System of Environmental Economic Accounting

Overview of Scenario Analysis modelling for policy mainstreaming in the context of SEEA EEA

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Overview

- Definition of scenarios for policy analysis
- Methods and models used to generate quantitative scenarios
- How SEEA-EEA can inform decision making by strengthening scenario analysis?
- Indonesia case study: lessons learned

Defining scenarios (what, why)

Scenarios are expectations about possible future events, used to analyze potential responses to new and upcoming developments.

Scenario analysis:

- *An exercise in which several future development alternatives are identified, explained, and analyzed.*
- *Designed to improve decision making, allowing it to embrace uncertainty and risk.*
- *Used to explore the impacts of planned interventions and unexpected events, increasing the general readiness to unforeseen external impacts.*

Both the private and public sector have used scenario analysis over the last few decades to manage risk and develop robust strategic plans in the face of an uncertain future.

Defining scenarios (when and how)

Scenarios primarily support the first phases of the decision-making process: agenda setting and strategy-policy formulation.

Scenarios can be classified as:

- *(Baseline) Scenarios: elaborated to define the trends we assess performance against (e.g. population, food demand trends).*
- *(Policy) Scenarios: generated to determine how we affect the performance of a system (e.g. investment in irrigation infrastructure).*

Scenario planning exercises can be:

- *Static: there is a vision (a clear objective) for a given year, and changes are assessed based on this vision, looking backwards to identify what needs to be done.*
- *Dynamic: there is a vision (a clear objective) for a given year and, as actions unfold, feedback effects (action/reaction) are triggered, allowing us to better understand whether and how the vision is realized.*

Methods used to generate quantitative scenarios

- Econometrics:

A methodology that measures the relation between two or more variables, running statistical analysis of historical data and finding correlation between specific selected variables.

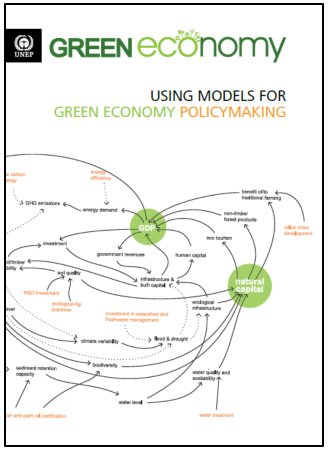
- Optimization:

A method that aims at identifying the best solution (with regard to some criteria) from some set of available alternatives.

- Simulation (agent based and causal descriptive models)

A method that uses a "what if" approach, based on descriptive models that focus on the identification of causal relations between variables. Its main pillars are feedback loops, delays and nonlinearity (also, in some cases, through the explicit representation of stocks and flows).

Methods used to generate quantitative scenarios



Methodology	Main strengths in assessing the green economy	Main trade-offs relative to the green economy	Problem identification	Policy formulation	Policy assessment	Policy M&E	Complementarity	Accessibility – participation
Dynamic (projections)								
Econometrics	Entirely based on historical trends; quick implementation	Traditional modelling lacks the explicit representation of feedbacks and does not capture possible emerging dynamics. Time series modelling has the potential to solve these issues.	✓		✓	✓	✓	✓
Optimization	Supports the estimation of target; understanding key limits of the system	Provides and "end" with little insights on the "means"; not viable for highly dynamic and cross-sectoral systems		✓	✓			✓
System dynamics	Focuses on structure to drive behaviour; horizontal sectoral representation; knowledge integrator (ad hoc)	Highly reliant on knowledge available in other fields; relatively long implementation time for national models	✓	✓	✓		✓	✓

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Models used to generate quantitative scenarios

Models can be categorized in many ways, for instance:

- Scenario creation tools (qualitative):

e.g. system maps, tree diagrams, dynamic pathways

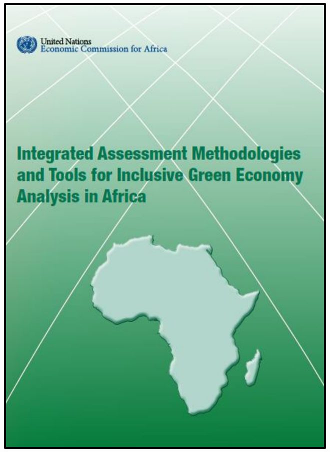
- Scenario forecasting tools (quantitative):

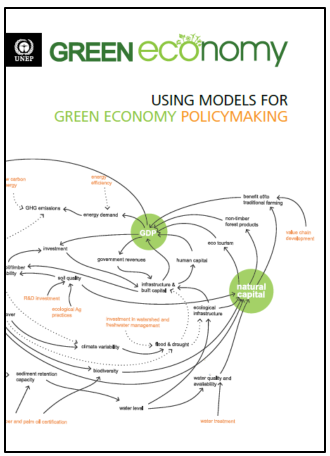
economy (general and partial equilibrium models), infrastructure (systems engineering models), land use (spatially explicit models), green economy (systems models)

- Complementary approaches used to inform and/or evaluate scenarios:

e.g. Cost Benefit Analysis (CBA), impact assessment, lifecycle analysis

Models used to generate quantitative scenarios





		Representation of key pillars (and capitals) of sustainable development										Analysis of climate change			GE intervention analysis	
		Economic dimension				Social dimension			Environmental dimension							
Model	Scope of the analysis	Economic capital	Sustainable Consumption and production	Competitiveness	Capital misallocation	Human capital	Human well-being	Social equity	Natural capital	Ecological scarcities	Environmental risks	CC impacts	CC mitigation	CC adaptation	Investment analysis	Policy analysis
Input-output (I-O)	Macro, with high level of sectoral disaggregation, for monetary and physical flows	✓	✓	✓		✓									✓	
Energy and other system engineering models	Sectoral analysis, with high level of detail	✓	✓										✓	✓	✓	✓
Geographical information system (GIS) and InVEST	Highly geographically disaggregated, with analysis ranging from local to national						*		✓	✓	✓	✓	✓	✓		✓
Computable general equilibrium (CGE)	Macro, with sectoral disaggregation	✓		✓		*		✓							✓	✓
CGE and system engineering (energy and natural resources)	Macro, with sectoral detail	✓	✓	✓	✓	*	*	✓	*	✓		*	✓	✓	✓	✓
System dynamics (SD) models (e.g., T21)	Macro, with the possibility to add sectoral detail with social, economic and environmental variables	✓	✓	*	✓	✓	*	✓	*	✓	*	*	✓	✓	✓	✓

The * indicates the possibility to include basic variables and to address the criteria more extensively with information generated by other models.

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How can SEEA-EEA inform decision making? (take 1)

(Guidelines on the use of ecosystem accounts in policy scenario analysis in the context of SEEA-EEA)

Policy Question: how to reduce deforestation? (LAND)

- Why is this a policy problem/opportunity?
- How can SEEA EEA accounts support scenario analysis?
  - *Overview (e.g. what step of the policy process can be informed?)*
  - *SEEA EEA accounts: contributions of using extent, condition and ecosystem service accounts, plus economic valuation*
- What methods and models are available and suitable?
  - *Description of the functioning mechanisms of each method/model*
  - *Data requirement, and information provided by SEEA EEA accounts*
  - *Software and other technical requirements*
- How to interpret the results of these models to inform policy decisions?

How can SEEA-EEA inform decision making? (take 2)

(Guidelines on the use of ecosystem accounts in policy scenario analysis in the context of SEEA-EEA)

Question: what models and policy process we can inform with the SEEA-EEA accounts (e.g. LAND)

- What data are being collected and organized in the SEEA-EEA?

- SEEA EEA accounts: contributions of using extent, condition and ecosystem service accounts, plus economic valuation

- What models use this information already?
- What models could make use of this information?

- Economic planning, infrastructure planning (e.g. water, energy) as well as water and energy planning, agriculture

- What policy questions are being answered with these models?
- How policy analysis improves when SEEA-EEA data are used?

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How can SEEA-EEA inform decision making?

- Integrating knowledge across disciplines, and bringing experts and decision makers together.
- Bringing the social, economic and environmental dimensions of development to the same table, with the same weight (and possibly similar unit of measure).
- Coupling models or creating new integrated ones:

Extending the analysis provided by SEEA, by forecasting scenarios.

Improving the analysis performed with sectoral models, by introducing physical indicators and hence generating a higher degree of realism.

How can SEEA-EEA inform decision making?

- Highlighting the importance of stocks and flows:

Estimating stocks and flows, and the quality of stocks.

Showing the existence of different types of stocks (e.g. renewable and non-renewable).

- Representing time in an explicit manner.

Forecasting the speed of change for social, economic vs environmental indicators

Showing possible "worse before better" situations

Estimating the impact of accumulation

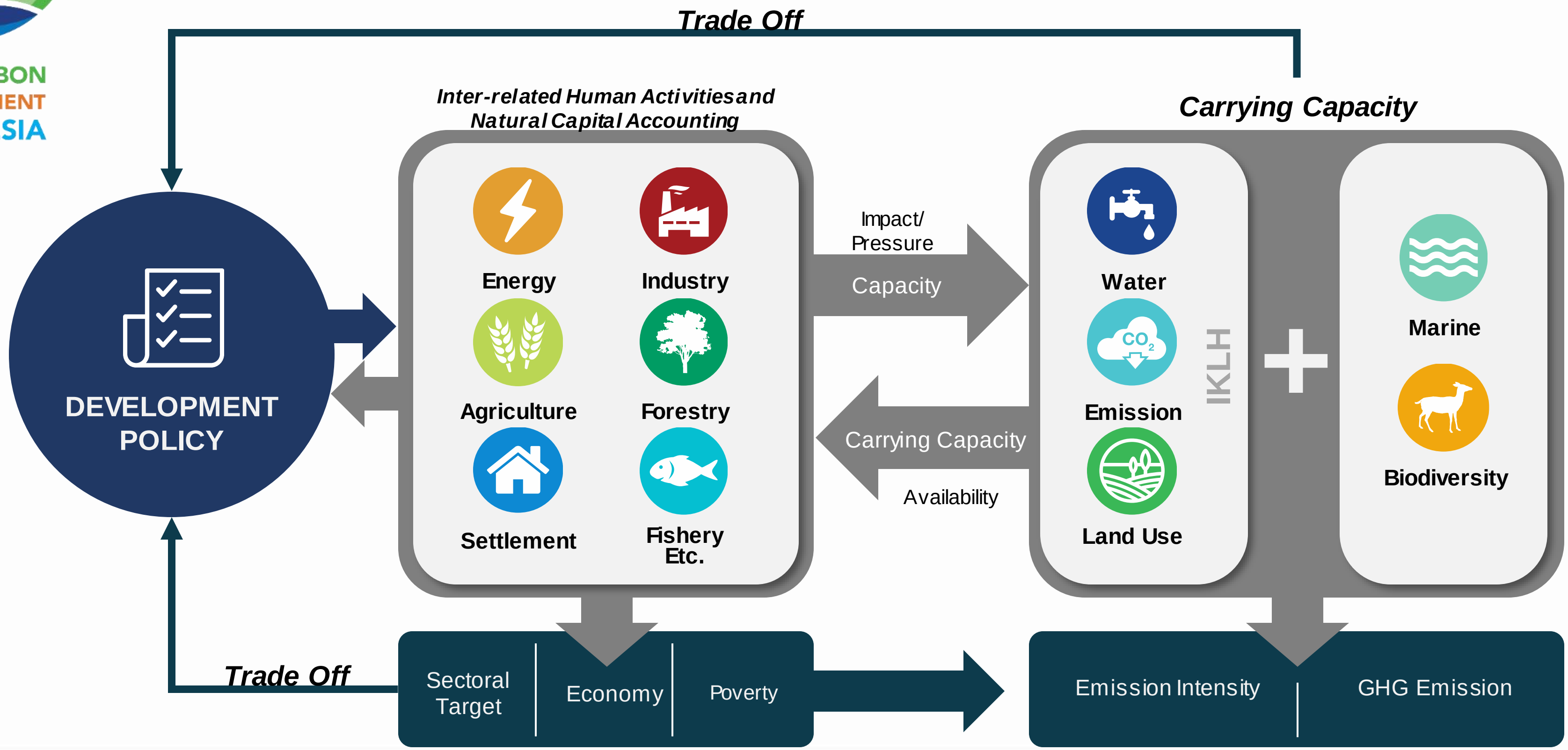
- Supporting the assessment of impacts across (i) sectors, (ii) economic actors, (iii) dimensions of development, (iv) over time and (v) in space.

Indonesia case study: lessons learned

Low Carbon Development plan is a set of inclusive development planning policies and low-carbon investment strategies for the RPJMN 2020-2024 and the Roadmap of SDG 2030 that encourage Indonesia to reduce the intensity of emissions and GHG Emissions

Kementerian PPN/ Bappenas

LOW CARBON DEVELOPMENT INDONESIA



Indonesia case study: lessons learned

In the end:

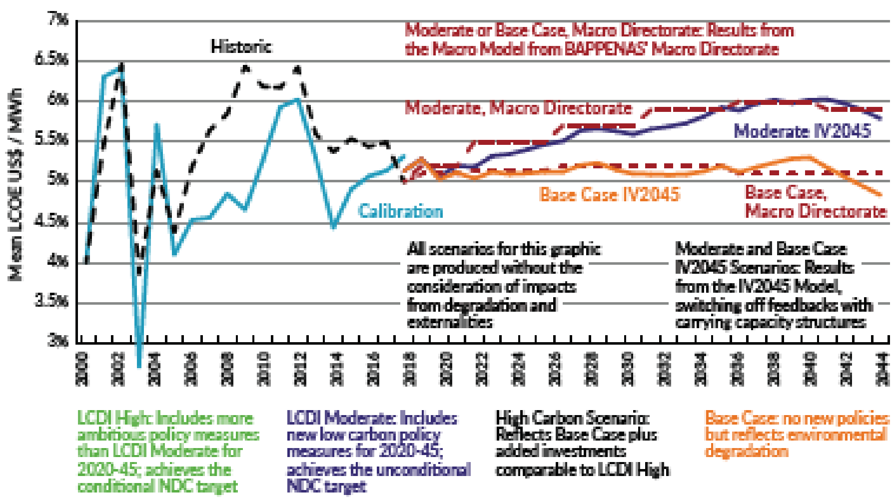
- Multidisciplinary team
- Various modeling approaches and sectoral models used, as well as multiple data sources (e.g. SISNERLING)
- Integration of knowledge in a "systems model", with a spatial component

Initially:

- Heavy reliance on economic forecasts based on budgetary requirements for a given GDP growth rate
- Disconnected research and modeling exercises, using different assumptions
- "Fear" of developing models that are too complicated (rather than complex)

Indonesia case study: lessons learned

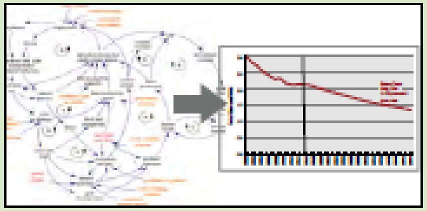
FIGURE 34:
Real GDP Growth, Historical and Model calibration (2000–2017); and Base Case and Moderate Scenarios, both from IV2045, Excluding the Impacts of Degradation and Externalities



Source: BAPPENAS Environment Directorate, based on results from Indonesia Vision 2045 Model, and Macro model from Directorate for Macro Planning and Statistical Analysis

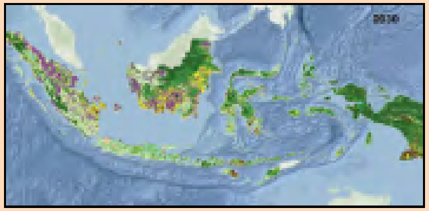
FIGURE 20:
IV2045 and INDOBIOM

IV2045: System Dynamics Model (Non-spatial)



- To know and understand the dynamic behavior of a phenomenon (based on changes in time)
- To identify changes in variables
- To test the sensitivity of the model through the intervention of these variables
- Variables that sensitive to change in behavior can be classified as Leverage Policy which is useful in the process of policy making

INDOBIOM: Spatial Analyses



- To understand and describe spatial behavioral phenomena
- Become a spatial policy evaluation tool and help to predict the future spatial impacts due to certain interventions
- Estimate land use changes that may occur in the future

Source: BAPPENAS

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Indonesia case study: lessons learned

Carrying capacity is embedded in the model using two main dynamics:

- **Ecosystem services:** water and air quality have a negative impact on labor productivity and therefore on economic performance. This impact becomes stronger over time in the baseline scenario, and declines in LCDi simulations.

- **Ecological scarcity:** the use of natural resources is essential for production. The decline of the stock of available natural resources leads to price increases (e.g. imports are generally more expensive than domestic production, and fossil fuels become more and more expensive to extract as depletion increases).

Two more considerations are made:

- Ecological scarcity is only relevant for production (constraining it) when we run out of resources. If we don't, then the only impact is through prices.
- Ecological scarcity is a local driver of change, it doesn't affect the whole country in the same way.
- The economic valuation of ecosystem services shoudl also take into account different provincial context.

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Indonesia case study: lessons learned

GDP Growth with Natural Resources Limitations

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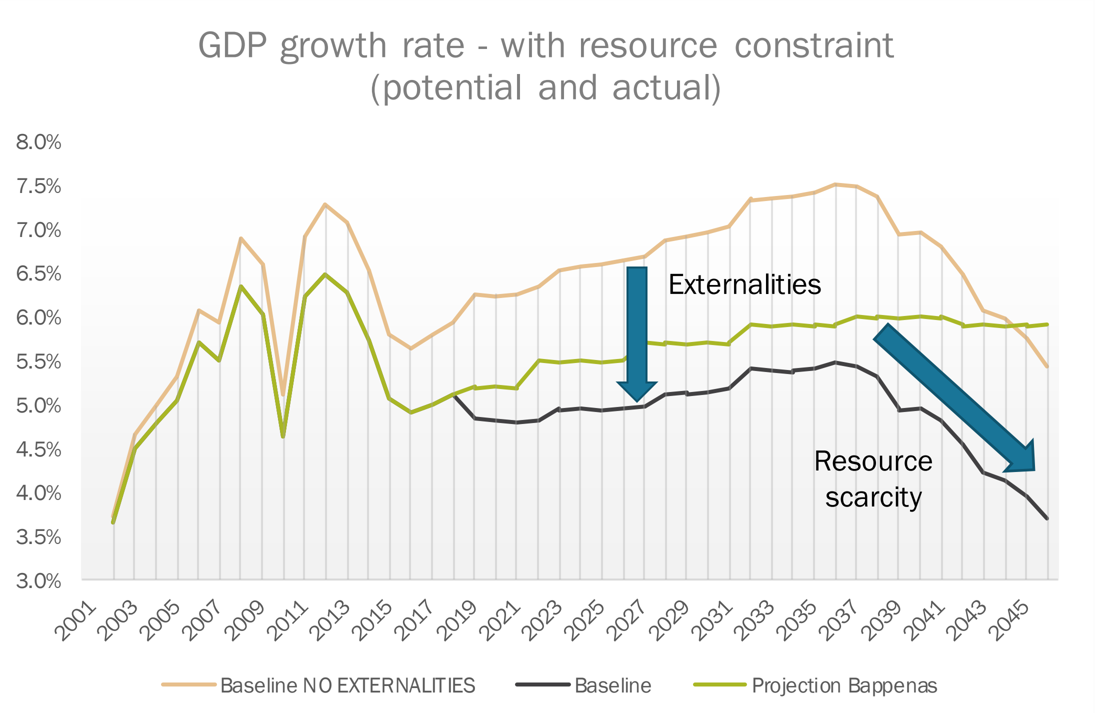

Projection: Projection of Deputy of Economy Bappenas
Potential No Externality: Indonesian Simulation of IV2045 with unlimited resources
Baseline No Externality: Indonesian Simulation of IV2045 no externalities, with resource scarcity

The limitations of natural resources (depletion of Water, Energy and Forests) are projected to **hamper economic growth** if there is no intervention in development policies that **pro-carrying capacity**

Availability of Natural Resources → Real Level of GDP growth

Note: Temporary simulation results and validation will be carried out

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Thank you

For questions please contact me at:

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