FULL REPORT

THE GREEN RESET:

ENHANCING AMBITION FOR EMISSION REDUCTION FROM THE ENERGY SECTOR IN POST-PANDEMIC INDONESIA

DECEMBER 2021

19,94 atau 25,37 $MtCO_2e$

net sink pada 2060 bila emisi net zero dicapai pada 2050 atau 2045, lebih rendah daripada bila emisi net zero dicapai pada 2060.

6,4 persen

pertumbuhan ekonomi rata-rata 2031-2060 bila pencapaian emisi net zero dipercepat dari 2060 menjadi 2050 atau 2045, lebih tinggi daripada 6,0 persen bila dicapai pada 2060.

Rp95,1 juta atau Rp97,5 juta

pendapatan masyarakat per kapita pada 2060 bila pencapaian emisi net zero dipercepat dari 2060 menjadi 2050 atau 2045, lebih tinggi daripada Rp85,6 juta bila dicapai pada 2060.

3,3 atau 3,8 persen

tingkat pengangguran pada 2060 bila pencapaian emisi net zero dipercepat dari 2060 menjadi 2050 dan 2045, lebih rendah dari 5 persen bila dicapai pada 2060.

Rp2,7 ribu triliun

tambahan investasi per tahun untuk mencapai emisi net zero pada 2060 dibandingkan BAU.

Rp3 ribu triliun

tambahan investasi per tahun untuk mempercepat pencapaian emisi net zero dari 2060 ke 2050.

Rp5,8 ribu triliun

tambahan investasi per tahun untuk menpercepat pencapaian emisi net zero dari 2060 ke 2045.

Background

To keep global heating well below 2 degrees Celsius (°C) and not to exceed 1.5 °C, global emissions need to reach net zero by mid-century. The Paris Agreement has committed the world to inasmuch as possible keep the global heating not to exceed 1.5 °C, but at least well under 2 °C.[1] This requires a massive reduction of emissions from today that will peak at least by 2030, and eventually to reach net zero by mid-century. In order to achieve it, the world needs to start transformational actions as soon as possible.[2] Countries around the world also need to enhance their emission reduction commitments to be consistent with the objective of the Paris Agreement.[3]

1 UNFCCC (United Nations Framework Convention on Climate Change), 2015. The Paris Agreement, UNFCCC Decision No. FCCC/CP/2015/10/Add.1.

2 IPCC (Intergovernmental Panel on Climate Change), 2021 (in press). "Summary for Policymakers", in Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.), Climate Change 2021: The Physical Science Basis, Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge.

3 UNFCCC, 2021a. Nationally determined contributions under the Paris Agreement: Revised synthesis report by the secretariat, Document No. FCCC/PA/CMA/2021/8/Rev.1 (October 25, 2021); UNEP (United Nations Environent Program), 2021. The Heat Is On: A World of Climate Promises Not Yet Delivered. United Nations Environment Program, Nairobi.

To reach net zero emission target by 2060 or earlier, Indonesia needs a comprehensive road map for a transition from fossil fueled energy system to renewable energy, to be well prepared prior to the G20 Summit in Bali, October 30-31, 2022. This request has been made by the Indonesian Presiden Joko "Jokowi" Widodo at the plenary cabinet meeting as well as a special meeting with senior executives of among the most strategic state-owned energy companies, Pertamina and State-Owned Electricity Company (Perusahaan Listrik Negara, PLN).[4] The Presiden requested that prior to the aBali G20 Summit the road map shows comprehensively the action plan, how it affects Indonesian economy, the required investments, including the gaps that remain in financing the transition, and possibly how the additional financing can be raised.[5] Indonesian ambition to reach net zero emissions have been considerably strengthened especially after the President attended the G20 Summit in Rome, Italy, followed immediately by the 26th Conference of the Parties (COP26) of the United Nations Framework Convention on Climate Change (UNFCCC) in Glasgow, the United Kingdom, recently.[6]

Indonesia's position as Chair of the G20, the group of the largest economies in the world, is immensely strategic. The President stressed that G20 needs to be an example for other countries. G20 also needs to be a catalyst for green recovery. Indonesia can contribute its strategic position to the global efforts to address and solve the climate crisis.[7]

4 "Jokowi Minta Komitmen RI Sulap PLTU Jadi EBT Benar-benar Jalan", CNN Indonesia (17 November 2021); Fajrian, H., 2021. "Jokowi Minta PLN dan Pertamina Tak Menunda Transisi Energi", Katadata (November 20, 2021).

5 Umah, A., 2021. "Jokowi Minta Roadmap EBT-Setop PLTU Tuntas Sebelum G20 2022", CNBC Indonesia (November 22, 2021).

6 Susanto, V.Y., 2021. "COP26 Glasgow, Jokowi sampaikan komitmen Indonesia dalam penanganan perubahan iklim", Kontan (November 2, 2021).

7 "President Jokowi: Indonesia Wants G20 to Set Example in Handling Climate Change", Cabinet Secretariat of the Republic of Indonesia (https://setkab.go.id/en/president-jokowi-indonesia-wants-g20-to-set-example-in-handling-climate-change/, accessed on November 29, 2021)

The Climate Crisis and the Urgency of Energy Transition in Indonesia

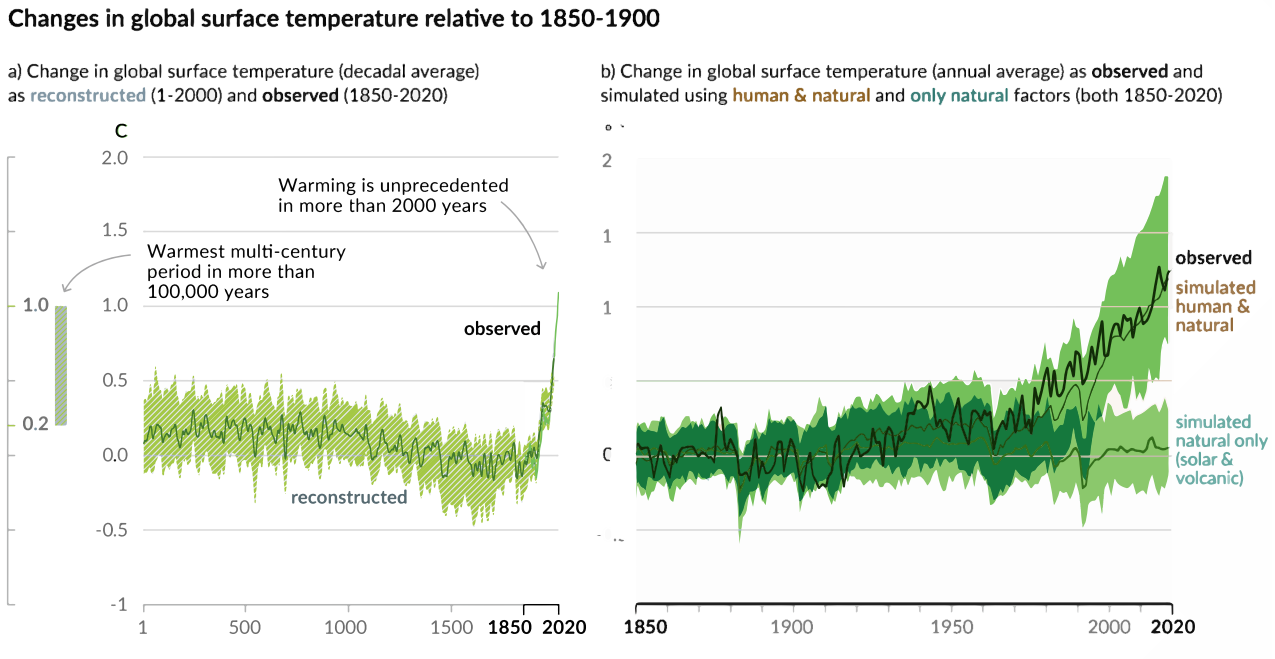


Figure 2.1. Changes in global surface temperature relative to 185-1900. We are currently more than 1 °C hotter.
Source: IPCC, 2021.

"A code red for humanity", Antonio Guterrez was quoted as saying, commenting on the latest report on the climate crisis. The Secretary General of the United Nations (UN) was responding to the Science Basis of the Sixth Climate Change Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) in September 2021 that notes that the world is at least 1.1 degrees Celsius (°C) hotter than that compared with the preindustrial era in the middle of the 1800s, and the window of opportunity to halt the heating not to exceed 1.5 °C — as stated as the objective of the Paris Agreement — is swiftly closing.[8] There is a need for transformational ambitions and actions, as recognized in the Glasgow Climate Pact, in mitigation, adaptation, and financing.[9]

The world needs to reach net zero emissions by mid-century. In 2015, the world adopted the Paris Agreement, which ultimate objective is to keep the global heating well below 2 °C and not to exceed i.5 °C.[10] To acheve this, the cumulative carbon "budget" needs to be kept no more than 580 GtCO2e with 50 percent probability and 420 GtCO2e with two-thirds probability, which then requires global emissions to reach net zero in the next 30 years or 20 years, respectively, or earlier, and reached its peak by 2030 or earlier — about 10 years from now.[11]

The world requires enhanced ambition to radically reduce emissions. Current commitments to limit emissions, however, remain far from sufficient to reach the peaking, the net zero emissions target, and overall the temperature targets in time. Prior to COP26 in Glasgow, the world was committed to limiting emissions that commensurate to about 2.7 °C increase of temperature.[12]

8 McGrath, M., 2021. "Climate change: IPCC report is 'code red for humanity'", BBC News (9 Agustus 2021); IPCC, 2021, op cit.

9 UNFCCC, 2021b. Glasgow Climate Pact.

10 UNFCCC, 2015, op cit.

11 IPCC, 2021, op cit.

12 UNFCCC, 2021, op cit; UNEP, 2021, op cit.

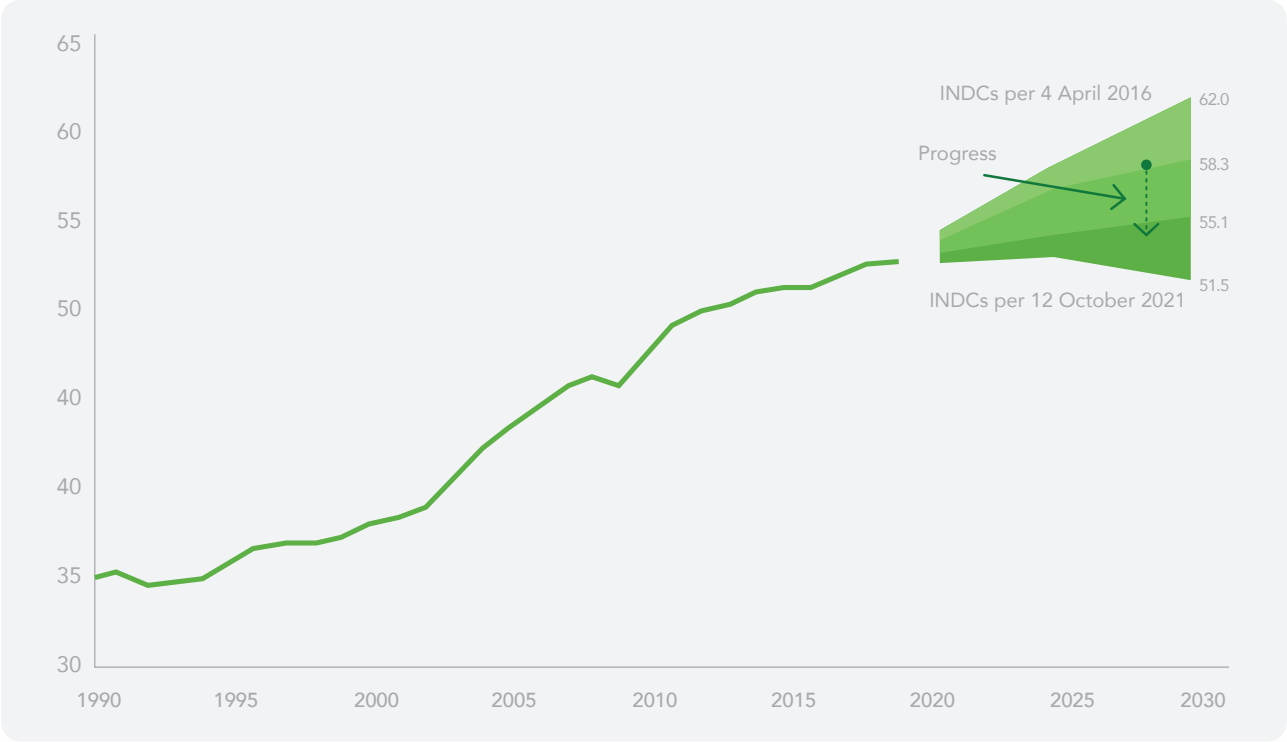


Figure 2.2. Emissions in billion tons (gigatons) of carbon dioxide equivalent (GtCO2e) using Global Warming Potential (GWP) of 100 years from the Sixth Climate Change Assessment Report (IPCC, 2021), and the contributions of the emission limitations from all countries in the world.

After Glasgow, with new commitments being announced, it might have progressed to about 1.8 °C.[13] Still, stronger commitments are needed globally by all countries in the world.[14]

Indonesian commitment to limit its emissions is strong but still needs to be enhanced. Indonesia has ratified the Paris Agreement through Law No. 16/2016. And through its Nationally Determined Contribution (NDC) under the Paris Agreement, Indonesia has committed to limiting its emissions by 29 percent below its otherwise business-as-usual (BAU) with own resources and enhanced to 41 percent with international assistance.[15] The Climate Action Tracker however considers this commitment (excluding the forestry sector) as highly insufficient.[16] More recently, however, Indonesia has also announced its commitment to reach net zero emissions economy-wide by 2060 or earlier, showing considerable increase in ambition.[17] Emissions in the energy sector will surpass that of the currently dominant forestry sector.

13 IEA (International Energy Agency). 2021a. World Energy Outlook 2021: Technical note on the emissions and temperature implications of COP26 pledges (November 2021). International Energy Agency, Paris; Birol, F., 2021. "COP26 climate pledges could help limit global warming to 1.8 °C, but implementing them will be the key", Commentary. International Energy Agency (4 November 2021).

14 Boehm, S., K. Lebling, K. Levin, H. Fekete, J. Jaeger, A. Nilsson, R. Wilson, A. Geiges, and C. Schumer, 2021. State of Climate Action 2021: Systems Transformations Required to Limit Global Warming to 1.5 °C. World Resources Institute, Washington, D.C.

15 The Government of the Republic of Indonesia (RI), 2016. Undang-Undang No. 16/2016 mengenai Pengesahan Paris Agreement to the United Nations Framework Convention on Climate Change (UNFCCC) (Persetujuan Paris atas Konvensi Kerangka Kerja Perserikatan Bangsa-Bangsa mengenai Perubahan Iklim) (25 Oktober 2016). Law No. 16/2016 on the ratification of the Paris Agreement to the UNFCCC.

16 Climate Action Tracker, "Indonesia", https://climateactiontracker.org/countries/indonesia/ (accessed on December 5, 2021). The commitment reviewed excludes the forestry sector.

17 Rosana, F.C., 2021. "Luhut Sebut RI Targetkan Nol Emisi Karbon pada 2060 atau Lebih Cepat", Tempo (4 November 2021).

The emissions limitation in the energy sector will be achieved mainly through increasing the share of renewables in the national energy mix to 23 percent by 2025 and 31 percent by 2050, as well as other policies such as the establishment of carbon price through tax, levies, and carbon markets, expansion of electric transportation system, and others.[18]

The questions remain: will Indonesia be able to reach net zero emissions earlier than 2060? What is the impact on the Indonesaian economy? How much additional investments that are required to enhance Indonesia's ambition and to accelerate the achievement of the net zero emission target? What is the best structure to raise the needed financing? These questions need to be properly and adequately answered before the G20 Summit in October 2022.

18 RI, 2014. Government Regulation No. 79/2014 on the National Energy Policy.

The Great Reset:

Resetting the World's Economy

Covid-19 pandemic has led to deep recession. Ever since the corona virus was found in Wuhan, China, in January 2020, the world has not been the same, probably ever. The virus quickly spread and government responded rapidly by limiting activities, interactions, and mobility, causing the economy to enter into among the worst recessions.[19] Real Gross Domestic Product (GDP) fell by negative 3.3 percent in 2020 compared to 2019.[20] By the end of 2021, the world appeared to have begun to recover with real GDP growth back to positive 5.9.[21] The emergence of the Omicron variant may slightly delay the full recovery.

The Covid-19 pandemic has thwarted Indonesia's development progress. 2019 was a very promising year in the journey of Indonesia's economic development.

19 Mou, J., 2020. "Research on the Impact of COVID19 on Global Economy", Earth and Environmental Science 546 (2020).

20 IMF (International Monetary Fund). IMF Datamapper (https://www.imf.org/external/datamapper/profile/WEOWORLD, accessed on December 28, 2021).

21 IMF. IMF Datamapper, World (https://www.imf.org/external/datamapper/profile/WEOWORLD, accessed on December 28, 2021).

Poverty has been reduced to less than 10 percent, which was the lowest in history.[22] Indonesia was also moved up from a lower middle-income to become an upper middle-income country.[23] But the 2020-2021 pandemic caused a long recession. In 2020, the economy contracted, and real GDP growth fell, although by 2021 it was back to 3.2 percent, and in 2022 it is expected to be back at the pre-pandemic level at 5.9 percent.[24] The recession had quite a devastationg impacts on the Indonesian people. It has been estimated that about a quarter, even more, of Indonesians went back into poverty.[25]

The National Economic Recovery Program (Program Pemulihan Ekonomi Nasional, PEN) was initiated to bring Indonesia out of the recession. The world's economy is going through a "great reset".[26] President Jokowi used the analogy that the economy is akin to a computer that is currently freezing that requires a reset to bring it back to life.[27] Starting from the second quarter of 2020 that showed a year-on-year contraction of -5.32 percent to the first quarter of 2021 that still showed a contraction of -0.71 percent, the recession took quite an extended period.[28] To protect and heal from the pandemic, to shield the people from the recession, and to stimulate the economy to get out of the economy,

22 Pratama, A.M., 2018. "Sri Mulyani: Angka Kemiskinan di Bawah 10 Persen Pertama Kalinya dalam Sejarah Indonesia", Kompas (17 Juli 2018).

23 Jayani, D.H., 2020. "Ekonomi Indonesia Naik Kelas", Katadata (10 Juli 2020).

24 International Monetary Fund. IMF Datamapper, Indonesia (https://www.imf.org/external/datamapper/profile/IDN, accessed on December 28, 2021).

25 UNICEF (United Nations Children Fund), UNDP (United Nations Development Program), Prospera (Australia Indonesia Partnership for Economic Development), and SMERU, 2021. Analysis of the Social and Economic Impacts of COVID19 on Households and Strategic Policy Recommendations for Indonesia. United Nations Children Fund, Jakarta.

26 "The Great Reset", World Economic Forum (https://www.weforum.org/focus/the-great-reset, diakses pada 26 November 2021).

27 "Jokowi Sebut Ekonomi Negara Mirip Komputer 'Hang'", CNN Indonesia (14 Agustus 2020).

28 BPS (Badan Pusat Statistik), 2021. Berita Resmi Statistik (5 November 2021).

	2020		2021			2022
	Budget	Realized	Budget	Revised Budget	Realized	Budget
Health support	99.5	63.51	176.31	214.96	198.5	122,5
Social safety net	230.21	220.39	157.41	186.64	171	154,8
Priority programs	67.86	66.59	125.18	117.94	105.4	178,3*
Support for micro, small, and medium-scale enterprises.	236.91	173.57	186.82	162.4	116.2	
Incentives for businesses	62.2	56.12	53.85	62.83	67.7	
	696,68	580,18	699,6	744,8	658,8	455,62

Tabel 3.1. Summary of the budget and realization of PEN, 2020-2022. **Source:** Ministry of Finance and other sources. **Note:** figures are in trilliun rupiah, (*) includes both the SMEs and priority programs.

the government issued the Government Regulation No. 23/2020 on the National Economic Recovery.[29] Since its enactment, Rp1,238.98 trillion ($85 billion, more than half of the government's yearly budget) excluding what has been realized in 2022, out of the Rp1,897.05 trillion ($130.8 billion) budgeted, have been spent on recovery. In 2022, Rp455.62 trillion ($31.42 billion) has been budgeted. About one quarter of which was to pay for some arrears due to increased hospitalization caused by the Delta wave in 2021.[30] Quite a significant amount of the PEN funding was spent in 2021 due to the variant Delta wave. The 2021 budget was revised to reflect the increased need for health support.

The budget for health support was increased by 22 percent, social safety net was increased by 19 percent, and the overall budget was increased by 6.5 percent. Even so, some of the hospital bills amounting somewhere between Rp80 – Rp100 trillion ($5.5 - $6.8 billion) was carried over to be included in the 2022 budget.

The fulfillment of short-term requirements to address the pandemic and the following recession should be done in parallel with the fulfullment of medium- and long-term commitments to address the climate crisis. Unfortunately, the share of green recovery in PEN is miniscule. Early estimates show that 10 percent of the total 2020-2021 budget for PEN has relevance to climate crisis. However, after closer look, the share of the green recovery was only about 0.12 percent (2020) and 0.3 percent (2021) of the total budget under PEN.

Obviously, this is too modest. Even an allocation of 10 percent would only cover about 8 percent of the total investment required until 2025, and only about 0.04 percent until 2060. The economic recovery budget under PEN could have been strategic as a leverage for green investment to reach net zero by 2060 or earlier.

29 RI, 2020. Peraturan Pemerintah No. 23/2020 tentang Pelaksanaan Program Pemulihan Ekonomi Nasional dalam Rangka Mendukung Kebijakan Keuangan Negara untuk Penanganan Pandemi Corona Virus Disease 2019 (COVID-19) dan/atau Menghadapi Ancaman yang Membahayakan Perekonomian Nasional dan/atau Stabilitas Sistem Keuangan serta Penyelamatan Ekonomi Nasional (Government Regulation No. 23/2020 on the Implementation of the National Economic Recovery Program to Support the State's Financial Policy to Address the Corona Virus Disease 2019 (Covid-19) and/or to address the Dire Threat to the National Economy and/or the Stability of the Financial System and the Rescue of the National Economy.

30 "Menkeu: Kebijakan PEN 2022 Responsif dan Fleksibel", Kementerian Keuangan (18 Agustus 2021) (https://www.kemenkeu.go.id/publikasi/berita/menkeu-kebijakan-pen-2022-responsif-dan-fleksibel/, accessed on November 28, 2021).


200
200
EURO
PEER TO PEER
DECENTRALIZED
CRYPTOCURRENCY
BITCOIN

The Green Reset:

Building Back from the Resession with Enhanced Ambition

Stimulating the economy out of recession can be carried out while achieving mid- and long-term objectives for sustainability. Typically, a pandemic response includes increased support for public health services, support for affected sectors, regions, and socio-economic groups, and stimulus for sectors that have strategic and significant multiplier effects to bring the rest of the economy out of recession. This includes maintaining the level of consumption, or at least to keep it not to slump too deeply. Both fiscal measures such as tax cut, increased subsidies, and financial measures as simple as handing direct cash transfers can both be employed. The consolidation of short term needs to get out of recession and keeping the development trajectory consistently towards sustainability can be achieved when the stimulus package is strategically allocated to foster the right sectors.

The pandemic has caused massive recession, but a sufficiently large amount of stimulus budget has been allocated worldwide that could facilitate transition to clean energy. Fifty largest economies have committed about $14.6 trillion for post-pandemic recovery in 2021, up from $11.8 trillion that the world committed in 2020.[31] This amount actually dwarfs the investments needed to facilitate the world to clean energy system.[32] But out which, only less then one fifth has been allocated in the right sectors that foster green, instead of dirty, sectors. Only 2.5 percent of the entire support and 18 percent of the "green" portion of the stimulus budget will effect emission reductions except only a few.[33] There simply is not enough climate action in the world's stimulus plans.[34]

Some countries have shown leadership in green recovery. EU member countries are committed to allocating 37 percent of their recession recovery budgets for green recovery. The European Union's Next Generation EU (NGEU) Fund supports economic recovery by investing in green incentives that leads to net zero emissions and zero pollution by 2050. Carbon border adjustment mechanism (CBAM) will also be imposed on imported goods into the EU which production processes are taxed at different levels compared with that in the EU. A $113 fund is made available for vulnerable regions in Europe.[35] The Korean New Deal, a consolidation between the Green New Deal and the Digital New Deal is focused on green infrastructure transition, low carbon energy supply, and green industrial innovation, and is expected to create 1.9 million new jobs. About $145 billion is made available with $66.7 billion (about 45 percent) is allocation for the Green New Deal.[36] Meanwhile, Turkey may actually be the only country that commits to 100 percent green recovery. Poland introduced green investment in June 2020 that includes investments in clean air and solar energy, in addition to economic recovery with about $2 billion budget. Sweden invests in energy efficient buildings, wetland restoration, low emission transportation, and shifting of tax system that allows for increasing environmental taxes while reducing income and corporate taxes. Denmark released a plan to reduce emissions, invest in green energy, and increase energy efficiency in May 2021. Norway announced a green plan in May 2020. But its $380 million budget to reduce emissions was heavily criticized as it was considered too small compared to its support to the oil industry.

31 Fleming, S. ,2021. "These countries are leading the way on a post-pandemic green recovery", (April 29, 2021) *World Economic Forum*. World Economic Forum, Geneve; Dagnet, Y. and J. Jaeger, 2020. "Not Enough Climate Action in Stimulus Plans", *World Resources Institute* (September 15, 2020). World Resources Institute, Washington, D.C.

32 Andrijevic, M., C-F., Schleussner, M.J. Gidden, D.L. McCollum, and J. Rogelj, 2020. "COVID-19 recovery funds dwarf clean energy investment needs", Science 370, pp. 298–300.

33 Fleming, 2021, op cit.

34 Dagnet, Y. and J. Jaeger, 2020, op cit.

35 EC (European Commission), 2021. "Recovery Plan for Europe", European Commission (https://europa.eu/next-generation-eu/index_en, accessed on December 1, 2021).

36 Ho, J., Muhammad, H., Brurce, Z., Mecca, M., Rabinsa, A., Keewon, H., Lee, K. S., and Rosidah, R., 2021. Leveraging fiscal stimulus to improve energy transition: Case of South Korea and Indonesia. Climate Policy Initiative, San Francisco.

Spain (who has exceeded the 37 percent minimum allocation for green recovery as stipulated by the EU), Germany, and the United Kingdom also showed similar commitments.[37]

Indonesia could also recover from the pandemic-driven recession while moving towards stronger, more sustainable economy through subtantial allocation of green recovery. Unfortunately, the share of green recovery in PEN is miniscule. Early estimates show that 10 percent of the total 2020-2021 budget for PEN has relevance to climate crisis. However, after closer look, the share of the green recovery was only about 0.12 percent (2020) and 0.3 percent (2021) from the total budget under PEN. Even an allocation of 10 percent would only cover about 8 percent of the total investment required until 2025, and only about 0.04 percent until 2060.[38] The economic recovery budget under PEN could have been strategic to become a leverage for green investment to reach net zero by 2060 or earlier.

With strong focus on short-term objectives, the economic recovery program in Indonesia, PEN, cannot be considered as "green" yet. Out of the 30 countries ranked by Vivid Economics, Indonesia sits on the 25th. Some of the PEN budget as well as some policies made during the pandemic have even been considered detrimental to the environment.[39] Climate Policy Initiative (CPI) and Vivid Economics find that 96 percent of PEN were allocated for dirty sectors.[40]

While there has been quite an intense discourse, and the benefits of green recovery has been shown in studies and reports, green recovery apparently is not yet prioritized in the process of getting out of the pandemic-driven recession in Indonesia.[41]

37 Evans, S., and J. Garbatiss, 2020. "Coronavirus: Tracking how the world's 'green recovery' plans aim to cut emissions", Carbon Brief (June 16, 2020).

38 Habir, M.T., and W. Wardana, 2020. "COVID-19's Impact on Indonesia's Economy and Financial Markets". Perspective (December 15, 2020). Yusof Ishak Institute, Institute for South East Asian Studies, Singapore.

39 Vivid Economics, 2021. Greenness of Stimulus Index: An assessment of COVID-19 stimulus by G20 countries and other major economies in relation to climate action and biodiversity goals (July 2021). Vivid Economics and Finance for Biodiversity Initiative, London.

40 Aylward-Mills, D., J. Payne, M. Sudirman, M.E. Wijaya, B.M. Mecca, M. Zeki, dan A.R. Haesra, 2021. Improving the impact of fiscal stimulus in Asia: An analysis of green recovery investments and opportunities (February 2021). Climate Policy Initiative and Vivid Economics, Jakarta and London.

41 Greenpeace and INDEF (Institute for Development Economics and Finance), 2020. Pemulihan Ekonomi Nasional: Business as Usual atau Pro-Lingkungan? Briefing Paper Diskusi Greenpeace Indonesia-INDEF (September 10, 2020).

Recover Stronger:

Fostering Energy Transition in Achieving and Accelerating Net Zero Emissions Target

Sectors	Emissions (MtCO2e)				Limitation (MtCO2e)		Limitation (percent)	
	2010	2030 BAU	2030 UNC	2030	2030 UNC	2030 COND	2030 UNC	2030 COND
Energy	453	1.669	1.355	1.223	314	446	19	27
Waste	88	296	285	285	11	40	4	14
Industrial Processes and Product Use (IPPU)	36	70	67	66	3	3	4	4
Agriculture	111	120	110	116	9	4	8	3
Forestry	647	714	714	22	497	692	70	97
Jumlah	1.335	2.869	2.034	1.683	834	1.185	29	41

Table 5.1. Indonesia's commitment to limit its future emissions in 2030, submitted to the UNFCCC in its Updated Nationally Determined Contribution. **Note:** UNC is unconditional limitation with own resources, and COND is conditional limitation with international assistance. Source: RI, 2021, updated from data from ESDM for the conditional limitation by 2030.

Indonesia already shows its commitment to limit future emissions from the energy sector and is willing to enhance its ambition. Indonesia has committed itself to limiting its greenhouse gas emissions by 29 percent with own resources and 41 percent with international assistance below BAU trajectories in 2030. This commitment has been submitted to the UNFCCC as its NDC.[42] Climate Action Tracker considers this commitment, especially excluding that in the forestry sector, as highly insufficient.[43] Although more recently, it also has committed to an apparently more ambitious target of reaching net zero emissions by 2060 while turning its forestry sector into net sink by 2030.[44]

As a carbon-intensive economy, Indonesia starts from a challenging position. Indonesia is the largest coal exporter and the fifth largest coal producer in the world. Production of coal in Indonesia is to increase to 663 million tons in 2022, up from 625 million tons in 2021, itself was increased from the original production target of 550 million tons due to sudden spike of coal demand in the world in 2021. Coal resources in Indonesia are enormous with 149 billion tons of proven and 37.6 billion tons of potential reserves. Additionally, there was also 2.48 billion barrerls of proven and 1.29 barrels potential reserves of oil, while there was 49.74 barrels of oil equivalent proven and 27.55 barrels of oil potential reserves of gas in 2019.[45]

42 RI, 2021. Updated Nationally Determined Contribution Republic of Indonesia (July 21, 2021).

43 Climate Action Tracker, "Indonesia", https://climateactiontracker.org/countries/indonesia/ (diakses pada 5 Desember 2021). The ranking excludes emissions from the forestry sector.

44 Rosana, F.C., 2021. "Luhut Sebut RI Targetkan Nol Emisi Karbon pada 2060 atau Lebih Cepat", Tempo (November 4, 2021);

45 Mudassir, R., 2022. "ESDM Bidik Target Produksi 663 Juta Ton Baru Bara Pada 2022", *Bisnis Indonesia* (January 12, 2022); Umah, A., 2021. "Resmi! Target Produksi Batu Bara 2021 Naik Jadi 625 Juta Ton", CNBC Indonesia (April 14, 2021).

Coal also dominates the energy mix in Indonesia. With 554 million barrel of oil equivalent (BOE), coal contributed 38 percent of the total of 1,493 million BOE in the Indonesian energy mix, while total share of fossil fuels (coal, oil, and gas) was 88.74 percent in 2020. Renewables only constituted the remaining 11.28 percent.[46] In the electricity sector, coal is also dominant. The role of coal in the electricity production was 66.3 percent in 2020, up from 43.6 percent in 2011 and 56 percent in 2015.[47] As such, coal plays a strategic role in the country's economy. A transition away from coal imposes a great challenge indeed.

Reduction of energy intensity in the economy and expansion of clean energy needs to be accelerated. Indonesia is committed to increasing the share of renewable energy by 23 percent in 2025 and 31 percent in 2050, as embodied in its National Energy Policy that has already been translated into a National General Energy Plan.[48] The scenario to reach net zero emissions requires the reduction of energy intensity to be accelerated from 2.5 percent to 3.9-4.5 percent per year in the period of 2021-2030 and increased to 6 percent per year in 2031-2060. Through the accelerated efficiency, Indonesia will have to use less than ten percent of energy for every unit of GDP in 2060 compared with today. By 2060, Indonesia will have to fulfil its energy demand (almost) entirely with clean energy — renewable energy, hydrogen, and nuclear. Indonesia will also need to significantly increase the use of electric vehicles by 2060 (and a small share of hydrogen).

To reach net zero emissions by 2060, the share of renewables in the energy mix needs to continue to increase to 60 percent by 2030 and 83 percent by 2053 before reaching zero in 2060.[49] Carbon pricing that has been put into regulation since 2021 will begin at a low carbon tax level but is expected to increase to $40, $50, and even $60 per ton. The higher the carbon tax level the faster the country will reach net zero emissions.[50]

46 ESDM (Ministry of Energy and Mineral Resources of the Republic of Indonesia), 2020. Handbook of Energy and Economic Statistics of Indonesia 2020. Ministry of Energy and Mineral Resources of the Republic of Indonesia, Jakarxta.

47 PLN, 2021. Rencana Usaha Penyediaan Tenaga Listrik (RUPTL) PT PLN (Persero) 2021-2030. PT Perusahaan Listrik Negara, Jakarta.

48 RI, 2014. Governmental Regulation No. 79/2014 on the National Energy Policy; RI, 2017. Presidential Regulation No. 22/2017 on the National General Energy Plan.

49 Bappenas (The Ministry of National Development Planning of the Republic of Indonesia), 2021. *A Green Economy for a Net-Zero Future: How Indonesia Can Build Back Better After Covid-19 With The Low Carbon Development Initiative (LCDI)*. Kementerian Perencanaan Pembangunan Nasional, Jakarta.

50 Monoarfa, S. 2021. *Pembangunan Rendah Karbon Indonesia dan Net Zero Emission Menuju Ekonomi Hijau*, presented at the Indonesia Net Zero Summit 2021, Save Indonesia Gold 2045 from the Threat of the Climate Crisis. Ministry of National Development Planning, Jakarta.

At COP26 Indonesia pledged to phase out of coal from its energy system by 2030-2040. Indonesia is one of the more than 40 countries that pledged to phase out from coal, and among the few who is pledging it for the first time. It is curious, however, that other major coal countries such the United States, China, India, and Australia are absent from this pledging group.[51] Indonesia will also retire some old coal power plants earlier than scheduled. With the Philippines and Viet Nam, Indonesia has joined the Asian Development Bank (ADB) -initiated Energy Transition Mechanism (ETM). The mechanism aims to take 50 percent of the coal power plant capacity offline in the next 10 – 15 years in Indonesia, the Philippines, and Viet Nam, amounting about 50 GW in total. At present, about 1.77 GW of which will start as a pilot in 2022-2023. In the next two to three years, there will be about five to seven coal-fired power plants to be retired early in Indonesia and the Philippines.[52] The Indonesian Ministry of Energy and Mineral Resources estimates that the accelerated retirement will impose additional cost of about Rp40 trillion (about $2.76 billion).[53]

Renewable energy resources in Indonesia are ample but immensely underutilized. Indonesia houses an enormous amount of renewable energy potential. But from the 443 gigawatt (GW) total potential, only about 8 GW or about less than 2 percent had been utilized by 2015. Table 5.2 below shows the comparison between the potential and the utilization of renewable energy in Indonesia.[54]

51 "COP26: More than 40 countries pledge to quit coal", *BBC News* (November 4, 2021).

52 Aldila, N., dan H. Alaydrus, 2021. "ADB Kaji Pensiun 7 Pembangkit Listrik Bahan Bakar Batu Bara di Indonesia dan Filipina", ***Bisnis Indonesia*** (4 November 2021).

53 Presentation by Director General of Electricity, Ministry of Energy and Mineral Resources, as cited in Sumarno, T.B., and L. Sanchez, 2021. How Indonesia Can Achieve Both a Covid-19 Recovery and Its Climate Targets (September 2021). International Institute for Sustainable Development and Global Subsidies Initiative, Winnipeg.

54 PLN, 2021, op cit.

Renewable Energy Types	Potential (megawatts, MW)	Utilization (MW)	Percentage (%) of Utilization
Geothermal	29,544	1,438.5	4.9
Hydro	75,091	4,826.7	6.4
Mini dan microhydro	19,385	197.4	1.0
Bioenergy	32,654	1,671.0	5.1
Solar	207,898 (4,8 kWh/m2/day)	78.5	0.04
Wind	60,647 (4 m/s or more)	3.1	0.01
Ocean wave	17,989	0.3	0.002
Total	443,208	8,216	1.85

Tabel 5.2. Renewable energy potentials in Indonesia and their utilization, in 2015. **Source:** PLN, 2021, from Presidential Regulation No. 22/2017 on the National General Energy Plan.

Sitting on top of the Pacific "ring of fire", Indonesia houses among the largest potential of geothermal resources. Installed capacity of geothermal power plants in Indonesia was 1,948.3 MW in 2021, putting it as the third largest geothermal utilizing country in the world behind the United States (2.5 GW) and the Philippines (2 GW).[55] With Turkey and Kenya, Indonesia also leads the capacity growth.[56] The total potential for geothermal in Indonesia is about 24 GW with about 14.6 GW reserves. Of which, 3 GW of proven, 1.8 GW of probable, and 9.6 GW of possible reserves.[57] Indonesia is expected to have installed about 3.5 GW of geothermal power plants by 2025 and more than 4 GW afterwards.[58]

The potential for hydro power plants is also massive. The total potential is most recently estimated to be about 26.3 GW after having for a while been estimated to be about 75 GW, while the most realistic and accessible among them are expected to be about 8 GW. About 4.3 GW have been operational while 5.9 GW are still under construtions.[59]

The immense potential of solar and wind energy has been grossly underutilized. Worldwide, solar and wind power have been the fastest-growing renewable energy in the past decade. In 2020, even during the pandemic-driven recession, solar photovoltaic (PV) generation increased by 156 terra-watt-hours (TWh), a record jump of 23 percent to reach 821 TWh.

55 PLN, 2021, op cit.; IRENA, 2017, op cit.

56 IEA, 2021b. Geothermal Power. International Energy Agency, Paris.

57 PLN, 2021, op cit.

58 IRENA, 2017, op cit.

59 PLN, 2021, op cit. JICA (Japan International Cooperation Agency and Nippon Koei, 2011. Project for the Master Plan Study of Hydropower Development in Indonesia, Final Report Vol. II, Main Report (August 2011). The Ministry of Energy and Mineral Resources, Republic of Indonesia, and PT PLN (Persero), Jakarta.

China, United States, and Viet Nam led the growth of installed capacity with a total of 134 GW.[60] The price of solar PV has also been falling precipitously over the last decade of about 80 percent between 2010 and 2017. With potential of about 200 GW, solar power may have the largest energy potential that remains underutilized in Indonesia. But with installed capacity of about 78.5 MW, installed capacity is only a miniscule 0.04 percent. PLN plans to develop utility scale centralized and concentrated solar power plants in a hybrid system with other power plant technologies.

60 IEA, 2021c. Solar PV. International Energy Agency, Paris (https://www.iea.org/reports/solar-pv, accessed on 29 December 2021).

Already, Indonesia is constructing floating solar panels on top of the Cirata dam, a large hydropower on Java, expected to be the largest floating solar power plant in Southeast Asia. PLN has acknowledged that without the price of battery, solar technology produces cheaper electricity compared with coal power plants.[61] There is an apparent opportunity for a $19 billion investment in the next decade and $7.2 billion for utility-scale.[62]

61 Setiawan, V.N., 2021. "PLN Sebut Harga Listrik Tenaga Surya Lebih Murah Ketimbang Batu Bara", Katadata (March 2, 2021).

62 Esser, S., C. Chua, and A. Vagneur-Jones, 2021. 2030 Indonesia Roadmap: Multiplying the Transition: Market-based solutions for catalyzing clean energy investment in emerging economies (October 2021). Bloomberg NEF and Climate Investment Funds, New York.

BOX 1

Surya Nusantara and the Expansion of Solar Energy in Indonesia

Solar energy is possibly among the most underutilized source of renewable energy in Indonesia. But the Indonesian government appears to have seen the potential and begun to expand its utilization. Surya Nusantara is a program initiated by the Ministry of Energy and Mineral Resources to scale up the utilization of rooftop solar PV technology. The concept is to shift the subsidy provided to PLN's subsidized household customers for the provision of rooftop solar PV, financed by state budget.[63] Surya Nusantara was originally initiated and recommended by the Institute for Essential Services Reform (IESR), a think tank that strives to campaign and advocate on sustainable energy in Indonesia.[64] IESR recommends Surya Nusantara as a recovery program that at the same time increases utilization of renewable energy and reduction of greenhouse gas emissions.[65] The initiative strives to install about 1 GW-peak (GWp) rooftop solar on the roofs of about 500-600 thousand of poor households per year in 2020-2021 to be continued to 2025. The initiative is expected to absorp 30,000 new jobs, to reduce electricity subsidies by Rp800 billion – Rp1.3 trillion ($55 – $89 million), to reduce as much as 1.05 MtCO2e per GWp towards meeting Indonesia's NDC while growing green businesses.[66]

The initiative requires financing from the state budget. A standard amount of capital expenditure for 1 kWp of rooftop solar amounts to between Rp14 – Rp15 million (about $1,000). This includes hardware costs (solar panels and balance of system), installation, survey, and interconnection to the PLN grid. For 1 GWp, there is an expected budget amounting Rp14 – 15 trillion (about $1 billion) or lower. There are four steps in the initiative. First, planning of sites and targets that includes the Ministries of Energy and Mineral Resources, Finance, provincial governments, as well as PLN. Second, appointment and procurement of rooftop solar equipment (domestically-produced and imported) and registration of companies that can implement the initiative. Third, recruitment of skilled workers and training to equip workers with appropriate skills. And finally, fourth, installation, monitoring, and evaluation.[67]

There are also other initiatives that the government carries out in expanding the utilization of solar energy. In addition to Surya Nusantara, the Indonesian government drives the expansion of the use of solar energy through utility-scale solar power plants, including through a collaboration with the ADB. Also, the government is developing solar power plants in ex-mining sites amounting about 2.3 GW, consists of that in Bangka Belitung at 1.25 GW, in Kutai Barat at 1 GW, and in Kutai Kartanegara at 53 MW. Additionally, floating solar power plants are to be developed in existing hydropower dams, including in Wonogiri dam in Wonogiri, Mrica dam in Banjarnegara, Sutami dam in Karang Kates, Wonorejo dam in Tulung Agung in Central Java, Jatiluhur and Saguling dams in West Java, and Singkarak dam in West Sumatera. Already, the 145 MW floating solar power plant in Cirata dam in West Java is being developed. Three international banks have committed to financially support the project. When the project is finished, it will be the largest solar power plant in Southeast Asia.[68]

The government is also developing and improving the regulations needed to expand the utilization of solar energy. The Ministerial Decree No. 49/2018 has already accelerated the adoption of solar rooftop from 609 users in 2018 to 4,262 in 2021. With the recent issuance of the Ministerial Decree No. 26/2021 on XX that replaces the Decree No 49/2018, to commence implementation on January 18. 2022, Indonesia is committed to 3.6 GW utilization target for solar rooftop.

63 "Akselerasi PLTS Atap, Kementerian ESDM Siapkan Program Energi Surya Nusantara", Press Release, Directorate General of New and Renewable Energy and Energy Conservation, Ministry of Energy and Mineral Resources of the Republic of Indonesia (September 25, 2020).

64 ibid.

65 Syahni, D., 2020. "Kementerian Energi Adopsi Program Surya Nusantara?" Mongabay Indonesia (July 1, 2020).

66 Tumiwa, F., 2020. Akselerasi Pembangunan PLTS Atap Sebagai Strategi Green Economic Recovery Pasca-Covid-19 di Indonesia, Policy Brief, Institute for Essential Services Reform (April 2020).

67 ibid.

68 Arkyasa, M., 2021. "Indonesia Develops First Floating Power Plant", Tempo (October 10, 2021).

Biofuel is an interesting solution albeit temporarily, but may bring additional risks. Biofuel development is an interesting initiative. Indonesia is the largest producer and exporter of palm oil in the world, producing 47.12 million tons of crude palm oil (CPO) per year from the 14.46 million ha of oil palm plantations in the country in 2020.[69] In the wake of the decision by the EU to phase out palm oil imports from Indonesia, the government established a massive biofuel program to increase domestic demand and eventually to maintain sufficiently high international price that renders producing palm oil to be sufficiently profitable.

Additional benefit for Indonesia would be to reduce expensive oil imports.[70] Vivid Economics considers the government subsidy to biofuel industry during the pandemic being positive.[71] However, the $163 million pandemic stimulus allocated for the B30 development (mixing 30 percent of pure biofuel into regular fuel) mainly produced from palm oil may have some environmental risks, such as additional lands required for plantation expansion that risk increasing deforestation and corollary emissions.[72]

69 BPS (Badan Pusat Statistik, the National Central Statistical Agency), 2020. Indonesian Palm Oil Statistics. Badan Pusat Statistik, Jakarta.

70 Sari, A., 2020. "Dilema Produksi Solar Nabati", Kompas (September 14, 2020).

71 Vivid Economics, 2021, op cit.

72 Greenpeace Indonesia and Institute for Development Economics and Finance, 2020, op cit.

Net zero requires almost an entire energy system delivered as electricity, including for transportation sector. As modern sources of renewables are more easily delivered in the form of electricity, the shares of fossil fuel used as final energy need to be zeroed out and transformed into electricity. This includes a transformation of the transportation sector to as much as possible utilize electric vehicles. In 2025, the share of electricity in the final energy mix is expected to be about a quarter (24.5 percent). In 2050, the share is expected to increase to about a third (31.2 percent). The share of renewables in the non-electricity portion of the final energy mix is expected to be 9.5 percent in 2015 and 11.9 percent in 2050.[73] Electrification of the transport system is also known as a "two-step measures" because electrification alone is not sufficient before the carbon intensity of the electricity system is reduced. But without electrification, it is very difficult to reduce emissions in the transportation sector.

The growth of the use and production of electric vehicles is skyrocketing. Globally, there are already about 3 million electric vehicles, more than 1 million of which were sold in 2017 alone. China was the largest producer and buyer of electric vehicles with more than half of the sales in 2017 — about 580,000 — were sold in China alone. In Norway, 39 percent of new car sales in 2017 were electric, followed by Iceland (11.7 percent) and Sweden (6.3 percent). Current strong growth will see 125 million electric vehicles by 2030. With additional policy and fiscal push the figure may reach 220 million.[74] The Electric Vehicle Initiative of the International Energy Agency (IEA) announced a transitional target to achieve "at least 20 percent of all road transport vehicles globally to be electrically driven by 2030 — if warming is to be limited to 2 degrees or less".[75]

Indonesia has begun to see the benefits of electric vehicles and commence the steps to prepare for its development domestically, but execution remains to be seen. Political will appears to be increasingly strong. At the opening ceremony of an automotive show, President Jokowi expressed his concerns about the looming challenge of the world's trends that favor electric vehicles.[76] At the inauguration of the conference of the Indonesian Petroleum Association, he expressed his commitment that Indonesia will catch up, and eventually lead the electric vehicle transformation.[77] Further, he announced that, in attending the inauguration of the first Indonesian electric vehicle factory, PT Wijaya Manufacturing, that Indonesia would produce 60,000 electric vehicles in 2019.[78] Presidential Regulation No. 55/2019 on the Acceleration of the Program on Battery-Based Electric Vehicles for Road Transportation has already been enacted since August 12, 2019, providing the legal basis for the program.**Investors and the private sector have embraced the commitment to expand the use of electric vehicles**. In addition to PT Wijaya Manufacturing, Blue Bird, a major taxi company, started with a token use of electric vehicles by operating 25 BYD and 4 Testa cars in its fleet.[79] A major ride sharing company Gojek started to rent out electric motorcycles to its drivers.[80] When the trend becomes stronger and internal combustion vehicles are no longer produced or used, oil consumption will decrease considerably. Also, the need for biofuel will also decrease considerably.

73 RI, 2017, op cit.

74 OECD/IEA (Organization for Economic Cooperation and Development / International Energy Agency), 2018. Global EV Outlook 2018: Towards Cross-Modal Electrification. International Energy Agency, Paris, France.

75 The EV30@30 campaign by the Electric Vehicle Initiative, initially officially announced on June 8, 2017 in Beijing, China, updated on September 11, 2018 in Birmingham, United Kingdom.

76 Wira, I.N., 2018. "President Jokowi Optimistic About Electric Cars in Indonesia," *The Jakarta Post* (April 20, 2018).

77 "President Jokowi Pushes for Electric Car Development in Jakarta," Sekretariat Kabinet (Cabinet Secretary, setkab.go.id) (May 2, 2018).

78 "Indonesia To Produce 60,000 EV Motorcycles in Indonesia," Tempo.co (November 7, 2018) ; Fitra, S., 2018. "Indonesia's First Step To Become Electric Car Manufacturer," Kata Data (December 6, 2018).

79 Nugroho, S.A., 2019. "Blue Bird Hadirkan Mobil Listrik Tesla dan BYD", Kompas (April 22, 2019).

80 Dananjaya, D., 2021. "Gojek Bakal Sewakan Motor Listrik buat Mitra Drivers", Kompas (November 23, 2021).

But progress to date is concerning. With the rate of expansion of only about 500 MW per year or less, the target to increase the share of renewables to 23 percent by 2025 from about 11.5 percent today seems unattainable. It practically doubles the share in only about four years.[81] By 2018, total renewable energy installed was only about 9.4 GW, well below the target set by the Ministry of Energy and Mineral Resources of 15.5 GW.[82] Meanwhile, there will be 40.5 GW of new power plants while 20.9 GW of which is expected to be from renewables until 2030.[83] Even with the gap between today's achievements and the target, and the apparent challenges ahead, the Ministry of Energy and Mineral Resources, however, remains optimistic that Indonesia will increase reach the renewable energy target of 23 percent by 2025.[84] This optimism is indeed commendable since about six month prior there was an acknowledgement that the target was difficult to reach.[85]

Later, new forms of renewable and carbon capture and storage technologies need to take place. It is expected that by mid-century, almost half of the technologies used are ones that are at present still under development. They include carbon capture and storage, green hydrogen, sustainable aviation fuels, green ammonia, and others. As such, financing for achieving net zero should include funding for research and development.[86]

Green hydrogen is a promising possibility. Globally, about 120 million tons (megatons, Mt) of hydrogen has already been produced per year today.[87] But they are mostly produced from fossil fuels or from electricity generated by fossil fuels that obviously are carbon-intensive. Only less than one percent is what is called "green" hydrogen. Fortunately, there is progress with the development of 10 MW electrolyzer in Japan.[88] "Green" hydrogen is produced by renewable electricity, and the cost gas fallen rapidly.[89] By 2050, International Renewable Energy Agency (IRENA) expects that hydrogen will account for 12 percent of final energy use.[90]

81 Umah, A., 2020. "24 Proyek Listrik Terbarukan Masih Gantung Pendanaannya", CNBC Indonesia (28 Juli 2020); Sulaeman, 2020. "DPR: Penerapan Energi Terbarukan 23 Persen di 2025 Sulit Tercapai", Liputan 6 (21 Desember 2020).

82 Suharsono, A., N. McCulloch, M. Mostafa, R. Bridle, L. Lontoh, P. Gass, 2019. Getting to 23 Percent: Strategies to scale up renewables in Indonesia, GSI Report (July 2019). The International Institute for Sustainable Development, the Global Subsidies Initiative, and the Swedish Energy Agency, Winnipeg.

83 PLN, 2021, op cit.

84 Sidik A., B., 2021. "Optimisme Pencapaian Bauran Energi Baru dan Terbarukan", Kompas (Dcember 31, 2021).

85 Ridwan, M., 2021. "Menteri ESDM: Target Bauran Energi 23 Persen Sulit Dicapai", Bisnis Indonesia (July 27, 2021).

86 WEF (World Economic Forum), 2021. Financing the Transition to a Net-Zero Future, Insight Report (October 2021). World Economic Forum in collaboration with Oliver Wyman, Geneva.

87 IRENA (International Renewable Energy Agency), 2019. Hydrogen: A renewable energy perspective. International Renewable Energy Agency, Abu Dhabi.

88 "Japan opens world's largest green-hydrogen plant near Fukushima disaster site", Recharge (March 9, 2020).

89 IRENA, 2020. Global Renewables Outlook 2020: Energy Transformation 2050. International Renewable Energy Agency, Abu Dhabi.

90 IRENA, 2021. World Energy Transition Outlook: 1.5 °C Pathway. International Renewable Energy Agency, Abu Dhabi.

Carbon capture (utilization) and storage may be useful and needed, but cost remains of concern. CC(U)S is a process that separates carbon dioxide from a source, transport, and store it in isolation (almost) permanently, or at least for a very long period of time, or utilized for something useful like being used as an industrial input.[91] There are a number of pilot projects currently operating in the world, such as the Tomakomai in Japan, Drax BECCS that combines bioenergy with CCS in the UK, the Northern Lights in Norway that aims to serve not only Norway but the rest of Europe as well, and the first-ever direct air capture (DAC) plant in the United States that sequesters carbon directly from the atmosphere in a big scale.[92]

But at present there are only about 20 commercial-scale CC(U)S in operation.[93] Among which, only one commercial power plant that is still in operation that utilizes CCUS technology.[94] Plans to construct 30 more have been announced, with about $27 billion investment.[95]

Among the most cited reasons was that CC(U)S remains costly. The capture costs can range between $15-$25 per ton of CO2 for industrial processes needing high concentration of carbon dioxide to $40-$120 for processes with dilute gas streams such as cement or power plants, plus about $2-$14 per ton of CO2 of transport costs and storage costs.[96]

91 IPCC, 2005. Special Report on Carbon Dioxide Capture and Storage. Cambridge University Press, Cambridge.

92 IEA, 2021d. "CCUS around the world", International Energy Agency (April 2021) (https://www.iea.org/reports/ccus-around-the-world, accessed December 28, 2021).

93 IEA, 2020. Energy Technology Perspectives 2020: Special Report on Carbon Capture Utilization and Storage: CCUS in clean energy transitions. International Energy Agency, Paris.

94 IEA, 2021e. "CCUS in Power", International Energy Agency (November 2021) (https://www.iea.org/reports/ccus-in-power, accessed on December 28, 2021).

95 IEA, 2020, op cit.

96 Baylin-Stern, A., and N. Berghout, 2021. "Is carbon capture too expensive?" International Energy Agency (February 17, 2021).

CC(U)S is also controversial. In addition to the high cost, investment in CC(U)S technologies is often seen as crowding invesment out of technologies that contribute to real reductions such as renewable energy and green hydrogen. The risk of leakage is another consideration. Carbon needs to be protected in its storage practically forever. How long is long enough to be considered forever remains debatable. The "utilization" part of CCUS is also seen as problematic. Captured carbon dioxide can be used to carry out Enhanced Oil Recovery (EOR). The gas is stored into old oil wells and is used to increase the pressure inside the wells to pump some oil remaining in the wells that otherwise would be too difficult to pump. The problem is that the additional oil pumped out will eventually release emissions when burned, and possibly offset the amount of emissions sequestered by the CCUS.

But interest in CCS has grown stronger lately. There is increased realization that, when used appropriately, CCS can contribute to increasing sequestration of the atmospheric carbon dioxide and as such to reaching net zero emissions faster. Some are even of the opinion that reaching net zero will be virtually impossible without CC(U)S.[97]

CC(U)S is currently being explored in Indonesia. It began with the First Asia CCUS Network Forum on June 22-23, 2021, supported by the Japanese government. There is already a Joint Crediting Mechanism (JCM) between Indonesia and Japan that allows for Japanese investment that can reduce emissions in Indonesia (usually also with Japanese technologies) can gain emission reduction credits that can be used to fulfil Japanese domestic emission reduction obligations. Through the JCM, Electric Power Development Co. (J-Power) and Japan NUS Co. developed CCS in the Gundih gas field in Central Java. When successful, the project is supposed to be able to sequester about 300,000 tons of carbon dioxide per year. Similar project was piloted in Hokkaido at the cost of about Y6,000 ($57) per ton of carbon dioxide.

Indonesia has also accelerated the use of carbon pricing instruments. Two legal products have been released more recently. The new Law No. 7/2021 on the Harmonization of Taxation Regulations for the first time included carbon tax. The minimum carbon tax rate is set at Rp30 per kg, or about $2 per ton. It will escalate to be at least at the same rate or more than the carbon price in the carbon market, although it has not been decided which market it will refer to. The carbon tax will commence in April 2022 with PLN-owned coal fired power plants. Additionally, the Presidential Regulation No. 98/2021 on the Implementation of the Economic Valuation of Carbon for the Achievement of the Nationally Determined Contribution and Managing Emissions of Greenhouse Gases in the National Development (usually shortened as the Economic Valuation of Carbon) for the first time governs the application of carbon pricing, namely carbon tax and levies, carbon trading in the forms of cap-and-trade, and carbon offset, as well as results-based payment. The regulation covers domestic as well as international carbon trading.

97 IEA, 2020, op cit.

Enhanced Clicmate Ambition Affects the Economy Positively

"All models are wrong, but some are useful", George E.P. Box said in his seminal article in 1976.[98] There is no model that can accurately predict the future. Nevertheless, some of them may be useful when they can be used as a learning tool. The learned logic and inclination of the trends can still be a very useful basis in a decision making process. With this in mind, model simulations have been carried out to observe the possible impacts of different policy options on the overall economy, especially on key indicators such as economic growth, disposable household income, job creation, investment requirements, as well as emissions. A Low Carbon Development Initiative (LCDI) model, a system dynamic model, has been developed by the Ministry of National Development Planning in the context of developing low carbon development roadmap. Two reports have been produced based on the modeling exercise.

The general conclusion is that low carbon policies lead to positive impacts on the economy.[99] This report utilizes the same model — with additional sub-models to simulate additional assumptions and questions that are not accommodated yet by the original model.

Indonesia can get out of the recession with stronger ambition to accelerate the achievement of the net zero emissions target earlier than 2060, with positive impacts on the overall economy. The implications of the acceleration of the net zero emissions scenarios are observed for a number of key indicators, namely economic growth, income of the population, unemployment rate, and investment requirements. The diagram below depicts the structure of this techno-economic model.

98 Box, G.E.P., 1976. "Science and Statistics", in Journal of the American Statistical Association 71 (356), pp. 791-799.

99 Bappenas (Ministry of National Development Planning), 2019. Low Carbon Development: A Paradigm Shift Towards a Green Economy in Indonesia. Ministry of National Development Planning, Jakarta; and Bappenas, 2021, op cit. These reports utilized the Indonesian Vision 2045 (IV2045) model developed using system dynamic. The same system dynamic model is used, with additional modules and additional set of assumptions, to carry out the analysis for the Green Reset.

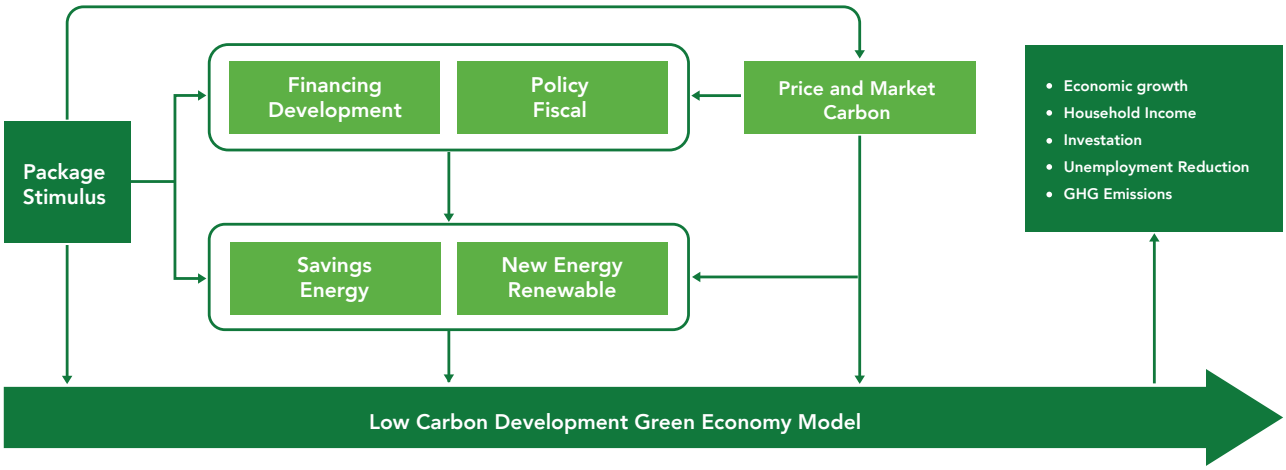


Figure 6.1. Diagram of the system dynamic model urilized to carry out the techno-economic assessment of the acceleration of the net zero emission targets of 2060 and earlier.

As shown on Figure 6.1 above, the LCDI model is utilized to observe the impacts of the achievement of the net zero emissions targets by 2060, 2050, and 2045. PEN and the allocation for green recovery is included into the LCDI model. Different emission outcomes will be produced when the allocation of resources in end-used energy efficiency and the expansion of the utilization of renewable energy are simulated with different assumptions. The green recovery can also serve to provide leverage to develop relevant policies (such as carbon tax or levies) and leverages on private investments. The impacts of the allocation of PEN on the economy happens directly and indirectly. For example, the direct cash assistance will directly affect household income. The direct and indirect impacts observed in the modeling exercise are as follows.

- Directly, PEN and the larger state budget (Anggaran Pendapatan dan Belanja Negara, APBN) will affect a number of sectors and economic variables relevant with prosperity in addition to greenhouse gas emissions.
- In the first order through several policy options, PEN and APBN will affect end use efficiency and expansion of renewable energy through direct allocation of budget to support such sectors. The changes will eventually affect the overal economy, including people's prosperity as well as greenhouse gas emissions.
- In the second order also through several policy options, PEN and APBN will provide the potential to drive the economy through investments through fiscal policies and leveraging of private investments through blended financing. The fiscal and leveraging policies will affect the economy directly or indirectly through policies that affect end use efficiency and expansion of renewable energy. The changes in end use efficiency and expansio of renewable energy will eventually affect the overall economy and the prosperity of the people, as well as green house gas emissions.

BOX 2

The Low Carbon Development Initiative System Dynamic Model

The Low Carbon Development Initiative (LCDI) is developed based on the Indonesia Vision 2045 (IV2045), which is a macro system dynamics model in a modeling platform Vensim. LCDI simulates in an intergrated manner the socio-economic dynamics and the supporting natural resources. Throught simulating on a number of policy options, policy makers can identify possible ways to take to achieve the goals of mid- and long-term development and their consequences. The model also takes into acount the externality values of the different policy options. The simulation can also identify influencing points that are more effective. Intersectoral synergy can also be carried out more simply while inter-sectoral tradeoff can be avoided.

System dynamics makes this model unique because it is a system thinking that looks at a problem in its entire ecosystem instead of partially. System thinking is carried out with an understanding that structure leads to behavior, namely how dynamic interation between socio-economic and environmental situations form the sustainable development trends in Indonesia.[100]

A system dynamic model is identified by the explicit feedback loops, delays, and non-linearity, all of which represent how they work in real life. Causal loop diagram (CLD) is used to identify key variables that need to be included into the model and how those variables interact with each other dynamically. The CLD is formed in a participatory and consultative process together with key stakeholders of the model and is used as the blue print for the quantitative system dynamic model enables identifying actions and expected reactions.

Specifically, the feedback loops that are reinforcing can be identified, for example, economic growth and social development can be explained by the dominant role of reinforcing loops. This is especially made possible through investment and the availability of natural resources that, when not managed well, may jeopardize the economic growth itself and create a balancing loop. In short, CLD captures the hypothesis on the causes of the dynamics, the mental model of the individuals and the team, and also the feedbacks that drive the system. Numbers and equations then are included in to the qualitative CLD and is used to quantify the trends and to estimate the impacts of policy options while assessing the feasibility of each of the options.

100 Meadows, D.H., 2008. Thinking in Systems: A Primer. Chelsea Green Publishing for Sustainability Institute, White River Junction.

The government has announced a net zero emissions target by 2060 or earlier. The common translation to this target is that Indonesia will reach net zero emissions by 2060 with its own resources (unconditional) and is willing to accelerate it earlier subject to availability of international assistance (conditional).[101] Four scenarios were developed and simulated using the LCDI model, namely (1) business as usual (BAU) without any net zero target beyond 2030; (2) net zero emissions to be reached by 2060; (3) net zero emissions target to be accelerated to 2050; and (4) net zero emissions target to be accelerated to 2045. Each of these scenarios were ran using two different assumptions, namely early and delayed actions. The impacts of these scenarios under different assumptions on the economy, especially on GDP growth, household disposable incomes, job creation, and required investments will then be observed.

101 Shofa, J.N., 2022. "Indonesia Asks Developed Countries to Fund Energy Transition", Jakarta Globe (January 20, 2022).

Additional set of scenarios were simulated to observe the difference between early actions and delayed actions in reaching each of the four scenarios including the three net zero emissions targets. Additional investments are needed to reduce emissions and to reach net zero emissions. On the other hand, through a proactive approach represented by early actions will create inter-sectoral synergy that will produce accumulation of economic benefits in the short term. This is another way to show that low carbon development is also a potentially effective building back strategy for post-pandemic recovery.

There are two distinct simulations being observed in the modeling exercise. First, the impacts of different net zero emission targets on the economy. And second, the different options for strategies that may be utilized to raise the required amount of financing to reach such net zero targets. In summary, the following are the simulations carried out in the modeling exercise.

- The net zero simulations were carried out to assess the possibly social, economic, and environmental implications of achieving net zero by 2060 and accelerating it to 2050 and 2045. Two possible trajectories were carried out for each of the scenarios, namely early and delayed action options.
- Different financing strategy that involves different assumptions of allocation of green recovery budget in PEN, the levels of carbon tax and levies, and the leveraging ratio of public investment to attract private financing with different assumptions of leveraging ratio. Revenue from carbon tax can be reallocated to provide leveraging public investment. This simulation is required not only to estimate the potential for PEN to contribute to commencing emission reduction trajectories, but also to highlight its limited role in mid- and long-term compared to that in the immediate short-term. While PEN is immensely useful in the short-term, it needs to be followed by proper policies including carbon pricing in the mid- and long-term.

The results of the simulations are summarized in Table 6.1 below.

	BAU	2060	2050	2045
Emisi karbon dioksida tahunan pada 2060 (juta ton, atau mega ton, setara karbon dioksida, MtCO2e)	4.638,9	-6,1	-19,94	-25,27
Pertumbuhan ekonomi rerata 2031-2060 (persen).	3,8	6,0	6,4	6,4
Pendapatan masyarakat per kapita pada 2060 (*household disposable income per capita*, Rp juta).	43,2	85,6	95,1	97,5
Tingkat pengangguran pada 2060 (persen)	17,5	5	3,3	3,8
Total investasi rendah karbon (Rp ribu triliun per tahun) sampai 2060.	158	266	340	410
Tambahan investasi rendah karbon dari BAU (Rp ribu triliun per tahun) sampai 2060 untuk mencapai emisi *net zero* pada 2060, 2050, dan 2045.	—	108	182	254
Tambahan investasi rendah karbon dari 2060 untuk mempercepat pencapaian emisi *net zero* menjadi 2050 dan 2045.	—	—	74	145

Table 6.1. Indication of achievements by 2060 based business as usual (BAU) scenario, net zero emissions by 2060, and the acceleration of net zero emissions to be achieved by 2050 and 2045.

Table 6.1 above shows the summary of the results of the simulations. Early action of each of the net zero targets will need more investment but produce higher GDP growth, more jobs, and bigger household disposable incomes. Also, accelerating net zero achievement earlier than 2060 will be more beneficial to the economy.

Delayed actions will require less investment but concentrated in a shorter period and as such will pose significant challenge in the execution. Delaying action will also pose more risks of not meeting the net zero targets as the window of opportunities may be closing more rapidly.

Net Zero Emissions Lead to Higher Economic Growth

Accelerating the achievement of net zero emissions leads to increased economic growth. As shown on Table 6.1 above, the results of the simulations show that achieving net zero by 2060 will increase the average economic growth between 2031 and 2060 from 3.8 percent in the BAU (no emission reduction) scenario to 6.0 percent. Accelerating the achievement of net zero emissions from 2060 to 2050 and 2045 leads to even higher growth of 6.4 percent on average.

Figure 6.2 below shows the different pathways of emissions following the four simulated scenarios. The higher economic growth results from higher investments and increased efficiency as well as avoided public health costs. In turn, it will also increase job creation, and household disposable income. Appropriate steps and approaches in the short-term will attract the necessary and needed investments to achieve net zero emissions.

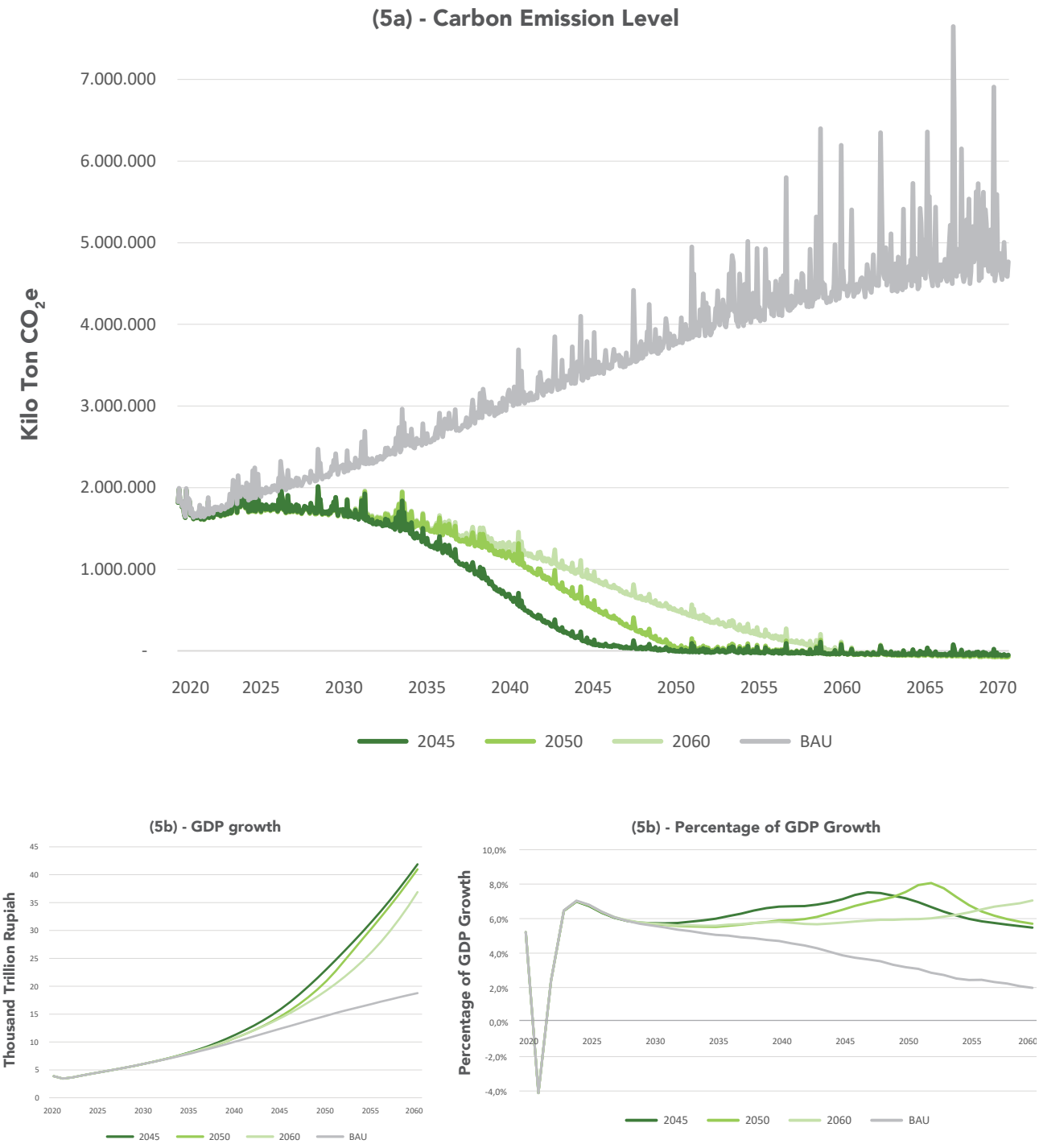


Figure 6.2. The results of the simulations with BAU assumptions, net zero emissions target as set by the Government of Indonesia, and accelerated to 2050 and 2045. Figure 4(a) shows emissions. Figure 4(b) on the left is the comparison of economic growth achieved by the BAU scenario and net zero emissions by 2060, 2050, and 2045. Figure 4(c) is the comparison of economic growth in percentage achieved by the BAU scenario and by the net zero emissions by 2060, 2050, and 2045.

The earlier the actions to reach net zero emissions, the larger investments will be required but also the earlier the benefits can be enjoyed. Reaching net zero emissions requires substantial amount of investments. But there is a difference between investing early and investing late in the period leading towards the net zero target year. Figure 6.3 below shows that early actions will require 12 to 17 percent of current investment, whereas delayed actions will require 3 and 12 percent of current investments increasing over time towards the net zero target year. With the right strategy and structure, higher investment opportunities realized early will lead to increased benefits to be enjoyed early. The actual timing of the commencement of the actions toward achieving net zero may be adjusted based on the actual amount of investments that are successfully raised.

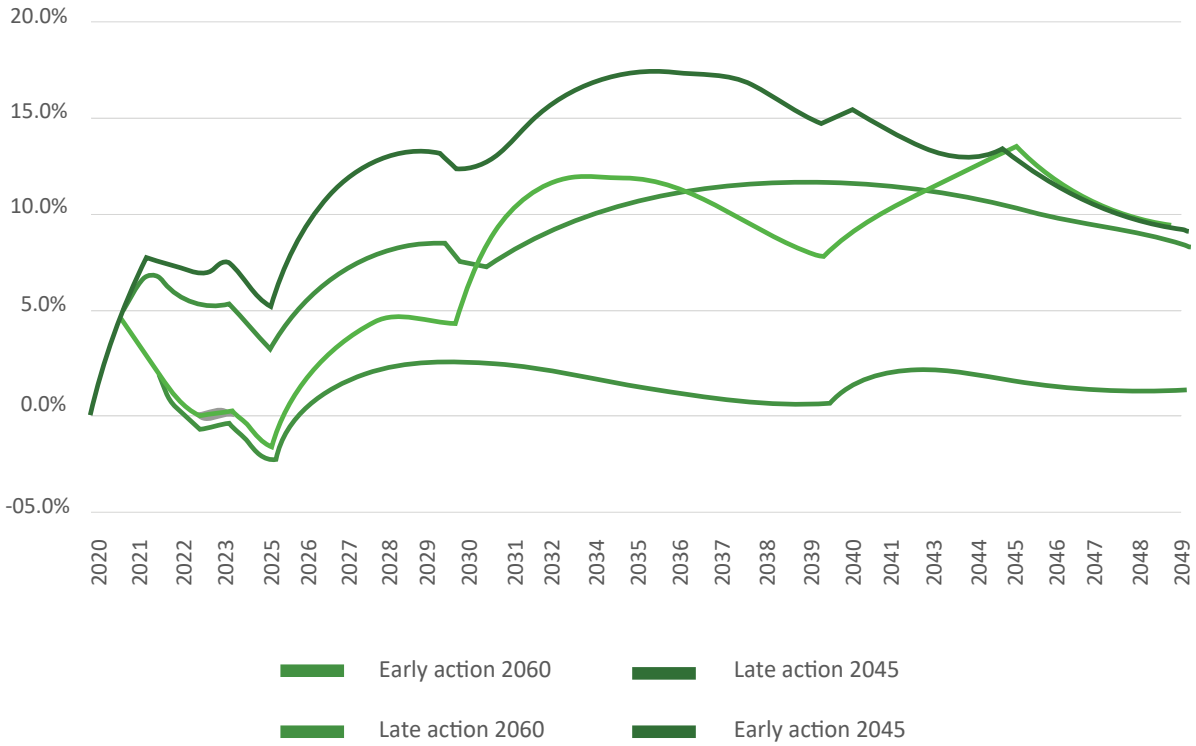


Figure 6.3. Low carbon investments as a portion of total investments for different net zero emission target years and different commencing time (early vs delayed) for each of the net zero target years, shown 2060 and 2045.

Figure 6.3 above compares two most extreme scenarios, namely the early actions to achieve net zero emissions in 2045 and the late action to achieve net zero emissions in 2060, as well as the late and early actions in those two years. For the early action to reach net zero emissions by 2045, it requires larger amount of investments in shorter period of time, about 8 percent of the GDP in 2035.

But the financial requirements will decrease over time because the requirements for operation and maintenance as well as infrastructure expansion will also be minimal by 2045. In the case of late action to reach net zero by 2060, the required investments as a portion of GDP are relatively stable over time. The lower investment requirement is the result of reduced expected costs in the future.

Net Zero Emissions Lead to More Prosperous Population

Net zero emissions will lead to creation of new jobs. The earlier the net zero target is achieved, the better. Creation of new jobs especially in the energy sector is a result of investments in energy efficiency, electrification in the transportation system, development and expansion of the utilization of renewable energy, and eventually development of new energy such as hydrogen, and the likes. Job creation is a direct result of the expansion in the manufacturing and installation of new capacity, operations, and management. Figure 5 below shows that there will be about 1.6 million additional jobs created due to the additional investments in low carbon sectors in order to achieve the net zero emission target. Overall, combined with jobs created in other sectors, there will be about 3.2 million new jobs to be created while half of which will be in the energy sector due to the massive expansion of renewables.

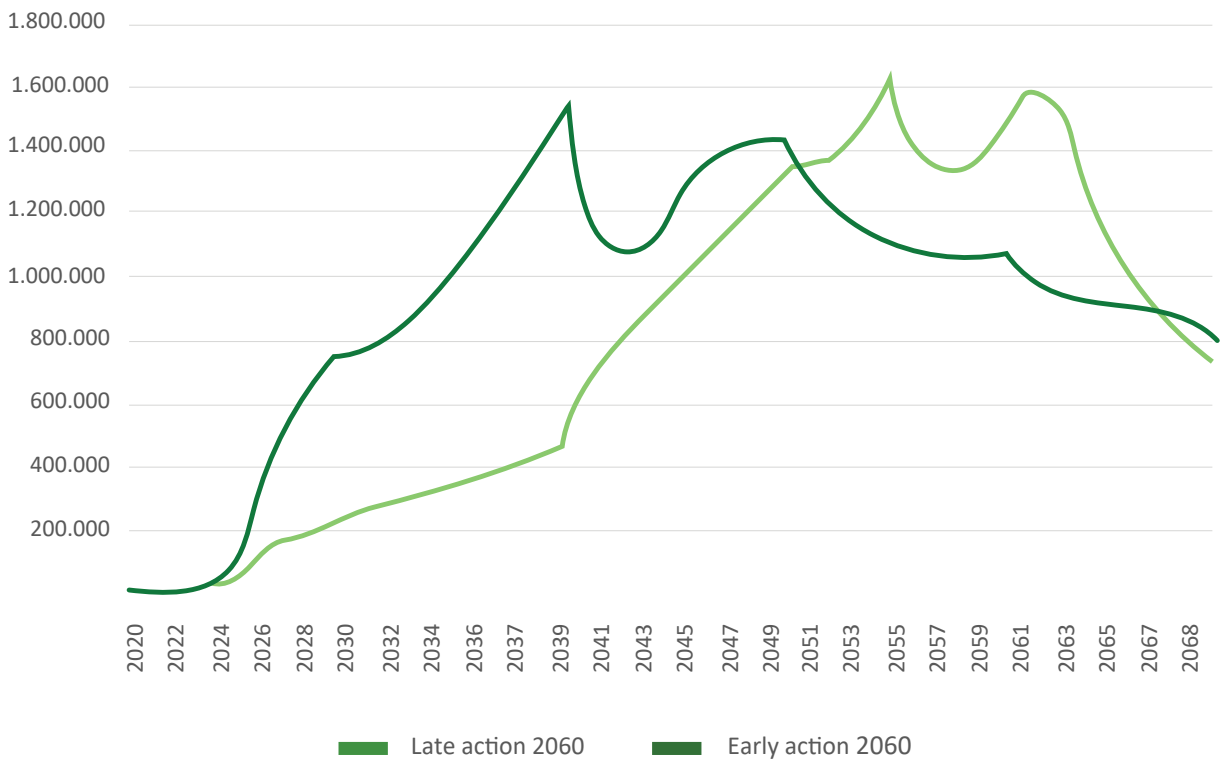
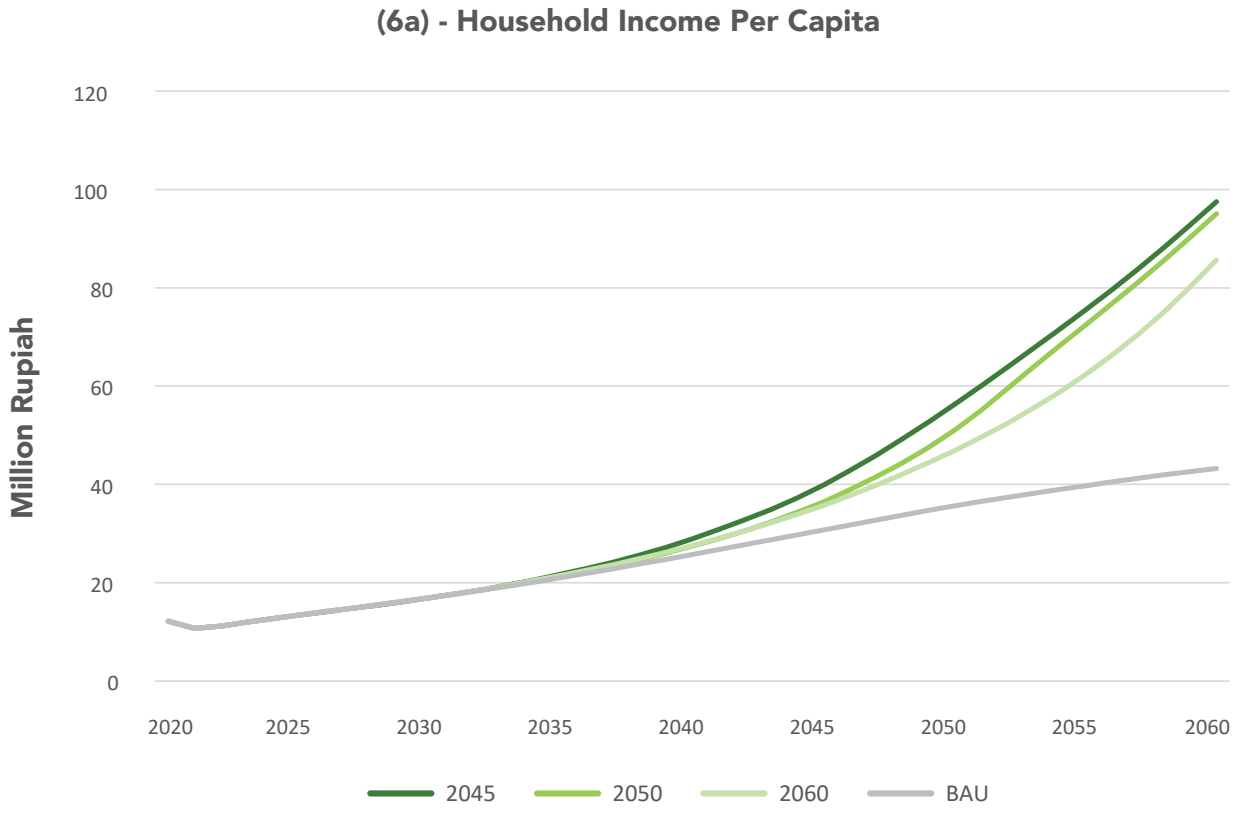


Figure 6.4. Comparing the impacts of two extreme net zero scenarios, namely net zero emissions in 2060 with delayed actions and net zero emissions in 2045 in 2045 with early actions.

Net zero emissions will also generate more household income. As shown on Table 1, above, household disposable per capita income will reach about Rp85.6 million in 2060, about twice as high as that in the BAU scenario. The number is higher when the net zero achievement is accelerated, to Rp95.1 million when achieved in 2050, and Rp97.5 million when achieved in 2045. Achievement of net zero emissions will also reduce unemployment rate to 3.3 percent when achieved by 2050 and 3.8 when achieved in 2045. This is better compared with 5 percent when achieved in 2060, or even 17.5 percent in the BAU scenario.



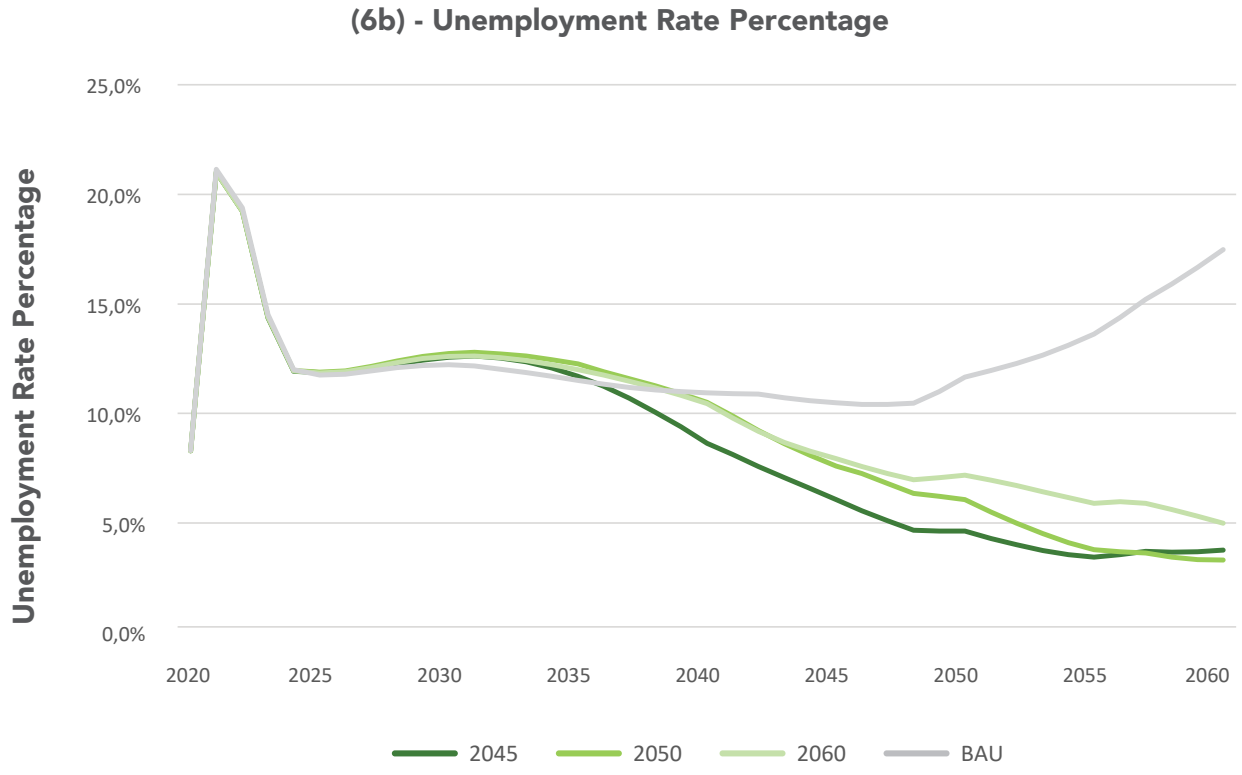


Figure 6.5. The positive impacts of the acceleration of net zero emissions target on the population. The figure on the left is the household disposable per capita income of the population in million rupiah, whereas the one on the right is the comparison of the unemployment rate between the BAU scenario and the achievements of the net zero emission targets by 2060, 2050, and 2045.

Net Zero Emissions Open Investment Opportunities

Bringing emissions to net zero by 2060 requires additional investment. The additional requirement should be considered as additional opportunity for investment in Indonesia. To reach net zero emissions by 2060, there is a cumulative investment amounting Rp266 quadrillion ($18.3 trillion) within the period of 2021-2060, while more than half of which will be needed in last 15 years of the period (2046-2060). Additional Rp108 quadrillion ($7.5 trillion) is therefore required compared with the Rp158 quadrillion required in the BAU scenario or roughly about Rp2.7 quadrillion ($186 billion) on a yearly basis.

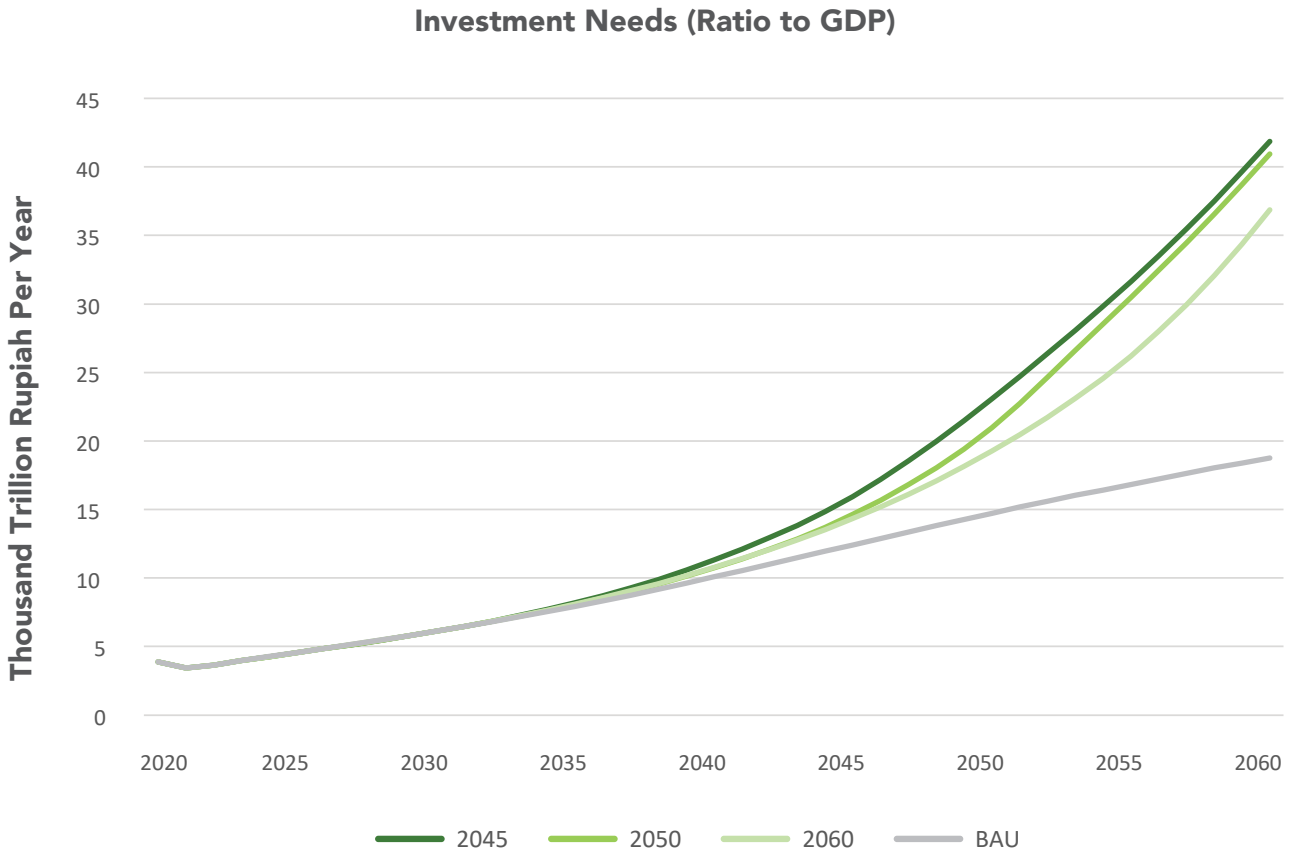


Figure 6.6. Investments required in the BAU scenario, in the net zero emissions target by 2060 scenario, and in the accelerated achievement of the net zero emissions target by 2050 and 2045 scenarios.

Accelerating the achievement of net zero emissions by 2050 and 2045 requires larger additional investments while bringing additional benefits. The simulations show cumulative investments of about Rp340 quadrillion ($23.4 trillion) to accelerate the achievement of net zero emissions by 2050 and Rp 410 quadrillion ($28.3 trillion) by 2045. This means that there is an additional investment amounting Rp182 quadrillion (Rp4.5 quadrillion or $313 billion per year) to reach net zero emissions by 2050 and Rp 254 quadrillion (Rp6.35 quadrillion or $437 billion per year) when 2045 in the period of 2021-2060, compared with that in the BAU scenario. When compared between the BAU and the accelerated ones, the additional investment requirements will be about Rp74 quadrillion ($5.1 trillion) when net zero emissions target is accelerated to 2050 (Rp 3 quadrillion or $206 billion per year) and Rp145 quadrillion ($10 trillion, or Rp 5.8 quadrilliun or $400 billion per year) when accelerated to 2045 in the period of 2021-2060.

Early Actions Provides More Benefits than Delayed Actions. Figure 5 and 6 above shows the different pathways between early and delayed actions. Early actions will bring more benefit since there will be larger amount of investments made available early and as a result can bring the benefits from the additional investments early. Delayed action may need slightly less amount of investment, but may bring additional risk of missing the window of opportunities that arises from the early actions. However, the lower amount and more evenly distributed amount of investments required in the delayed actions may also be useful in the effort of sufficiently raising the financing resources.

Financing Net Zero Emissions

Climate financing is one of the biggest homework for setting up net zero emissions target. At COP15 in Copenhagen, developed countries have pledged to provide US$100 billion a year by 2020 for climate finance for adaptation with and mitigation to climate change.[102] At COP26, however, world leaders recognized that current financing remains far from the pledged amount, and agreed on a delayed the delivery of the hundred billion, even when the actual financial need is far larger than that.[103] The IPCC estimated that $1.6 - $3.8 trillion are needed to avoid global heating to exceed 1.5 °C, while the WEF estimated about $4 - $5 trillion, per year.[104]

Current level of financing falls short of the requirements. It already fell short of the billion pledged amount. The Climate Policy Initiative (CPI) estimated that total climate finance has reached $632 billion in 2019/2020, from almost half-and-half between public and private sources. About three-quarters flowed domestically, mainly in developed countries. The majority of climate finance (about 91 percent) went to solar energy, while electric vehicles was gaining momentum being the most rapidly-growing recipient.[105]

In Indonesia, additional $186 billion per year may be required to achieve net zero emissions by 2060. From which, additional $5.1 trillion and $10 trillion are required to accelerate the achievements of net zero emissions by 2050 and 2045, respectively. As Table 3 and Figure 6 above shows, additional investment to reach net zero emissions by 2060 may amount to about Rp108 quadrillion ($12 trillion) in the 40 years period to 2060, or about Rp2,700 trillion ($186 billion per year).

102 Timperley, J., 2021. "How to Fix the Broken Promises of Climate Finance", Nature 598 (October 21, 2021), pp. 400-402.

103 UNFCCC, 2021b, op cit.

104 IPCC, 2018. Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. Intergovernmental Panel on Climate Change, Geneva; WEF, 2021, op cit.

105 Buchner, B., B. Naran, P. Fernandes, R. Padmanabhan, P. Rosane, M. Solomon, S. Stout, C. Strinati, R. Tolentino, G. Wakaba, Y. Zhu, C. Meattle, S. Guzman, 2021. Global Landscape of Climate Finance 2021 (December 2021). Climate Policy Institute, London.

And to accelerate the net zero emissions target to 2050 or 2045, additional investments of about Rp74 quadrillion ($5 trillion) and Rp145 quadrillion, ($10 trillion) respectively, or about Rp1,875 trillion ($129 billion) and Rp3,625 trillion ($250 billion) annually, respectively. The additional investment required to achieve net zero emissions by 2060 is expected to come from own efforts, while the efforts to accelerate it earlier than 2060 will be subject to availability of international financial assistance.

Financing for net zero emissions need innovative strategy that blends financial sources. Greening PEN will provide additional resources to leverage green investments but needs to be sustained with additional sources and policy in the mid- and long-term actions leading up to the net zero year. Among the factors that contribute to addressing the challenges of financing the net zero action plans are innovative and strategic blending of financial resources and targeted public intervention. Innovative and strategic blending is required so that public investment can attract additional resources in the form of private financing.[106] Blended financing is a way to use public or philanthropic investments strategically to leverage private financing. Blending different sources of financing aims to match different risk appetite of each of the blended resources with the risk profile of the financing pipeline in order to reallocate risks, and in turn increase the potential for the pipeline to be fully financed and realized.[107]

Strategic public investment intervention can serve to leverage additional investments from the private sector. The role of private financing is key in power sector transition. In its latest report, the World Bank recommends the following strategies, namely strengthening the power sector institutions, enabling private investments in renewable energy, ensuring

private sector financial sustainability, and paving a just transition for all.[108] Public investment can be strategically utilized to attract private financing. In addition to the green recovery portion under the PEN in the short term, other mid- and long-term sources of public financing can also be utilized, such as carbon tax, other carbon pricing mechanism such as carbon market, and the usual state budget. Simulations of different scenarios of public financial sources and different assumptions of leveraging ratio of the public investment to successfully attracting private financing are carried out as a part of the modeling exercise. This financial model is not in the original LCDI model and is being developed solely to analyze the effectiveness of each of the scenarios in sufficiently providing the required investments to reach net zero emissions. The model is still rough and will continue to be refined in the next iteration, but the result can still be instructive.

106 WEF, 2021, op cit.

107 Blended Finance Taskforce, 2018. Better Finance Better World: Consultation Paper of the Blended Finance Taskforce. Blended Finance Taskforce in partnership with Business and Sustainable Development Commission and SystemIQ, London.

108 The World Bank, 2021. A Green Horizon: Toward a High Growth and Low Carbon Economy, Indonesia Economic Prospects (December 2021). The World Bank Group, Jakarta.

Different net zero emission target years require different strategies. Three financing options are simulated in the model as follows. The first is the "private sector-heavy" option. This option simulates a situation where the leveraging ratio, which is the amount of government investment required to attract certain amount of private investment, is rather ambitious, namely 1:10 (one rupiah of public investments will attract 10 rupiah of private investments), whereas the amount of carbon tax is at its minimum as already stipulated by the government, namely Rp30 per kg ($2 per ton). The second is called "carbon tax-heavy" option where allocation of green recovery is the same, while the carbon tax rate is relatively high at Rp600 per kg, about $40 per ton and investment leveraging ratio at 1:3. Finally, the third is an "APBN-heavy" option, focused on government investment. In this simulation, allocation of green recovery under PEN is doubled with carbon tax amounting Rp450 per kg ($30). The assumptions and simulation results can be seen in Table 7.1 below.

Skenario pendanaan	Private sector -heavy	Carbon tax-heavy	APBN-heavy
Leveraging ratio (public vs private investment)	1:10	1:3	1:3
Green recovery share in the state budget (APBN) compared with its current allocation under PEN	Same	Same	Doubled
Carbon tax (rupiah per kg)	30	600	450
Sufficiency of financing to achieve net zero emissions by 2060 (percent)	59%	85%	98%
Sufficiency of financing to achieve net zero emissions by 2060 (percent)	49%	87%	68%

Table 7.1. Summary of financing scenario: private sector-heavy, APBN-heavy, and carbon tax-heavy, with different assumptions of leveraging ratio, share of green recovery in the state budget, and the level of carbon tax.

The role of the government investment, especially through reinvesting the revenue from carbon tax in leveraging private investment, is immensely strategic. The result of the simulation shows that the APBN-heavy will provide the closest amount of the investment requirement (about 98 percent of what is required) for net zero target year of 2060, but only second (about 68 percent of what is required) to carbon tax-heavy for net zero target year of 2050. Carbon tax-heavy option will provide 85 and 87 percent of what is required to reach net zero emissions by 2060 and 2050, respectively.

Carbon tax will be especially effective in earlier net zero emissions targets. Carbon tax is not only about increasing the government's tax revenue, but also about reducing emissions. Carbon tax — carbon pricing in general — is meant to reduce emissions by providing disincentives for carbon-intensive sectors. The use of the revenue to support low-carbon sectors will provide further fiscal difference between carbon-intensive and low-carbon sectors. As such, over time, carbon tax will reduce carbon emissions and corollary carbon tax revenue will decrease.

Due to the inertia of the sectors, in the first years the revenue from carbon tax will remain high that it could sufficiently provide most of the necessary public investments to leverage private financing when the net zero emission target is early.

But for later net zero emission targets, the effectiveness of carbon tax is reduced and as such requires additional supplement from other source of government funding.

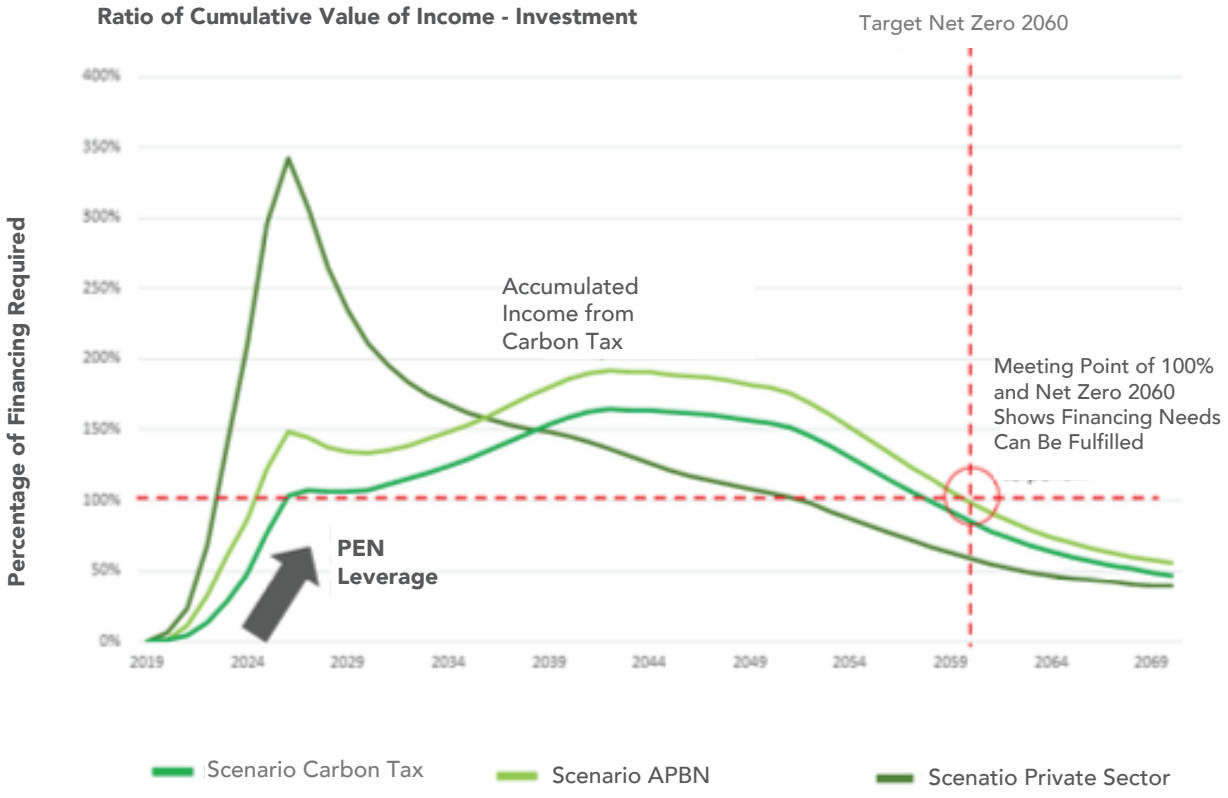


Figure 7.1. (1) APBN-heavy option shows a scenario of green recovery share being doubled from the current amount under PEN, carbon tax of $30 per ton, and leveraging ratio of government financing of 1:3; (2) carbon tax-heavy option shows a scenario of high carbon tax at $40 per ton, green recovery share at the same amount as the current one under PEN, and leveraging ratio of government financing 0f 1:3, and (3) Private sector-heavy option shows a scenario with the same amount of green recovery share under PEN, carbon tax at a minimum level of $2 per ton, and government investment ratio of 1:10.

Private sector investment is indeed important but only when supplemented by supportive government policy. High leveraging ratio without sufficient investment from the government will not lead to sufficient amount of financing required to reach net zero. Carbon tax can be tolling for the private sector. But when structured right, it can provide not only incentive and disincentive purposefully, but also as complementary resource in a strategic blended financing structure. The public funding can serve as a way to reallocate risks and to provide comfort to private investors. In the modeling simulations, the private sector-heavy will only provide 59 and 49 percent of what is required to reach net zero emissions by 2060 and 2050, respectively.

Conclusion

Reaching net zero is a proxy of a low carbon green economy. Addressing climate crisis requires systemic change in the way the world looks at economic progress and growth. It requires much more than piece-meal technological and economic fixes leading towards the so-called "net zero" in short- and mid-terms, but a long-lasting sustainability, in which net zero emissions is an inevitable element. A sustainable economy is one that is compatible with the climate system.

Green recovery or green reset will provide short-term trigger as a momentum to provide direction to reach net zero emissions target, but needs to be sustained with additional financial sources and appropriate policies. The pandemic-driven recession spurs massive recovery program that not only supports the population from the massive public health challenges, but also shields the economy from worsening recession and eventually supports key sectors that will lead to recovery. When structured and prioritized well, the recovery program can at the same time lay the foundations to lead to better and more sustainable economy and net zero emissions. To have a long-lasting effect, however, the short-term utilization of green recovery budget needs to be augmented by appropriate policies such as strong support for phasing out fossil fuels, development of renewable energy, sufficiently high carbon price and its utilization, and supportive intervention that attracts the participation of private investors in green investment.

As opportunity to invest is increased, reaching net zero emissions will provide positive impacts on the economy. The earlier net zero emissions are achieved, the larger the benefits will be. Reaching net zero emissions by 2060 will require additional investments that eventually will lead to increased economic growth, household disposable incomes, job creations, as well as reduced emissions. The earlier net zero emissions are achieved, the larger the investment opportunities will be, but also the larger the benefits will be on the economy when the required investments are sufficiently fulfilled. Additionally, the earlier actions to reach net zero, the earlier and larger the benefits that can be enjoyed by the economy compared with delayed actions. Additionally, with delayed actions there may be a risk of missed deadlines.

To reach net zero emissions by 2060, Indonesia needs additional cumulative investment of Rp108 quadrillion (Rp2.7 quadrillion, or about $186 billion per year) between 2021 and 2060. An additional Rp74 quadrillion (Rp 3 quadrillion or $206 billion per year) is needed to accelerate the net zero emission target to 2050, and Rp145 quadrillion (Rp5.8 quadrillion or $400 billion per year) to reach it by 2045, compared with what is needed to reach it by 2060. From the current investment needs of about Rp158 quadrillion per year, Indonesia will need about Rp266 quadrillion in total to reach net zero by 2060. The government can provide a portion of the investment needed sourced from the green recovery budget, carbon tax and levies, or other sources.

The role of private financing is immensely strategic, but only when public intervention, including investment, is appropriate. Private financing can be leveraged through strategic public investment. For which, strategic allocation of green recovery can be a good start for the short-term. However, it needs to be followed by additional public resources for the mid- and long-term that can be used to leverage private investment. In addition to state budget, appropriate amount of carbon tax and other carbon pricing instruments can be a good source of public financing when appropriately reallocated to attract private investment. Additionally, policies that facilitate end-use energy efficiency, renewable energy development, and overall low carbon development need to be in place for the investments to be effective.

As the Chair of the G20, Indonesia is in the spotlight for the world to see. At the G20 Summit in Bali in late October, Indonesia needs to show its leadership not only among the G20 member countries, but also worldwide. This is not only a challenge, but also an opportunity for Indonesia to collaborate within the framework of the G20 to benefit not only the country and its people, but also the global community, to address the climate crisis.

References

"COP26: More than 40 countries pledge to quit coal", *BBC News* (November 4, 2021).

"Jokowi Sebut Ekonomi Negara Mirip Komputer 'Hang'", *CNN Indonesia* (14 Agustus 2020).

"Jokowi Minta Komitmen RI Sulap PLTU Jadi EBT Benar-benar Jalan", *CNN Indonesia* (17 November 2021).

"Japan opens world's largest green-hydrogen plant near Fukushima disaster site", *Recharge* (March 9, 2020).

""Menkeu: Kebijakan PEN 2022 Responsif dan Fleksibel", Kementerian Keuangan (18 Agustus 2021) (https://www.kemenkeu.go.id/publikasi/berita/menkeu-kebijakan-pen-2022-responsif-dan-fleksibel/, accessed on November 28, 2021).

"President Jokowi Pushes for Electric Car Development in Jakarta," Sekretariat Kabinet (Cabinet Secretary, setkab.go.id) (May 2, 2018).

"President Jokowi: Indonesia Wants G20 to Set Example in Handling Climate Change", Cabinet Secretariat of the Republic of Indonesia (https://setkab.go.id/en/president-jokowi-indonesia-wants-g20-to-set-example-in-handling-climate-change/, accessed on November 29, 2021)

Indonesia To Produce 60,000 EV Motorcycles in Indonesia," *Tempo.co* (November 7, 2018).

"The Great Reset", World Economic Forum (https://www.weforum.org/focus/the-great-reset, diakses pada 26 November 2021).

Aldila, N., dan H. Alaydrus, 2021. "ADB Kaji Pensiun 7 Pembangkit Listrik Bahan Bakar Batu Bara di Indonesia dan Filipina", *Bisnis Indonesia* (4 November 2021).

Andrijevic, M., C-F., Schleussner, M.J. Gidden, D.L. McCollum, and J. Rogelj, 2020. "COVID-19 recovery funds dwarf clean energy investment needs", *Science* 370, pp. 298–300.

Aylward-Mills, D., J. Payne, M. Sudirman, M.E. Wijaya, B.M. Mecca, M. Zeki, dan A.R. Haesra, 2021. *Improving the impact of fiscal stimulus in Asia: An analysis of green recovery investments and opportunities* (February 2021). Climate Policy Initiative and Vivid Economics, Jakarta and London.

Bappenas (Ministry of National Development Planning), 2019. *Low Carbon Development: A Paradigm Shift Towards a Green Economy in Indonesia*. Ministry of National Development Planning, Jakarta;

Bappenas, 2021. *A Green Economy for a Net-Zero Future: How Indonesia Can Build Back Better After Covid-19 with the Low Carbon Development Initiative*. Ministry of National Development Planning, Jakarta.

Baylin-Stern, A., and N. Berghout, 2021. "Is carbon capture too expensive?" International Energy Agency (February 17, 2021).

Birol, F., 2021. "COP26 climate pledges could help limit global warming to 1.8 °C, but implementing them will be the key", Commentary. International Energy Agency (4 November 2021).

Blended Finance Taskforce, 2018. *Better Finance Better World: Consultation Paper of the Blended Finance Taskforce*. Blended Finance Taskforce in partnership with Business and Sustainable Development Commission and SystemIQ, London.

Boehm, S., K. Lebling, K. Levin, H. Fekete, J. Jaeger, A. Nilsson, R. Wilson, A. Geiges, and C. Schumer, 2021. *State of Climate Action 2021: Systems Transformations Required to Limit Global Warming to 1.5 °C*. World Resources Institute, Washington, D.C.

Box, G.E.P., 1976. "Science and Statistics", in *Journal of the American Statistical Association* 71 (356), pp. 791-799.

BPS (Badan Pusat Statistik, the National Central Statistical Agency), 2020. *Indonesian Palm Oil Statistics*. Badan Pusat Statistik, Jakarta.

BPS (Badan Pusat Statistik), 2021. *Berita Resmi Statistik* (5 November 2021).

Buchner, B., B. Naran, P. Fernandes, R. Padmanabhan, P. Rosane, M. Solomon, S. Stout, C. Strinati, R. Tolentino, G. Wakaba, Y. Zhu, C. Meattle, S. Guzman, 2021. *Global Landscape of Climate Finance 2021* (December 2021). Climate Policy Institute, London.

Climate Action Tracker, "Indonesia", https://climateactiontracker.org/countries/indonesia/ (accessed on December 5, 2021). The commitment reviewed excludes the forestry sector.

Dagnet, Y. and J. Jaeger, 2020. "Not Enough Climate Action in Stimulus Plans", *World Resources Institute* (September 15, 2020). World Resources Institute, Washington, D.C.

Dananjaya, D., 2021. "Gojek Bakal Sewakan Motor Listrik buat Mitra Drivers", *Kompas* (November 23, 2021).

EC (European Commission), 2021. "Recovery Plan for Europe", *European Commission* (https://europa.eu/next-generation-eu/index_en, accessed on December 1, 2021).

ESDM (Ministry of Energy and Mineral Resources of the Republic of Indonesia), 2020. Handbook of Energy and Economic Statistics of Indonesia 2020. Ministry of Energy and Mineral Resources of the Republic of Indonesia, Jakarta.

Esser, S., C. Chua, and A. Vagneur-Jones, 2021. *2030 Indonesia Roadmap: Multiplying the Transition: Market-based solutions for catalyzing clean energy investment in emerging economies* (October 2021). Bloomberg NEF and Climate Investment Funds, New York.

Evans, S., and J. Garbatiss, 2020. "Coronavirus: Tracking how the world's 'green recovery' plans aim to cut emissions", *Carbon Brief* (June 16, 2020).

Fajrian, H., 2021. "Jokowi Minta PLN dan Pertamina Tak Menunda Transisi Energi", *Katadata* (November 20, 2021).

Fitra, S., 2018. "Indonesia's First Step To Become Electric Car Manufacturer," *Kata Data* (December 6, 2018).

Fleming, S. ,2021. "These countries are leading the way on a post-pandemic green recovery", (April 29, 2021) *World Economic Forum*. World Economic Forum, Geneve.

Greenpeace and INDEF (Institute for Development Economics and Finance), 2020. *Pemulihan Ekonomi Nasional: Business as Usual atau Pro-Lingkungan?* Briefing Paper Diskusi Greenpeace Indonesia-INDEF (September 10, 2020).

Habir, M.T., and W. Wardana, 2020. "COVID-19's Impact on Indonesia's Economy and Financial Markets". *Perspective* (December 15, 2020). Yusof Ishak Institute, Institute for South East Asian Studies, Singapore.

Ho, J., Muhammad, H., Brurce, Z., Mecca, M., Rabinsa, A., Keewon, H., Lee, K. S., and Rosidah, R., 2021. *Leveraging fiscal stimulus to improve energy transition: Case of South Korea and Indonesia*. Climate Policy Initiative, San Francisco.

IEA, 2020. *Energy Technology Perspectives 2020: Special Report on Carbon Capture Utilization and Storage: CCUS in clean energy transitions*. International Energy Agency, Paris.

IEA (International Energy Agency). 2021a. *World Energy Outlook 2021: Technical note on the emissions and temperature implications of COP26 pledges* (November 2021). International Energy Agency, Paris;

IEA, 2021b. *Geothermal Power*. International Energy Agency, Paris.

IEA, 2021c. *Solar PV*. International Energy Agency, Paris (https://www.iea.org/reports/solar-pv, accessed on 29 December 2021).

IEA, 2021d. "CCUS around the world", International Energy Agency (April 2021) (https://www.iea.org/reports/ccus-around-the-world, accessed December 28, 2021).

IEA, 2021e. "CCUS in Power", International Energy Agency (November 2021) (https://www.iea.org/reports/ccus-in-power, accessed on December 28, 2021).

IMF. IMF Datamapper (https://www.imf.org/external/datamapper/profile/WEOWORLD, accessed on December 28, 2021).

IMF (International Monetary Fund). IMF Datamapper, Indonesia (https://www.imf.org/external/datamapper/profile/IDN, accessed on December 28, 2021).

IMF. IMF Datamapper, World (https://www.imf.org/external/datamapper/profile/WEOWORLD, accessed on December 28, 2021).

IPCC, 2005. *Special Report on Carbon Dioxide Capture and Storage*. Cambridge University Press, Cambridge.

IPCC, 2018. *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. Intergovernmental Panel on Climate Change, Geneva; WEF, 2021, *op cit*.

IPCC (Intergovernmental Panel on Climate Change), 2021 (*in press*). "Summary for Policymakers", in Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.), *Climate Change 2021: The Physical Science Basis*, Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge.

IRENA (International Renewable Energy Agency), 2019. *Hydrogen: A renewable energy perspective*. International Renewable Energy Agency, Abu Dhabi.

IRENA, 2020. *Global Renewables Outlook 2020: Energy Transformation 2050*. International Renewable Energy Agency, Abu Dhabi.

IRENA, 2021. *World Energy Transition Outlook: 1.5 °C Pathway*. International Renewable Energy Agency, Abu Dhabi.

Jayani, D.H., 2020. "Ekonomi Indonesia Naik Kelas", *Katadata* (10 Juli 2020).

JICA (Japan International Cooperation Agency and Nippon Koei, 2011. *Project for the Master Plan Study of Hydropower Development in Indonesia, Final Report Vol. II, Main Report* (August 2011). The Ministry of Energy and Mineral Resources, Republic of Indonesia, and PT PLN (Persero), Jakarta.

McGrath, M., 2021. "Climate change: IPCC report is 'code red for humanity'", *BBC News* (9 Agustus 2021); IPCC, 2021, *op cit*.

Meadows, D.H., 2008. *Thinking in Systems: A Primer*. Chelsea Green Publishing for Sustainability Institute, White River Junction.

Monoarfa, S. 2021. *Pembangunan Rendah Karbon Indonesia dan Net Zero Emission Menuju Ekonomi Hijau*, presented at the Indonesia Net Zero Summit 2021, Save Indonesia Gold 2045 from the Threat of the Climate Crisis. Ministry of National Development Planning, Jakarta.

Mou, J., 2020. "Research on the Impact of COVID19 on Global Economy", *Earth and Environmental Science* 546 (2020).

Mudassir, R., 2022. "ESDM Bidik Target Produksi 663 Juta Ton Baru Bara Pada 2022", *Bisnis Indonesia* (January 12, 2022); Umah, A., 2021.

"Resmi! Target Produksi Batu Bara 2021 Naik Jadi 625 Juta Ton", CNBC Indonesia (April 14, 2021).

Nugroho, S.A., 2019. "Blue Bird Hadirkan Mobil Listrik Tesla dan BYD", *Kompas* (April 22, 2019).

OECD/IEA (Organization for Economic Cooperation and Development / International Energy Agency), 2018. *Global EV Outlook 2018: Towards Cross-Modal Electrification*. International Energy Agency, Paris, France.

PLN, 2021. *Rencana Usaha Penyediaan Tenaga Listrik (RUPTL) PT PLN (Persero) 2021-2030*. PT Perusahaan Listrik Negara, Jakarta.

Pratama, A.M., 2018. "Sri Mulyani: Angka Kemiskinan di Bawah 10 Persen Pertama Kalinya dalam Sejarah Indonesia", *Kompas* (17 Juli 2018).

The Government of the Republic of Indonesia (RI), 2014. Government Regulation No. 79/2014 on the National Energy Policy.

RI, 2017. Presidential Regulation No. 22/2017 on the National General Energy Plan.

RI, 2016. Undang-Undang No. 16/2016 mengenai Pengesahan Paris Agreement to the United Nations Framework Convention on Climate Change (UNFCCC) (Persetujuan Paris atas Konvensi Kerangka Kerja Perserikatan Bangsa-Bangsa mengenai Perubahan Iklim) (25 Oktober 2016). Law No. 16/2016 on the ratification of the Paris Agreement to the UNFCCC.

RI, 2020. Peraturan Pemerintah No. 23/2020 tentang Pelaksanaan Program Pemulihan Ekonomi Nasional dalam Rangka Mendukung Kebijakan Keuangan Negara untuk Penanganan Pandemi Corona Virus Disease 2019 (COVID-19) dan/atau Menghadapi Ancaman yang Membahayakan Perekonomian Nasional dan/atau Stabilitas Sistem Keuangan serta Penyelamatan Ekonomi Nasional (Government Regulation No. 23/2020 on the Implementation of the National Economic Recovery Program to Support the State's Financial Policy to Address the Corona Virus Disease 2019 (Covid-19) and/ or to address the Dire Threat to the National Economy and/ or the Stability of the Financial System and the Rescue of the National Economy.

RI, 2021. *Updated Nationally Determined Contribution Republic of Indonesia* (July 21, 2021).

Ridwan, M., 2021. "Menteri ESDM: Target Bauran Energi 23 Persen Sulit Dicapai", *Bisnis Indonesia* (July 27, 2021).

Rosana, F.C., 2021. "Luhut Sebut RI Targetkan Nol Emisi Karbon pada 2060 atau Lebih Cepat", *Tempo* (4 November 2021).

Sari, A., 2020. "Dilema Produksi Solar Nabati", *Kompas* (September 14, 2020).

Setiawan, V.N., 2021. "PLN Sebut Harga Listrik Tenaga Surya Lebih Murah Ketimbang Batu Bara", *Katadata* (March 2, 2021).

Shofa, J.N., 2022. "Indonesia Asks Developed Countries to Fund Energy Transition", *Jakarta Globe* (January 20, 2022).

Sidik A., B., 2021. "Optimisme Pencapaian Bauran Energi Baru dan Terbarukan", *Kompas* (Dcember 31, 2021).

Suharsono, A., N. McCulloch, M. Mostafa, R. Bridle, L. Lontoh, P. Gass, 2019. *Getting to 23 Percent: Strategies to scale up renewables in Indonesia*, GSI Report (July 2019). The International Institute for Sustainable Development, the Global Subsidies Initiative, and the Swedish Energy Agency, Winnipeg.

Sumarno, T.B., and L. Sanchez, 2021. *How Indonesia Can Achieve Both a Covid-19 Recovery and Its Climate Targets* (September 2021). International Institute for Sustainable Development and Global Subsidies Initiative, Winnipeg.

Susanto, V.Y., 2021. "COP26 Glasgow, Jokowi sampaikan komitmen Indonesia dalam penanganan perubahan iklim", *Kontan* (November 2, 2021).

Timperley, J., 2021. "How to Fix the Broken

Promises of Climate Finance", *Nature* 598 (October 21, 2021), pp. 400-402.

Umah, A., 2020. "24 Proyek Listrik Terbarukan Masih Gantung Pendanaannya", *CNBC Indonesia* (28 Juli 2020); Sulaeman, 2020. "DPR: Penerapan Energi Terbarukan 23 Persen di 2025 Sulit Tercapai", *Liputan 6* (21 Desember 2020).

Umah, A., 2021. "Jokowi Minta Roadmap EBT-Setop PLTU Tuntas Sebelum G20 2022", CNBC Indonesia (November 22, 2021)

UNFCCC (United Nations Framework Convention on Climate Change), 2015. *The Paris Agreement*, UNFCCC Decision No. FCCC/CP/2015/10/Add.1.

UNFCCC, 2021a. *Nationally determined contributions under the Paris Agreement: Revised synthesis report by the secretariat*, Document No. FCCC/PA/CMA/2021/8/Rev.1 (October 25, 2021); UNEP (United Nations Environent Program), 2021. *The Heat Is On: A World of Climate Promises Not Yet Delivered*. United Nations Environment Program, Nairobi.

UNFCCC, 2021b. *Glasgow Climate Pact*.

UNICEF (United Nations Children Fund), UNDP (United Nations Development Program), Prospera (Australia Indonesia Partnership for Economic Development), and SMERU, 2021. *Analysis of the Social and Economic Impacts of COVID19 on Households and Strategic Policy Recommendations for Indonesia*. United Nations Children Fund, Jakarta.

Vivid Economics, 2021. *Greenness of Stimulus Index: An assessment of COVID-19 stimulus by G20 countries and other major economies in relation to climate action and biodiversity goals* (July 2021). Vivid Economics and Finance for Biodiversity Initiative, London.

WEF (World Economic Forum), 2021. *Financing the Transition to a Net-Zero Future*, Insight Report (October 2021). World Economic Forum in collaboration with Oliver Wyman, Geneva.

Wira, I.N., 2018. "President Jokowi Optimistic About Electric Cars in Indonesia," *The Jakarta Post* (April 20, 2018).

World Bank, 2021. *A Green Horizon: Toward a High Growth and Low Carbon Economy*, Indonesia Economic Prospects (December 2021). The World Bank Group, Jakarta.

THE GREEN RESET:

ENHANCING AMBITION FOR EMISSION REDUCTION FROM THE ENERGY SECTOR IN POST-PANDEMIC INDONESIA

DECEMBER 2021

Pangeran Diponegoro Street no. 2. Central Jakarta, Jakarta Capital - Indonesia