DEEP DECARBONIZATION PATHWAYS

# POLICY LESSONS ON DEEP DECARBONIZATION

## in large emerging economies

# INDONESIA

*Boer R., Siagian U., Retno Gumilang Dewi, Rossita A.1, Anggraeni L., Immanuel G.S.*

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***Contact***

Henri Waisman, henri.waisman@iddri.org

Rizaldi Boer, rizaldiboer@gmail.com

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Editing: Marta Torres Gunfaus, Anna Pérez Català, Henri Waisman.

Layout: Ivan Pharabod.

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*Boer R.*[1], *Siagian U.*[2], *Retno Gumilang Dewi*[2], *Rossita A.*[1], *Anggraeni L.*[1] , *Immanuel G.S.*[1]

1 Center for Climate Risk and Opportunity Management (CCROM) in Southeast Asia and Pacific, IPB University
2 Center for Research on Energy Policy (CREP), Bandung Institute of Technology (ITB)

## Disclaimer

The results presented in this report are outputs of the academic research conducted under the DDP BIICS project as per the contractual agreement. The academic work does not in any way represent our considered opinion for climate negotiations and also does not reflect the official policy or position of the Government of Indonesia.

## WHY IS THIS REPORT SUBMITTED TO GST, AND WHAT TO EXPECT?

This report contains policy recommendations to realise national deep decarbonization pathways based on in-country scientific model-based analysis in four countries: Brazil, India, Indonesia and South Africa. This digest includes a description of deep decarbonization scenarios' main features, main synergies and trade-offs with country non-climate objectives, priority short-term policies and actions and key international enablers and accelerators of domestic transitions. Thus, it provides relevant information for the Mitigation, Finance flows and Means of Implementation & Cross-cutting thematic areas of the Global Stocktake (GST). Whereas the report does not provide a collective picture, bottom-up granular policy lessons from these four large emerging economies are essential input to assess the adequateness of the progress achieved and necessary action to keep the global long-term goals of the Paris Agreement within reach.

For each of these areas, we identify in the table below against which specific guiding questions, this report can provide relevant elements:

| | In the DDP BIICS Policy Lessons Report you can find… |
|---|---|
| **Mitigation** | |
| **2**. What is the collective progress made towards achieving the long-term mitigation goal in Article 4.1 of the Paris Agreement, in the light of equity and the best available science? | Country assessments explored Current Policy Scenari-os (CPS) to understand the outcome of the current policy packages: main features and emission profiles can be found in Part I of each of the country chapters. Priority short-term policies and actions section in Part II discusses priorities based on a gap analysis be-tween CPS and Deep Decarbonisation scenarios (DDS). |
| **3.** What are the projected global GHG emissions and what actions are Parties undertaking to achieve a balance between anthropogenic emis-sions by sources and removals by sinks of GHGs, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty (Article 4.1 Paris Agree-ment, Decision 19/CMA.1, paragraph 36(b))? | The emission profiles of the DDS scenarios are in Part I of each of the country chapters. They represent a country-driven perspective of the national contribu-tion to the Paris Agree-ment global mitigation goal in the context of sustainable development. Projections explicit emissions by sources and removals by sinks. |
| **Finance flows and Means of Implementation** | |
| **11.** What are the barriers and challenges, including finance, technology development and transfer and capacity-building gaps, faced by developing coun-tries? | All country chapters put an emphasis on barriers and chal-lenges for realising the domestic transformations. This is namely covered in Part 2, including two specific sections on Investment patterns and Key international enablers and accel-erators of domestic transitions. |
| **12.** What is the collective progress made towards achieving the long-term vision on the importance of fully realizing technology development and transfer in order to improve resilience to climate change and to reduce greenhouse gas emissions referred in Article 10.1 of the Paris Agreement? What is the state of cooperative action on technology develop-ment and transfer? | This is best reflected under Key international enablers and accelerators of domestic transitions section in Part II for each of the country chapters. This digest focuses on the key enablers for the priority actions that have been identified to get onto the right path towards deep decarbonisation. |
| **13.** What progress been made on enhancing the ca-pacity of developing country Parties to imple-ment the Paris Agreement (Article 11.3 Paris Agreement)? | Progress on the enhancement of capacity is implicit in the assessment of the progress (as modelled in the CPS scenario) and the policy analysis of the gap that exists between current trends and the required level of action. |

| Cross-cutting | |
|---|---|
| **16.** To achieve the purpose and long-term goals of the Paris Agreement (mitigation, adaptation, and finance flows and means of implementation, as well as loss and damage, response measures), in the light of equi-ty and the best available science, taking into account the contextual matters in the preambular paragraphs of the Paris Agreement:<br>a. What are the good practices, barriers and challenges for enhanced action?<br>b. What is needed to make finance flows consistent with a pathway towards low GHG emissions and cli-mate-resilient development?<br>c. What are the needs of developing countries related to the ambitious implementation of the Paris Agree-ment? | The DDP approach underlying this report's research is fundamentally a country-driven exploration, back casting from the mid-century emission and socio-economic objectives to inform the short-term deci-sions within and across systems. Sectoral deep dives allow for an in-depth investigation of all levers, which are traditionally represented poorly in existing long-term roadmaps. Country-level lessons derive critical information for international discussion on overall progress, thus the entire report brings relevant evi-dence to this cross-cutting question. |
| **17.** What is needed to enhance national level action and support, as well as to enhance international co-operation for climate action, including in the short term? | The analyses underpinning this report have been de-signed under the premisses that scientific assess-ments should be seen less as an instrument to illus-trate transition pathways in a normative manner than as a way to determine the inclusive whole-of-society conversation that would be required to make the transition effective and acceptable in specific contexts. The gap between existing evidence and concrete ac-tion highlights that the carbon neutral transition is not only a matter of techno-economic feasibility but es-sentially a question of political economy and policy implementation. The report intends to bring clarity for each of the countries about the choices to be made in the transition, about the concrete policies and ac-tions that can be envisaged, about those who can be winners and those who may lose, and the measures adopted to manage the socio-economic costs of the transition. As a high-level digest, this is captured in Part 2 of the country chapters. |

# FOREWORD

Henri Waisman, Marta Torres Gunfaus, Anna Perez Catala, IDDRI.

The world has agreed to prevent the irreversible damages to human and natural ecosystems caused by anthropogenic global warming by limiting the rise of global temperature to well below 2°C and to pursue efforts to limit it to 1.5°C. To this, the Paris Agreement grounds this goal in terms of global emission trajectories and the need to embed them in the in the context of sustainable development and efforts to eradicate poverty. Subsequently science (IPCC SR1.5) further specifies that global neutrality concerning carbon dioxide specifically should happen between 2050 (for 1.5°C) and 2075 (for 2°C). It also points out the necessity of minding non-$CO_2$ forcers to maintain the global objective. To reach this scale of emission reductions, the scientific assessment concludes that rapid and far-reaching transformations, far beyond what has been observed in the past, are required in all components of the economic system, ie in energy, urban and infrastructure, industry and land and ecosystems. Such drastic transitions in turn require profound changes in technologies but also in social, economic, institutional and policy conditions. Science finally shows that the changes required by climate objectives can be compatible with broader sustainable development objectives if action is implemented without delay, is guided by strategic visions of transformations informing the design of well-designed policy packages and the cooperation among actors and is enabled by effective international cooperation. With these framework conditions at hand, countries are set to explore national pathways to explain how the rapid and far-reaching transitions required globally can happen in each country context.

National deep decarbonisation of large emerging economies has been largely explored from a techno-economic perspective, resulting in viable sets of long-term pathways under a number of conditions. Existing analysis shows that the national transition can mostly been initiated using existing technologies and market instruments at low and often net negative financial cost and that, usually, these transformations can have associated large overall net economic benefits when external economic costs and benefits are factored in. However, similar to most parts of the world, most major necessary decarbonisation transformations are either not happening or happening at a slower pace. This gap between existing evidence and concrete action highlights that the carbon neutral transition is not only a matter of techno-economic feasibility but essentially a question of political economy. Actual implementation requires clarity about the choices to be made in the transition, about the concrete policies and actions that can be envisaged, about those who can winners and those who may loose and the measures adopted to manage the socio-economic costs of the transition. Scientific assessments should therefore be seen less as an instrument to decide transition pathways in a normative manner than as a way to inform the inclusive whole-of-society conversation that would be required to make the transition effective and acceptable.

The DDP community behind this report has committed to this vision of the role of scenario analysis in the public debate. The body of knowledge emerging from this community aims at ensuring that the features of the techno-economic deep decarbonisation transformations are contextualized in the diversity of country circumstances and described with sufficient details and granularity to inform decisions required to drive these transformations. Key challenges to date, which are critical to increase ambition and accelerate action, include: connecting the scenarios analysis and the diversity of policies and actions to implement in the real world; revealing the critical conditions that are outside the control of national authorities, where international cooperation must play a role; ensuring ownership of the insights emerging from the scenarios by a diversity of actors to empower them in the public debates.

The DDP approach underlying this report's research is established with these key challenges in mind. It is fundamentally a country-driven exploration, back casting from the mid-century emission and socio-economic objectives to inform the short-term decisions across systems. Sectoral deep dives allow for an in-depth investigation of all levers, opportunities and challenges suited to inform domestic stakeholder debate in highly complicated sectors, such as transport, industry, or agriculture/land-use, which are traditionally represented poorly in existing long-term roadmaps. The stakeholder engagement approach to the development of the scenarios and emanating policy insights is an essential mean for these scientific assessments to serve an action agenda.

This report presents a synthesis of the results of the assessment conducted in India. Part I describes the main features of the economy-wide Deep Decarbonization Scenario(s) (DDS), including a description of key national-scale socio-economic aspects and an explicit characterisation of the emission objective and trajectory. To realise the necessary changes to get on track to this path, a description of the Current Policy Scenario (CPS) is also presented, including a description of the main policies and actions considered. Scenario results include an in-depth description at sector level for the deep dives selected by each country. Part II focuses on key policy lessons, which can serve as direct inputs into policy conversation at the country level. It includes a description of the main synergies and trade-offs with country non-climate objectives, priority short-term policies and actions, with a focus on where shifts from current paths are critically required, investments patterns and key international enablers and accelerators of domestic transitions.

# INDONESIA

## INTRODUCTION

Indonesia submitted its Long-Term Strategy (LTS) to the UNFCCC in July 2021. In its most ambitious pathway, this strategy describes options for peaking national greenhouse gas emissions in 2030 and reaching 756 $MtCO_2e$ in 2050, with the possibility of achieving carbon neutrality in 2060 or sooner. This submission demonstrates a firm commitment to the Paris Agreement of a country of utmost importance for the global ambition—the 4$^{th}$ largest in terms of population, 16$^{th}$ largest economy and 8$^{th}$ largest greenhouse gas emitter in the world. It is particularly noteworthy as it comes from a developing country with severe development challenges—ranked 107 in HDI index—and brutally affected by the COVID-19 crisis, demonstrating that ambitious climate action and socio-economic development can go hand-in-hand. The detailed strategic visions supporting the emission pathways reveal the required efforts for the national low-carbon transition and highlight the key domestic and international enablers.

Indonesia's LTS has been developed through an in-depth participatory process led by the Government of Indonesia and guided by detailed research analysis of transition pathways exploring different technical and socio-economic trajectories from the present to mid-century. More specifically, the LTS considers three pathways: the Current Policy Scenario (CPOS), which reflects an extended version of Indonesia NDC's unconditional scenario; the Transition Scenario (TRNS), with a more diversified energy sector; and the Low-Carbon Compatible with Paris Scenario (LCCP), which shows national emissions peaking in 2030 and reaching 735 $MtCO_2e$ in 2050, at a rate that, if maintained in post-2050, would lead to carbon neutrality in 2060 or sooner. This document presents a synthesis of key results of the decarbonization scenarios developed to inform Indonesia's LTS, particularly the CPOS and the LCCP (which is referred to as DDS in this document). It describes the key national and sector level techno-economic transformations to 2050, their main socio-economic aspects and resulting emission profiles. It also distills main policy implications and challenges, investment insights and necessary developments in international enablers.

# PART 1: SCENARIO RESULTS

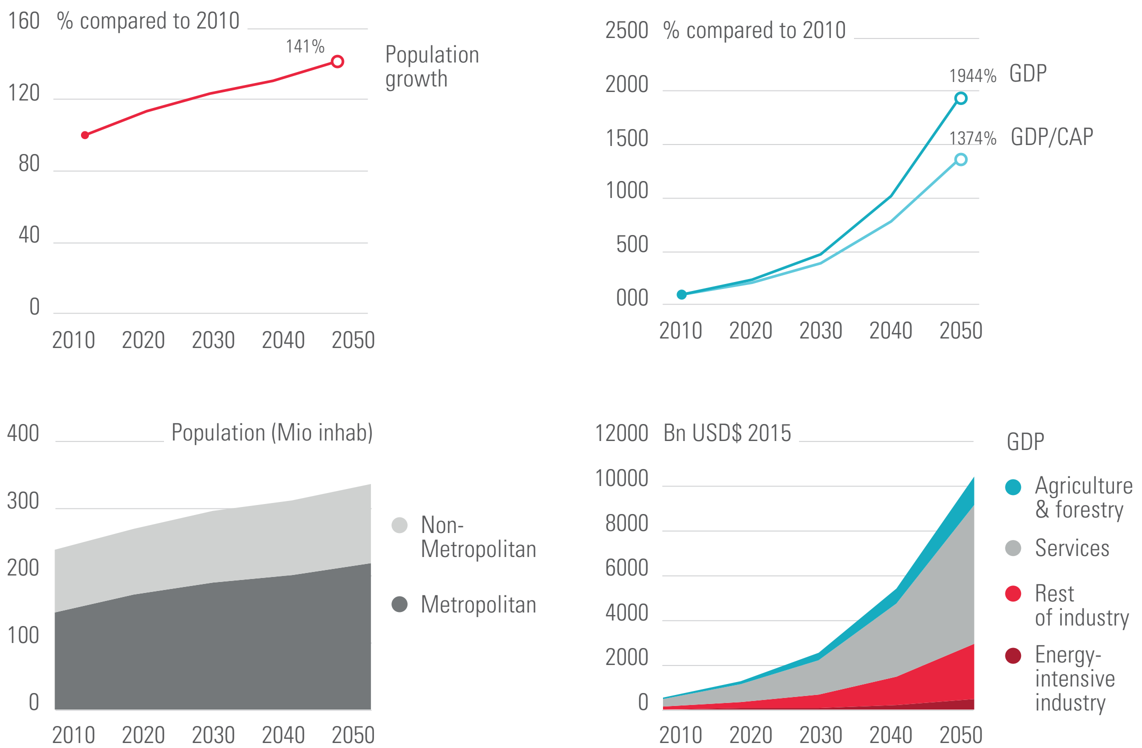
## SOCIO-ECONOMIC FEATURES OF THE SCENARIOS

Article 28 H of Indonesia's constitution (UUD 1945) mentions that it is the state's obligation to ensure a decent life and healthy environment for citizens. From the formulation of the National Action Plan of GHG emission reduction document (Rencana Aksi Nasional Gas Rumah Kaca, RAN-GRK) to the ratification of the Paris Agreement in 2016 and the First NDC submission, Indonesia has been strongly engaged in climate commitment. It is not without interference for Indonesia, as a developing country, to maintain the mitigation pace while reaching its goal as an upper-income country and world food barn. Therefore, it is a necessity to incorporate the socio-economic conditions and political direction which act as the drivers of change in activity level and GHG intensity to the long-term climate commitment.

Under the 5% average of historical GDP annual growth, Indonesia is entering upper-middle-income countries in 2019 with USD 4,135 GDP per capita (current USD price) (data.worldbank.org). And the national goal is to escape the middle-income trap in the next two decades. In 2020, the COVID-19 pandemic has become the turntable, dragging the national economy to recession. It is assumed that the recovery process will take longer than a year, hence shift the future GDP growth to 3% for the 2020-2025 period. The growth will return to 5% in the period 2025-2030 and lead to the peak of GDP growth in 2030-2035 to 6%. The GDP growth is assumed to be saturated at a 4.5% level in the period of 2045-2050.

At the regional level, a higher pace of economic growth in the period 2030-2050 with intense infrastructure growth (e.g., international airport, commercial building equipped with air conditioner, etc.) and crowded air traffic is predicted to be found in East Kaliman-

**Figure 1.** Economy-wide assumption for both CPOS and DDS scenarios



tan, where the new Capital City of Indonesia located. However, it is estimated that the traffic load in Jakarta will remain high. Massive development of transport infrastructure, including MRT and LRT, will occur in new metropolitan cities. Following rapid economic growth, Indonesia's economic structure will shift to industry and services/tourism. Under the utilization of CCS in industrial fossil energy systems, electrification of industry equipment, and use of renewables (e.g., hydropower in metal industries), GHG emission intensity for industry under mitigation scenario is expected low.

Indonesian population in 2010 was 239 million people and projected to increase to 296 million people in 2030 (1% p.a.) and reach 336 million people by 2050 (0.9% p.a.). Population structure proportion (0-14, 15-64, over 65 years old) in 2010 was 29% (0-14), 67% (15-64), 5% (over 65); 22%, 68%, 10% in 2030; and 19%, 66%,15% in 2050. At present, people live in the rural/countryside 48% and 52% in the urban cities. From historical data, the urbanization rate is 4.1% per year. By 2030, the share of people living in urban areas is projected to reach 60% and 80% by 2045. The high rate of urbanization also affects labour in the agriculture sector, which demands labour efficiency by large-scale agricultural technology and machinery adoption.

## EMISSION PROFILES

Based on this socio-economic picture, two scenarios have been developed: Current Policy Scenario (CPOS) and Deep Decarbonization Scenario (DDS). CPOS reflects an extension of current policy packages to 2050, whereas DDS has in-built increased mitigation ambition to set a path to carbon neutrality.

Indonesia's DDS reaches 496 $MtCO_2e$ in 2050, towards net zero in 2060. It represents a deep cut of fossil fuel in the power sector, the utilization of CCS technology and emphasizes the net sink role from the AFOLU sector.

Under the increased population and pressure to maintain staple food self-sufficiency, the dynamics of food demand (i.e., food consumption, food waste, and food loss) and land-use efficiency/land capacity to produce commodities are pivotal to achieve a net-sink target for the AFOLU sector. In the DDS scenario, net sink is reached in 2030 and emissions are negative (-201 $MtCO_2e$) in 2050. This sequestration role requires a massive cut of both legal and illegal deforestation, conservation and restoration of the degraded peatland at an accelerating rate, and increased land-use efficiency (e.g., improved productivity and cropping intensity, efficient technology from harvest to post-harvest to reduce food loss, etc.) followed by sustainable consumption.

Implementation of efficiency measures, decarbonization of power using large renewable and coal with CCS/CCUS, and biofuel use in transport will enable the energy sector to achieve significant emission reduction. After peaking at 1,274 $MtCO_2$ in 2030, the emissions of the energy sector decline to around 720 $MtCO_2$ in 2050 in DDS scenario.

## SECTORAL DEEP DIVES

### *AFOLU*

*Activity level.*

Main activities considered in the AFOLU sector are reduction of deforestation, forest conservation and sustainable forest management, protection and restoration of peatland, carbon sink enhancement, water management in the rice field, the use of the low emitted variety, biogas from livestock waste, feed supplement for livestock, and application of organic fertilizer.

Indonesia's land cover is classified into the forest area and non-forest area or other land uses (APL), with an area of 120.6 Mha and 67.4 Mha, respectively. Natural forest in forest area is approximately 82.5 Mha, of which 6.3 Mha are located in the convertible production forest, hence subject to deforestation. As supported by a number of regulations, including a ban to convert forested land in the forest area and moratorium to natural forest and peat, cumulative area to be deforested until 2050 for CPOS and DDS scenarios are 14.6 Mha and 6.8 Mha, respectively.

The Medium-Term National Development Plan (RPJMN) plans to have in concession area and APL approximately 5.2 Mha of natural forest indicated as protected zone. Under the concession area, the degradation rate of these forests could be minimized by mandatory issuance of certification system through sustainable logging technique. At present, only 76% of the forest concessionaire have issued this certification. Under the CPOS scenario, the issuance rate will follow the historical pace, while for the DDS scenario, it is expected that all the concessionaires have implemented sustainable harvesting practices. For the area outside the concession area, the effort emphasizes enhanced natural regeneration (ENR) to assist in faster natural regeneration. The implementation of the ENR in 2050 for CPOS and DDS scenarios are 1.6 Mha and 8.8 Mha, respectively.

As peatland contributes to half of AFOLU emissions, the Government of Indonesia has provided supporting policies to protect peatland and its management. Under the CPOS scenario, it is expected that the improvement of peatland and water management by 2030 and 2050 reaches 0.86 Mha and 1.04 Mha consecutively, while under the DDS scenario it reaches 0.95 Mha by 2030 and 1.04 Mha by 2050. For peatland restoration, peatland being restored under the CPOS scenario should reach 1.03 Mha by 2030 and 1.7 Mha by 2050, while under the DDS scenario, the target will be more ambitious to 2.7 Mha by 2030 and 4.2 Mha by 2050.

Total unproductive land (i.e., shrubs, grassland, and bare land) in Indonesia is considerably high, amounted to 30.1 Mha. Approximately 18% of these areas are considered as critical and very critical land, which demand immediate rehabilitation through several programs (e.g., social forestry, land rehabilitation program, multi permit, etc.). Under the CPOS scenario, the targeted area for land rehabilitation is about 4.32 Mha by 2030 and 8.6 Mha by 2050. Under the LCCP scenario, a more ambitious target is set to 5.3 Mha by 2030 and 10.6 Mha by 2050.

Mitigation actions in rice fields are categorized based on the availability of water management in the fields. For a field without water management, the mitigation action is to use low emission variety, while for an area with proper water management, SPR/STT, minimum input, and improved water use efficiency system, is the most feasible action. Under the CPOS scenario, the adoption of low-emission variety is expected to be 0.93 Mha by 2030 and 1.96 Mha by 2050, while an ambitious target is set in the DDS scenario to 0.97 Mha by 2030 and 2.07 Mha by 2050.

Following the GDP per cap growth, it is expected that demand for meat and milk will continue to increase. To increase the milk productivity and tons of carcass, feed supplement has to be added, a combination of the greenery, and an additional feed supply of tannin from legume crops or urea molasses block, in the livestock diet. The cumulative target for feed supplement under the CPOS and DDS scenarios in 2050 is 3.42 million head and 6.58 million head, respectively. In addition, to utilize the livestock waste, mitigation action for biogas implementation is taken into account. The CPOS and DDS have a similar target for biogas implementation, which amount to 41,000 head in 2030 and 94,000 head in 2050.

For cropland areas, the main mitigation activity is to reduce dependency on nitrogen fertilizer by substituting urea application with organic fertilizer. Under the CPOS scenario, the adoption of this mitigation action in 2030 and 2050 are expected to reduce the use of urea to 3,089 ton and 58,513 ton, respectively. Under the DDS scenario, the reduction of total urea used in 2030 and 2050 is expected to be 5,374 tons and 65,697 tons, respectively.

The main policies considered in the AFOLU sector scenarios are:

*Social forestry/TORA*

Ministerial Regulation No.83/2016 has stated social forestry as a scheme aimed to allocate 12 million ha forest area for the community. In addition to that, approximately 5 million ha to be released as non-forest area, under agrarian reform policy-TORA. Under the social forestry/TORA, agricultural land under forest area is now receiving legality status and can receive an incentive and/or capacity building program from the government. With more assured financial access and technical support, the yield gap between the community and private is expected to be reduced. Social forestry is also a key policy to address the tenurial issue for the community near the forest area. Under the Deep Decarbonization Scenario (DDS), the implementation of this policy should meet the target in 2030, while for the Current Policy Scenario (CPOS), approximately only half of the allocated area meets the target.

*Forest and peatland moratorium*

Presidential Instruction No.5/2019 states permanent extension for forest and peatland moratorium and its governance improvement. The regulation aims to protect the remaining natural forest which is primarily located in production forest area (subject to conversion) and further degradation to peatland ecosystem due to draining and land conversion.

*Multi permit scheme*
The government of Indonesia has developed new policy on multi permits–multiple uses of forest management–which allow any entities to have multiple business activities including agriculture (in the past, each entity could only be granted with one permit, e.g., timber plantation). At present, many areas under concession are occupied by communities for agriculture activities. These areas are claimed by communities and cannot be utilized and managed by concessionaires. Under the multi-permit policy, concession holders can establish a partnership with communities who occupied their concessions to establish mixed farming or develop a new scheme for environmental services-based business.

*Sustainable agriculture land*
Referring to the high urbanization rate in the future (more than 60% of the population will live in cities in 2035), it is expected that massive conversion of paddy fields and cropland will occur following the expansion of the urban area. Law No.41/2009 regulates the protection of sustainable agricultural land by restricting the conversion of agricultural land to non-agriculture land. The rationale behind this law was to ensure sustainable and consistent food production for independence, resilience, and national food sovereignty.

*Integrated livestock and plantation*
To ensure the fulfilment of land demand for livestock, the utilization of grassland is allowed after the need for land for livestock is satisfied. In this case, increasing grassland demand for livestock might lower unproductive land available for afforestation/reforestation. Under the ambitious national plan to reach meat self-sufficiency, an increased livestock population is expected. Integrated livestock plantation, as regulated by Ministerial Law of Agriculture No.105/2014, will increase land-use efficiency and its economic value. In addition, the integrated system will support palm oil production and strengthen meat production under a low carbon framework, of which the livestock will provide organic fertilizer that improves soil texture, reduce the production cost, and increase oil palm productivity.

*SDG 12: responsible consumption and production*
Following population increase in the future, it is estimated that rice consumption per capita will increase by 0.94 kg p.a. Under this pattern, calory intake per capita in 2010, 2030, and 2050 are assumed to be 1,825, 2,184, and 2,450 kcal/cap/day, respectively. In addition, following the increased GDP per capita, food waste is assumed to be increased in a logarithmic pattern, from 21 kg/cap/year in 2010 to 97 kg/cap/year in 2050 under the current policy scenario (CPOS). Under Deep Decarbonization Scenario (DDS), food waste increases less rapidly, up to 76 kg/cap/year in 2050.
In reverse to food waste, increased GDP which triggered advanced technology and efficient on-farm procession, food loss decreases, from 70 kg/cap/year in 2010 to 40 kg/cap/year under the CPOS scenario and 34 kg/cap under the DDS scenario in 2050. At present, the government encourages the use of technology and machinery, and has aid measures to support the adoption of the technology. However, large-scale adoption is limited by financial constraints. Increased financial access to bank or non-banking financial institutions (NBFI), as well as improvement of farmers grouping, is key to increase the adoption of post-harvest technology.
In case of food waste, large-scale campaign and education for consumer side and business owner side (e.g., administrative sanction and certification, minimizing food waste and reprocessed food waste for livestock feed) is needed. In addition, as national policy regarding waste is still general, there should be a formulation of a new policy that is specified in food waste (i.e., food waste categorization, food waste management, etc.).

***Physical transformation.***
The key transformation to achieve net zero-emission in the AFOLU sector is increasing land-use efficiency (e.g., increased productivity, increased cropping intensity) and maintaining sustainable consumption. Under this condition, land demand for food and forest product is fulfilled without being exacerbated by massive clearance of natural forest and land degradation.

Though supporting policies are available to make the LUCF sector shifted into a net sink, these policies are still poor of implementation scheme and enabling mechanism.

At the local level, Forest Management Unit (FMU) has a crucial role to play to reduce the risk of deforestation in the forest area. At present, the capacity of most of the FMU is still lacking in terms of human resources and supporting infrastructure as well as authorities for managing forest; capacity enhancement of the FMU should therefore be the main priority in near future.

In the case of increasing land-use efficiency, technology improvement and high-quality inputs (e.g., seeds, fertilizer, etc.) are central. Agricultural machinery is the key to increasing productivity to address increasing food demand in the future. Currently, pre-harvest machine distribution accelerates at a higher pace than post-harvest machines. In addition, the adoption of technology highly relies on government support. Increase farmer's access to other sources of financial support is one of the breakthroughs required in the AFOLU sector. Convenience access to financial credit should increase technology adoption in the future.

Currently, credit distribution for agriculture, forestry, livestock and fisheries, forestry, and plantations represent only 9% of total bank credit, due to collateral requirement issues and farmer's income fluctuation. Under the CPOS scenario, value chain finance such as the Warehouse receipt system, Peer to Peer lending (P2P), and credit program provides credits to buy agricultural inputs and tools for technology adoption to support low-carbon agriculture. To enable low-carbon transformation, the development of an innovative scheme is needed. Under the DDS scenario, innovation in value chain financing schemes is needed to sync with food security-related policies that were in line with emission reduction targets, for example, the development of main food commodities and provision of forest areas for social forestry.

Under more advanced agricultural technology, the labour skill should be improved. Under the CPOS scenario, revitalization of institutional and agricultural extension institutions will make a positive contribution to improving agricultural human resources. Under the DDS scenario, providing sufficient space for the private sector (e.g., traders, modern market) and research agencies/universities to actively engage in empowerment programs can be a solution to increase production and market.

### *Emissions.*

Under the CPOS scenario, total emissions consistently decline and reach -41.25 $MtCO_2e$ in 2050. Under the DDS scenario, total emissions decline more sharply than the CPOS scenario and reach net-sink in 2030 with -235 $MtCO_2e$ in 2050. Emission breakdown for LULUCF and agriculture for the DDS scenario are provided in **Figure 2**.

**Figure 2a.** Emission measured under CPOS and DDS Scenarios for LULUCF

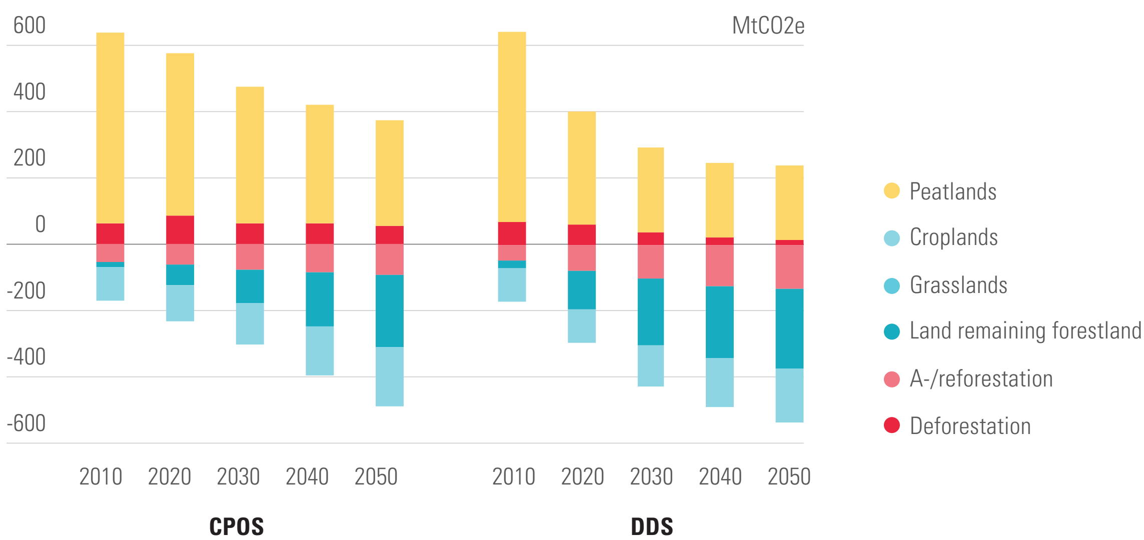
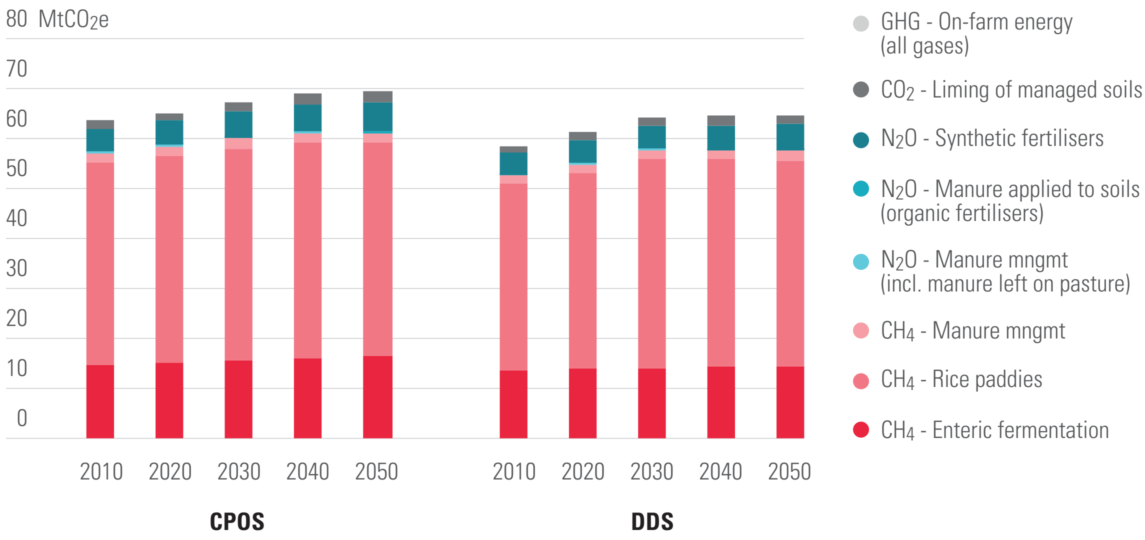


**Figure 2b.** Emission measured under CPOS and DDS Scenario for agriculture sectors




## ENERGY (POWER AND TRANSPORT)

### *Activity level.*

Energy demand grows in accordance with the development drivers (economic and population). Annual GDP growth in 2010-2020 is 5% and decrease to 1% in 2020 due to COVID-19 pandemic, then gradually increase to 6% in 2025, with the growth of 2025 to 2040 is 5% growth and 2040-2050 is 4.5%. This annual economic growth is lower than those assumed in the National Energy Policy (Kebijakan Energi Nasional-KEN) projection which is 7%-8%. Therefore, the primary energy projection of DDS in 2050 is around 500 Mtoe, lower than that of the KEN which is 1,000 Mtoe in 2050. As the result of efficiency measures, the energy intensity of all energy-consuming sectors in 2050 is much less than that of the base year.

In major industry fuels (gas, electricity, oil fuels, coal with CCS/CCUS), the establishment of a $CO_2$ cap will have been implemented, CCS/CCUS business using pipeline transport and trucking are already in place, and $CO_2$ from major industry will be handled by CCS/CCUS.

The energy input to industries will be transformed from primarily coal and oil fuels to natural gas, renewable (especially in smelters), and electricity, in decreasing order. By utilizing CCS/CCUS in industrial fossil energy systems, electrification of industry equipment, and use of renewables especially hydropower in smelters, GHG emission intensity for the industry is expected to decrease. However, the level of GHG emission intensity will depend on the carbon content of the electricity supplied by the utility and the access of smelters to hydropower resources.

Decarbonization of the energy sector in DDS results in peaking of $CO_2$ emissions at 1,164 Mton in 2030 and declining to around 766 Mton $CO_2$ in 2050, largely enabled by the implementation of efficiency measures, decarbonization of power using large renewable and coal with CCS/CCUS, and biofuel use in transport.

### *Physical transformation.*

*Electric Power*

Demand for electricity comes from residential, commercial, and industry, with a small fraction of the demand coming from transport (train). In the future, a significant fraction of electricity will be used by transport which is expected to shift to electric vehicles. Indonesia's electricity consumption grows at an average rate of 5.9%, from 190 TWh in 2010 to 240 TWh in 2019 (source: HEESI-2020).

In 2020, Indonesia household electrification reached 98% (MEMR 2020), which was connected to on-grid (large power plants) and off-grid electricity (smaller plants, mostly renewables). It is targeted that in the future all households will have electricity access through grid and non-grid as well as roof-top solar PV.

Based on past experience, the demand growth of electricity will be around 5% per year. The need for new capacity, replacement, and transmission expansion will be in line with the demand growth. At present, power generation is mainly fuelled by coal, while other power plants use gas, hydropower, and geothermal. It is expected that in 2050 the power sector will practically be decarbonized through: (i) utilization of renewables (hydro, geothermal, solar, wind, biomass) on a massive scale; (ii) most coal powerplants are equipped with CCS/CCUS; and (iii) biomass power plants are connected to CCS (Biomass Energy with Carbon Capture and Storage or BECCS).

Since Indonesia is an archipelago, the power system will be developed in the form of distributed power, instead of a large centralized system. Power systems with various types of power plants and different degrees of intermittency will have to cope with grid stability. Therefore, the power sector will require reliable technology and dispatch management that ensure electricity grid stability. Given that BECCS is expected to play a significant role in GHG mitigation of the power sector, a large amount of solid biomass supply for the BECCS needs to be prepared and developed; therefore, an integrated land use planning is crucial to ensure sustainable feedstock supply of biofuel and wood biomass for BECCS.

The power situation in 2050 under DDS is envisaged to be as follows:

- Power generation mix are: renewables (43%), coal (38%), natural gas (10%) and BECCS (8%).
- The renewables include hydro, geothermal, solar PV, biomass, biofuel, and wind.
- Around 76% of the coal power plant are equipped with CCS to achieve zero emissions in coal power plants.
- The installed capacity of renewable power generation mix is solar PV 113 GW, hydro 68 GW, geothermal 23 GW, wind power 17 GW, biomass 13 GW, biofuel 14 GW, and BECCS 23 GW with negative emissions.
- The supply availability of some renewable power plants is intermittent, and therefore, in order to have a reliable supply system, it will require integration with a continuous stable power supply system (baseload) such as coal power plants.
- The carbon intensity of power generation: 104-gram $CO_2$/kWh.
- Increasing development of off-grid and micro-grid.
- Due to a significant portion of intermittent renewable (solar and wind) will be deployed in the future, it will require the development of a smart grid that can handle large supply intermittency.
- A power plant with 100% renewable energy in remote areas will need Smart Micro Grid.

*Transport:*

In 2010 the metropolitan population accounts for 18% of the total population and is projected to reach around 25% in 2050 with increased population density in city centres and urban peripheries.

The type of land use in old town areas of metropolitan cities can be categorized as mixed land use where residential development, shops, employment community, and recreation facilities, parks, and open space are located close to each other. However, the recent development of areas in metropolitan can be categorized as specialized land use, where the industrial area is located outside the cities and new housing is built at the periphery of cities. In non-metropolitan cities, the land use type can be categorized as mixed land use. Previous spatial distribution of population did not consider transport network. Recently, site selection for new housing complex especially in metropolitan cities begins to consider the development of transport networks such as BRT, LRT, dedicated lane for buses, and inter-modality. Current transport infrastructure development focuses on motorized transport systems. Sociocultural practices, lifestyles, and social status affect transport. Transport infrastructure development has focused on motorized transport systems. In the future, the majority of the population will need to use public transport due to overloaded traffic by excessive use of private vehicles. Information and Communication Technology (ICT) development will encourage tele-activity and eventually lessen personal transport load in metropolitan as well as in non-metropolitan cities. Carpooling which has been partially practiced recently in metropolitan cities will continue to be implemented, driven by needs such as avoiding traffic jams.

The transport sector in the future is envisaged to drastically change, with the passenger transport mode being mostly mass public transport (buses, MRT, LRT) in metropolitan, buses in smaller cities, trains and big buses for inter-city transport, and air transport for between metropolitan and inter-island (ships and ferries). At the moment, freight transport relies on train for the inter-city trips, trucks/trailers, air, and ships for inter-island cargoes, as well as small trucks in cities.

The main energy sources for transport are biofuels, oil fuels, and electricity. Mitigation target in transport will be achieved by: (i) electrification of transport; (ii) supplying more biofuels for diesel substitute (fatty acid methyl ester and bio-hydrocarbon or green diesel), and (iii) gasoline substitute (bioethanol and CPO-based gasoline). For the past 10 years, the government has introduced biofuels made from CPO, which is blended with petroleum diesel and is called B20 (20% biodiesel plus 80% petroleum diesel).

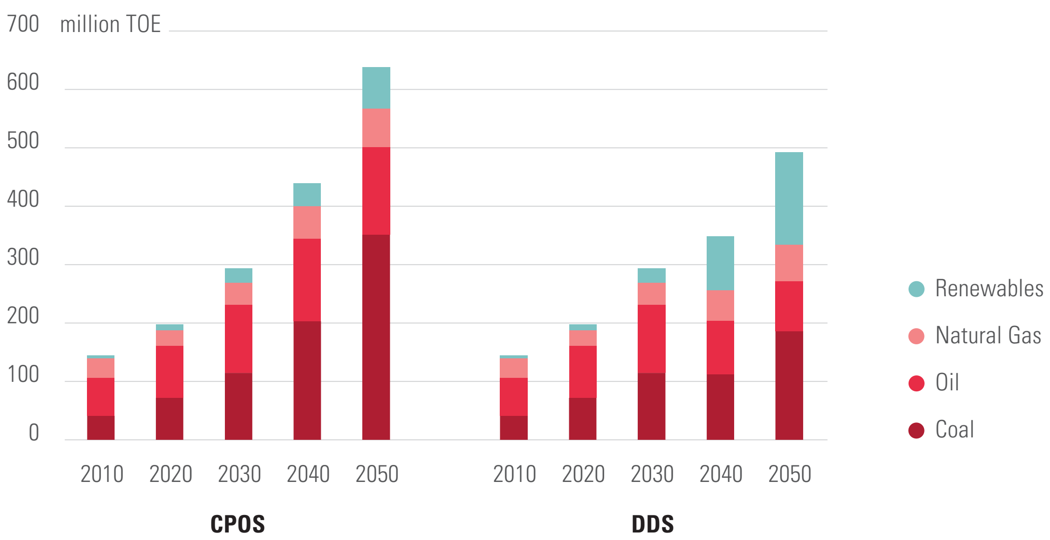
It is envisaged that the Indonesian transport situation in 2050 under DDS will be as follows:

- Transport distance of non-constrained transport (leisure, social, or family visits) in metropolitan is around 10 km.
- The travel distance of constrained transport (home-to-work/school) is around 40 km (in Jakarta).
- Some fraction of the workforces are working from home (teleworking) by opening businesses at their homes such as small shops, maintenance, and repair services, and restaurants.
- The breakdown of transport energy in 2050 are biofuels (52%), oil fuels (30%), electric vehicles (14%), and natural gas (4%). The biofuel (CPO-based) program is considered successful and will be continued to 2050 by supplying biofuel with higher biodiesel proportions (B30, B40, B50), which will be produced from sustainable sources.
- "Mobility as a service" will continue to grow.
- Household expenditure for transport is around 20% of total household spending.
- Choice of the mode of transport is affected by cost, comfort level, and social status.
- Many cities are connected by inter-city trains, especially in Java. The existing plan shows that 3,200 km of train tracks will be built to serve transport in Sumatra, Java, Kalimantan, and Sulawesi.

*Primary Energy Supply:*

The types of primary energy used in Indonesia are coal, oil fuels, natural gas, and renewables (hydropower, geothermal, solar, wind and bioenergy). Coal and natural gas are also used as final energy in industry, natural gas is also used as final energy in residential and commercial. It is estimated that from 2010 to 2050, the primary energy supply will grow, on average, around 3% per year. The projections of primary energy by types of energy for the 3 scenarios are presented in **Figure 3**. The Figure shows that CPOS gives the largest energy supply (due to the largest energy demand), which indicates that current policy will not lead to efficient energy systems. The DDS has a lower energy supply due to lower energy demand resulted from energy efficiency measures in end users.

**Figure 3.** Projection of primary energy supply under CPOS and DDS



The scenario that will result in the lowest primary energy supply is the DDS. **Figure 3** shows all energy types will continue to increase until 2050 except for oil. The share of oil will become the lowest in 2050. Under DDS, a notable change is projected to occur in 2050 where the share of renewable will become the highest in the energy supply. **Figure 3** also indicates that even until 2050, the role of coal in the energy supply will remain significant, especially in the power sub-sector which will be equipped with carbon capture and storage (CCS) systems.

*Final Energy Demand:*

The projection of by-type final energy demand for the 2 scenarios is presented in **Figure 4**, which indicates that there will be a significant change toward 2050 i.e., electricity is projected to be the most dominant type of energy.

**Figure 5**, which shows the projection of final energy demand by the consuming sectors, indicates that the distribution of the sectoral energy consumption in 2050 will remain the same as that in 2010 and the share of commercial and residential consumption significantly increase in 2050 due to the increasing role of the commercial sector in the economy and increase of people welfare.

*Electric power generation and grid emission factor*

The projection of the power generation mix and the associated emission factor of electricity are shown in **Figure 6**, which shows that electricity generation will increase significantly as a result of economic development, people welfare, and population growth. From 2010 to 2050, electricity generation will increase on average 5.5% per year, which is about the same as the average economic growth. This may be the result of electrification of end-users where people prefer electricity than combustion energy systems, also because of the development of a commercial sector where its energy consumption is mostly in the form of electricity.

**Figure 6** shows a significant difference in the power generation mix in the two scenarios: CPOS will rely primarily on coal, while the DDS is more diversified, as DDS has more coal power plant equipped with CCS/ CCUS and renewables, including BECCS in 2050. Under DDS, where the share of CCS is significant, the resulted emission factor will be significantly lower than the other scenarios. In 2050, the emission factor of CPOS and DDS are 502 and 104 gram $CO_2$ per KWh respectively.

**Figure 4.** Projection of final energy demand by fuel type under CPOS and DDS scenarios

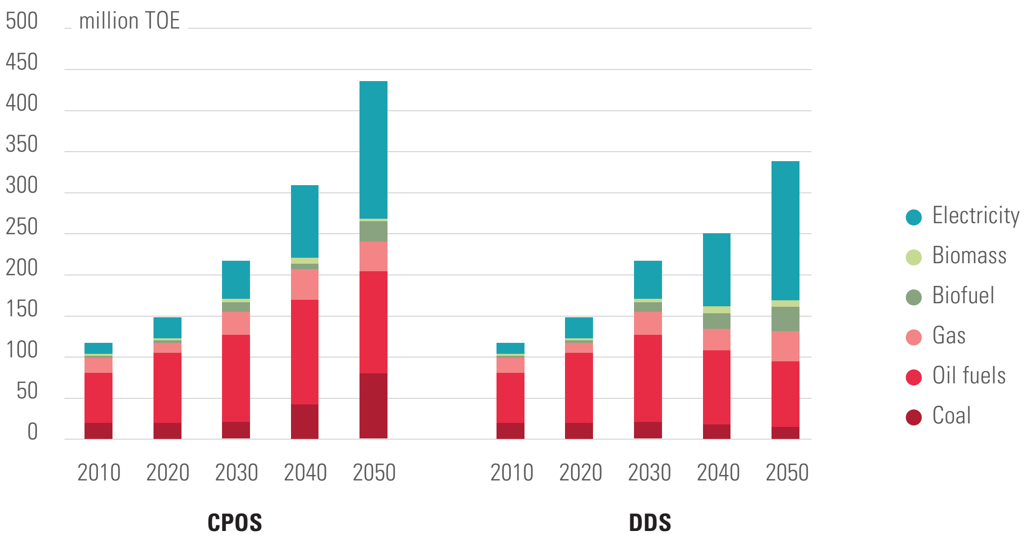


**Figure 5.** Projection of final energy demand by consuming sector under CPOS and DDS scenarios

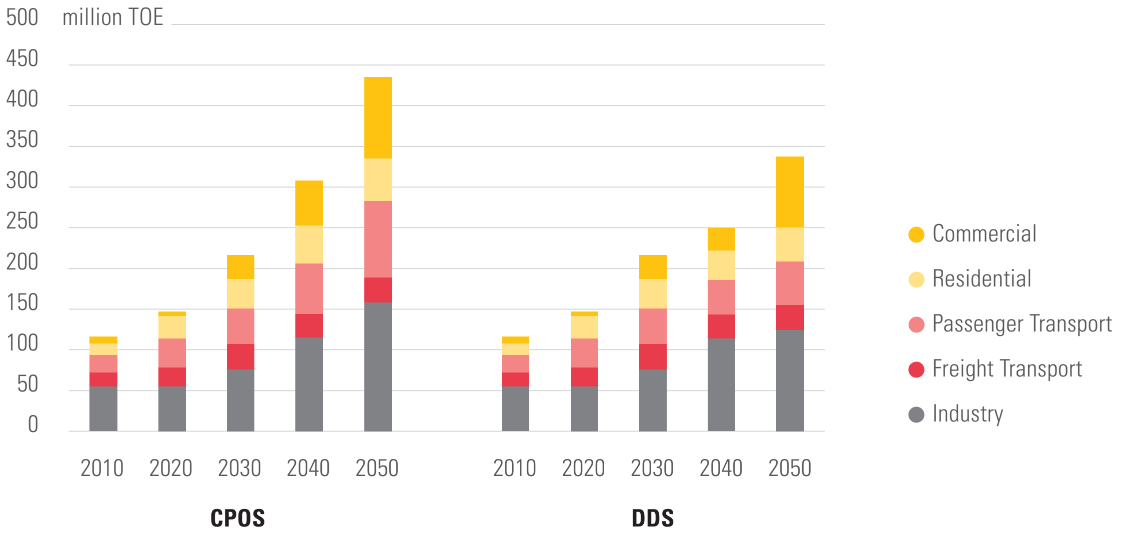
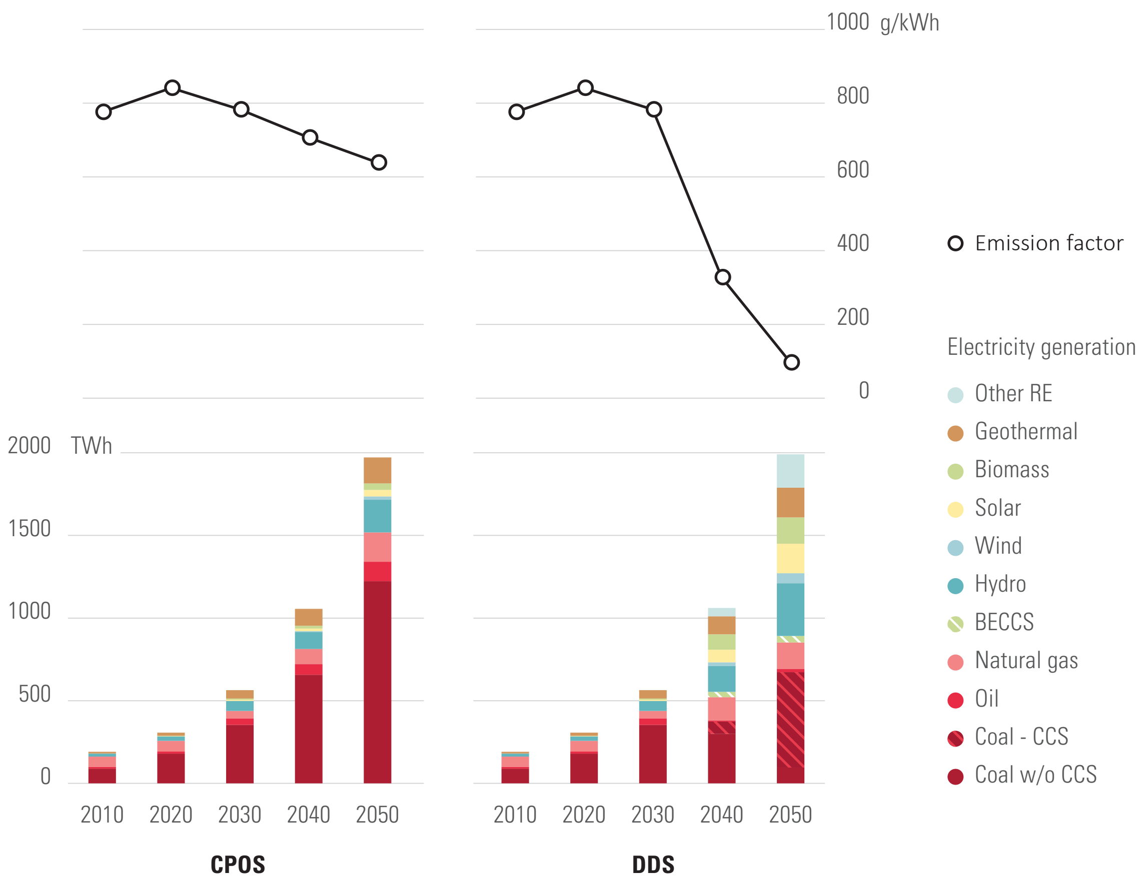


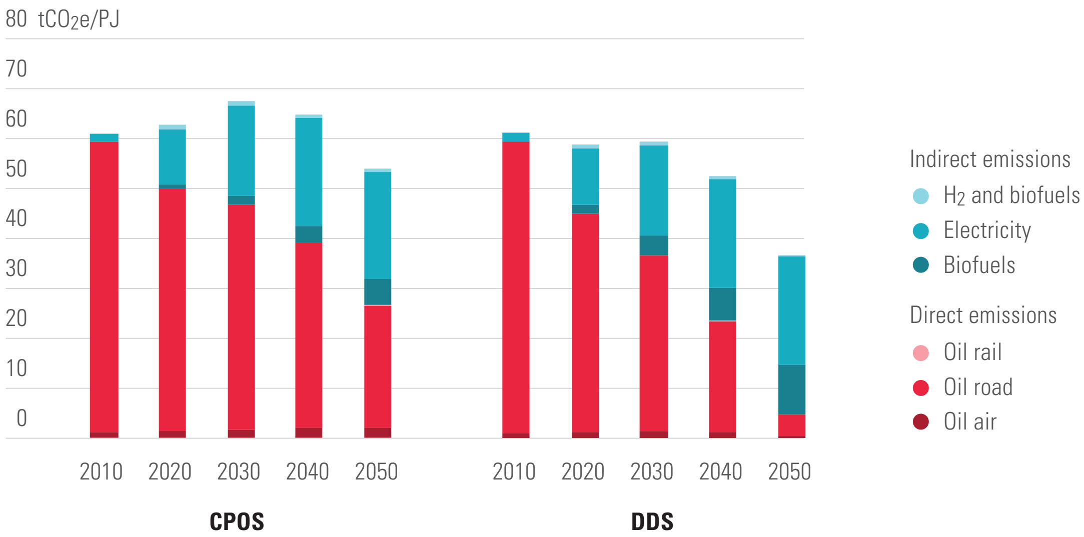

**Figure 6.** Projection of the power generation mix and grid emission factor under CPOS and DDS scenarios



*Emissions.*
Under the CPOS scenario, total emissions from passenger transport consistently decrease and reach 32 $MtCO_2e$ emissions in 2050. Under the DDS scenario, total emissions reach 15 $MtCO_2e$ in 2050 (**Figure 7**).

Under the CPOS scenario, total emissions from the energy sector consistently increase and reach 3,170 $MtCO_2e$ emissions in 2050. Under the DDS scenario, total emissions reach their peak in 2030: 1,274 $MtCO_2e$. After the peak period, emissions start to decrease and reach 720 $MtCO_2e$ in 2050.

**Figure 7.** Emission (CO2) from passenger transport under CPOS and DDS scenarios



# PART 2: KEY POLICY LESSONS

## PRIORITY SHORT-TERM POLICIES AND ACTIONS

Aiming for net-zero emissions under the DDS pathways requires breakthrough policies transformation and growing enablers to ensure policy implementation. The factors that make the difference between CPOS and DDS in the energy and transport sector mainly include the coal phase-out direction and the use of biofuels.

Coal use in power generation had been dominant in the past 4 decades. In order to alter the upward trajectory of GHG emissions, it is critical to phase down or phase out coal power. Short-term policies and actions in support of this objective are needed otherwise there will be a lock-in in coal power; and in the long run it would be difficult to obtain economic and social justification to stop the lock-in plants for phasing out coal as it would be expensive.

Fortunately, PLN (Indonesian national electric power utility) has moved toward the coal phase-out direction. It will retire some existing coal power plants beginning 2025. There will be no new coal power contract after 2025. Some that are already on schedule will remain on stream until 2028. Coal power retirement staging based on the coal technology type and age is already scheduled. The phase-out will begin with subcritical technology (2025-2035), followed by supercritical technology (2040-2045), and then ultra-supercritical (2045-2055).

The coal complete phase-out is expected to occur in 2055. Substitutes for coal power are gas and renewables. Massive development will occur in solar power. Solar PV plus the battery is expected to serve as baseload power. Another non-fossil power that will be developed is nuclear, which is expected to begin on stream in 2040. PLN targets to achieve carbon neutrality in 2060. According to the DDS scenario, other important mitigation actions are the deployment of CCS in coal power plants and biomass power plants (BECCS). Short-term priority policy actions in support of these mitigation actions, such as capacity building policy for CCS technology development, need to be designed and implemented. Other short-term policy actions that are critical in support of decarbonization are incentives for non-utility renewable power such as solar rooftops. An example of an incentive is to provide an attractive feed-in tariff and power purchase guaranty.

Other large coal use also occurs in some industries such as cement, pulp and paper, iron-steel, and petrochemicals. These industries are known to be hard-to-decarbonize industries. Some international pressures for decarbonization through carbon-footprint criteria may be applied for some export-oriented industries such as pulp and paper. The cement industry primarily supplies the domestic market and cannot be encouraged to decarbonize by carbon-footprint mechanism. Besides, there is a limited option for cement decarbonization technologies.

In the transport sector, the main component of decarbonization is through massive substitution of oil fuels by biofuels. Critical short-term policy action that is needed in biofuel development is the incentives to biofuel production through special funding for biofuel feed development especially replanting and biofuel production technology.

Reaching for AFOLU net-sink demands a massive-scale paradigm change to perceive forest and a carbon-rich ecosystem as part of a nature-based solution. In the AFOLU sector, Indonesia's land-based policies have been growing remarkably and aligned with Indonesia's vision for the DDS scenario. The only thing that distinguishes the existing policies and the ambitious DDS scenario is the implementation rate of the policies, which includes all the enablers and implementation schemes.

Transformative policies required for Indonesia's AFOLU sector include social forestry, multi permit scheme, peatland moratorium policies, and forest conversion ban, oil palm domestic certification, and increased agricultural land-use efficiency.

Ministerial Law of MoEF No.9/2021 and No.83/2016 has stated social forestry as a scheme aimed to allocate forest area legally for the community and to provide an access to incentive and/or capacity building programs to increase land productivity. By regulation, cultivated land inside forest areas is not allowed and is considered an illegal area and illegible to receive government support (e.g., incentive). Under this policy, not only tenurial issues can be addressed but potential income for the community from non-timber forest products (e.g., medicinal plants, forest honey, etc.) can also be increased. At present, the effectiveness of the policy implementation is still low. Based on the progress of the implementation of the social forestry program, by 2030 community access to the social forestry program may reach only 1.4 Mha (12%) and by 2045 it will reach 3.4 Mha (28%). However, under the deep decarbonization scenarios, the social forestry and TORA program should be fully implemented by 2030. One is by simplifying the administration process and pairing up the scheme with the country's land rehabilitation agenda, to ensure support from the government permanent nursery. In addition, referring to Government Regulation No.26/2020, the social forestry program could receive support from the regional government and other sources (including the private sector). Increasing the participation of the NPA's actors in this scheme will eventually lower the burden of mitigation cost from the state budget.

MoEF has established a multi-permit scheme that allows any entities to have multiple business activities and partner with communities, particularly in the disputed land (under profit-sharing mechanism), to establish mixed farming. The multi-permit scheme also allows the utilization of natural forest inside concession areas for non-timber forest products (NTFP) and environmental services-based business. With multiple benefits accrued, further, the implementation of the scheme should be used as part of the sustainability certification standard. As this scheme is relatively new, there is a growing interest from the private sector to join the scheme; however, only if the incentive from the environmental services benefits is assured. Along with the domestic carbon market that is currently prepared by the GoI, the multi-permit scheme is potentially implemented by all forestry concessionaire owners.

Peatland moratorium policy (Presidential Instruction No.5/2019) is intended to protect peatland forests subject to conversion and degradation, and under Government Regulation No.104/2015, the conversion of productive production forest for development purposes is banned, except for a region with no unproductive lands available. These policies are central to forest protection in the DDS scenario with cumulative deforested area amounted to 6.8 Mha until 2050.

Degradation of natural forest under the concession area could be minimized by mandatory issuance of certification system through sustainable logging technique. At present, only 76% of the concessionaire have received good forest certification. To support the forest degradation quota in the DDS scenario, the certification should become mandatory and be supported by incentive and disincentive schemes. Regarding the certification scheme, GoI has also established Indonesia Sustainable Palm Oil (ISPO) as an oil palm domestic certification scheme. To date, ISPO has been improving along with recently published Presidential Regulation No.44/2020 which was ratified in March 2020. The regulation is replacing the previous Ministerial Law of Agriculture No.11/2015, with the main amendment on a more independent ISPO process compared to the previous process, monitoring process from an independent party, public participation in the certification, and mandatory for all oil palm plantation with a 5-year grace period. Under a more strict monitoring process, it is expected that ISPO certification could assure forest protection under the oil palm concession area.

Mitigation activity in the agriculture sector is in indirect synergy with the FOLU sector. The success of the implementation of FOLU mitigation depends on the agricultural conditions, where high planting intensity and improved productivity with support from advanced technology will reduce pressure on the forest and avoid forest conversion. Improved agricultural technology is the key to this case. Adoption of technology by farmers should not merely rely on government support (input subsidies, credit program) but should also mobilize other sources of support including access to bank or non-banking financial institutions-NBFI (cooperatives, warehouse receipts systems, financial technology companies). In addition, improving agricultural human resources by the revitalization of institutional and agricultural extension institutions, development of the agricultural vocational school is important to ensure technology adoption in the future.

## INVESTMENTS PATTERNS

Compared to the CPOS scenario, there will be some changes needed in investment patterns for DDS. The shift of development trend in the power sector especially PLN, which is moving away from coal power, is partly driven by consideration that financing for dirty power plants would be very difficult. Although investment may be made from domestic funds, PLN is aware that domestic financial institutions are not independent of international ones. It is expected that under Paris compatible pathways, international pressure for green financing is not only by preventing/disincentivizing carbon-intensive investments but also to provide incentives for green financing- made it easier to obtain loan/financing for low carbon power plant investments. A similar change of investment pattern will also occur in sectors such as transport (more investment in biofuel and EV) and industry. Investment in EV components, especially batteries, is expected to increase in the future as the government continues to pursue higher local content in many development sectors.

Some policies were taken by the government of Indonesia to increase the diversification of finance sources from both national and international–public and private sources. Fiscal policy as a financial strategy to meet the emission reduction commitment has been strongly progressed in Indonesia. The main fiscal instrument that potentially fills the budget demand for the DDS scenario is carbon pricing (e.g., emission trading, carbon tax), ecological fiscal transfer (EFT), and payment for environmental services (PES).

EFT is a grant mechanism, transferred from higher-level government to the lower-level government with the inclusion of ecological variables (e.g., forest area). The EFT has been applied by numerous jurisdictions (e.g., North Kalimantan Province, Jayapura City). Contrary to the other two fiscal instruments, the PES instrument existed before; however, the instrument has been applied commonly by NGOs and private sectors. Under Government regulation (PP) No. 46/2017 concerning Environmental Economic Instruments, PES is expected to be mainstreamed and applied by the local government.

For the public investment strategy, the Ministry of Finance has launched Green Planning and Budgeting Strategy for Sustainable Development, specifically aimed at the key sectors to low-carbon transition (e.g., renewable energy, etc.). In addition, GoI has also issued Green Bonds and Green Sukuk as innovative financing to funds green and SDG-related projects.

Indonesia's Financial Service Authority (OJK) holds a key role in the development and implementation process of innovative financing for the climate. Currently, OJK has established the Roadmap for Sustainable Finance in Indonesia, Guidance for Green Building, and OJK regulations for sustainable finance implementation (e.g., green bonds, banking supervision to support low carbon emission vehicles).

Furthermore, Indonesia continues to mobilize international financial sources through bilateral, regional, and multilateral channels, including result-based payment for REDD+ under the Paris Agreement, grants, and other potential sources and mechanisms.

## SYNERGIES AND TRADE-OFFS WITH COUNTRY NON-CLIMATE OBJECTIVES

There are several synergies between climate objectives and non-climate objectives such as SDG. Carbon pricing policies in energy sectors (power, industry, transport) will drive the use of greener fuels, moving away from coal and oil fuels, which will lead to cleaner air. In addition, the application of a green building policy will lead to a more efficient energy system (long-term economic benefit).

For the bioenergy case, palm oil fund collection and management by the Agency for the Management of Palm Oil Mill Funds (BPDPKS) will support research on biofuel production technology and at the same time provide support for replanting of palm oil plantations. This gives financial incentives for plantation companies as well as farmers.

The development of solar power could drive domestic solar industries (improve investment and employment) especially when international enablers help provide funding and technology transfer schemes. However, besides synergies, there is also a possibility of a trade-off between climate objectives and environmental objectives. For example, EV with battery and renewable power sources will be good for climate and employment creation but this development may create problems with mining wastes and smelters associated with solar cell production and metals (Li, Co, Ni) for battery production and also the possibility of waste handling problems of used battery disposal. To ensure the synergy of the DDS ambition, Indonesia's vision toward net-zero needs to be mainstreamed to the local development planning. To enable the top-down implementation of the climate commitment at the local level, local governments are mandated to conduct Strategic Environmental Assessment (SEA) to ensure a sustainable development plan under Governmental Regulation No.46/2016. This provides guidance on the integrated, comprehensive, spatially explicit land-use planning at the national and sub-national level aiming at food, water, and energy security based on sound ecosystem management. The environmental benefits as captured from the SEA could bridge the regional government to receive additional funds from the ecological fiscal transfer (EFT) scheme, to improve local community welfare.

## KEY INTERNATIONAL ENABLERS AND ACCELERATORS OF DOMESTIC TRANSITIONS

Key international enablers that will assist the decarbonization pathways include the application of emission standards/carbon footprint to internationally traded products. Such standards are expected to drive producers to manufacture products with a lower carbon footprint.

While CCS holds an important role in cutting emissions from the energy sector, CCS is very expensive and when implemented will require significant additional investment. For such cases, an international enabler in the form of financial support/low-interest loan is needed.

PV development under the Paris-compatible pathway will involve installation up to 100 GW in 2050. Therefore, it is reasonable to expect that a local manufacturer of solar PV cell and support systems would be required. To accelerate local manufacturing capacity, international enablers in the form of investment financing and technology transfer would be required. To be more specific, the expected technology transfer is in the area of efficient solar cell manufacturing.

At the international level, a fair-trade deal is crucial to maintain the country's supply of the exported agricultural product while fulfilling partner countries' demand for sustainable commodities. It means that agricultural production for the international market should not cause deforestation through Indirect Land Use Change (ILUC). International financial support is also important for Indonesia's forestry to achieve the net-sink target with less cost burden on the state budget. In addition, international cooperation on low-carbon transition research with a research centre and think tanks is also needed to support the evidence-based policy in the country.

International enablers (carbon footprint requirement, investment financing, technology transfer), besides providing support to the achievement of decarbonization objectives, will also positively impact the Indonesian socio-economy (GDP growth, employment creation, trade balance, improved environment quality).

The DDP is an initiative of the Institute for Sustainable Development and International Relations (IDDRI). It aims to demonstrate how countries can transform their economies by 2050 to achieve global net zero emissions and national development priorities, consistently with the Paris Agreement.. The DDP initiative is a collaboration of leading research teams currently covering 36 countries. It originated as the Deep Decarbonization Pathways Project (DDPP), which analysed the deep decarbonization of energy systems in 16 countries prior to COP21 (deepdecarbonization.org). Analyses are carried out at the national scale, by national research teams. These analyses adopt a long-term time horizon to 2050 to reveal the necessary short-term conditions and actions to reach carbon neutrality in national contexts. They help governments and non-state actors make choices and contribute to in-country expertise and international scientific knowledge. The aim is to help governments and non-state actors make choices that put economies and societies on track to reach a carbon neutral world by the second half of the century. Finally, national research teams openly share their methods, modelling tools, data and the results of their analyses to share knowledge between partners in a very collaborative manner and to facilitate engagement with sectoral experts and decision-makers.
www.ddpinitiative.org

The institute began as an agricultural school formed by the Dutch colonial regime in the early 20th century. After independence it was part of the University of Indonesia before becoming an independent institute on September 1, 1963. Prof. Dr. Arif Satria, S.P., M.Si. serves as its director.

https://www.ipb.ac.id

The Bandung Institute of Technology (Indonesian: Institut Teknologi Bandung, abbreviated as ITB) is a state, coeducational research university located in Bandung, Indonesia. Established in 1920, ITB is the oldest and first technology-oriented university in Indonesia. According to the rector of ITB, ITB had built an eight-storey mining research centre for both national and international research such as research on oil reservoirs, production optimisation, geological exploitation and coal exploitation development worth Rp110 billion ($12.1 million).

http://www.itb.ac.id

The Institute for Sustainable Development and International Relations (IDDRI) is an independent, not-for-profit policy research institute based in Paris. Its objective is to identify the conditions and propose tools to put sustainable development at the heart of international relations and public and private policies. IDDRI is also a multi-stakeholder dialogue platform and supports stakeholders in global governance debates on the major issues of common interest, such as actions to mitigate climate change, protect biodiversity, strengthen food security, and to manage urbanisation. The institute also participates in work to build development trajectories that are compatible with national priorities and the sustainable development goals.

www.iddri.org