Integrated Economic-Environmental Modeling (IEEM) for Evidence-Based Public Policy and Investment Design.

May 2 to 5, 2023. Santiago, Chile.

OUTLINE AND OBJECTIVES

- Who we are.
- Workshop objectives:

1. Understand how to integrate natural capital (SEEA) and Ecosystem Services (ES) in computable general equilibrium models (CGE; IEEM+ESM; GTAP+InVEST).
2. Gain familiarity with each of the three components (**IEEM**, Land Use Land Cover (LULC) change and **ES modeling**).
3. Gain practical experience in implementing ES models and a basic simulation with IEEM.
4. Know how to continue learning more about integrated economic-environmental modeling.

Integrated Economic-Environmental Modeling (IEEM) for Evidence-Based Public Policy and Investment Design.

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FIRST SESSION OUTLINE

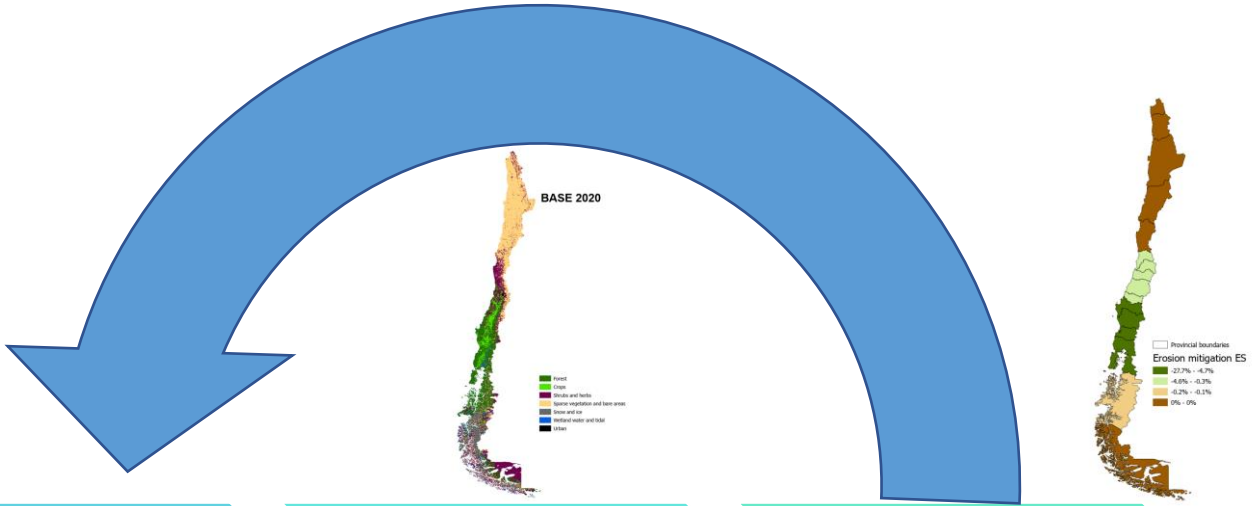
1. Where we are headed: IEEM+ESM applied to Chile's Nationally Determined Contributions (NDCs). Reducing deforestation by 25%, increasing afforestation and forest restoration both by 200,000 ha; simultaneous implementation of all policies. A first application of IEEM+ESM to Chile.

2. IEEM overview.

3. CGE and IEEM modeling basics.

4. IEEM Case Study: The Sustainable Development Goals in Guatemala.

CHILE'S NDCs AND THE IEEM+ESM WORKFLOW



Policy question: Chile's NDCs → Calibrate IEEM → Run BASE + scenarios in IEEM → Spatially allocate LULC change, **Dyna-CLUE** → Model ES with InVEST and IEEM+ESM data packets

- IEEM, the LULC change model and ES models are iterated to account for agent response to changes in future ES flows.
- An economic value estimate of regulating ES is generated consistent with Chile's System of National Accounts.

THE IEEM PLATFORM MOTIVATION

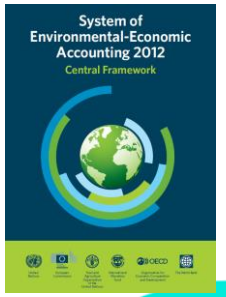
- Economy-wide CGE models are widely used for public policy and investment analysis. Four decades of literature.
- Ministries of Finance/Central Banks, IDB, World Bank, IMF et al. undertake/contract CGE analysis. Cost Benefit Analysis.
- Kenneth J. Arrow, Nobel laureate in economics, affirmed, "…in all cases where the repercussions of proposed policies are widespread, there is no real alternative to CGE" (Arrow, 2005, p.13).
- Natural capital and ecosystem services almost absent.
- IEEM Video.

IEEM EARLY DEVELOPMENT AT THE IDB

- How do we integrate ES in CGE? The challenge: cannot include goods/services for which there is no transaction (non-market ES).
- System of Environmental-Economic Accounting (SEEA) was published ~2014; logical first step was SEEA integration in CGE; IEEM conceptual framework.
- Development of natural resource modules. Applications (Guatemala SDGs, forest/fuelwood).
- Next step was to link IEEM with ES modeling. IEEM generated changes in land use. The missing link: LULC change modeling.
- IEEM+ESM's first application to Rwanda (Science for Nature and People Partnership); dynamic IEEM+ESM to Guatemala.

A Conceptual Framework for Integrated Economic–Environmental Modeling

Onil Banerjee[1], Martin Cicowiez[2], Mark Horridge[3], and Renato Vargas[4]



VALUE-ADDED OF THE IEEM APPROACH

- IEEM is a dynamic **economy-wide** CGE model for future-looking scenario analysis of public policy/investment. With it, we ask "What if…?" questions.

- IEEM integrates **SEEA**, covering market ES.
- IEEM has natural resource modules with policy relevant features.
- IEEM generates standard economic indicators relevant to Ministries of Finance and others in addition to natural capital and wealth metrics.
- IEEM is linked with a microsimulation model to estimate distributional/poverty impacts.

- IEEM is linked with spatial LULC and ES modeling (IEEM+ESM) to estimate impacts non-market ES.

NATURAL CAPITAL

MANUFACTURED CAPITAL

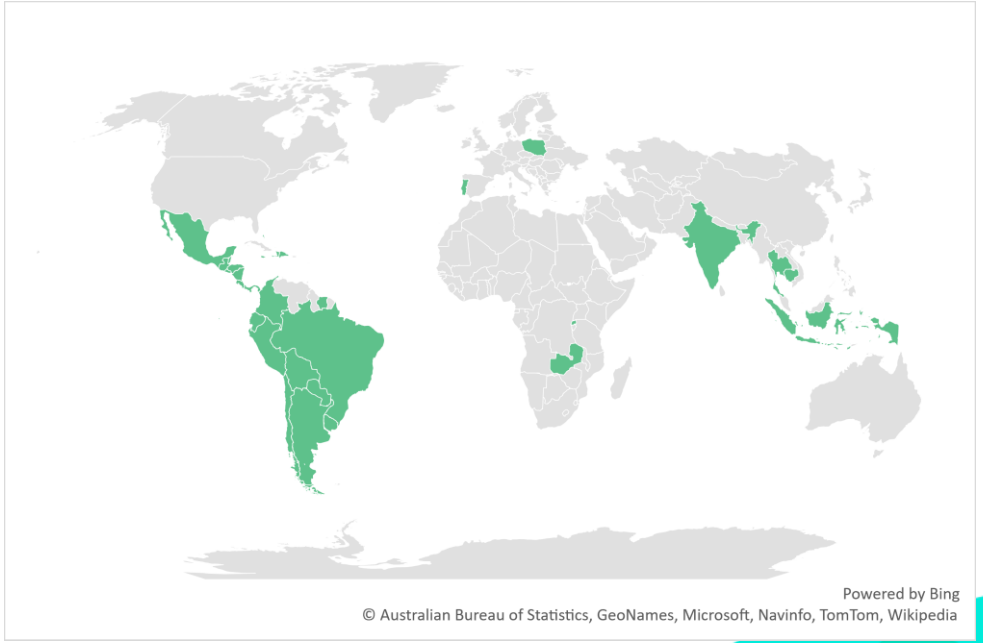
HUMAN CAPITAL

PAST, PRESENT AND FUTURE OF IEEM+ESM

- IEEM's three-prong strategy:

(1) Expand coverage of IEEM+ESM (Latin America/IDB and Beyond). (2) Enhance linkages between IEEM and ESM. (2) Collaborate on applications, build capacity and generate demand for integrated analysis.

- Hundreds of policy applications in collaboration with Ministries of Finance, Central Banks, line ministries; UN, WB, FAO, CI; IDB project design.
- OPEN IEEM Platform: IEEM models for LAC countries, LULC model, ES datapackets, and training resources now available. Parallel platform for countries beyond LAC.
- Robust and timely evidence-based policy advice at lower cost and focusing on innovation.



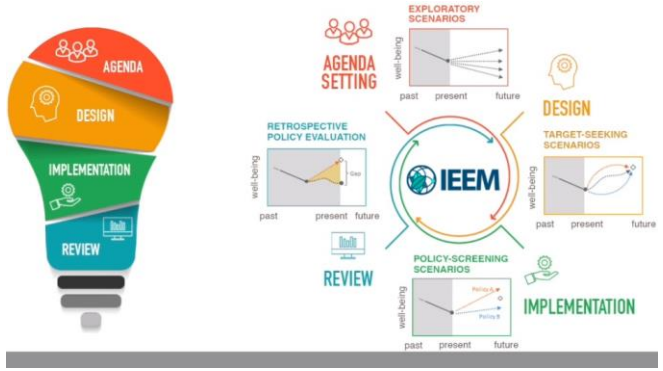
IEEM+ESM countries shaded green.

OPEN IEEM TOUR

CLICK ABOVE TO VISIT OPEN IEEM PLATFORM AT THE IDB

CGE AND IEEM MODELING BASICS

OVERVIEW OF A CGE



- A CGE model captures all interactions in an economy across all economic sectors; includes direct and indirect effects. It is a system of non-linear simultaneous equations representing agent behavior (household utility, profit maximization) and equilibrium conditions (savings = investment).
- Main database is a Social Accounting Matrix (SAM) which represents all transactions in an economy for a base year; System of National Accounts.
- Dynamics: investment, population/labor force growth, changes in natural capital.

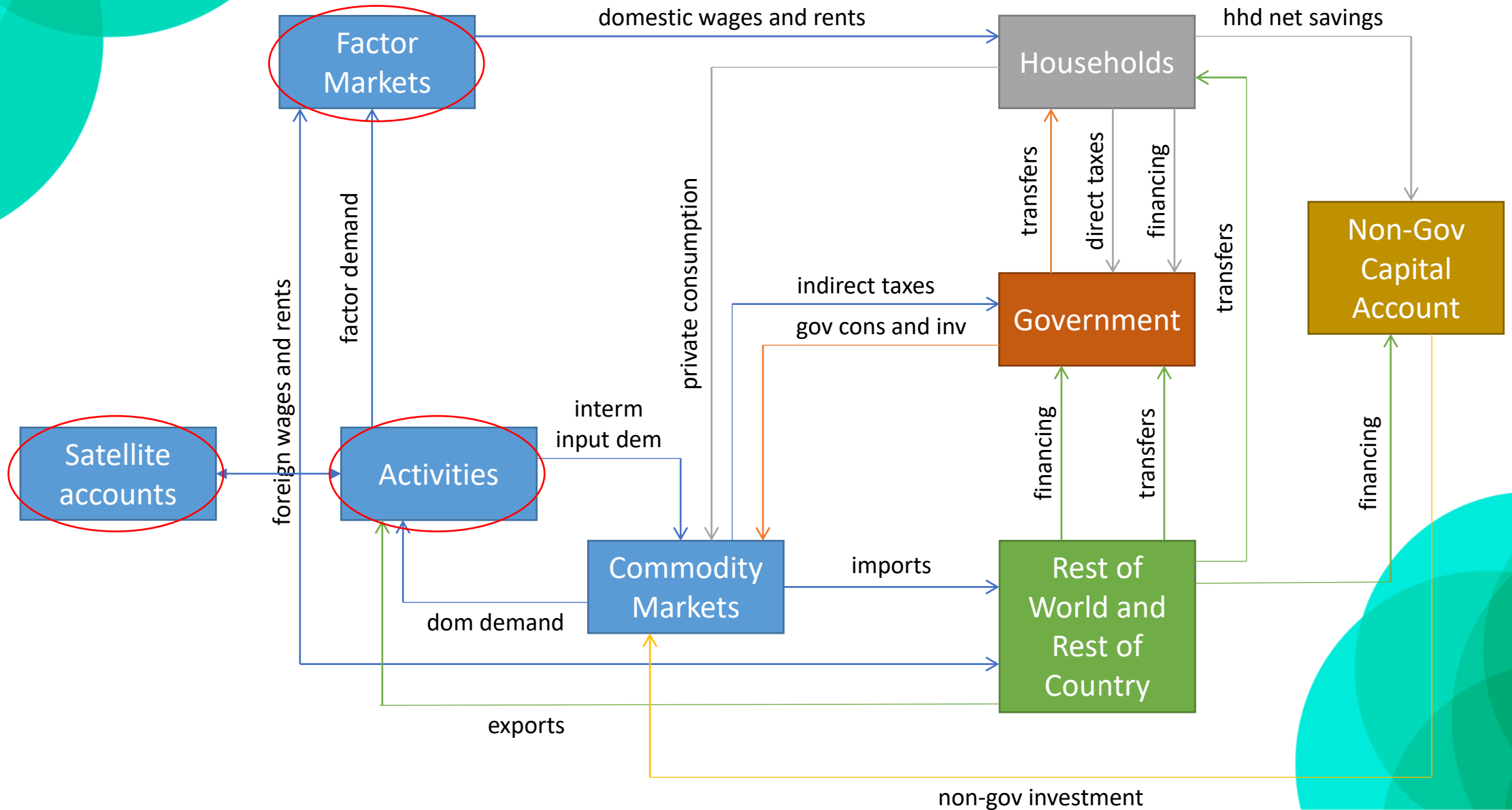
Analytical workflow:

1. Baseline projection: impose GDP/population growth trajectory.

2. Policy scenario: modify policy instrument, investment, land use or other parameters (world prices, export demand, productivity, etc).

3. Analyze and validate; explain differences between baseline and scenario; transmission pathway.

IEEM BASIC MODEL STRUCTURE



IEEM BASIC DATA STRUCTURE: THE SOCIAL ACCOUNTING MATRIX

	ACT	COM	FAC	TAX	HH	GOV	ROW	SAV-INV	TOTAL
ACT		133							133
COM	46				103	2	7	15	173
FAC	85						1		85
TAX	2	1			1				5
HH		12	85			6	17		120
GOV				5					5
ROW		27	0						27
SAV-INV					15	(3)	2		15
TOTAL	133	173	85	5	120	5	27	15	

- A statistical representation of all transactions; CGE equations explain these transactions. The dimensions of the model are given by the number of activities and products/factors; institutions.

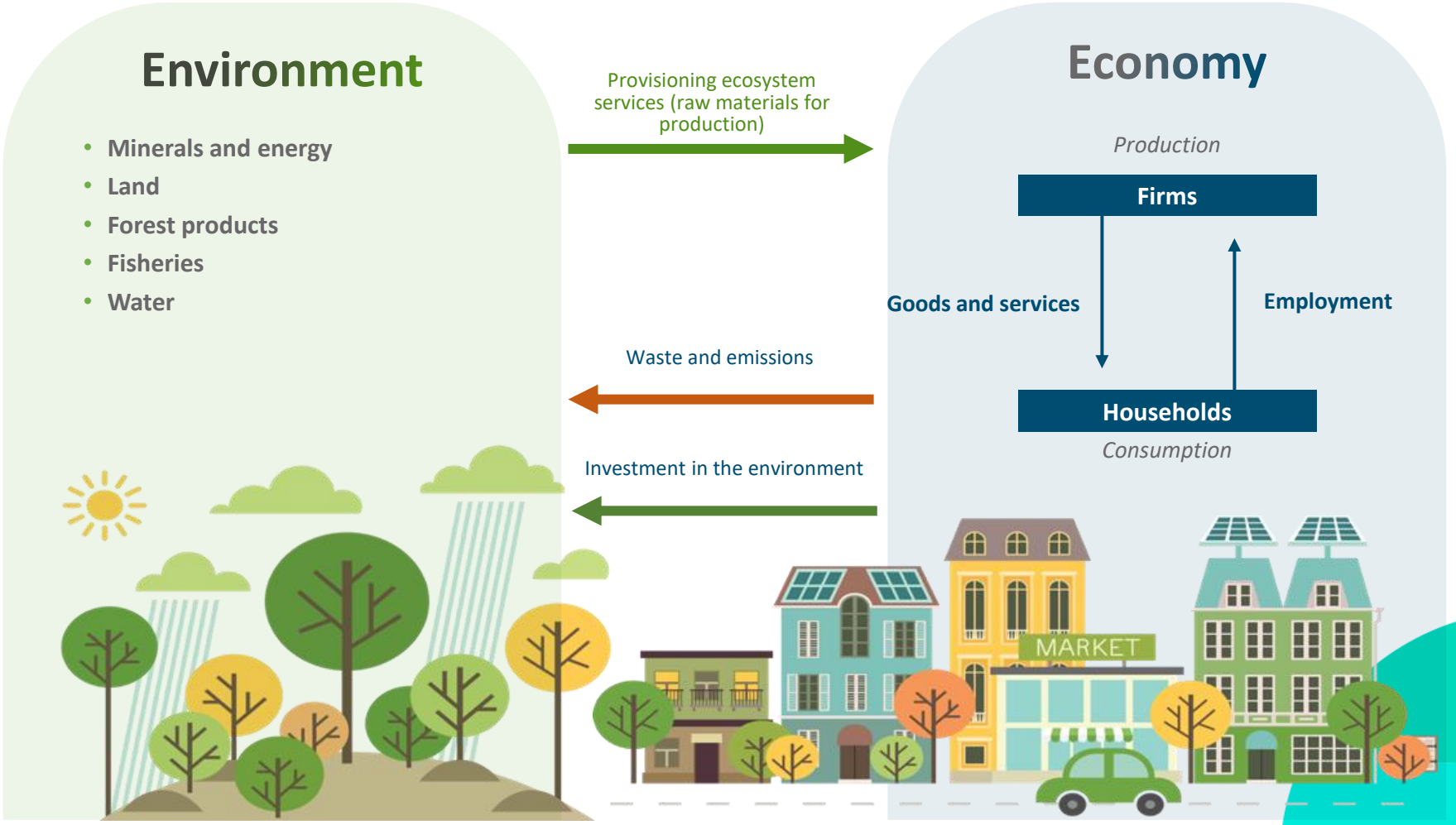
TYPES OF POLICY QUESTIONS

- Thematic scenarios: public investment and fiscal reform; exogenous shocks (disaster, COVID); Paris Agreement and decarbonization; Green Growth; Sustainable Development Goals.
- Natural capital and environment scenarios: climate change, Nationally Determined Contributions, agriculture/livestock, deforestation, forest plantations, mining, fisheries.
- Domestic policy/investment scenarios: (i) expenditure: government current account and investment account- sector-specific; (ii) income: tax, transfers/distribution and internal/external debt.
- Global/regional scenarios: export prices, sectoral (tourism) demand, debt relief, remittances.

MAIN IEEM RESULTS

- IEEM has a customized and extensive reporting system.
- Key economic indicators: public and private income, expenditure, investment; GDP, sector output, exports and imports; employment, poverty, and inequality.
- Results expressed in value terms, rates of growth, GDP shares; annual values/growth or average values/growth over period; cumulative values.
- Natural capital indicators: deforestation, stocks of forest and land; emissions; water consumption; mining stocks. IEEM+ESM: changes in ES supply (carbon storage, water purification, water regulation, erosion mitigation, crop pollination ES).
- Wealth, net present value and internal rate of return with/without natural capital, environmental quality and ES.

ECONOMIC-ENVIRONMENT INTERACTIONS IN IEEM



Developing IEEM Modeling Infrastructure and Capacity Around the World.

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