Low Carbon Development Plan In Japan

1. If we cannot go to LCS,…
2. LCS offers higher QOL with less energy demand and lower-carbon energy supply
3. LCS needs good design, early action, and innovations

Junichi FUJINO (fuji@nies.go.jp)
NIES (National Institute for Environmental Studies), Japan
Workshop on A Systematic and Quantitative Design of Low Carbon Development Plan for Cambodia
Phnom Penh, 22 April, 2013

Designed by Hajime Sakai
Japan LCS study by AIM

1990  start AIM (Asia-Pacific Integrated Model) project

1997  COP3 simulations (very hard battle with…)

2004-2008 NIES has coordinated Japan LCS research project funded by MOEJ (led by Prof. Shuzo Nishioka with 60 team members)

2008-2009 COP15 simulations (AIM/Enduse[Japan], AIM/CGE[Japan], AIM/Enduse[global])

2009- Middle and Long term roadmap development under MOEJ (led by Prof. Shuzo Nishioka with 8 working groups and more than 100 experts)

2011- Revision of “Energy and Climate Change Policy” by cabinet office together with METI and MOEJ (with AIM)
2004-2008

Japan LCS research project
Research project on Japan Low-Carbon Society (LCS) scenarios development FY2004-2008 sponsored by Ministry of the Environment, Japan

5 teams: Scenario, Criteria, ICT, Transportation, Urban
Technology development, socio-economic change projected by historically trend

Forecastsing from now and Backcasting from future prescribed/normative world

1. "Target" is tough
2. We need "Visions"
3. We need "Innovation" to realize visions

Environmental pressure

Long-term target year

Reference future world

Required intervention

Mitigation Technology development

Service demand change by changing social behavior, lifestyles and institutions

3. We need "Innovation" to realize visions

required intervention policy and measures

Checking year(2015)

Checking year(2025)

Release of AIM result

50% reductions in the world
Scenario Approach to Develop Japan Low-Carbon Society (LCS)

Step 1: Depicting socio-economic visions in 2050

Step 2: Estimating energy service demands

Step 3: Exploring innovations for energy demands and energy supplies

Step 4: Quantifying energy demand and supply to estimate CO₂ emissions

Step 5: Checking potentials for energy supply

Achieving energy-related CO₂ emissions target
As for LCS visions, we prepared two different but likely future societies.

<table>
<thead>
<tr>
<th>Vision A “Doraemon”</th>
<th>Vision B “Satsuki and Mei”</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</td>
<td>Produce locally, consume locally</td>
</tr>
<tr>
<td>/recycle</td>
<td></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>

Doraemon is a Japanese comic series created by Fujiko F. Fujio. The series is about a robotic cat named Doraemon, who travels back in time from the 22nd century. He has a pocket, which connects to the fourth dimension and acts like a wormhole.

Akemi Imagawa

Satsuki and Mei’s House reproduced in the 2005 World Expo. Satsuki and Mei are daughters in the film "My Neighbor Totoro". They lived in an old house in rural Japan, near which many curious and magical creatures inhabited.
Utilizing solar power

Photovoltaic
- Monitoring system equipped with appliances
- 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%)

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%

Good information for economy and environment makes people’s behavior low-carbon

High efficiency appliances reduce energy demand and support comfortable and safe lifestyle

LCS house in 2050
Comfortable and energy-saving house
AIM (Asia-Pacific Integrated Modeling) for Japan LCS scenarios

Energy supply & demand:
- Residential sector
- Commercial sector
- Transportation sector
- Industrial sector
- Energy supply sector

Stock:
- Material stock & flow model
- Building dynamic model

Activity:
- Household Prd. & lifestyle model
- Residential energy service model
- Commercial energy service model
- Passenger Trns. demand model
- Freight Trns. demand model
- Industrial production model

Macro economy:
- Population and household model
- Population Labor
- Investment
- Efficiency

Check consistency!

Model:
- Backcast Model

Data flow:
- Energy supply model
- Environmental option database, Bottom-up engineering model
- Energy Snapshot Tool
Residential sector

Energy demand reduction potential: 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

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
Energy demands for achieving 70% reduction of CO$_2$ emissions

Secondary Energy Demands (Mtoe)

Possible energy demands reductions for each sector:
- Industry: structural change and introduction of saving energy tech. 20~40%
- Passenger Transport: land use, saving energy, carbon-intensity change 80%
- Freight Transport: efficient transportation system, energy efficient 60~70%
- Residential: high-insulated and energy-saving houses 50%
- Commercial: high-insulated building and energy saving devices 40%
Energy supply for achieving 70% reduction of CO₂ emissions

Primary Energy Consumption (Mtoe)

2000(Actual)

- Coal
- Oil
- Gas

2050(Scenario A)

- Coal
- Oil
- Gas
- Nuclear

2050(Scenario B)

- Coal
- Oil
- Gas
- Biomass
- Nuclear
- Solar and Wind

Centralized style
Decentralized style
Micro grid

Coal  Oil  Gas  Biomass  Nuclear  Hydro  Solar and Wind
Japan LCS research project and CC policy

0. FY1990- start AIM (Asia-Pacific Integrated Model) project
   ▶ FY1997 AIM provided Kyoto Protocol simulations for Japan
   ▶ FY2000 AIM provided IPCC SRES/A1B marker scenario

1. 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
   ▶ June 9th 2008 Former Prime Minister Fukuda set the target of Japanese CO2 emissions reduction by 60-80% in 2050


3. April 2009, The Mid-term Target Committee, “six options for 2020” (including 7%, 15%, 25% reduction compared as 1990 level)
   ▶ September 22nd 2009, New Prime Minister Hatoyama set the target as 25% for 2020.
2008-2011 LCS Middle (2020) and Long (2050) term strategy and roadmap for COP15 and further
Japanese Emissions Targets towards 2050

- Kyoto Protocol during 2008-2012
  (Sink 3.8%, credit 1.6 %)
- 25% in 2020
  (incl. credit? )
- 80% in 2050

Former Prime Minister Hatoyama 鳩山由紀夫
An 80% emission reduction by 2050 will create a largely different society from today. It will be critical to strategically move forward under mid-term 2020 and 2030 targets that take into account this eventual 80% reduction.

1) Parenthesis indicates the age of which persons born in each respective year will be in the year 2050
2) Future GDP values are assumed values based on scenarios A and B from the NIES Low Carbon Society Research Project 2050
Interactions between simulations and policy assessments

- The model calculations maintain the overall alignment of the path, and the estimated volume of emissions and economic impact are evaluated.
- The overall review panel / WG examines a specific plan that will enable reductions in each field.

Premise for the Macro-frame

Model calculations

At time of November 11 task force

Suppositions for the introduction of countermeasures, etc.

Display as rough draft

Case setting for 2020 estimate
- 25% (1): including about 10% of international contribution and sinks
- 25% (2): including about 5% of international contribution and sinks
- 25% (3): Not including international contribution and sinks

Model calculations

Checking of consistency

Examination results

Examination of specific plan

Social and economic impact

Volume of emissions
Volume of reduction

Necessary promotion policy
CO2 originating from power generation

Before shift (direct emissions)

After shift (indirect emissions)

Volume of greenhouse gas emissions
(100 million tons of CO2 in 2007)
地球温暖化対策に係る中長期ロードマップのまとめにより、各WGの現時点での

平成22年12月21日
Without nuclear, we have to depend much on renewable energy and CCS (Carbon Dioxide Capture and Storage). Possibility depend on how we design Japanese future. Service oriented society can achieve 80% reduction with domestic CCS but industry oriented society needs foreign CCS.
Analysis by AIM/Enduse in Japan

Final energy consumption in 2030 (low growth case)

- **Transport**
  - EV/HV: 70 to 90% of new car sales
  - About 40% improvement of freight vehicle efficiency
  - Eco-driving in practice: 15 to 40% (passenger), 25 to 55% (freight)

- **Commercial**
  - Ensure all newly built homes and buildings use advanced insulation and energy saving designs/features
  - High-efficiency water heater: 75 to 90% in households, 40 to 90% in commercial building
  - Home/Building energy management system
  - PV power: 28 Mil. kW in households, 38 to 73 Mil. kW in commercial building

- **Residential**
  - Commercialization and popularization of best-available-technology
  - Fuel conversion to natural gases

- **Industry**

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Final Energy Consumption (Million kL of Oil Equivalent)

- '90: 359
- '05: 413
- '10: 387
- 2030: 369
  - Fixed: 328
  - Low: 309
  - Medium: 298
  - High:
Mitigation cost curve in Japan to take aggressive emissions reductions options by 2030

削減量（千トンCO2）

Longer-term investment

Shorter-term investment

削減費用(円/tCO2)

The result by AIM/Enduse[Japan]
As for the investment amount for global warming, half of the overall investment amount will be collected by 2020 and an amount equal to the investment amount will be collected by 2030 based on energy expenses that can be saved through technologies introduced.

Relationship between low-carbon investment amount and energy reduction expense

<table>
<thead>
<tr>
<th>Year</th>
<th>Energy saving investment through 2020</th>
<th>Volume of reduction from energy saving technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
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<tr>
<td>2020</td>
<td></td>
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<tr>
<td>2025</td>
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<tr>
<td>2030</td>
<td></td>
<td></td>
</tr>
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</table>

Energy saving investment through 2020

Volume of reduction from energy saving technologies

In the case of device with 10 year lifespan

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

Energy reduction expense from energy saving investment = approx. 51 trillion yen (25% reduction (3))

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Simulation results provided in June 2012

For discussion on future energy and mitigation plan after accident at Fukushima dai-ichi nuclear power plant of TEPCO.

Cumulative additional investment by 2020 and 2030
[Results from Enduse]

Macro economic impact compared to reference case in 2030,
Low economic growth case
[Results from CGE]

CGE can use any values as parameters, but by using Enduse results, more realistic values are available.

0%*: Nuclear will be 0% in 2020.
2011.3.11-

Revision of Energy and Climate Change Policy
Post-Fukushima Japan: Response to power deficiency

Energy consumption in Tokyo electric power company (9am-21pm)

Ex) energy consumptions in 30 degrees (2010=100)
2011=84
2012=84

Energy consumption in Kansai electric power company (9am-21pm)

Ex) energy consumptions in 30 degrees (2010=100)
2011=95
2012=86

Presentation by the Center for Low Carbon Society Strategy, the Japan Science and Technology Agency (JST), July 2012
### Energy reductions in maximum peak demand in 2011 compared to 2010

Maximum peak demand (kW) - week days from 9:00-20:00

<table>
<thead>
<tr>
<th></th>
<th>Tokyo electricity Company (w/o regard to temp.)</th>
<th>Tokyo electricity Company (with regard to temp.)</th>
<th>Tohoku electricity company (w/o regard to temp.)</th>
<th>Kansai electricity company (w/o regard to temp.)</th>
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<tbody>
<tr>
<td>Reduction target of peak demand</td>
<td>-15% (2011)</td>
<td>-</td>
<td>-15% (2011)</td>
<td>-10% (2011&amp;2012)</td>
</tr>
<tr>
<td>Large electricity customers</td>
<td>-29% (▲600)</td>
<td>-27%</td>
<td>-18%</td>
<td>-9%</td>
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<td>Small electricity customers</td>
<td>-19% (▲400)</td>
<td>-19%</td>
<td>-20%</td>
<td>-10%</td>
</tr>
<tr>
<td>Household</td>
<td>-6% (▲100)</td>
<td>-11%</td>
<td>-22%</td>
<td>-14%</td>
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<tr>
<td>2011 Total (July-Sept)</td>
<td>-18%</td>
<td>-</td>
<td>-15.8%</td>
<td>-10%</td>
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<tr>
<td>2012 Total (July-Aug)</td>
<td>Under calculation (Jul: -6.4% from 2011)</td>
<td>-</td>
<td>Under calculation (Jul: +0.1% from 2011)</td>
<td>-11.1% (Jul: -10.6% from 2011)</td>
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</table>

Source: IGES 2011 using data from METI etc

Supply-Demand gaps
- Expected shortage of supply was 6.2GW
- Set up 15% reduction target in peak demand
- As a result, achieved totally 18% (10.77GW) reductions compared to 2010 summer

Maximum peak demand (kW) - week days from 9:00-20:00

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</tbody>
</table>

Source: IGES 2011 using data from METI etc
Response to power deficiency by sector

**Tokyo electric power company**
- Before 3.11
- After 3.11
- Gap: 2700000 MWh

**Large consumer**
- Gap: 1700000 MWh

**Household**
- Gap: 2000000 MWh

**Others (Commercial)**
- Gap: 2500000 MWh

Source: IGES 2011 using data from METI
Demand measures of summer in 2011

Large consumer

• L/c voluntarily develop and implement a plan to reduce energy use during a peak demand (Such as shift adjustment of operation and business)
• Gov. invoked Article 27 of the Electricity Business Act (Limit electricity use)

Small consumer

• Gov. provided a list of energy-saving measures as examples (energy-saving of lighting, air conditioning, OA (office automation))
• Gov. promoted s/c to develop and announce voluntary energy conservation action plan (Provided a format)
• Gov. operated door-to-door visits and briefings

Household

• Gov. provided the list of energy-saving measures for households
• Gov. called for the implementation of energy saving through media etc
• Gov. distributed education materials about “energy-saving” to elementary and junior high schools

Cross-cutting

• Gov. conducted energy-saving public campaign through various media
• Visualization of electric power supply and demand data (Electricity Forecast)
• Gov. announced the info of the tight power supply and demand

Source: METI 2012
April 2012 in Fukushima
Demand side

Reconsider how much satisfaction we can get thorough energy

How to increase service level with less service input

Energy saving technology

Clean energy supply technology

Supply side

Secondary energy × Primary Energy × CO₂ emission = CO₂ Emissions

Efficient energy conversion tech

Low CO₂ energy input
Examples of QOL improvement

Effect to prevent disease

Impact of High insulation building

<table>
<thead>
<tr>
<th>disease</th>
<th>rate (%)</th>
<th>before</th>
<th>after</th>
</tr>
</thead>
<tbody>
<tr>
<td>アレルギー性鼻炎</td>
<td>28.9</td>
<td>21.0</td>
<td></td>
</tr>
<tr>
<td>アレルギー性結膜炎</td>
<td>13.8</td>
<td>9.3</td>
<td></td>
</tr>
<tr>
<td>アトピー性皮膚炎</td>
<td>8.6</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>気管支喘息</td>
<td>7.0</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td>高血圧性疾患</td>
<td>6.7</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>関節炎</td>
<td>3.9</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>肺炎</td>
<td>3.2</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>糖尿病</td>
<td>2.6</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>心疾患</td>
<td>2.0</td>
<td>0.4</td>
<td></td>
</tr>
</tbody>
</table>

※アンケート調査等に基づくものであり、医学的検証は必ずしも十分ではない
(出典) 伊香賀俊治、江口里佳、村上周三、岩前篤、星旦二ほか:健康維持がもたらす間接的便益(NEB)を考慮した住宅断熱の投資評価、日本建築学会環境系論文集、Vol.76、No.666、pp.735-740、2011.8

このスライドは住宅・建築物WGとりまとめ資料を元に作成

Effect to temperature level

Temperature without warming devices after East Japan earthquake (2011.3.11)

<table>
<thead>
<tr>
<th>熱損失係数Q (W/m²•K)</th>
<th>H11年基準以上</th>
<th>H11年基準未満（Ⅱ・Ⅲ地域）</th>
<th>H11年基準未満</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3.0</td>
<td>2.5</td>
<td>2.0</td>
</tr>
<tr>
<td>0.5</td>
<td>2.5</td>
<td>2.0</td>
<td>1.5</td>
</tr>
<tr>
<td>1</td>
<td>2.0</td>
<td>1.5</td>
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<tr>
<td>1.5</td>
<td>1.5</td>
<td>1.0</td>
<td>0.5</td>
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<tr>
<td>2</td>
<td>1.0</td>
<td>0.5</td>
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<tr>
<td>2.5</td>
<td>0.5</td>
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<td>3</td>
<td>0.0</td>
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<tr>
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<td></td>
<td></td>
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</tr>
</tbody>
</table>

※1: アンケート結果一覧をもとに作成。室温の回答に幅がある場合は、平均値を採用。なお、H11年基準未満の住宅のQ値は、H4年基準レベルと仮定。
※2: 青森、岩手、宮城の3県において、3月に実施した調査の結果。グラフには、調査戸数54件のうち、停電後1〜5日間の室温に関して定量的な回答があったもののみを記載。なおアンケート回答により、外気温は-5〜-8℃程度と推測
(出典) 香港三、(2011)、「ライフラインが断たれた時の暖房と室温低下の実態調査」、(財)建築環境・省エネルギー機構 CASBEE-健康チェックリスト 委員会資料より作成
Expectations on Cambodia and Japan: “How to deploy LCS study to real world?”

Policy makers
Central/ regional government managers
NGOs

Proposal/ collaborative activity on LCS scenario and roadmap making

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

Each country’s domestic/local research institute
Application and development to actual LCS processes

Development and maintenance of study tools/models

Research members
LCS is Risk Management

• We always face to risks if we are alive.
• Global warming is one of risks in our daily life, but it might become one of the huge/ biggest risks in some future…
• Overshoot (expect future technology development) / Early Action (Stern Review)
• Short-term Sweet (Benefit) / Long-term Legality
• Neo Liberalism / Eco Modernization -> Smart Regulation
• Crisis = 危(danger) + 機(chance)
• 創(create) 新(something new) = Innovation
• Sense of Urgency for Good Design of our Society
Sustainable Low-Carbon Asia comes from design, imagination and co-working...

Let’s work together!

Asia LCS

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