Indonesia's Coal Dynamics:

Toward A Just Energy Transition

IESR

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Abbreviation

BAU	:	Business As Usual
BPP	:	Biaya Pokok Produksi / Production Cost
ca.	:	Circa
CFPP	:	Coal Fired Power Plant
CO2 / CO2-e	:	Carbon Dioxide / Carbon Dioxide equivalent
CPO	:	Crude Palm Oil
DGE/DJK	:	Directorate General of Electricity / Direktorat Jenderal Ketenagalistrikan
DMO	:	Domestic Market Obligation
e.g.	:	For Example
FTP	:	Fast Track Program
GDP	:	Gross Domestic Product
GHG	:	Greenhouse Gas Emission
GNI	:	Gross National Income
GW	:	Giga Watt
IDR	:	Indonesian Rupiah
IEA	:	International Energy Agency
IEEFA	:	Institute for Energy Economics and Financial Analysis
IUP	:	Izin Usaha Pertambangan / Mining Business License
JATAM	:	Jaringan Advokasi Tambang
kcal	:	kilocalorie
KEN	:	Kebijakan Energi Nasional / National Energy Policy
kg	:	kilogram
KPK	:	Komisi Pemberantasan Korupsi / Corruption Eradication Mechanism
kWh	:	kilo Watt per hour

LCOE	:	Levelized Cost of Electricity
Li-ion	:	Lithium Ion
LULUCF	:	Land Use, Land-Use Change, and Forestry
MCA	:	Minerals Council Australia
MEMR	:	Ministry of Energy and Mineral Resources
MODI	:	Minerba One Data
MOEF	:	Ministry of Environment and Forestry
MTOE	:	Million Tonnes of Oil Equivalent
Mton	:	Metric Ton
MW	:	Mega Watt
MWh	:	Mega Watt per Hour
NDC	:	Nationally Determined Contribution
NOx	:	Nitrogen Oxides
PLN	:	Perusahaan Listrik Negara / Electricity State-Owned Company
PM	:	Particulate Matter
PP	:	Peraturan Pemerintah / Government Regulation
PPP	:	Purchasing Power Parity
PV	:	Photovoltaic
RE	:	Renewable Energy
RPJMN	:	Rencana Pembangunan Jangka Menengah Nasional (National Mid-Term Development Plan)
RUEN	:	Rencana Umum Energi Nasional (General Planning of National Energy)
RUPTL	:	Rencana Umum Penyediaan Tenaga Listrik
SOX	:	Sulphur Oxides
UNFCCC	:	United Nations Framework on Climate Change
USC	:	Ultra Super Critical
USD	:	United States Dollar
VRE	:	Variable Renewable Energy
WACC	:	Weighted Average Cost of Capital
WTE	:	Waste to Energy

Contents

1. Introduction

The economy of Indonesia has shown significant growth over recent decades. It is now the largest economy in Southeast Asia and the 7th largest economy in the world on a gross domestic product (GDP) at purchasing power parity (PPP) basis. Historically, Indonesia's economic development has evolved during the latter part of the 20th century: from agricultural self-sufficiency in the 1950s, the industrialization due to urbanization in 1960s, and the manufacturing starting from the mid-1980s (Stephen Elias and Clare Noone, 2011).

Indonesia's electricity consumption increases accordingly. Data from the World Bank show that electricity consumption in Indonesia in 2014 was 812 kWh per capita or 26% of the world average. In 2017, it rose to 1,021 kWh per capita (Directorate General of Electricity [DGE], 2018). To meet electricity growth, Indonesia depends heavily on fossil-fueled power plants, dominated by coal. This is reflected in the Fast-Track Program (FTP) 1 & 2 and 35,000 MW Program[1], where coal power plant dominates new-power plants built and planned. Moreover,

1 Fast-Track Program (FTP) and 35,000 MW are programs launched by the Government of Indonesia to accelerate the development of new power capacity. FTP 1 and 2 were initiated in 2006 and 2010 respectively, and 35,000 MW program was established in 2015.

according to the PLN's Electricity Supply Business Plan (RUPTL 2018-2027), the amount of power capacity planned to build until 2027 reaches 56 GW: of which 48% is coal-fired power plants and 26% is gas-fired power plants.

Without considering external cost of a coal power plant, coal is a cheap source of energy to support Indonesia's economic development. Environmental damage and health issues (especially respiratory diseases) are two significant external costs. Global climate commitment, stipulated in Indonesia's National Determined Contribution (NDC), also gives pressure to reduce coal-fired power plant utilization if Indonesia wants to reach its climate goal. On the other hand, the costs of renewable energy have been declining at unprecedented rates. Once renewables reach grid parity, coal energy would be significantly lessened.

This paper will discuss the possibilities of energy transition in Indonesia, particularly the transition from coal-fired power plants while also considering the implications to coal sector.

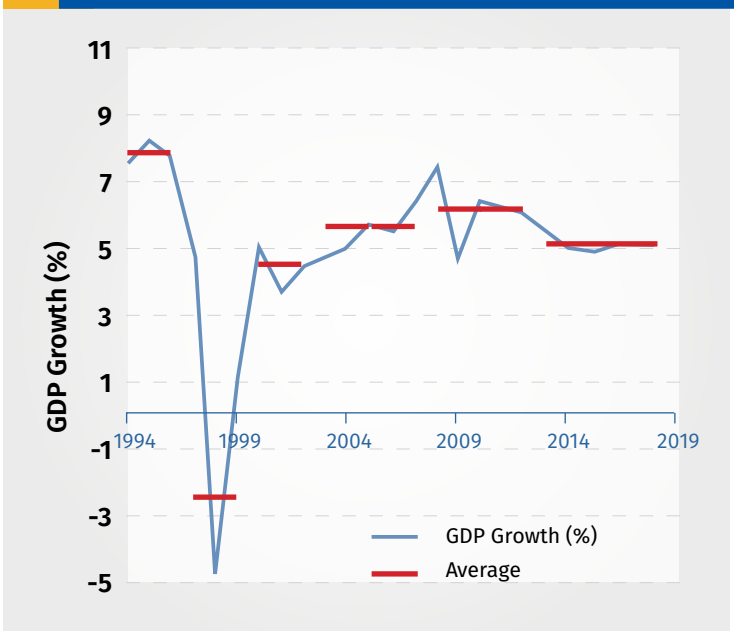
2. Overview of Coal Sector in Indonesia

2.1 Introduction to Indonesia's Economy

The economy of Indonesia has been fluctuated for the last two decades. Recovered from the Asian financial crisis in 1998/1999, Indonesia reached 7.4% of economic growth in 2007-2008. However, there has been a slowdown in the country's economic growth since the commodities export boom ended in 2012. As of now, the country's GDP growth is projected to be stable at an average of 5.24% for the next five years (IMF, 2018). This robust and steady economic growth may drive Indonesia to be the fifth-largest economy in the world by 2030 and the fourth-largest one by 2050 on purchasing power parity basis (PwC, 2017).

Indonesia's economic growth can also be measured through GNI per capita. It is usually related to inflation, productivity, infrastructure growth, as well as social factors: such as the country's population health, education, and skill (Amadeo, 2018). World Bank categorizes Indonesia as a lower-middle income country (based on GNI per capita using the Atlas method (current USD)). Despite the stable economic growth, the growth of GNI per capita in Indonesia has stagnated around $3,500 over the last six years. It experienced a short downtrend after 2013 which coincided with the end of the commodity boom period. However, a

Figure 1 Year-on-year GDP growth (IMF, 2018)

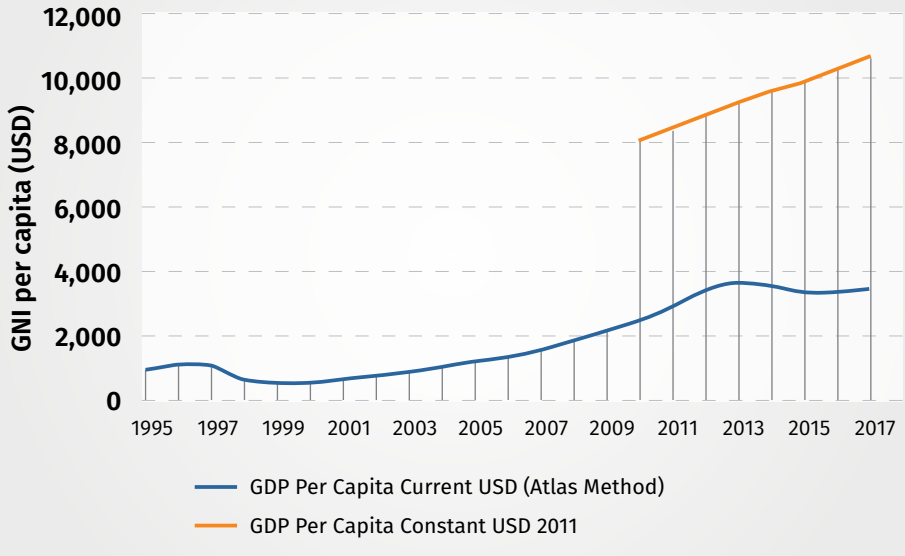


closer look at the GNI per capita with constant price of 2011 shows a steady increase instead. This showcases that the average income of the residents in the country still experienced improvement along with economic growth. The stagnated GNI per capita could then be attributed to devaluation of IDR toward USD since the commodity boom period ended.

Indonesia's energy consumption per capita is also a reflection of its low-income population. Even though Indonesia is among the largest energy consumers in the world, the country is merely ranked 5th among Southeast Asian countries on energy consumption per capita basis by a large margin. In 2014, energy consumption per capita of Indonesia was only one-tenth of Brunei Darussalam and about half of Thailand whose sitting on the world's average (World Bank, 2018a).

Fossil fuel resources still dominate primary energy consumption in Indonesia; with oil, coal and gas shares reaching 42.1%,

Figure 2 Year on Year GNI per capita growth (World Bank, 2018)



30.3%, and 21.3% in 2017, respectively (MEMR, 2018). Transportation is the primary consumers of oil, while power sector is fueled mainly by coal. Even though fossil fuel is the dominant source of energy, the country does not have a large amount of reserve compared to others. Oil, coal, and gas reserves of Indonesia accounted for only 0.2%, 2.2%, and 1.5% of total world reserves (BP, 2018). Nevertheless, 43% of its gas production is exported. At current production rate, the gas reserve will be depleted in 40 years if there is no exploration and no new operational gas wellhead. The country has also become a net importer of oil since 2004 as the national consumption exceeds its production (PwC, 2018). Since oil production has been decreasing, the macroeconomic stability of the country will be at a risk. Indonesia will have a large foreign trade deficit because of the increasing oil import.

Coal usage in generating electricity increases strongly as coal in Indonesia has a higher reserve to production ratio compared to oil and gas. Also, it can reduce the risk of current account deficit and inflation due to oil imports. Careful management and utilization of fossil fuel resources are critical to overcoming this challenge.

2.2 Coal in Indonesia's Energy Sector

The General Planning of National Energy (RUEN-2014) specifies the role of energy sources: maximizing the share of renewables in the national energy supply mix while optimizing gas, minimizing oil, and using coal as baseload to fulfill the remaining of energy needs. Historically, Indonesia's primary energy mix shows a different story. Coal is on the rise in the primary energy mix in the last decade due to the acceleration of the power plant development program. Renewables mix is also increasing although at a much slower pace. The renewables increase is mainly contributed by the biofuel usage to replace fuel diesel in industry and transportation sectors and by geothermal for electric power.

Coal domination is more apparent in the power sector as coal contribution reached 50% of the installed capacity in Indonesia and 58.1% of electricity generation in 2017 (DJK ESDM, 2018; MEMR, 2018). Without taking into account the externality cost, coal usage is preferred by PLN, a state-own utility company with a single right to offtake electricity, to generate electricity for the next decade. In PLN RUPTL (2019-2028), an additional 27 GW of coal-fired power plant (CFPP) or 48% from total installed capacity

Figure 3 Year on Year Percentage of Primary Energy Mix (MEMR, 2018)

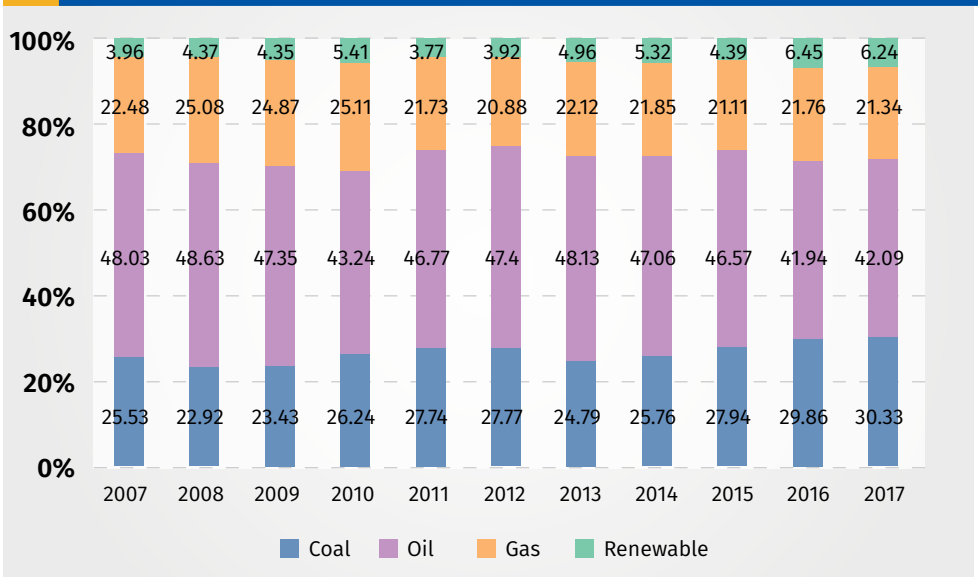
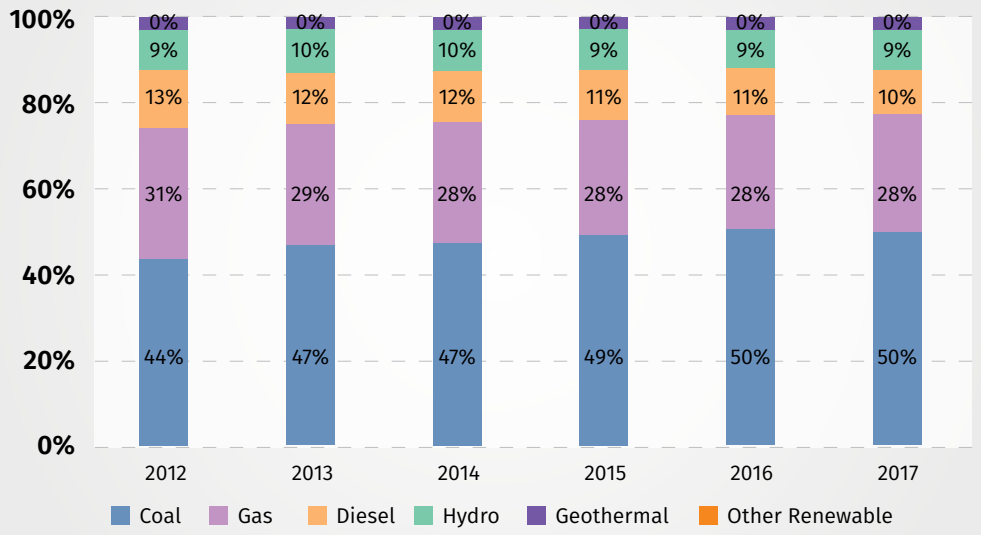


Figure 4 Year on Year Percentage of Installed Capacity Mix (DJK MEMR, 2018)



is planned and therefore potentially increase the coal shares in electricity mix to 60-65% (PLN, 2018a).

2.3 Coal in Indonesia's Economy

Coal in Indonesia's National Economy

In addition to its role in energy sector, coal also contributes to national development as a revenue stream for the State Budget. According to government regulation no. 9/2012, there are three ways on how coal sector can contribute to state revenue: land rent, royalty/tax, and sales of mining product. For the last four years, coal revenue collected is averaging around IDR 31 trillion (2.17 billion USD) or averaging close to 80% of total non-oil & gas revenue. However, coal revenue contribution to the state budget is relatively low, around 1.5 to 2 % of total revenue (Mariatul Aini, 2018).

The contribution from coal sector to state revenue is influenced by coal sale, both domestically and internationally. For example, the amount of coal production and export has increased in the last four years because coal price has risen from 60

Figure 5 Revenue from the coal sector (Mariatul Aini, 2018; Ministry of Finance, 2019)

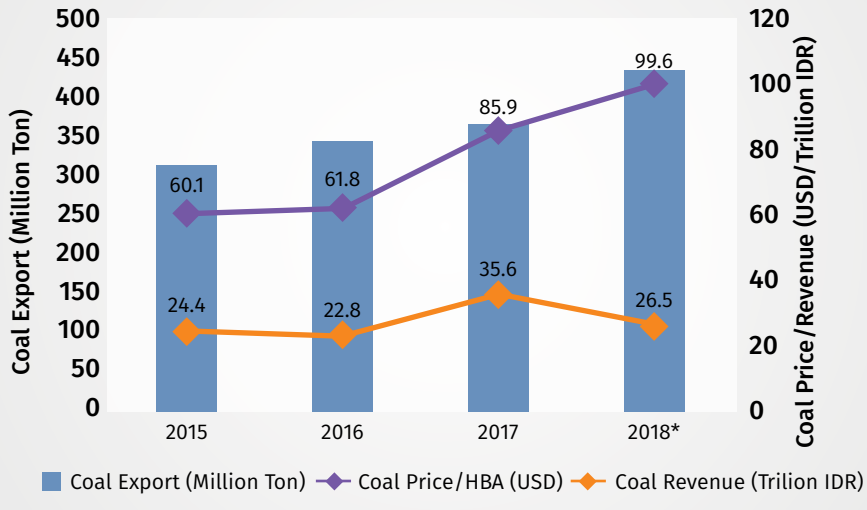
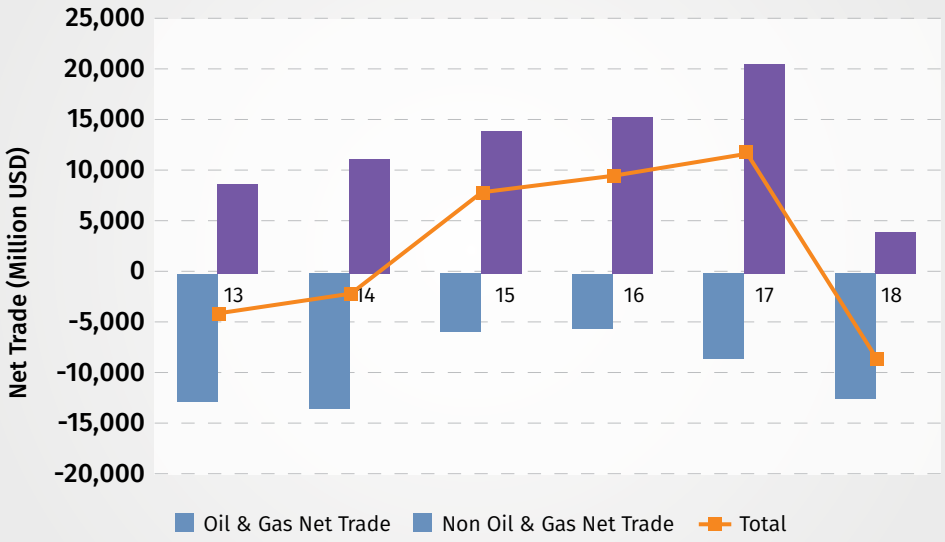


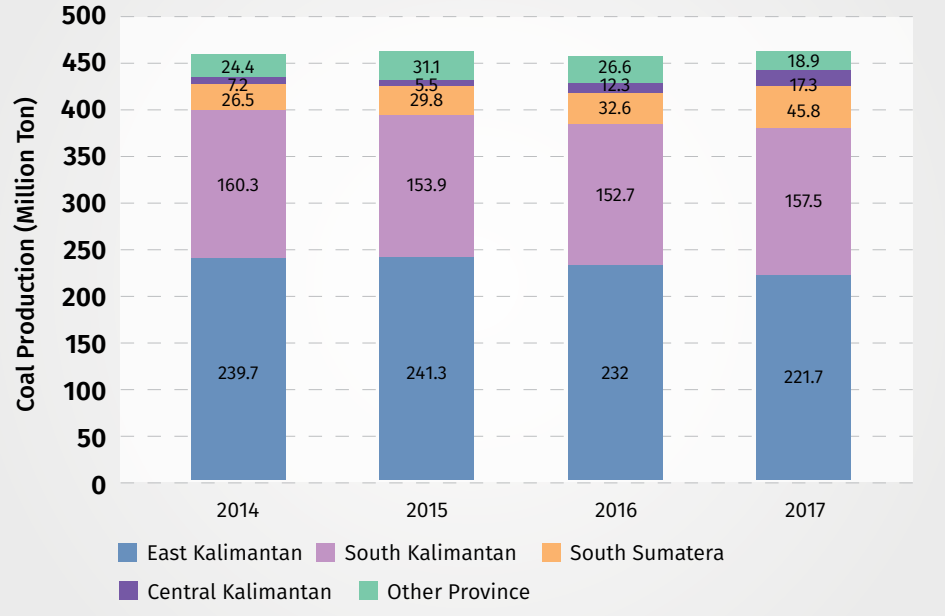
Figure 6 Indonesia's Trade Balance (Ministry of Trade, 2019)



to 100 USD; that led to more revenue gained from the coal sector. Coal price has a significant influence over the production and export of coal.

The government's reasoning over the exploitation of coal is to increase trade revenue and help in counterbalancing deficit coming from oil and gas trade (Syahni, 2018). Indonesia's import has risen by 22.2 % from 2017's figure, mainly dominated by the increasing of raw material import for industry and fuel (Ministry of Trade, 2019). Nevertheless, Indonesia experienced the worst net trade record in 2018, reaching minus 8.57 billion USD. The record is worse compared to the 2013 and 2014 trade deficit value of 4.08 and 1.89 billion USD, respectively (Fajriah, 2019). It is

Figure 7 Coal Production in four provinces (Petromindo, 2019)



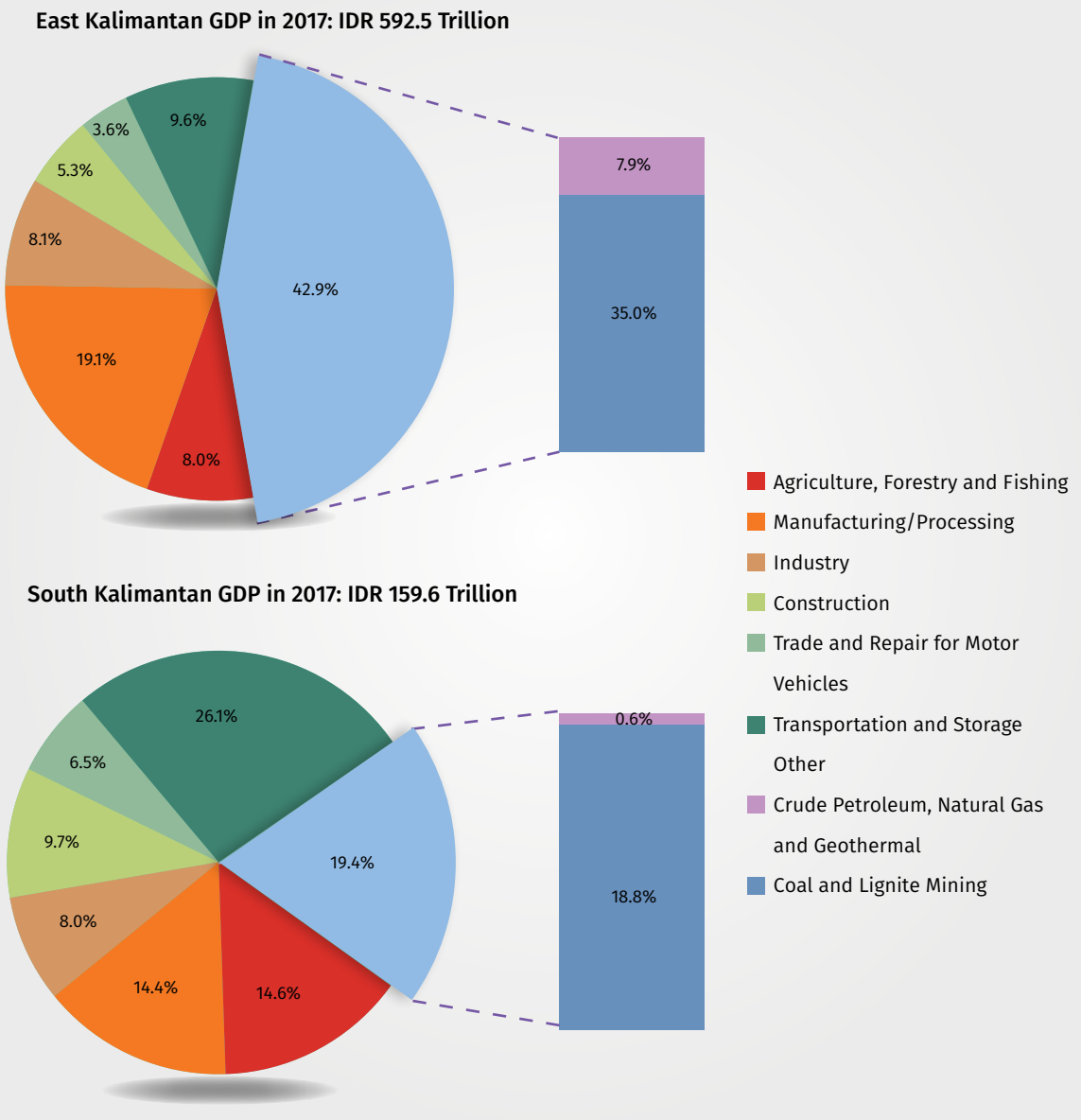
more than likely that the trend will continue in 2019 and thus the government will still look to coal export as one of the options for trade deficit balancing (given that the international price of coal stays high at >90 USD/ton) while building a strategy on reducing imports of consumer goods.

Coal in Local Economies

Indonesia's coal resources and production are mainly distributed over only four provinces out of 34: East Kalimantan, South Sumatera, South Kalimantan, and Central Kalimantan. Kutai, Tarakan, and Barito coal basins located in East Kalimantan have medium-quality coal (calorific value between 5100-6100 kcal/kg) while the Central and South Sumatera Basins have low-quality coal reserves (calorific value <5100 kcal/kg) (Adiatma et al., 2018).

Coal has a substantial contribution to the local economy of the four provinces. In East Kalimantan, coal sector contributed up to 35% of the provincial GDP in 2017. By adding oil and gas to the figure, the number almost reach half of the provincial GDP. This

Figure 8 Comparison of GDP of South Kalimantan and East Kalimantan (BPS, 2018)



indicates that East Kalimantan economy relies heavily on fossil fuel. A similar condition can be found in South Kalimantan province. Although South Kalimantan has lower GDP value compared to East Kalimantan, South Kalimantan's coal sector contribution is rather high, ranging between 19-26% of the provincial GDP in the last five years. Considering the high share of GDP from coal sector and also the discrepancy between coal and other sectors' development in both provinces, coal transition may have more impacts on their economics, social, and political environment.

East Kalimantan's economy is four times larger than South Kalimantan's. The sources of South Kalimantan's economy are diverse (e.g., coal mining, industry, trade, and transportation) and are comparable in size. On the other hand, the East Kalimantan's economy depends mostly on coal sector with more than a third of its GDP contribution coming from coal. The next largest GDP contributor in this province is the manufacturing/processing industry, agriculture, and construction with a considerable difference of value compared to coal sector's contribution. Overcoming this gap would be more challenging and would be a crucial strategy for East Kalimantan to shift away from its coal-dominated industry.

2.4 Summary to this Section

In short, several messages can be summarized in this section:

- Coal dominates Indonesia's energy and electricity mix. Without taking into account the externality cost, coal is perceived as a cheap energy source despite the coal price cap policy that the government had to introduce to keep the electricity tariff constantly low.
- Despite government's intention of utilizing coal as one of energy sources to create multiplier effects and accelerate domestic economic development, in practice coal is still heavily exported.
- Coal is perceived as one of the sources of foreign exchange. The government would likely still rely on coal export to balance the trade deficit for the next few years, given the current coal price would stay high. One of the reasons for such policy is the trade deficit the country had suffered this year due to oil import. However, coal export alone will not be sufficient to cover the deficit from oil & gas trade.
- Most of Indonesia's coal resource and production are from only four out of 34 provinces. Out of those four, East Kalimantan's and South Kalimantan's economic development are highly dependent on coal sector's contribution.

3. Indonesia's Coal Dynamics

3.1 Policy Directives

Indonesia's energy policy evolves over time but it emphasizes on diversification, intensification, and conservation of energy sources. The latest energy policy is Kebijakan Energi Nasional (KEN) or National Energy Policy 2014 (KEN 2014). The overarching objectives of Indonesia's National Energy Policy (KEN) are to create energy independence and maintain national energy security based on the principle of fairness, sustainability, and environmental consideration. KEN 2014 has two main strategies: energy diversification and energy efficiency and conservation.

KEN 2014 is based on response measures to the oil price crisis occurred in 2005. Global oil price increased dramatically from 2005 to 2012, causing a financial burden for the government due to soaring fuel subsidies and increasing oil import that disrupted the country's balance of trade. Since Indonesia possesses abundant coal and renewables resources, energy diversification strategy is aimed at maximizing these resources, including the use of vegetable oil, mainly crude palm oil (CPO) as biofuel feedstock to reduce oil import.

In KEN 2014, usage of coal as reliable source for national energy supply is one of Indonesia's national energy priority until 2050, mainly to substitute diesel oil usage in power plants. However, coal share is expected to be reduced in national energy

mix and replaced by renewable energy sources later on. The target is to have renewable energy share of 23% by 2025 and 31% by 2050, as specified in the General Planning on National Energy (RUEN) issued in 2017.

Under RUEN, government sets to limit domestic coal production at 400 million tons per year starting 2019, unless domestic demand exceeds this amount. In the past ten years, coal production rapidly increases and the number is floating above 400 million ton annually. In the Mid-Term Development Plan (RPJMN) 2015-2019, annual coal production is also planned to be 400 million tons in 2019, of which 60% is consumed domestically. Since 2009, coal companies are obliged to supply a certain percentage of their production to domestic buyers, known as Domestic Market Obligation (DMO). Each year, MEMR sets the amount of DMO for coal producing companies through a Ministerial Decree.

Indonesia is a party of the United Nations Framework on Climate Change (UNFCCC) and supporter for the global climate agreement. In 2015, in Paris Climate Conference, President Joko Widodo committed to reduce Indonesia's Greenhouse Gas (GHG) emission. Later in 2016, the government of Indonesia ratified Paris Agreement and submitted its Nationally Determined Contribution (NDC). Under NDC, the government pledged to reduce GHG emission by 29% of the BAU scenario in 2030 unconditionally, and additionally, 12% more with international supports. GHG emission from energy sector is to be reduced by 11% unconditionally (or 14% conditionally). Moreover, as the issue of climate change started receiving global attention, meeting the Indonesia's pledge to reduce GHG emission against the business as usual scenario by 2030 is crucial.

NDC for energy sector lines up a variety of mitigation activities but lack in clear strategy and program to meet the mitigation goal (Tumiwa, 2017). The emission from power sector also increases with the incremental number of coal power capacity added from 2017 to 2022. Achievement of NDC's non-LULUCF target requires Indonesia to meet the renewable energy target as stipulated in KEN 2014. However, under current policy, Indonesia will not be able to meet its KEN 2014 target (Climate Action Tracker, 2018).

The Ministry of Environment and Forestry (MOEF) in December 2017 proposed a stricter emission standard for coal-fired power plant to replace the currently low standard applied since 2008. The proposed standard

Table 1 Electricity generation according to RUPTL 2018-2027 (TWh)

No.	Type of Fuel	2018	2020	2025	2027
1	Hydro	18.9	18.1	43.1	46.7
2	Geothermal	14.7	17.5	50.8	49.2
3	Other Renewables	0.4	2.9	6.3	6.6
4	Gas	57.0	76.1	96.5	103.5
5	Fuel	11.6	7.1	1.8	2.0
6	Coal	169.6	194.2	236.8	293.9
7	Import	1.4	0.9		
Total		**273.8**	**316.7**	**435.5**	**501.9**

is comparable to international practice for new power plants delivered after 2021 and can potentially reduce air pollution from coal-fired power plant by 50% for PM, 47% for SOx, and 58% for NOx. This plan was, however, challenged by the power sector lobby and has yet to be finalized until the end of 2018 (Indonesian Center for Environmental Law & Centre for Science and Environment, 2018).

3.2 Coal Production Dynamics

KEN stipulates that coal must be prioritized as national development capital instead of as a commodity (for trading/export). Despite this rhetoric, practically, coal is currently still considered as "easy money"; a source of district's, provincial's, and state's revenues and is used to cover foreign trade deficit. Local miners can easily boost their production to chase the benefit of increasing price of coal at the international market, that is influenced by increasing demand from China and India.

Coal mining has become a political commodity and source of funding for political campaigns at national and local level (Deha, 2018). Since stakeholders view coal as a trading and political commodity, it is difficult to control its production and export as they benefit from it. Moreover, coal industry (both in the mining and power sector) is tightly connected to political elites in Indonesia, involving several big names in current national political landscape (including political patrons, parliamentarians, ministers and presidential candidates). The decentralization in 2009 Mining Law provided an opportunity for local politicians to also take benefit from the coal industry (Greenpeace, Mining Advocacy Network (JATAM), Indonesia Corruption Watch, & Auriga, 2018).

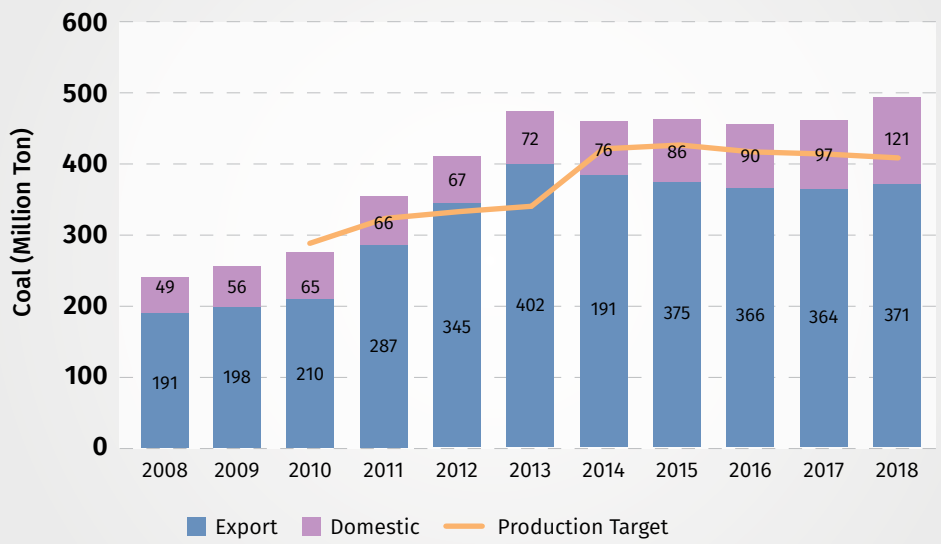
Indonesia's coal production has been increasing significantly since 2006 and coal export has increased about 250% in only a decade. The actual coal production since 2016 has always been above the RUEN target. Even the annual target set by MEMR were above RUEN and RPJMN (National Mid-Term Development Plan) target. In 2018, for example, RUEN and RPJMN target was 403 million tons and 406 million tons, respectively; while MEMR target was 485 million tons and according to MODI actual production was 557 million tons (Dirjen Minerba, 2019). In that same year, the government even allowed miners to increase coal production for more than 100 million ton over MEMR target to compensate for DMO cap-price policy.

One of main drivers of Indonesia's overproduction of coal is the over-licensing of new mines. The boom in coal mining in Indonesia occurred during the last 15 years, started by Government Regulation (Peraturan Pemerintah/PP) No. 75/2011 which effectively hands over the licensing authority from central government to local governments. In 2001, the number of mines license issued by the central government was ca. 750 and then increased significantly to over 8.000 licenses by the end of 2008 (Hayati, 2015). During 2010 – 2014, close to 3.000 mining licenses were issued, bringing the number to 10.900. From that massive numbers, 40% is coal mining IUP (Izin Usaha Pertambangan/Mining Business License) with a total area of 16.2 million ha (PWYP Indonesia, 2016).

The over-licensing amplifies production and export rates. With Indonesia's economy also relies heavily on minerals export, coal mines create numerous problems, including illegal mining, corruption, and deforestation. There are several changes during recent years aiming to tackle some of the problems, which includes revision of the Decentralization Law and the issuance of Clean and Clear program[2]. Corruption

2 Clean and Clear is a review process to certify the applied miners that they have clear records from royalty obligations, debts, property and permit issues, and have fulfilled their environmental commitments.

Figure 9 Indonesia Coal Production and Target (Dirjen Minerba, 2018, 2019)



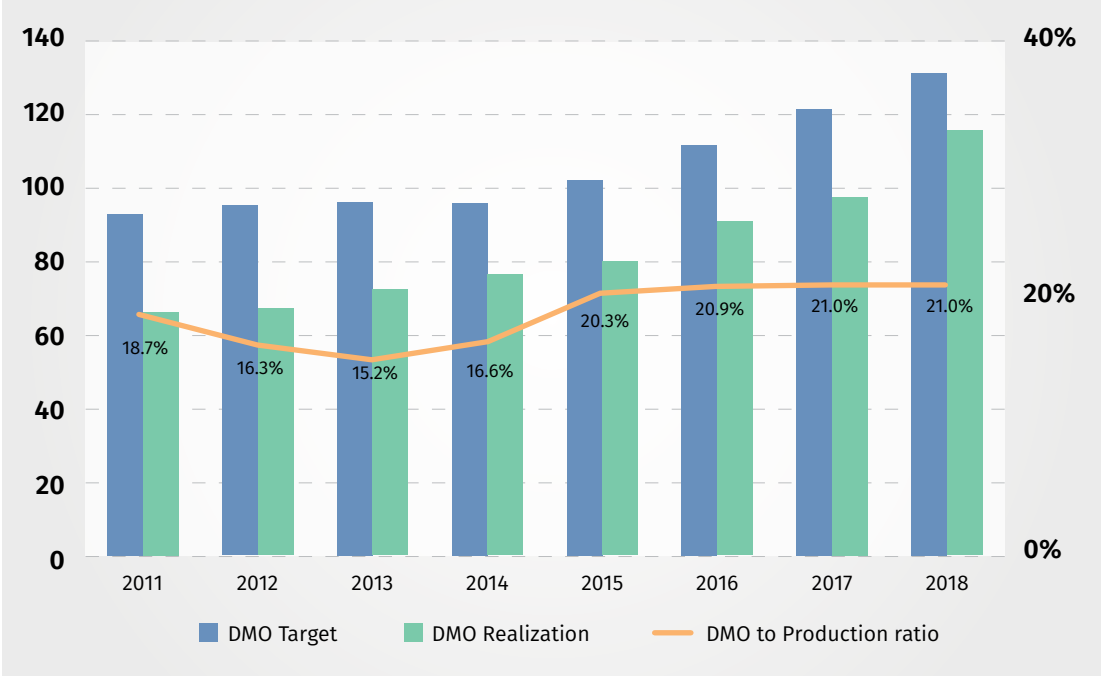
surrounding coal mining has also been an important issue for the public, as Indonesia's Corruption Eradication Commission (KPK) recommended that around 3,900 mining permits should be revoked due to mining infringements (Fazli, 2016). In East Kalimantan, one of the "big four" of Indonesia's coal mining provinces, the provincial board announced in 2017 that they withdrew 400 licenses, mostly due to lack of Clean and Clear certification.

In 2016, the government was under pressure from neighboring countries due to peat fires. Thick, fast-spreading haze from slash-and-burn practice to open new palm oil plantation and coal mines made its way to Malaysia and Singapore, and the government was forced to react. President Joko Widodo announced a moratorium on issuing new coal mine licenses, a plan that was included in RUEN 2017 (Rencana Umum Energi Nasional/National Energy Plan). This was not that first time the government announced a moratorium, as in 2009 after the issuance of Mining Law, the government also suspended new IUP until the new regulation was properly in place. However, local governments mostly did not comply to the moratorium announcements since there has yet to be a sound regulation being issued by the national government, and in terms of national production, Indonesia keeps producing coal over its national target.

3.3 Domestic Coal Demand Dynamics

Although Indonesia's coal production remains heavily exported, the increases in domestic demand affect its coal dynamics. Coal domestic demand is mostly coming from power generation as Indonesia is attempting to boost its economic growth and also to provide universal energy access (electrification ratio currently stands at 98.3%, which counts solar home systems). Government energy policy, for example, sets an ambitious goal to increase Indonesia's power generation by 35 GW in 5 years (2015 – 2019), of which only 2.6 GW is currently in operation as of December 2018 (MEMR, 2019). The energy plan calls for an increase in coal production, as more than half of energy sources in Indonesia's energy mix is contributed by coal. This approach is apparent since the government puts a heavy emphasis on energy security, translated to

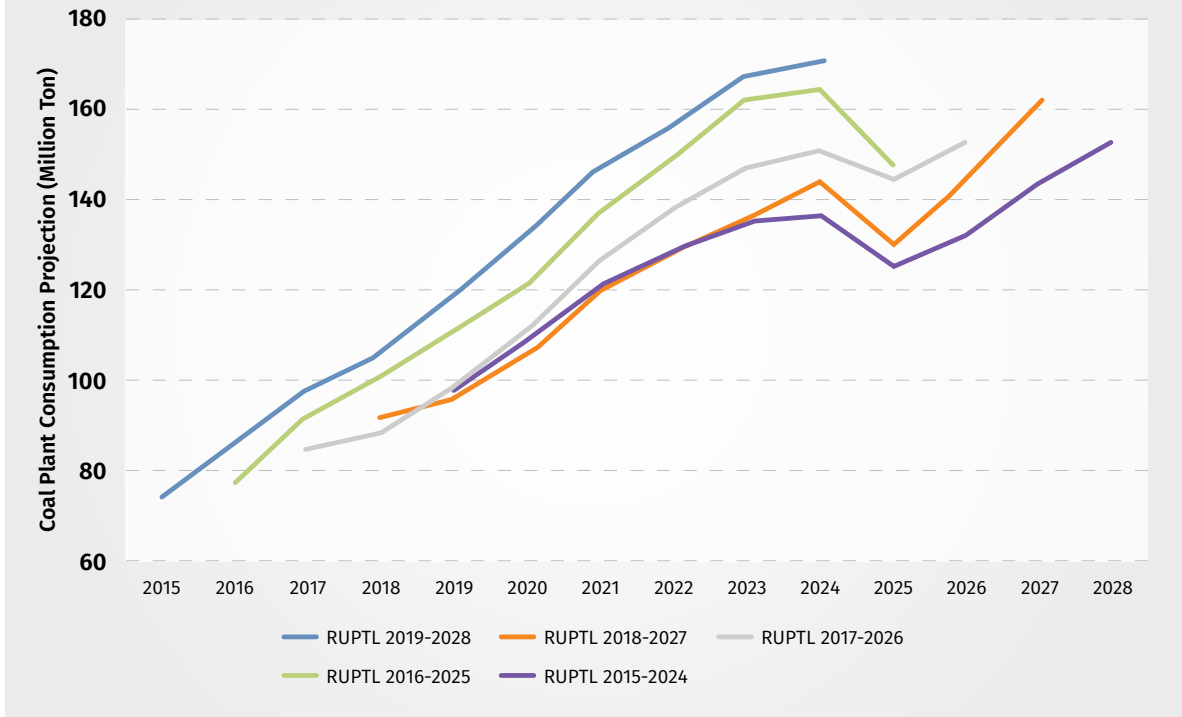
Figure 10 Coal Domestic Obligation Target and Achievement (Dirjen Minerba, 2018, 2019)



maximizing the use of its own natural resources for economic and social development.

The government introduced MEMR Regulation No. 34/2009 on Domestic Market Obligation (DMO) to secure the supply of coal for domestic needs, The regulation mandates coal companies to allocate a certain percentage of its production for national use. However, since its implementation, only an average of 20% of coal is used domestically. The DMO implementation has also consistently failed to achieve its set target. Despite the low

Figure 11 Coal Consumption Projection for Indonesia Power Sector (from RUPTL 2015-2019)

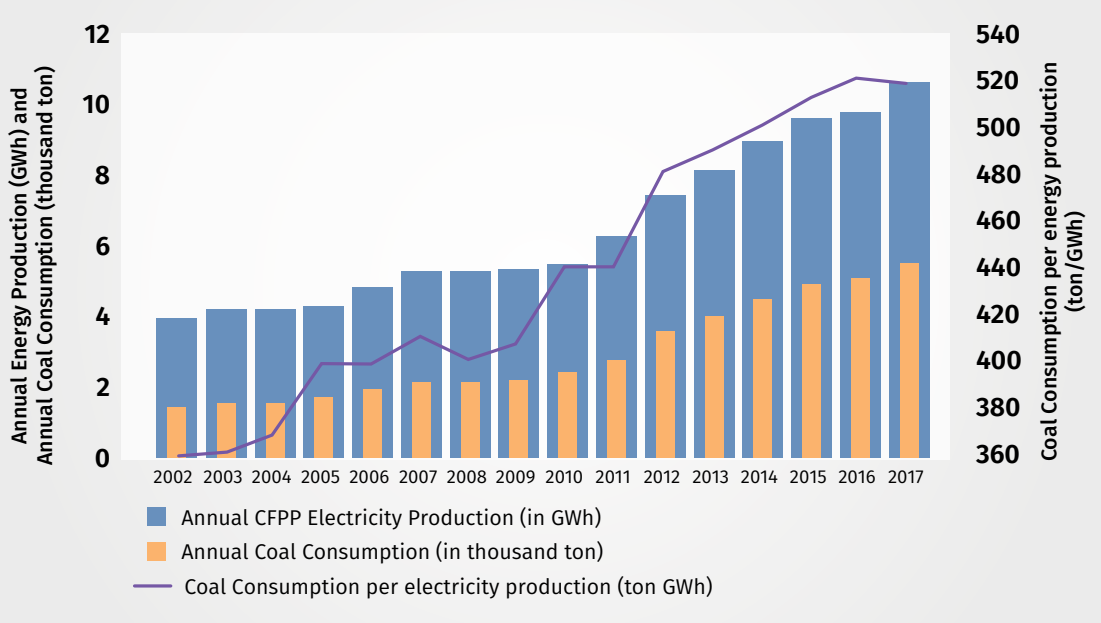


achievement, the government established a minimum of 25% production for DMO through MEMR regulation no. 23/2018. Moreover, according to MEMR Decree no. 1395/2018, the government has capped domestic coal price for power generation at USD 70/ton to protect PLN from the risk of fluctuating price in the international market and maintain the status quo of coal as a cheap electricity source (Firmansyah, 2018).

The state-owned electricity company, PLN, also has a strong position over domestic energy development. The company prefers short-term economic benefit by favoring coal due to its subsidized price, aiming to minimize generation cost amid over-projection of electricity sales. Historically, PLN through RUPTL has consistently overestimated their coal projection. Each year, revision of RUPTL has shown a considerable reduction in the coal projection (RUPTL 2015-2019). While the over-projection causes PLN to revise their RUPTL, planned coal-fired power plants are reduced by only 5 GW, while gas and renewable are reduced by 10 GW and 6,7 GW, respectively (RUPTL 2018 – 2027). The recent RUPTL (2019-2028) does not even introduce a reduction to planned coal-fired power plants. It is evident that domestic demand for coal will continue to increase if the government holds its stance towards power generation.

Domestic consumption is also expected to rise due to an increase in coal consumption per unit of electricity production. An analysis on PLN's coal-fired power plant statistics shows there is an increase of coal consumption by 44% over the last 15 years (Adiatma et al., 2018). Several factors affecting the increase are inefficient operation of the power plants and the use of lower quality of coal. Indonesia's reserves of higher calorific value coal are declining, with 62% of the reserves consists of lignite. Newer power plants in Indonesia are designed to use coal with calorific value of 4,000 kcal/kg, including the recently halted mine-mouth power plant in Riau and other mine-mouth power plants in South Sumatra. Wood Mackenzie projects that Indonesia's consumption of domestic coal for coal-fired power plants will doubly increase from 83 million tons in 2018 to 157 million tons by 2027. If this trend continues, Indonesia's coal production will shift to the domestic market.

Figure 12 PLN Coal Consumption per Unit of Electricity Produced (Adiatma et al., 2018)



3.4 Indonesia's Coal Export

Over 80% of Indonesia's coal production is exported, with one-third of it exported to China (MEMR, 2018). With a substantial portion of coal being sent overseas, coal demand in Indonesia relies heavily on the dynamics of the global coal market. When international coal prices dropped significantly, domestic production rates also followed the trend. In 2015, many Indonesian mining companies ceased activity and lowered their production when coal prices hit USD 50/ton. Indonesia's coal export to China decreased by 30% that year.

From the 1990s and early 2000s, Indonesia coal export was mostly dominated by Japan and Taiwan. In the mid-2000s, exports to China and India began to increase dramatically. In 2009, the amount of coal exported to China and India increased by 150% and 50%, respectively, compared to the previous year. Since then, coal export growth to both countries doubles each year up to 2013 for China and 2015 for India.

In the case of China, its substantial increase was driven by a shift from direct end use to transformation, i.e., from industrial to thermal electricity generation. Between the year 2000 and 2006, direct end use of coal decreased to 26% from 35%, but coal for power generation increased by 8% (Aden, Fridley, & Zheng, 2008). This change was driven by a high rate of urbanization, rising consumption, and heavy industry growth. Since Indonesia is producing steam coal which is suitable for power generation, the trend was observed that China keeps importing steam coal from Indonesia in a large amount. Indonesia coal export to China plunged in 2015 but has since increased to its pre-2015 amount. Half-year coal export to China in 2018 was recorded at over 80 million tons, rising by 30% compared to the same period in 2017 (Merry Maryati, 2018).

Since the early 2000s, Indonesia also saw a steady increase in coal export to neighboring countries. Although the numbers are pale in comparison to export to China and India, economic growth in Southeast Asia also drives the need for more power generation in Thailand, the Philippines, and Malaysia. For those developing countries, coal remains the most competitive in power generation cost. Malaysia, for example, fully imports its coal due to its heavy dependence on fossil fuels. More than 60% of its coal is imported from Indonesia.

Figure 13 Indonesia coal export by countries (processed from BPS and Kemendag)

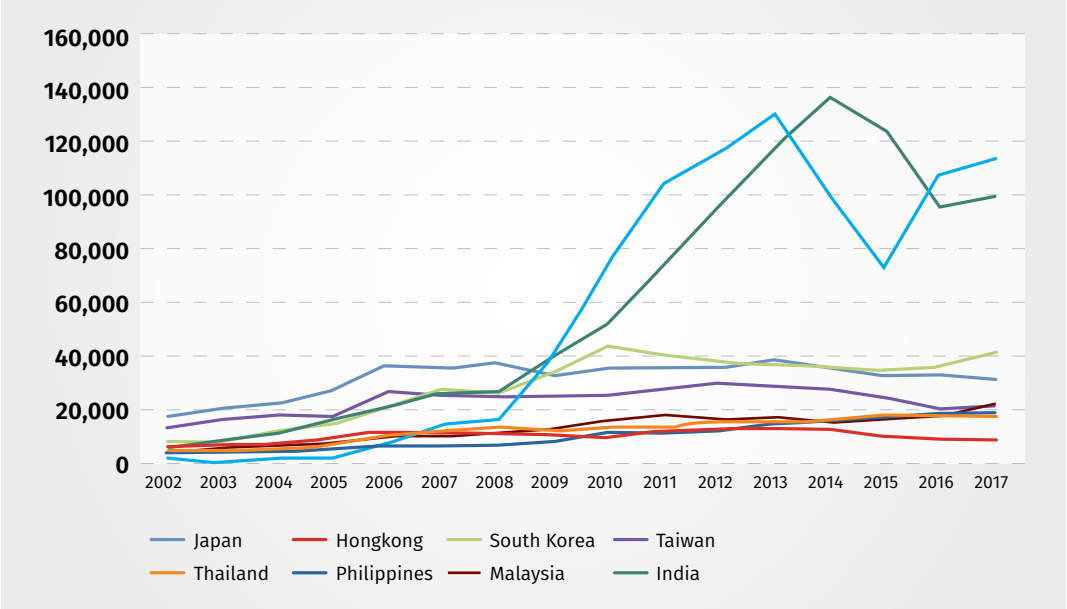
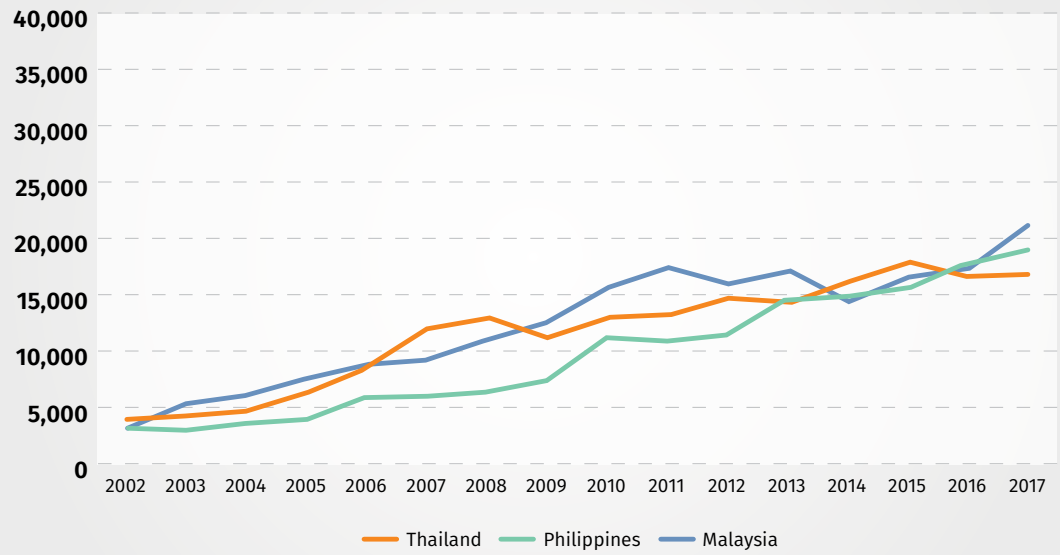


Figure 14 Indonesia coal export to SEA countries (processed from BPS and Kemendag)



3.5 Summary to this Section

In summary, we can conclude that under current circumstances, the domestic coal demand will continue to increase while the coal export will soon be decreasing. The domestic coal increase will come from power sector with around 27 GW of coal-fired power plants planned for the next decade. On the other hand, demand for export will gradually decrease from China (and India) although import to the South East Asia country will have a marginal increase. Overall, there will be no significant change in national coal production.

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4. Coal Transition in Indonesia's Power Sector: Drivers and Challenges

Coal has been the dominant source of electricity mix in Indonesia, and its share is increasing over the last decade. While PLN owns the majority of coal-fired power plants, the share of coal electricity from IPP has been increasing as well. Electricity generation cost of PLN has been fluctuating following the price of coal, since cost of fuel makes up 76% of electricity generation cost in coal-fired power plant.

Figure 15 Indonesia Electricity Mix from Coal (processed from handbook of Energy and Economics)

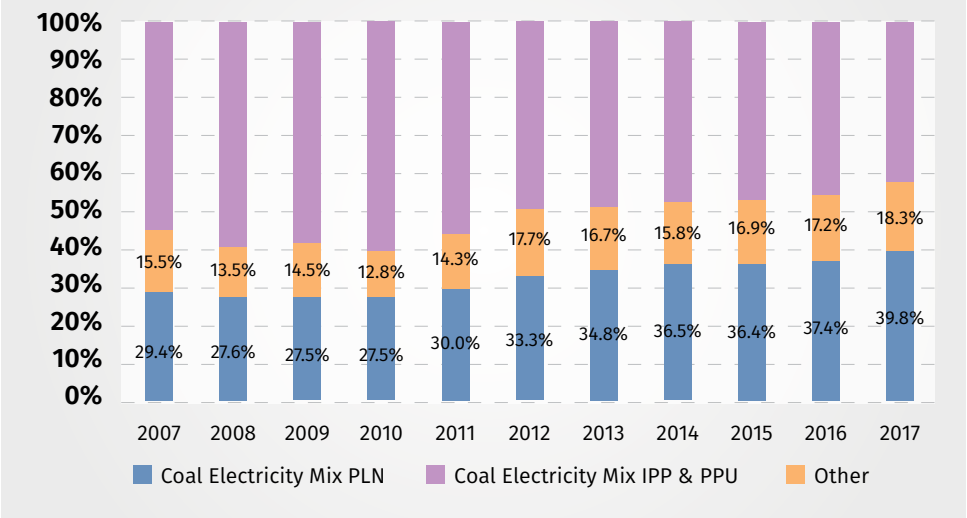
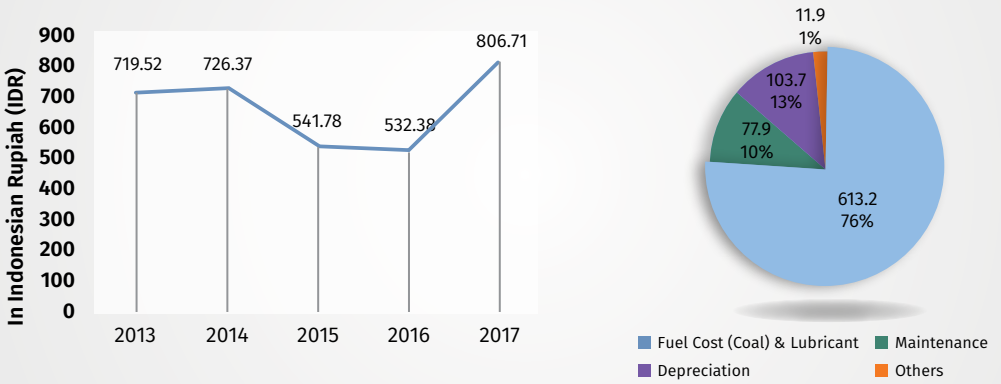


Figure 16 Cost of Electricity Generation from Coal Power Plant (PLN, 2018b)



4.1 Cost of Different Generation Technologies

The cost of electricity generation from renewable sources, mainly solar and wind, has been declining globally, driving the energy transition from coal. Many factors drive the price down, such as economies of scale, improvement in the manufacturing process, and increasing capacity factors (IRENA, 2018).

We calculated the LCOE of different generation technologies with the financial and technological data obtained provided by the National Energy Council (Dewan Energi Nasional, 2017). The calculated LCOE is presented in Figure 13 and Table 2. This LCOE solely represents the technology cost, excluding land cost, pre-development cost, decommissioning cost, and taxes. The WACC applied is 10% for all technologies and the calculation utilizes only the data available in the publication mentioned.

In 2020, most of the renewables will still be more costly than the ultra-supercritical (USC) coal power plants. However, the costs will decline, and by 2030, geothermal- and solar PV- generated electricity will already be cheaper than the coal-generated one. By 2050, wind power will be already on par with coal. WTE thermal will still be costly, but it

Figure 17 LCOE of Different Power Generation Technology in 2020 and 2050

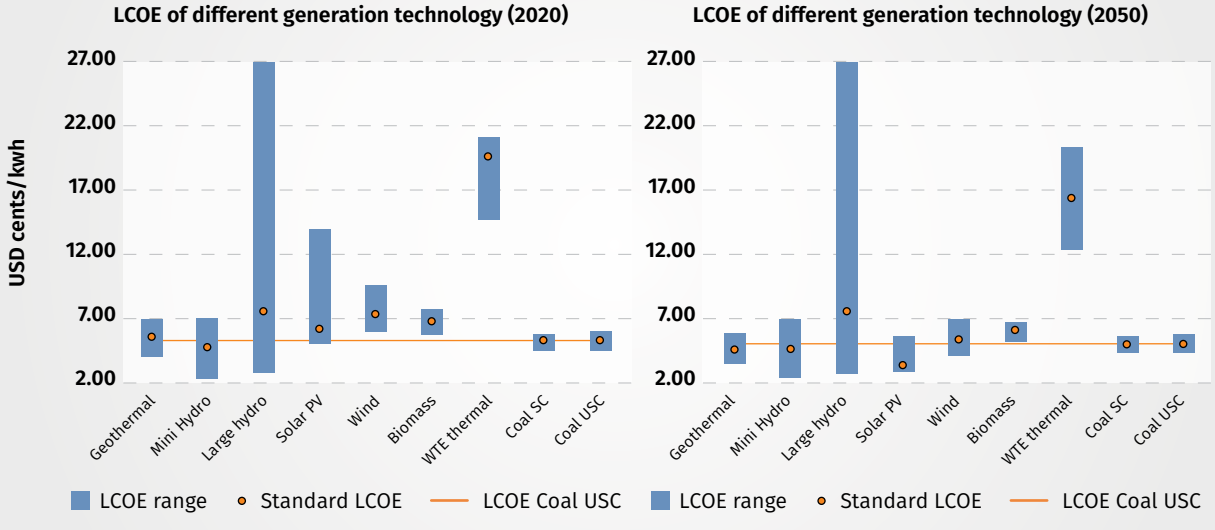


Table 2 Standard LCOE of different technology in 2020, 2030, and 2050 (in USD cents/kWh)

	2020	2030	2050
Geothermal	5.58	5.11	4.63
Mini-hydro	4.78	4.74	4.69
Large hydro	7.66	7.59	7.52
Solar PV	6.26	4.69	3.35
Wind	7.47	6.23	5.14
Biomass	6.73	6.40	6.06
WTE thermal	19.56	18.28	16.34
Coal SC	5.30	5.15	5.01
Coal USC	5.39	5.25	5.10

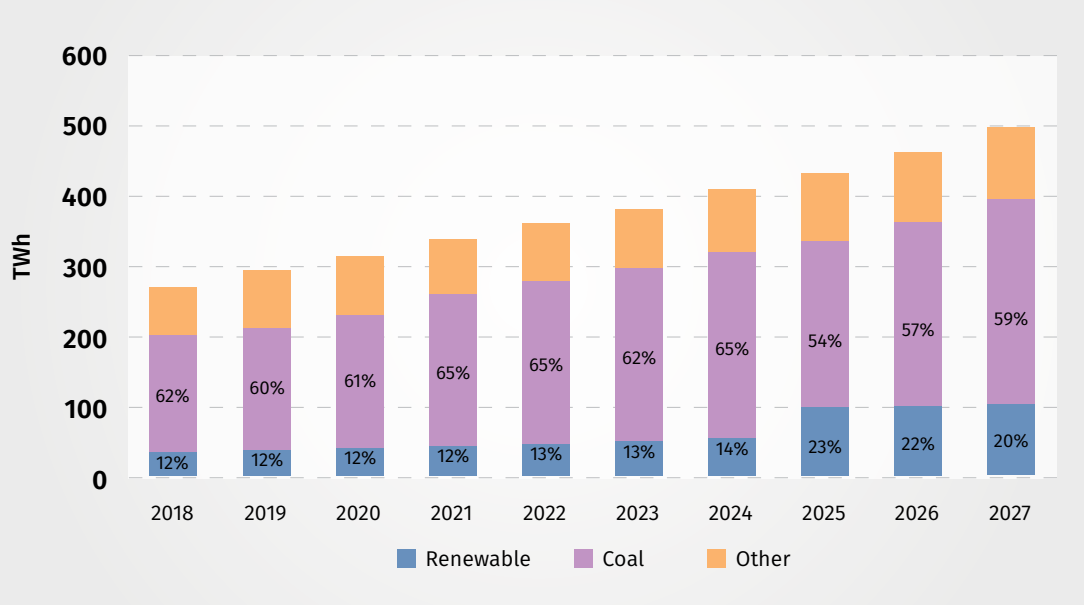
has not included the tipping fee for managing waste. This result did not consider the cost of CO_2 emission and air pollution from coal power plants that might also be imposed in the future.

The declining cost of renewables-based electricity poses a risk for coal power plants as they will become stranded assets. According to IEEFA projection, based on RUPTL 2017-2026, in Java-Bali only, there will be 5.1 GW of unused coal power plants capacity that will worth USD 16.2 billion over their 25 years operational lifetime. (Chung, 2017). On the other hand, a recent study showed that a potential cost saving of USD 10 billion could be achieved if renewable energy power plants are to be built instead of coal power plants planned under RUPTL 2018-2027 (taking into account potential savings from energy efficiency as well) (Liebman & Foster, 2019)

4.2 Inefficiency in Coal Power Plants Operation

The government focuses on pushing down electricity production cost. This is manifested in the regulation that limits electricity production cost of new power plants not to be higher than the existing production cost (BPP). By externalizing most

Figure 18 Share of renewables and coal in electricity generation according to RUPTL 2018-2027



of its cost, coal is currently considered as the cheapest power source. Moreover, coal is relatively abundant in Indonesia, although they are mostly low-rank coal. Consequently, coal becomes the priority for power generation source. This is reflected in PLN's business plan that still aims to have almost 60% of its power generation in 2027 coming from coal.

This heavy reliance on coal poses several problems. One of the issues is the declining performance of existing coal power plants over the years, probably due to declining efficiency of old coal power plants, lower quality of coal consumed, and poor performance of new coal power plants built by Chinese contractors. In the last 15 years, PLN's coal consumption has increased from 360 tons/GWh to 520 tons/GWh (Adiatma et al., 2018). If PLN tries to maintain the operation of low performing coal-fired power plants, the BPP of electricity will increase over the years, and not for a good cause.

4.3 Increasing Cost of Coal Mining

The production cost of coal is increasing over the years. Rosyid & Adachi (2016) showed that production cost increases along with cumulative production. They projected that the average operating cost (including extraction, processing, transportation, and royalty payment) of Indonesia's coal would increase up to USD 100 per ton in 2040. Meanwhile, coal price is predicted to decline to its 2015 price in 2030 (The World Bank, 2018). Coal price in 2015 was remarkably low, causing hundreds of small coal mining company to stop operation. Coal industry might face a major economic issue if this forecast do occur in the future, and therefore need to diversify their business as soon as possible.

4.4 Subsidy in Coal Sector

Indonesia's coal industry is heavily subsidized, both by the state and by the citizens. The government subsidizes coal industry sector through loan guarantee, tax exemption, and preferential royalties and tax rates. The number of subsidies quantified so far reached at least USD 946.2 million and USD 644.8 million for 2014 and 2015 respectively (Attwood et al., 2017). The figure can be translated to USD 2 per ton and USD 1.4 per ton of coal produced in 2014 and 2015.

Moreover, through the Ministerial Decree 1395K/30/MEM/2018 published in March 2018, the government has imposed a price cap on coal consumed for public power generation, keeping power generation cost from coal low during increasing global coal price. The decree has put a ceiling of USD 70 per ton coal consumed by domestic coal power plants (for coal with calorific value of 6322 kcal/kg). Although coal price cap policy has allowed PLN to reduce their electricity generation cost and therefore decreasing electricity subsidies required from the government, the policy has also caused a loss of state revenue from coal tax for the government. It is estimated that PLN can save up to IDR 18 trillion (around USD 1.3 billion) while the loss of revenue from the government is around IDR 9 trillion (around USD 630 million) (Suzuki, 2018; www.indonesia-investments.com, 2018). Our own calculation using data of electricity generation cost from PLN shows an even higher number of subsidies given to PLN because of this regulation, reaching USD 1.59 billion in just nine months in 2018. The number is almost equal to one month of PLN's revenue in 2017 (PLN, 2018b).

The citizens also bear environmental and social cost that is not included in coal production cost, such as CO2 emission, air and water pollution, food crops and fisheries productivity decline, health problems, and corrupt government (Waterkeeper Alliance & Mining Advocacy Network (JATAM), 2017). Moreover, there is also a negative impact

coming from coal power plants. If all environmental and health cost is to be externalized and the subsidy is to be revoked, the cost of coal-generated electricity could increase by more than double and become higher than renewables (Attwood et al., 2017).

4.5 Inconsistent Policy Implementation

Indonesia has committed in Paris Agreement and followed through with the publication of its first Nationally Determined Contribution (NDC). The NDC showed that under business as usual scenario, GHG emission from energy sector will increase from 453.2 Mton CO_2-e in 2010 to 1669 Mton CO_2-e by 2030, making the sector the highest contributor of GHG emission in 2030. Some mitigations actions considered in the NDC for energy sector are the increasing penetration of renewable energy in power sector and utilization of clean coal technology (Ministry of Environment and Forestry, 2016). The energy policy, KEN and RUEN, also supports NDC with its 23% renewable energy target in primary energy supply by 2025.

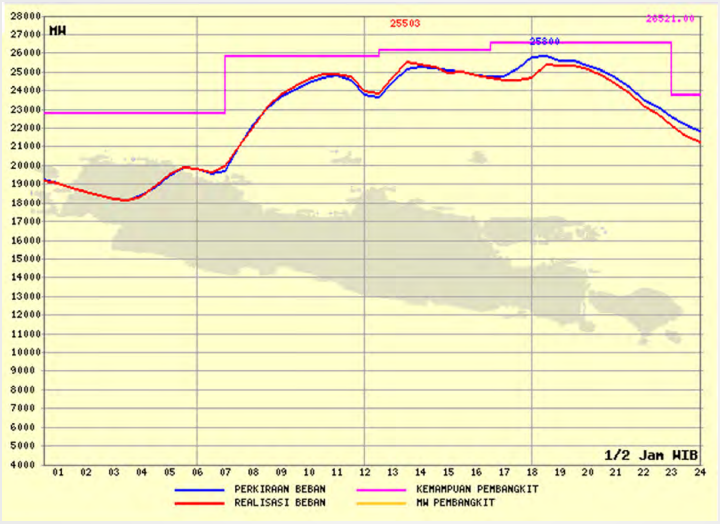
However, there is a lack of consistency between policy and the implementing regulation. Although renewable is prioritized in the policy, recent regulations on renewable (e.g. MEMR regulation no. 50/2017, MEMR regulation no. 49/2018) have introduced an increased risk and ultimately become the barrier for higher penetration renewables in Indonesia (Simamora et al., 2018).

PLN also has its own translation over the target in national energy policy. In its RUPTL, PLN translates the 23% primary energy mix target in KEN/RUEN into achieving electricity generation mix of 23% from renewables by 2025 (PLN, 2019b) while RUEN translates the target into building 45 GW of renewable installed capacity by 2025. Despite the difference, the government still approved the new RUPTL which still planned an additional 27 GW capacity of coal power plants for the next decade.

4.6 System Integration Challenge

While the LCOE of renewables are dropping and becoming more competitive, system integration and its cost, especially for variable renewable energy (wind and solar power), still poses a challenge. Experience from China, for example, suggests that a high deployment of renewable power plants without sufficient grid improvement causes a high curtailment

Figure 19 Sample of load profile of the Java-Bali grid on Monday, 7 January 2019 (taken from http://hdks.pln-jawa-bali.co.id)



rate (Simamora et al., 2018). However, currently there is no study on system integration cost of renewables-based electricity in Indonesia.

Integration cost, in general, comprises of grid cost, balancing cost, and cost affects existing power plants. According to Agora Energiewende (2015), integration cost will be a significant component of VRE costs, i.e., around 5-20 Euro/MWh, even for a very high solar and wind penetration scenario of 50% in Germany.

The current renewable penetration in Indonesia is still far below the level at which integration becomes costly. However, in the long run, solar power, which has the most potential in Indonesia, will contribute more to the grid. Thus, integration cost will become more important. According to RUEN, only 18% of RE power plants (or 6% of total power plants) in 2025 will be solar or wind power, but it will increase to 40% of RE capacity (or 15% of total capacity) in 2050. PLN will require more thorough planning to integrate variable renewables into the transmission.

The integration cost can be mitigated through demand response policy, for example, the introduction of electric vehicle technology or volatile price policy. An important aspect to be considered is the different load profile in each region. In Java island, only 37% of electricity consumption came from the household sector, while the industrial and commercial sector consumed 40% and 17%. These sectors create high demand in the day, balancing the high electricity consumption by the household during the evening. With this profile, electricity produced by solar PV during the day can be consumed directly, alleviating the problem of grid flexibility and storage need. However, outside of Java, electricity consumption is dominated by household by 55%, while industry and commercial only consumes 14% and 22%. This implies a higher load during the evening. Unfortunately, actual load profile of power system outside of Java is not available.

With its declining cost, power storage technology is also of potential help to reduce integration cost. In specific Indonesia context, power storage is more important to overcome geographical constraints. As an archipelago with a lot of small islands and remote areas, off-grid power generation is unavoidable for some regions, and demand response policy is not applicable to this system.

Pumped storage is currently the cheapest energy storage technology and suitable to satisfy peak demand due to fast load gradient. However, it requires large space for the water reservoir, as in large hydro case (Dewan Energi Nasional, 2017). In 2018-2027 RUPTL, PLN has planned for 2.9 GW pumped storage plant along Java between 2024-2027. Another option for storage is the Li-ion battery, which is very flexible in discharge capacity and time. Li-ion battery is suitable for frequency regulation (such as wind power smoothing) or energy-intensive application (such as time shifting for solar PV). However, the cost of a Li-ion battery is still much higher than the hydro pumped storage (Dewan Energi Nasional, 2017).

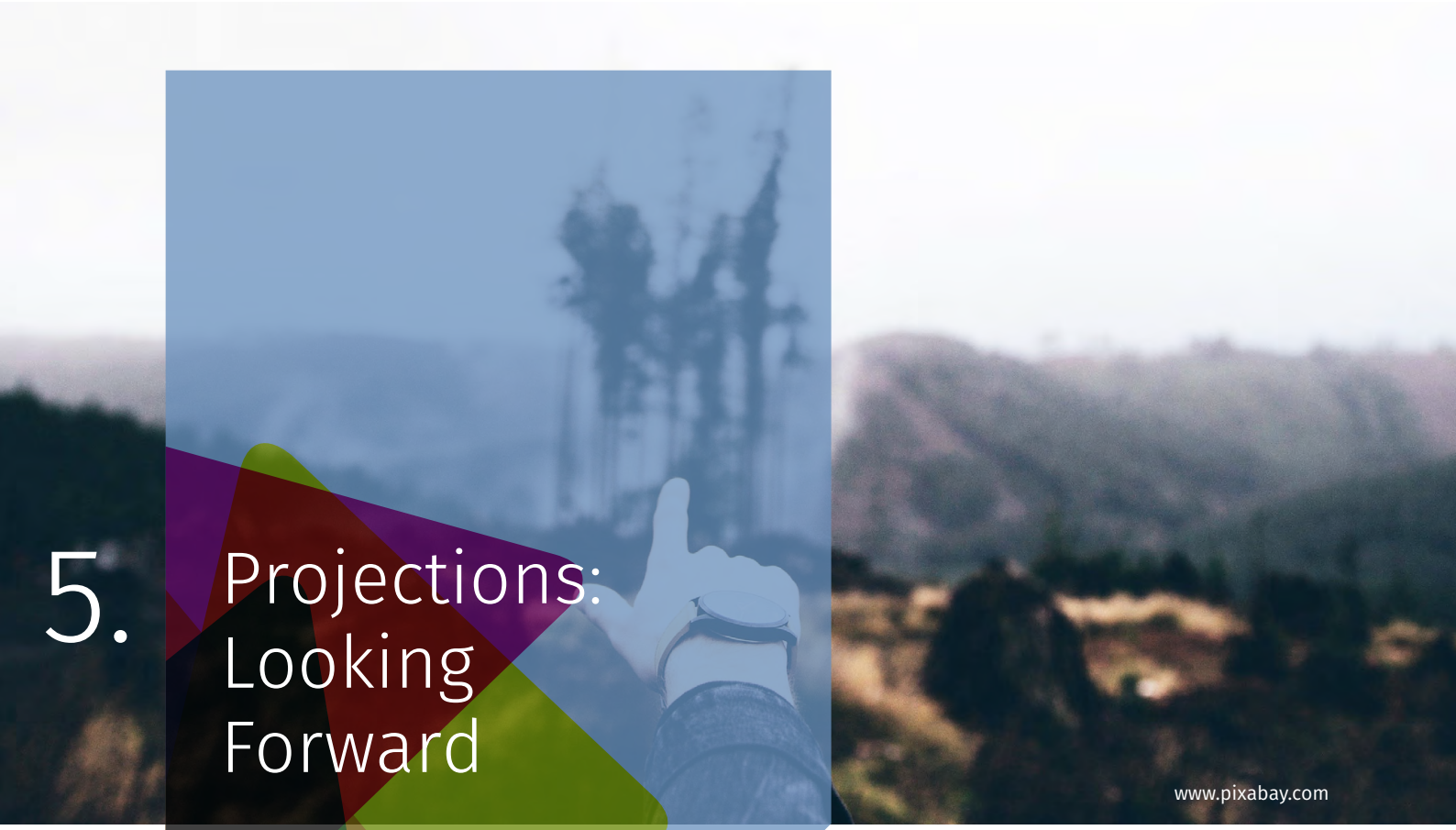
4.7 Summary to This Section

In summary, the Indonesia's government has planned for an increased share of coal and renewables in the national energy supply. In practice, however, coal is being prioritized than renewables, due to its cheap cost. The perception of coal as cheap energy source comes from the externalized cost that has to be borne by society. Moreover, there are a number of subsidies given to both coal industry and coal power plants.

Cost of renewables, especially wind and solar, is declining significantly and becoming more competitive to coal. Electricity from solar PV will be already cheaper than coal by 2030, while wind will be as cheap as coal

by 2050. This poses a threat to newly built coal power plants, as there is high probability they will become stranded assets.

Integration of VRE into power system, in case of a high penetration rate, will require cost and therefore is needed to be planned thoroughly. The current penetration rate in Indonesia is not yet at the level that makes grid integration becomes costly.



5. Projections: Looking Forward

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5.1 Coal Export

Low-quality and medium-quality coal (less than 5,100 kcal/kg and between 5,100 and 6,100 kcal/kg calorific value, respectively) make up most of Indonesia's coal export. The relatively low price due to a combination of lower quality coal and cheap labor price (Indonesia Investment, 2018a), as well as low sulfur content; are the selling point of these coal in the international market. It allows blending with higher calorific value coal to produce ones with desired calorific value that can still comply with environment emission standard (because of the low sulfur content). Moreover, Indonesia's geographical conditions put the country into an advantageous position to market its coal toward Southeast Asia and South Asia market compared to other major coal exporters such as Australia and South Africa (Indonesia Investment, 2018a).

Indonesia's coal export projection will then likely be influenced by the demand for steam coal from current coal export destination countries. As basis for this analysis, we looked at the thermal market report published by Minerals Council Australia along with own assumptions and other related reports. The market report itself had looked through the policy in

Figure 20 Coal Export Trajectory of Indonesia

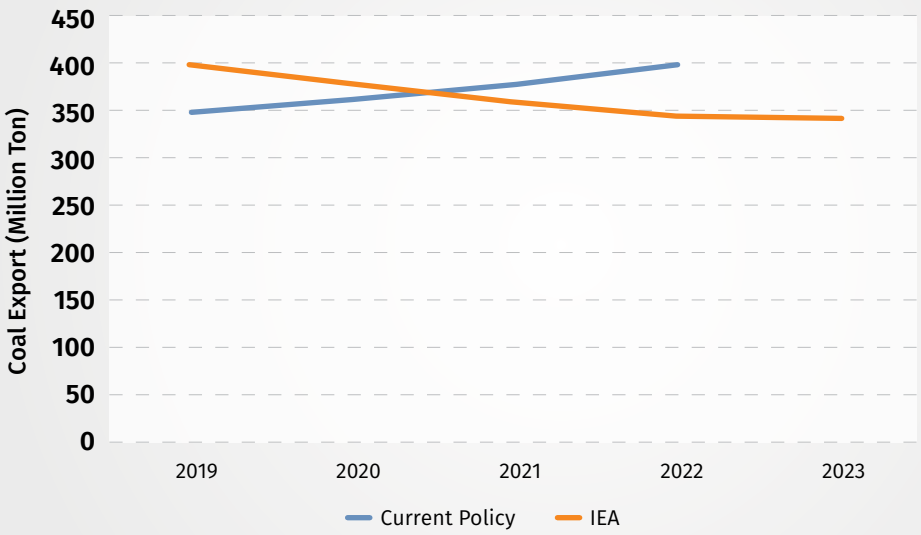


Figure 21 Indonesia's Coal Export Projection to Different Countries (million Ton)

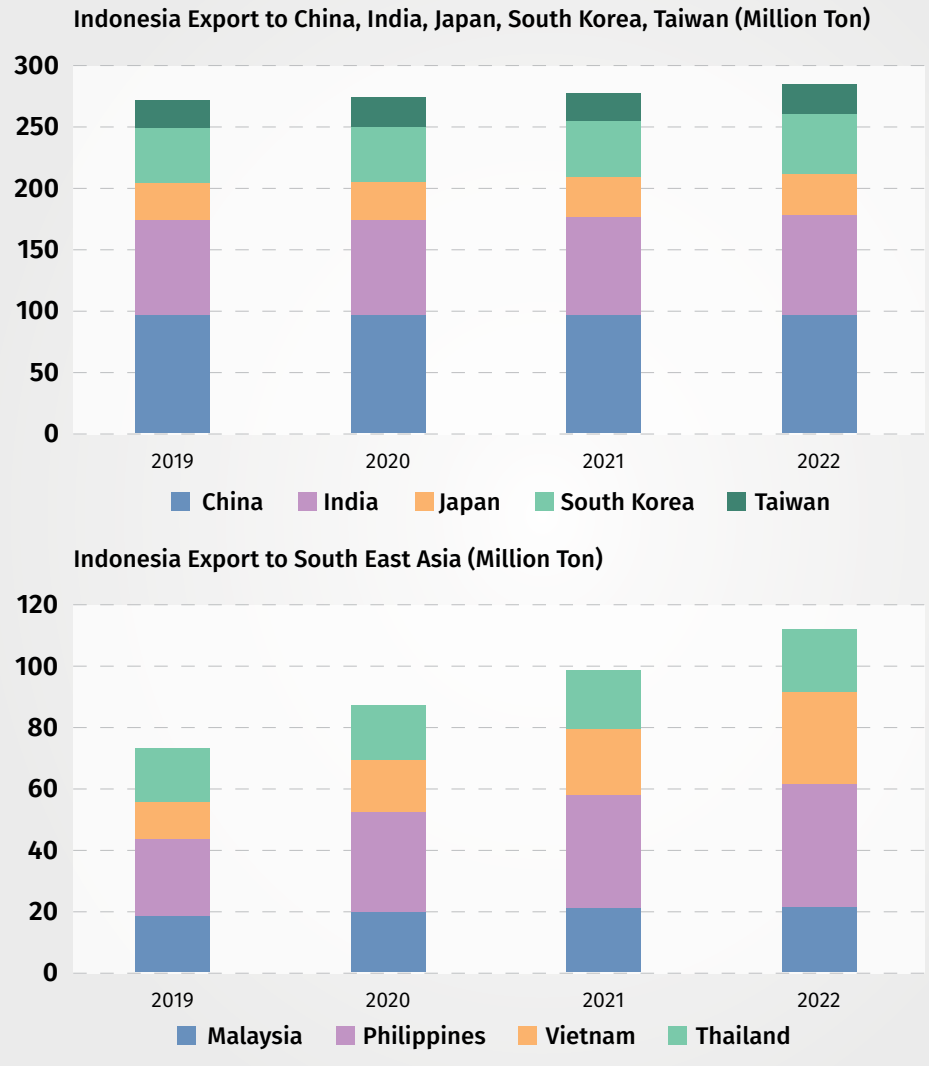
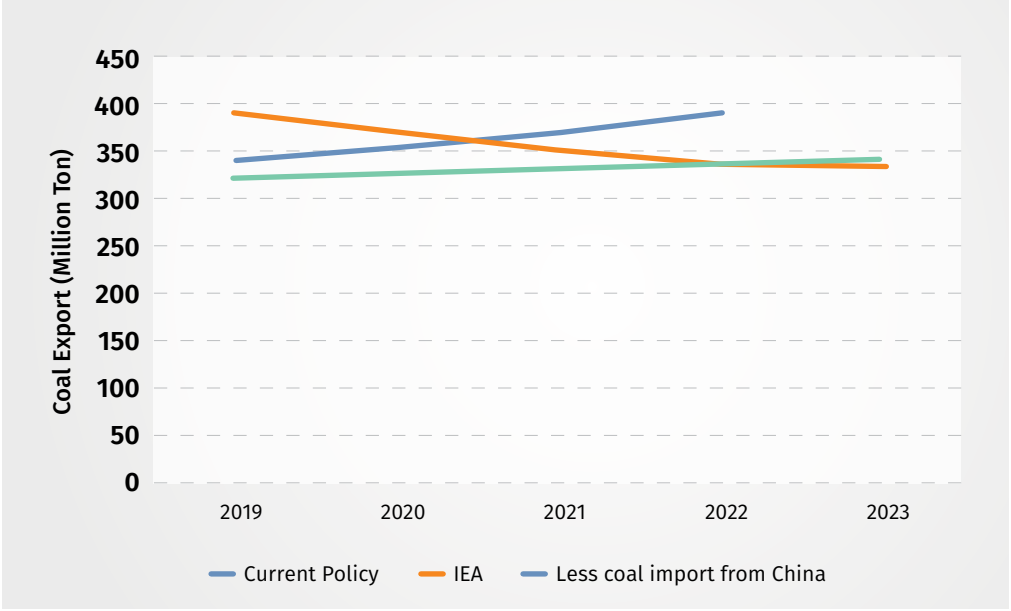


Figure 22 Projected Indonesia's Coal Export with Additional Scenario of Lower China Coal Import Demand



power sector to predict the growth of coal demand within a country and project the steam coal import after comparing it with forecast of coal production in the country (if the country has coal production). For India case, we used the analysis of MCA report from India Power Review that uses a more realistic thermal share decline rate (Worringham, 2019). This projection scenario is labeled as current policy. For comparison purpose, we also added projection of coal export from IEA to the figure.

The current policy scenario shows an increasing trajectory for coal export. Figure 21 below showcases increase in demand is coming from Southeast Asia countries, especially the Philippines and Vietnam. The Philippines is looking to add 6.7 GW of coal power plant fleets between 2019-2022 while Vietnam is even more ambitious with 13.7 GW of coal power plant fleets planned to built within the timeframe (Mineral Council Australia, 2018). On the contrary, coal export to current major export destination (China, India, Japan, South Korea, and Taiwan) remains stable because of policies in those countries; they are looking to reduce electricity generation mix from coal in the long run.

Important note for China is that its coal import market is volatile and very subjective to change because of government policy. The government utilizes coal import to balance and stabilize the coal price within the country to protect the downstream coal businesses. China's government will also look to limit coal import to protect local coal mining industry (Research and Markets, 2019). Therefore, although China's coal import is expected to remain stable over the next few years, there is still a possibility of sharp changes in the figure. If China is to gradually limit its coal import over the next five years, it will significantly affect Indonesia's coal export demand. The figure below will illustrate this condition.

In 2017, around 70% of 270 million ton of coal import in China was steam coal, and of which 109 million ton is imported from Indonesia (Research and Markets, 2019) or roughly almost 30% of total coal exported that year. In short, Indonesia's coal export is rather dependent on China's coal import market. This has introduced a risk for coal mining industry in Indonesia. Moreover, since China contributes a fair share in international coal demand, the sudden change in coal import figure in China could

certainly affect international coal price. The price should have higher impact on Indonesia's coal mining industry due to Indonesia's relatively low-priced coal.

Small scale coal producers holding provincial mining permit is the most price-sensitive parties among Indonesia's coal producers. For example, in 2017 when coal price began to rise, small scale producers produced around 140 million ton of coal which was almost twice the 73.8 million production target imposed to them that year (Adiatma et al., 2018). Conversely, when coal price sunk between 2013-2015, small scale producers were the first one to suffer since they were not able to cope with decreasing price due to lack of capability to reduce their production cost. Some of them were even forced to shut down their coal mines during that time period.

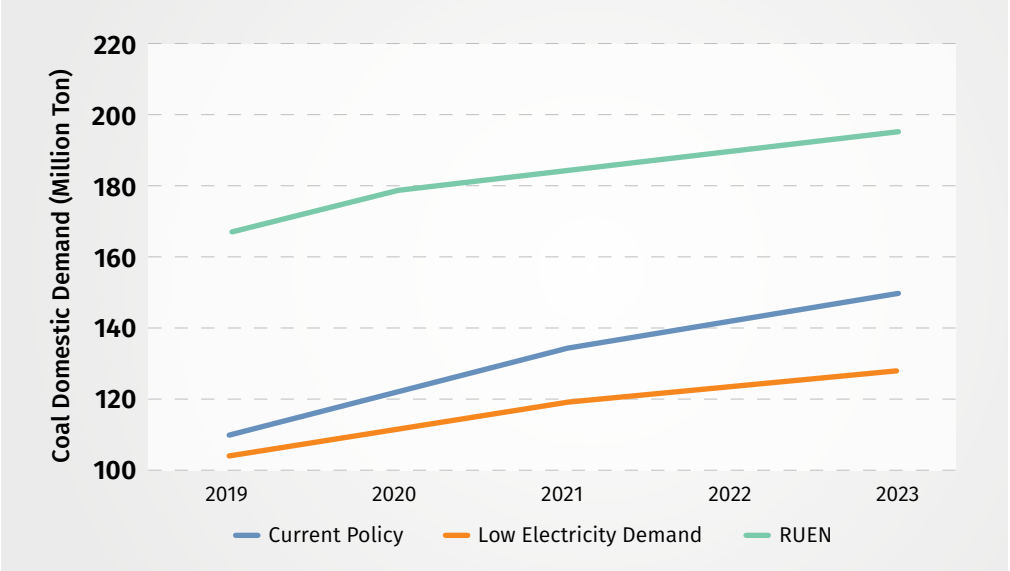
5.2 Domestic Coal Consumption

About 98% of domestic coal consumption is coming from power and cement industry. Therefore, it is evident that domestic coal demand will depend on the development of both sectors for the next few years.

Based on PLN's latest RUPTL, there are 27.1 GW of a coal power plant or around 48% of the total installed capacity planned up until 2028 planned in the RUPTL. Coal projection from PLN shows that coal consumption will consistently increase every year into reaching 153 million ton by 2028 (PLN, 2019). The cement industry, as the next largest consumer of coal, has also shown growth, although small, over the last few years. The substantial rise of cement sales in Indonesia during 2010-2013 has triggered an investment toward cement production capacity within the country; causing overcapacity (Indonesia Investment, 2018b). It means that coal consumption will increase as increasing cement sales. A modest assumption using average growth of cement sales since 2014 is used to estimate cement production and coal consumed within the industry. The projected coal consumption under this scenario is labeled as current policy.

For comparison, two other coal consumption scenarios are used. The national policy scenario will use the plan/projected domestic coal consumption under KEN/RUEN scenario while the low demand growth scenario will showcase projection under lower installed capacity of coal power plant built because of lower electricity demand growth compared to RUPTL (4.6% electricity demand growth instead of 6.42%)

Figure 23 Projected domestic coal consumption (IESR calculation)



(Liebman & Foster, 2019). The later scenario will utilize coal power plant capacity projection from the study "Roadmap for Indonesia's Power Sector" and combined with RUPTL where data is not available. This assumption results in roughly 42 GW of coal power plant installed capacity in 2028 instead of 53.5 GW in the RUPTL scenario.

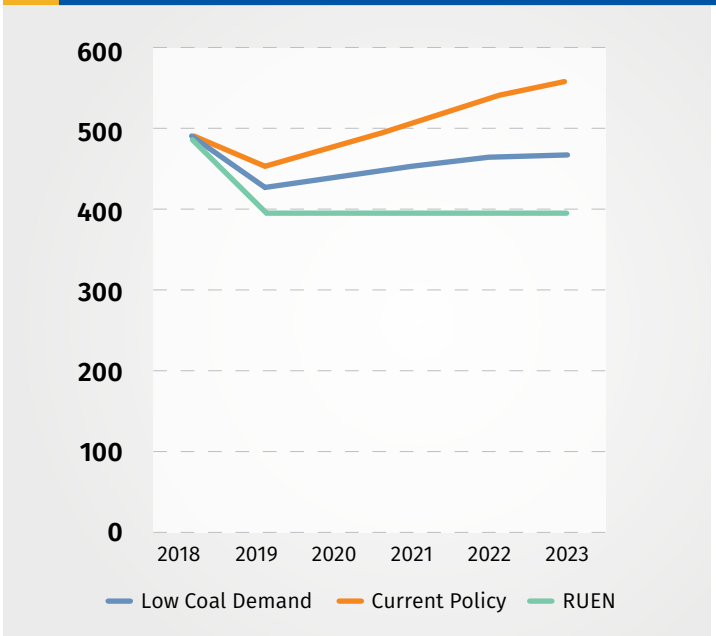
Both current policy and low electricity demand scenarios have far lower coal consumption projection against RUEN (Figure 23). However, RUEN projected 400 MTOE primary energy supply by 2025 while the actual number was only 196.34 MTOE in 2017, growing by 2.7% since 2014 (MEMR, 2017, 2018). If we assume a constant growth rate of primary energy supply from current status until 2025, the primary energy supply can only increase to 242 MTOE by 2025. Therefore, higher coal consumption under RUEN scenario is based on higher growth assumption used in the modeling of RUEN.

Under current policy assumption, we can expect an increase of 53 million ton of domestic coal consumption in 2023 from 2017's figure. However, it is also important to note that there are numerous factors affecting power sector planning, such as energy policy, actual economic growth, electricity sales, and renewable technologies penetration. One possibility is shown with the low electricity demand growth scenario; where the increase of coal consumption only reaches 31 million ton. There is also a chance that future coal consumption in power sector could be lower than projected following the global trend that favors renewable energy over coal.

5.3 Implications of Coal Sector Trajectory

The growth of coal export market and domestic coal demand will determine Indonesia's coal production. Based on projection results on the previous section, we will briefly discuss their possible implication to Indonesia. In this chapter analysis, we will compare three different projections. The RUEN scenario will look at the impact if the government wants to comply with existing RUEN limit on coal production of 400 million ton after 2019. The current policy scenario will reflect coal demand due to current planning of power plants in Indonesia and policy in power sector from major coal export destination countries (combination of both current

Figure 24 Indonesia Projected Coal Production (IESR Calculation)



policy projection in coal domestic demand and coal export chapters). The low coal demand scenario is the addition of lesser coal from China's scenario (see coal export chapter) with low electricity demand growth scenario (see domestic demand chapter). The figure below depicts estimated coal production in those three scenarios. The 2018 coal production is using actual coal production value.

Coal has been one of the sources of state revenue other than taxes and more significantly, has contributed to foreign exchange balance of the country. In 2018, coal contributed roughly 2.1% of state revenue or around IDR 41.4 trillion through royalty tax and mining product sales (Penjualan Hasil Tambang/PHT) (Mariatul Aini, 2018; Ministry of Finance, 2019). Using international coal price projection from World Bank (World Bank, 2018b), we project state revenue from coal sector for the three scenarios chosen.

Higher coal production from the current policy scenario against RUEN scenario could introduce a difference of around IDR 13 trillion to state revenue in 2023. However, considering overall coal sector contribution to state revenue, there will not be a significant change in state revenue even if the country is complying to RUEN. Unfortunately, there is a different story in the case of foreign exchange balance. In 2018, Indonesia's export accounted for a total of 180.2 billion USD; of which 24.61 billion USD (around 13.7%) is coming from the export of coal commodity (Ministry of Trade, 2019). Considering that in the same year Indonesia suffered from 8.5 billion USD trade deficit, the difference of several billions could be significant. Comparing the current policy scenario with RUEN, there is a difference of 9 billion USD to the foreign exchange balance in 2023. Also, the amount of foreign exchange gained every year per ton of coal exported is reduced due to lower coal price assumption used in this calculation.

Many factors influence the number of labor needed for coal sector. One of the most important factors is coal price; as it can have a great impact for small scale coal producers and even force them to cease operation, meaning less labor in coal sector. The big coal producers are usually more resilient toward changing coal price and are also able to easily expand their production (and labor) capacity. In this projection, we

Figure 25 Historical State Revenue and Projection from Coal Sector (IESR calculation from various sources)

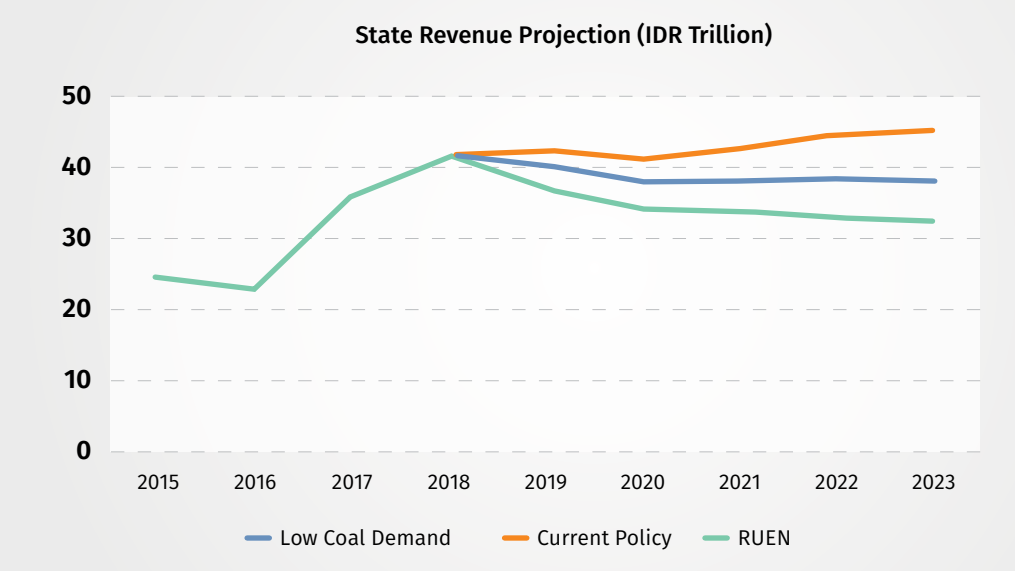
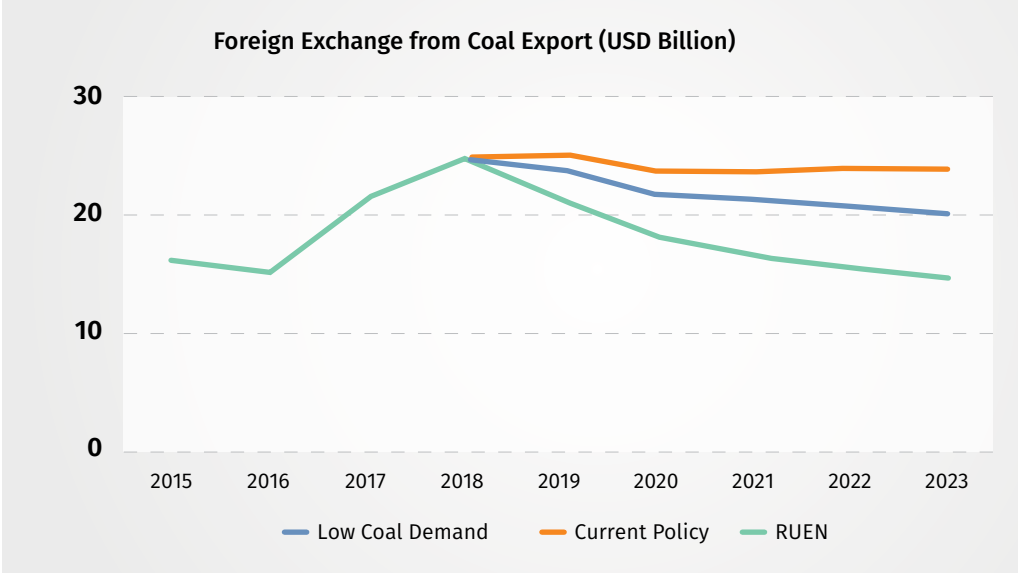


Figure 26 Historical Foreign Exchange and Projection from Coal Export (IESR calculation from various sources)

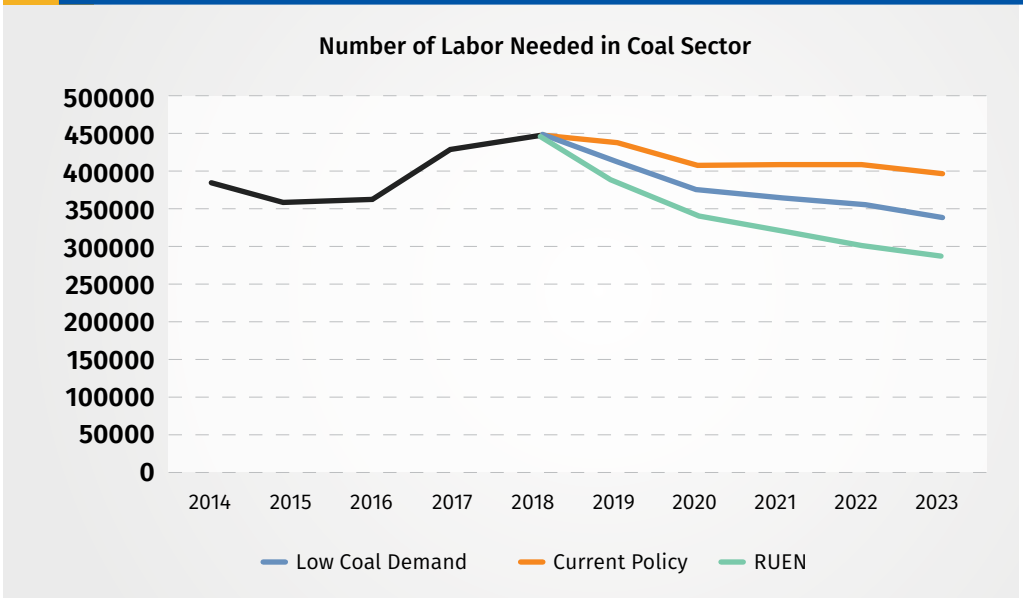


will illustrate the possibility of changes in the number of labor needed in coal sector based on coal production needed, forecasted coal price, and increasing labor productivity. In general, we expect the number of labor in coal sector to decrease over time due to lower coal price forecasted in the next few years and insignificant coal production target increase. The current policy scenario shows stagnant labor required at around 400 thousands labor, while a significant reduction in coal production according to RUEN has caused the number to plummet to around 300 thousands labor.

Implications on East Kalimantan Province

Historically, East Kalimantan has experienced several economic transformations

Figure 27 Number of Labor in Coal Sector (IESR calculation from various sources)



since the 1970s. The province had undergone a shift from wood-based economy (1970-1990), into oil and gas (1990-2008), and then into coal-heavy industry since then (2008-now). Each economic transformation process had caused a significant slowdown in economic growth in the province and thus increasing the number of unemployment at the same time. The most significant economic downturn had happened during the shift from oil and gas to coal in 2008; in which the economic growth had dropped from 5.41% to 3.94%. The number of unemployment was at its peak during that year, reaching 12.83% (Ishak, Rusmadi, Ruhiyat, & Yusuf, 2013). As of now, the economic growth of the province has flourished with the development and stability of coal sector.

East Kalimantan will inevitably go through another economic transformation. The coal-heavy economy will only last for a few decades, counting on the available reserves and current production rate. Comparatively, East Kalimantan may be the first province out of the four coal provinces (South Kalimantan, Central Kalimantan, and South Sumatera) that will deplete its coal reserves if current situation persists. Therefore, a transformation towards a more sustainable economy which is based on renewable resource is needed. The government should focus more effort on findings alternative economic development and mitigating the risk of economic growth slowdown and increasing unemployment number.

In 2017, the workforce in East Kalimantan had accounted for 1.53 million people (BPS Provinsi Kalimantan Timur, 2018). The coal sector, as a capital-intensive industry, has only managed to absorb 7.5% of labor. On the other hand, agriculture (including palm oil plantation), restaurant, and social works are labor-intensive sectors. Eventhough coal sector is not labor-intensive, it has the highest GDP/labor ratio which reached IDR 2.39 billion/labor. The only sector that comes close to coal is the manufacturing and processing industry with IDR 1.37 billion/labor and construction with IDR 0.6 billion/labor. These data have showcased inequality in rural development in East Kalimantan. However, it can also be perceived as an opportunity for a sectoral shift in the economy. Therefore, theoretically, the labor from coal sector could be easily moved-away to other sectors.

Figure 28 East Kalimantan GDP and Labor distribution (BPS, 2018)

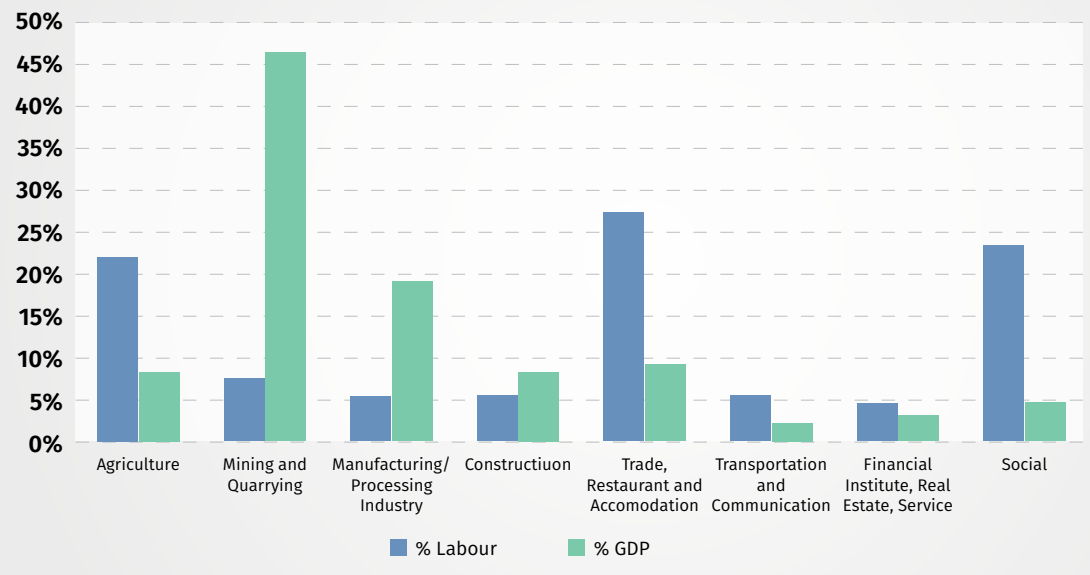
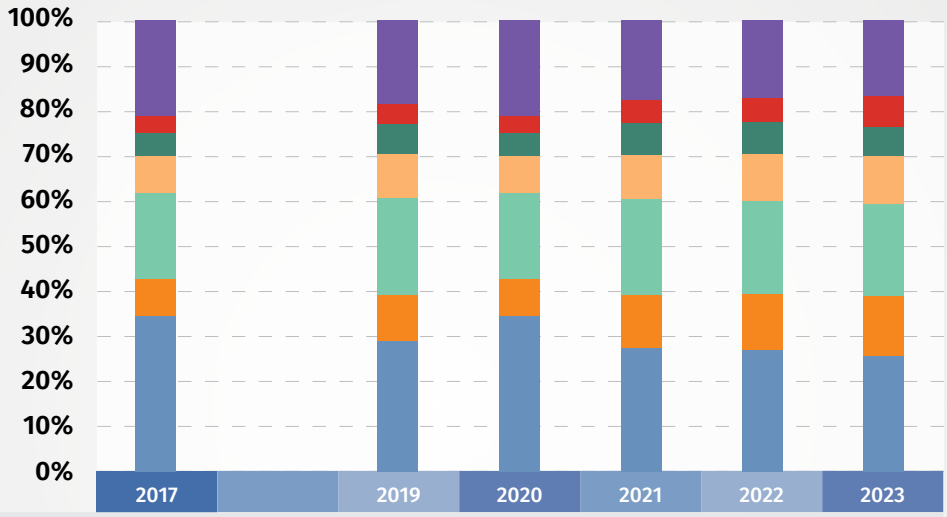


Figure 29 Projected change in GDP proportion of East Kalimantan for maintaining stable 5.2% economic growth (IESR calculation from various sources)



	2017	2019	2020	2021	2022	2023
Other	21.0%	18.3%	17.8	17.5%	17.3%	17.3%
Transportation and Storage	3.6%	4.7%	4.9	5.2%	5.5%	5.8%
Trade and Repair for automotive	5.3%	6.4%	6.6	6.7%	6.9%	7.0%
Construction	8.1%	9.6%	9.8	10.0%	10.1%	10.3%
Manufacturing/Industry	19.1%	21.3%	21.1	20.8%	20.5%	20.3%
Agriculture, Forestry and Fishing	8.0%	10.3%	10.9	11.5%	12.2%	12.9%
Coal Mining	35.0%	29.4%	28.8	28.2%	27.4%	26.3%

Economic growth in Indonesia has been stable at around 5.2% over the last few years. If East Kalimantan is to keep the economic development on par with the national level; then the province cannot keep on relying on its coal sector. For example, although current coal policy allows for coal production to grow for the coming years, the number does not keep up with expected economic growth. Assuming a constant growth from 2013-2017, East Kalimantan will roughly need additional GDP of 66 trillion IDR over the next 5 years if they want to keep their economic development at the expected value; due to its limited increased production in coal sector. This number will increase to 190 trillion IDR and 310 trillion IDR in the case of low coal demand scenario and RUEN scenario, respectively. It is clear that the provincial government will need to accelerate the development of other large sectors (e.g. industry, agriculture, construction, trade and repair, and transportation) in order to keep up with its expected economic growth.

The current coal-based economy should be able to provide necessary fund (and provincial government income) to ignite rapid development of other sectors. One of potential sectors to develop is processing industry. Being located in the center of Indonesia, as well as close to two neighboring countries, East Kalimantan could potentially become a center of such industry. Moreover, the province already has a matured fertilizer and gas processing industry located in Bontang. The area can act as a base for industrial center development for other value-added industry (Ishak et al., 2013). The industrial complex can also be developed with supply of raw materials already produced in the province, such as palm oil and mineral

resources.

Another potential sector is tourism industry. The province had strength on its cultural heritage (Dayak tribe) and preserved natural environment; such as long beachline and beautiful islands (Derawan island). Major infrastructure necessary is already there with the inauguration of the international airport in Balikpapan. What's lacking is the connecting infrastructure to the tourist hotspots and human resources to promote and manage the attraction (Wijayansyah, 2019). In summary, current financial benefit from coal economy should be allocated to overcome the challenge in other sectors to accelerate their development and to provide the basis for smooth transition.

6. Conclusion

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- **Coal, just like other natural resources, attracts many kind of interests to monetise the resources. Indonesia's coal industry has strong ties and alignment with political system at local and national level. The entire supply chain of the industry is major source of revenues at provincial and district level and contribute to local development. This realities make coal transition is politically challenging.**

  Several political elites in Indonesia have a close connection with coal mining businesses in the country. This condition, combined with weak Indonesia's law, has opened up the possibility of corruption in the sector. There is even an indication that coal mining sector has been the source of fund for political moves for the last two decades (Deha, 2018).

  Moreover, the decentralization law has given the power for regional politicians over licensing and permits in coal mining sector. The tendency of local governments to overissue permits, due to decentralization law and lack of supervision, could be an indication of corruption at the regional level. The condition has also hindered coal transition; as coal mining business and political interest are still closely tied to each other.

- **As energy transition is underway in some**

emerging economies, relying on coal export would put Indonesia economy at risks coming from policy changes in major coal export destination countries. Indonesia's coal production still relies on coal demand from the international market. The global coal demand will be affected as major coal export destination countries, such as China, India, Japan, South Korea, Taiwan and Thailand, move forward to phase-out or at least limit newly built coal power plants. Some countries like China and India also impose a higher standard of emission, leading to reduction of coal consumption per unit energy generated; which might reduce coal demand in the near future. Because of this, Indonesia's coal export could decrease by 15.7% by 2023 (IEA, 2018). Moreover, if those countries implement a higher standard of GHG emission in coal-fired power plant, it would further jeopardize Indonesia's coal export since Indonesia's low-quality coal would not be able to cope with the higher standard. In this case, the estimated steam coal export value and coal export volume could be reduced by 14-72% and 23-84%, respectively (estimated from percentage of coal export foreign exchange value from low and medium quality coal in 2018) (Ministry of Trade, 2019).

- **Perception of policymakers and utility that coal is a cheap energy source to power the country sets a major obstacle to advance energy transition in Indonesia's power sector.**
  Government of Indonesia's policy direction is providing electricity with the lowest cost possible. Government's policy effort focuses on reducing the cost of PLN's electricity generation and to increase electricity access to the entire country. The government and PLN prioritize coal to meet these two objectives as Indonesia has abundant resource of it (compared to gas and oil) and historically has experience in building coal power plants. According to PLN, electricity from coal power plant costs between USD 0.037-0.057 per kWh between 2013-2017, making it the second cheapest electricity generation cost after hydropower (PLN, 2018b). However, this number does not reflect the actual cost as there are number of subsidies received by coal power plants (such as domestic market obligation and later on domestic coal price cap of USD 70/ton in 2018) and coal mining industry (tax exemption, loan guarantee, etc; that at least amount to USD 1.4-2 per ton of coal). Furthermore, if environmental and health factor is taken into account, electricity price from coal could double from current existing number (Attwood et al., 2017). On the operational side, PLN's coal-fired power plants efficiency has been dropping and the cost of mining coal in Indonesia will increase in the future. All things considered, coal-based electricity now costs more than what it seems on PLN's statistics and would eventually cost a lot more in the future. Failure to recognize this possibility can cause losses and risks of stranded assets of both coal power plants and coal mines.

- **Coal transition is inevitable due to declining cost of variable renewables, such as solar and wind, and storage technologies. Swift decision from policymakers, both at national and local level, to support coal transition could avoid larger scale of impact/losses during the process.**
  Global financial sector has shown a trend of shifting away from coal financing, so is an alliance of countries, government, and some businesses under Powering Past Coal Alliance. Others will likely soon

to follow. Coal transition is already happening globally, and Indonesia must take this phenomenon under consideration.

LCOE calculation for Indonesia's electricity shows that cost of electricity from solar and geothermal plants would already be cheaper than coal by 2030; while the cost of electricity from wind would be equal to coal by 2050. This LCOE decline could occur faster if Indonesia's government sets to build conducive policy environment and supportive financing for renewables. In short, coal transition is also happening in Indonesia. Coal power plants and coal mining as a business is a long term investment and return. Coal power plants could operate for more than 30 years and coal mines could have an operational permit of at least 10 years with huge assets According to IEEFA projection, based on RUPTL 2017-2026, in Java-Bali only, there will be 5.1 GW of unused coal power plants capacity that will worth USD 16.2 billion over their 25 years operational lifetime. Sonny Mumbunan in his paper in 2016 found that there will be at least USD 40 billion total of stranded assets in coal mining; given there is a shift of total demand and price of coal by 20% from 2014 value (Mumbunan, Silangen, & Sari, 2016). The potential of losses in stranded assets could grow if more coal power plants are built and coal production is increased.

In national economy level, coal plays a significant contribution on foreign exchange level. However, the contribution would more than likely to decrease in the coming years as the price of coal is expected to decline in parallel with global coal demand. Alternatives source of foreign exchange would then be needed and possibly in the form of value-added goods rather than a commodity.

Indonesia's national strategy for coal transition should also be aligned with the interest of big four coal producer provinces. The revenue stream gained from coal could be utilized for the development of other sectors and for diversifying their local economy. This is one of the strategies that could be implemented in these coal producer provinces. Doing so would be the first step to kickstart local economy's shift from coal while also tackling the problem of foreign trade balance at national level.

- **Developing local renewable energy industry would contribute toward coal transition, national energy security, and climate policies.**

  Renewables have become a global trend in power sector due to its rapid decline in cost of technology. Eventually, the same pattern could occur in Indonesia. Indonesia's energy policy and NDC have already given direction toward the development of renewables. Therefore, the next step would be creating a conducive environment for renewable industry to grow through favourable regulation and incentives. Potential benefits that may come with such plan are more employment opportunities, higher economic growth in industry, and the decline of renewables cost in Indonesia. Those benefits could lead to cheaper and cleaner electricity that is aligned with public needs and government policies.

Coal transition in Indonesia requires multi-level medium- and long-term planning and collaborative work from multiple sectors, ministries, and local government.

As of now, coal still plays significant roles in national foreign trade balance and local economic development. The process of shifting away from coal-based

economy means that Indonesia, and more importantly local governments, need to build alternative economic pathways and development. This will require comprehensive and long-term planning between ministries, provincial, and district government. Establishing value-added manufacturers, processing, and downstream industries would be the logical choices due to the multiplier effects they can introduce to the economy as well as to reduce Indonesia's dependency on the export of commodities. At the very least, a collaboration from the Ministry of Industry, Ministry of Energy, Ministry of Finance, and Ministry of Home Affairs are necessary to create a supportive policy framework for local economic transition. Other potential sectors would be the agricultural-based industry and tourism sector. Government shall develop and facilitate local entrepreneurs and provide vocational training of new skills for local labor to anticipate the dynamic of coal market in the near future; in order to mitigate its impact to local and national economies when the market is down or if the transition is starting to take place.

- **The government's strategy of increasing domestic coal demand by strongly depending on power sector development could put a risk to the public.**
  Indonesia's power sector has been the major consumer of domestic coal. However, there are two issues arisen: inefficiency of coal power plants in Indonesia due to low quality of coal being used and low power plant performance, as well as increasing cost of coal mining production. Both issues can cause higher electricity production cost that would eventually increase electricity price (or electricity subsidy) in the near future. At the end, it would be the end users bearing the cost. In addition, burning more coal could jeopardize the environment, air quality, and worsened climate change impacts that could affect public health and add more to its externalities cost.

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