Low Carbon Society Scenario Project

Third Annual Meeting
Integrated Assessment Modeling Consortium (IAMC)

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Modeling Sustainable Low-Carbon Asia

“Asian Low-Carbon Society Scenario” project develops scenarios by (1) Depicting narrative scenarios for LCS, (2) Quantifying future LCS visions and by (3) Developing robust roadmaps by backcasting. This study for FY2009-2013 is funded by Global Environmental Research Program, MOEJ
Formulation of LCS
- To make a real progress

Target should be in line with the long-term climate target

General objective of the study

In order to realize Asian Low Carbon Societies, ....

1. We focus on domestic and international factors which control the realization of LCS,

2. Describe the development, accumulation, and deepening of factors which control LCS with multi-layered, spatial, and integrated quantification models/tools,

3. Apply quantification models/tools to various Asian regions,

4. Taking account of regional distinctive diversified characteristics,

5. And design positive Asian low carbon societies and roadmaps towards the LC societies, in each region with a back-casting methodology.
What are the Asian Low Carbon Societies, we target in the study?

By the middle of this century (2050), the target societies will satisfy the followings;

1. Harmonized with drastically changing future Asian society and economy,

2. Complying with each region's national reduction target that consists with the global low carbon target, under the global, national and regional constraints on fossil and renewal energy resources, and land resource,

3. Developing/devising/promoting LCS policies based on each region’s characteristics,

4. Also utilizing effectively co-benefits of LCS policies and neighboring policies.
In order to taking account of multilayered characteristics of Asian LCS issue

Two approaches are adopted in order not to loose perspective and reality of LCS

1. Region specific study: Country/region specific approach collaborating with domestic research institutions, and putting more focus on regional initiative and acceptability

2. Pan Asian-Pacific approach: Put more emphasis on comprehensiveness and compatibility among global and pan Asian-Pacific regions
Approaches to develop LCS scenarios

1. Setting Framework
2. Description of socio-economic assumptions
3. Quantification of socio-economic assumptions
4. Collection of low carbon measures
5. Setting introduction of measures in target year
6. Estimation of GHG emissions in the target year
7. Confirming measures set and suggestion of policy recommendations
How do we implement these approaches?
Flow diagram of the study

**Local region specific study**

Regional LCS study collaborated with domestic institutes [some exemplified regions]

- **Narrative scenarios** of socio-economic future [nations/regions]
- **Quantification of long-term socio-economic-energy drivers:** Demography, DP, labour productivity, technology development, saving and investments, institutional efficiency, etc. [Whole Asia and some exemplified regions]
- **Narrative scenarios** of socio-economic futures [Global]
- **Allowable GHG global emission paths** [global]
- **Process analysis** (stock dynamics, bottom-up analysis using end-use model,…) of national LCS scenarios [Whole Asia and some exemplified regions]
- **Designing burden sharing schemes** [Global]
- **Design and proposal of region specific LCS scenarios and roadmaps** [some exemplified nations/regions]
- **National and regional CGE models**
  - Enduse model, Snapshot tool, Backcasting tool
- **National GHG reduction targets and schedules** [Global]

**Pan-Asia Pacific study**

- **Designing burden sharing schemes** [Global]
- **Design and proposal of Pan-Asian Pacific LCS scenarios and roadmaps**
  - ExSS (Snapshot model)
  - BCM/BCT (Backcasting model/tool)
  - National and regional CGE models
  - Enduse model, Snapshot tool, Backcasting tool
- **Quantification of national socio-economic and LCS scenarios by top-down approach**

- **Process analysis** (stock dynamics, bottom-up analysis using end-use model,…) of national LCS scenarios [Whole Asia and some exemplified regions]
Three regional/time scales we are concerning
To all scales, our methodology has been applied, and they are inter-connected each other.

Global development scenarios and Low Carbon World Roadmaps, 2005-2100

National development scenarios and Low Carbon nations Roadmaps, 2005-2050

Local development scenarios and Low Carbon Cities Roadmaps, 2005-2030

Scale 1: Global and whole Asian scale analysis
Scale 2: National scale analysis
Scale 3: Local scale analysis
Region specific studies in progress

Policy makers
Central/regional government administration
Development Agencies
NGOs

Collaboration for LCS scenario development and building roadmaps

Request of more practical, realistic roadmaps and also tractable tools for real world

Each country’s domestic/local research institute

Application and development to actual LCS processes

Core research members

Development and maintenance of study tools/models

<table>
<thead>
<tr>
<th>Region</th>
<th>Country</th>
<th>Domestic counterpart institutions</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>Japan</td>
<td>NIES, Kyoto Univ. and 23 institutions in Japan</td>
<td>Preliminary stage completed. Implementation to policy making in progress</td>
</tr>
<tr>
<td>Iskandar development region</td>
<td>Malaysia</td>
<td>University Technology Malaysia, Iskandar Regional Development Authority, Federal Department of Town and Country Planning Malaysia, Malaysia Energy Centre</td>
<td>Preliminary stage completed. Implementing to policy making in progress</td>
</tr>
<tr>
<td>India</td>
<td>India</td>
<td>Indian Institute of Management, Ahmedabad</td>
<td>Preliminary stage completed.</td>
</tr>
<tr>
<td>Ahmedabad city</td>
<td>India</td>
<td>Indian Institute of Management, Ahmedabad</td>
<td>Preliminary stage completed.</td>
</tr>
<tr>
<td>Bhopal</td>
<td>India</td>
<td>M. A. National Institute of Technology, Bhopal School of Planning &amp; Architecture, Bhopal</td>
<td>Just started</td>
</tr>
<tr>
<td>Guangzhou city</td>
<td>China</td>
<td>Guangzhou Institute of Energy Conversion, CAS</td>
<td>Just started</td>
</tr>
<tr>
<td>Shiga prefecture</td>
<td>Japan</td>
<td>Lake Biwa Environmental Research Institute</td>
<td>Implementation stage</td>
</tr>
<tr>
<td>Kyoto city</td>
<td>Japan</td>
<td>Kyoto city government</td>
<td>Implementation stage</td>
</tr>
<tr>
<td>Kyoto prefecture</td>
<td>Japan</td>
<td>Kyoto prefectural government</td>
<td>Just started</td>
</tr>
<tr>
<td>Vietnam, Thailand, Indonesia, Korea</td>
<td></td>
<td>Just started</td>
<td>Just started</td>
</tr>
</tbody>
</table>
Region specific studies in progress

Communication and feedbacks of LCS study to real world
Case study in Japan
Roadmap toward LCS

**Policy Target**
Minus 80% reduction by 2050, Share of renewable energy: 10% by 2020

**Macro Frame**
GDP, Population, Production, Unemployment rate, trade, etc.

**Technology Data**
- Energy consumption
- Equipment cost
- Running cost
- Share, etc.

**Supply Constraint**
Nuclear power CCS Renewable energy, etc.

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Evaluate by backcasting

When and What kind of policies should we introduce?

80% GHG reduction

- Energy consumption
- Equipment cost
- Running cost
- Share, etc.
## Overall roadmap: order of policies and effects

<table>
<thead>
<tr>
<th>Policies</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>▶ Mechanism to reward people and companies cooperating in reducing emissions</td>
<td>▶ Spread of low-carbon technologies</td>
</tr>
<tr>
<td>▶ Making emissions volumes known</td>
<td>▶ Expansion of new industries and new markets</td>
</tr>
<tr>
<td>▶ Policy to promote the mass spread of existing technologies</td>
<td></td>
</tr>
<tr>
<td>▶ Low-carbon infrastructure</td>
<td></td>
</tr>
<tr>
<td>▶ Promotion of R&amp;D</td>
<td></td>
</tr>
<tr>
<td>▶ Human resources and Env. Education</td>
<td></td>
</tr>
<tr>
<td>▶ Vitalization of environmental finance</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reduction of greenhouse emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
</tr>
<tr>
<td>Existing technologies; period of expansion of the domestic market; period of entrance into the global market</td>
</tr>
</tbody>
</table>

- **Cap and trade system for trading domestic emissions volumes**
- **Global warming countermeasures tax**
- **Fixed-price purchasing system**
- **Promotion of voluntary efforts**
- **Thoroughly making known for all main constituents**
- **Appropriate combination of restrictions and support**

- **Resources**
- **Promotion of R&D**
- **Human resources and Env. Education**
- **Vitalization of environmental finance**
- **Existing low-carbon technologies**
- **Revolutionary low-carbon technologies**

**(Nishioka, 2010)**
### Short-term target analysis to meet the long-term goal

**Volume of greenhouse gas emissions [2020/2030]**

- It is technically possible to domestically reduce the volume of greenhouse gas emissions by 25% in 2020 compared to the level in 1990.
- Efforts in daily life (household, operations, transportation) will have a major effect.

<table>
<thead>
<tr>
<th>Year/Category</th>
<th>Non-energy sector</th>
<th>Energy transfer sector</th>
<th>Transportation sector</th>
<th>Operation sector</th>
<th>Household sector</th>
<th>Industry sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>1,261</td>
<td>834</td>
<td>217</td>
<td>155</td>
<td>1,101</td>
<td>78</td>
</tr>
<tr>
<td>2000</td>
<td>1,291</td>
<td>794</td>
<td>206</td>
<td>157</td>
<td>1,011</td>
<td>94</td>
</tr>
<tr>
<td>2005</td>
<td>1,317</td>
<td>713</td>
<td>237</td>
<td>188</td>
<td>946</td>
<td>188</td>
</tr>
<tr>
<td>2008</td>
<td>1,026</td>
<td>713</td>
<td>228</td>
<td>188</td>
<td>1,061</td>
<td>188</td>
</tr>
<tr>
<td>2020</td>
<td>834</td>
<td>834</td>
<td>211</td>
<td>228</td>
<td>834</td>
<td>78</td>
</tr>
<tr>
<td>2030</td>
<td>34%</td>
<td>39%</td>
<td>34%</td>
<td>43%</td>
<td>43%</td>
<td>43%</td>
</tr>
</tbody>
</table>
Short-term target analysis to meet the long-term goal

Relationship between low-carbon investment amount and energy reduction expense

- As for the investment amount for global warming, half of the overall investment amount will be collected by 2020 and an amount equal to the investment amount will be collected by 2030 based on energy expenses that can be saved through technologies introduced.

<Low-carbon investment amount and energy reduction expense>

- Additional investment ('11 – ’20 total)
- Energy reduction expense ('11 – ’20 total)
- Energy reduction expense ('21 – ’30 total)

Energy saving investment through 2020
Volume of reduction from energy saving technologies
In the case of device with 10 year lifespan

Energy reduction expense from energy saving investment = approx. 51 trillion yen (25% reduction (3))
Energy reduction expense from energy saving investment = approx. 53 trillion yen (25% reduction (3))
Example of concrete execution plan towards Local LCS - Roadmap towards Low Carbon Kyoto study -

**Region Specific Studies**

**Kyoto, Japan**

**STD4** Regional Development Strategy

**STD4.1** Development Plan

- **STD4.1.1** Regional Development Strategy
  - **STD4.1.1.1** Strategic Vision
  - **STD4.1.1.2** Regional Objectives
  - **STD4.1.1.3** Regional Policies
  - **STD4.1.1.4** Regional Programs

**STD4.2** Regional Action Plan

- **STD4.2.1** Regional Action Plan
  - **STD4.2.1.1** Action Plan Overview
  - **STD4.2.1.2** Action Plan Objectives
  - **STD4.2.1.3** Action Plan Strategies
  - **STD4.2.1.4** Action Plan Programs

**STD4.3** Regional Implementation Plan

- **STD4.3.1** Regional Implementation Plan
  - **STD4.3.1.1** Implementation Plan Overview
  - **STD4.3.1.2** Implementation Plan Objectives
  - **STD4.3.1.3** Implementation Plan Strategies
  - **STD4.3.1.4** Implementation Plan Programs

**STD4.4** Regional Monitoring and Evaluation Plan

- **STD4.4.1** Regional Monitoring and Evaluation Plan
  - **STD4.4.1.1** Monitoring and Evaluation Plan Overview
  - **STD4.4.1.2** Monitoring and Evaluation Plan Objectives
  - **STD4.4.1.3** Monitoring and Evaluation Plan Strategies
  - **STD4.4.1.4** Monitoring and Evaluation Plan Programs

**STD4.5** Regional Stakeholder Engagement Plan

- **STD4.5.1** Regional Stakeholder Engagement Plan
  - **STD4.5.1.1** Stakeholder Engagement Plan Overview
  - **STD4.5.1.2** Stakeholder Engagement Plan Objectives
  - **STD4.5.1.3** Stakeholder Engagement Plan Strategies
  - **STD4.5.1.4** Stakeholder Engagement Plan Programs

**STD4.6** Regional Governance Plan

- **STD4.6.1** Regional Governance Plan
  - **STD4.6.1.1** Governance Plan Overview
  - **STD4.6.1.2** Governance Plan Objectives
  - **STD4.6.1.3** Governance Plan Strategies
  - **STD4.6.1.4** Governance Plan Programs

**STD4.7** Regional Budget Plan

- **STD4.7.1** Regional Budget Plan
  - **STD4.7.1.1** Budget Plan Overview
  - **STD4.7.1.2** Budget Plan Objectives
  - **STD4.7.1.3** Budget Plan Strategies
  - **STD4.7.1.4** Budget Plan Programs

**STD4.8** Regional Risk Management Plan

- **STD4.8.1** Regional Risk Management Plan
  - **STD4.8.1.1** Risk Management Plan Overview
  - **STD4.8.1.2** Risk Management Plan Objectives
  - **STD4.8.1.3** Risk Management Plan Strategies
  - **STD4.8.1.4** Risk Management Plan Programs

**STD4.9** Regional Capacity Building Plan

- **STD4.9.1** Regional Capacity Building Plan
  - **STD4.9.1.1** Capacity Building Plan Overview
  - **STD4.9.1.2** Capacity Building Plan Objectives
  - **STD4.9.1.3** Capacity Building Plan Strategies
  - **STD4.9.1.4** Capacity Building Plan Programs

**STD4.10** Regional Monitoring and Evaluation Plan

- **STD4.10.1** Regional Monitoring and Evaluation Plan
  - **STD4.10.1.1** Monitoring and Evaluation Plan Overview
  - **STD4.10.1.2** Monitoring and Evaluation Plan Objectives
  - **STD4.10.1.3** Monitoring and Evaluation Plan Strategies
  - **STD4.10.1.4** Monitoring and Evaluation Plan Programs
Target in Kyoko

- Base year: 2005
- Target year: 2030
- Target area: Kyoto city area
- Target activity:
  - Residential, commercial and industrial activity in Kyoto city area
  - Transport originated in Kyoto city area
- Target gas:
  - CO2 from fossil fuel combustion
  - CO2 from waste (plastic) incineration
- Low-carbon target: -40% compared to 1990 level

Municipal Ordinance was adopted on 14 October 2010
A roadmap in Kyoko

Kyoto style building and forest management
Comprehensive use of renewable energy
Low-carbon lifestyle

Workable city, Kyoto
Decarbonization of industry

Walkable City, Kyoto
Kyoto-style Buildings and Forest Development
Low Carbon Lifestyle
Decarbonation of Industry
Comprehensive Use of Renewable Energy
Case study in India
Sustainable Low Carbon Cities: Ahmedabad

Ahmedabad (2009) Pop 5.5 Mil

Mitigation Contributions
- Transport Efficiency
- Industry Efficiency
- Building Efficiency
- Fuel Switch
- Energy Service demand
- Coal + CCS
- Emissions

67%

2005
2035 BaU
2035 LCS

Passenger Transport Sector
- Freight Transport
- Passenger Transport
- Industry
- Commercial
- Residential

Source: Shukla
Bhopal LCS Preliminary Results

**GHG Emission Scenario**

- Residential
- Industry
- Freight Transport

**Passenger Transport Sector**

- 2005
- 2035_BaU
- 2035_LCS

**Mitigation Contributions**

- Efficiency Improvement (Transport)
- Efficiency Improvement (Industry)
- Efficiency Improvement (Building)
- Fuel Switch

- Improvement in Energy Intensity
- Emissions
Study results from AIM/Enduse Study: Bhopal

- Residential Sector
- Transport Sector

Bhopal - BAU and LCS scenarios in Residential and Transport Sectors
Barriers to overcome in LCS Pathways

- No common generalized policies can be developed, Individual solutions are needed for each of the city
- Success depends on the participation of local government / people
- Almost no awareness in smaller cities
- Capacity building is slow and time taking
- Good quality infrastructure and services are almost always necessary that are already stressed
- Development priorities may not be in line with LCS objectives
- Economic implications are not easy to anticipate
Thanks for your attention!
Example of technology deployment through 2050

**Passenger Vehicle**

- Plug-in HV (2045)
- Plug-in HV (2030)
- Plug-in HV (2010)
- HV (2045)
- HV (2030)
- HV (2010)
- Gasoline (2045BAT)
- Gasoline (2030BAT)
- Gasoline (2010BAT)
- Gasoline (Stock)

**Lighting in residential sector**

- High efficient lighting (2030)
- High efficient lighting (2020)
- High efficient lighting (2015)
- High efficient lighting (2010)
- Lamp type fluorescent lamp
- Incandescent lamp
- Incandescent lamp