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SUMMARY REPORT THE 2ND POLICY DIALOGUE

DECARBONISATION STRATEGIES AND POLICIES IN INDONESIA

JANUARY

2023

2nd Policy Dialogue on Decarbonisation Strategies and Policies in Indonesia (Summary Report)

January 19th, 2023

I. Energy Transition Projects and Decarbonisation Efforts in Indonesia

1.1. Opening Remarks

By: Yusuf Suryanto (Directorate of Electricity and Information Technology - KTI, Ministry of National Development Planning – BAPPENAS)

This policy dialogue aims to prepare the RPJMN (Medium-term National Development Planning) 2025-2029 and RPJPN (Long-term National Development Planning) 2025-2045 and support the implementation of the energy transition as climate change mitigation. This activity cannot be separated from BAPPENAS' efforts to prepare RPJMN and RPJPN. At the same time, the challenges will also intensify, such as the covid pandemic in 2020 and the need to become a developed nation or escape the middle-income country trap (5% GDP – Gross Domestic Product growth). Currently, BAPPENAS is formulating six initiatives that can aid these efforts to promote the development of Indonesia. A plan for a low-carbon economy is one of them, while energy transition and digital transformation are also crucial. BAPPENAS concludes from these techniques that the importance of data collecting with big data will necessitate increased capacity, particularly for the energy transition.

BAPPENAS, in collaboration with Su-re.co, has held the first policy dialogue on decarbonisation policies and strategies in Indonesia. As a follow-up agenda, the Second Policy Dialogue is organised to introduce methods and modelling related to climate change, land cover, energy and economy. The next policy dialogues between the Indonesian Government and Su-re.co will result in more real initiatives. Su-re.co and its partners can give policy input to the policy-making process through this policy discussion.

1.2. Su-re.co's Current and Ongoing Projects related to Decarbonisation

By: Dr Takeshi Takama and Fabian Wiropranoto (su-re.co)

Su-re.co has various research projects in energy transition, decarbonisation, and land use. For example, TIPPING+ is a project related to the energy transition from coal to renewable energy. LANDMARC (Land Use Based Mitigation for Resilient Climate Pathways) is a project on climate change mitigation in the land sector. There are several upcoming projects, for example, a project with CIFOR (Center for International Forestry Research) regarding a carbon offset project. This project will not only focus on carbon offsets but also will apply several co-benefits that can help farmers in Indonesia. Su-re.co does not only concentrate on research; su-re.co also develops a programme for implementation, giving direct benefits to farmers. For instance, su-re.co has accomplished IKI (International Climate Initiative), a biogas project in which su-re.co successfully provided 40 biodigesters to farmers across Indonesia. Su-re.co also hosted several training sessions with college students from Japan and Indonesia. As a result, business, training, and research outcomes are integrated into su-re.co's activities, the majority of which focus on low-carbon development.

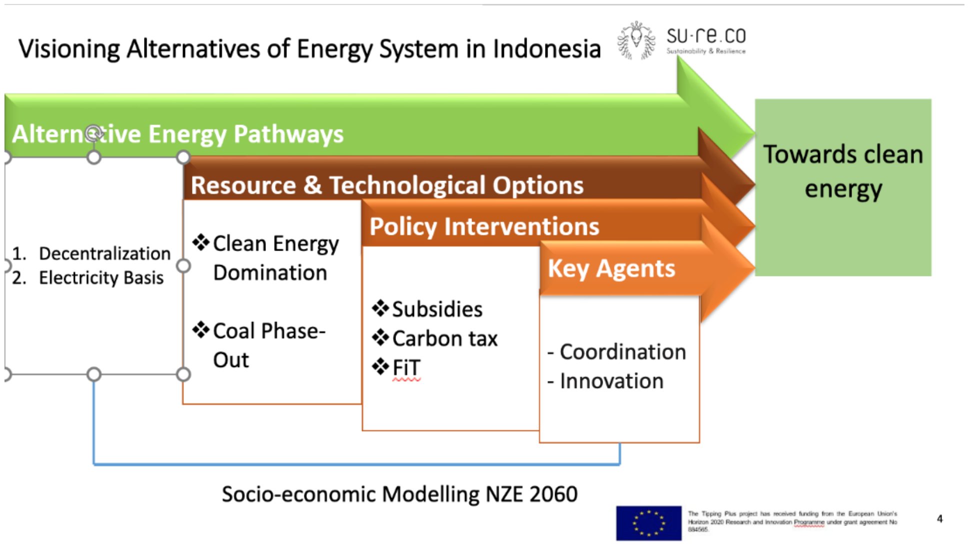

Figure 1 Visioning Alternatives of Energy System in Indonesia

According to the stakeholder engagements under TIPPING+ (Figure 1), the stakeholders visualise the future energy pathways of Indonesia. The future energy system will be decentralised and electricity basis**Error! Reference source not found.**. To achieve this, the stakeholders perceive clean energy resources & technology will be dominantly supported by enabling policy interventions (e.g., subsidies, carbon tax) and collaborative key agents. Since the government and non-governmental stakeholders cannot act individually, networking is essential to maximise the efforts. To support the policy-making, modellers will jointly provide scientific-based results to generate effective policy interventions to bring Indonesia from a coal and carbon-intensive region towards clean energy.

LANDMARC is a project to promote decarbonisation through Land-based Mitigation Technologies (LMTs). The project's goal is to understand better the impacts of Land-based Carbon Dioxide Removal (CDR) on various aspects of the environment and society. The project achieves this by combining multiple techniques, including earth observation, modelling and simulation, stakeholder engagement, climate resilience assessments, co-benefits, and trade-offs. The aim is to provide a comprehensive understanding of the effects of LMTs so that decision-makers can make informed choices about how to mitigate the impacts of climate change through sustainable land use practices. Su-re.co conducted a social impact study for the LANDMARC project, which included a farmer interview project to help identify the social impacts of biogas installations, particularly on clean cooking energy and gender equity in SDGs.

The upcoming project is the Mount Batur Reforestation project, funded by Hummingbirds and started in December 2022. It started with a feasibility study that ended in January 2023. Su-re.co surveyed 75 farmers and FGD (Focus Group Discussion) with 15 heads of villages around the Batur area to identify current conditions to support the upcoming large-scale projects in the next phase. This project is also supported by Geographic Information Systems (GIS) analysis of degraded land with CIFOR-ICRAF (Center for International Forestry Research – World agroforestry). There will be five selected villages as pilot projects to implement some of these projects: smart climate agroforestry, reforestation, climate-smart technology deployments such as biogas, and financial-business management.

The IKI Small Grants funded the biogas initiative project, which was completed in October 2022 with three main outputs; biogas installation with gas meters, climate field school (CFS) as a capacity building program, and feasibility study of the carbon market. By the end of October 2022, su-re.co had installed 42 biogas digesters along with gas meters; 108 farmers participated in the CFS, then ended with a feasibility study on how household-scale biogas can access the carbon market. Su-re.co conducted a carbon market workshop in the form of a panel discussion with speakers from the Ministry of Environment and Forestry, Ministry of Energy and Mineral Resources, Ministry of Finance, and also from the National Research and Innovation Agency to discuss the potential of the doing small-scale projects to access the carbon market. The second phase of this project, still in planning, is to conduct a two to a three-year project focused on scaling up the biogas system by developing a business plan to obtain carbon offset certificates. The MRV (monitoring, reporting, and verification) system improvement is necessary and conducting policy dialogue can integrate policies with carbon offset implementation.

There is also EbA-Enhanced Climate Field Schools for Climate Resilience (EECCLIRE), a joint project with SEI (Stockholm Environment Institute) funded by IUCN (The International Union for Conservation of Nature). This project is a climate field school implemented with EbA or Ecosystem-Based Adaptation. This project has four main outputs: EbA-enhanced CFS and coffee agroforestry conducted and sustained, biogas digesters installed in Bali and Flores, appropriate sustainability standards explored, and increasing the capacity of policymakers, notably BMKG (Meteorological, Climatological, and Geophysics Agency) and DKLH (Forestry and Environment Agency) in institutionalising EbA-enhanced CFS as an approach for other commodities.

II. Indonesia Portfolio in Land Mitigation under LANDMARC

By: Siti Indriani (Su-re.co)

With the theme of decarbonisation in the policy dialogue, two themes will be discussed further: energy and land. The energy topic was already presented in the summary of policy dialogue 1, which mainly discusses bioenergy. The 2nd policy dialogue is a continuation that will discuss the land sector and modelling in climate, land, and energy. One of the project cases in land mitigation is LANDMARC, a 4-year land use mitigation project financed by the EU (European Union). In this LANDMARC project, several modellers will model 3 things: climate, land use, and energy economy, which are expected to contribute to answering the needs of the Indonesian government for decarbonisation policies.

In the first two years, su-re.co has conducted desk research, surveys, and interviews, followed by four online workshops and FGDs in biogas and land mitigation. Su-re.co has drafted the Indonesia LMT portfolio (Land-based Mitigation Technologies) that the public can access later. The LMT portfolio will be used as input for model scenarios expected from the case study scale to be upscaled to national and regional scales. There are four LMTs: afforestation and agroforestry, peatland management, agriculture, and soil carbon enhancement (biogas and compost). Since bioenergy had been discussed in the previous policy dialogue, and modellers will explain the energy model, the fourth LMT will not be presented in this session. The LMT portfolio will be presented from various sides, such as policy, research gap, co-benefits, and land-use change.

For the afforestation portfolio (Figure 2), on the policy side, there is a 2030 FOLU (Forestry and Other Land Use) net sink document and the National Forestry Plan where the Ministry of Environment, Forest and Climate Change (MOEF) pledged to rehabilitate degraded land and industrial forestry by 2030. In the land use change, the competition in afforestation has decreased, and oil palm plantation is still the number one driver, followed by land alteration into mixed farming. Regarding the co-benefits side, there is potential carbon sequestration, sink, and food security. There is a need to be more in-depth action for research gaps, especially in climate, such as mapping every risk caused by climate change. The goal is that later modellers in the field of environment & energy can provide input on which locations LMT or bioenergy can be implemented appropriately.

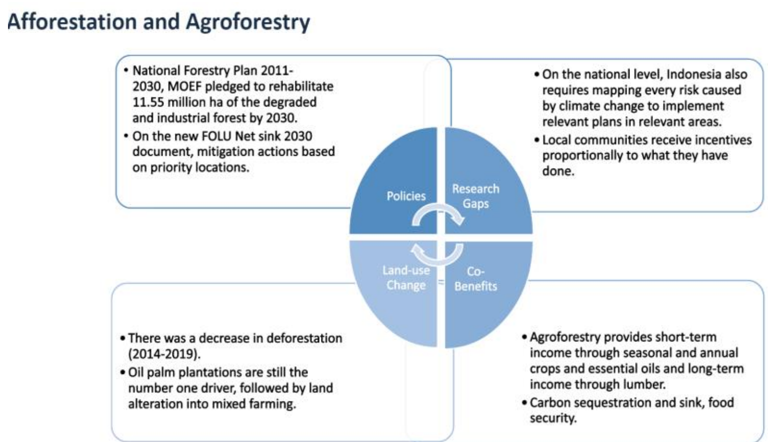

Figure 2 Afforestation and agroforestry portfolio

Peatland, the largest carbon-contributing sector in Indonesia, can be seen from various sectors (Figure 3). For the peatland management portfolio, in the research gaps side, the focus will be on something other than management practices but on instrumentations and tools such as remote sensing or satellites so that modelling can assist MRV. For the policy side, the BRGM (Peatland and Mangrove Agency) can also help to achieve the peatland management target by the end of 2020. On the co-benefits side, through paludiculture, peat can provide economic benefits to the local community.

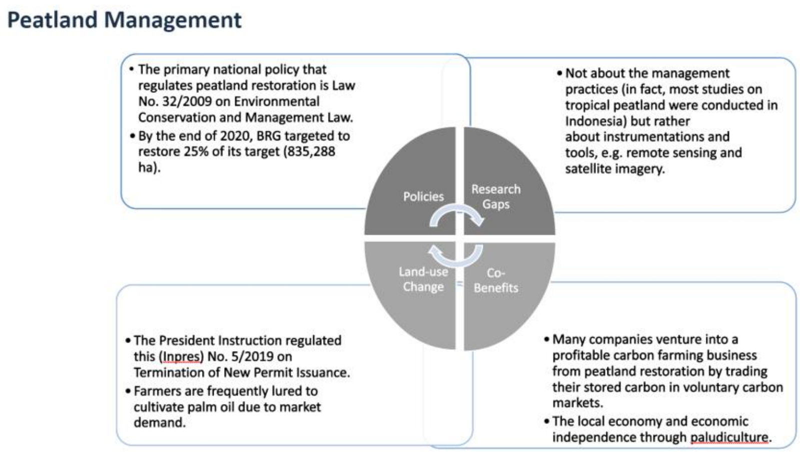

Figure 3 Peatland management portfolio

In the land-use change side of the agriculture portfolio (Figure 4), land-use competition is still very high. From the research gaps side, deeper analysis in the social economy field is needed. Another recommendation is how carbon capture can be the potential element, and then modelling the climate, energy and land use can answer the research gap. From the co-benefits side, how much money is spent on food production can be predicted. This policy dialogue with a theme of decarbonisation will cover energy and land, for power itself will be devoted to bioenergy and other renewable energy options.

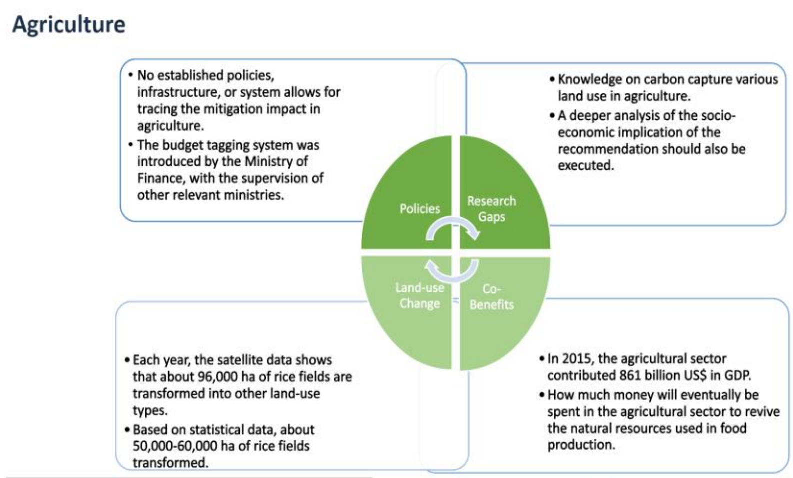

Figure 4 Agriculture portfolio

III. Retrieved Results of Feasibility Study on Agroforestry

Restoring degraded landscape through climate-smart agroforestry: a potential solution for decarbonisation strategy in Indonesia

By: Agus Muhamad Maulana (CIFOR)

The CIFOR and ICRAF have merged into one organisation focused on solving global problems in agroforestry and agriculture. Their research expertise includes genetic resources and biodiversity, sustainable value chains and investments, climate change, energy and low-carbon development, soil and land health, governance, equity, and well-being. The organisation has hub offices in multiple tropical countries, including Indonesia, and plays a role in Indonesia's efforts to reach its 2030 decarbonisation targets in the forestry and agriculture sectors.

Indonesia has great potential for agroforestry due to its large amount of forest (64% of total land). Many people living around forests engage in agricultural activities (34% of the total population in Indonesia), an existing "social forestry" scheme from the Ministry of Environment and Forestry (>285,000 ha of Indonesian communities in 30 provinces farming on land with social forestry licenses), the huge land potential for carbon capture (>315,000 ha of land in Java and surrounding areas with potential for agroforestry), and vast biodiversity (74 ecosystem types, 15.5% of the world's total flora, and 16% of the world's whole mammals).

Agroforestry can be an effective solution for decarbonisation by restoring mosaic landscapes and collaborating with forest crops and agricultural activities. Agroforestry can also help achieve nine of the 17 Sustainable Development Goals (SDGs); hunger, poverty, good health and well-being, gender equality, clean water sanitation, climate action, responsible consumption and production, and living on land. It can act as an effective tool for climate change adaptation and mitigation and support ecosystem goods and services at the farm and landscape scale.

Not only that, agroforestry is closely related to ecosystem services. By planting trees in the forest, there will be ecosystem services such as regulating services (climate regulation, pollination, disease regulation, water regulation and purification), cultural services (recreation, aesthetics, education, cultural heritage) and supporting services (soil formation, nutrient cycling, primary production). This reason is why agroforestry-based ecosystems can provide advantages over conventional agriculture.

There are ongoing projects with Sustainable Community-based Reforestation and Enterprises (SCORE). CIFOR implemented climate-smart agroforestry in that project, increasing carbon storage, biodiversity, and ecosystem services through landscape improvement. Also, it will engage communities to explore options for non-timber forest products (NFTP), sustainable wood and agri-food products and biomass enterprises that will provide co-benefits in the form of income. There are already six areas that have been restored using bioenergy crops with agroforestry systems: South Sumatra (Perigi), Central Kalimantan (Kalampangan, Buntoi, TRH Bukit Soeharto), Java (Giriwono), and Bali (Mt. Batur Geopark).

The goal of restoring land with agroforestry is to address the issue of 5.8 million ha of degraded land in Indonesia that has limited food production, low carbon sequestration, and low biodiversity (Figure 5). Of the total land area, 3.5 million ha have the potential for the growth of bioenergy species. Five species are modelled: *C. calothyrsus, G. sepium, R. trisperma,* and *C. inophyllum*. Bioenergy crops chosen are not timber crops because they can provide NTFP options. Therefore, farmers can utilise the yields from energy plants that fruits or seeds can extract to produce oil (biofuel) so that ecosystem services are maintained because the crops are not cut down in a rapid cycle.

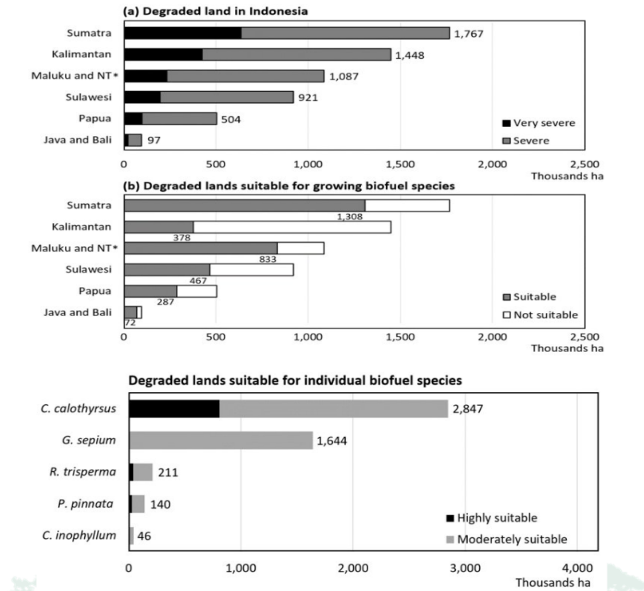

Figure 5 Data on degraded land and potential biofuel plants to be planted

There is also joint research between CIFOR and BRIN (National Research and Innovation Agency) on *Pongamina pinnata* and *Calophyllum Inophyllum* that provides information on the energy content of their seed production, which serves as a baseline for all bioenergy species planted in the field (Figure 6). In addition, plant growth monitors are carried out four times a year to measure the growth, survival rate, flowering, and grains of bioenergy plant species planted in both mineral soil and peatland. CIFOR also measures aboveground biomass to see the percentage of carbon capture generated from land restoration using bioenergy crops.

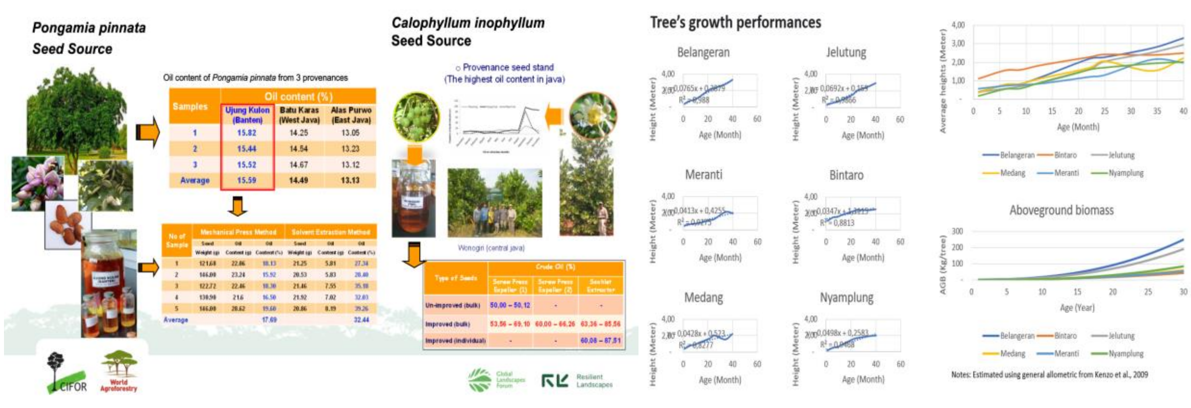

Figure 6 Information on the energy content of Pongamia pinnata and Calophyllum Inophyllum (left) and data on the plant's growth monitor (right)

The research is community-based and considers the wishes of the landowner or community about the types of plants they want to plant in their fields. The research is not only introducing the preferred species but also seeing the perspective of the community and farmers regarding what species they are familiar with and exist around the forest or plantation. Since tree planting is done in the field, there will be a decrease in productivity for agricultural products. Therefore, CIFOR modelled bioenergy crops planted with crops to determine the reduction in productivity because the crops will compete for land due to needing to be cut down to sequester carbon to produce seeds or fruits, which are energy sources (Figure 7). However, since the selected trees are NTFPs, farmers will also earn from selling grains, fruits, or extracts from the energy crops.

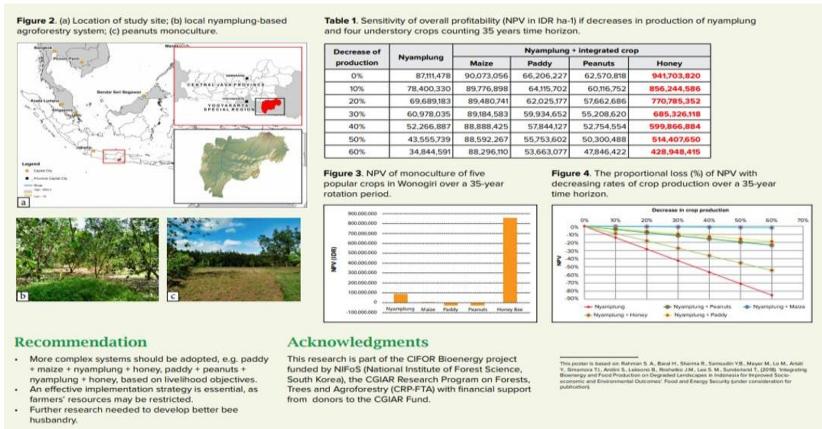

Figure 7 Integrating bioenergy and food production on the degraded landscape in Indonesia

Although the market in Indonesia still has limited access, further studies will be conducted on bioenergy crops that already have a demand and collaborate with the government to see the potential of other crops. Because Indonesia is amid an energy transition, there will be a high demand for fuel alternatives. Farmers will be more interested in planting bioenergy crops if the market already exists. In this case, Allometric measurements were made to see the percentage of carbon captured over time for each type of energy crop. This measurement begins with biomass size, which is then converted to measure the rate of carbon retained. At the site scale, in the Perigi area, agriculture still utilises Songor rice (fire potential). CIFOR modelled how the business-as-usual scenario and conventional agriculture are applied with an agroforestry revegetation model (Figure 8). The results showed the potential of 567 tons of carbon sequestration on 10 ha of land and 2,795 tons in 30 years. Also, in 1 ha, 93 tons of carbon dioxide are generated from agroforestry systems with bioenergy crops.

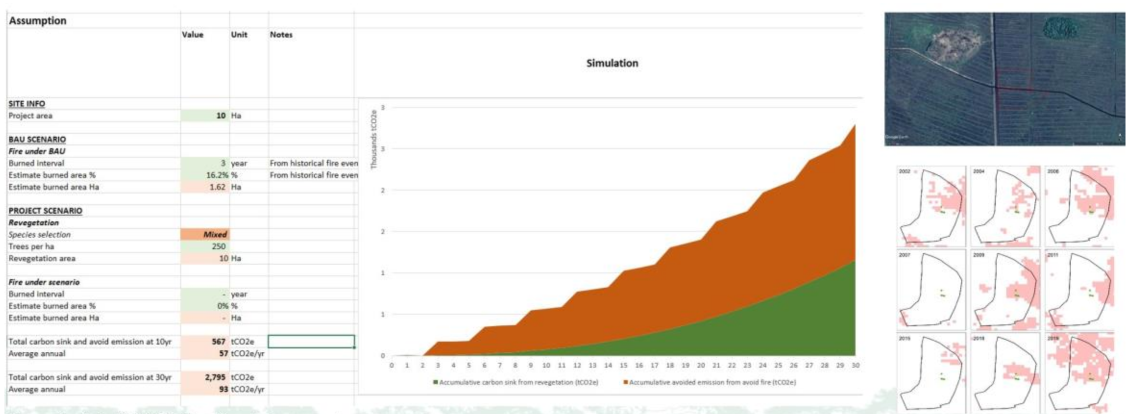

Figure 8 Site simulation model for 10 years in Perigi

In conclusion, agroforestry can be a tool for adapting to and reducing the effects of climate change as it can capture carbon, provide ecosystem goods and services in line with the SDGs, make landscapes more resilient, and reduce the threat of climate change.

IV. Introduction of Climate-Land and the Energy-Economic Modelling

4.1. The Climate-Land Model under LANDMARC

4.1.1. ALCES

By: David Ismangil (TU DELFT/LANDMARC)

The ALCES is top-down modelling of land use mitigation techniques and options, bottom-up integration of stakeholder knowledge, and stakeholder insights (Figure 9). One of the model's corrections is how to bridge this scale where it can be seen a lot of top-down climate models that model different climate mitigation options and a lot of top-down policy, perception and knowledge of stakeholders.

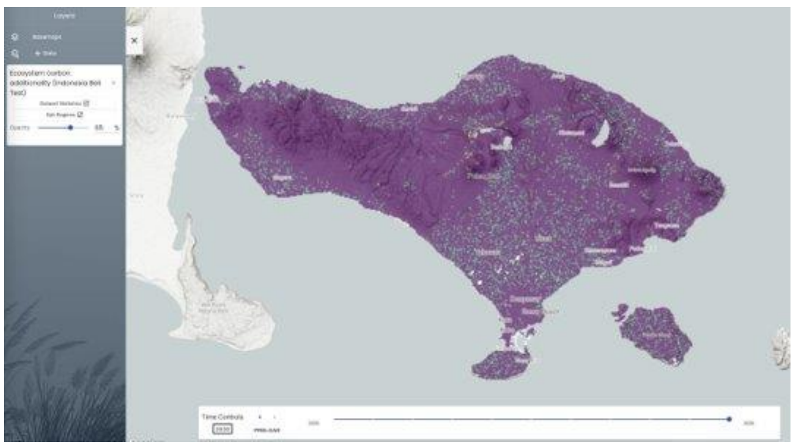

Figure 9 Overview of the ALCES model

Through scenario co-creation, the ALCES flow model is a tool to engage stakeholders in exploring different land use mitigation portfolios, such as agroforestry, peatland management, and biogas management. The goal is to bridge top-down and bottom-up mitigation in planning and implementation and provide more information from dialogues, scenarios, perceptions, and opportunities based on different portfolios.

ALCES model is designed to be a dynamic land use model for near-midterm planning that is stakeholder-friendly. It enables the exploration of various land-based mitigation portfolios by incorporating stakeholders' opinions, viewpoints, and expertise. The model outputs, which are based on scenarios given by stakeholders, can assist in identifying long-term strategies for land use mitigation portfolios. The approach aims to bridge top-down and bottom-up approaches through stakeholder co-creation, increase implementation ownership and enhance the permanence of the implementation.

This model is a method for bridging and a tool to determine the risks and opportunities involved in scaling up these techniques or practices from a local to a national level. The involved stakeholders are those with ideas for successful strategy implementation. In order to have role-form scenarios and narratives, this model has thus far concentrated on policymakers, land users, land owners, NGOs (Non-Governmental Organizations), and industries. This is because their views span the widest range of necessary information.

The type of inputs is very broad, so the scenarios and narratives could be a pessimistic or optimistic implementation of certain techniques or portfolios, i.e. in 2050, Indonesia would like to have 30% of its set of agroforestry. Stakeholders can explore this, and here, it can be seen that the perspectives of each stakeholder can be discussed (Figure 10). There could also be geographical differences, especially in Indonesia, which varies in islands, and agroforestry practices could have different impacts or applications. In order to demonstrate how a geographic file could affect a certain outcome, users can upload it and utilise the model to create a geographic application based on user input.

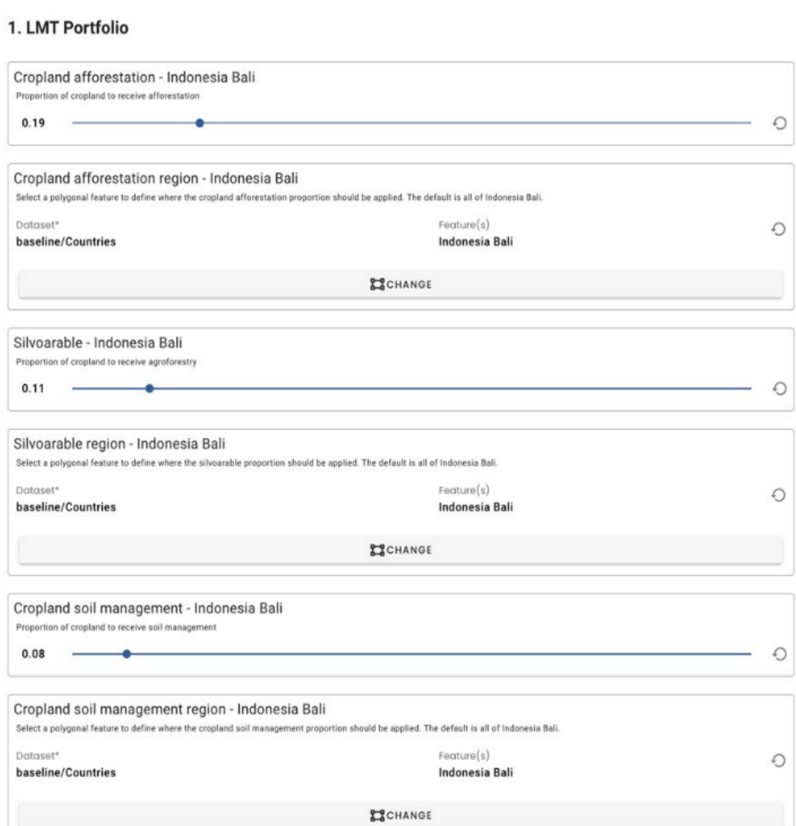

Figure 10 Overview of the stakeholders setting to determine the optimistic or pessimistic scenario

At a more detailed level, the model's current assumption is based on tier 1 IPCC (Intergovernmental Panel on Climate Change), which are rough numbers as they were set up to apply for a global scale-up case study. However, the model has allowed for input of localised data, carbon fluxes/flow, geographic application, and rough implementation cost. How much portfolio measures cost if LMT is applied at a certain level, and where the best location is can be analysed. The broad outputs would be stakeholders defining inputs and scenarios, the stakeholder perspectives on implementation risk, opportunities, benefits, trade-off, and uncovering mid-long term approaches for land use mitigation portfolios.

Applying this policy could benefit policymakers by enabling them to explore various land-based mitigation portfolios and stakeholder perspectives on risks, opportunities, benefits, and trade-offs. It is designed for workshops, allowing stakeholders to provide input and generate visual outputs. It can bridge the top-down and bottom-up approaches by enabling stakeholder co-creation. This is important in land use mitigation and increasing implementation ownership, feasibility, and buy-in from locals and landowners, which can enhance the permanence of implementation in the long term.

4.1.2. LandSHIFT

By: Janina Onigkeit (UniKassel)

The LandSHIFT model is a tool to explore potential future land use changes in Indonesia and other regions, focusing on identifying trade-offs and synergies between land cover, land production, and LMTs implementation (Figure 11**Error! Reference source not found.**). The model increases the reliability or plausibility of information on the contribution of LMTs to climate change mitigation in that it considers the competition for land, e.g. food production. For this, it requires integrating local stakeholder knowledge in the form of scenarios on the future deployment of LMT options and s bio-geophysical information on a spatial scale, from the local to the national levels.

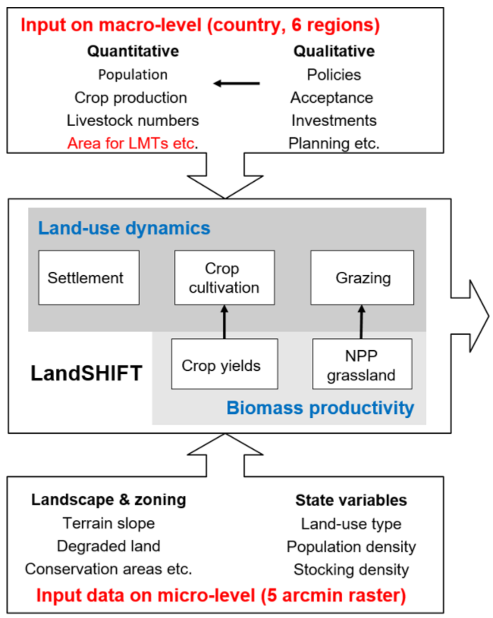

Figure 11 Overview of the LandSHIFT model

For example, in Indonesia, the model considers four categories of LMTs, focusing on afforestation and rehabilitation of degraded and industrial forest areas (about 12 million hectares between 2011 and 2030). Based on the scenario exercise, the information could be used as a starting point for scenarios (Figure 12). If the scenario given is the LMT per decade target is approximately 6 million ha per decade, to realise this, the model needs spatial data on degraded industrial forest areas all over Indonesia and future trends up to 2050 from a wide group of stakeholders.

Scenario input – Level of LMT implementation

	Trend/ Today	SCEN-1		SCEN-2		SCEN-3		Narratives
LMT – Options	2020	2030	2050	2030	2050	2030	2050	
Afforestation/-reforestation	6 mill ha/decade	0	++	+	+++	-	+	Rehabilitation of degraded and industrial forest area…
Peatland management								
Agriculture								
Agroforestry								
Soil carbon enhancement								

Figure 12 Example of a scenario input for LMT implementation in Indonesia

The LandSHIFT model's outputs cover the entire area of Indonesia in six groups (regions): the five main islands (Papua, Java, Sulawesi, Kalimantan, and Sumatra) and a different group of small islands. The information will be provided in graphs and maps of land cover changes, and acquired data can aggregate this information to LMTs implementation by 2050. The model can also estimate the amount of CO2 sequestered over time, applying the IPCC Tier1 approach (Figure 13 illustrative example**Error! Reference source not found.**).

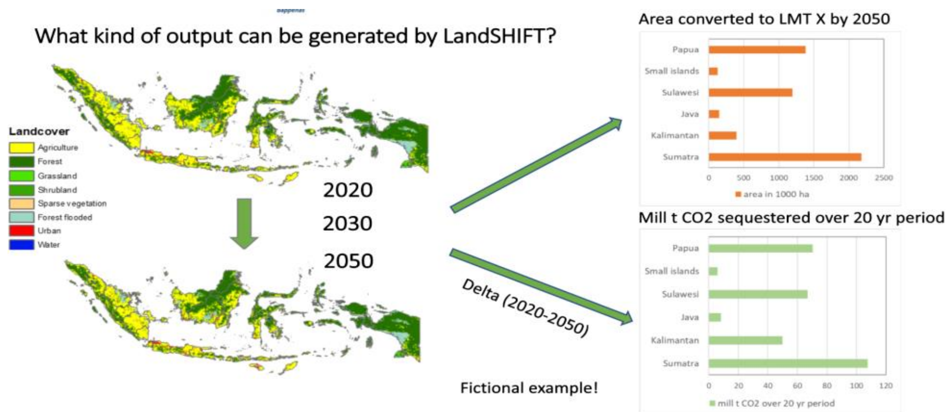

Figure 13 Overview of outputs generated by the LandSHIFT model

The model provides users and stakeholders with more reliable information on the contribution of LMTs to climate change mitigation in Indonesia, a set of quantified scenarios for land use planning across sectors, assistance in the elaboration and development of consistent strategies for agriculture, climate mitigation, and related fields, as well as identification of potential risks and opportunities in various LMT portfolio implementation strategies.

4.2. Energy-Economic Modeling

4.2.1. E3ME MODEL

By: Eva Alexandri (Cambridge Econometric)

E3ME is a global model aggregating and analysing the economy, energy system, and environment. It comprises 71 regions and 44 sectors, including Indonesia. The model includes interactions between the areas within the model and uses estimated parameters, such as investment and trade by industry, to simulate the behaviour and interactions of the economy. It comprises a collection of behavioural equations and accounting identities and is used for scenario analysis and impacts on a baseline rather than making precise forecasts.

This model aims to demonstrate the impacts of economic, energy, and environmental policies by considering the interplay of the economy, energy, and environment, as well as how changes in one can affect the others. It also incorporates innovation and R&D (Research and Development), which can drive technological change and efficiency. The goal is to show how different policies can affect a given baseline scenario by considering the interactions between the economy, energy, and environment and the role of innovation and R&D (Figure 14).

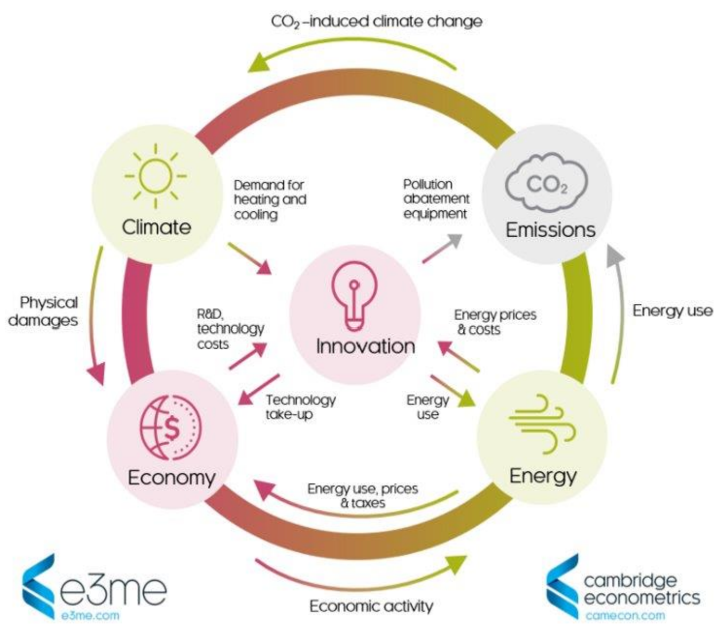

Figure 14 Overview of the E3ME Model

The focus is on energy and environment policies, including a carbon tax, subsidies for certain technologies, compensation for the early phase-out of certain fuels, and policies around coal phase-out. The information needed includes details on specific policies being considered, such as subsidising electric vehicles and regulating the production of diesel vehicles. Data on financing and investment requirements are also needed, including assumptions on how stakeholders will cover the cost and the potential for adjustments. Additionally, there is a request for information on specific bioenergy technologies, including deployment potential, fees, and timelines for deployment or phase-out.

The outputs are grouped into the economy, society, and the environment.

- The economy's outputs include GDP and its parts, sectoral output and GVA (Gross Value Added), prices, trade and competitiveness effects, bilateral sectoral international marketing, consumer prices and spending, and the distributional effects on households.

- For society, the outputs include sectoral employment by gender, labour force and participation rates by gender and age group, the unemployment rate, the sectoral wage rate, and real income for different socio-economic groups.
- For the environment, the outputs include energy demand by user and fuel, energy prices, power sector results like the use of solar and wind, CO2 emissions by sector and fuel, other airborne emissions, and material demand by user and material.

The model can predict the economic and labour market impacts of different pathways, sectoral impacts, and possible pathways based on current structures and policies. The model can also show the impacts of other policies on the economy and labour market outcomes, as well as energy and environment results, such as energy use, power sector mix, and emission reductions by sector. The model also considers Indonesia's impact on the rest of the world and can estimate the differences between what other countries are doing.

4.2.2. Computable General Equilibrium (CGE)

By: Raphaela Maier (UniGraz)

CGE is a macroeconomic model that is supply-side constrained rather than demand-side constrained; this means that capacities such as labour, capital, and resource endowments constrain economic growth. The model is based on national accounts and input-output tables (with globally consistent trade flow data—the Global Trade Analysis Project, or GTAP), which allows for modelling trade revenue for a specific country and quadrant countries. The economic model is structured into domestic firms (production sectors) and final demand agents (private households and governments), with all agents optimising their behaviour under relevant market conditions (a medium-term tendency towards general equilibrium "supply = demand"). This tool covers the global level of multiple regions and can focus on Indonesia under the TIPPING+ project.

The model aims to provide insights into achieving a net-zero power sector in Indonesia by 2060. A suggestion for research questions to achieve a net-zero power sector in 2060 are:

1) *"What are the macroeconomic implications of a net-zero power sector by 2060?"* and
2) "What are the macroeconomic implications of comparing an emission reduction of 41% by 2030 to one of 29%?".

However, these are not final research questions; they are adjustable based on the inputs and interests of the stakeholders. The selected time horizon is 2060 due to Indonesia's net-zero power and coal phase-out plan. The model accounts for energy and process emissions (e.g. from the steel industry). General model assumptions include:

- Shared socio-economic pathways (SSP) are usually used for general socio-demographic development (population growth, economic growth, and productivity growth);
- Labour supply follows population growth;
- Fixed saving rate (the fixed portion of income is invested);

- In terms of the power sector, disaggregated power generation technologies, as in the GTAP database, are nuclear, coal, gas, hydroelectric, wind, oil, solar, and others; for the Indonesian case, the model will be expanded for geothermal and biomass technologies
- Exchange with BAPPENAS on the existing CGE model to have the same model input and compare the results.

For developing a net-zero scenario for electricity, the following are needed: current electricity mix, future electricity mix (including renewable), GHG (Green House Gas) emission reduction targets for mid-term (2030) and long-term (2060), and demand of electricity from different sectors (e.g., industry, transport). Subsequently, the CGE can simulate policy and technological changes' direct and indirect effects on different sectors and agents. For example, *how does a systemic intervention in one industry (e.g., the power or the industrial sector) spread to all the other industries and agents? What are the implications for the iron and steel sector if there are changes in the power sector?*

By comparing different regions, the model can identify structural changes in the economy, such as price changes, GDP, income distribution, foreign trade balance, and labour market trends. These changes can help identify the implications of changes in one sector, such as the power sector, on other sectors, such as the iron and steel sector. The model's potential policy recommendations include the following:

- Investment in green energy technologies;
- Determination of necessary CO2 prices to achieve emission reduction targets;
- Workforce

The benefits of the model for Indonesia include understanding the economic impacts of a net-zero energy policy on structural change, the activity level of sectors, and overall, as well as identifying opportunities and risks for climate policies.

V. Discussion Session

Question 1:

Yudiandra Yuwono – GIZ Indonesia, Energy Program CASE

From what you just elaborated on the CGE's efforts, I think you are aware that there are some existing works by the CGE in BAPPENAS. However, I would also like to add that many other government-led efforts are working towards similar targets when GIZ talks about emissions, net zero pathways, and other details. One of those is also in GIZ's program, which also sits under BAPPENAS KTI, so considering that there is a huge opportunity for synergy, especially alignment in inputs and exact targets, they might fit well and cover each other's gaps. At the end of the model, behaviour is determined by each model. There are potential areas for all synergy, particularly what you mentioned. So, I think it is a consideration. I will also offer it to the BAPPENAS colleague if this potential synergy sounds appealing; GIZ might need to arrange a follow-up meeting.

Answer:

Raphaela Maier – UniGraz

Thank you very much. It would be good to work together, exchange models, and arrange something to follow up.

Question 2:

Devi Laksmi (Directorate of Energy Conservation, Ministry of National and Development Planning - ESDM):

This is very interesting from what was said; will various forms of modelling be done, and will the results be harmonised between the models? Because it is the first time in policy dialogue that we can see cross-sectoral models for the policy recommendation.

Answer:

1) **Yusuf Suryanto – BAPPENAS, Direktorat KTI**

   The specifics of the modelling work are not yet planned; BAPPENAS is currently discussing a list of potentials for various models that must be used. In general, they already have the data, but collecting it will take a long time, and the sources are not only on our side. For this time, the purpose of this meeting is to explore further the topic of modelling, which can cover climate, land, and energy sectors. In sum, these models are not being implemented at this point.

2) **Takeshi Takama – su-re.co**

   The project is research-based, not a consultancy, but if you are asking about the results from those models and are interested in receiving the results, it can still be used. Su-re.co plans to work on policy development; if ESDM colleagues are interested in using the results and working on this project, we should talk further.

3) **Yusuf Suryanto – BAPPENAS, Direktorat KTI**

   Modellers, do you already have a result for Indonesia, and can it be shared? What should we do shortly to conduct the research?

4) **Raphaela Maier – UniGraz**

   The CGE model does not have a result yet, so we want to work with you on the research question soon and come up with a result in the next three to five months so policymakers can use the data to make policy decisions.

5) **Karl Steininger – UniGraz**

   I can add to what Raphaela said. We also want to be consistent in our interpretation, for example, in the CGE model, so we need to ensure that the models use the same input. So that is the current state: to harmonise the inputs with your existing model.

6) **Eva Alexandri – Cambridge Econometric**

I presented some preliminary results for Indonesia, but these are from a generic scenario where the world transitions to 1.5. The E3ME model is looking for information on how to personalise for Indonesia, so if you have specific timelines, targets, and policies, we want to add those specifics for Indonesia.

7) **Janina Onigkeit – UniKassel**

The LandSHIFT model respects the harmonisation of the different models to increase the consistency of different scenarios so that they can be integrated. From the LANDMARC models, all of our scenarios from the model inputs are based on medium IPCC scenarios and social-economic pathway tools, so only medium scenarios and no extremes are expected in the future. I can say the same for the LandSHIFT model; we have population and agriculture production input based on the agroeconomic model. So, I think the consistency is more or less covered. I am interested in how we can use inputs from other models to enrich our scenario. This is the case in LANDMARC from the ALCES model, so we need some data on realistic future trends for the LMT area.

As I heard from Raphaela, your model deals with the implementation of bioenergy; for this, you need land, and you will also need labour forces. This is a central aspect when discussing the speed of implementing different options. If we can obtain the scenario assumptions required to fit into the model to obtain results, I think the LandSHIFT project can cover this. I hope there will be some iterations in model production between given inputs, discussing the model result, and seeing how the scenarios should be adapted and made more reliable for their final uses. So, the model integration is possible; however, data and policy input need to be specific.

8) **Raphaela Maier – UniGraz**

I see what you mean, for example, the technological overlap regarding the labour force. Karl, maybe you can share your thoughts about the specific technology in the model. The model can implement the necessary land, but it has not done so thus far.

9) **Karl Steininger – UniGraz**

I think it is to make the scenario consistent, as Janina said, and to learn from the more detailed land use in the LANDMARC project and make it consistent with the scenarios the CGE model uses. The strength is that the model can see a stronger inter-sector connection and dependence, starting with the consistent land scenarios. This is also part of the analysis, triggering all impacts across sectors.

10) **David Ismangil – TU Delft**

LANDMARC is set up because different models meet different needs in modelling global climate mitigation. So, we have DAYCENT and ALCES that go up to the national scale, and we also have LANDSHIFT and other models that go up to a global scale. So, the model has different sets of models for different scales, out of which scenarios or narratives can be used to fit into one another. Working with stakeholders can be used for multiple models and different outputs that can also be used to fit into different needs. For instance, the Indonesian government might want to know what this will do for global mitigation in Asia or at a more local level.

11) **Yusuf Suryanto – BAPPENAS, Direktorat KTI**

This is a very preliminary meeting. If we consider that these models can support us, we could follow up for further action. They are researchers, not consultants; thus, we will need further discussions if we want to work with them. We want to learn more about the relationship between climate, land, agriculture, forestry, and energy. If we can see that it is all interconnected and can be implemented, it will help us all be on the same page.

Question 3:

Budi Utomo – Coordinating Ministry for Economic Affairs (KEMENKO)

1. Can the micro scenario (the coal phase-out plan) be assessed for feasibility at the macro level?
2. Miss Eva raised the implications of increasing the target from 29% to 41%. Can the implications be assessed, including the availability of support from foreign funding? Because of the high-rise interpretation, the cost of capital has increased.

Answer:

1) **Eva Alexandri – Cambridge Econometric**

On the coal phase-out, E3ME can model the power system. In the modelling, E3ME has the option to ban the building of new power plants after certain years, but the model also has the option to retire existing power plants early. The model will calculate a timeline based on the average lifetime of the power plant and try to replace it with something else. E3ME did this under the 1.5 scenarios, in which the model prohibited the construction of new coal power plants and retired some existing plants early to achieve aggressive emission reductions. The model also assumed that if the powerplant is retired early, there will be compensation, but that assumption can be changed. The target change's assumption on foreign capital is that E3ME can ascertain what they look like, so the model can choose from among the available assumptions in the model to provide the answers. So financing is something E3ME construct by talking to policymakers and creating assumptions. So, there are some defaults, but they can be changed to reflect policy.

2) **Karl Steininger – UniGraz**

The dynamic CGE model is a macro-model, so what the model can use as an input is time to end (i.e., coal power plants are no longer installed after a certain period). It depends on what incentives there are, remodel those and give the macro-model feedback. The micro-energy model does not tell you how many incentives the model needs. The model has micro results from the scenario and macro feedback on the scenario's implications, ranging from 29% to 41% with the foreign aid scheme. The model's output is seen in two scenarios: *how the foreign trade balance changes and how the capital account changes*. Moreover, similar to the E3ME, CGE can compare different scenarios on different financing conditions. Indonesia is too small to have global finance feedback on the market, so the model believes it is more about the global financing market scenario than relating to the macro impact under certain scenarios.

3) **Janina Onigkeit – UniKassel**

The LandSHIFT model can contribute to this question. The target was 2030, and the LandSHIFT model can estimate the potential contribution of LMTs to this target in the form of negative emissions technologies. If the model gets scenarios for this time and time, the model could compute this and share the impact on the food production sector, which would be a more cross-sector aspect of the question.

Question 4:

Budi Utomo – Coordinating Ministry for Economic Affairs (KEMENKO)

If this is used as a constraint, for example, because KEMENKO has energy access along the biodiversity, KEMENKO cannot immediately use so many mega-intermittent. KEMENKO will make a constraint to limit it. Is it possible to include it as input and scenarios?

Answer:

1) **Karl Steininger – UniGraz**
If I am understood correctly, by "diversity constraints," do you mean energy constraints? If yes, the model needs to specify how the constraints translate to the specific energy capacity expansion, so I have a land and land use model I should give Janina and David to tell them. How to implement a biodiversity constraint in the land and land use model. The first-derived electricity mix generation technology is suitable for macroeconomic feedback. However, I will assume it is closer to the direct land use model for biodiversity.

2) **Janina Onigkeit – UniKassel**
Yes, the model can include biodiversity because LandSHIFT expands land use types by granting certain suitability to land cover to protect protected areas and primary forests from conversion to other land uses. Given the right scenarios, the LandSHIFT model can accomplish this.

3) **David Ismangil (TU Delft)**
The ALCES model defines land use simply by having a grid in the model, and each grid has a certain value added to it based on current and future land use. So, for example, the model could have biodiversity designated as protected areas and give less protected areas a higher carbon value. Another option is if stakeholders have different types of agroforestry or protection, you can define this differently and assign different carbon values for the specific piece of land as long as you know where to apply it or roughly where to apply it. Maybe if it is not a hardcore number generator in the case of ALCES, you could say, "The model thinks this would be 20% higher or 20% lower than the reference value." In that case, stakeholders could explore and define the different gradations of biodiversity and apply them to different sets of geographically limited areas.

Question 5:

Astika Andhini – Ministry of Industry of the Republic of Indonesia (KEMENPERIN)

In this model, what is the competitiveness of national industrial products? Also, what is its effect on the growth of the industrial sector? KEMENPERIN see that economic aspects are also part of the model. For information, this year, KEMENPERIN also made a "green industry road map," which included a roadmap related to decarbonisation in the industrial sector.

Answer:

1) **Raphaela Maier – UniGraz**
   You are right: if the energy prices differ due to other energy technologies, this will impact other industries (e.g. steel). With the indirect effects the CGE model has, for example, on the iron and steel industry, the sector's output will increase or decrease if prices rise or fall. So that is one thing the CGE model can say about iron and steel. The CGE model could also look at the industry's low-carbon technology, such as hydrogen technology, to see how this and the energy sector might evolve; this is one thing the CGE model can do and get a result. Overall, the CGE model can see all the shifts in different production sectors. The model can also say which sector will gain or if the decarbonisation of the power sector will impact some sectors more positively than others. In general, the CGE model can make different aggregations of the industry sectors. It can be interesting to discuss which industrial sector stakeholders are interested so that the model can disaggregate those sectors.

2) **Eva Alexandri – Cambridge Econometric**
   The E3ME model does have effects on the industry. In the model, it can be divided into two parts: the price effect, which means that changes in prices may affect the competitiveness of the sector and the economy (import or export), and the demand effect, which means that if you are going to manufacture most solar panels, then demand, and production will increase; and the efficiency effect, which means that if the E3ME model is investing more to make the sector more efficient, it could be that they become more efficient in using energy and use less energy so that that mitigates the changes in prices. So that is something the E3ME model can capture, particularly concerning steel, because it is a very important sector in some countries. The E3ME model has a sub-model that looks at different steel technologies, whether blast furnaces, gas-related or electricity-related. The E3ME model can encourage the sector to change to different technologies to mitigate this change in competitiveness.

Question 6:

Astika andhini – Ministry of Industry of the Republic of Indonesia (Kemenperin)

Does the model also take into account global competitiveness? What about other global industries that do not use decarbonisation (a sort of comparison)? Does the model also analyse this?

Answer for the CGE model:

1) **Eva Alexandri – Cambridge Econometric**
   So even if the sector is not directly related to decarbonisation, if you have changes in general price levels or consumer expenditure patterns, this will affect the industries even if they have no direct link.

2) **Karl Steininger – UniGraz**
   Yes, same with the CGE model. For example, the model has the labour market and the prices of other factors that affect other sectors that might not be influenced by decarbonisation.

Question 7:

Dr Kristian Mairi – Strategic Policy Centre, Ministry of Environment and Forestry of The Republic of Indonesia (KLHK)

The forestry ministry has new knowledge in climate mitigation; there is a climate change directorate. KLHK is concerned that each sector deals with climate change in its field. KLHK has an echelon 2 that records all forms of change. In principle, to achieve NZE, the calculation is based on input-output and how much is released into the air and absorbed. The forestry sector contributes to all decarbonisation calculations in Indonesia. Therefore, the forestry sector would like to get a model or input on good carbon accounting on a small, regional, and national scale. I want to get inputs related to national carbon calculations in various land use and forests because the calculation methods differ.

Answer:

Janina Onigkeit – UniKassel

One aspect is the uncertainty of the numbers you will get when you calculate or use a model to calculate. I would say this is one of the reasons why LandSHIFT chose the scenario technique. LandSHIFT does not provide numbers or fixed numbers in our model. However, rather than use the scenario approach to compare the results of different pathways, LandSHIFT uses different options to see the outcome and the most promising way to get the best reduction. It will not use 60 million tons of CO2, but pathway 1 gives a much better result than the second pathway. LandSHIFT does not want to reduce the sector's emissions by 20% by 2030. However, the demand for land or certain types of land will change in time due to agricultural production or certain policies to implement LMTs. The model sees what land use changes, sequences the CO2 emissions or sequestration in one year, and compares with a year in the future to see the net outcome.

VI. Concluding Remarks

The importance of land in meeting energy targets lies in its potential to provide space for the development and deployment of various land-use mitigation technologies (LMTs). These LMTs are critical in decarbonising the energy sector and reducing greenhouse gas emissions. By utilising land effectively, renewable energy sources such as wind and solar can be deployed, and energy-efficient infrastructure can be constructed, leading to a more sustainable energy system. As a result of the policy dialogue, these models are very interesting as they can potentially be used in developing policy recommendations in the future, particularly when dealing with cross-sectoral issues such as land, energy, the economy, agriculture, and food. It is an intriguing approach, especially because it is unique to Indonesia. Within 6-7 months, Indonesia must be able to follow up on the G20 targets immediately and prepare the final draft of RPJMN 2025-2029 and RPJPN 2025-2045. There will be potential meetings in the future for further discussion to discuss further details of modelling and policy input and recommendations.

Appendix 1: Online and offline attendance List

Name	Organisation	Offline/Online
Yusuf Suryanto	BAPPENAS - Direktorat Ketenagalistrikan, Telekomunikasi dan Informatika	Offline
M Asrofi	BAPPENAS - Direktorat Ketenagalistrikan, Telekomunikasi dan Informatika	Offline
Jayanti Maharani	BAPPENAS - Direktorat Ketenagalistrikan, Telekomunikasi dan Informatika	Offline
Ferdy Nur Alamsyah	BAPPENAS - Direktorat Ketenagalistrikan, Telekomunikasi dan Informatika	Offline
Wiwin Siahaan	BAPPENAS - Direktorat Ketenagalistrikan, Telekomunikasi dan Informatika	Offline
Nararya Berlianti	BAPPENAS - Direktorat Ketenagalistrikan, Telekomunikasi dan Informatika	Offline
Paska Rina	BAPPENAS - Direktorat Ketenagalistrikan, Telekomunikasi dan Informatika	Offline
Andreas Satriadi	BAPPENAS - Direktorat Ketenagalistrikan, Telekomunikasi dan Informatika	Offline
Izudin Alqosam	BAPPENAS - Direktorat Ketenagalistrikan, Telekomunikasi dan Informatika	Offline
Rijananto P	BAPPENAS - Direktorat Ketenagalistrikan, Telekomunikasi dan Informatika	Offline
Usamah Hujjatul	BAPPENAS - Direktorat Sumber Daya Energi, Mineral dan Pertambangan	Offline
Erwin R	BAPPENAS - Direktorat Sumber Daya Energi, Mineral dan Pertambangan	Offline
Takeshi Takama	su-re.co	Offline
Siti Indriani	su-re.co	Offline
Cynthia Ismail	su-re.co	Offline
Oktavianna Winda	su-re.co	Offline
David Ismangil	TU Delft	Offline
Agus Muhammad Maulana	CIFOR-ICRAF	Offline
Robert Finlayson	CIFOR-ICRAF	Offline
Bimo Dwi Satrio	CIFOR-ICRAF	Offline
Yudiandra Yuwono	GIZ CASE	Offline
Fajrin Hanggoro	GIZ CASE	Offline
Iqbal Ilham	GIZ CASE	Offline
Dr. Kristian Miair, S.ut, M.Sc.	Pusjakstra KLHK	Offline
Ihwan	Pusjakstra KLHK	Offline
Devi Laksmi	ESDM - Direktorat Konservasi Energi	Offline
Nurhayati	ESDM - Direktorat Konservasi Energi	Offline
Satrio Swandiko	GIZ ExploRE	Offline
Satria Wira	GGGI	Offline
Emi Fatma	GGGI	Offline

Ambolas Manalu	GGGI	Offline
Ramous	Setjen DEN	Offline
Hanry T	Setjen DEN	Offline
Sadmoko HP	Setjen DEN	Offline
Dwi Septi Cahyawati	Kemenko Ekonomi	Offline
Budi Utomo	Kemenko Ekonomi	Offline
Bambang Iswanto	PLN	Offline
Sidik Mustafa	PLN - Pengembangan, Ijin dan Lahan Aneka EBT	Offline
Dinda Alamsyah	PLN	Offline
Rusdi Karim	PLN	Offline
Agus Setyawan	BRGM - Sub Kelompok Kerja Perencanaan Restorasi Gambut	Offline
Hens Saputra	BRIN	Offline
Sumbogo Murti	BRIN	Offline
Wahid	BRIN	Offline
Andhika	BRIN	Offline
Derry Wanta	ICCTF	Offline
Sarah Wibisono	su-re.co	Online
Bianca Angelique	su-re.co	Online
Hendiliana Dewi	su-re.co	Online
Imelda Magdalena	su-re.co	Online
Pasthika Dirda	su-re.co	Online
Fabian Peri	su-re.co	Online
Evangela Carolina	Kemenko Ekonomi	Online
Dessyana Adhiarizki	Kemenko Ekonomi	Online
Akthia L. M.	Kemenko Ekonomi	Online
Yunita Ariyani	ESDM - Direktorat Bioenergi	Online
Ari Harianto	PLN	Online
Yudas Agung	PLN	Online
Wisnu Nugraha	PLN	Online
Muryono	PLN	Online
Rizka Tri W	Kementerian Industri	Online
Astika Andhini	Kementerian Industri	Online
Sri Gadis Pari Bekti	Kementerian Industri	Online
Janina Onigkeit	UniKassel	Online
Eva Alexandri	Cambridge Econometric	Online
Raphaela Maier	UniGraz	Online
Karl Steininger	UniGraz	Online
Annemarie Lechte	UniGraz	Online
Agil Abdur Rohim	Interpreter	Online
Kenia AS	Interpreter	Online

Appendix 2: Documentation