Getting to 23 Per Cent:

Strategies to scale up renewables in Indonesia

GSI REPORT

Anissa Suharsono
Neil McCulloch
Mostafa Mostafa
Richard Bridle
Lucky Lontoh
Philip Gass

IISD International Institute for Sustainable Development
Global Subsidies Initiative
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Head Office

111 Lombard Avenue, Suite 325
Winnipeg, Manitoba
Canada R3B 0T4

Tel: +1 (204) 958-7700
Website: www.iisd.org
Twitter: @IISD_news

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Global Subsidies Initiative

International Environment House 2,
9 chemin de Balexert
1219 Châtelaine
Geneva, Switzerland
Canada R3B 0T4

Tel: +1 (204) 958-7700
Website: www.iisd.org/gsi
Twitter: @globalsubsidies

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Written by Anissa Suharsono, Neil McCulloch, Mostafa Mostafa, Richard Bridle, Lucky Lontoh and Philip Gass

Photo: Ed Wray for IISD

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Abstract

As part of the Paris Agreement, Indonesia committed to reducing greenhouse gas emissions by 29 per cent below its baseline emissions by 2030 (and by 41 per cent conditional on international support). In addition to the 23 per cent renewable energy goal, Indonesia also has a target of reaching 100 per cent electrification ratio by 2020. These targets reflect the stated desire of the Indonesian government to meet its climate change commitments under the Paris Agreement, as well as its political commitment to the Indonesian people to supply all Indonesians with electricity.

However, Indonesia is currently off target. Contrary to the government's predictions, installed capacity additions of renewable energy power plants have been slow over the past three years. The total renewable installed capacity stood at 9.4 GW as of the end of 2018, well under the Ministry of Energy and Mineral Resources' target of 15.5 GW by the second quarter of 2018. In 2018, the International Institute for Sustainable Development published a report identifying a series of "roadblocks" for renewable energy development in Indonesia. Moreover, the report argued that the low prices and constantly fluctuating policies were the result of a fundamental political challenge, or trilemma, facing the sector.

Despite the challenging policy environment, there are also opportunities for real progress in several areas between now and 2025. This report addresses seven concrete ways in which the Indonesian government can overcome the existing obstacles and make significant progress to grow renewable energy before 2025. In particular, to make progress it will be necessary to change the way in which key institutions operate and the incentives that they face. But if these changes are made, it is possible for Indonesia to have an energy policy that fulfills energy sovereignty, moves toward energy self-sufficiency and achieves energy justice for all.

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Acronyms and Abbreviations

B20	20% blending
BPP	Biaya Pokok Pembangkitan (local average generation cost)
CPO	crude palm oil
DMO	Domestic Market Obligation
EBTKE	Energi Baru Terbarukan dan Konsersasvi Energi
EU	European Union
FIT	feed-in tariff
FTP	Fast Track Program
GAR	gross as received
GHG	greenhouse gas
IESR	Institute for Essential Services Reform
IISD	International Institute for Sustainable Development
IPP	independent power producers
IRENA	International Renewable Energy Agency
MEMR	Ministry of Energy and Mineral Resources
MoEMR	Ministry of Energy and Mineral Resources
Mt	million tonnes
NRE	new and renewable energy
PLN	Perusahaan Listrik Negara [Indonesia's government-owned electricity distribution company]
PPA	power purchase agreements
PPLSA	Rooftop Solar Power Users Forum
PV	photovoltaic
RUPTL	Rencana Usaha Penyediaan Tenaga Listrik [Indonesia Electricity Supply Business Plan]

1.0 Introduction: The challenge and solutions

As part of the Paris Climate Agreement, Indonesia committed to reducing greenhouse gas (GHG) emissions by 29 per cent below its baseline emissions by 2030 (and by 41 per cent conditional on international support) (Republic of Indonesia, 2016). Since more than a third of Indonesia's GHG emissions come from the energy sector, one of the key efforts toward this goal was setting a national target of achieving 23 per cent new and renewable energy in the energy mix by 2025 (see Box 1).

In January 2019, Minister of Energy and Mineral Resources Ignasius Jonan reiterated that the government remains committed to increasing the use of renewable energy in the national energy mix, in line with their commitment during the 21st Conference of the Parties to reduce GHG emissions (Republic of Indonesia, 2016). This commitment to use "new and renewable energy"[1] covers electricity and transportation. Minister Jonan cited the use of large-scale hydropower and the 20 per cent biodiesel blending in transport fuels as a way to meet the renewable energy target (Kurniawan, 2019).

In addition to the 23 per cent renewable energy goal, Indonesia also has a target of reaching 100 per cent electrification ratio by 2020 (Dewan Energi Nasional, 2017). By the third quarter of 2018, Indonesia's electrification ratio reached 98 per cent,[2] a 13.65 per cent increase from 84.35 per cent back when President Joko Widodo took office in 2014. In order to reach 100 per cent, there are approximately 5.2 million more people to be electrified. Since most of these houses are located in remote areas beyond the Perusahaan Listrik Negara's (PLN) grid, the Ministry of Energy and Mineral Resources (MEMR) is attempting to reach this target by utilizing more off-grid electricity using renewable energy such as solar panels, energy-efficient solar lamps and mobile power plants powered (in part) by biofuels (Arvirianty, 2018).

These targets reflect the stated desire of the Indonesian government to meet its climate change commitments under the Paris Agreement, as well as its political commitment to the Indonesian people to supply all Indonesians with electricity. In other words, the targets matter—both in terms of Indonesia's international reputation as a country that fulfills its obligations in the global effort to counter climate change and domestically, in delivering clean, affordable and modern electricity to all its people.

[1] Indonesia's targets are for "new and renewable energy" rather than "renewable energy." New energy sources include liquefied coal, coalbed methane, gasified coal, nuclear energy and hydrogen. Renewable energy sources are defined as including geothermal resources, hydropower, bioenergy, solar, wind and ocean energy. See PricewaterhouseCoopers (2018) for further details.

[2] Because this number includes houses that are on-grid and off-grid, as well as houses with no PLN meter (Kementerian Energi dan Sumber Daya Mineral, 2018), the quality of electricity provided within this ratio varies quite differently.

Box 1: Indonesia's climate, renewable energy and renewable power generation targets

Climate change

- 29 per cent reduction below its baseline emissions by 2030 (and by 41 per cent conditional on international support) (Republic of Indonesia, 2014)

Renewable energy in the primary energy mix

- New and renewable energy (NRE) of at least 23 per cent of primary energy demand by 2025 as well as oil of less than 25 per cent; coal of at least 30 per cent and natural gas of at least 22 per cent (Republic of Indonesia, 2014)
- 23 per cent NRE is composed of: 10 per cent bioenergy, 7 per cent geothermal, 3 per cent hydropower and 3 per cent other NRE
- NRE of at least 31 per cent of primary energy demand by 2050 as well as oil of less than 20 per cent; coal of at least 25 per cent; and natural gas of at least 24 per cent (Republic of Indonesia, 2014)

Renewable power generation

- The power generation energy mix should comprise approximately 23 per cent of NRE, 54.6 per cent coal, 22 per cent gas and 0.4 per cent diesel fuel by 2025 (PLN, 2019)

However, Indonesia is currently off target.

In the electricity sector, the share of renewable energy to date is around 13 per cent. The government estimated an increase to 16–17 per cent in the next 2–3 years, with several large-scale hydroelectric power plants and geothermal power plants coming online. Recent projects include the 75 MW PLTB Sidrap Wind Farm, which started operating in 2018 and the 72 MW PLTB Jeneponto, which is due to start operating in 2019 (Kurniawan, 2019).

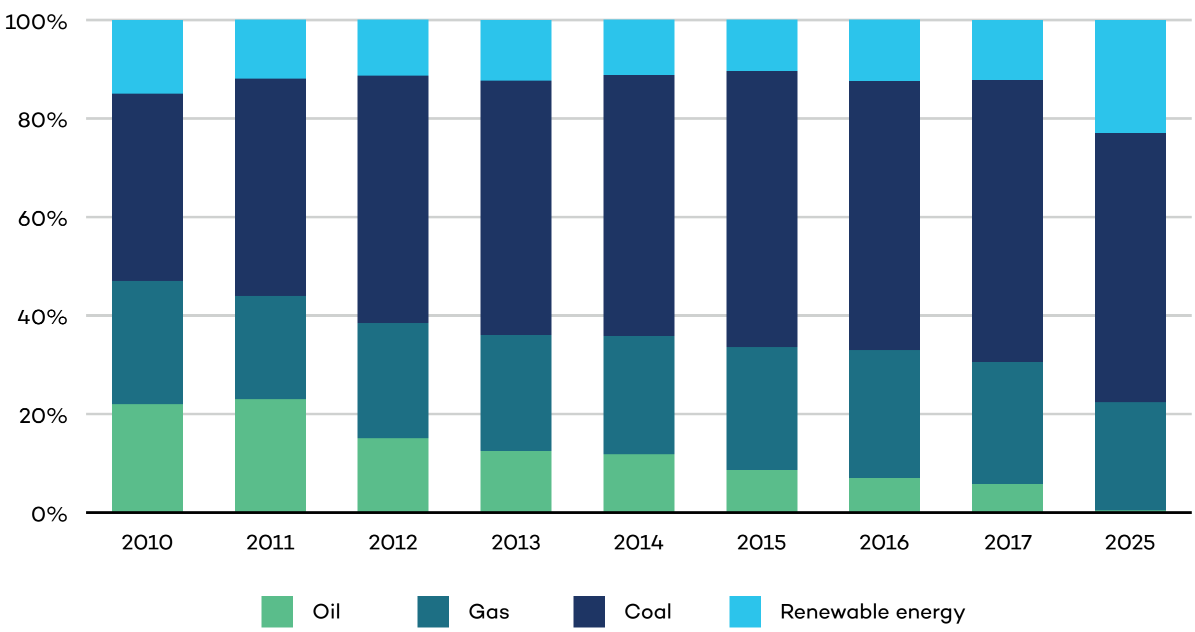

Figure 1. Development of fuel mix for installed power generation

Note: RE = renewable energy
Source: PricewaterhouseCoopers, 2018; PLN, 2019.

Figure 1 shows the development of the fuel mix for installed power generation from 2010 to 2017, as well as the projected fuel mix in 2025. The figure shows that the share of coal has been growing significantly in the past few years, while the growth of renewable energy seems to be stagnant, and energy is still dominated by coal. Contrary to the government's predictions, installed capacity additions of renewable energy power plants have been slow over the past three years, with only 320 MW of additional capacity being installed. The total renewable installed capacity stood at 9.4 GW as of the end of 2018, well under MEMR's target of 15.5 GW by the second quarter of 2018 (Institute for Essential Services Reform [IESR], 2019b). Research from IESR (2019b) concludes that the current slow growth of renewable capacity will continue in 2019. Despite the target of 23 per cent renewable energy by 2025, coal is expected to be the main component in the power generation fuel mix (PLN, 2019).

Progress toward the renewables target is being hampered by a series of roadblocks.

In 2018, the International Institute for Sustainable Development (IISD) published a report identifying a series of "roadblocks" for renewable energy development in Indonesia. The roadblocks identified in the report were:

- Power purchase prices are simply too low to allow developers to recover their investments and make reasonable profits, especially since the introduction of Regulations 12/2017 and 50/2017 capping power purchase prices at 85 per cent of the local average generation cost in most regions (also known in Indonesian as Biaya Pokok Pembangkitan [BPP]).
- Frequent changes to policy, regulatory delays and patchy implementation of government policy by PLN all play a role in further undermining investor confidence and increasing project development risk.
- Developers are also concerned that the new system of pricing does not provide any recognition of the environmental benefits of renewable energy, and in fact favours fossil fuel sources. By subsidizing and financially supporting the coal industry, the Government of Indonesia is indirectly and artificially decreasing the average generation cost of electricity. Since renewable energy prices are now linked to these prices through the BPP, unsubsidized renewables are competing against subsidized coal generation.
- Industry stakeholders also believed that the broad remit and power of PLN present a number of conflicts of interest. PLN's role as fuel supplier to diesel generators means it stands to lose a revenue stream if remote diesel generators are sidelined. PLN owns and operates the majority of fossil fuel generation capacity and has an interest in maintaining the status quo to avoid stranded assets.

Moreover, the report argued that the low prices and constantly fluctuating policies were the result of a fundamental political challenge, or trilemma, facing the sector, as shown in Box 2.

Box 2: Indonesia's energy trilemma

The fundamental political challenge facing renewable energy development is that policy-makers need to meet three mutually incompatible objectives:

- The need to keep tariffs low.
- The need to keep subsidy costs low.
- The need to meet the renewable energy targets.

Most of the actors would like to be able to meet all of these conditions, but, in practice, it is only ever possible to meet two of the objectives. For example, it would be relatively straightforward to meet the renewable energy targets if PLN were willing to sign power purchase agreements (PPAs) with renewables developers at prices that reflect the current costs of renewables. However, this might require an increase in electricity prices, which is politically unpalatable. Such a price increase could be avoided if subsidies were increased—but this is incompatible with good fiscal management.

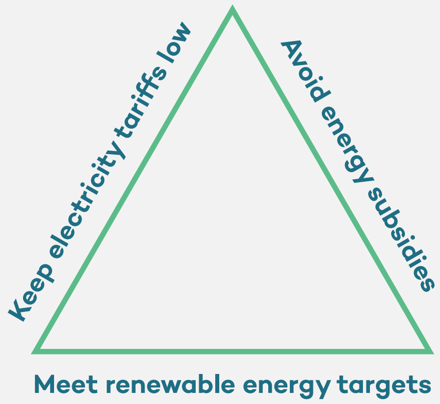

Figure 2. Indonesia's energy trilemma

Despite the challenging policy environment, there are also opportunities for real progress in several areas between now and 2025.

There are seven concrete ways in which the Indonesian government can overcome the existing obstacles and make significant progress to grow renewable energy before 2025.

1. Coal: Do not resuscitate!

Indonesia has invested heavily in coal, leading to an oversupply of electricity in Java and Bali. This is resulting in additional pollution and further GHG emissions. Moreover, coal investments threaten to increase, rather than decrease, long-run costs as the prices of renewable technologies continue to fall. Placing a moratorium on new coal power plants is essential if Indonesia is to meet its climate change (and renewable energy) targets.

2. Seize the sun

Indonesia has an extensive solar resource and yet has barely begun to exploit it. Several issues are hampering the development of solar power in Indonesia, not least the complex and long-standing problems of land access. However, one source of land already exists and is immediately available—roofs. Progress on rooftop solar has been extremely slow. In this report, we put forward ways in which the rules could be changed to provide a step change in solar power installation in the country.

3. Access for all

Indonesia has made rapid progress toward its energy access goals, particularly over the last five years. However, there are still probably 4,000 villages that do not have access to electricity, as well as many others in connected areas that do not have access. The government needs a more systematic plan for reading off-grid areas and a stronger focus on access for remote areas.

4. Building a modern and resilient grid

One of the main challenges of adding intermittent renewables in Indonesia is the fragile state of many of the 600 isolated grid systems throughout the country. However, the government has invested very little in making the grid more able to absorb more intermittent power, and PLN has a strong institutional bias against intermittent power. Investments in interconnectors, better generation technologies, smarter energy management systems and improved storage could dramatically enhance the ability of the grid to absorb a far larger share of intermittent renewables.

5. Getting the price right; making the price just

The main reason for the slow development of renewable energy in Indonesia is the low prices provided accompanied by considerable regulatory uncertainty. The current benchmark for setting the price (the BPP) is non-transparent, inefficient and biased against renewables; better mechanisms exist, but they have not been used. Shifting to prices based on an evaluation of the full economic costs of generation—including pollution and climate change costs—could result in an energy mix that would improve welfare for all Indonesians.

6. Bioenergy versus biofuel

Indonesia has huge potential for bioenergy. The government has responded to this by putting a strong focus on biofuel. However, the evidence that this reduces carbon emissions is slim—it may even do harm if it perpetuates deforestation and environmental damage. We put forward additional, potentially better, ways to exploit Indonesia's abundant bioenergy resources.

7. Change the focus on finance

There are many sources of finance for renewable energy and much enthusiasm to fund the sector. But private lenders regard the sector as risky, primarily because of the low prices and uncertainty in the regulatory environment. Despite much work on sustainable finance, the bankability of projects depends on more fundamental challenges. It would be better to focus less on finance and more on addressing these core challenges.

Achieving these changes may require some difficult decisions.

In particular, to make progress it will be necessary to change the way in which key institutions operate and the incentives that they face. But if these changes are made, it is possible for Indonesia to have an energy policy that fulfills energy sovereignty, moves toward energy self-sufficiency and achieves energy justice for all.

2.0 Coal: Do not resuscitate!

2.1 The Current Situation

Indonesia has invested heavily in coal…

In 2006, President Susilo Bambang Yudhoyono launched the first Fast Track Program (FTP-1), which aimed to build 10,000 MW of power generation. According to Presidential Regulation no. 71/2006, the 10,000 MW was to come from coal-fired power plants, of which at least 5,700 MW was located in Java and Bali (Muna, 2014). As of November 2018, 9,647 MW of FTP-1 was operational, 280 MW was still being constructed and 48 MW was cancelled.

Although FTP-1 missed its deadline by over five years, the Government of Indonesia launched a second FTP (FTP-2) in 2010. The list of projects was set out under Ministry of Energy and Mineral Resources (MoEMR) Regulation No. 15/2010 and amended by MoEMR Regulation No. 40/2014 to 17,458 MW. FTP-2 focuses on the use of independent power producers (IPPs) and the use of coal and renewable sources of energy such as geothermal and hydro (PricewaterhouseCoopers, 2018). Out of a total of 17,458 MW, 10,320 MW comes from coal, 4,855 MW from geothermal, 280 MW from gas and 1,803 MW from hydro. As of November 2018, only 755 MW of these projects was operational: 100 MW from PLTU (coal power plants) Punagaya and the rest from geothermal power plants (PLN, 2019).

In 2015, President Joko Widodo launched another program to boost electricity generation, namely the 35,000 MW program. Fifty-seven per cent of the power under this program will come from coal, which leads to a huge expansion in the share of coal in the energy mix in recent years. The new 35,000 MW program superseded FTP-2, and all of the projects planned for completion between 2015 and 2019 have been rolled into the 35,000 MW program (PricewaterhouseCoopers, 2018). As of November 2018, 2.9 GW of these projects was operational; 18.2 GW was being constructed; 11.5 GW had been awarded PPAs but had not yet entered construction phase; 1.7 GW was in the procurement process; and the remaining 1 GW was still in the planning process. If electricity demand growth is lower than initially projected, the commercial operation date of these projects will be adjusted (PLN, 2019).

…leading to an oversupply of electricity in Java and Bali.

The addition of coal capacity has led to the Java–Bali electricity system having a surplus of electricity. Back in 2018, the peak load in the Java–Bali system was only around 25,000 MW, while the total power capacity was 33,000 MW, resulting in a reserve of 8,000 MW (32 per cent). According to the General Plan for National Electricity (Rencana Umum Ketenagalistrikan Nasional), the reserve margin for the Java–Bali system is set at 30 per cent (Kementerian Energi dan Sumber Daya Mineral, Direktorat Jenderal Ketenagalistrikan, 2016b).

Notwithstanding this oversupply, there are several proposed coal plants in Jakarta alone that will add even more to the electricity surplus: the 500 MW Pembangkit Listrik Tenaga Gas dan Uap (PLTGU)(gas and coal combined cycle) Muara Karang Extension, the 600 MW PLTGU Muara Tawar and the 800 MW PLTGU Tanjung Priok. Since there is a "Take or Pay" mechanism included in the PPA, if this excess electricity is not absorbed, PLN will be forced to buy the excess electricity anyway, which could eventually endanger PLN's finances (Agustinus, 2018).

Coal investments also threaten to increase, rather than decrease costs.

The Indonesian power sector provides capacity payments to IPPs to give assurance of a revenue stream for investments. All PPAs between PLN and IPPs for thermal power plants have a fixed term of between 25 and

30 years after commercial operation date. Capacity payments are calculated based on the power capacity of a plant, regardless of whether the power produced by the plant is dispatched. The payment is made by the offtaker (PLN) for each kilowatt of available capacity and usually makes up 30–40 per cent of the total tariff.

However, this practice poses risks for PLN and consumers by creating an obligation to pay for power that is not needed. According to the Indonesia Electricity Supply Business Plan (Rencana Usaha Penyediaan Tenaga Listrik [RUPTL]) 2017–2026, the proportion of coal-fired power generation capacity assigned to IPPs from 2017 to 2026 is 12,845 MW (PLN, 2016). Using this amount as a basis, assuming that at least 40 per cent of this capacity will remain undispatched, considering the current utilization rate of 57 per cent, this would amount to 5,138 MW of unused capacity, translating into an obligation to pay USD 16.2 billion for idle capacity (Chung, 2017).

The Institute for Energy Economics and Financial Analysis (IEEFA) estimates that PLN, in aggregate, will pay an estimated USD 76 billion over the course of its 25-year PPAs (Chung, 2017). As renewable sources such as wind and solar become cheaper and contribute a greater proportion of the overall energy mix through priority dispatch, PLN will face the unwelcome prospect of having to continue to make capacity payments to thermal power IPPs even though less power will be sourced from them (Chung, 2017). PLN uses the least-cost principle when it comes to power dispatch, which means that the cheapest form of power has to be dispatched first. Eventually, when renewable becomes cheaper, coal will be the last priority to be dispatched.

In addition to the risk of capacity payments, the low prices for coal are currently only sustained via the Domestic Market Obligation (DMO) and the coal price cap. The DMO determines that a minimum share of all coal produced by local coal mining companies must be sold to the Indonesian market. The DMO for 2018 is set at 25 per cent of the total production volume by coal mining companies. Around 114 Mt was consumed by the domestic market, including coal for coal-fired power plants. Coal accounts for more than half of all fossil fuels used by PLN and IPPs for their power plants. Under normal conditions, the price of coal sold under the DMO is linked to international price benchmarks. However, the MoEMR issued a decree in March 2018 that capped the price of coal sold to power plants at a maximum USD 70 per tonne for coal with a calorific value of more than 6,000 kilocalories (kcal)/kg gross as received (GAR), and the price cap is scaled according to a formula for lower grades of coal. As most of the coal consumed by PLN and coal-fired IPPs has a calorific value between 4,200 and 4,500 kcal/kg GAR, they effectively pay USD 37 per tonne (Asmarini & Jensen, 2018). Since international coal prices back in 2018 can go well above USD 100/tonne (Sengupta, 2018), this implies that PLN is paying far below the world market price, providing a large implicit support to coal-fired generation.

2.2 The Proposal

Place a moratorium on all new coal power plants.

Reversing or cancelling existing PPAs for coal power plants could be costly and involve legal complications. However, it will cost the government nothing to impose a moratorium on new coal power plants. PLN, which is required to adopt the "least-cost option" in their power generation strategy, would then have to switch to renewable power plants, particularly as the levelized cost of electricity for renewables continues to fall. If the government continues to encourage investment in coal power plants, there is a risk that PLN will be burdened with capacity payments from unutilized coal power plants in addition to constructing a set of assets that will be stranded as dispatch comes from other sources.

Figure 3 shows all the coal-fired power plants in operation (grey), under construction (yellow) and announced/permitted (red). The size of the circles represents the capacity (MW) of each power plant.

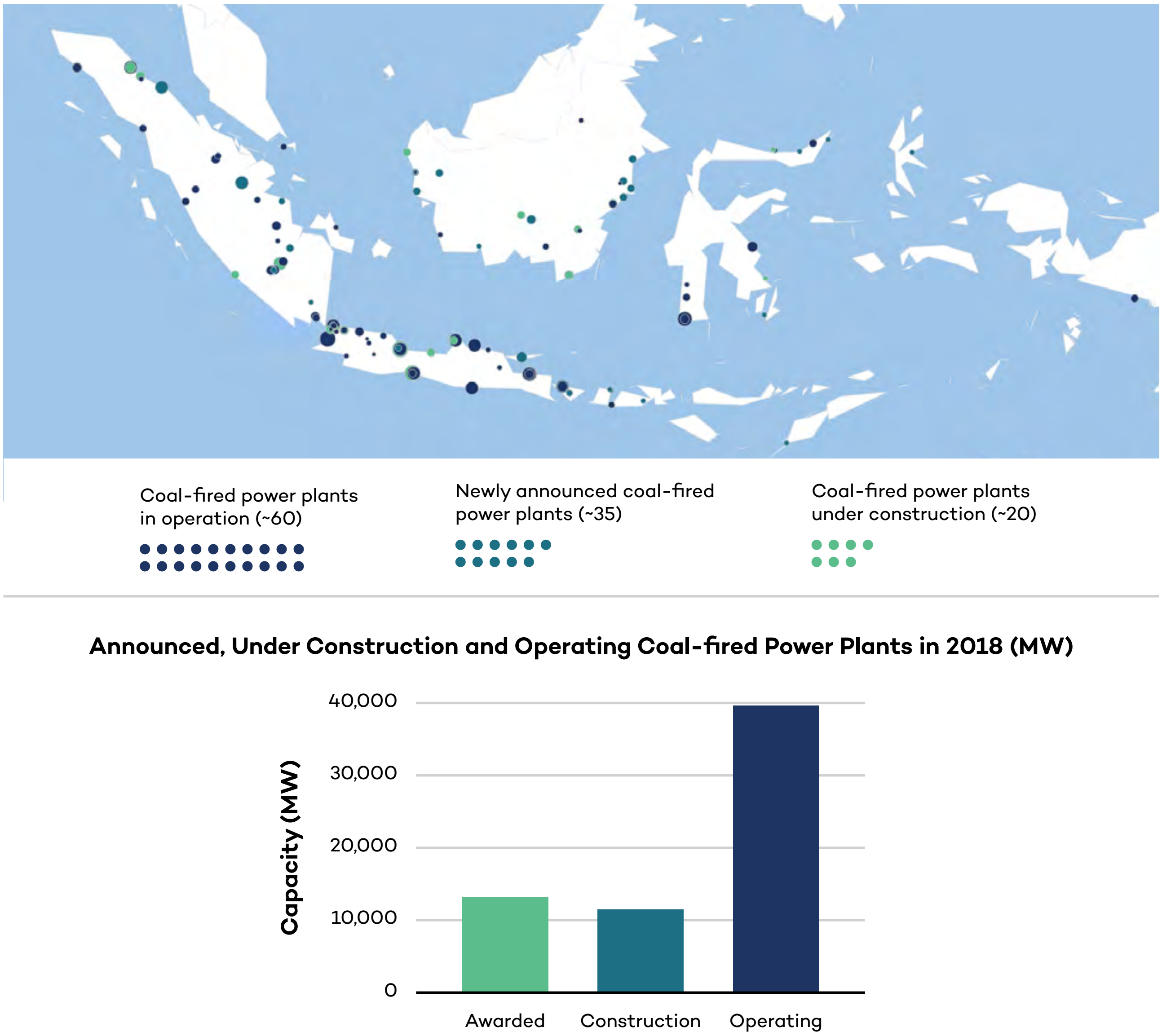

Figure 3. Coal-fired power plants in Indonesia (1984–2028)

Source: Carbon Brief, 2019.

In 2018, Indonesia had approximately 39 GW of installed coal-fired power plant capacity in operation. Coal accounted for almost 60 per cent of Indonesia's power generation fuel mix. According to the RUPTL 2019–2028, 25 GW of new coal-fired power plants are either under construction or announced (PLN, 2019). That is an increase of 62.5 per cent to the total existing and operating coal power plants. Indonesia's abundance of coal favours investments in coal-fired power plants. All the projects that have not yet entered the construction stage are under a moratorium. Referring back to the previous section, where IEEFA estimated PLN's obligation to pay USD 16.2 billion for idle capacity of coal power plants due to the additional 12,845 MW of coal power up to 2026, scrapping 26.7 GW of coal power that is currently still in the pipeline will save PLN from the possibility of paying an even larger capacity payment obligation.

The 35 GW Power Development Programme and the 2018 RUPTL focus strongly on the expansion of Indonesia's coal power plants and remain anchored to old technology. Looking more closely, the majority of the newly announced coal power plants are located in Kalimantan, Sulawesi, Sumatra, Bali and Lombok—an attempt to expand electrification and industrialization beyond Java.

Furthermore, Table 1 below shows the growth of coal power plants from selected countries from 2006 to 2018. It can be seen from the table that Indonesia has the fourth largest growth worldwide. When compared to other countries in the region, Indonesia has the largest growth. The closest neighbouring country, Malaysia, only added 7,098 MW in the past 12 years and did not build any coal power plants in 2018.

Although China and India are currently leading in the share of coal power plants globally, the share of coal in China is predicted to drop from 73 per cent in 2014 to 51 per cent in 2030. The same trend is expected in South Asia, where the coal share is expected to drop from 71 per cent in 2014 to 56 per cent in 2030, mostly through India's contribution (Zhai, Mo, & Rawlins, 2018). Considering the possibility of having to pay a massive amount in capacity charges as well as the cost of pollution and climate change, imposing a moratorium could be the simplest way of avoiding excessive coal capacity. To show a stronger political commitment to reducing GHG emissions and meeting the Nationally Determined Contribution target, the Government of Indonesia should go beyond a moratorium to consider developing a coal phase-out plan, where the end goal is to close down all coal power plants within the next 30 years and replace coal with a more environmentally friendly fuel mix.

Table 1. New coal plants for selected countries 2006–2018 (MW)

Country	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total 2006–2018
China	63,856	62,861	52,209	51,707	38,697	65,417	47,545	35,115	34,514	735,276
India	12,195	15,160	17,961	18,388	20,643	21,130	18,715	8,618	7,720	159,329
United States	5,876	4,253	3,952	1,812	106	50	0	0	0	21,654
Indonesia	646	4,695	4,045	2,024	1,080	2,471	1,395	1,250	480	20,927
South Korea	250	123	0	59	1,800	0	5,341	5,262	0	19,161
Vietnam	300	1,280	450	1,040	3,104	4,490	150	2,444	1,800	15,992
Turkey	1,390	600	0	328	1,550	1,140	1,850	1,320	330	9,935
Malaysia	0	0	0	0	0	1,080	1,000	1,000	0	7,098
Japan	900	0	0	1,850	0	0	112	500	597	5,662
Philippines	267	349	0	600	82	585	1,314	465	570	4,516
Brazil	414	0	360	1,085	0	0	0	0	0	1,947
Taiwan	0	50	0	0	0	0	800	800	1,600	3,800
Pakistan	0	0	0	0	0	0	40	2,260	660	2,960
Thailand	85	0	660	0	0	0	0	0	0	2,215
Laos	0	0	0	0	0	1,252	626	0	0	1,878
Australia	0	0	114	0	0	0	0	0	0	1,330
Sri Lanka	0	300	0	0	600	0	0	0	0	900
Cambodia	0	0	0	0	235	135	0	135	0	505
Bangladesh	0	0	0	0	0	0	0	0	275	525
Myanmar	0	0	0	0	0	0	0	40	0	40
World total	**89,405**	**92,975**	**84,130**	**81,196**	**72,120**	**105,837**	**84,069**	**62,575**	**50,265**	**1,054,807**

Source: End Coal, 2019.

2.3 Implementation Challenges

In order to justify the implementation of a coal moratorium, the government should undertake a detailed study on the kind of impact it might have on the country's energy mix, level of emission reduced, air quality improvement and cost savings. Although coal is said to be the cheapest energy source, the government should take a more holistic approach when calculating the cost impact of large-scale coal utilization by including the cost of externalities and the implication of capacity charges for unutilized coal power.

However, this idea will most likely face strong opposition from coal mine owners and developers of coal-fired power stations, as well as PLN themselves. Indonesia has been dependent on coal as the main power source for decades, and this trend is expected to continue in the coming years. Coal mine owners and coal companies have very strong bargaining power and are very much entrenched in Indonesia's energy industry. The government's latest policy to prioritize mine-mouth coal power plants stands to benefit those with large coal resources, and they would not take the decision to end coal power lightly.

2.4 The Bottom Line

A coal moratorium would be a quick way of signalling a shift to renewable energy with few, if any, major costs.

3.0 Seize the Sun

3.1 The Current Situation

Indonesia has extensive solar resources…

Indonesia has huge solar energy potential estimated at more than 500 GW—larger than any other renewable source in the country. The International Renewable Energy Agency (IRENA) (2018) estimated that Indonesia could develop up to 3.1 GW of solar energy per year from 2016 to 2030 and attain 47 GW of solar capacity in 2030. This potential should be sufficient to meet the General National Energy Plan (Rencana Umum Energi Nasional [RUEN]) target of 6.5 GW of solar power in 2025.

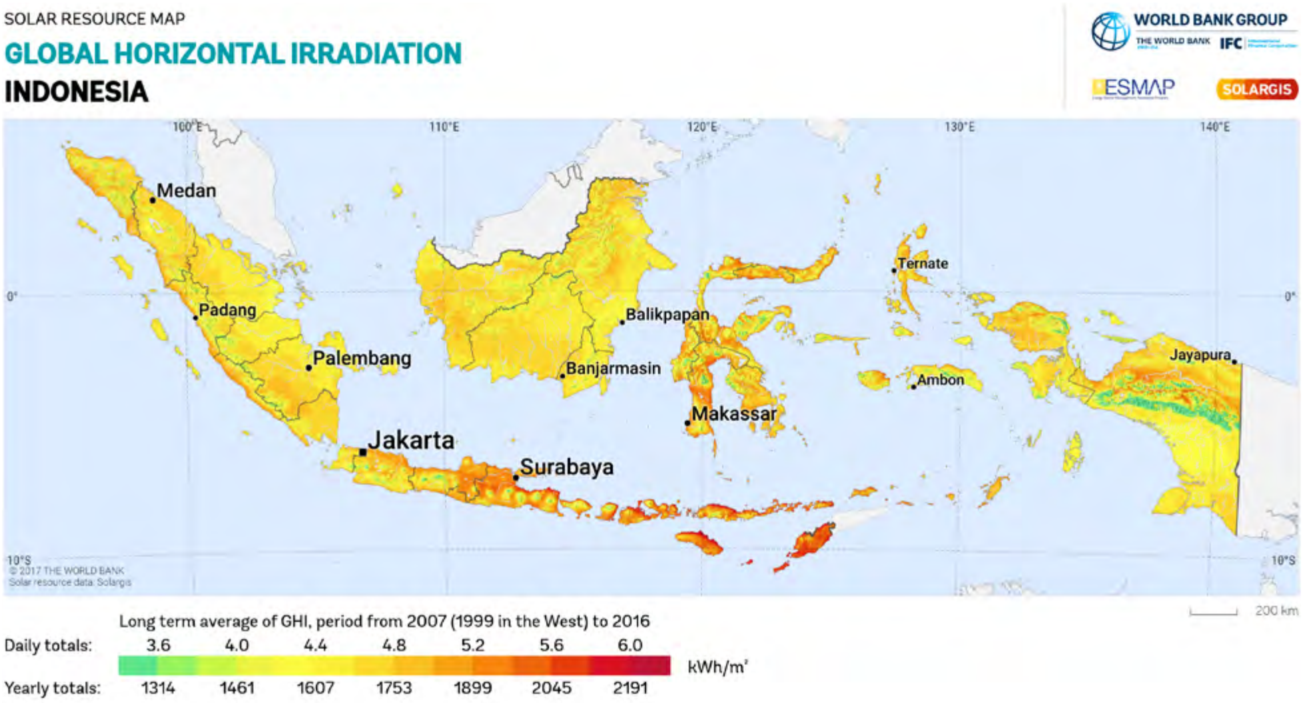

Figure 4. Global horizontal irradiation for Indonesia.
Source: Solargis, 2017.

…but it has barely begun to exploit it.

Despite its huge potential, the country has barely begun to exploit solar power. By the end of 2017, only 80 MW of solar energy had been installed; those installations were dominated by stand-alone off-grid systems in remote locations (64 MWp), while the on-grid systems account for only 16 MWp. The current installed base is almost exclusively made up of small units that lack the economies of scale associated with the industrial-scale solar units commonly found in other countries. The largest utility-scale solar power plant that is currently running in Indonesia has an installed capacity of only 5 MW and is located on an isolated island grid in Kupang, East Nusa Tenggara (Hamdi, 2019).

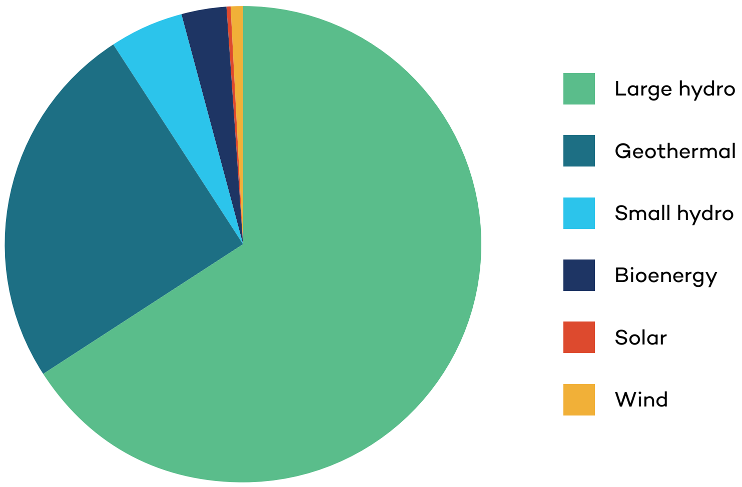

Figure 5. Renewable installed capacity (on-grid) in 2018

Source: IESR, 2019c.

Out of 9.4 GW of on-grid renewable power plants, around 66 per cent of were large hydro power. Geothermal, small hydro and bioenergy contributed 25 per cent, 5 per cent and 3 per cent, respectively, while solar and wind each contributed less than 1 per cent of total capacity (IESR, 2019c). The recently launched Indonesia Electricity Supply Business Plan (RUPTL) 2019–2028 even decreases its solar plan by 137 MW or 13 per cent less compared to the previous RUPTL, bringing into question PLN's willingness to support the solar sector (PLN, 2019).

Figure 6 shows solar energy installed capacity by country in 2017. This chart again shows how Indonesia has barely exploited its solar potential even when compared to other countries in the same region.

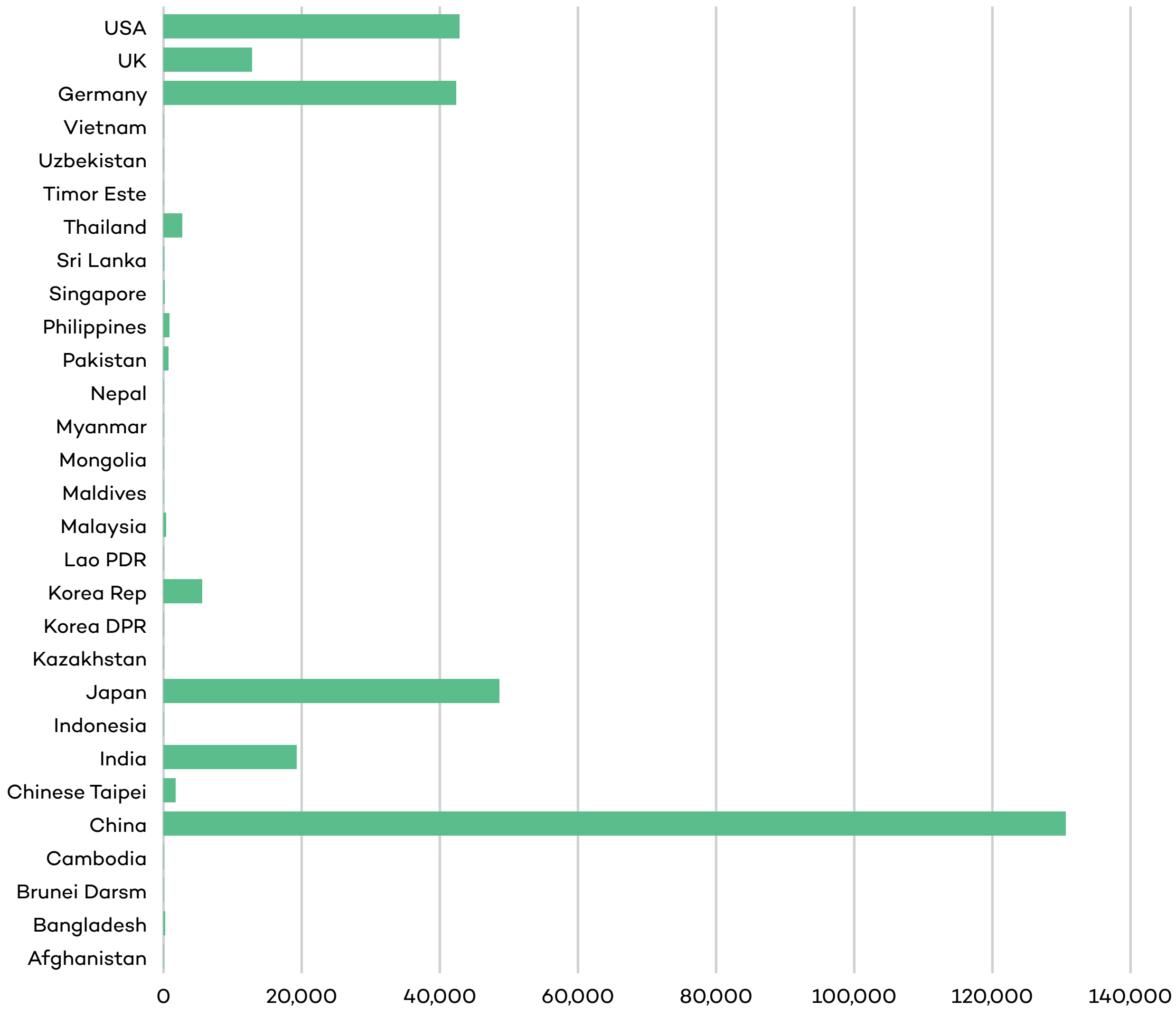

Figure 6. Solar energy installed capacity by country in 2017 (MW)

Source: IRENA, 2018.

There are four issues that inhibit the development of more solar power in Indonesia:

- **The inability of the grid to absorb large amounts of intermittent power**
  One of the most common concerns expressed by PLN about solar power is that the grid is not currently capable of absorbing a significant amount of intermittent power. However, no one is asking for the grid to absorb large amounts of intermittent power immediately. Even though the grid and its management definitely needs updating, it could absorb intermittent power in its infancy while PLN learns how to manage a future grid with more intermittent power, perhaps even in large amounts, eventually.
- **The uncertainty regarding the tariff**
  The decision to use BPP as the benchmark for solar tariffs has created a great deal of uncertainty in the market. The calculation of the BPP is currently not transparent and it is therefore impossible for developers to predict how the tariff they receive will fluctuate over time and how this relates to the real costs of generation. This uncertainty makes developers reluctant to invest in the sector. This is discussed further in Section 4.
- **The difficulty in accessing land for land-mounted solar photovoltaic (PV) power**
  One of the most common issues for large-scale land-mounted solar PV is the fact that it requires a

large area of land. Land acquisition has always been difficult in the power sector (and the infrastructure sector more broadly). It is not uncommon to have large projects delayed because of issues associated with land acquisition.

- **The additional costs caused by strict local content rules**
  Currently, solar power projects in Indonesia are subjected to local content regulation in the Ministry of Industry Regulation No. 5/2017 (and further detailed in the Ministry of Industry Regulation No. 4/2017). These regulations mean that IPPs are obliged to use more expensive local panels, while at the same time, the electricity tariff is benchmarked to heavily subsidized baseload coal power units (BPP) (Hamdi, 2019). Employing a high threshold for using local content therefore makes it difficult for the sector to scale up.

The long-standing issues of access to land will not be solved quickly...

One of the most common issues causing delays for power plant projects is land acquisition. When it comes to acquiring a large plot of land, especially outside Java, this can mean dealing with dozens of landlords and local regents, in addition to applying for various permits. Large-scale solar power plants require a significant land area, suggesting that innovative solutions to deal with land acquisition problems are needed—not just for solar power but for all development. With that said, more densely populated countries than Indonesia (such as India) have been able to integrate large-scale solar farms.

...but one source of land exists that is immediately available and extensive—roofs.

In 2017, MEMR announced The First Gigawatt solar power program. This program aims to produce 1 GWp of electricity nationwide from rooftop solar panels before 2020. This is not an unreasonable target. There are 30 million household customers in Java alone, of which at least 10 million households are classified as upper-middle class. If just the middle class households installed at least 4 kWp each, this would amount to up to 4 GWp of solar power (Wijiatmoko, 2017). IESR and Gesellschaft für Internationale Zusammenarbeit (GIZ) also did a market survey in October 2018 that showed that there are at least 4 million–4.5 million households (>1.3 kVa) in Java that are interested in installing rooftop solar (IESR, 2019c). Based on these data, a target of 1 GW should be achievable.

To date, progress on rooftop solar has been extremely slow.

Despite MEMR formally endorsing the First Gigawatt solar power program and incorporating rooftop solar as the main strategy in the National Energy Plan (RUEN) for developing solar power, rooftop solar PV remains insignificant in the Indonesian power sector. According to the Rooftop Solar Power Users Forum (PPLSA), by June 2018, Indonesia had only installed 521 kWp of residential, 5 kWp of social and 1080 kWp of industrial rooftop solar PV. The annual solar PV capacity addition plummeted from around 11 MW in 2015 to 916 kW in 2018. The installation costs for residential rooftop solar PV have been stagnant for the last three years at around IDR 18 million/kWp (IESR, 2019c).

One of the reasons for the very slow progress of solar power is actually the regulations issued to try to encourage the use of solar power. MEMR Regulation No. 49/2018 on the use of electricity produced through roof solar PV panels for PLN customers was supposed to encourage people to install solar panels, with MEMR claiming that the installation of rooftop solar panels could reduce a household's monthly electricity bill by 30 per cent (Jakarta Post, 2018). However, these long-awaited regulations have been a disappointment to sector participants, and the PPLSA has called on the government to revoke them.

The key problems with the current regulations are:

- **Capacity restrictions**
  First, the regulation imposes a capacity restriction, in which customers can only install up to 100 per cent of their grid-installed capacity. This implies that customers are not allowed to produce more electricity than their current capacity, therefore decreasing the chance of exporting energy to PLN's grid.
- **The 65 per cent rule**
  Before Regulation No. 49/2018, for every kWh of power exported to the PLN grid, customers would be given credit equal to 100 per cent of the applicable PLN customer tariff. The new regulation now says that exported energy to the PLN grid will only be given credit of 65 per cent of the applicable PLN customer tariff, which greatly reduces the economic value of rooftop solar panels. IESR calculated that using the 65 per cent export calculation, the returns on investment will take 11–12 years, compared to around eight years if the electricity production was calculated at 100 percent (IESR, 2019a).
- **Minimum charge**
  In addition to the above rules, customers will still have to pay a minimum charge. This means that even if the installed rooftop panels produced enough electricity to cover the customer's entire monthly usage, the customer will still have to pay a minimum charge to PLN.

The new regulations therefore push back the payback period for residential rooftop solar panels, making installation uneconomical and unattractive to the wider population.

The current rules constraining rooftop solar are inconsistent with the country's renewable energy goals and do not make economic sense.

Rooftop solar displaces electricity that would otherwise have to be provided from the grid. It should therefore be evaluated at the price of grid electricity. As long as the levelized cost of electricity of rooftop solar is lower than that of the grid when evaluated without the above restrictions, then every unit of rooftop solar reduces the overall cost for the country as a whole. Hence, the new regulations make electricity provision more expensive for the country as a whole.

Responding to criticism from the industry, MEMR has defended the regulation, saying that it would keep the regulation in place for at least a year and thereafter the ministry would evaluate its implementation (Sulaiman, 2019).

3.2 The Proposals

Pricing policy should be changed to ensure the viability of installing rooftop solar on industrial and commercial buildings. A study should then be done to assess the costs and benefits of requiring installation for buildings above a certain size within a five-year period.

As noted above, the combination of capacity restrictions, the 65 per cent rule and the minimum charge make the installation of rooftop solar unattractive, even on large industrial and commercial buildings. It clearly makes no sense for policy to discourage major commercial actors from doing something that is of significant economic and environmental benefit to the entire country. These policies should be changed so that the installation of rooftop solar on large commercial and industrial buildings is reasonably attractive.

At the same time, it is reasonable for the government to ask large businesses to share some of the costs of the transition to renewables. The government should therefore commission a study to assess the scope for rooftop solar on industrial and commercial buildings in Indonesia's major cities and the costs and benefits of installation. If it is found that the overall benefits of installation significantly outweigh the costs, then businesses above a certain size could be required to undertake this installation within, say, a five-year period. The government should also enforce, and budget for, the existing requirement for government buildings to install solar panels. These steps could dramatically kick-start the solar industry in Indonesia, providing a scale of demand that could reduce the costs of supply, thereby encouraging further expansion.

Provide households with a subsidized 900 VA connection with the option of installing solar PV on their rooftops.

Customers with 450 VA and 900 VA connections receive heavily subsidized electricity. As a result, they cost PLN a lot more to supply than their contribution to PLN's revenues; supplying less electricity to such households benefits PLN. In many cases, installing rooftop solar on 450 VA connections is unlikely to be financially viable due to the fixed costs of supply and the typically small size of the system. However, if subsidized 900 VA households were helped to install solar PV on their roofs, this could reduce their bills, even if electricity prices were higher, because part of their electricity would come for free. Hence both PLN and households would win. Finally, as PLN's cost of supplying subsidized households fell, and as prices were gradually increased for 900 VA customers, the Ministry of Finance would be able to reduce its subsidy to PLN. This is a rare instance of a win, win, win policy. Because the value of the electricity saved is higher than the cost of installing the systems, implementing this proposal would be a net benefit to Indonesia, where the net benefit can be shared between the Ministry of Finance, PLN and customers.

A Big Idea for Indonesia's energy transition: supply subsidized 900 VA customers with rooftop solar panels.

In 2017 there were 4.1 million 900 VA customers that received a subsidized tariff. Currently, such customers pay IDR 605/kWh instead of the normal tariff of IDR 1,300/kWh, which implies a 53.4 per cent subsidy (KataData, 2017). The average consumption for 900 VA customers is 124 kWh/month and the annual cost of this subsidy to the Indonesian government is IDR 4.53 trillion (USD 313 million). If these 900 VA customers install 700 W rooftop solar panels, IISD calculation shows that it could reduce their electricity usage by over 50 per cent, with a payback period of approximately seven years. Indeed, the reduction in electricity usage resulting from the installation of rooftop solar panels would reduce the household electricity bill even if they were being charged the full supply cost of electricity for their remaining consumption.

The installation of solar panels also means that PLN no longer has to supply as much subsidized electricity to the 900 VA customers. Since the cost of supplying these customers is much higher than the revenue received from them, reducing the amount supplied to subsidized households is a benefit to PLN. In addition, the government no longer needs to provide PLN with a subsidy for these customers; this saves the government IDR 3.35 trillion (USD 232 million) in electricity subsidies each year.

However, this policy would have one major cost: that of supplying and installing 4.38 million households with 700 W solar panels. Our estimates are that this would cost between IDR 26 trillion and IDR 35 trillion over the entire period of the program. It is likely that the mass installation of solar panels would dramatically reduce the costs of the equipment and of installation due to economies of scale. We estimate that, if the cost of an installation were around IDR 7 million for a 700 W system, then the reduction in the subsidy to PLN would cover the cost of installing the solar panels. Alternatively, the government could maintain the subsidy to PLN at existing levels and charge PLN with the responsibility of procuring and installing the panels. A third alternative would be for the government to work with local banks to design a credit scheme for the purchase of the rooftop solar panel system, which could then be paid back in instalments. Annex 1 shows the detailed calculations.

3.2 Implementation Challenges

Although these proposals could be complex and costly to implement, if successful they could very much transform the landscape of Indonesia's solar industry that has been rather dormant in the past years. Given that the current Regulation No. 49/2018 is amended to be more in favour of encouraging customers to install rooftop solar, it would be better to start with the industrial and commercial buildings, since there are far fewer of these and the economics are likely to be much better. For example, there are a lot of RE100 companies[3] that are located in Indonesia, especially in Jakarta and its surrounding areas, that own their own buildings or warehouses, such as IKEA, Johnson & Johnson, Nestle, Nike and many more. These are the companies that have pledged to become 100 per cent renewable. Because they are increasingly focused on greening their supply chains, they will favour green electricity.

In order for this idea to take off, it will be necessary to ensure a bulk supply in the market of high-quality solar PV panels. Therefore, allowing the use of imported solar panels without being limited by local content requirements could be the key during the initial stage. At the same time, local manufacturing capabilities are also being developed through cooperation with these foreign manufacturers to ensure quality as well as installation skills. A system should also be developed to monitor and verify the quality of installation. Building up experience in this way could help lay the groundwork for the much larger-scale household program. Local assembly companies will strongly support this measure as consistent with industrial strategy.

PLN could oppose this proposal because it could reduce the amount of electricity that they sell. This is particularly important for commercial and industrial customers, where PLN makes a profit. However, a calculation done by IESR actually shows that the fears of losing revenues are overestimated. For 1 GW of rooftop solar PV by 2020, IESR calculated that PLN revenues would only decline by 0.58 per cent. And even after MEMR Regulation No. 49/2018 takes effect, it will only be reduced by 0.52 per cent. This reduction is negligible compared to the benefits it brings to the country (IESR, 2019c).

3.3 The Bottom Line

Dramatic expansion of rooftop solar is possible and would kick-start a new green industry, but it will require careful planning and execution over several years.

Box 3: Enhance the electricity grid's ability to accept more renewable energy

In addition to the energy pricing and generation technology challenges presented in this study, Indonesia also faces grid challenges that are worth noting. An archipelago including more than 13,000 islands, Indonesia faces unique challenges related to designing, constructing and operating electricity networks. In many countries, the end state for electricity networks is for every significant urban and rural area to be connected to a single national transmission grid. PLN operates and manages over 600 local electricity grids throughout the country. Most of the grids are very small and are not connected. The large grids are mainly powered by coal-fired power plants. Smaller grids and off-grid communities are mostly powered with diesel fuel (IISD, 2018).

The geographical factors that have influenced grid design have also constrained potential renewable generators from connecting to these networks, because renewable resources are often not located near to the population centres. For example, the areas with the strongest solar irradiation are in eastern Indonesia, which has a much smaller and sparser population than Java, Bali and Sumatra. In particular, some areas

[3] RE100 companies have committed to sourcing 100% of their power from renewable sources. For more information, see: http://there100.org/re100

with high potential for intermittent renewables have very small grids, making it difficult for those grids to absorb this power. Conversely, the variable output from large-scale renewable generation is easier to accommodate in larger grids such as Java's, where demand and supply are aggregated across a large number of consumers and generators (IISD, 2018).

This problem can be overcome through a combination of strategies: on-grid management, upgrading grid equipment, the addition of electricity storage in the distribution and transmission grid and further integration of regional electricity networks through increased deployment of interconnectors.

Electricity by its nature must have supply match demand exactly at every second; if supply suddenly falls, then this affects the voltage and frequency of electricity supply. This can damage equipment in the electricity grid (e.g., transformers and appliances). Hence, keeping this balance right is a requirement for a stable grid. Intermittent renewables (e.g., solar and wind energy) are challenging because they disrupt the conventional methods for daily planning and dispatching. Their power fluctuates. Grid operators have to adjust their day-ahead and intra-day operating procedures.

However, it is possible to compensate for the additional intermittency and uncertainty. These strategies can be used to integrate larger amounts of renewable energy in Indonesia's electricity grid:

1. **Provide a strong interconnection of the electricity grid between regions using high-voltage power lines spanning long distances:** By joining different grids, the electricity that is not needed in one place can be channelled somewhere else, smoothing out the peaks and troughs of supply and demand. This makes supply less dependent on local weather and greatly reduces the amount of storage needed to achieve stability. The grid operator is only concerned with balancing the total amount of energy supplied into and taken from the grid. If areas are connected, then the law of large numbers reduces the overall variance of supply in the system and therefore the amount of reserve capacity required to balance the system.
2. **Spinning reserve/automatic generation control:** Typically, this reserve capacity is created by generators that are already synchronized with the power grid but are not operating at full capacity. If backup power is needed, utilities will increase the output of these generators. Typically, a 10-minute response time is a minimum requirement to qualify as spinning or "operating" reserves. This is the role often played by gas power stations. In addition, all generators can use automatic generation control, which instantly speeds up or reduces generation to balance the grid. Indonesia needs to ensure that all of its generation capacity installs and uses the most effective methods of generation control.
3. **Provide energy storage in the form of pumped hydro energy storage and batteries, coupled with demand management:** Storing energy in surplus times allows energy to be released during peak demand times. Indonesia has enormous pumped hydro storage potential. This needs to be developed to help balance the addition of solar and wind power into the grid. Large-scale battery storage solutions have been successfully implemented in Australia and can be replicated to effectively flatten the load curve, potentially reducing the need for additional capacity to meet peak demand.
4. **The power of prediction—forecasting:** A key way of ensuring that supply equals demand is to know what both will be. This means better forecasting of patterns of demand as well as better micro-level weather forecasts to predict when the peaks and troughs of supply will occur. Experience has shown that it is possible to effectively model and predict the aggregate renewable power available to the grid since both wind and solar supply can be forecasted with reasonable accuracy.

Improving these areas would enable the grid to take far more electricity from solar and wind. At the moment, research shows that the grid could already take far more renewables than PLN currently allows—but improving these four areas could enable far greater absorption of intermittent power and remove the common misconception that the grid is not stable enough to take intermittent power. Some of these solutions are not easy or low cost, and they are long-term commitments, but so too is the long-term trend to increase renewable energy and reduce GHG emissions.

4.0 Getting the Price Right; Making the Price Just

4.1 The Current Situation

The main reason there is so little renewable energy in Indonesia is because of low prices and regulatory uncertainty.

The prices offered to generators of renewable electricity are based on the local average generation cost (BPP). Ministry of Energy Regulation ESDM No. 50/2017 regulates the maximum electricity purchase price from renewable energy sources. It states that (Kementerian Energi dan Sumber Daya Mineral, 2017):

1. For electricity purchased from solar, wind and ocean-hydro power plants:
   a) If the local BPP is equal to or below the national BPP, the electricity purchase price will be decided on a business-to-business basis.
   a) If the local BPP is above the national BPP, the maximum electricity purchase price is 85 per cent of the local BPP.
2. For electricity purchased from geothermal, hydro and waste power plants:
   a) For power plants located in Sumatra, Java and Bali, all electricity purchase prices will be decided on a business-to-business basis.
   a) For the rest of Indonesia, the maximum electricity purchase price is 100 per cent of the local BPP.

The effect of capping the price, particularly for solar and wind power outside of Java/Bali to 85 per cent of the local BPP is that no new PPAs have been signed since the regulation took effect. This is because most developers consider that the power purchase prices are unattractive for developers to recover their investments and make reasonable profits. Developers are also concerned that the new system of pricing does not provide any recognition of the environmental benefits of renewable energy, and, in fact, favours fossil sources.

The BPP is a non-transparent, inefficient and biased way of determining the price.

Based on our interviews with several sources in the industry, the methodology for calculating the BPP is not transparent. The tariffs determined by MEMR are based on the BPP, which is calculated by PLN. However, the exact formula or methodology for calculating the BPP has never been disclosed, so there is no way to determine the accuracy and suitability of the BPP as a benchmark for all renewable energy tariffs.

What is clear is that the pricing system for generation does not favour renewable generators. The combination of capping the price of renewable energy at levels often lower than those paid to coal generators, while simultaneously reducing the fuel costs of coal generators through the provision of subsidized coal, has created a significant competitive disadvantage for renewable energy generators compared to those that use coal.

Better mechanisms for price discovery have been designed … but are not used.

Internationally, a variety of different policies have been pursued to promote the deployment of renewables, including subsidies, feed-in tariffs (FITs), tax incentives and auctions. Auctions, in particular, have provided an efficient mechanism for contracting renewable electricity in several countries. The design of auction schemes should take into consideration the National Energy Plan as well as the size and maturity of the renewable energy market. For example, technology-specific auctions allow for the promotion of certain technologies and the diversification of the portfolio, while technology-neutral auctions can also promote renewable energy technologies where they have been able to compete with fossil fuels (Lucas, Ferroukhi, & Hawila, 2013).

Another type of auction system is reverse auction. A reverse auction is a process by which an entity, generally the government, announces that it wants to purchase a certain amount of a product or service—in this case electricity from renewable sources—and solicits competitive bids to acquire it at the lowest cost, with bidders each providing their lowest acceptable price. This is generally accompanied by a requirement to purchase the electricity (Cozzi, 2012). This kind of reverse auction mechanism has actually already been designed for Indonesia and was even signed off by the previous Minister of Energy in 2015. However, the change in ministers resulted in the scrapping of the reverse auction mechanism.

Evaluation of costs should be based on full economic costs, not just the cost to PLN.

In 2017, IISD released *Financial Supports on Coal and Renewables in Indonesia*. This report shows that the "true cost" of coal, including subsidies and externalities, is considerably greater than the cost of renewable energy. In 2015, subsidies to coal production were estimated to be worth approximately IDR 8.5 trillion (USD 644 million) in comparison to roughly USD 133 million for renewables. The report demonstrates that subsidies to the coal industry are associated with significantly higher external costs than renewable energy. There is strong evidence that, from a "true cost" perspective, the overall goal of Indonesia's energy policy should be to increase the share of renewable energy while reducing the share of coal.

PLN, as a state-owned entity, should make its decisions based on its responsibility of maximizing the welfare of Indonesians. That is, it should use the "true costs" of different energy sources when making decisions about the energy mix. Unfortunately, its incentives are not aligned in this direction. Rather, it has a responsibility to maximize its financial profits (or minimize its financial losses). As a result, it has a strong incentive to maximize the use of fuels with the lowest rupiah cost, regardless of the wider negative impact on people and the environment. This bias can only be redressed by changing the way energy costs are considered.

4.2 The Proposal

Publish methodology and data for calculation of the BPP.

Because all power plant projects in Indonesia depend on the BPP as the reference price, the methodology and data for the calculation of the BPP should be published and discussed openly. Although MEMR is the institution that officially calculates and publishes the final tariffs, these numbers depend on the accuracy of the data supplied by PLN. Based on our interviews with various sources, we were not able to determine precisely how the BPP is calculated. Without this information, it is impossible to assess whether using BPP as a reference price is the right approach for power plant projects.

Incorporate full economic costs in BPP, including pollution and carbon costs.

Currently, the BPP does not refer to international prices, which is good practice in cost–benefit analyses. Indeed, it does not even use domestic market prices; rather, the BPP uses the amount actually paid by PLN for generation. This suggests that the cost of generation submitted to MEMR ignores the inherent subsidies for coal via the price cap and the DMO. In addition to this, the calculation does not distinguish between generation from fully amortized assets and generation from new assets. With all these factors ignored, the BPP gives a false picture of coal being the least-cost option for power generation, hence skewing investment toward coal and away from renewable energy. Using full economic costs—the costs to the country as a whole—would create a more accurate reference price. These should include air pollution costs, which are reflected in respiratory illnesses, as well as climate change costs, which are currently paid in ways such as farmers experiencing droughts and coastal communities experiencing inundation and salination of soils.

Calculating the full economic cost of supply is useful and provides policy-makers with a mechanism for putting downward pressure on costs. However, the BPP is not this measure and therefore is not the right reference point for bids. Capping tariffs, particularly for renewable energy, at a percentage of BPP does not reduce full economic costs, it increases them by discouraging investment in technologies that have much lower negative impacts on the rest of society. Ultimately, benchmarking against the BPP is simply not a good way of identifying true costs. Where feasible, auctions should determine the price in a technology-neutral way. Whether the winning price is above or below the BPP is irrelevant.

Establish an integrated and consistent system of least-cost planning for each grid area.

Currently there does not appear to be any clear methodology for grid planning. With programs such as the 35,000 MW program, the government seems to be focused on generation and is not giving as much attention to grid planning, expansion and improvement. This can also be observed in how the plan for grid expansion in the RUPTL changes from year to year—sometimes quite radically—with no clear explanation. For example, Table 2 compares the RUPTL 2019–2028 to the previous year (RUPTL 2018–2027). It shows large reductions in the grid expansion plan.

Table 2. Expansion plan comparison

No	Item	Unit	RUPTL 2018–2027	RUPTL 2019–2028
1	Total Planned Transmission Network Expansion	Kms	63,855	57,293
2	Total Planned Substation Construction	MVA	151, 424	124, 341
3	Total Planned Distribution Network Expansion	Kms	526, 390	472, 795
4	Total Planned Distribution Station Construction	MVA	50, 216	33, 730

Source: PLN, 2018, 2019.

The reason cited for these decreases is the same as that given for changes in planned generation: that electricity demand growth is slower than previously predicted. PLN stated in the RUPTL that they plan on a least-cost basis; however, the methodology for how they make these calculations and arrive at their decisions is unknown. Their approach should be published. The methodology should take into consideration demand and future costs of all technologies. Ideally, it should be technology-neutral to ensure that the energy mix in each grid area is determined by the lowest cost provision, taking into account expected future changes in costs.

Box 4: Big Ideas for Indonesia's energy transition: A temporary fossil fuel levy to kick-start renewables deployment

In 1990, the United Kingdom imposed the Non-Fossil Fuel Obligation, which was the government's previous major instrument to encourage growth within the renewable energy industry. The Non-Fossil Fuel Obligation required electricity supply companies to secure specified amounts of new generating capacity from non-fossil fuel sources, including renewables. Additional costs incurred by the electricity suppliers under these contracts were financed through the Non-Fossil Fuel Levy. It was funded by all final electricity consumers as a levy on electricity consumption. The levy rate was set by the regulatory body each year, and in 2003 stood at 0.3 per cent of the cost of fossil fuel sources of electricity (International Energy Agency, 2013).

The same mechanism may be applied in Indonesia to fund solar rooftops. The idea is for the government to impose a temporary fossil fuel levy, which would go into an Energy Justice Fund. The fund will then be used for two things: first, to fund the roll out of the rooftop solar idea described above and second, to be recycled to companies that pay the tax for investment in building capacity in renewables (in effect incentivizing major investments by the fossil fuel companies in renewables).

4.3 Implementation Challenges

Until 2017, Indonesia applied the FIT scheme for renewable energy electricity. The switch from the FIT scheme to the BPP scheme came as a big disappointment for renewable energy developers and investors, since it renders the tariff unattractive (Dunia Energi, 2016). On the other hand, the reason the FIT scheme was revoked was because it was considered to favour the big developers making huge profits instead of prioritizing the general public's interest in having affordable electricity tariffs. It is difficult to come up with a price scheme that would be agreeable to all stakeholders, whether it be PLN, MEMR or the general public. Each of the stakeholders will have their own version of vested interest. As a solution, the government could form an independent commission consisting of experts to design a new pricing methodology based on best practices.

Introducing reverse auctions and other mechanisms of price discovery is not technically difficult since the work has been done. However, this should be part of a broader revamping of the procurement processes to ensure that they are clean and efficient.

While least-cost planning and procurement reforms may reduce prices, full economic costing may increase prices, and so it may meet with opposition from politicians and the general public. For this reason, it will be important to communicate the changes effectively and to mitigate any increases using the mechanisms that support facilitation of renewables without inviting large price increases.

4.4 The Bottom Line

Price and price uncertainty lie at the heart of Indonesia's struggle to expand renewable energy. A revamp of the pricing mechanism is needed to provide greater transparency and rationality in decision making.

5.0 The Biofuel Bonanza

5.1 The Current Situation

Indonesia has huge potential for bioenergy.

The Government of Indonesia estimates that the potential of bioenergy in Indonesia is around 32.6 GW (see Table 3). Given the huge potential, the government is keen to expand bioenergy power generation.

Table 3. Bioenergy potential of (in MW).

No	Type of Bioenergy	Total (MW)
1	Palm	12,654
2	Cane	1,295
3	Rubber	2,780
4	Coconut	178
5	Rice husk	9,808
6	Corn	1,722
7	Cassava	270
8	Wood	1,335
9	Cow dung	535
10	Municipal solid waste	2,066
	Total	**32,654**

Source: Kementerian Energi dan Sumber Daya Mineral, Direktorat Jenderal Energi Baru dan Terbarukan, 2016a.

Despite its huge potential, the development of bioenergy in Indonesia has faced numerous challenges. These include:

- The availability of biomass feedstock on a continuous and reliable basis
- The lack of a competitive tariff
- Complex processes of permitting and coordinating between regional authorities
- High costs as a result of the remote locations in which the resources are found
- The absence or suitability of grid infrastructure or distance from grid connections
- The availability of local technical competencies and spare parts.

As a consequence, only 1.8 GW of capacity has currently been installed, and most of this is off-grid. To date, the capacity of bioenergy power plants connected to PLN's electricity grid is only around 131.4 MW (PricewaterhouseCoopers, 2018).

Indonesia has put a strong focus on developing biofuel.

Notwithstanding the large potential for bioenergy, the main policy focus has been on the production and use of biofuels and, in particular, biodiesel. Biodiesel is produced by refining palm oil. The biodiesel blending program was first introduced in 2015 through MEMR Regulation No. 12, which targeted 20 per cent blending (B20) by 2016 for transportation and industrial use. In September 2018, the government expanded the subsidy scheme to non-Public Service Obligation organizations through Presidential Regulation No. 66/2018. This means that, if previously the use of B20 was only obligatory for public service activities such as public transport and power generation, after September 2018 this program is also mandatory for other sectors such as mining and other diesel-using industries.

Moreover, the target for blending will increase further. The government projects a strong increase in the use of liquid biofuels as a result of the requirement for 30 per cent biodiesel blending (B30) and 20 per cent ethanol (E20) blending from 2025 onwards. Total liquid biofuel use per year is projected to increase to 25 billion litres by 2030, compared to 1.35 billion litres of biodiesel that was blended in the first half of 2016.

One of the reasons the government is pushing for the utilization of crude palm oil (CPO) domestically is the abundance of palm production in 2018 (47.43 Mt). The oversupply of palm oil has been caused in part by the European Union's (EU) recent decision that palm oil-based biofuels can no longer be counted toward EU member states' GHG emissions reductions targets (EU, 2018). This threatens to reduce demand for, and therefore exports of, Indonesia's palm oil. The biofuel policy is therefore designed to provide an additional domestic market for CPO.

In addition to providing an additional domestic market for palm oil, the biofuel policy aims to reduce diesel fuel imports (and thereby boost the trade balance) (Andriyanto, 2018) and to reduce the fiscal cost of subsidizing diesel. Indonesia spends, on average, USD 5.5 billion per year on diesel oil imports. Through the B20 program, MEMR targeted USD 3.3 billion in foreign exchange savings by the end of 2019 as the result of the reduction in diesel oil imports as well as the rise of the palm oil price.

The biofuel policy does not reduce the trade deficit and widens the fiscal deficit.

MEMR has stated that the implementation of the B20 program has successfully reduced crude oil imports. It was announced earlier in March 2019 that, throughout 2018, the B20 program resulted in state budget (Anggaran Pendapatan dan Belanja Negara [APBN]) "savings" of USD 2.01 billion. This means that USD 2 billion less is required for importing crude oil and that this money could then be moved to the budget for biodiesel blending. The production of biodiesel and biofuel throughout 2018 reached 6.01 million kl, which exceeded the target of 5.70 million kl (EBTKE, 2018).

However, while it is certainly true that the program may save the government billions of dollars of avoided crude oil imports, this is offset by the opportunity cost of not exporting the palm oil. Table 4 demonstrates that, using the fluctuating prices of diesel and CPO throughout 2018/19, the overall effect of using CPO to produce biodiesel rather than importing diesel had a negative impact on the trade balance in most months. For example, in April 2019, the cost of a tonne of CPO was USD 501; it takes 1.24 tonnes of CPO to produce a kilolitre of biodiesel, so producing this fuel meant USD 622 of export value lost. By contrast, importing a kilolitre of fossil fuel diesel would have cost USD 498. Thus the policy of producing biodiesel worsened the trade balance by around USD 124 for each kilolitre produced—or USD 62 million for that month alone.[4] Overall, from May 2018 to April 2019, the policy worsened the trade balance by USD 553 million.

[4] Assuming production of around 500,000 kl per month.

Table 4. B20 scheme effect on trade balance.

Month	CPO USD/t	tCPO/kl diesel replaced	CPO export value USD/kl diesel replaced	USD/kl diesel	Effect on trade balance USD/kl diesel reduced
03/18	598	1.24	742	490	-252.33
04/18	601	1.24	746	480	-266.63
05/18	590	1.24	733	514	-219.37
06/18	572	1.24	711	551	-159.94
07/18	551	1.24	685	540	-144.94
08/18	512	1.24	636	533	-102.77
09/18	479	1.24	595	542	-52.88
10/18	472	1.24	587	570	-17.26
11/18	453	1.24	562	598	35.67
12/18	404	1.24	502	540	37.71
01/19	405	1.24	503	443	-59.31
02/19	462	1.24	573	429	-144.24
03/19	504	1.24	626	471	-155.35
04/19	501	1.24	622	498	-124.14

Source: Dirjen EBTKE, 2019.

Furthermore, the biofuel policy relies upon a mechanism that recycles export taxes back to biodiesel refiners through the Estate Crop Fund. Figure 7 shows how this works. CPO exporters must pay an export tax, designed to share the benefits of these exports with the country when CPO prices are high. However, rather than going to the Ministry of Finance, this export tax flows to the Estate Crop Fund. Biodiesel refiners supply biodiesel to Pertamina. However, Pertamina only pays the Platts Average Price for fossil diesel, which is well below the cost of producing biodiesel. The difference is made up by a subsidy from the Estate Crop Fund. In essence, the process recycles the CPO export tax back to CPO firms that have refineries, as illustrated in Figure 7.

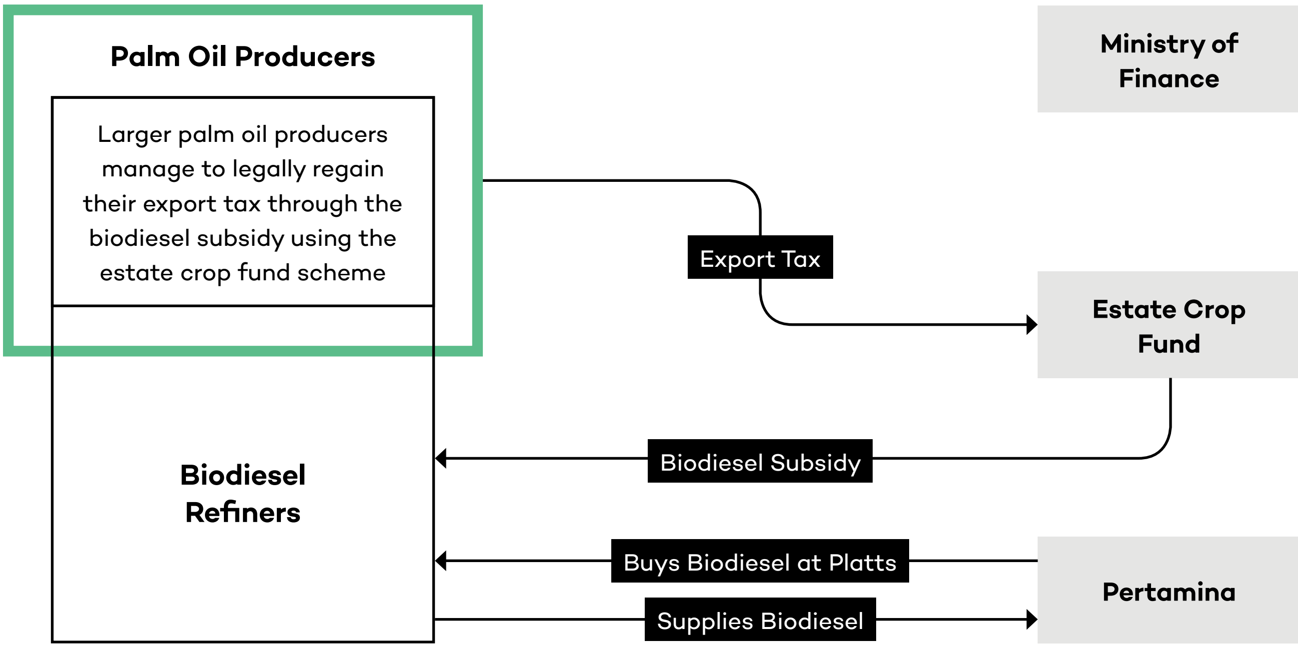

Figure 7. Biodiesel incentives circular flow

Based on Badan Pengelola Dana Perkebunan Kelapa Sawit (BPDP-KS) data in 2018, the five largest palm oil companies received 76.87 per cent of total payments, or around IDR 7.92 trillion; the remaining 23.13 per cent was allocated to 14 other companies. In 2017 the palm oil funds received IDR 14.2 trillion for the export of 37 Mt of CPO products and derivatives. BPDP estimated a lower income for 2018, ranging from IDR 10.9 trillion to IDR 13 trillion, due to the projected export challenges in the U.S. and European markets (Primadhyta, 2018). The biofuel policy therefore does not reduce the fiscal deficit. If there were no biofuel policy, the CPO would be exported, yielding IDR 10 trillion to 14 trillion per year in tax revenue. Instead, as a result of the policy, this revenue is used to subsidize the production of biofuel (without appearing on the budget).

Other countries are countering Indonesian subsidies on biofuel.

In 2018, the United States confirmed that it would impose anti-dumping duties on Indonesian biodiesel of between 126.97 and 341.38 per cent, because they regard the current mechanism of BPDP-KS giving incentives to producers as a form of subsidy. To avoid being accused of providing a subsidy, the government considered a new mechanism where the incentives would be paid directly to Pertamina, instead of to producers. This would mean that Pertamina would buy biodiesel based on the market price of fossil diesel from producers, and BPDP would pay the price difference to Pertamina (Firman, 2017). It is not clear how this would eliminate the subsidy and, to date, the proposal has not been implemented with the current mechanism still applying.

Similarly, the EU also imposed anti-dumping duties on Indonesian biodiesel. Indonesia appealed these anti-dumping duties and, in March 2018, the European Court of Justice, the EU's highest court, ruled that it must do away with the anti-dumping duties of between 8.8 and 23.3 per cent on imports of Indonesian biodiesel products. However, as noted above, subsequent EU legislation has meant that biodiesel can no longer be counted toward emission reduction targets, leading to a fall in demand for CPO.

The biofuel policy also runs the risk of perpetuating further deforestation and environmental damage.

The University of Maryland stated that, in 2017, Indonesia lost 355,500 hectares of forest, of which 80,000 hectares were due to palm oil plantations. They believe that the existing plantation area will not be enough to support the B20 program, let alone B30 or B100. In addition to this, the fact that B20 became mandatory because of the declining price of palm oil suggests that, if the palm oil price rises, palm oil producers may opt to focus on exporting their commodities again, leaving behind the damage from deforestation caused by opening up land to fulfill the B20 program (Thomas, 2019).

The impact of palm oil on deforestation is a crucial variable in determining whether biodiesel reduces or increases GHG emissions. If no additional land is needed, then biodiesel may have lower overall emissions than burning fossil diesel, although at a very high cost for each tonne of carbon dioxide abated. However, there have been concerns from the EU that biodiesel made from palm oil actually has very high GHG emissions—three times the emissions of diesel oil, because palm expansion drives deforestation and peatland drainage (Keating, 2018).

Even if one assumes no additional deforestation from biofuel production, biofuel is a costly way of reducing GHG emissions. Research from Chatham House in the United Kingdom examined the cost of reducing GHGs through different fuel mixes. They found that the cost of reducing emissions using biofuels ranged between USD 165 and 1,000 per tonne of carbon dioxide. They suggest that, if the United Kingdom sourced 10 per cent of transport fuels from biofuels by 2020, it would cost motorists an additional USD 2 billion a year by 2020 (Bailey, 2013).

5.2 The Proposal

Estimate the true cost of biofuels and make the subsidies to biofuel explicit.

Given the growing evidence that the biofuel policy is not achieving its aims, the government should commission and publish an independent study of the costs and benefits of the biofuel policy. In addition, the biofuel sector has boomed as a result of generous support from the Estate Crop Fund. However, these are not transparent and not included in the government budget. The revenue from the export tax on CPO should flow to the Ministry of Finance, like all other taxes. If the government then chooses to support the industry, it should do so through the budget so that the use of these resources can be weighed against alternatives, as is done for other government expenditures.

Shift the focus from biofuel to bioenergy.

Not all forms of bioenergy bring additional costs or increase deforestation. One example is biomass from waste including timber processing wastes, urban waste wood, landfill and other agriculture residues. Converting these residues into bioenergy may avoid competition for land (Steer & Hanson, 2015) and also present cost-effective bioenergy opportunities.

Moreover, generally, to avoid mass deforestation to fulfill the biofuel target while still exploiting Indonesia's biomass potential, the focus of the country's policy should be shifted from biofuel to biopower. This biopower can be generated either through combustion or gasification of dried biomass or biogas (methane), and the electricity produced from this is sold directly to the grid. The fuel needed for this process should be locally sourced from existing plantations or waste matters. To improve cost-effectiveness while also reducing air pollutants, co-firing of biomass and fossil fuels may also be considered in some areas.

To encourage the development of bioenergy, the government should develop policy support to ensure that bioenergy utilization is proportional to its environmental benefit and cost. This means that cheap processes that utilize waste products or any other fuel that demonstrates overall emission savings should receive larger support, and where evidence shows that a certain fuel type has negative net impacts, it should not be supported.

5.3 Implementation Challenges

Commissioning a study and making any biofuel support explicit can be done immediately. These are easy and quick reforms that would improve transparency and accountability.

Technically, it is easy to stop the ramping up of biofuel targets. However, this may be more challenging in practice. Clear targets have been set for biofuel blending and it may therefore be difficult for the government to go back on these commitments. Again, better information about the costs and benefits of the policy—and, in particular, how shifting from B20 to B30 and above might affect the trade and fiscal deficits and the environment, may provide an impetus for reform.

There may be opposition to a shift away from biofuels, unless an alternative source of revenue is provided. While the "first best" policy would be for any existing subsidies to be brought back under the government budget, this may be difficult to achieve. A "second best" option, which would ameliorate the economic and environmental costs of the current policy, would be to reduce or stop the use of the Estate Crop Fund to support biofuel, but allow it to be used to support the generation of bioenergy (e.g., through an FIT for bioelectricity). This would ensure that resources continue to flow to the same group of actors, but with a significantly improved environmental impact. Careful study would have to be done to ensure that this approach did not suffer from the same challenges as the current policy. However, it could provide a mechanism of uniting CPO interests and environmental groups under a new policy that would respect Indonesia's understandable desire to exploit its huge bioenergy potential.

5.4 The Bottom Line

The biofuel policy is a very expensive way of being green; a bioenergy policy would be better.

6.0 Conclusion

Indonesia's renewable potential is huge…

Indonesia has an extraordinary endowment of natural resources that could be harnessed to provide renewable energy. Sitting on the "ring of fire," its geothermal resources are unparalleled; its tropical location generates an immense biomass resource, providing huge bioenergy potential; its heavy rainfall and high mountains provide substantial hydro potential; and solar irradiation, particularly in eastern Indonesia, is high and, currently, virtually unexploited. Indonesia's ocean location even provides the potential for harnessing new forms of renewable energy based on ocean current flows. Altogether, Indonesia should be a renewables giant that is more than capable of meeting its entire energy needs from renewable resources.

…and the president has stated a strong commitment to renewable energy by setting the 23 per cent target.

Indonesia is fortunate to have a president committed to renewable energy. As he said during the inauguration of the Sidrap Wind Farm, President Widodo is confident that Indonesia can achieve the 23 per cent renewable energy target by 2025, and he will keep pushing for Indonesia to further utilize the immense potential of renewable energy in the country (Meilanova, 2018). He has set, and repeatedly reiterated, the government's commitment to the target of 23 per cent of the primary energy mix coming from renewables. His personal commitment to the issue was illustrated by his election campaign—even his campaign video featured the president opening the new 75 MW Sidrap Wind Farm. The government has worked hard to make the president's renewable energy vision a reality and is continuing to do so.

But the reality has fallen far short of the commitment, for good reason.

Despite high-level commitment and significant efforts, the reality has fallen far short of the promise. The current share of renewables in the energy mix is 12.5 per cent and will need to double in only six years. Similarly, the share of renewables in power generation is only 13 per cent. While the government still states that its aim is to achieve 23 per cent by 2025, the latest Energy Supply Business Plan (RUPTL) shows that it expects the share to be 16 per cent in 2024 (PLN, 2019)—apparently a miracle is expected the following year. Indeed, the share of renewables planned in the latest version has gone down, rather than up.

The reason that such slow progress has been made is a simple and honourable one: the government is committed to trying to ensure that electricity remains affordable for all Indonesians. It has therefore avoided policies that it believes would have increased the cost of electricity. In particular, the prices that it pays for electricity have been anchored by the price of coal-fired generation (or lower). This has made generation from renewables unviable for many projects and developers. In essence, the government sees itself caught in a "trilemma" of trying to achieve low prices, ensure that subsidies remain sustainable and achieve its renewable energy targets. Unable to achieve all three, it has, in practice, chosen to slip on its renewable energy targets.

This report has shown that the government can overcome the trilemma.

It is possible to achieve the 23 per cent target (as well as the energy access target) without increasing the overall cost of power to the people or expanding the size of subsidies. This can be achieved for two reasons.

First, because the economic costs of the current energy system are much higher than the financial costs. For example, prices currently do not reflect the damage caused by pollution or climate change. Yet these have real consequences in Indonesia, imposing a burden on ordinary Indonesians as well as the government. Shifting to a system that reflects the true costs of different energy choices can reduce the costs to the country as a whole.

Second, some renewable technologies—notably solar—are experiencing dramatically falling costs. Costs in the future are likely to be substantially lower than they are today. As a result, investing in these technologies will reduce overall costs for all Indonesians. By contrast, the costs of fossil fuel technologies are not falling. Indeed, as power is increasingly drawn from cheaper renewable sources, the costs of capacity payments for fossil fuel generation will rise inexorably.

But achieving the transition to renewable energy will require strong political leadership.

In particular, four major changes are needed:

1. **Press pause on coal.** Coal has been the mainstay of Indonesia's energy system. But it is the world's dirtiest fuel, generating pollution and high GHG emissions. And, as noted above, its costs are likely to rise sharply. Indonesia needs a concerted plan to phase out coal, starting with a moratorium on all new coal-fired generation.
2. **Achieve a solar transformation.** Indonesia's solar potential is immense and virtually untapped. Although providing the grid infrastructure in remote areas will take time, the government could immediately hugely expand rooftop solar. Making it viable for all large industrial and commercial buildings to install rooftop solar could kick-start a new solar industry. And providing solar panels to poorer households at minimal cost could reduce bills for households, reduce costs for PLN and reduce the subsidy needed from government.
3. **Get the prices right—and make them fair.** Indonesia's energy system has gotten the prices wrong in two ways. First, prices for electricity fail to account for the external costs imposed by different forms of power generation—notably, pollution and climate change. Ensuring that prices reflect true costs will lower, not raise, the overall costs for all Indonesians. Second, current pricing policies discourage renewables by requiring generation to be only 85 per cent of the (financial) cost of coal; by under-pricing coal inputs; and by paying only 65 per cent of the value of electricity generated by rooftop solar panels. Changing these policies would not only boost renewables, it would allow a more transparent distribution of the costs of power, which would make the energy system fairer for all.
4. **Reorient from biofuel to bioenergy.** The government's biofuel policy has succeeded in boosting the supply and use of biodiesel. But it has done so at a significant cost. Claiming to reduce the trade and fiscal deficits, it has, in fact, done the opposite, while doing little, if anything, to reduce GHG emissions. The government needs to shift its focus from biofuel to bioenergy, exploiting the immense biomass potential to generate green electricity.

Other steps will also be key. For example, major investment is needed to ensure that the grid is not only extended to many more households but made capable of absorbing far more intermittent power. The above four steps would enable Indonesia to achieve its 23 per cent target for renewables and, more importantly, set it on a path to achieving energy justice for all Indonesians.

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Annex 1. A New Model for Expanding Solar Panel Usage

Table A1 shows the total monthly cost to customers, PLN and the government if the tariff were be raised from IDR 605/kwh to the supply cost of IDR 1,119/kwh and the government were to pay the full cost of installation of the solar panels. This shows that customers, PLN and the government would all be better off (or no worse off) as a result of this change—even when using a cost of supply (IDR 1,119/kWh), which does not include any allowance for the negative externalities caused by predominantly coal-fired generation. In other words, for these customers, switching to solar rooftop is already economically sensible at current prices.

Table A1. Total cost to customers, PLN and the Ministry of Finance of installing solar panels on the rooftops of subsidized 900 VA customers

	Current	New	Units
Price for 900 VA customer	605	1,119	
Customers pay	75,020	70,021	IDR/month
Total cost to customers	**0.33**	**0.31**	**IDR trillion/month**
PLN receives from customers	0.33	0.31	IDR trillion/month
PLN receives from Ministry of Finance	0.38	0.10	IDR trillion/month
Total revenue of PLN	0.71	0.40	IDR trillion/month
Cost of supply	0.61	0.31	IDR trillion/month
Total cost to PLN	**0.10**	**0.10**	**IDR trillion/month**
Ministry of Finance pays a subsidy to PLN	0.38	0.10	IDR trillion/month
Ministry of Finance pays for solar panels	0	0.28	IDR trillion/month
Total cost to Ministry of Finance	**0.38**	**0.37**	**IDR trillion/month**

Note: The cost of installing 700W is assumed to be IDR 7 million per household.

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IISD Head Office

111 Lombard Avenue, Suite 325
Winnipeg, Manitoba
Canada R3B 0T4

Tel: +1 (204) 958-7700
Website: www.iisd.org
Twitter: @IISD_news

Global Subsidies Initiative

International Environment House 2
9 chemin de Balexert, 1219 Châtelaine
Geneva, Switzerland

Tel: +41 22 917-8683
Website: www.iisd.org/gsi
Twitter: @globalsubsidies

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Global Subsidies Initiative