Indonesia's Untapped Potential in Renewable Energy

In the lead up to the United Nation's 26th Change Conference of the Parties (COP26) in November 2021, Indonesia maintained its 2015 Nationally Determined Contribution (NDC) targets of reducing emissions by 29% unconditionally, or by 41% conditionally (with international assistance) compared to its business-as-usual scenario in 2030. The Indonesian government also unveiled its Long-Term Strategy for Low Carbon and Climate Resilience (LTS-LCCR) in July 2021. Under this long-term strategy, the government envisaged peaking the country's emissions in 2030, and turning the forest and land-use sector into a net-sink of 540 Mton CO2e by 2050.[1] What was also eye-catching was the government's aspiration to reach net zero emissions by 2060 or sooner, which would mean reducing emissions from the energy sector to near zero. Considering that up to this point, few Indonesian policymakers had publicly talked about a net zero target, this represented a significant milestone in Indonesia's climate policy.[2] Still, compared to countries that had pledged to reach net zero by 2050 or earlier, Indonesia was considered a laggard in climate ambition.

A sprawling archipelago in Southeast Asia with about 270 million people spread over more than 17,000 islands, Indonesia was highly exposed to the risks and impacts of climate change, especially extreme weather and sea level rise. Globally, Indonesia ranked among the top ten largest historical emitters of greenhouse gases (GHG), accounting for 4% of historical GHG emissions, largely due to historical land use change and forestry.[3] At the same time, it had access to abundant natural resources, such as coal and natural gas as well as renewable energy sources like as hydropower, geothermal, and solar.

Given its size and position as a large developing country, and vulnerability to climate change, Indonesia could serve as a leading example of low-carbon development. In fact, COP26 President Alok Sharma dubbed Indonesia a potential "climate superpower", a reflection of the country's tracts of tropical rainforests which served as carbon sinks, its vast potential in renewable energy, and its role as a G20 member in international climate goals.[4] However the government was expecting emissions to rise significantly across several sectors in the coming years, which would require even steeper reductions in subsequent years. What was holding the country back from staking out more ambitious national climate goals?

Coal-dependent energy sector

After emissions from land use change and forestry, energy use was the second largest – and growing – source of GHG emissions in Indonesia. The country's primary energy supply mix was dominated by fossil fuels – coal

[1] Republic of Indonesia, *Indonesia Long-Term Strategy for Low Carbon and Climate Resilience 2050*, July 22, 2021, iii, https://unfccc.int/documents/299279

[2] Guntur Sutiyono, "Indonesia Raises Its Net Zero Ambition—Can It Be a Leader for Climate Commitments in Southeast Asia?", *Asian Development Bank*, September 22, 2021, https://seads.adb.org/solutions/indonesia-raises-its-net-zero-ambition-can-it-be-leader-climate-commitments-southeast

[3] "Analysis: Which countries are historically responsible for climate change?", *Carbon Brief*, October 5, 2021, https://www.carbonbrief.org/analysis-which-countries-are-historically-responsible-for-climate-change

[4] Jayanty Nada Shofa, "Indonesia Can Become a Climate Superpower: UK", *Jakarta Globe*, October 28, 2021, https://jakartaglobe.id/news/indonesia-can-become-a-climate-superpower-uk#:~:text=Being%20blessed%20with%20abundant%20renewable,the%20current%20total%20energy%20demand

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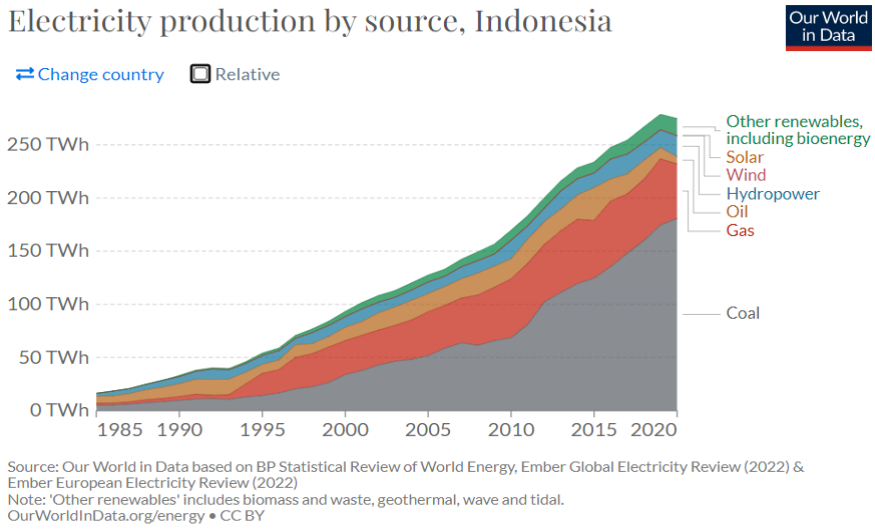
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accounted for 37%, oil 31.6%, and gas 16.8% in 2020.[5] Since 2010, primary energy demand had increased by an average of 3% per year, largely due to the expanding transport sector which consumed more oil products.[6] While sectors like waste and agriculture had seen their emissions reduce or largely stabilise, carbon emissions from electricity, transportation, industry, and manufacturing sectors had risen in tandem with Indonesia's economic growth.

Indonesia's electricity consumption grew from 147 TWh in 2010 to 245 TWh in 2019.[7] PLN, Indonesia's vertically integrated state electricity corporation, acted as a single off-taker of electricity from independent power producers, and owned more than two-thirds of generation and most of the network infrastructure.[8] PLN's ten-year Electricity Power Supply Business Plan (RUPTL) for 2019 to 2028 initially projected that electricity demand would rise by 6.4% annually, but actual demand growth dipped in 2020 due to the Covid-19 pandemic.[9] Power demand and new capacity projections were adjusted downwards in the subsequent RUPTL 2021-30.

Electricity generation capacity reached 62.8 GW in 2019. Over the longer run from 2010 to 2050, the government projected that electricity generation would increase by an average of 5.5% per year, on par with average annual economic growth.[10] Power generation was similarly dominated by coal (50.7%) and gas (26%), with far smaller shares from oil (7.4%), hydropower (7%), geothermal (3%), biomass (2.7%), wind (0.2%), biogas (0.2%), and solar (0.1%).[11] In particular, the share of coal and gas in electricity generation had roughly doubled respectively from about 29.5% and 10.3% in 1990 to 65.8 and 18.6% in 2020 (*Figure 1*), largely at the expense of oil as Indonesia sought to reduce its energy dependence on oil imports.[12]

Figure 1: Electricity production by source in Indonesia, 1985-2020



Source: "Electricity production by source, Indonesia", *Our World In Data*, accessed April 26, 2022, https://ourworldindata.org/grapher/electricity-prod-source-stacked?country=~IDN

[5] Ministry of Energy and Mineral Resources, *Handbook of Energy & Economic Statistics of Indonesia 2020,* 20-21, https://www.esdm.go.id/assets/media/content/content-handbook-of-energy-and-economic-statistics-of-indonesia-2020.pdf
[6] Asian Development Bank, *Indonesia Energy Sector Assessment, Strategy, and Road Map – Update* (Mandaluyong City: Asian Development Bank, 2020), 4, http://hdl.handle.net/11540/13848
[7] Ministry of Energy and Mineral Resources, *Handbook of Energy,* 97
[8] Asian Development Bank, *Indonesia Energy Sector Assessment*, 7,
[9] Asian Development Bank, *Indonesia Energy Sector Assessment,* 3-4.
[10] Republic of Indonesia, *Indonesia Long-Term Strategy*, 63.
[11] Asian Development Bank, *Indonesia Energy Sector Assessment*, 9,
[12] "Electricity production by source, Indonesia", *Our World in Data*, accessed April 21, 2022, https://ourworldindata.org/grapher/electricity-prod-source-stacked?stackMode=relative&country=~IDN

Renewables as a key decarbonisation strategy

Indonesia's president Joko Widodo, who was seen as being supportive of renewables and set broad targets for emissions reductions,[13] had spoken of the need for a 'just energy transition' where all would have access to clean energy.[14] Developing renewable energy (hydro, geothermal, solar PV, and wind, including capacity development to produce solar PV and batteries) in power, transport and industry, to replace coal was thus a key decarbonisation strategy. For the Ministry of Energy and Mineral Resources (ESDM), its overriding policy objective for the power sector was to ensure affordability of electricity.[15] The transition to low-carbon economy also raised fears about the challenges for the country's energy systems and the impact on Indonesia's pandemic-battered economy. According to Bappenas, Indonesia's national development planning agency, becoming carbon neutral by 2060 could cost some US$150-200 billion a year from 2021 to 2030, and even more in subsequent years.[16]

At the same time, Indonesia is rich in renewable energy sources. In terms of potential energy, it had the world's largest geothermal energy (23.9 GW), hydropower of more than 94 GW, solar energy of 208 GW, wind energy of 60.6 GW, ocean and tidal energy of 17.9 GW, as well as biomass potential of more than 32.6 GW, and a biogas potential of 200,000 barrels per day (*Figure 2*).[17] Energy policy and planning was spread across a number of ministries and public sector organisations. The 2014 National Energy Policy (KEN), formulated by the National Energy Council (DEN),[18] set out overall plans to grow the share of renewable and new energy to at least 23% of the primary energy mix by 2025 (31% by 2050), alongside minimum 30% (25% in 2050) for coal, minimum 22% (24% by 2050) for gas, and less than 25% (20% by 2050) for oil.[19] Under the National General Energy Plan (RUEN) which was also under the purview of DEN, the electricity generation target for renewables was 45 GW by 2024, and 168 GW by 2050 (*Figure 2*).[20] In addition, Bappenas was responsible for coordinating and monitoring national development and budget planning for the energy sector and the national action plan on GHG reduction.

Indonesia expected to largely decarbonise its power sector by 2050 through a massive deployment of renewables (hydro, geothermal, solar, wind, biomass), while equipping its coal power plants and biomass-coal co-firing power plants with carbon capture and storage technologies.[21] Specifically for the electricity sector, ESMD's National Electricity Plan (RUKN) set a long-term goal for new and renewable energy to generate 28%, coal 47%, gas 25%, and oil 0.1%, of electricity supply.[22] Under a more ambitious scenario aligned to the Paris Agreement, renewables could form an even higher share of 43%, while coal and natural gas would be reduced

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[13] "Indonesia's Renewable Energy Has Great Potential, President Jokowi Says", Cabinet Secretary of the Republic of Indonesia, November 22, 2021, https://setkab.go.id/en/indonesias-renewable-energy-has-great-potential-president-jokowi-says/

[14] "President Jokowi Reveals Three Big Challenges in Just Energy Transition", Cabinet Secretariat of the Republic of Indonesia, March 17, 2022, https://setkab.go.id/en/president-jokowi-reveals-three-big-challenges-in-just-energy-transition/

[15] Asian Development Bank, *Renewable Energy Tariffs and Incentives in Indonesia – Review and Recommendations* (Mandaluyong City: ADB, September 2020), 5, https://www.adb.org/sites/default/files/publication/635886/renewable-energy-tariffs-incentives-indonesia.pdf

[16] Shotaro Tani, "Indonesia needs $200bn a year until 2030 for net-zero emissions", *Nikkei Asia*, October 20, 2021, https://asia.nikkei.com/Spotlight/Environment/Climate-Change/Indonesia-needs-200bn-a-year-until-2030-for-net-zero-emissions#:%7E:text=JAKART%E2%80%A6

[17] Asian Development Bank, *Indonesia Energy Sector Assessment,* 3.

[18] DEN is chaired by the Minister of Energy and Mineral Resources.

[19] Republic of Indonesia, *Updated Nationally Determined Contribution 2021*, July 21, 2021, 6, https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Indonesia%20First/Updated%20NDC%20Indonesia%202021%20-%20corrected%20version.pdf

[20] Ministry of Development Planning (Bappenas), *Low Carbon Development: A Paradigm Shift Towards a Green Economy in Indonesia*, March 2019, 61, https://www.un-page.org/files/public/low_carbon_development-_a_paradigm_shift_towards_a_green_economy_in_indonesia_1.pdf

[21] Republic of Indonesia, *Indonesia Long-Term Strategy*, 57.

[22] Asian Development Bank, *Indonesia Energy Sector Assessment*, 3.

– but still significant – to 38% and 10%, and bio-energy and carbon capture and storage 8%, of the power generation mix by 2050.[23]

This shift was also reflected in the latest ten-year power supply plan, RUPTL 2021-2030, issued annually by PLN (*Figure 2*). This RUPTL was touted as the 'greenest' to date as it marked the first time renewables would account for half (21 GW) of total additional power generation capacity (40.6 GW) in Indonesia.[24] In particular, Java-Madura-Bali and Sumatra regions would see the highest addition of hydropower capacity, while Jamali and the eastern islands of Moluccas, Papua, and the Nusa Tenggara would have the largest addition of solar photovoltaics (PV). Moreover, with coal financing falling out of favour internationally, the Indonesia's energy ministry announced in May 2021 an end to new approvals for coal-fired power plants, although those under construction or had already achieved financial closure would be allowed to continue.[25]

Figure 2: Existing, targeted and potential capacities for renewable energy in Indonesia

	Current capacity	PLN: RUPTL 2018–2027	National General Energy Plan (RUEN)	Potential (GW or as noted)
Overall targets				
Primary Energy Mix			23% by 2025, 31% by 2050	
Electricity sector	12.45%	23% (by 2027)	45GW by 2025, 168GW by 2050	
Sector-specific targets for electricity	**Current capacity (GW)**	**Capacity by 2027 (GW)**	**Capacity by 2025 (GW)**	
Geothermal	1.4	4.6	7.2	29
Large hydropower (>10 MW)	5.3	7.5	17.9	75
Small hydropower (<10 MW)	0.323	0.8	3.0	
Solar PV	0.1921	1.0	6.5	207.8 GW
Wind	0.0083	0.6	1.8	60.6
Bioenergy	1.7	0.4	5.5	32.6
Others	0	0	3.1	17.9
Total	**8.9**	**14.9**	**45**	**423**
Biofuels			**Blending (%)**	
Biodiesel	12.1 million KL/year			
Transportation			30	
Industry			30	
Electricity			30	
Ethanol	40,000 KL/year			
Transportation			20	
Industry			20	
Aviation blending	0		2	

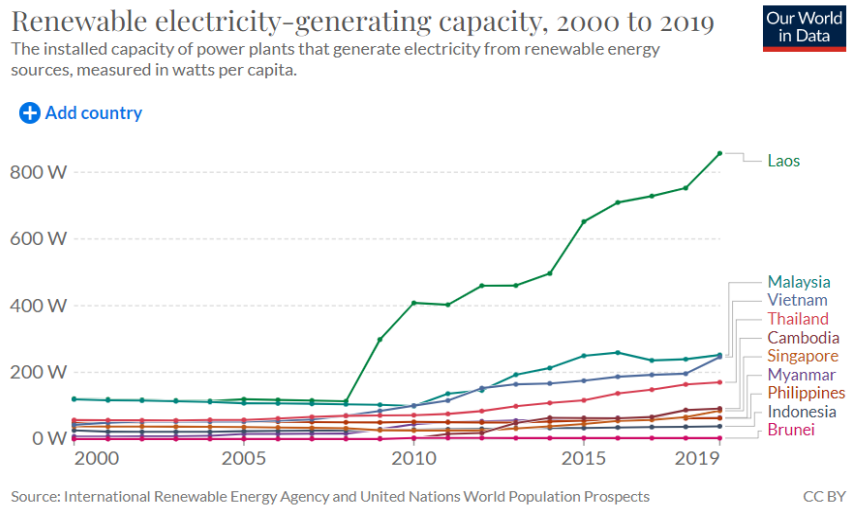
Source: Ministry of Development Planning (Bappenas), *Low Carbon Development: A Paradigm Shift Towards a Green Economy in Indonesia*, March, 2019, 61.

In reality, the government's renewable energy targets faced much uncertainty. An International Monetary Fund report on Indonesia assessed that "given the need to increase electric generation capacity to meet the needs of a growing economy, it seems uncertain that this target can be reached under current plans".[26]

[23] Republic of Indonesia, *Indonesia Long-Term Strategy*, 58.
[24] OECD, "RUPTL 2021-30: PLN steps up ambitions to accelerate clean energy investments in Indonesia", November 16, 2021, https://www.oecd.org/environment/cc/cefim/indonesia/RUPTL-2021-30-PLN-steps-up-ambitions-to-accelerate-clean-energy-investments-in-Indonesia.pdf
[25] "Indonesia to halt approval of new coal-fired power", *Argus*, May 31, 2021, https://www.argusmedia.com/en/news/2220098-indonesia-to-halt-approval-of-new-coalfired-power
[26] International Monetary Fund, "Indonesia: Selected Issues", IMF Staff Country Reports 2021 no. 47 (March 2021): 106, https://doi.org/10.5089/9781513570860.002

Renewables accounted for only about 12.2% of total electricity generation between 2015 to 2019, and even less in terms of the primary energy mix.[27] Capacity in renewables was also growing slowly. In 2019, Indonesia's electricity generation capacity in renewables was close to 9 GW, mostly from hydro and geothermal sources.[28] This had increased to only 10.49 GW in 2020.[29] On a per capita basis, Indonesia's renewable electricity-generating capacity was one of the lowest in Southeast Asia in 2019 (*Figure 3*).

Figure 3: Renewable electricity-generating capacity among ASEAN member countries



Source: "Renewable electricity-generating capacity, 2000 to 2019", *Our World in Data*.

However there were reasons for optimism for renewables in Indonesia. A 2021 study argued that achieving zero emissions in the energy sector (power, transport and industrial heat) by 2050, with renewables as a key pillar, was both technically and economically possible.[30] Moreover, the cost gap between fossil fuels and renewables like solar PV was also shrinking. For instance, some studies predicted that new solar PV in Indonesia would become cheaper than new coal plants by 2021, and cheaper than existing coal plants by 2028.[31] Despite Indonesia's natural advantages, other than some hydropower and geothermal projects, why had renewables been so slow to take off?

Challenges for renewables

There were several challenges to ramping up renewables in Indonesia. Though not insurmountable, there were some technical constraints and geographical limitations to the deployment of renewables in Indonesia. Some renewable energy resources like wind were unevenly distributed across the country. As a sprawling archipelago, Indonesia would also have to operate distributed power, such as small electricity grids and off-grid systems, instead of large centralised system to meet electricity demand throughout the country. While larger grids such as Java's could better accommodate intermittent output from large-scale renewable generation, geographical factors such as a lack of wind resources could negate the deployment of renewables at such sites. At the same time, the shift to renewables could also at risk due to climate change itself. For instance, hydropower could be affected by changes in rainfall and river discharge patterns.

[27] IESR, Agora Energiewende and LUT University, *Deep decarbonization of Indonesia's energy system: A pathway to zero emissions by 2050* (Jakarta: Institute for Essential Services Reform, 2021), 8.
[28] Ministry of Development Planning (Bappenas), *Low Carbon Development*, 60.
[29] IESR, Agora Energiewende and LUT University, *Deep decarbonization*, 8.
[30] IESR, Agora Energiewende and LUT University, *Deep decarbonization*.
[31] Matt Gray, Irem Kok, Sebastian Ljungwaldh, & Laurence Watson, *Economic and financial risks of coal power in Indonesia*, October 29, 2018, https://carbontracker.org/wp-content/uploads/2018/10/economic-and-financial-risks-of-coal-power-in-Indonesia-Vietnama-and-The-Philippines.pdf?lang=es

A bigger problem that potential renewables developers and investors had to deal with was the frequent changes to policies on renewables, regulatory delays, and patchy policy implementation, which undermined investor confidence and increased project risks. The private sector, rather than PLN, was expected to lead Indonesia's shift towards renewables. The latest RUPTL 2021-30 allocated 56% (11.8 GW) of renewable power capacity addition for development by independent power producers (IPP), and the remaining 44% (9.1 GW) to be developed by PLN. Among many renewables developers and potential investors however, renewables and investment policies in Indonesia were seen to 'change rapidly'.[32] Long-drawn negotiations of power purchase agreements and other regulatory hurdles, such as cancellation of proposed feed-in tariff rates and capping of power purchase prices, could delay projects significantly and create uncertainty for developers. In the case of geothermal, a 2017 regulation required a geothermal resource to be proven before a power purchase agreement could be negotiated, giving the private sector little incentive to invest upfront in high-cost and high-risk geothermal exploration in the first place.[33] Less investor-friendly policies included restrictions on ownership, such as a requirement for some power generation projects to be jointly owned projects with PLN holding a 51% share.[34] Other sectoral policies added hurdles for investors. For instance, Ministerial Decree 5/2017 raised local content requirements from 40% in 2017 to 60% in 2019, which increased costs for solar developers as local solar panel manufacturing was not yet internationally competitive.[35]

Another crucial factor in attracting private sector participation was the power purchase prices set by the government. Various feed-in tariffs had been proposed in Indonesia in earlier years. PLN was however reluctant to purchase power above that of the lowest financial cost which under prevailing circumstances, was usually coal-fired power.[36] Under the current processes, PLN received financial subsidies annually from the Ministry of Finance which did not provide clarity on how much renewable energy it could buy beyond the next year.[37] Unlike some countries which implemented renewable energy surcharges, PLN also had little leeway to recover additional costs incurred in purchasing renewable energy.

The introduction of Regulations 12/2017 and 50/2017 attempted to ease the financial burden on PLN, and corresponding government subsidies required, by capping renewable power purchase prices at 85% of the historical local average generation cost (BPP).[38,39] However the price cap was viewed by renewables developers and investors as setting power purchase prices too low, making renewable projects financially unviable and acting as a disincentive to the private sector.[40] There were some attempts to implement competitive auctions for renewable projects, but with little success so far. For instance, a large-scale reverse auction organised in 2013 for 140 MW of solar PV was cancelled when foreign bidders' practice of using only imported components was deemed unconstitutional.[41]

Politically, there was a pressing need to keep domestic energy prices under control through state energy subsidies for electricity, diesel and liquefied petroleum gas. Electricity tariffs in Indonesia covered about 86%

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[32] Richard Bridle, Philip Gass, Aidy Halimajaya, Lucky Lontoh, Neil McCulloch, Erica Petrofsky and Lourdes Sanchez, *Missing the 23 Per Cent Target: Roadblocks to the development of renewable energy in Indonesia* (International Institute for Sustainable Development, 2018), 9, https://www.iisd.org/publications/report/missing-23-cent-target-roadblocks-development-renewable-energy-indonesia

[33] Bridle et. al., *Missing the 23 Per Cent Target*, 15.

[34] Bridle et. al., *Missing the 23 Per Cent Target*, 16.

[35] Bridle et. al., *Missing the 23 Per Cent Target*, 9.

[36] Asian Development Bank, *Renewable Energy Tariffs*, 5.

[37] Bridle et. al., *Missing the 23 Per Cent Target*, 6-7.

[38] The BPP was calculated at the provincial level, and did not differentiate between areas within a region with main grid connection and those without. In the latter case, the main grid rate would be applied.

[39] Ministry of Development Planning (Bappenas), *Low Carbon Development*, 61.

[40] Bridle et. al., *Missing the 23 Per Cent Target*, 8.

[41] Paul J. Burke, Jinnie Widnyana, Zeba Anjum, Emma Aisbett, Budy Resosudarmo, and Kenneth GH Baldwin, "Overcoming barriers to solar and wind energy adoption in two Asian giants: India and Indonesia", *Energy Policy* 132 (2019): 1216-1228.

of power production costs, with the government forking out about US$4 billion a year to cover the shortfall.[42] PLN was thus under pressure to keep its electricity procurement costs down. Fossil fuels, especially coal, were still seen as cheap and reliable energy sources, at least in the short term. Between 2005 and 2019, Indonesia developed 25 GW of coal-fired power plants,[43] while another 27 GW of coal-fired generation was planned for 2019 to 2028.[44] Despite its shrinking role, coal would remain a significant energy source across the various national energy and electricity policies and plans. Moreover, fossil fuel interest entrenched in the country were difficult to dislodge and could resist wider deployment of renewable energy systems. For instance, coal was not only an important sector domestically, it was also a key export commodity for Indonesia which had become the world's top thermal coal exporter. In more remote and rural areas, diesel generators dominated electrification, even though renewables could be more cost-effective.

The positive externalities, such as lowering carbon emissions and air pollution, associated with renewables was also not priced in, putting renewables at a substantial financial cost disadvantage compared to fossil fuels like coal. Moreover, given the importance of the coal industry to the Indonesian economy, the coal industry received significant government support and subsidies, such as loan support, tax exemptions, and price guarantees. This disparity was especially stark considering that the power purchase prices for renewables were linked to the BPP which was in turn determined by existing fossil fuel-dependent power generation. One way to address this was to introduce a carbon tax. In October 2021, Indonesia announced a new levy – to be rolled out in Aril 2022 – on coal power plant operators set at 30,000 rupiah (US$2.09) per tonne of carbon dioxide equivalent (CO2e) for emissions above a set limit. In the face of surging energy prices in March and April however, news came that the government had decided to delay the levy roll-out to July 2022.[45]

The concentration of market power in PLN itself was another a concern. Although PLN was expected to develop 44% of new renewable power capacity, it was financially strapped and could be reluctant to directly develop capacity in renewables-generation. Not only did PLN have to invest in electricity generation, investment needs for transmission and distribution were also pressing. Between 2021 and 2030, PLN's investment needs were estimated at US$9.14 billion per year, 60% more than actual spending in 2019.[46] PLN itself owned and operated about 54% of Indonesia's coal power capacity in 2016, raising fears that it could be saddled with stranded assets.[47] There are possible conflicts of interest in PLN's role in some cases as both purchaser of power and fuel supplier to power generation projects.[48]

In the short term at least, despite the moratorium on new coal-fired plants, the Indonesia government looked set to continue investing in coal capacity. How could Indonesia better develop its untapped potential in renewables?

[42] "Ten ways to boost Indonesia's energy sector in a postpandemic world", McKinsey & Company, December 16, 2020, https://www.mckinsey.com/industries/oil-and-gas/our-insights/ten-ways-to-boost-indonesias-energy-sector-in-a-postpandemic-world
[43] IESR, Agora Energiewende and LUT University, *Deep decarbonization*, 9.
[44] Asian Development Bank, *Indonesia Energy Sector Assessment*, 21.
[45] Linda Yulisman, "Indonesia delays carbon tax till July to help economic recovery", *The Straits Times*, March 30, 2022, https://www.straitstimes.com/asia/se-asia/indonesia-delays-carbon-tax-till-july-to-help-economic-recovery#:~:text=Indonesia%2C%20the%20world's%20eighth%20biggest,market%20to%20begin%20in%202025.
[46] OECD, "RUPTL 2021-30".
[47] Bridle et. al., *Missing the 23 Per Cent Target*, 15.
[48] Bridle et. al., *Missing the 23 Per Cent Target*, 11.