its mandate. These include (i). revising the environmental standards by setting quantitative discharge limits based on economic and technical criteria; (ii) requiring regular self-monitoring and self-reporting funded by industries and periodical inspection by state-funded public authorities; (iii) providing adequate power and autonomy to the inspecting authorities and their inspectors to oversee environmental compliance while ensuring at the same time that inspectors are carrying out inspections in a transparent and accountable manner; (iv) providing an adequate budget to the inspection authorities to monitor and report on a regular basis about the industry compliance with environmental standards (v) collecting systematic data about the regulated community, its compliance behavior or enforcement sanctions. Many of these actions should be done in conjunction with involvement of significantly more participation of companies in PROPER.

7.2.2 Setting CO2 emission reduction targets

Setting CO_2 emission reduction targets for industry subsectors is important and possible with existing data. Setting and enforcing these targets should be imbedded in the Low Carbon Development Initiative.

7.2.3 Expanding waste management

Waste is one of the top GHS emission sources in Indonesia. Most of the collected waste is brought to open dumps or controlled landfills. The industrial hazardous waste managed in 2017 was 60.31 million tons. If accumulated from 2015, the quantity collected is less than 40% of the target for hazardous waste management. The causes of not reaching the target include the undocumented presence of hazardous waste and their illegal dumping in open dumps or controlled landfills.

7.2.4 Promoting advanced technologies

Science and technology play a vital role in encouraging the manufacturing sector to adopt sustainable patterns of production and economic growth. Since most developing countries adopt technological advancements from developed countries, government assistance programs are needed to facilitate both the absorption and diffusion of new technologies. Capacity development and technology transfer can be achieved through the provision of information, demonstration projects, technical assistance programs, workforce training, and the support of technical institutions.

7.2.5 Identifying resource efficiency potentials in energy and water intensive industrial sub sectors

Given the high rate of emissions and material use in the manufacturing sector, resource efficiency demonstrations are needed to show the cost-savings potential. Data on the main inputs and outputs would be collected in a systematic way to calculate the energy used in production and to analyze factors such as technology, productivity, process stability, resource efficiency and scrap quality. The analysis would include a broader life cycle view of energy efficiency as well as calculations of GHG emissions. Insights would be drawn from comparing performance among the Indonesian plants as well as global good practice standards. Because new technology alone cannot ensure good practice or good efficiency, priority should be placed on increasing the sector's capabilities for "digesting" new technology and achieving systematic improvements in productivity and efficiency from existing equipment. An initial analysis would be conducted for a limited number of plants and then extended to all related facilities using a simple spreadsheet model. The outcome of the demonstration would provide policy guidelines to the government for adopting efficiency policies at the national level.

7.2.6 Requiring environmental management plans and enhancing industrial symbiosis in industrial estates

Indonesia currently has several large industrial estates that do not have industrial environmental management plans (IEMP), which would move them towards compliance with national and international standards. A new Eco-Industrial Park (EIP) framework is an innovative approach for formulating IEMPs; it covers legal compliance as well as socio-economic, environmental and management aspects (UNIDO et al, 2017). Such standards provide benchmarks for assessing existing industrial parks, planning retrofitting measures for existing parks, or better planning for new industrial parks with the end goal of meeting SDG targets.

7.2.7 Strengthening the capacity of cleaner production centers

The government could assist the industrial sector by strengthening institutional and operation capacity of existing cleaner production centers. They in turn would advise the government on innovative policies, such as economic incentives needed to encourage industries to

meet the SDG targets and assist industrial plants in identifying the most cost-effective ways to improve their resource efficiency and comply with environmental standards. The assistance would enable enterprises in Indonesia to move toward the best-practice international benchmarks for energy, water, and material use. Most of these centers are embedded in existing institutions and carry out four functions – information dissemination and awareness raising; technical assistance, in-plant assessments, and policy advice.

7.2.8 Greening Exports

The product needing the most attention is oil palm production that supports the sector with greatest export potential, palm oil. However, the environmental impacts of new oil palm plantations are extensive. Deforestation is the major issue that continues to negatively impact this industry. In addition, these plantations degrade soil quality and increase GHG emissions. Efforts should be made to increase the yield per hectare of oil palm plantations to be comparable to that of Malaysia. In addition, actions should be taken to green the supply chain. Greening of this supply chain would ensure processing efficiency of raw material and use of the residual biomass for energy generation.

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