AIM (Asia-Pacific Integrated Assessment) project team
National Institute for Environmental Studies (NIES), Japan

Modeling Sustainable Low-Carbon Asia

Keywords: LCS Scenario, Low-carbon City, Action plans towards LCSs

Junichi Fujino, Mikiko Kainuma (NIES)

Researchers Meeting, International Research Network for Low Carbon Societies, - LCS-RNet-
1 – 2 April 2009, New Congress Center, AREA Science Park, Trieste Italy
NIES was established in 1974 in Tsukuba, Ibaraki Japan. http://www.nies.go.jp
LCS study in NIES, Japan

- FY1990- start AIM (Asia-Pacific Integrated Model) project
- FY1995- start AIM International Workshop
- FY2000 AIM provided SRES/A1B marker scenario

- FY2004-2008 NIES has coordinated Japan LCS research project funded by MOEJ
- FY2006-2008 Japan-UK joint LCS research project in collaboration with MOEJ, UK Defra, UKERC, Tyndall Centre for Climate Change

- FY2009-2013 NIES coordinates Asia LCS research project funded by MOEJ
1. Japan LCS scenarios study
Japan Low Carbon Society Scenarios toward 2050

Study environmental options toward low carbon society in Japan

Techno-Socio Innovation Study
- Green buildings
- Self-sustained city
- Decentralized services
- Eco awareness
- Effective communication
- Dematerialization
- Next generation vehicles
- Efficient transportation system
- Advanced logistics

Urban structure
- IT-society
- Transportation system
- Reduction Target study

Develop socio-economic scenario, evaluate countermeasures using econ-techno models

Long-term Scenario Development Study

GHG reduction target
- (eg. 60-80% reduction by 1990 level)
- Intervention scenario
- Valid
- Effective
- Equity
- Suitable

60 Researchers

Propose the direction of long-term global warming policy

[ FY2004-2008, Global Environmental Research Program, MOEJ ]

[http://2050.nies.go.jp]
NIES has coordinated this Japan LCS research project during FY2004-2008 in collaboration with around 60 researchers from Tokyo Univ, Kyoto Univ, TIT, TSU, Forest Research Institute, etc.
Path toward Low-Carbon Society: Japan and Asia -Results from Japan Low-Carbon Society (LCS) Scenarios Study- on February 12, 2009 in Tokyo Organized by MOEJ and NIES

1st session “The results of ‘Japan Low-Carbon Society Scenarios toward 2050’ Project”

1. Necessary volume of global and Japanese CO2 reduction for 2050 (Prof. Norichika Kanie, Tokyo Institute of Technology, Japan)
2. Japan 70% CO2 emissions reduction scenarios by 2050: Roadmap and Dozen Actions toward LCSs by Backcasting Methodology (Dr. Junichi Fujino, NIES, Japan)
3. Potential of formation of low carbon cities and its analysis (Prof. Keisuke Hanaki, The University of Tokyo, Japan)
4. Transportation in Low Carbon Society (Dr. Yuichi Moriguchi, NIES, Japan)
5. Low Carbon Society Scenario: ICT and Ecodesign (Prof. Jun Fujimoto, The University of Tokyo, Japan)
6. Wrap-up: What has been done in “Japan Low-Carbon Society Scenarios toward 2050’ Project” (Project leader Dr. Shuzo Nishioka, NIES, Japan)

All slides are available on Japan LCS study homepage: http://2050.nies.go.jp
Technology development, socio-economic change projected by historically trend

3. We need “Innovation” to realize visions

Required intervention policy and measures

Forecasting

Required

Policy intervention and Investment

Back-casting

1. “Target” is tough

Mitigation Technology development

Service demand change by changing social behavior, lifestyles and institutions

2. We need “Visions”

Normative target world

50% reductions In the world

Reference future world

Environmental pressure

Long-term target year

Release of AIM result

2000 2010 2020 2050

2020 2025

AIM result

Japan Low Carbon Society Scenarios toward 2050

[FY2004-2008, Global Environmental Research Program, MOEJ]
Emission reduction of Japan 2050: range of required reduction for 2°C target

Scenario Approach to Develop Japan Low-Carbon Society (LCS)

1. Depicting socio-economic visions in 2050
2. Estimating energy service demands
3. Exploring innovations for energy demands and energy supplies
4. Quantifying energy demand and supply to estimate CO₂ emissions
5. Checking potentials for energy supply

Achieving energy-related CO₂ emissions target
AIM (Asia-Pacific Integrated Modeling) for Japan LCS scenarios
**Visions**

we prepared two different but likely future societies for Japan

<table>
<thead>
<tr>
<th>Vision A</th>
<th>Vision B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vivid, Technology-driven</td>
<td>Slow, Natural-oriented</td>
</tr>
<tr>
<td>Urban/Personal</td>
<td>Decentralized/Community</td>
</tr>
<tr>
<td>Technology breakthrough</td>
<td>Self-sufficient</td>
</tr>
<tr>
<td>Centralized production/recycle</td>
<td>Produce locally, consume locally</td>
</tr>
<tr>
<td>Comfortable and Convenient</td>
<td>Social and Cultural Values</td>
</tr>
<tr>
<td>2%/yr GDP per capita growth</td>
<td>1%/yr GDP per capita growth</td>
</tr>
</tbody>
</table>

![Vision A and Vision B illustrations](image-url)
Visions and Innovations

LCS house in 2050
Comfortable and energy-saving house

Utilizing solar power

Photovoltaic
34-69MW
(25-47% house has PV on roof (now 1%))
and develop high efficiency (<30%) PV

Solar heating
Diffusion rate: 20-60%
currently 8%

Monitoring system
equipped with appliances

Super high efficiency air conditioner
COP (coefficients of performance=8), share 100%

Stand-by energy reduction
Reduce 1/3 energy demand, share 100%

Eco-life education
10-20% energy demand reduction

rooftop gardening

High efficiency lighting
[eg LED lighting]
Reduce 1/2 energy demand
Share 100%

High-insulation
Reduce 60% warming energy demand, share 100%

Fuel cell
share 0-20%

Heat-pump heating
COP=5 share 30-70%

Monitoring system
equipped with appliances
Good information for economy and environment makes people’s behavior low-carbon

High efficiency appliances reduce energy demand and support comfortable and safe lifestyle.
Residential sector
Energy reduction potential: 40-50%

- Change of the number of households: the number of households decrease both in scenario A and B
- Change of service demand per household: convenient lifestyle increases service demand per household
- Change of energy demand per household: high insulated dwellings, Home Energy Management System (HEMS)
- Improvement of energy efficiency: air conditioner, water heater, cooking stove, lighting and standby power
GHG 70% reduction in 2050  Scenario A: Vivid Techno-driven Society
Demand side energy -40% + Low carbonization of primary energy + CCS
with moderate cost of technological options as 0.3% of GDP in the year of 2050

- High economic growth, Increase of service demand per household, Increase of office floor (increase)
- Servicizing of industry, Decline in number of households, Increase of public transportation (decrease)
- Farm products produced and consumed in season
- Insulation
- Energy use management (HEMS/BEMS)
- Efficient heat pump air-conditioner, Efficient water heater, Efficient lighting equipment
- Development and widespread use of fuel cell
- All-electric house
- Photovoltaic
- Advanced land use / Aggregation of urban function
- Modal shift to public transportation service
- Widespread use of motor-driven vehicle such as electric vehicle and fuel-cell electric vehicle
- High efficiency freight vehicle
- Improvement of energy efficiency (train/ship/airplane)
- Fuel mix change to low carbon energy sources such as natural gas, nuclear energy, and renewable energy
- Effective use of night power / Electricity storage
- Hydrogen (derived from renewable energy) supply
- Power generation without CO2 emission
- Hydrogen production without CO2 emission
To achieve the 70% reduction goal by 2050, we investigated
- which options should be selected,
- when options should be introduced,
- how much of each option should be introduced at each stage,
with reference of candidate options as prepared.
# A Dozen Actions towards Low-Carbon Societies

**Residential/commercial sector actions**

1. **Comfortable and Green Built Environment**
   - Efficient use of sunlight and energy efficient built environment design. Intelligent buildings.

2. **Anytime, Anywhere Appropriate Appliances**
   - Use of Top-runner and Appropriate appliances.
   - Initial cost reduction by rent and release system resulting in improved availability.

**Industrial sector actions**

3. **Promoting Seasonal Local Food**
   - Supply of seasonal and safe low-carbon local foods for local cuisine

4. **Sustainable Building Materials**
   - Using local and renewable buildings materials and products.

5. **Environmentally Enlightened Business and Industry**
   - Businesses aiming at creating and operating in low carbon market. Supplying low carbon and high value-added goods and services through energy efficient production systems.

**Transportation sector actions**

6. **Swift and Smooth Logistics**
   - Networking seamless logistics systems with supply chain management, using both transportation and ICT infrastructure

**Energy supply sector actions**

7. **Pedestrian Friendly City Design**
   - City design requiring short trips and pedestrian (and bicycle) friendly transport, augmented by efficient public transport

8. **Low-Carbon Electricity**
   - Supplying low carbon electricity by large-scale renewables, nuclear power and CCS-equipped fossil (and biomass) fired plants

9. **Local Renewable Resources for Local Demand**
   - Enhancing local renewables use, such as solar, wind, biomass and others.

10. **Next Generation Fuels**
    - Development of carbon free hydrogen- and/or biomass-based energy supply system with required infrastructure

**Cross-sector actions**

11. **Labeling to Encourage Smart and Rational Choices**
    - Visualizing of energy use and CO2 costs information for smart choices of low carbon goods and services by consumers, and public acknowledgement of such consumers

12. **Low-Carbon Society Leadership**
    - Human resource development for building “Low-Carbon Society” and recognizing extraordinary contributions.
1. Comfortable and Green Built Environment

**Contribution of Building Owners**
- Selection of residential buildings with high environmental efficiency.
- Commission of low carbon design to architects and construction companies.

**Contribution of Architects, etc.**
- Development of low carbon architectural design methods. Investing for technology development in insulation technologies, etc.
- Sustenance of regional worker skills.

### Standardization Period

#### Environmental Efficiency Labeling Introduction Period

- Residential household energy demand: -40% (from FY2000 level)
- Building floor area energy demand: -40% (from FY2000 level)

### Barriers

- Complex energy-saving performance metrics, high calculation costs, insufficient personnel
- Insufficient incentives for choosing energy-saving residences and buildings

### Future Objectives

- Solar and wind utilization design
- Finance-friendly environmental efficiency
- Nurturing of worker skills & information transmission

### Timeline

- 2000: Establishment of simplified evaluation method for environmental efficiency of residences and buildings
- 2005: Dissemination of diagnosis practitioners for energy-saving and CO₂ reduction efficiencies
- 2010: Implementation and expansion of tax breaks and low interest loan financing based on the environmental efficiency label
- 2020: Introduction and expansion of residence and building labeling system for environmental efficiency (new building, renovation, mandatory indication upon leasing)
- 2030: Establishment and review of long-term energy-saving standard targets for buildings
- 2040: Nurturing of worker skills & information transmission
- 2050:...
Demonstration and publicity material of our LCS study on national-level and sub-national-level analysis
2. Asian LCS scenarios study
Path toward Low-Carbon Society: Japan and Asia
-Results from Japan Low-Carbon Society (LCS) Scenarios Study- on February 12, 2009 in Tokyo
Organized by MOEJ and NIES

2nd Session “Advancement of Low-Carbon Society Scenario Studies in Asian countries”

1. China Low Carbon Society Scenarios (Dr. Jiang Kejun, Energy Research Institute, National Development & Reform Commission, China)
2. India Low Carbon Society Scenarios (Prof. P.R. Shukla, Indian Institute of Management, India)
3. Thailand Low Carbon Society Scenarios (Prof. Ram Manohar Shrestha, Asian Institute of Technology, Thailand)
4. Implication of terrestrial carbon emissions in a LCS (Dr. Jae Edmonds, Pacific Northwest National Laboratory, USA)
5. Wrap-up “Direction of Low Carbon Asia Study (Dr. Mikiko Kainuma, NIES, Japan)

Workshop “Toward Low-Carbon Society: Japan Scenarios and Asian Challenge” on February 13, 2009 in Tsukuba

All slides are available on Japan LCS study homepage: http://2050.nies.go.jp
CO2 Emission from Energy Activities in China,
IPAC Results

- **Domestic Willing**
- **Low carbon tech and change of consumption**
- **Demonstrated by Developed Countries 70% to 80% emission reduction?**

### Graph Details

**Y-axis:** Mt-C (Metric Tons of Carbon)


- **Baseline**
- **Low Energy Policy**
- **LCS**
- **Global 50% Proposal**

Jiang Kejun (Energy Research Institute), *Low Carbon Society Scenario up to 2050 for China*
Japan Low-Carbon Society Scenarios toward, 2050 Project symposium
Measures to achieve low carbon society during 2005-2050

Cleaner Fuel Use and Environment
Friendly Public Transport System

Use of non-motorized transport systems
- shift to non-motorized transport

Master plan for compact cities
- Lowers travel demand

Public transport friendly design of cities and transport system
- modal shift, higher use of Mass Rapid Transits

Use of clean fuel and efficient vehicles
- improving efficiency and lowering carbon intensity of energy use in transport; promoting biofuels.

Energy Efficiency Improvements
(End Use and Industrial Production)

Labeling on electrical appliances

Energy auditing – promoting use of efficient technology in industries

Carbon emission labeling of industrial products
- Promoting use of low carbon products.

Low Carbon Electricity Generation

Efficient and cleaner power generation
- Promoting natural gas based advanced combined cycle power plants

Renewable Portfolio Standard (RPS)
- Biomass based power
- Solar based power

Nuclear power generation

Natural gas use in electricity generation

Building Insulation in Residential and Commercial Sector

Building codes
- Regulatory measures to lower energy use

Financial incentives through Energy Conservation Fund

Public awareness campaign
- to promote voluntary measures
Sustainable Cities: Planning and Infrastructures

- Land-use Planning
- Building Choices
- Infrastructures
- Service Networks

Bus Rapid Transport System

Technologies for Train Corridors

Low-Carbon Society Scenarios for India:

Aligning Sustainable Development and Climate Actions

P.R. Shukla, Indian Institute of Management

Japan Low Carbon Society Scenarios toward 2050 Project Symposium

Tokyo, Japan, February 12, 2009
We have just started new research project “Asian Low-Carbon Society Scenario Development Study” (project leader: Mikiko Kainuma) during FY2009-2013, funded by Global Environmental Research Program, MOEJ.
Asian Low-Carbon Society Scenarios toward 2050 (S-6)

S-6-1
Scenario Development
[NIES, Kyoto Univ.]

S-6-2
Diversity
In Asia [IGES]

S-6-3
Policy Framework
[TIT, NIES]

S-6-4
Material Flow
[NIES, Nagoya Univ.]

S-6-5
Transportation Sector
[Nagoya Univ.]

Qualitative Analysis
Quantitative Analysis

[FY2009-2013, Global Environmental Research Program, MOE]
What are the Asian low carbon societies we will design in this 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 country'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. and also utilizing effectively co-benefits of LCS policies and neighboring policies.
3. Research Collaboration, Outreach...
Japan LCS research project and Japanese CC policy

- Feb 13th 2007 Interim Report “Japan Scenarios towards Low-Carbon Society (LCS) - Feasibility study for 70% CO2 emission reduction by 2050 below 1990 level”
- May 24th 2007 Former Prime Minister Abe launched “Cool Earth 50” to reduce 50% GHG emissions by 2050
- March 2008 Japan-UK joint LCS research project released “Call for Action” to G20 in Chiba and G8 EMM in Kobe
- May 22nd 2008 Interim Report “Dozen Actions towards LCSs”
- June 9th 2008 Former Prime Minister Fukuda set the target of Japanese CO2 emissions reduction by 60-80% in 2050
Japan-UK Joint Research Project
Sustainable Low-Carbon Societies (LCSs)
(Co-chairs : Shuzo Nishioka (NIES) and Jim Skea (UKERC))

In 2006, the Governments of Japan and UK established an innovative joint research project with participation from a diverse group of some 20 countries including most G8+5 countries, Asian countries (Australia, Korea, Thailand, Nepal, Malaysia, Indonesia), African countries, and others.

Launch of the Project: 16th Feb 2006 (Anniversary of Kyoto Protocol)

Former Japanese Environment Minister Yuriko Koike and UK Ambassador to Japan Sir. Graham Fry announced the launch of the joint research of the Low-Carbon Society.

1st Workshop: June 2006
Developing Visions for a LCS through Sustainable Development

- A long-term perspective focusing on the need for urgent action to reduce CO₂ towards 2050.
- Achievement of LCS will involve the development and deployment of low carbon technologies, changes in lifestyles and institutions, and need to align with sustainable development.
1st workshop on Japan – UK Joint Research Project
Developing visions for a Low Carbon Society (LCS) through sustainable development on June 2006

Participants from 19 countries;
Asia: Japan, China, India, Thailand, Taiwan (China)
Africa: South Africa, Nigeria
Europe: UK, France, Germany, Denmark, Spain, Netherlands, Russia
Latin America: Brazil, Mexico, Chile
North America: US, Canada
2nd Workshop: June 2007  Achieving a Sustainable LCS

- A wide range of stakeholders—from government, business, and civil society need to be engaged in finding solutions.
- A significant share of GHG is due to cities. Effective Action can be and is being undertaken.

3rd Workshop: Feb 2008  Roadmap to Low Carbon World

- Creation of appropriate incentives for business using long-term policy signals to strengthen carbon pricing.
- Expanding financial flows, international cooperation in low-carbon approaches.
- Building trust between countries and stakeholders though enhancement of communication is important.

G8 Gleneagles 2005

G8 Environmental Ministerial Meeting, May 2008
G8 Japan, July 2008

“Call for Action” and WS3 “Executive Summary” were delivered to G20 in Chiba, March 14-16 2008.
Japanese Former PM outlines green 'Fukuda vision' on 9th June 2008 pledged to cut of 60-80 per cent of greenhouse gas emissions based on current levels by 2050 in Japan.

Side Event at UNFCCC/COP

• COP11 (2005), “Global Challenges Toward Low-Carbon Economy -Focus on Country-Specific Scenario Analysis-”
• COP12 (2006), “Global Challenges toward Low-Carbon Society (LCS) through Sustainable Development (SD)”
• COP13 (2007), “Low-Carbon Asia: To be or not to be”
• COP14 (2008), “Sustainable Low-carbon Asia: How can it change the post-2012 climate negotiations?”
• COP15 (2009), …
We support country-wise LCS modeling through SD for Asia-Pacific and the world

- We have continued AIM Training Workshops since 1997 -

2008 AIM Training Workshop
Oct 20-31, 2008 at Tsukuba

India  China  Thailand  Korea  Malaysia  Indonesia  Brazil  Russia  South Africa  Taiwan, China  USA  Japan

http://2050.nies.go.jp
Expectations on LCS-RNet:
“How to deploy our study to real world?”

- **Policy makers**
  - Proposal/collaborative activity on LCS scenario and roadmap making

- **Central/ regional government managers**
  - Request of more practical, realistic roadmaps and also tractable tools for real world

- **NGOs**

- **Research members**
  - Each country’s domestic/local research institute
  - Application and development to actual LCS processes
  - Development and maintenance of study tools/models
Designed by Hajime Sakai (airbox-pin@nyc.odn.ne.jp)
## Focused points in this modeling study

In this study, with models, quantification and consolidation of the following points are focused, and they are reflected in LCS roadmaps using the back-casting model.

<table>
<thead>
<tr>
<th></th>
<th>Issues</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Accumulation and deepening processes of the next five capitals.</td>
<td>How to integrated in LCS roadmaps with engineering/economic/financial/institutional rationality?</td>
</tr>
<tr>
<td></td>
<td>1) Energy infrastructure and technology, 2) Urban infrastructure, 3) Human capital, 4) Institution, 5) Social capital</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Resolution of urban and rural disparity, energy-poverty nexus.</td>
<td>Realization of renewable energy society, and leapfrogging to new rungs on the energy ladder</td>
</tr>
<tr>
<td>3</td>
<td>Development and specialization of industrial structure, external dependency and vulnerability of the region.</td>
<td>Trend-breaking to new material/energy efficient, economically robust, and endogenously developing industrial system</td>
</tr>
<tr>
<td>4</td>
<td>Deployment of urban and inter-urban traffic systems.</td>
<td>How to realize comfortable Asian compact cities?</td>
</tr>
<tr>
<td>5</td>
<td>Regional climate characteristics, building characteristics and lifestyle..</td>
<td>Harmonization and merging of appropriate life and building style, e.g. Asian vernacular habitation, modern highly insulated material intensive building, …</td>
</tr>
<tr>
<td>6</td>
<td>Potentials of renewable energy resources, and developments of their utilizing facilities.</td>
<td>Integration of natural conservation, regional tradition, renewable energy deployment, and energy security</td>
</tr>
</tbody>
</table>
Two stages of LCS scenario development and where to apply three model groups

**Stage 1: Design of a Low Carbon Society**

1. Creation of narrative storylines of future Low Carbon Societies
2. Description of sector-wise details of the future LCSs.
3. Quantification of the Macro-economic and social aspects of the LCSs.
4. Identification of effective policy measures and packaging them

**Stage 2: Putting them together and design roadmaps towards LCS**

1. Design of policy roadmaps toward the Low Carbon Society
2. Feasibility analysis of the roadmaps considering uncertainties involved in each policy option
3. Analysis of robustness of the roadmap caused by social, economical and institutional acceptability and uncertainties

**Group 1: Element models;**

1) Snapshot models;
   - cge[country]: Quasi steady computable general equilibrium (CGE) model
   - enduse[country]: Energy technology bottom-up models
   - ESM: Energy supply model
   - HPLM: Household production/lifestyle model
   - TDM: Transportation demand model

2) Transition models;
   - PHM: Population and household model
   - BDM: Building dynamics model
   - MSFM: Material stocks and flow model
   - EME: Econometric type macro-economy model

**Group 2: Extended Snapshot Tool (ExSS)**

**Group 3: Backcasting Model for roadmap design and transient control (BCM)**
Estimated results on potential CO₂ emission reduction in the urban area by HP, CGS and DHC with wheeling (aggregated by prefecture)

<table>
<thead>
<tr>
<th>Prefecture</th>
<th>Potential CO₂ reduction rate</th>
<th>Prefecture</th>
<th>Potential CO₂ reduction rate</th>
<th>Prefecture</th>
<th>Potential CO₂ reduction rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hokkaido</td>
<td>16.6%</td>
<td>Ishikawa</td>
<td>18.1%</td>
<td>Okayama</td>
<td>18.1%</td>
</tr>
<tr>
<td>Aomori</td>
<td>17.5%</td>
<td>Fukui</td>
<td>17.5%</td>
<td>Hiroshima</td>
<td>18.6%</td>
</tr>
<tr>
<td>Iwate</td>
<td>16.0%</td>
<td>Yamanasi</td>
<td>17.9%</td>
<td>Yamaguti</td>
<td>18.0%</td>
</tr>
<tr>
<td>Miyagi</td>
<td>18.7%</td>
<td>Nagano</td>
<td>17.9%</td>
<td>Toskushima</td>
<td>18.0%</td>
</tr>
<tr>
<td>Akita</td>
<td>15.9%</td>
<td>Gifu</td>
<td>16.5%</td>
<td>Kagawa</td>
<td>21.7%</td>
</tr>
<tr>
<td>Yamagata</td>
<td>17.1%</td>
<td>Shizuoka</td>
<td>21.0%</td>
<td>Ehime</td>
<td>18.8%</td>
</tr>
<tr>
<td>Hukusima</td>
<td>18.2%</td>
<td>Aichi</td>
<td>23.7%</td>
<td>Kochi</td>
<td>16.7%</td>
</tr>
<tr>
<td>Ibaragi</td>
<td>20.9%</td>
<td>Mie</td>
<td>19.3%</td>
<td>Fukuoka</td>
<td>24.3%</td>
</tr>
<tr>
<td>Tochigi</td>
<td>18.1%</td>
<td>Shiga</td>
<td>19.7%</td>
<td>Saga</td>
<td>19.6%</td>
</tr>
<tr>
<td>Gunma</td>
<td>20.7%</td>
<td>Kyoto</td>
<td>19.0%</td>
<td>Nagasaki</td>
<td>19.1%</td>
</tr>
<tr>
<td>Saitama</td>
<td>25.3%</td>
<td>Oosaka</td>
<td>30.0%</td>
<td>Kumamoto</td>
<td>18.5%</td>
</tr>
<tr>
<td>Chiba</td>
<td>21.6%</td>
<td>Hyogo</td>
<td>19.8%</td>
<td>Oita</td>
<td>17.0%</td>
</tr>
<tr>
<td>Tokyo</td>
<td>30.4%</td>
<td>Nara</td>
<td>22.2%</td>
<td>Miyazaki</td>
<td>17.5%</td>
</tr>
<tr>
<td>Kanagawa</td>
<td>29.5%</td>
<td>Wakayama</td>
<td>18.6%</td>
<td>Kagoshima</td>
<td>17.9%</td>
</tr>
<tr>
<td>Niigata</td>
<td>17.5%</td>
<td>Tottori</td>
<td>18.7%</td>
<td>Okinawa</td>
<td>21.9%</td>
</tr>
<tr>
<td>Toyama</td>
<td>18.4%</td>
<td>Shimane</td>
<td>16.3%</td>
<td>Japan</td>
<td>18.6%</td>
</tr>
</tbody>
</table>

### 2050Vision: Passenger transport

<table>
<thead>
<tr>
<th>Transportation system</th>
<th>Metro Urban</th>
<th>Metro Suburb</th>
<th>Provincial Urban</th>
<th>Provincial Rural</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact neighborhood</td>
<td>△ Rehabilitation</td>
<td>○ Rehabilitation</td>
<td>△ Rehabilitation</td>
<td>○ Compact Settlement</td>
<td>112→33Mt</td>
</tr>
<tr>
<td>Compact city</td>
<td>△ City center renewal</td>
<td>△ Withdrawal</td>
<td>△ City center renewal</td>
<td>×</td>
<td>To 1990 − 70%</td>
</tr>
<tr>
<td>Improve load efficiency</td>
<td>△ Utilize small vehicles</td>
<td>△ Enhance sharing</td>
<td>×</td>
<td>Including (Inter-city Passenger: 30km−)</td>
<td></td>
</tr>
<tr>
<td>Improve fuel consumption</td>
<td>○ Urban mode</td>
<td>○ local mode</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low carbon energy</td>
<td>△ less room for improve</td>
<td>○ biofuel, Low Carbon Electricity for EV and PHEV etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pop(million)</td>
<td>46→40</td>
<td>15→12</td>
<td>27→20</td>
<td>35→23</td>
<td>124→94</td>
</tr>
<tr>
<td>t−CO₂/capita</td>
<td>0.66→0.27</td>
<td>0.94→0.35</td>
<td>1.03→0.38</td>
<td>1.11→0.51</td>
<td>0.90→0.35</td>
</tr>
</tbody>
</table>

## Positive Against Negative Impact of ICT

### CO2 reduction of 2 to 3% in 2010

<table>
<thead>
<tr>
<th>Industry</th>
<th>Freight transport</th>
<th>Passenger transport</th>
<th>Office</th>
<th>Home</th>
<th>Recycling</th>
<th>Impact on CO2 emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diffusion of ICT equipment</td>
<td>Resource</td>
<td>Electric</td>
<td>Transport</td>
<td>Waste</td>
<td>Negative II</td>
<td>+1 to 2%</td>
</tr>
<tr>
<td>Supply chain management (B2B)</td>
<td>Resource</td>
<td>Resources</td>
<td>Number of shops</td>
<td>Electric power</td>
<td>Positive I</td>
<td>-3%</td>
</tr>
<tr>
<td>Internet shopping (B2C)</td>
<td>Resource consumption</td>
<td>Resource consumption</td>
<td>Number of shops</td>
<td>Electric power</td>
<td>Negative/Positive</td>
<td>-1%</td>
</tr>
<tr>
<td>Teleworking</td>
<td>Transport</td>
<td>Number of shops</td>
<td>Electric power</td>
<td>Positive III</td>
<td>-1%</td>
<td></td>
</tr>
<tr>
<td>Advanced traffic utilization system (modal shift in commuting, etc.)</td>
<td>Transport</td>
<td>Energy consumption</td>
<td>Positive II</td>
<td>-1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dematerialization system (newspaper, magazine, and CD)</td>
<td>Resource consumption</td>
<td>Transport</td>
<td>Number of shops</td>
<td>Positive III</td>
<td>-2%</td>
<td></td>
</tr>
<tr>
<td>Energy management (HEMS, REMS)</td>
<td>Energy consumption</td>
<td>Transport</td>
<td>Number of shops</td>
<td>Positive II</td>
<td>+10%</td>
<td></td>
</tr>
<tr>
<td>Eco-life guidance</td>
<td>Resource consumption</td>
<td>Power</td>
<td>Power</td>
<td>Positive I</td>
<td>-1%</td>
<td></td>
</tr>
<tr>
<td>A product and manufacture management</td>
<td>Resource consumption</td>
<td></td>
<td></td>
<td></td>
<td>Positive I</td>
<td>-1%</td>
</tr>
<tr>
<td>Recycling information system</td>
<td>Resource consumption</td>
<td></td>
<td>Waste</td>
<td>Negative/Positive</td>
<td>-1 to -2%</td>
<td></td>
</tr>
<tr>
<td>E-government</td>
<td>Transport</td>
<td></td>
<td>Wastes</td>
<td>Positive III</td>
<td>-1 to -2%</td>
<td></td>
</tr>
</tbody>
</table>

### CO2 reduction of 10% in 2050