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Introduction: Roles of Research Communities for Low Carbon Development and Climate Change Responses

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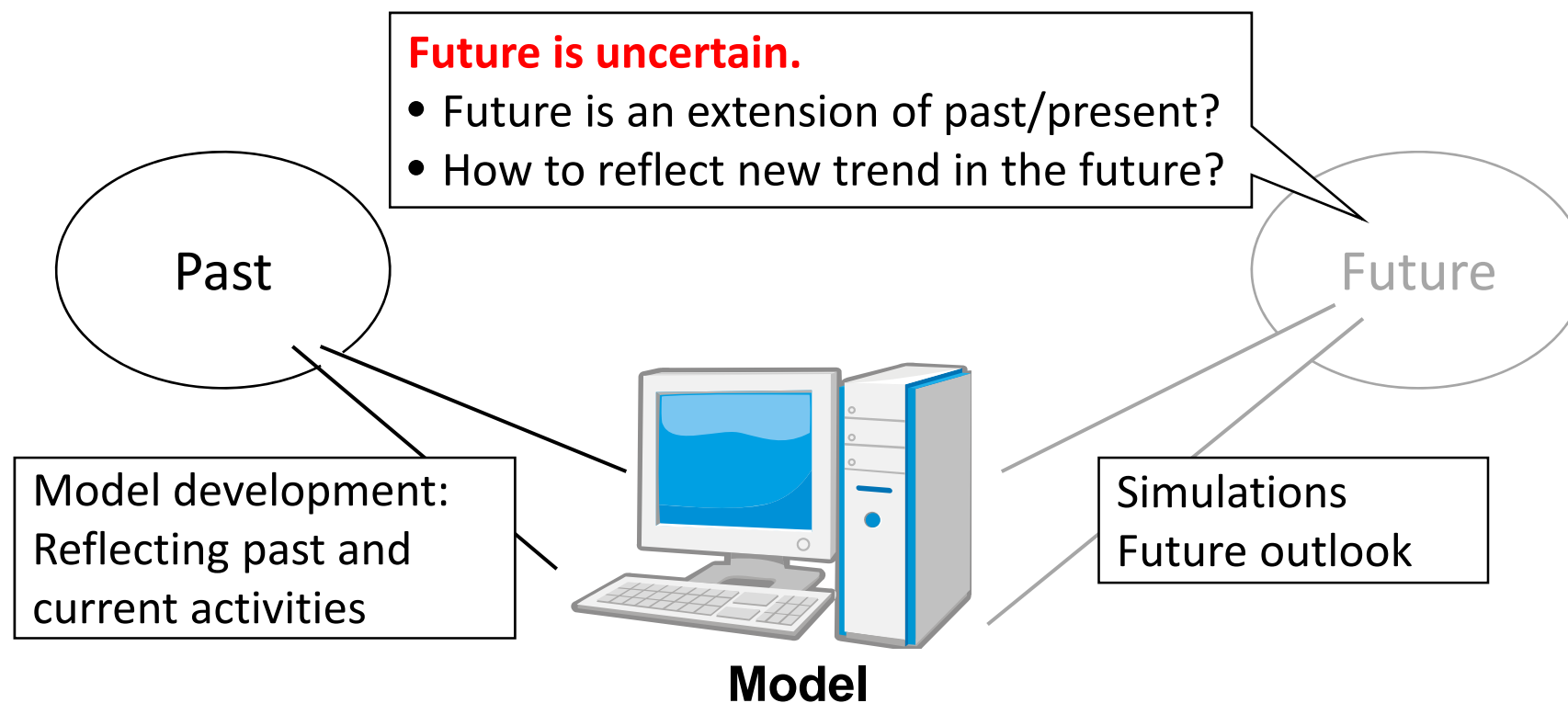


Asia-Pacific Integrated Model

<http://www-iam.nies.go.jp/aim/index.html>

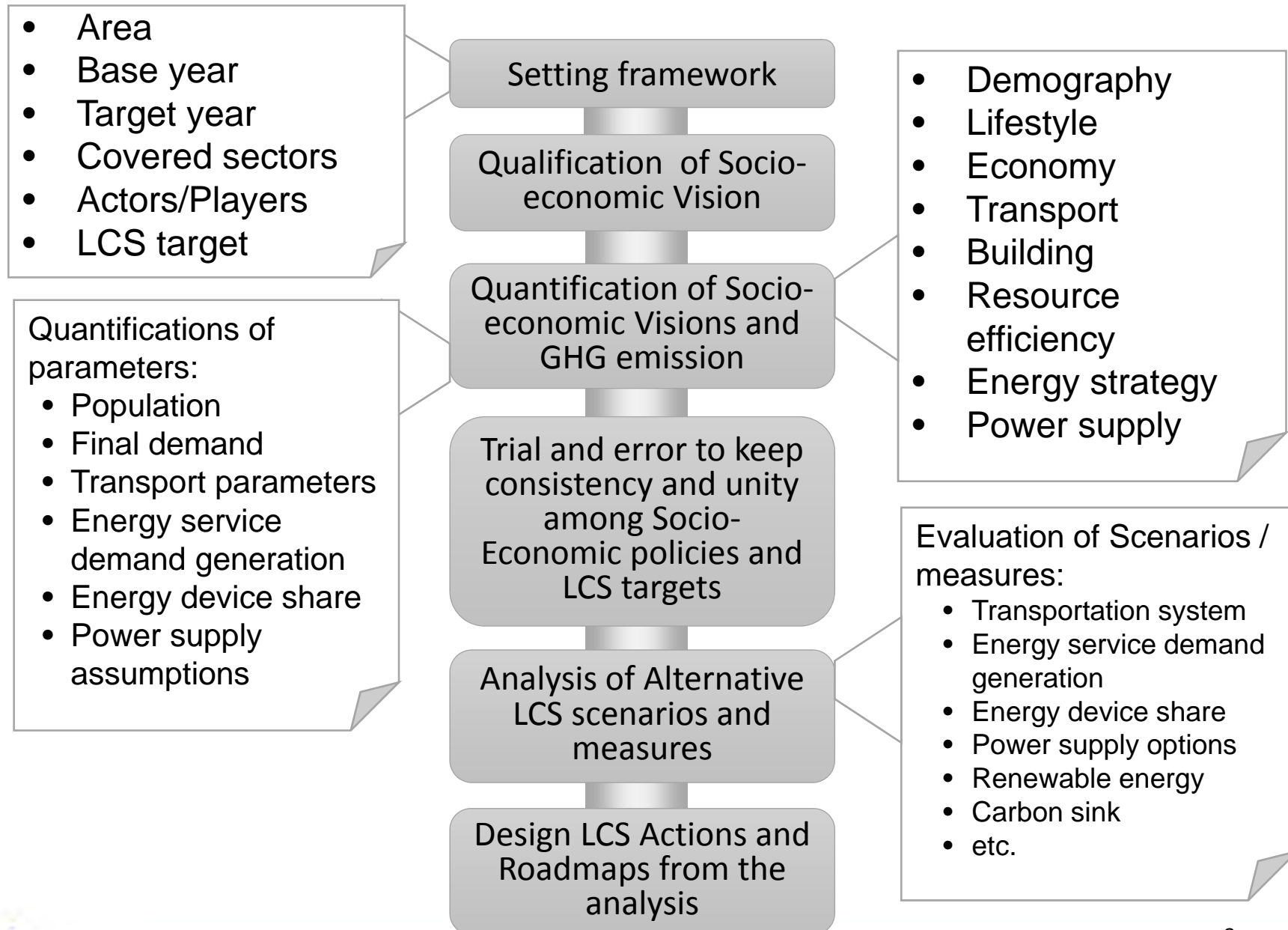


How to assess the future using a model?

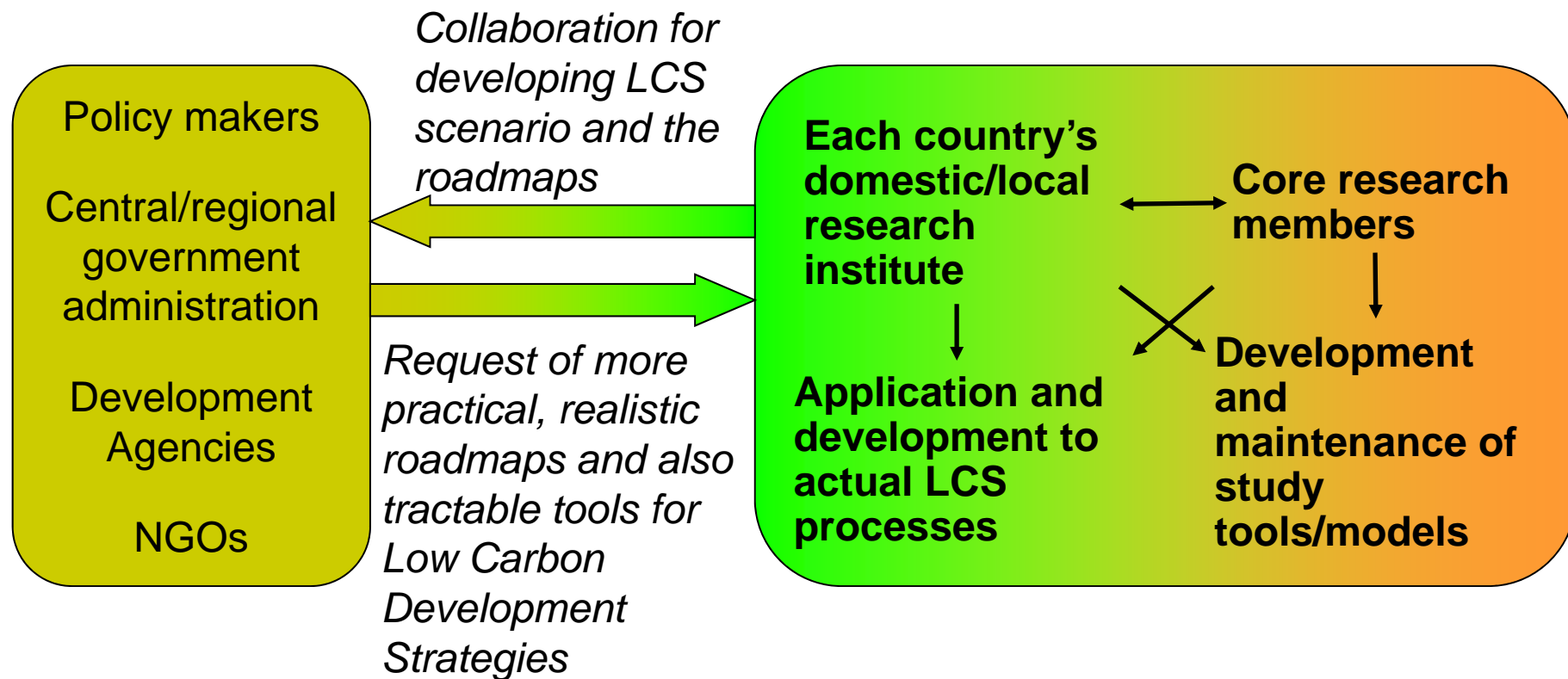


- Model cannot predict the future, but only shows a result corresponding to a set of inputs.
 - Model has both subjective and objective aspects.
 - Model has both advantages and disadvantages.
- We need to use model to meet a purpose.

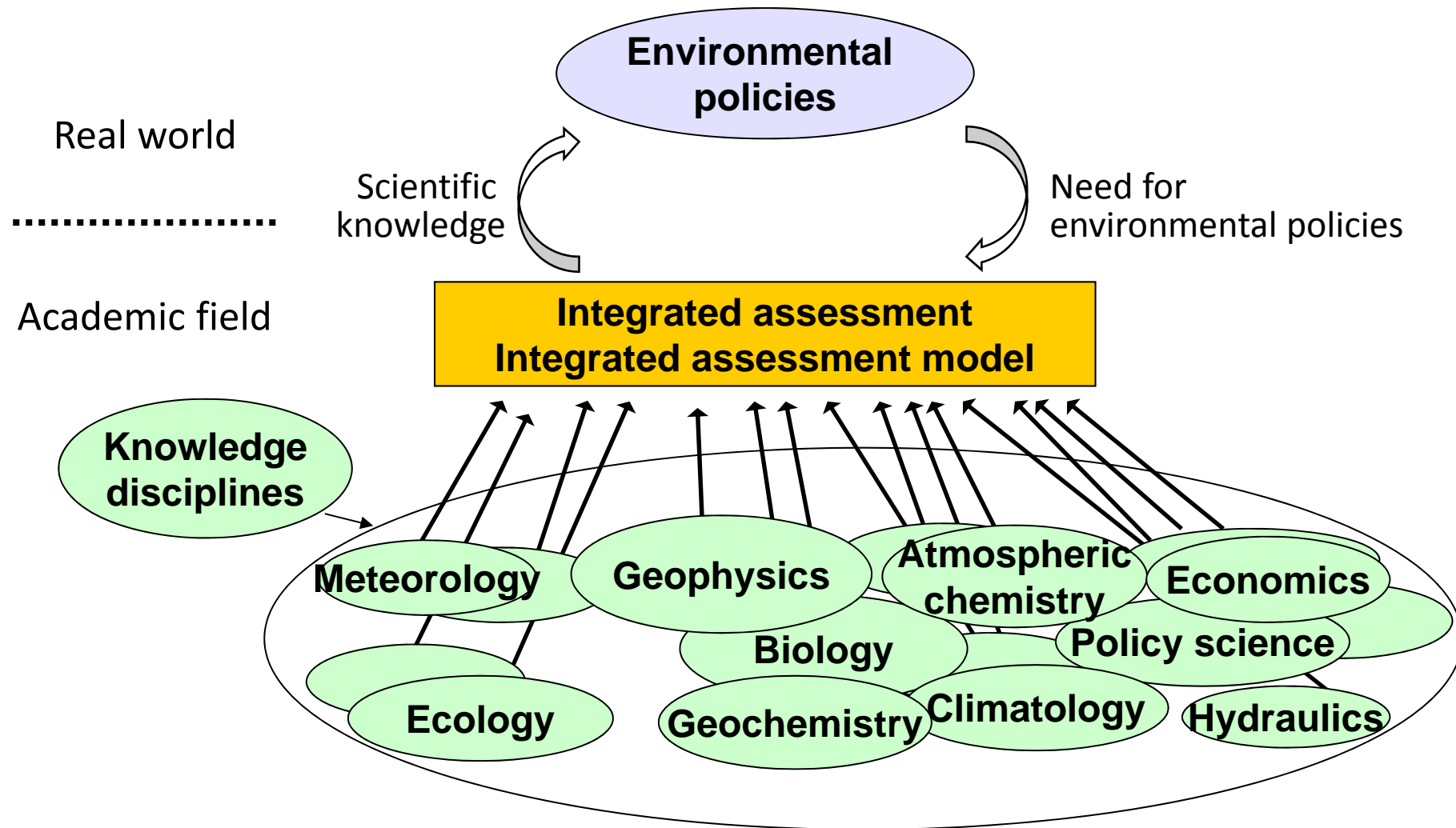
Overall research procedure of our LC Society Scenario approach



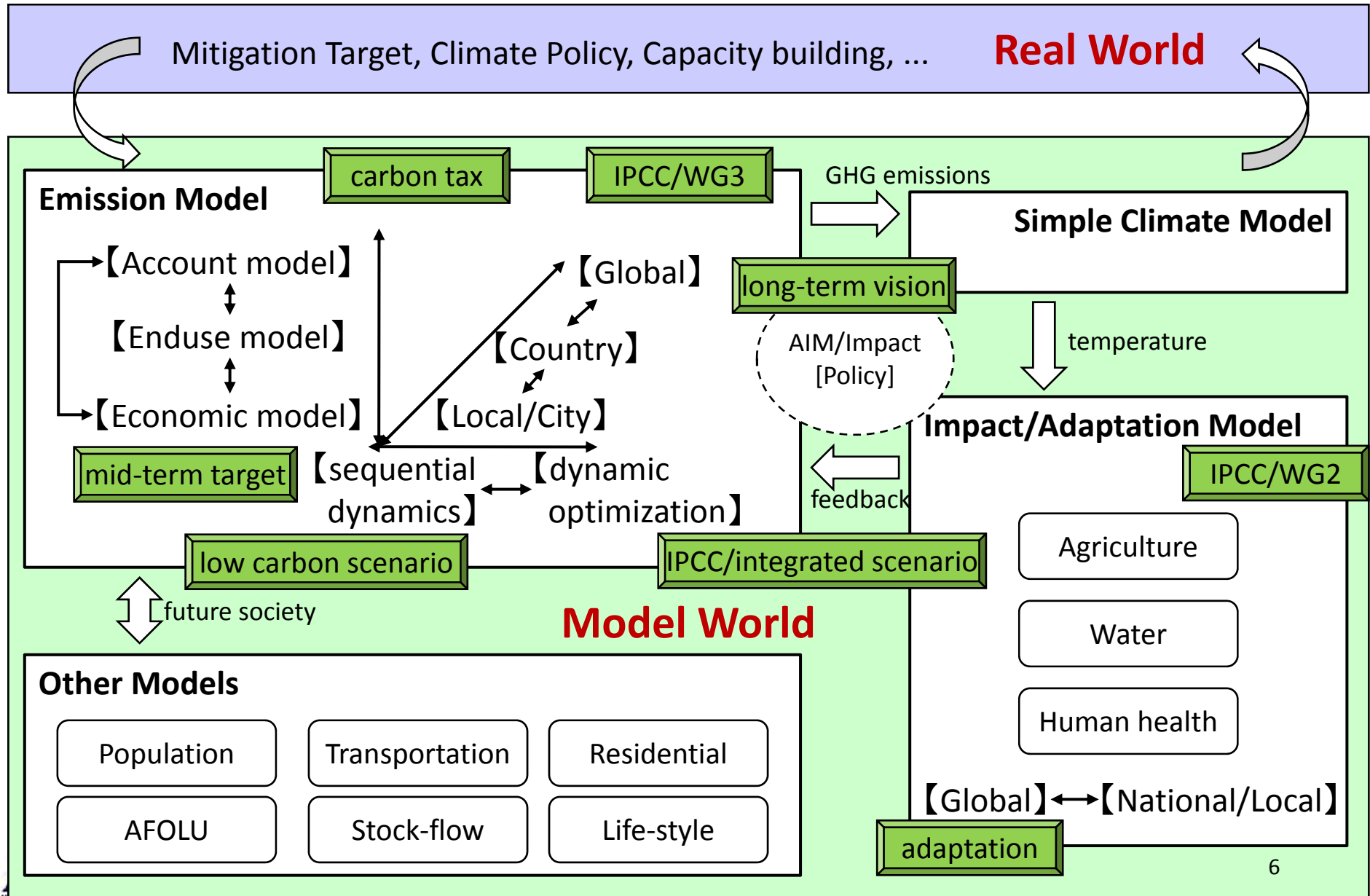
Collaboration with Asian countries; Scenario approach towards Low Carbon Society in Asia



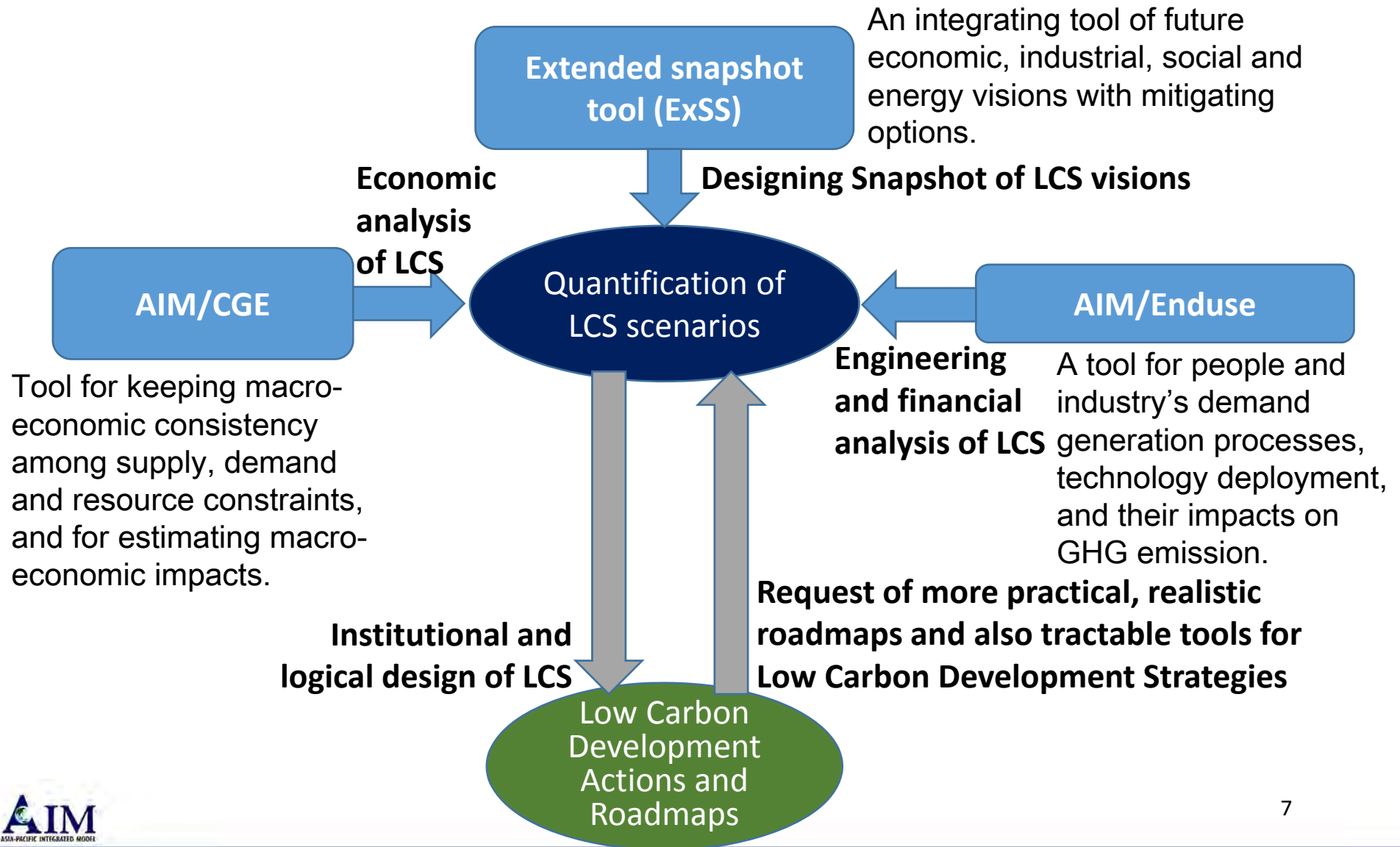
Integrated Assessment Model as a tool to support environmental policies



Overview of AIM (Asia-Pacific Integrated Model)

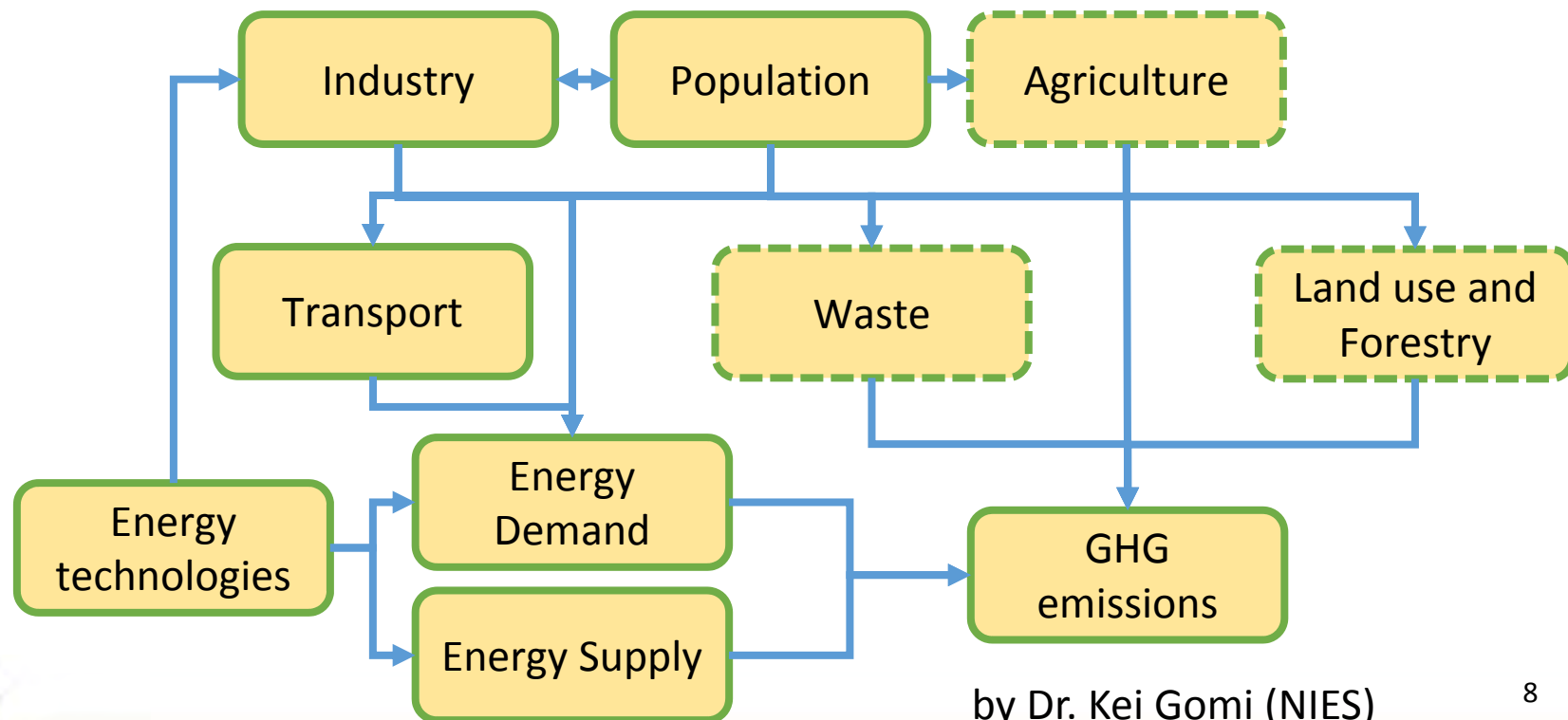


How to combine the tools in order to keep consistency and unity among socio-economic policies and LCS actions

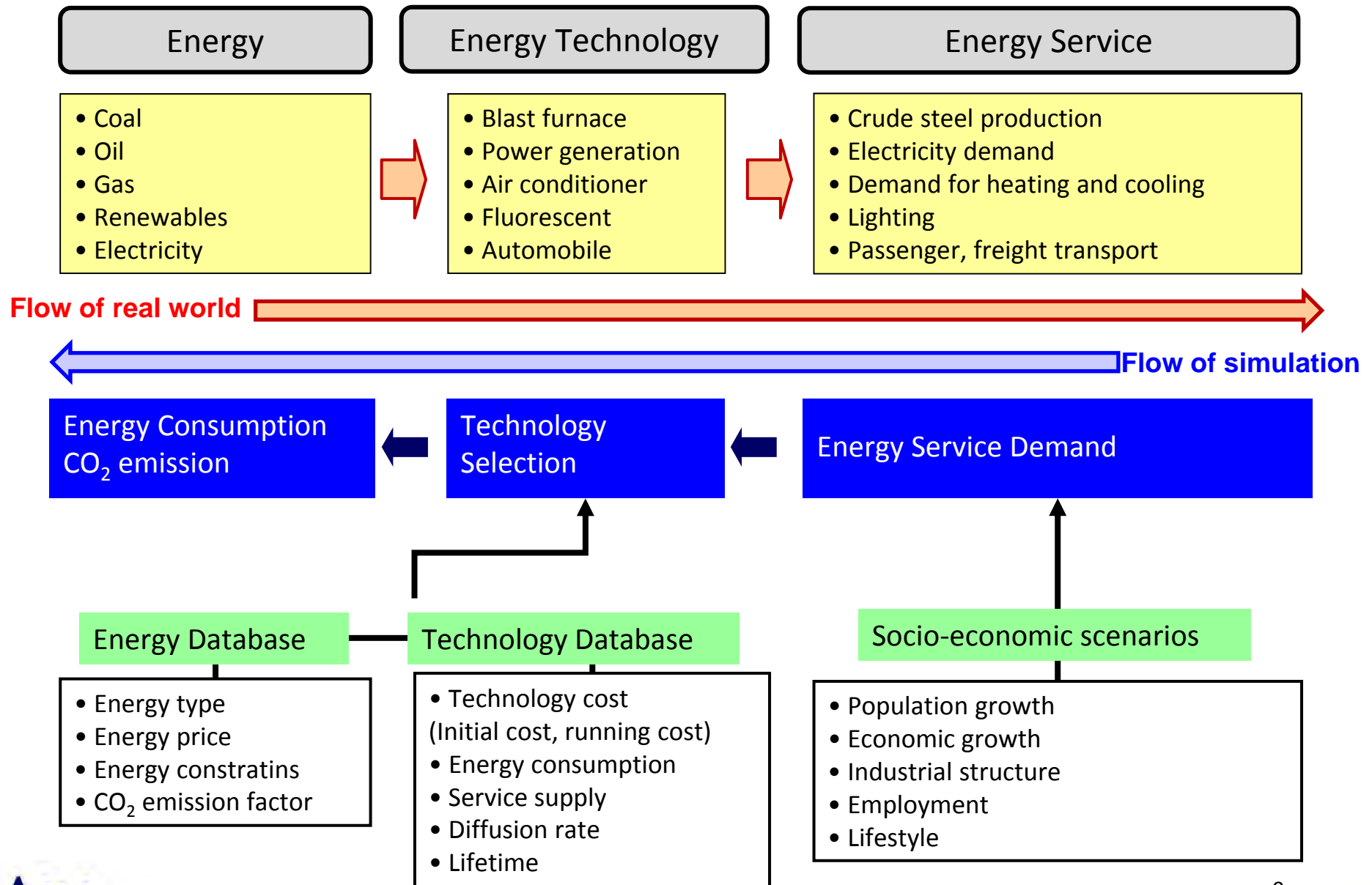


Extended Snapshot Tool (ExSS)

- Extended Snapshot Tool (ExSS) is an accounting type, static model consisting of simultaneous equations with about 6000 variables.
- It describes socio-economic activity, energy consumption, power generation, technology diffusion and GHG emissions in a future year.
- Coupled with waste and AFOLU model, it can show a comprehensive vision of a country or a region as a low-carbon society.
- Data requirement: Input-output table, energy balance table, demography, and transport data in a base year.



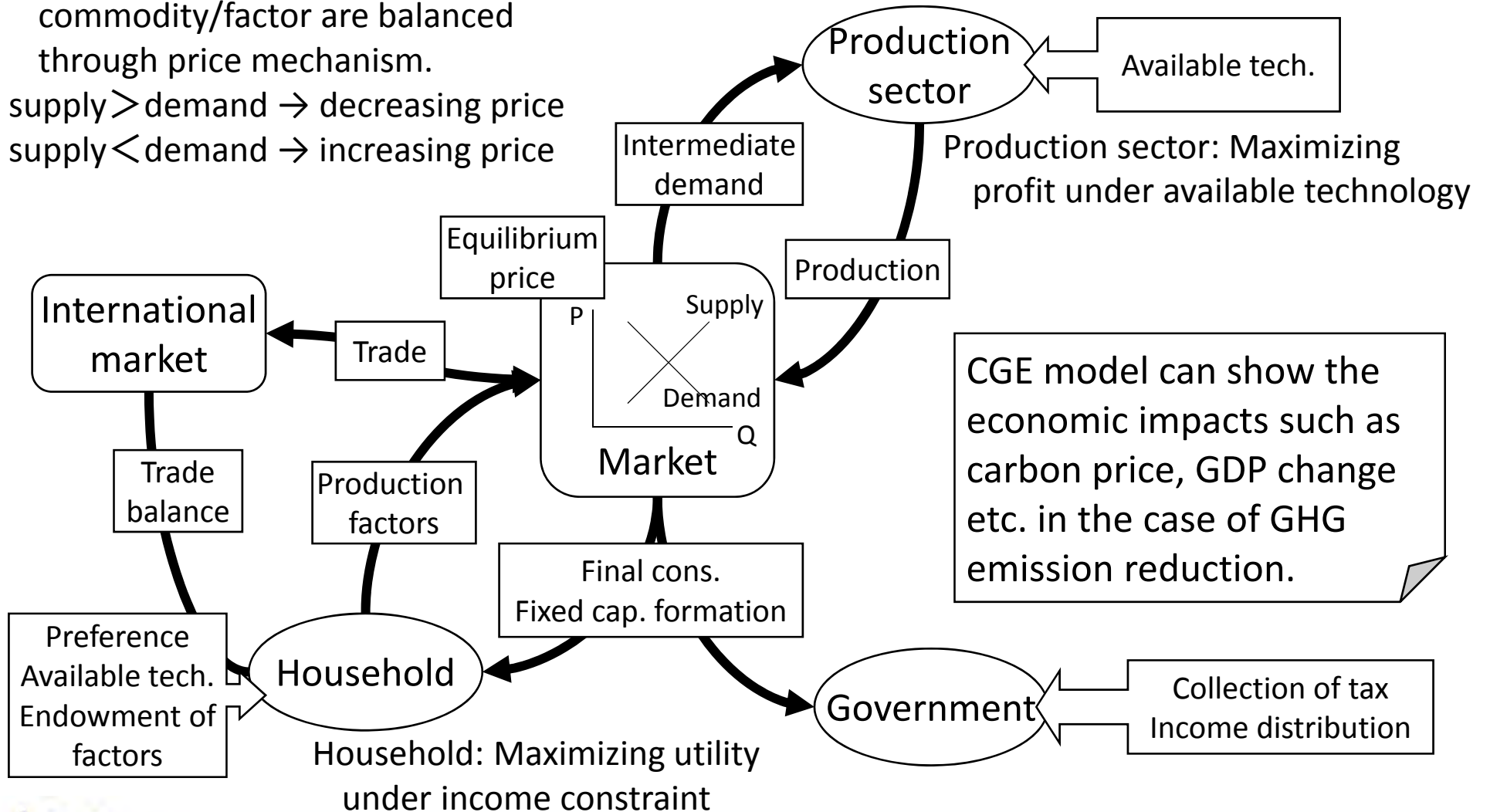
Overview of AIM/Enduse model



Concept of AIM/CGE (Computable General Equilibrium)

Market: supply and demand of every commodity/factor are balanced through price mechanism.

supply > demand → decreasing price
 supply < demand → increasing price



Brief history of climate policy in Japan and AIM

- 1997; Toward UNFCCC COP3, **Japan technology model** (AIM/Enduse) model was used to assess the mitigation target in Japan.
 - ✓ GHG mitigation target in Japan: **-6% compared to 1990 level**
- 2008; Based on three types of models (**global technology model**, **Japan technology model** and **Japan economy model**), options of Japan's middle-term target (2020 target) on GHG reduction were calculated.
 - ✓ Role of model was to provide 6 options as GHG mitigation target. (Final decision was done by policymakers.)
 - ✓ GHG mitigation target in Japan: -15% compared to 2005 level (-7% to 1990 level)
- 2009-2011; By using **Japan technology model** and **Japan economy model**, the possibility of **"25% reduction in 2020 compared to 1990 level"** was assessed.
 - ✓ Role of model was to show how to achieve the -25% target.
- **Great East Japan Earthquake and Fukushima Dai-ichi Nuclear Power Plant Accident in 2011**
 - The new mitigation target in 2020 was decided to be **"-3.8% compared to 2005 (+3.1% to 1990 level)"** on November 15, 2013.
 - ✓ Assumption: No nuclear power in 2020.
 - As a Japan's mitigation target, **"26% reduction compared with 2013 level"** was endorsed by the Cabinet on July 17, 2015.

Unfortunately, these days, models have no role to play for decision of mitigation target.
- In 2016, Cabinet decided **80% reduction of GHG in 2050 compared with present level.**
- Since 2016, MOEJ started to discuss long-term low carbon vision in Japan.
- In July 2018, the 5th Strategic Energy Plan was approved by the Cabinet.
- In June 2019, the long-term strategy of Japan was approved by the Cabinet.

In addition to AIM International Workshop, activities on capacity building in Asia are our important works.



Provision of AIM/CGE at Workshop on carbon neutral development in Bhutan on May 17 & 18, 2018



Training workshop on AIM/Enduse at SIIT, Thammasat Univ. from June 11 to 15, 2018 (10 Participants from 2 countries)



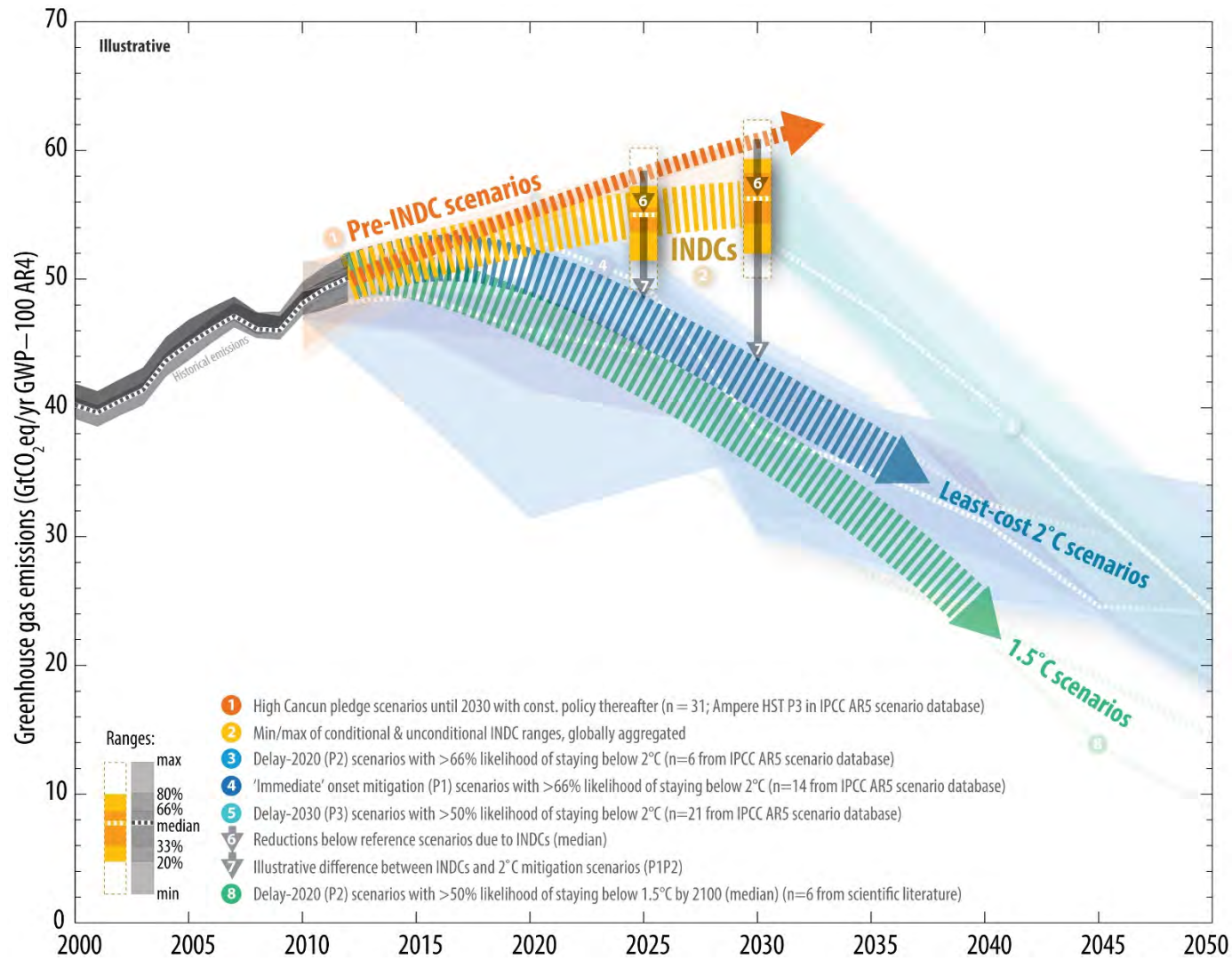
Training workshop on AIM/CGE at SIIT, Thammasat Univ. from June 26 to July 5, 2018 (7 participants from 3 countries)

NDCs of Asian countries

- Bhutan: To remain carbon neutral.
- Cambodia: 27% reduction in the year 2030 compared to the baseline.
- China: To reduce carbon intensity by 60% to 65% by 2030 below 2005 levels;
- India: To lower the emissions intensity of GDP by 33% to 35% by 2030 below 2005 levels.
- Indonesia: An unconditional 2030 GHG emissions reduction target of 29% below BAU including LULUCF emissions and a conditional 41% reduction below BAU by 2030 (with sufficient international support)
- Japan: To reduce emissions by 26% below 2013 emission levels by 2030.
- Korea: To reduce greenhouse gas emissions by 37% below BAU by 2030.
- Malaysia: To reduce GHG emissions intensity of GDP by 45% by 2030 relative to the emissions intensity of GDP in 2005.
- Nepal: 50% reduction in dependency on fossil fuels by 2050.
- Thailand: An unconditional 20% reduction in emissions by 2030, compared to BaU levels. This could increase to 25%, conditional upon the provision of international support.
- Vietnam: An 8% reduction in emissions by 2030, compared to BaU. This could be increased to 25% conditional upon international support.

- USA: To reduce economy wide emissions by 26% to 28% below 2005 domestically.
- EU: To reduce domestic greenhouse gases emissions by at least 40% below 1990 by 2030.

NDCs can achieve the 2 degree target?



Source: <http://unfccc.int/resource/docs/2016/cop22/eng/02.pdf>

Long-term low GHG emission development strategy

- Following countries have already submitted their long-term strategies to UNFCCC (as of November 1).

Country	Date submitted	GHG reduction target
USA	Nov. 16, 2016	80% reduction of GHG in 2050 compared to 2005 level
Mexico	Nov. 16, 2016	50% reduction of GHG in 2050 compared to 2000 level
Canada	Nov. 17, 2016	80% reduction of GHG in 2050 compared to 2005 level
Germany	Nov. 17, 2016 Rev: Apr. 26, 2017 Rev. May 4, 2017	Greenhouse gas neutrality by 2050 (Old target: 80-95% reduction of GHG in 2050 compared to 1990 level)
France	Dec. 28, 2016 Rev: Apr. 18, 2017	75% reduction of GHG in 2050 compared to 1990 level
Benin	Dec. 12, 2016	
Czech Republic	Jan. 15, 2018	80% reduction of GHG in 2050 compared to 1990 level
UK	April 17, 2018	80% reduction of GHG in 2050 compared to 1990 level
Ukraine	July 30, 2018	66-69% reduction of GHG in 2050 compared to 1990 level
Republic of the Marshall Islands	Sept. 25, 2018	Net zero greenhouse gas emissions by 2050
Fiji	Feb. 25, 2019	Negative emissions in 2050 (Very High Ambition scenario)
Japan	June 26, 2019	80% reduction of GHG in 2050, and decarbonized society as early as possible in the 2nd half of 21st century
Portugal	Sep. 20, 2019	Greenhouse gas neutrality by 2050

Past discussion toward long-term low carbon development strategy at MOEJ

- Discussion on long-term low carbon development strategy in Japan was started at Sub-committee on Long-term Low-Carbon Vision, Central Environment Council in July 2016.
 - ✓ In March 2017, The long-term low-carbon vision was reported.
English summary <http://www.env.go.jp/press/103822/713.pdf>
Japanese full report <http://www.env.go.jp/press/103822/105478.pdf>
 - ✓ In March 2018, "Basic concept toward ambitious GHG reduction" was reported by Central Environment Council.
http://www.env.go.jp/earth/earth/ondanka/post_38.html (in Japanese)
 - ✓ Main message: "Simultaneous solution" of economic and social problems such as population decrease and aging issue etc., and climate change
 - Innovation (on technology, socio-economic system and lifestyle) is the key
 - Actions to reduce GHG by 80% by 2050
 - Energy efficiency,
 - Low-carbon energy supply, and
 - Switch to low-carbon energies in end-use
 - Taking into account "Carbon budget"
 - Avoiding "Lock-in" effects
 - Introducing "Carbon Pricing" as a policy to strengthen market competitiveness

Japan's long-term strategy as a Growth Strategy

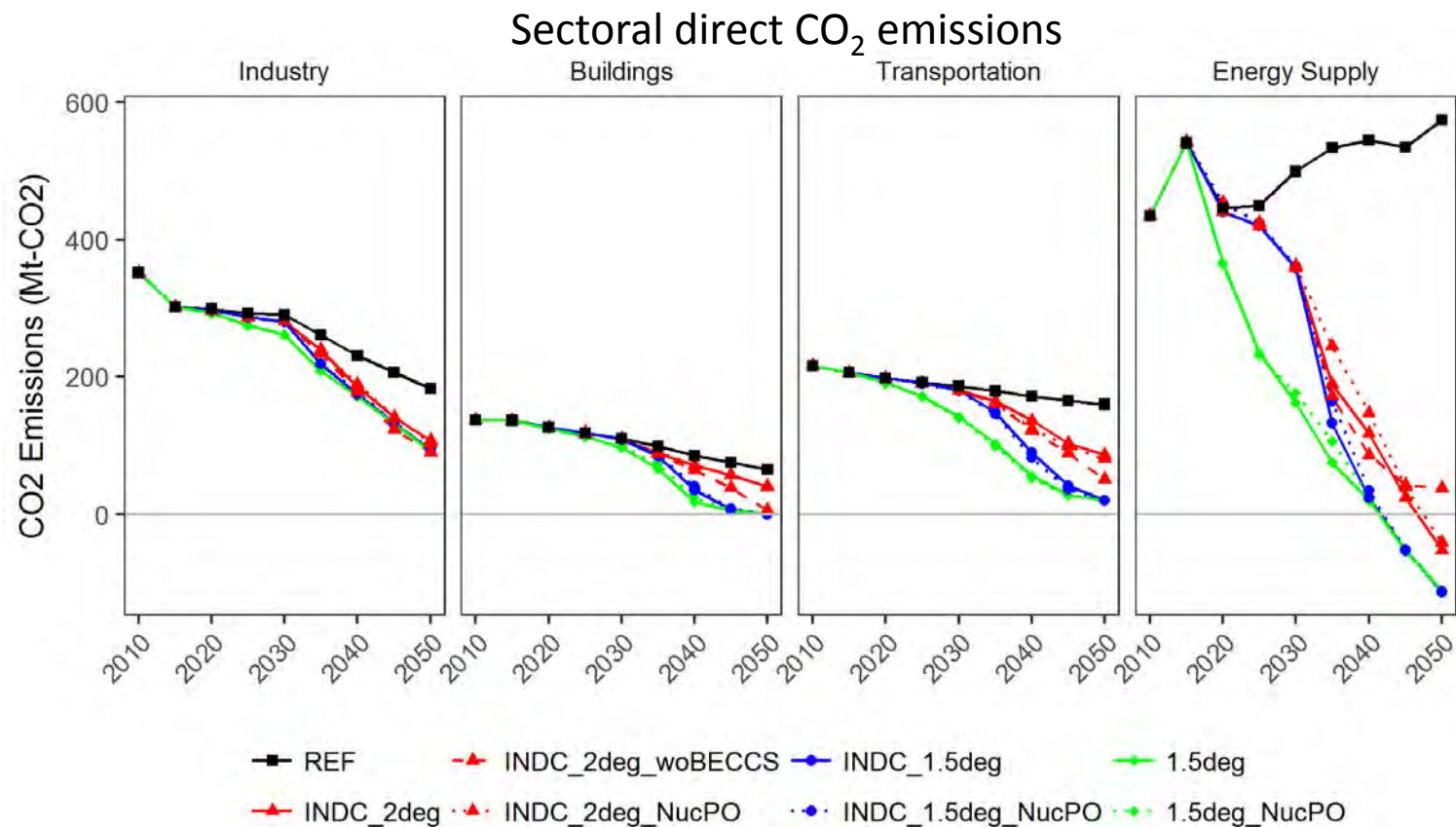
- At Council on Investments for the Future (June 2018), "achieving growth through investments in energy and the environment" was discussed (http://japan.kantei.go.jp/98_abe/actions/201806/_00013.html).
 - ✓ From obligatory measures in response to the Government's initiatives, To the accelerated virtuous cycle between the environment and growth, and encouraged technological innovations led by businesses
- Long-Term Strategy under the Paris Agreement as Growth Strategy (Aug. 2018-March 2019; https://japan.kantei.go.jp/98_abe/actions/201808/_00011.html)
 - ✓ Measures against global warming are no longer a cost for companies. They are a source of competitiveness. Companies that actively fight against environmental issues attract funds from all around the world, enabling them to prepare for the next phase of their growth and take further measures. This change, which can truly be called a virtuous cycle between the environment and growth, has spread throughout the world at an amazing pace in the past five years or so.
- Long-term strategy was approved by the Cabinet on June 11, 2019. (https://japan.kantei.go.jp/98_abe/actions/201906/_00031.html)
 - ✓ Only vision in 2050 / toward decarbonized society. No roadmap to realize vision.

Japan Long-Term Strategy under the Paris Agreement as A Growth Strategy

Outlines of Japan's Long-term Strategy under the Paris Agreement (Cabinet decision, June 11, 2019)	
Chapter 1: Basic Concepts	Provisional Translation
<p>➤ Proclaiming a “decarbonized society” as the ultimate goal and aiming to accomplish it ambitiously as early as possible in the second half of this century, while boldly taking measures towards the reduction of GHGs emissions by 80% by 2050 <small>* an unconventional vision of an “ideal future model” * contributing to the achievement of the long-term goals of the Paris Agreement, including efforts to limit the temperature increase to 1.5°C</small></p> <p>➤ Realizing “a virtuous cycle of environment and growth” towards the vision with business-led disruptive innovation, Swift implementation of actions from now, contributing to the world, Action Towards a bright Society with Hope for the Future <small>[Factors: Achievement of SDGs; “Co-innovation”, Society 5.0; the “Circulating and Ecological Economy”; and leading country in solving problems]</small></p>	
Chapter 2: The Vision of Each Sector and the Direction of Measures	Chapter 3: Cross-sectoral Measures for Achieving a Virtuous Cycle of Environment and Growth
<p>Section 1: Measures for Emissions Reductions</p> <p>1. Energy: For energy transition/decarbonization, pursuing every option</p> <ul style="list-style-type: none"> Utilizing renewable energy as the major power source Reducing CO₂ emissions from the thermal power in line with the long-term goals of the Paris Agreement Promoting CCS&CCU/Carbon Recycling Realizing a “Hydrogen Society”/battery/nuclear/energy efficiency <p>2. Industry: Decarbonized manufacturing</p> <ul style="list-style-type: none"> Use of CO₂-free hydrogen (e.g. a challenge towards “zero-carbon steel”) Feedstock change (e.g. CCU including artificial photosynthesis and biomass utilization) Achieving drastic energy efficiency, and complete transition from fluorocarbons in mid-long term <p>3. Transport: the challenge of “Well-to-Wheel Zero Emission”</p> <ul style="list-style-type: none"> Achieving the highest level of environmental performance of Japanese vehicles supplied worldwide by 2050 Road/transport systems using big data and IoT <p>4. Community and Living: Achieving carbon neutral, resilient and comfortable communities and living by 2050/ creating the “Circulating and Ecological Economy”</p> <ul style="list-style-type: none"> Capable communities and corporations to achieve carbon neutrality even before 2050 Shift to carbon neutral living (encouraging technology development and dissemination to achieve net Zero Energy Buildings, equivalency in stock average of housing and office buildings/ shift of lifestyles) Carbon-neutral community building (urban city building, farming/forestry/fishing villages building, and development of distributed energy systems) <p>Section 2: Measures for Carbon Sinks</p>	<p>Section 1: Promotion of Innovation</p> <ul style="list-style-type: none"> Promoting innovation for practical application and wide usage of cross-sectoral decarbonization technologies leading to drastic reduction of GHG, achieving cost that allows commercialization for social application <p>(1) Progressive Environment Innovation Strategy</p> <ul style="list-style-type: none"> Setting clear goals such as costs, maximizing investment of public and private resources, discovering and creating technological seeds in and outside Japan, setting issues from demands, strengthening support that leads to commercialization Challenging R&D, and enhancing alliances among R&D institutes with facilitation of international joint R&D activities [Research and Development 20 for clean energy technologies(RD20)] Target setting and visualizing challenges for the practical use <ul style="list-style-type: none"> Realizing hydrogen cost equivalent to existing energy: e.g. lowering manufacturing cost of CO₂-free hydrogen to 1/10 CCU/carbon recycled products to be provided with costs equivalent to existing products, nuclear power(such as Reactor, Fusion) <p>(2) Innovation in Economic and Social Systems/lifestyle</p> <p>Section 2: Promotion of Green Finance</p> <ul style="list-style-type: none"> Appropriately “visualizing” corporate efforts in innovation etc. and mobilizing finance for innovation by financial institutions <p>(1) Mobilizing green finance through TCFD[®] disclosures and dialogues ※Task Force on Climate-related Financial Disclosures</p> <ul style="list-style-type: none"> Industry: improving TCFD Guidance & Scenario Analysis Guide / Financial sector: Formulating a guidance on green investment Facilitating dialogue between industry and financial sector (TCFD Consortium) Promoting discussion and share the above initiatives with the world (TCFD Summit) <p>(2) Promoting initiatives to expand ESG finance</p> <ul style="list-style-type: none"> Initiatives for ESG finance (Support to the issuance of green bonds, encouraging local ESG finance), development of ESG Dialogue Platform, enhancing ESG finance literacy, ESG Finance High-Level Panel <p>Section 3: Business-led Promotion of International Application, and International Cooperation</p> <ul style="list-style-type: none"> Promoting competitive technologies and products with high environmental performance/ promoting co-innovation benefiting participants from both countries <p>(1) Promoting international application of decarbonization technologies together with policy/institutional development and international rule-making</p> <ul style="list-style-type: none"> Promoting international application of decarbonization technologies and reductions of GHG emissions through development of business environment by improving business environment including working for institutional development in partner countries leading international rule-making cooperating in building policy and institutional framework in partner countries and by international rule-making (e.g. establishing public and private-sector initiatives in ASEAN, and developing appropriate international frameworks for utilizing market-based mechanisms) <p>(2) Strengthening Development and Investment of infrastructure that contributes to CO₂ emission reductions</p> <ul style="list-style-type: none"> Development and investment of energy and city/transport infrastructure that contributes to CO₂ emission reductions in line with the long-term goals of the Paris Agreement (e.g. renewable energy such as offshore wind power and geothermal power, hydrogen, CCS&CCU/Carbon Recycling, smart cities) <p>(3) Creating platforms for global scale decarbonized society building</p> <ul style="list-style-type: none"> Supporting partner countries in the formulation of NDCs and mitigation measures, enhancing transparency in the overall supply chains
Chapter 4: Other Measures	Chapter 5: Review and Implementation of the Long Term Strategy
<ul style="list-style-type: none"> Human Resource Development Government-led initiatives Integrating climate change adaptation with development of a resilient society Carbon Pricing (Expert/technical level discussions) 	<ul style="list-style-type: none"> Review: Re-examining policies and measures flexibly every about 6 years with reference to situations, and improving the Long-term strategy if necessary Implementation: Analysing relevant factors responding to future changes in the situations / collaborating and having dialogues with stakeholders including the youth

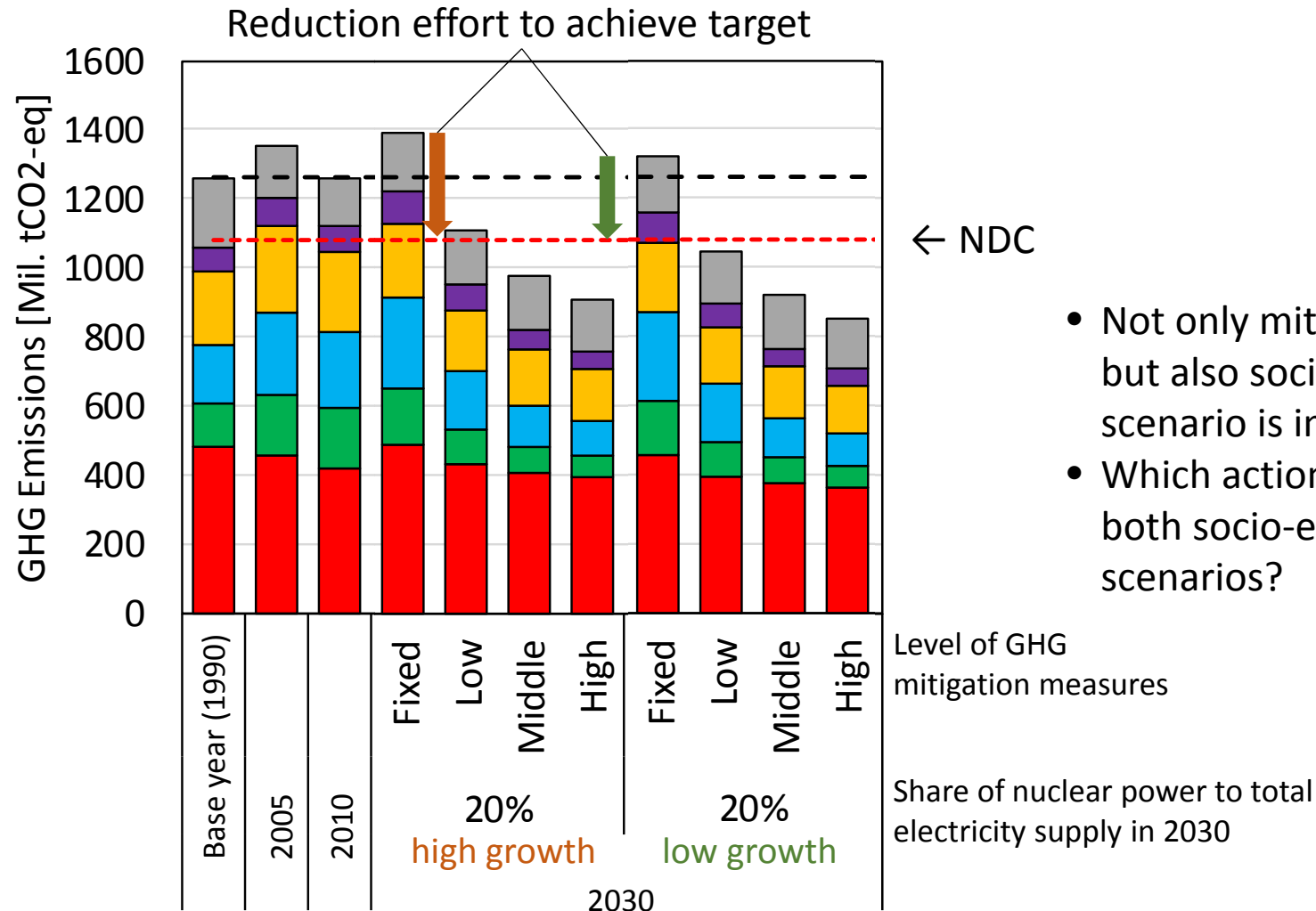
Sectoral challenges to net zero emission - Results from AIM/Enduse [Japan]

- Power sector requires large-scale transformation.
- Difference between net-zero and 80% reduction is moderate in the buildings and industry sector.
- Buildings sector needs to be almost decarbonized even in 80% reduction.



Oshiro, K., Kainuma, M., & Masui, T. (2017). Transformation of Japan's energy system to attain net-zero emission by 2050. Carbon management, (in press)

Necessary efforts to achieve the target



- Not only mitigation actions but also socio-economic scenario is important.
- Which action is effective for both socio-economic scenarios?

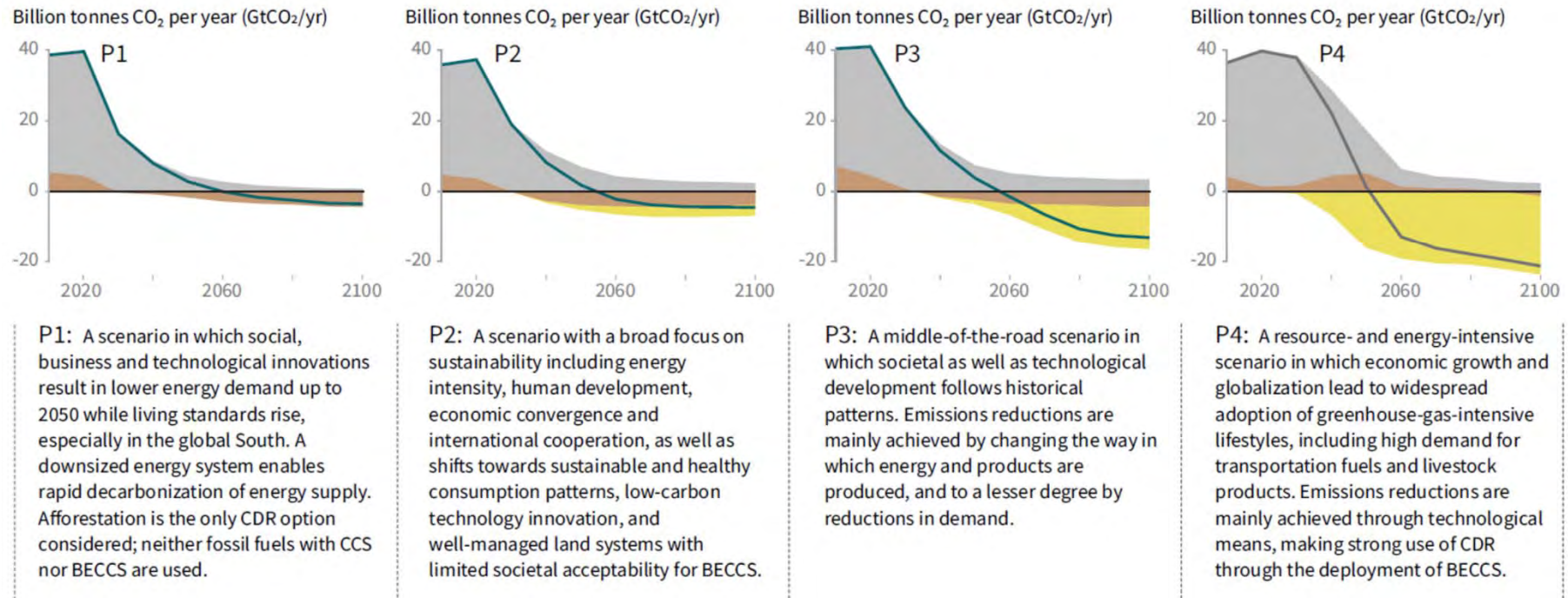
■ Industry ■ Residential ■ Commercial ■ Transport ■ Energy ■ Non-energy

as of June 2012

From IPCC SR1.5: Necessary measures and their volumes will depend on socio-economic conditions.

Breakdown of contributions to global net CO₂ emissions in four illustrative model pathways

● Fossil fuel and industry ● AFOLU ● BECCS



https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf

Final emission pathways are the same among the scenarios, but the necessary mitigation efforts are different because of the difference of baseline scenarios.

Roles of research communities

- Good communication with other stakeholders through integrated assessment models;
 - ✓ Model can be a core tool to assess future vision.
 - Model should be **transparent** to respond to criticism that "Model is black box."
 - All stakeholders must understand "What is model" correctly.
 - Model cannot predict the future but only show a **consistent future scenario** with inputs.
 - By using model, we can experiment.
 - But model is not real world. The most appropriate model must be used to meet purpose.
 - ✓ Not only model results but also clear **narrative storylines** are needed in order to communicate with various stakeholders and disseminate accurate information about simulation results.

Through good communication among all stakeholders, sustainable decarbonized society can be realized.