Ten Actions toward Low Carbon Asia

- Urban Transport
- Interregional Transport
- Governance
- Resources & Materials
- Buildings
- Biomass
- Energy System
- Agriculture & Livestock
- Forestry & Land Use
- Technology & Finance

http://2050.nies.go.jp/
The realization of Low Carbon Societies (LCSs) in Asia is imperative in order to achieve both sustainable economic growth and stabilization of climate change. Greenhouse gas (GHG) emissions from the Asian region accounted for approximately 36% of global emissions in 2005. Considering the rapid economic growth expected in the coming decades, the share of emissions from the Asian region is projected to rise further, accounting for about 50% of global emissions in 2050.

If Asian countries are to pursue short-term economic growth and delay actions to tackle climate change, it would lead to the reinforcement of energy intensive infrastructures and make it difficult for the countries to achieve sustainable development. Considering the need of the Asian countries to address a number of environmental and development concerns in parallel, it is necessary to identify leapfrogging development pathways and co-benefits to enable a shift to low carbon emissions and low-resource consumption societies, while simultaneously improving the economic standards of living.

What are the “Ten Actions toward Low Carbon Asia”?
Transition to an LCS is not an easy task. In order to realize an LCS that satisfies the multi-faceted needs and values of each Asian country, it is vital to gain the cooperation of a wide range of stakeholders, including policy makers, international aid agencies, private companies, local communities and NGOs, and share their long-term visions and strategies for an LCS.

“Ten Actions toward Low Carbon Asia” provides a guideline to plan and implement the strategies for an LCS in Asia. It takes into account the interrelationships between individual policies and the sequence in which they should

- **Action 1** Urban Transport Hierarchically Connected Compact Cities
- **Action 2** Interregional Transport Mainstreaming Rail and Water in Interregional Transport
- **Action 3** Resources & Materials Smart Ways to Use Materials that Realize the Full Potential of Resources
- **Action 4** Buildings Energy-Saving Spaces Utilizing Sunlight and Wind
- **Action 5** Biomass Local Production and Local Consumption of Biomass
- **Action 6** Energy System Low Carbon Energy System Using Local Resources
- **Action 7** Agriculture & Livestock Low Emission Agricultural Technologies
- **Action 8** Forestry & Land Use Sustainable Forestry Management
- **Action 9** Technology & Finance Technology and Finance to Facilitate Achievement of LCS
- **Action 10** Governance Transparent and Fair Governance that Supports Low Carbon Asia

Ten Actions toward Low carbon Asia
be implemented. It also discusses the necessary actions to be taken by governments, private sector, citizens, and international cooperation agencies on a priority basis.

**Actions in individual sectors and their GHG emissions**

Actions 1 to 6 focus on the mitigation of carbon dioxide (CO$_2$) emissions from the use of energy and materials. Such CO$_2$ emissions accounted for approximately 60% of Asian emissions in 2005 and are expected to increase further. Actions 1 and 2 emphasize the necessity of developing low carbon transport systems with well-designed city structures. Action 3 introduces the strategies for reducing consumption of resources. Actions 4, 5, and 6 focus on energy system both in demand and supply sides, e.g. promotion of energy efficiency improvement in buildings for the demand-side, and improvement of biomass use and development of smart energy systems for the supply side.

Action 7, on the other hand, is targeted at the reduction of nitrous oxide (N$_2$O) and methane (CH$_4$) emissions from agriculture. Action 8 deals with the land use related emissions and absorption of CO$_2$. Non-energy related GHG emissions account for approximately 40% of the total Asian emissions and the emission reduction potential from these sectors should not be underestimated.

Actions 9 and 10 are cross-sectoral; they are proposed to facilitate the previous eight actions and enhance their effects, through providing incentives and financial support for technology development and diffusion, and establishing transparent and fair governance system that is supportive of LCS development, particularly in Asia.

**Considerations when applying the actions in each country**

The roadmaps described in the “Ten Actions” regard the diverse Asian region as a single entity. Therefore, they should be adapted and modified when applying to each country based on the socioeconomic condition of the society in question as well as the progress of existing climate policies. In addition, it should be noted that the actions presented in this document are not the only pathways to achieve an LCS, and that several others also exist. The important point is to use this document to encourage discussions among the stakeholders and to develop specific actions for each country or area in the Asian region.

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*The Low-Carbon Asia Research Project* is supported by the Environment Research and Technology Development Fund (S-6) of the Ministry of the Environment, Japan.

*A research project to establish a methodology to evaluate mid- to long-term environmental policy options toward Asian low-carbon societies.*
Hierarchically Connected

Urban Transport

**AVOID Strategy**
Compact cities with well-connected hierarchical urban centers (transit-oriented development)

**SHIFT Strategy**
A seamless and hierarchical transport system (transit-oriented development)
(railway, bus rapid transit, conventional buses, paratransit, personal mobility)

**IMPROVE Strategy**
Low carbon vehicles and transport system (small vehicles, renewable energy + biomass fuel)

Low carbon vehicles and transport system (small vehicles, renewable energy + biomass fuel)

Image of future low carbon urban transport system
Compact Cities

Role of Private Sector

Industries are responsible for developing electrification technologies for personal vehicles to avoid excessive CO₂ emissions and road-space demand from rapidly increasing inner-city movement.

Role of Government

Taking into account the CO₂ emission target of a city, the government is responsible for determining appropriate types of urban structure and urban transport network as well as relevant policies.

Role of Citizens

Citizens should not follow the conventional path of mobility growth from bicycles and motorcycles to larger cars, but should explore well-balanced use of public transport and smaller private vehicles, which thus leads to a higher quality of life.

International Cooperation

Although developing countries should seek promising ways to realize self-financing, international financing needs to be greatly strengthened. More emphasis should be placed on green development in assessing international financial assistance.

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<thead>
<tr>
<th>2000</th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
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</thead>
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<td><strong>International</strong></td>
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<td>Financial schemes and emissions trading to support development of low carbon transport</td>
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<td>Preference for locations near stations</td>
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<tr>
<td>Separation of trunk and feeder bus/paratransit routes</td>
<td>Shift to “local production for local consumption” systems</td>
<td>Preference for short-distance travel, popularization of online shopping and telecommuting</td>
<td>Development of model cities for low-carbon transport</td>
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<td>Enhanced circulating local-transport services easily used by aged people</td>
<td>Tax systems to promote TOD</td>
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<td>Adoption of models of urban transport systems by other cities</td>
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<td>Efficient and modern public transport based on information and communication technologies (ICT)</td>
<td>Establishment of multigenerational service facilities around stations</td>
<td>Development of polycentric business centers in key transit nodes</td>
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<tr>
<td>Cooperative management of a comprehensive region-wide transport system</td>
<td>Development of radial and orbital public transport networks connecting urban centers</td>
<td>Establishment of freight distribution systems</td>
<td>Preference for small-size personal vehicles</td>
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<td>Expansion of slow-mode areas around stations</td>
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Vision of 2050

Urban trunk transport networks, such as railways and bus rapid transit (BRT), are established in accordance with the population density of a city, with a high rate of public transport use. As a consequence of the transition to an aging society from 2030, travel demand within local communities is significant. Accordingly, small-size personal vehicles for short-distance travel are popular, and the urban transport system hierarchically links feeder transport of the bus and paratransit modes to the trunk transport. This transport system is supported by a high-density, polycentric, and hierarchical land-use system, which allocates urban central functions from an existing single city center to key transit nodes. Furthermore, vehicle technologies for automobiles will catch up to well-advanced to a level of CO₂ emissions per passenger-kilometer similar to that of current developed countries.

Current Situation

Economic growth has led to rapid motorization and urban sprawl in major cities in Asia, giving rise to various problems such as traffic congestion and air pollution. Nevertheless, most developing countries lack sustainable and low-carbon city planning. Many developing countries have prioritized road development in response to growing transport demand, resulting in a vicious circle in which even greater car use is induced. Since around 2000, major cities in Asia have begun to undertake urban railway development, but so far the level is not at all adequate. Developing countries are also far behind developed countries in terms of vehicle technologies, as the advanced technologies are not currently affordable.

Challenges

Future economic development in Asia may further increase transport demand. Effective strategies for realizing low carbon urban transport will be to avoid unnecessary transport demand by creating compact cities (AVOID Strategy) and to shift to lower carbon transport modes by developing trunk public transport networks earlier (SHIFT Strategy) before a car-dependent society is formed. In addition, advanced vehicle technologies should be actively introduced (IMPROVE Strategy). It is important to first develop model cities in Asia on a short-term basis for use as a reference, and then to encourage adoption of their systems by other cities. Such development needs to be implemented at an early stage, as extensive infrastructure investment is only available in the growth phase of the economy.
Study of “leapfrog policy” combinations

Policies and technologies for achieving a low carbon transport system have been organized systematically by the World Conference on Transport Research Society (WCTRS) in the form of a matrix called the Comparative study on Urban Transport and the Environment (CUTE) matrix. These policies can be classified into three main categories: AVOID Strategy (avoid unnecessary transport demand), SHIFT Strategy (shift to low carbon means of transport), and IMPROVE Strategy (improve transport energy consumption efficiency). Further classifications are made according to the means by which these policies are achieved; i.e., technological, regulatory, informational, and economic.

<table>
<thead>
<tr>
<th>Means</th>
<th>AVOID Strategy</th>
<th>SHIFT Strategy</th>
<th>IMPROVE Strategy</th>
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<tbody>
<tr>
<td>Technological</td>
<td>Transit-oriented development (TOD)</td>
<td>Railways and BRT development</td>
<td>Development of electric vehicles</td>
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<td>Polycentric development</td>
<td>Interchange improvement among railway, BRT, bus, and paratransit modes</td>
<td>Development of biomass fuels</td>
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<td>Efficient freight distribution</td>
<td>Facilities for personal mobility and pedestrians</td>
<td>Smart grid development</td>
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<tr>
<td>Regulatory</td>
<td>Land-use control</td>
<td>Separation of bus/paratransit trunk and feeder routes</td>
<td>Emissions standards</td>
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<td>Local circulating service</td>
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<td>Control on driving and parking</td>
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<tr>
<td>Informational</td>
<td>Telecommuting</td>
<td>Intelligent Transport Systems (ITS) for public transport operation</td>
<td>Eco-driving</td>
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<td>Online shopping</td>
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<td>ITS traffic-flow management</td>
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<td>Lifestyle changes</td>
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<td>Vehicle performance labeling</td>
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<tr>
<td>Economic</td>
<td>Subsidies and taxation policies for locations</td>
<td>Park &amp; ride</td>
<td>Fuel tax/carbon tax</td>
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<td></td>
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<td>Cooperative fare systems among modes</td>
<td>Subsidies and taxation policies for low-emission vehicles</td>
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</table>

The level of implementation of each strategy (AVOID Strategy, SHIFT Strategy, IMPROVE Strategy) was examined to achieve a 70% reduction in CO₂ emissions from urban transport by 2050 for all urban areas in Thailand, as compared to 2005 levels. The results showed that, even if all passenger vehicles are electrified (IMPROVE Strategy) and the urban expansion rate is reduced by 10% from the Do Nothing scenario (AVOID Strategy), large-scale development of trunk public transport will be needed amounting to 4,420 km of railways, 220 km of light rail transit (LRT), and 1,260 km of bus rapid transit (BRT) (SHIFT Strategy). Accordingly, it is important that policies to advance technologies and change the land-use system be extensively implemented earlier as a package in order to develop a low carbon urban transport system in Asian developing countries.
Mainstreaming Rail and Transport

AVOID Strategy
Spatial development driven by a low carbon interregional transport system

SHIFT Strategy
A rail/water-oriented intermodal passenger/freight transport system (high-speed passenger railways, freight railways, and maritime/river transport)

IMPROVE Strategy
Low carbon automobile/airplane technologies (electric vehicles, alternative fuels, lightweight vehicles/vessels)

Interregional Transport

International interregional transport

① Coastal corridors of low carbon transport

② Inland corridors of low carbon transport

Domestic interregional transport

Promoting multiple growth poles

Image of future low carbon interregional transport systems
# Water in Interregional Transport

## Role of Government

Realize future intermodal low carbon networks for interregional transport including passenger and freight railways and ports, along with inland distribution centers (dry ports), led by backcasting from the CO₂ emission reduction targets for 2050.

## Role of Private Sector

In order to shift to low carbon interregional passenger and freight transport in Asia, for which a great increase in demand is expected as a result of economic growth, the role of industries is to construct low carbon emission supply-chain networks that make intensive use of railways and maritime transport. They also need to promote low carbon transport technologies for automobiles and airplanes.

## Role of Citizens

Evaluate and select the transport systems by considering their impact on CO₂ emissions. This includes not only appropriately choosing modes of travel but also consumer goods with a low carbon footprint. Use rail and water transport modes, and shorter distance transport, as much as possible even if it is not the highest speed option.

## International Cooperation

Official development assistance (ODA) and other international funding mechanisms should be used to promote low carbonization of interregional transport networks based on rail and water transport in inland routes and offshore corridors.

## Strategic Actions

### Government

- **2000**
  - Development of ports and airports as international hubs
  - Official development assistance (ODA) and other international funding mechanisms to promote low carbonization of interregional transport networks based on rail and water transport in inland routes and offshore corridors.

- **2010**
  - Development of high-speed passenger railways between domestic regions
  - Development of freight railways and maritime transport between domestic regions

- **2020**
  - Development of high-speed passenger railways between domestic regions
  - Development of freight railways and maritime transport between domestic regions

- **2030**
  - Development of high-speed passenger railways between domestic regions
  - Development of freight railways and maritime transport between domestic regions

- **2040**
  - Development of high-speed passenger railways between international regions
  - Development of freight railways and maritime transport between international regions

- **2050**
  - Development of high-speed passenger railways between international regions
  - Development of freight railways and maritime transport between international regions

### Private Sector

- **2000**
  - Development of ports and airports as international hubs
  - Development of high-speed passenger railways between domestic regions

- **2010**
  - Development of high-speed passenger railways between domestic regions
  - Development of freight railways and maritime transport between domestic regions

- **2020**
  - Development of high-speed passenger railways between domestic regions
  - Development of freight railways and maritime transport between domestic regions

- **2030**
  - Development of high-speed passenger railways between domestic regions
  - Development of freight railways and maritime transport between domestic regions

- **2040**
  - Development of high-speed passenger railways between international regions
  - Development of freight railways and maritime transport between international regions

- **2050**
  - Development of high-speed passenger railways between international regions
  - Development of freight railways and maritime transport between international regions

### Citizens

- **2000**
  - Development of ports and airports as international hubs
  - Development of high-speed passenger railways between domestic regions

- **2010**
  - Development of high-speed passenger railways between domestic regions
  - Development of freight railways and maritime transport between domestic regions

- **2020**
  - Development of high-speed passenger railways between domestic regions
  - Development of freight railways and maritime transport between domestic regions

- **2030**
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  - Development of freight railways and maritime transport between domestic regions

- **2040**
  - Development of high-speed passenger railways between international regions
  - Development of freight railways and maritime transport between international regions

- **2050**
  - Development of high-speed passenger railways between international regions
  - Development of freight railways and maritime transport between international regions

### International

- **2000**
  - Development of ports and airports as international hubs
  - Development of high-speed passenger railways between domestic regions

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- **2050**
  - Development of high-speed passenger railways between international regions
  - Development of freight railways and maritime transport between international regions

## Strategic Options

- **AVOID Strategy**
  - Development of ports and airports as international hubs
  - Domestic fuel tax/carbon tax
  - Replacement of business travel by online videoconferencing
  - Diesel-hybrid cargo vehicles

- **SHIFT Strategy**
  - Development of high-speed passenger railways between domestic regions
  - Development of freight railways and maritime transport between domestic regions
  - Optimization of supply chains for low carbon transport (passengers/freight)
  - Development of lightweight airplanes and biofuels
  - Optimization of ship speeds minimizing CO₂ emissions
  - Electrofication of ships

- **IMPROVE Strategy**
  - Development of ports and airports as international hubs
  - Domestic fuel tax/carbon tax
  - Replacement of business travel by online videoconferencing
  - Diesel-hybrid cargo vehicles
  - Optimization of ship speeds minimizing CO₂ emissions
  - Electrofication of ships

## Key Strategies

- **Realize future intermodal low carbon networks for interregional transport including passenger and freight railways and ports, along with inland distribution centers (dry ports), led by backcasting from the CO₂ emission reduction targets for 2050.**

- **In order to shift to low carbon interregional passenger and freight transport in Asia, for which a great increase in demand is expected as a result of economic growth, the role of industries is to construct low carbon emission supply-chain networks that make intensive use of railways and maritime transport. They also need to promote low carbon transport technologies for automobiles and airplanes.**

- **Evaluate and select the transport systems by considering their impact on CO₂ emissions. This includes not only appropriately choosing modes of travel but also consumer goods with a low carbon footprint. Use rail and water transport modes, and shorter distance transport, as much as possible even if it is not the highest speed option.**

- **Official development assistance (ODA) and other international funding mechanisms should be used to promote low carbonization of interregional transport networks based on rail and water transport in inland routes and offshore corridors.**

- **Modal choice of transport (passengers) and consumption preferences (freight) that emphasize “local production for local consumption.”**

- **Increasing preference for “slow tourism” using railways and ships.**

- **Integration of railway-track gauges in Asia.**

- **Application of standards for international transport system.**
Taxation of environmental loads requires decisions as to where to locate industries and their freight distribution systems, considering both costs and environmental loads. Consequently, regional development is generated according to the development of low carbon interregional transport systems, based on rail and water transport (AVOID Strategy). In coastal zones stretching from Japan and China to Southeast Asia, regional development based on maritime transport is promoted, and these regions are linked by low carbon transport systems such as railways and large trailers equipped with advanced technologies (SHIFT Strategy, IMPROVE Strategy). As economic growth expands from coastal regions, more industrial agglomeration also takes place in inland regions, and low carbon transport systems are introduced to link the coasts with inland regions, forming intermodal passenger and freight transport systems.

Developing countries in Asia currently have the highest rate of growth in demand for passenger air travel and international freight compared with other regions of the world. In overland freight transport within the Greater Mekong Subregion (GMS), truck transport is dominant. While domestic freight transport in China centers around railways, truck transport is on the rise for short and medium distances. International freight transport within the overall Asian region is dominated by maritime transport, which already constitutes low carbon transport. However, in terms of the demand for international passenger transport, the growth of low cost carriers (LCCs) has reduced the average airfare per unit of distance, and as a result, both demand for air transport and CO₂ emissions are increasing. The development of the global economy and the establishment of an ASEAN bloc economy in 2015 (ASEAN Economic Community: AEC) are expected to increase international travel demand above the level of domestic economic growth.

As increases in international passenger and freight demand in Asia are unavoidable, implementation of AVOID Strategy is not easy. However, it is necessary to promote development based on rail and water transport for SHIFT Strategy to take place. In passenger transport, it is effective to promote a modal shift from air transport to high-speed railways in the continental region from China to the GMS. In overland freight transport, a modal shift from trucks to rail and river transport must be promoted. On the other hand, as it is not easy to solve all problems by such modal shifts alone, the use of IMPROVE Strategy policies, such as the development of low carbon technologies for large trailers, airplanes, and ships and the development of alternative fuels, is also necessary. Furthermore, the needs for increased investments in roads and air transport infrastructure make the shift to a low carbon transport system difficult. Accordingly, investments in a low carbon transport system must be made early by setting the future vision at the initial stage of economic growth.
Study of “leapfrog policy” combinations

As in the case of inner-city transport, policies and technologies for achieving a low carbon interregional transport system can be organized systematically using the Comparative study on Urban Transport and the Environment (CUTE) matrix proposed by the World Conference on Transport Research Society (WCTRS). In interregional transport, a shift to low carbon transport modes (SHIFT Strategy) and technical innovation of transport-energy efficiency (IMPROVE Strategy) are expected to be particularly effective.

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<td>Construction of interregional high-speed railways</td>
<td>Development of low emission ships and airplanes</td>
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<td></td>
<td>Construction of coastal region development axis and transport infrastructure</td>
<td>Construction of inland interregional railways</td>
<td>Reduction of fuel consumption for airplane takeoff and landing</td>
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<td></td>
<td>Construction of inland interregional railways</td>
<td>Freight transport bases (dry ports)</td>
<td>Shift to electrically powered ships</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Shift to diesel and hybrid freight vehicles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Technical innovations for fuels (biofuels, airplane, automobile, railway, ship)</td>
</tr>
<tr>
<td>Regulatory</td>
<td>Regulations for location and development that are not based on railways or maritime transport</td>
<td>Liberalization of domestic maritime transport</td>
<td>Emissions standards</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint delivery</td>
<td>Establishment of high-carbon-efficiency vessel speeds (ships)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Promotion of railway freight transport</td>
<td>Integration of international railway track standards</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Promotion of coastal freight transport</td>
<td>Internationalization of railway track standards in Asia</td>
</tr>
<tr>
<td>Informational</td>
<td>Use of videoconferencing</td>
<td>Increased preference for “slow tourism” using railways and ships</td>
<td>Navigation systems</td>
</tr>
<tr>
<td></td>
<td>Education regarding low carbon lifestyles</td>
<td></td>
<td>Labeling of airplane and ship performance</td>
</tr>
<tr>
<td>Economic</td>
<td>Fuel taxes/carbon taxes (domestic)</td>
<td>Fuel taxes/carbon taxes (domestic)</td>
<td>Fuel taxes/carbon taxes (domestic)</td>
</tr>
<tr>
<td></td>
<td>Emissions trading (international)</td>
<td>Introduction of international funding mechanism</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Emissions trading (international)</td>
<td></td>
</tr>
</tbody>
</table>

High-speed railway development

Since the establishment of high-speed railway services in China, Korea, and Taiwan, air transport services have been suspended in the 300-600 km range due to shifting demand from air to high-speed rail. Further development of high-speed railway is planned in Thailand, Vietnam, India, and other countries.

Promotion of coastal freight transport

In the short-distance transport of high-value-added freight, SHIFT Strategy is underway from air to maritime transport (roll-on/roll-off (RORO) ships equipped with deck plates to allow trailers to roll on and roll off by themselves).

Freight transport centers (dry ports)

In Europe, the development of dry ports (inland distribution centers) has increased the volume of intermodal freight transport by facilitating the loading and unloading of goods to realize seamless transport combining railways, trucks, ships, and airplane. Dry port development plans are being considered in various parts of Asia.
Smart Ways to Use Materials that Realize the Full Potential of Resources

Production that dramatically reduces the use of resources

Resources & Materials

Use of products in ways that extend their lifespan

Development of systems for the reuse of resources
### Role of Government
Design low-carbon cities and national land based on a medium- to long-term perspective, and construct a long-lasting infrastructure. Develop systems for recycling and reusing various articles, and support studies on the effective use of resources.

### Role of Private Sector
Develop and install technological systems that reduce product weight, replace carbon-intensive materials, extend product life, and achieve recycling and reuse to provide the same services using materials that are less resource intensive and generate a smaller environmental load.

### Role of Citizens
Create a lifestyle that is less material intensive and yet offers a sense of richness. Select recyclable and reusable products that are long-lasting and less resource intensive, while changing residences at different stages of life.

### International Cooperation
Foster international cooperation in research on technical development related to the effective use of resources as well as promotion and dissemination of new technologies. Technically improve the environmental labeling system for internationally traded products.

<table>
<thead>
<tr>
<th>Year</th>
<th>Role of Government</th>
<th>Role of Private Sector</th>
<th>Role of Citizens</th>
<th>International Cooperation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>Design of low-carbon cities and national land</td>
<td>Development and active deployment of technologies for weight reduction and carbon intensive materials replacement</td>
<td>Creation of lifestyle that is less material intensive and yet offers a sense of richness</td>
<td>Cooperation in research on technological development related to effective use of resources</td>
</tr>
<tr>
<td>2010</td>
<td>Implementation of low-carbon urban and national design</td>
<td>Development and active deployment of life-extension technologies and maintenance systems</td>
<td>Change of residences at different stages of life</td>
<td>International promotion and dissemination of new technologies</td>
</tr>
<tr>
<td>2020</td>
<td>Construction of long-lasting infrastructure and support for such construction</td>
<td>Development and active deployment of technological systems for recycling and reuse</td>
<td>Selection of recyclable and reusable products that are long-lasting and less resource intensive</td>
<td>Technical improvement of environmental labeling system for internationally traded products</td>
</tr>
<tr>
<td>2030</td>
<td>Establishment and operation of organization to evaluate effectiveness of public works</td>
<td>Development and introduction of recycling and reuse systems for various products</td>
<td></td>
<td>Development of environmental load intensity database for new technologies</td>
</tr>
<tr>
<td>2040</td>
<td>Support for research on technological development related to the effective use of resources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2050</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Vision of 2050**

Infrastructure is developed efficiently under urban and national plans based on a medium- to long-term perspective. The use of materials with higher functionality and efficient product design makes it possible to provide the same services using materials that are less resource intensive and generate a smaller environmental load. Maintenance technologies and systems also improve, helping to achieve product life extension and resulting in a significant reduction in the demand for materials. Materials are recycled using clean energy, and the reuse market is growing. Such systems are supported by citizens.

**Current Situation**

Development of infrastructure of various types such as housing, transportation, communication, water supply, and sewerage is needed in rapidly developing Asian countries such as China and India, and the dissemination of durable consumer goods such as automobiles, televisions, and refrigerators as well as increased consumption of nondurable goods such as paper and food are expected. This will cause substantial growth of demand for materials with high carbon intensity such as steel, cement, and paper, leading to increased emissions of GHGs. Moreover, rapid diffusion of mitigation technologies, including solar and wind power generation, fuel cells, and storage batteries, might create a shortage of resources used for these technologies.

**Challenges**

Efficient use of resources and a dramatic reduction in demand for resources themselves are necessary for meaningful reduction of GHGs. To achieve this, infrastructure design must be based on long-term prospects at the urban and national levels. Products must be made lighter, carbon-intensive materials must be replaced, and product life must be extended to reduce resource consumption and the environmental load while providing the same services. Used products must be recycled using cleaner energy, and total demand for resources must be reduced by increasing the practice of reusing used products.
Increase in materials use in China due to economic development and possibility to reduce such materials use

The development of infrastructure, increase in diffusion of consumer durables, and higher use of consumer goods associated with economic development in many Asian countries are expected to require the use of greater amounts of steel, cement, paper, and many other materials. Such an increase in the use of materials is likely to facilitate the growth of GHG emissions associated with those materials (emissions generated from the stage of collecting natural resources to the processing and production of the materials). The percentage of such GHG emissions caused by material use in total GHG emissions is very high. Substantial reductions in the amounts of materials used will therefore contribute greatly to a decrease in total GHG emissions.

In the light of the aforementioned points, the project team has been forecasting demand for infrastructure, consumer durables, and consumer goods in Asian countries; estimating the amounts of materials used to fulfill this demand as well as GHG emissions associated with such material use; and analyzing the feasibility of dramatically reducing the amounts of material use and GHG emissions through the smart ways of using materials. The following paragraphs introduce one of a series of such case studies conducted for China.

In this case study, a model was developed to analyze material flows and stocks for cement, steel, wood, gravel, and sand used for buildings, roads, and railroads in China. Using this model, the team also estimated the amounts of materials used and waste discharged in the “business as usual” case up to 2050. In addition, changes in the amounts of materials used and waste discharged in the case of extended product life and a higher recycling rate were analyzed by assuming the same level of possession of goods as in the “business as usual” case. The results show that, despite some time required before the effects are notable, these measures are expected to have an impact from approximately 2020 and to bring about a significant reduction in the amounts of materials used by 2050.

Estimated amounts of materials used and waste discharged up to 2050 in China
Action 4

Energy-Saving Spaces Utilizing Sunlight and Wind

- Realizing of energy-saving spaces by buildings with high insulation
- Incentives for diffusing energy-efficient appliances
- Verification of energy saving efforts through third-party evaluations
Gain knowledge about environmentally friendly products and energy-efficient appliances, and purchase energy-efficient devices when buying new products. Houses that are newly constructed or renovated houses are fitted with high insulation.
Vision of 2050

“Asian” design with low energy consumption is widely disseminated among Asian countries. Such design includes wind corridors and solar insulation, and can maintain sufficient floor space while lowering energy consumption. Appliances are energy-efficient, and used effectively. Buildings have a solar photovoltaic system and solar heating system as a matter of standard. International standards for environmental performance help to visualize efforts to design and construct energy-efficient buildings.

Current Situation

Most Asian countries are located in tropical and subtropical regions, and cooling service demand in the residential and commercial sectors is relatively higher than in other regions such as Europe. Future economic development will lead to growing demand for cooling; however, building design with low energy consumption for cooling that matches the local conditions in different Asian countries are yet to be developed and widely promoted.

The diffusion rate of household and commercial appliances is expected to increase with growing electrification in Asian countries. On the other hand, the energy efficiency of such appliances in most of the Asian region is relatively lower than that in industrialized countries. Therefore, economic, financial, and institutional incentives need to be established to increase the penetration of energy-efficient appliances.

Challenges

There are some challenges to be overcome in order to construct energy-efficient buildings in Asian countries, such as the establishment of architectural design principles matching Asian climate conditions, and the introduction of performance evaluation criteria for buildings and promotion of their widespread use at the building planning stage. Reduction of the cost of energy-efficient appliances in the residential and commercial sectors is also an important challenge in order to achieve a low carbon society. To overcome these barriers, it is important for building designers, owners, and others involved to share information with each other and form a consensus on the benefits of energy-efficient buildings, and to establish institutional and political incentives as well as international support for the installation of energy-efficient appliances.
Performance indicators for buildings in Asian countries—Examples from Japan and Malaysia

It is important to evaluate the performance of energy efficiency in existing buildings and the level of energy efficiency in the building design phase by means of fair rules.

Several building evaluation indicators have been proposed throughout the world, and some of these have been incorporated in actual buildings. Indicators in Japan and Malaysia are described in this column.

One of the typical energy-efficiency indicators in Japan is the Comprehensive Assessment System for Built Environment Efficiency, or CASBEE. CASBEE considers various aspects of buildings, such as comfort, the environmental load, and energy efficiency, then gives a ranking of BEE (Built Environmental Efficiency) based on the environmental quality and environmental load. Figure 1 shows an example of analysis by CASBEE.

In Malaysia, one of the major performance indicators for buildings is the Green Building Index, or GBI. The GBI covers not only energy efficiency levels but also broader aspects of buildings such as water efficiency, materials and resources, and indoor environmental quality. GBI gives a score to buildings as shown in the following table. The total possible score is 100, and each element has a maximum number of points. For example, the energy-efficiency score is limited to a maximum of 35 points, indoor environmental quality is limited to 21 points, and so on. The GBI rating has four categories depending on the total points: certified, silver, gold, and platinum.

![Figure 1. Example of CASBEE Assessment Sheet](image)

**Performance indicators for buildings in Malaysia - the Green Building Index**

<table>
<thead>
<tr>
<th>PART</th>
<th>ITEM</th>
<th>MAXIMUM POINTS</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Energy Efficiency</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Indoor Environmental Quality</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sustainable Site Planning &amp; Management</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Materials &amp; Resources</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Water Efficiency</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Innovation</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TOTAL SCORE</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

**GREEN BUILDING INDEX CLASSIFICATION**

<table>
<thead>
<tr>
<th>POINTS</th>
<th>GBI RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>86+ points</td>
<td>Platinum</td>
</tr>
<tr>
<td>76 to 85 points</td>
<td>Gold</td>
</tr>
<tr>
<td>66 to 75 points</td>
<td>Silver</td>
</tr>
<tr>
<td>50 to 65 points</td>
<td>Certified</td>
</tr>
</tbody>
</table>

![Table 1](image)
Local Production and Local Consumption of Biomass

- Sustainable biomass utilization with sustainable food products
- Low carbon energy system using local biomass resources in rural areas
- Improvement of in-house environmental quality with modern biomass utilization
Role of Private Sector
Increasing the productivity of biomass crops through breeding supports the development and commercial production of biomass that does not compete with food production. In addition, research and development to reduce the cost of high-efficiency furnaces will promote widespread use of biomass.

Role of Citizens
Together with the government, citizens participate in sustainable land use control in order to satisfy the needs of both biomass production and food production through land use management. Citizens also control the amount of forest biomass harvested and encourage the sustainable management of forests.

International Cooperation
International organizations assist in the development of technologies for biomass energy and their utilization, and also promote transfer of best practice technologies to Asian countries based on best practices. Carbon credits for energy conversion using advanced biomass technologies and their utilization will encourage widespread use of such technologies as well as investments in the biomass field from other countries.

<table>
<thead>
<tr>
<th>Year</th>
<th>Government</th>
<th>Private Sector</th>
<th>Citizens</th>
<th>International</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>Support for dissemination of energy-efficient furnaces</td>
<td>Improvement and improved dissemination of energy-efficient furnaces</td>
<td>Knowledge sharing for advanced use of stoves</td>
<td>Establishment of financial scheme to support development and diffusion of technologies</td>
</tr>
<tr>
<td>2010</td>
<td>Policy support for technology transfers and establishment of advanced biomass technologies</td>
<td>Commercial production of biomass that does not compete with food production</td>
<td>Understanding for sustainable forest and agricultural area management and biomass production</td>
<td>Accumulation of global wisdom concerning technology transfer programs</td>
</tr>
<tr>
<td>2020</td>
<td>Formulation and implementation of land use and food production policies to avoid conflicts with biomass production</td>
<td>Promotion of research and development and technology introduction for next-generation biomass</td>
<td>Introduction of advanced biomass utilization technologies for communities</td>
<td>Sharing and dissemination of knowledge obtained</td>
</tr>
<tr>
<td>2030</td>
<td>Education on the transition from traditional to modern uses of biomass</td>
<td>Technology development for biomass CCS technology</td>
<td></td>
<td>Carbon credits for use of advanced biomass technologies</td>
</tr>
<tr>
<td>2040</td>
<td>Institutional and policy support related to the sustainable management of forests and farmland</td>
<td>Implementation of biomass CCS technologies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2050</td>
<td>Phasing out of fossil fuel subsidies</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) CCS: Carbon Capture and Storage
Vision of 2050

Rural areas have low carbon energy systems using local biomass. Biomass resources come from forest and energy crops, and a community forest and land use management system is established in order to avoid unnecessary conflict with food production in the area. Improved cooking stoves are installed in all households, contributing to energy self-sufficiency and improvement of health. Some regions export their biomass resources to other regions and companies by producing biofuels and pellets.

Current Situation

In the Asian developing countries, firewood and charcoal are one of the major energy sources for cooking and hot-water supply in the residential sector. The efficiency of utilization of such fuels is not high, and they also cause serious health problems.

Challenges

Although it is necessary to introduce advanced technologies for the energy-efficient utilization of biomass, it will take several years or possibly decades to disseminate such technologies to all Asian countries. As the first step, governments should start to disseminate existing energy-efficient technologies such as improved cooking stoves, then gradually promote the installation of more advanced technologies such as biomass boilers and methane fermentation systems. Governments should also support technology development and technology transfers from developed countries.
Improvement of living standards — Co-benefits of improving the use of biomass

In developing countries, especially in rural areas, most energy consumption is accounted for by wood burning for cooking. For example, 300 million people out of the total population of 1,200 million in India still depend on traditional biomass, and, even in 2030, it is expected that 16.5% of total energy consumption will still depend on the traditional biomass. A survey of an un-electrified rural area in the Indian state of Assam with a population of 5,958 people in 485 households has shown that 85% of energy consumption is accounted for by biomass used for cooking (see the figure below).

In areas that depend on traditional biomass, advanced biomass utilization technologies will contribute not only to economic development embodying the low carbon approach but also enhancement of the socioeconomic situation of rural areas such as improvement of health and increased job opportunities. Indoor utilization of traditional biomass generates respirable suspended particulate matter (RSPM), which is considered to be one of the causes of respiratory disease in developing countries. Women in particular are exposed to RSPM while cooking. The table below summarizes the daily time allocations for women and RSPM concentration by type of cooking and location in houses. Cooking with traditional biomass causes high exposure in the kitchen when cooking, and even in the living area the RSPM concentration is relatively higher than outdoors. Diffusion of biogas cooking equipment as well as improved cooking stoves will help to reduce the levels of exposure to RSPM throughout the entire house.

<table>
<thead>
<tr>
<th>Daily time allocations for women and RSPM concentration in India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time allocation (hours)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>RSPM concentration (µg/m³)</td>
</tr>
<tr>
<td>Traditional wood stove</td>
</tr>
<tr>
<td>Improved wood stove</td>
</tr>
<tr>
<td>Gas stove</td>
</tr>
</tbody>
</table>

4) UNDP/ESMAP, 2004. The impact of energy on women’s lives in rural India.
Low Carbon Energy System Resources

- Sustainable local energy system with renewables
- Smart energy supply and demand system
- Enhanced energy security with collaboration between low carbon energy sources and fossil fuels

Cooperation between centralized and decentralized energy systems

Decentralized and Regional Energy Supply Systems

National Electricity Grids
- Nuclear
- Hydro
- Thermal

Fossil Fuels
- Coal
- Oil
- Gas

Storage
Solar PV
Electricity
Wind
Tidal
Fuel Cell
Biomass
Hydrogen

Cooperation between centralized and decentralized energy systems
Role of Private Sector

Technological innovation in the industrial sector will accelerate low carbonization of the energy system by means of renewables. The technologies include grid control systems and smart grids with various energy sources such as renewables, cogeneration, and hydrogen. Technology innovations on the demand side are also a key to achieving a low carbon energy system. Key technologies include those for energy efficiency and demand response. The industrial sector will play a central role in consensus building among stakeholders, including households and governments, which will accelerate the diffusion of such innovative technologies.

Role of Government

Contribute mainly to the establishment of a low carbon energy system through medium- and long-term policy and planning as well as introduction of supportive regulations, which provides a clear direction to citizens as well as other countries regarding the realization of a low carbon society as a national policy. The government policy includes targeted technological and financial incentives and institutional interventions to accelerate widespread use of local renewable resources.

Role of Citizens

Choose low carbon energy (e.g. renewables) and energy efficient technologies and thereby contribute to reduced energy demand and peak shifting; alter consumption behavior such as increasing their use of non-motorized or mass transport.

International Cooperation

International bodies will promote the establishment of an Asia grid network among Asian countries by using international financing mechanisms. The development of uniform standards and infrastructure are keys to achieving the Asia grid network. In addition, to promote the international dissemination of weather information toward the use of renewable energy, targeting local areas in particular, joint development and sharing of weather information and forecasting tools are necessary to achieve a low carbon energy system in the Asian region.

<table>
<thead>
<tr>
<th>Year</th>
<th>Government</th>
<th>Private Sector</th>
<th>Citizens</th>
<th>International</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>Promotion of rural electrification – expansion of electrified areas</td>
<td>Research on high-efficiency power generation</td>
<td>Preference given to low carbon electricity sources (e.g., purchase of green electricity)</td>
<td>Development of concept of and support for Asian energy system network</td>
</tr>
<tr>
<td>2010</td>
<td>Development of a medium- to long-term low carbon energy plan</td>
<td>Development of control methods and smart grid systems making use of a wide variety of energy sources and technologies</td>
<td>Cooperation with demand management initiatives such as peak shifting</td>
<td>Unification of electric power standards at international level</td>
</tr>
<tr>
<td>2020</td>
<td>Implementation of pilot project for smart grid in Asia</td>
<td>Establishment of demand response technologies and consensus building among utility customers</td>
<td></td>
<td>Development of appropriate financial support mechanisms for Asian energy system network</td>
</tr>
<tr>
<td>2030</td>
<td>Establishment of relevant regulations</td>
<td>Technological development and implementation of hydrogen utilization technologies</td>
<td></td>
<td>Joint development and knowledge sharing of technologies and tools for weather information and forecasting</td>
</tr>
<tr>
<td>2040</td>
<td>Introduction of measures to stimulate positive attitude toward renewable energies (e.g., FIT/RPS) and automatic dissemination of renewables</td>
<td>Coping with cyber security problems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2050</td>
<td>Provision of land for CCS</td>
<td>Establishment of demand response technologies and consensus building among utility customers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FIT: Feed-in-Tariff
RPS: Renewables Portfolio Standard
Vision of 2050

Near-total electrification is achieved across Asia. While the energy supply of urban areas is provided by the core system, that of rural areas is provided by micro-grids powered by renewable energies. Through sophisticated projections of power generation and highly developed power storage technologies, the capacity for utilization of renewable energies has increased significantly. The efficiency of thermal power generation is drastically improved, and effective carbon capture and storage (CCS) is developed for widespread use.

Current Situation

The electrification rate in Asia is nearly 80%; 800 million people do not have access to electricity, particularly in South Asia. The renewable energy technologies are now penetrating in rural areas through market and policy driven dynamics, but they have not reached the stage of serving as core energy resources. While nuclear energy is being promoted as an option for low carbon and large-scale power generation, its prospects in Asia remain uncertain in the aftermath of the nuclear accident in Fukushima, Japan.

Challenges

Challenges for the future are: (1) to develop a power grid connecting all the countries in Asia, in order to improve the energy supply in each country and make flexible power interchanges possible between countries; (2) to promote a decentralized energy supply system, particularly in rural areas, besides providing a stable energy supply through micro-grids connected to the core electricity system; and (3) to facilitate the effective use of renewable energies by introducing power storage systems at the local, regional, and national levels in regions with good weather conditions.
Role of renewables toward the Asian low carbon societies

Toward the realization of the Asian low-carbon societies, it is important to utilize renewables such as solar and wind. On the other hand, since these resources are dependent on certain conditions including solar radiation, wind speed, and land use, it is necessary to understand both the natural conditions and availability of renewables in a given area.

This project assessed the renewable energy potentials of selected Asian countries, and its results are summarized in the table below, focusing on solar, wind, and biomass. The table shows physical potentials that can be determined by natural conditions. Because there are several barriers such as costs and stages of technology developments, a gap persists between technological potentials and market potentials that are effectively usable. However, compared to the projections of primary energy demands in the Asian countries as shown in the figure, the renewable energy resources shall continue to exceed the future primary energy demand. Enhancing the penetration of renewables by overcoming the economic and technological barriers will be a key to a low carbon society transition in Asian countries.

### Solar, wind, and biomass renewable energy potentials of several Asian countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Solar Potential (TWh/yr)</th>
<th>Wind Potential (TWh/yr)</th>
<th>Biomass (TWh/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grade I</td>
<td>Grade II</td>
<td>Grade III</td>
</tr>
<tr>
<td>Japan</td>
<td>0</td>
<td>465</td>
<td>39,692</td>
</tr>
<tr>
<td>China</td>
<td>434</td>
<td>32,845</td>
<td>45,610</td>
</tr>
<tr>
<td>India</td>
<td>4,255</td>
<td>46,136</td>
<td>169</td>
</tr>
<tr>
<td>Indonesia</td>
<td>5</td>
<td>1,625</td>
<td>3,699</td>
</tr>
<tr>
<td>Korea</td>
<td>0</td>
<td>3,759</td>
<td>6,604</td>
</tr>
<tr>
<td>Thailand</td>
<td>0</td>
<td>10,322</td>
<td>881</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0</td>
<td>1,243</td>
<td>2,361</td>
</tr>
<tr>
<td>Vietnam</td>
<td>0</td>
<td>1,278</td>
<td>535</td>
</tr>
<tr>
<td>Philippines</td>
<td>0</td>
<td>1,304</td>
<td>9</td>
</tr>
<tr>
<td>Singapore</td>
<td>0</td>
<td>1,180</td>
<td>776</td>
</tr>
</tbody>
</table>

### Future primary energy consumption and renewable energy potential in Asia

![Graph showing future primary energy consumption and renewable energy potential in Asia](image-url)
Low Emission Agriculture

Agriculture & Livestock

Water management in rice paddies

Highly efficient fertilizer application and residue management

Recovery and use of methane gas from livestock manure
Role of Government

Expand irrigation for water management in rice paddy and implement manure management plants for diffusion of low emission agricultural technologies. Promote the dissemination of appropriate information on fertilization. In particular, in areas with excessive reliance on fertilizers, gradually shift to the management of fertilization at the proper times and in the proper quantities.

Role of Private Sector

Adopt low carbon water management such as midseason drainage by paddy farmers and collection of manure and management of fertilizer and crop residue. Additionally, actively use the methane gas emitted from manure as energy. Positively adopt new technologies with the aim of achieving compatibility between productivity improvement and reduction of emissions.

Role of Citizens

Select locally cultivated or raised products to contribute to the vitalization of local agriculture. Display a preference for agricultural products produced by low carbon farming methods, which will enhance their market value.

International Cooperation

Promote the international joint development of low emission agricultural technologies such as improvement of feed, improvement of the productivity of livestock, technologies for paddy field management, and so on. Additionally, encourage the introduction of international certification for low carbon agricultural products and the promotion of their dissemination.

<table>
<thead>
<tr>
<th>Year</th>
<th>Role</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>Government</td>
<td>Social infrastructure for agricultural technology diffusion (irrigation, manure management systems)</td>
</tr>
<tr>
<td>2010</td>
<td>Government</td>
<td>Introductions of regulations and obligations (regulations on managements of crop residue and livestock manure, cessation excessive reliance on fertilizers)</td>
</tr>
<tr>
<td>2020</td>
<td>Government</td>
<td>Research and development of technologies considering regional specific conditions</td>
</tr>
<tr>
<td>2030</td>
<td>Government</td>
<td>Technology transfers for water management in rice paddy</td>
</tr>
<tr>
<td>2040</td>
<td>Government</td>
<td>Dissemination of technology and information on highly efficient fertilizer application</td>
</tr>
<tr>
<td>2050</td>
<td>Government</td>
<td>Development of slow-release fertilizers and reduction of their costs</td>
</tr>
<tr>
<td>2000</td>
<td>Private Sector</td>
<td>Water management in rice paddy and fertilizer management in croplands</td>
</tr>
<tr>
<td>2010</td>
<td>Private Sector</td>
<td>Utilization of methane from livestock manure</td>
</tr>
<tr>
<td>2020</td>
<td>Private Sector</td>
<td>Active participation in technical training</td>
</tr>
<tr>
<td>2030</td>
<td>Private Sector</td>
<td>Replacement of roughage by concentrate feed</td>
</tr>
<tr>
<td>2040</td>
<td>Citizens</td>
<td>Preference for agricultural products obtained by low carbon farming methods</td>
</tr>
<tr>
<td>2050</td>
<td>Citizens</td>
<td>Self-consumption of methane from manure management</td>
</tr>
<tr>
<td>2050</td>
<td>International</td>
<td>Preference for low carbon agricultural products</td>
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</tbody>
</table>

Low Emission Agricultural Technologies
Vision of 2050

Water management in paddy fields, such as midseason drainage and alternative flooding and drainage or appropriate incorporation of rice straw, is well disseminated among paddy farmers to reduce methane (\(\text{CH}_4\)) emissions. In dry fields, highly efficient fertilizer application (split fertilization, slow-release fertilizers, etc.) sharply reduces nitrous oxide (\(\text{N}_2\text{O}\)) emissions. Most livestock manure is appropriately managed, and \(\text{CH}_4\) from manure decomposition is captured and used as fuel for cooking and lighting or for generation of electricity. Improvement of livestock feed leads to reductions of ruminant \(\text{CH}_4\) emissions and improvements of livestock productivity.

Current Situation

Even though there are various sources of emission and various countermeasures in the agriculture sector, such countermeasures and information about them are not sufficiently widespread. In most countries of the Asian region, since improvement of the quality of life and economic development are high-priority issues, people tend not to pay attention to countermeasures for mitigation of climate change, with the result that information is not widely disseminated to farmers. In some countries or areas, fertilizer is distributed by the government for free or at a low price as a subsidy. This distribution of low-priced fertilizer without sufficient information may cause excessive fertilizing and increases in \(\text{N}_2\text{O}\) emissions.

Challenges

Not only technology development but also sufficient funding and enhanced information sharing are required to appropriately transfer agricultural technologies for climate change mitigation and to overcome different economic and climate conditions at the local level. Additionally, appropriate support of information and funding, development of social infrastructure and improvement of education and training of local people are required in order for farmers to implement these technologies. Systems involving the national and local governments, farmers, and companies need to be established. At the rural community level, “agriculture cooperative producer organizations” consisting of small farmers also play an important role in this action.
Various countermeasures for emission reduction in the agricultural sector

Countermeasure against CH₄ emissions from rice cultivation (midseason drainage)
Fields that are continuously flooded during the entire cultivation period cause more CH₄ emissions than fields that are not flooded the whole time. Such “midseason drainage” involves the removal of surface water from the field during the cultivation period. This is a longstanding custom to prevent root decay and increase crop yield in Japan. Moreover, alternative flooding and drainage is also applied to manage crop growth and avoid lodging. Recently, this practice has also come to be considered as a means of reducing CH₄ emissions. The compatibility of productivity improvement and control of emissions can be expected from this technique.

Countermeasure against N₂O emissions from cropland (efficient use of fertilizer)
In the soil, N₂O is generated from the biological reaction of microbes with nitrogen fertilizer applied to croplands. Avoiding excessive use of nitrogen fertilizer and increasing the efficiency of nitrogen use reduce N₂O emissions from croplands. “Split fertilization” (the application of small amounts of fertilizer several times) is considered a good practice for efficient utilization of fertilizer to meet the nitrogen demand of crops.

Countermeasure against CH₄ emissions from enteric fermentation
Ruminant livestock such as cattle and sheep are one of the sources of CH₄. Changing feedstuff from roughage (fresh forage, hay, straw, and so on) to concentrate feed containing higher energy and less fiber and water improves productivity of milk and meat and makes it possible to reduce the population of livestock. The addition of fatty acid calcium or polyphenols to feed also reduces CH₄ fermentation.

Countermeasure against CH₄ emissions from manure management
Untreated manure releases CH₄ emissions into the atmosphere due to anaerobic decomposition. Therefore, the use of CH₄ derived from manure as energy realizes compatibility between GHG emission reduction and energy supply. In some Asian countries, there are examples of simple, low-cost, and small-scale unheated digesters and tubular digesters in a hole dug underground being used to recover CH₄ from manure management, with the CH₄ mainly being consumed as fuel for cooking and lighting or for generation of electricity.
Sustainable Forestry Management

- Forest protection and effective plantation
- Monitoring and management of forest fires
- Sustainable peatland management

Forestry & Land Use
Role of Government
Implement land-use zoning and manage usage status of land for forest protection and for stopping illegal logging and unplanned land clearance. Eliminate wood products made from illegal logged timber and regulate exportation of the products. In illegal logging areas, support economic independence by enhancing the level of education of the poor, etc. Introduce licenses for plantations and land clearance to give incentive to landowners for sustainable land use.

Role of Private Sector
Operate logging and plantation on land licensed under regulations, and prevent disorderly land clearance. Manage fires lit to clear the land, and encourage the learning of forestry management skills aimed at appropriate logging and forestation and the maintenance of land after logging for forest regeneration. Abstain from illegal logging and not consume illegally logged timber.

Role of Citizens
Understand the importance and multiple functions of forestry ecosystem and manage forest at local level. Strive to select products made of certificated wood as much as possible. In deprived areas, actively participating in programs of the government, NPOs, international society, etc. and economic activities in non-forestry sectors will diversify income sources and reduce excessive dependence on forestry.

International Cooperation
Establish an international system to certificate sustainable management of biofuel production and wood production, and regulate the importation of products that do not meet the criteria. Additionally, promote international cooperation for forestation and capacity development in timber-producing areas. Introducing high efficient agricultural technologies (i.e. high-yield crop species) will contribute to reduce land clearance and deforestation.

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<thead>
<tr>
<th>Year</th>
<th>Government</th>
<th>Private Sector</th>
<th>Citizens</th>
<th>International</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>Establishment of land-use plan</td>
<td>Elimination of wood products made from illegal logged timber and use certificated products</td>
<td>Locally autonomous managements for forest resources, Strengthening of economic activities other than primary sector of industry</td>
<td>Prohibition of importation of illegally logged wood, Certification of oil palm and wood products</td>
</tr>
<tr>
<td>2010</td>
<td>Formulation and tightening of rules for land use, Classification of protection forest area, Land-use zoning</td>
<td>Logging, plantation and land clearance on land in licensed under regulations</td>
<td></td>
<td>International cooperation for afforestation and education, Sharing of monitoring facilities such as a satellites</td>
</tr>
<tr>
<td>2020</td>
<td>Introduce licenses for usage in forestland and peatlands and plantation</td>
<td>Learning of forestry management skills for appropriate logging and forestation</td>
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<tr>
<td>2030</td>
<td>Stop unplanned cropland expansion</td>
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<tr>
<td>2040</td>
<td>Enhanced control of illegal logging</td>
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<tr>
<td>2050</td>
<td>Enhance fire management</td>
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</table>
Vision of 2050

Logging and plantation is operated only on land licensed under regulations based on land-use zoning. Producers of timber and palm oil have motivation for sustainable land management. Local people understand the importance and multiple functions of the forestry ecosystem and stop most illegal logging and land clearance. Countermeasures are implemented and a robust social infrastructure is established for forest and ecosystem protection and for sustainable production of agricultural and wood products.

Current Situation

The area of forests in Asia decreased until 2000 then recently increased during the period 2000 to 2010. Even though illegal logging still continues in protected forest areas, it is difficult to implement countermeasures because the livelihoods of some local people depend on illegal logging. In addition to this, in Indonesia and Malaysia, high demand for palm oil and wood products in the global market may promote excessive logging, land clearance and deforestation for exports of such products. Emissions from peatlands and peat fire are also a serious problem in the countries concerned. Peatland drainage to expand cropland areas and peatland fires started from fires lit to clear land are major sources of the emissions from peatlands.

Challenges

Based on land use zoning including protected forests, illegal logging and land clearance must be strictly controlled. Regulations on forestry and plantations need to be appropriately implemented and an infrastructure to control licenses for plantations and land clearance should be established. Companies producing palm oil and wood products should operate plantations only on land that is licensed under the regulations. These actions will take a long time to realize, but it is essential that they will be implemented by educating and training local people in forest management and creating jobs to provide their livelihood. At the rural community level, “agriculture and forestry cooperative producer organizations” consisting of small farmers also play an important role in this action.
Various strategies related to forestry and land use change

**Afforestation/Reforestation**
Afforestation is the establishment of forest cover in an area where there was no forest. Reforestation is the reestablishment of forest cover in an area where there was forest. Under the Kyoto Protocol, both the plantations are allowed as Clean Development Mechanism. Afforestation, reforestation and forest management leads to strengthened carbon sequestration.

**Forest protection/Avoid deforestation**
Deforestation causes CO$_2$ emissions through soil disturbance. The reduction of logging and forest protection holds the carbon in the forest and reduces CO$_2$ emissions. “Avoid deforestation” is not permitted as countermeasures under the Kyoto Protocol. A new international framework including avoid deforestation may promote participation of countries with large emission from deforestation.

**Reduced impact logging**
The continued existence of degraded forests after inadequate logging causes reduction in productivity or damage to biomass growth in the future. Improved logging techniques such as suppressing the disturbance of soil when logging minimize damage to the forest, reduce CO$_2$ emissions, and increase carbon sequestration.

**Peatland management/Fire management**
Peat oxidation resulting from peatland drainage for expansion of cropland area causes CO$_2$ emissions. Fires lit to clear land can rapidly spread out of control. Peatland fires cause huge amounts of CO$_2$ emissions. Conservation and rehabilitation of peatland are essential not only for mitigation of GHG emissions but also for conservation of forest ecosystems and biodiversity.
Technology and Finance
Achievement of LCS

Stable incentives for companies to invest in technology research and development

Technology & Finance

Adequate financial support for technology diffusion

Incentives for enlightened consumers to choose low-emission products

Picture of a solar panel and a solar-powered car.
Citizens are expected to be smart consumers that purchase low carbon products even if they are more expensive than other, less environmentally friendly products. They are also expected to support government policies that give priority to the development and diffusion of low carbon technologies.

Private companies play a central role in technology development and diffusion. With the support of their governments, the industrial and commercial sectors are expected to draw attention to institutional barriers against the smooth diffusion of technology. These sectors are also expected to formulate marketing strategies to promote low carbon products.

A financial mechanism to support technological development and diffusion in the Asian region is needed. Technology information centers will contribute to the sharing of knowledge on the latest technologies. The establishment of carbon efficiency standards will promote trading of the best available carbon technologies in Asia.

### Technology and Finance to Facilitate Achievement of LCS

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<th>2000</th>
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<tr>
<td>Government</td>
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<tr>
<td>Technology development in industrialized countries</td>
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<tr>
<td>Establishment of programs for achieving green technology within science &amp; technology policies</td>
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<tr>
<td>Financial support for investments by companies</td>
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<tr>
<td>Financial support for price reduction of low carbon products</td>
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<td>Subsidies for prompt diffusion of existing low carbon products</td>
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<td>Standardization of energy/emission efficiency of products</td>
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<td>Commercialization of innovative technologies</td>
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<td>Support for large-scale projects such as CCS</td>
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<td>Establishment of technology funds</td>
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<td>Payback period by commercialization of technologies</td>
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<tr>
<td>Private Sector</td>
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<tr>
<td>Development of low-carbon technologies</td>
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<tr>
<td>Increasing investments in technology R&amp;D with government support</td>
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<tr>
<td>Publicizing of strategies to inform consumers of low carbon products</td>
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<tr>
<td>Exchanges of views with governments on institutional barriers against technology diffusion</td>
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<tr>
<td>Citizens</td>
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<tr>
<td>Smart consumers that select low carbon products</td>
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<tr>
<td>Appropriate use of low carbon products without unnecessary uses</td>
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<tr>
<td>International</td>
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<tr>
<td>Strategies to establish Asia-wide funding mechanism for technologies</td>
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<td>Capacity building toward recognition of IPR</td>
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<td>Establishment of Asian technology information centers</td>
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<tr>
<td>Asia regional ownership of innovative technologies</td>
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Vision of 2050

Gaps between countries in Asia in terms of economic development have decreased. Products of the best available technology are used in all countries. These products are subsidized, so that the prices are lower than those of products with higher GHG emissions. Low carbon businesses flourish in many countries. Private companies and research institutes compete for innovative technologies that further reduce GHG emissions. Investments for technological development are financially supported by private investments and international funding mechanisms.

Current Situation

Rapid transfer and diffusion of existing technologies, as well as the development of innovative new technologies, are indispensable for the Asian countries to achieve an LCS. Today, however, there are many factors that hamper such diffusion and development. There is a need to eliminate these hurdles, while increasing positive incentives for private companies to invest in new technology development. There is also a need for financial support for private companies and the least developing countries, to stimulate technology development and diffusion.

Challenges

The development of institutions for swift technological development and diffusion in Asia is necessary. Meanwhile, it is also essential to consider sufficient protection of intellectual property rights (IPR) and other related rights. The challenge for Asia is to achieve a society where all necessary technologies to decrease GHG emissions are diffused by 2050. Financial assistance from developed countries is not sufficient for the required investments in technological development and diffusion. All countries need to play their respective role in technological investment and diffusion.
Technology and Finance to Facilitate Achievement of LCS

What are the best institutions to promote development and diffusion of low carbon technologies?

Many initiatives have been taken at the international level since the early 2000s toward the development and diffusion of low carbon technologies. There have been strong calls for low carbon technologies not only under the United Nations Framework Convention on Climate Change (UNFCCC), but also in other forums such as the G-8, G-20, APEC, and ASEAN. Possibilities for public-private partnerships (PPPs) are also being investigated. The effectiveness of these technological initiatives, however, is viewed as unsatisfactory.

One of the reasons for the disappointing assessment of current initiatives is the existence of a large gap between technologies owned by the private sector, and government policies aimed at controlling the use of these technologies. In addition, the institutions necessary for technologies differ according to the type of technology and the stage of the technology’s life cycle (R&D stage, commercialized stage, etc.).

In the case of technologies that are still at the R&D stage, such as carbon capture and storage (CCS), institutions should focus on establishment and strengthening of technological information networks aimed at facilitating R&D. On the other hand, technologies that are already at the diffusion stage need other types of institutions. Policies in India and China to promote wind power plants, for example, are considered to be successful, but expensive royalties related to the technology are said to be a barrier to their faster diffusion. Many bioenergy-related technologies are already at the diffusion stage in Asia, but a lack of capacity in the hosting countries in terms of skilled workers and technical knowledge is considered to be another barrier against technological diffusion. In such cases, intellectual networking is needed to connect producers and host countries.

In recent years, an agreement has been reached to establish the Climate Technology Centre and Networks (CTCN) under the UNFCCC framework, and the UN Environment Programme (UNEP) has started to investigate effective institutions for such technologies. An agreement was also reached under the UNFCCC for a new financing mechanism, the Green Carbon Fund (GCF), that is expected to collect 100 billion USD a year by 2020. These mechanisms can become “hubs” of international technological cooperation, constructing a technology-promoting regime both at the multilateral and regional levels.

Examples of Technological and Financial Institutions for Each Stage in the Technology Life Cycle
Construction of a transparent and responsive administrative management framework

Corporate activities based on fair business practices

Enhancement of environmental policy and technology literacy

Governance

Renewable Energy and Energy Efficiency Partnership

Major Economies Forum

UNFCCC

International Solar Energy Society

Zero Emissions Platform

International Renewable Energy Agency

Asian Pacific Partnership

International Partnership for the Hydrogen Economy

Carbon Sequestration Leadership Forum

International Energy Agency

GEN IV Nuclear Energy Systems

Global Methane Initiative

Global Bioenergy Partnership

Global Gas Flaring Reduction Partnership

Pursuing governance that ensures LCS strategies to be envisaged and implemented by multiple stakeholders

Supports Low Carbon Asia
Based on improved literacy with respect to environmental policies and technologies, citizens have higher awareness of sustainability issues. They engage in sustainable consumption patterns, participate in policy formulation and implementation, and monitor transparency of the national and local administrations.

In order to increase the transparency and efficiency of national and local governments in Asia, international cooperation supports policy development and implementation in these countries by assisting in the realization of administrative capacity and a framework for better governance.

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<th>2000</th>
<th>2010</th>
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<tr>
<td><strong>Government</strong></td>
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<tr>
<td>Establishment and implementation of legal and institutional arrangements for fair and equal resource allocation</td>
<td>Construction of administrative framework for delivering LCS</td>
<td>Establishment of framework to ensure transparent governance</td>
<td>Provision of environmental policy and technology literacy education</td>
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<td><strong>Private Sector</strong></td>
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<tr>
<td>Establishment of fair and transparent business practices</td>
<td>Improvement of compliance with internationally agreed business and market principles</td>
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<td><strong>Citizens</strong></td>
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<tr>
<td>Behavioral changes for environmentally desirable consumption patterns</td>
<td>Advocating of policy recommendations and monitoring of administrative transparency</td>
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<tr>
<td><strong>International</strong></td>
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<tr>
<td>Creation of LCS governance indicator</td>
<td>Capacity building for technology, policy, and administrative efficiency</td>
<td>Establishment of framework for technology transfers</td>
<td>Support of management framework for improved government administration</td>
<td>Establishment of framework for policy transfers</td>
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</tbody>
</table>
**Vision of 2050**

An efficient governance management framework prevails in Asian countries. Fair and transparent decision-making processes are ensured, and thus corruption and illegal practices are excluded from governments and societies. The governance framework is designed in such a way that government personnel with higher motivation are appropriately rewarded, contributing to smoother policy implementation. Business communities and citizens at large have sustainability awareness, and a higher degree of participation in policy formulation and implementation. The improved governance leads to more international technology and financial cooperation among countries.

**Current Situation**

Currently, there are several Asian countries that have established action plans addressing a low carbon society. These plans, however, are not necessarily being implemented effectively. Due to the lack of the required legal and/or governance framework, as well as administrative transparency, physical, economic, and human resources are not effectively mobilized. The governance framework is mechanisms that ensure authorities to be accountable for better development results. The less effective governance framework often leads to a lack of information sharing among different government agencies, which results in duplicated policies.

**Challenges**

In order to improve organizational and institutional transparency, an effective administrative management framework needs to be established. International cooperation currently recognizes the importance of technology transfers, but must also emphasize the importance for building the capacity to formulate and implement policies by supporting the establishment of a governance framework in Asian countries. The aim of such international support will be to enable the governments of Asian countries to play a pivotal role in creating transparent and fair societies and markets.
Addressing the role of governance — The case of Indonesian geothermal development

Indonesia has approximately 40% of the world’s geothermal energy reserves, with 27,000 MW potential. Currently, it is ranked as one of the top five countries in the world for geothermal energy consumption, together with the U.S. the Philippines, Mexico and Italy. The Indonesian government recently established the goal of increasing geothermal resources by 9,500 MW by 2025, to make it one of the world’s largest producers of geothermal energy.

It seems, however, that the Indonesian government is at the stage of seeking to find ways to achieve the target. In order to make the geothermal target feasible, it would be important that the Indonesian geothermal roadmap specifies what policies are requested by when, and who will implement them through various policy options, spanning political, economic and social issues. For example, the issues such as reducing subsidies for fossil fuels to increase the competitiveness of geothermal energy, preparing risk hedge programs, should be considered upon formulating governance strategies to overcome the structural problems in the energy industry and to invite more players to join the Indonesian geothermal business.

In order for the Indonesian national and local governments to achieve this ambitious geothermal target, the international community is expected to play an important role in supporting the emergence of an improved governance framework to deal with the barriers ahead of the Indonesian energy transition.

Reference

Indonesia National Energy Mix 2025

The Development to 9500MW in the Year of 2025

Source: Data taken from BPPT

Source: PLN Geothermal
Low-Carbon Asia Research Project

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Cover designed by Information and Public Relations Group,
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