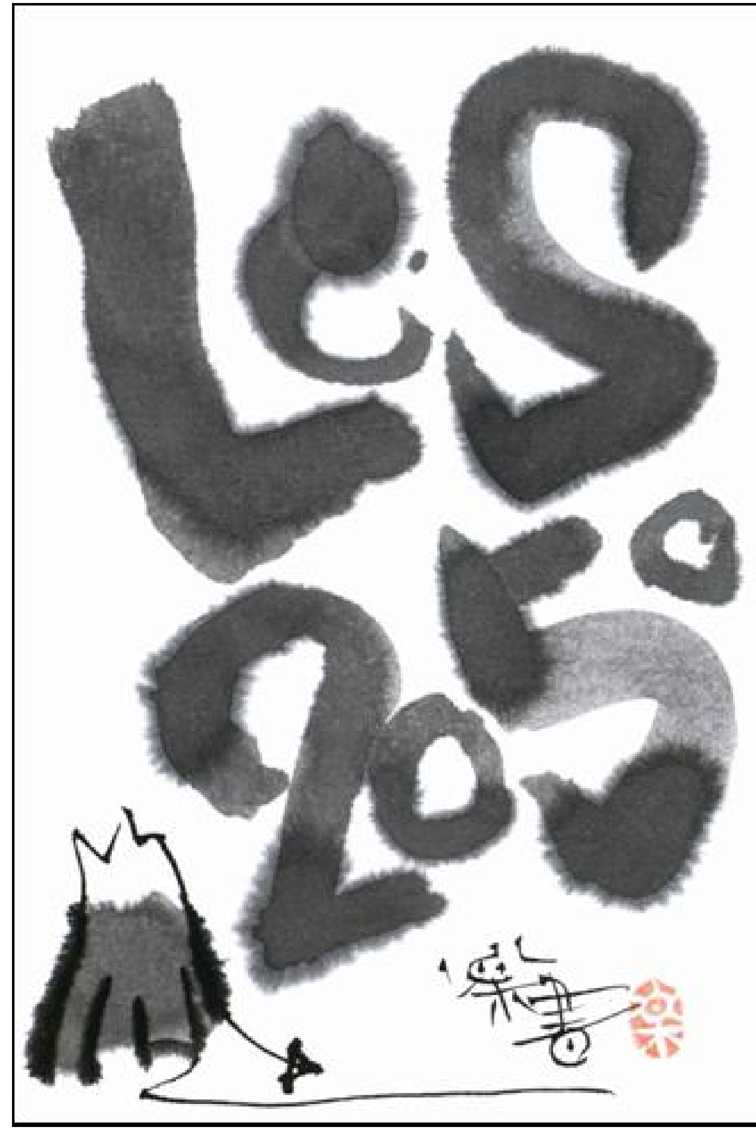
# Purpose of this workshop and Introduction of Japan Scenario



Designed by Hajime Sakai

**Junichi Fujino (fuji@nies.go.jp)**

NIES (National Institute for Environmental Studies), Japan

2007 AIM Training Workshop, October 22, 2007

# We support country-wise LCS modeling through SD for Asia-Pacific and the world

Japan Low Carbon Society 2050

## - We have continued AIM Training Workshops since 1997 -

**Oct 16-20, 2006 at NIES**





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

http://2050.nies.go.jp

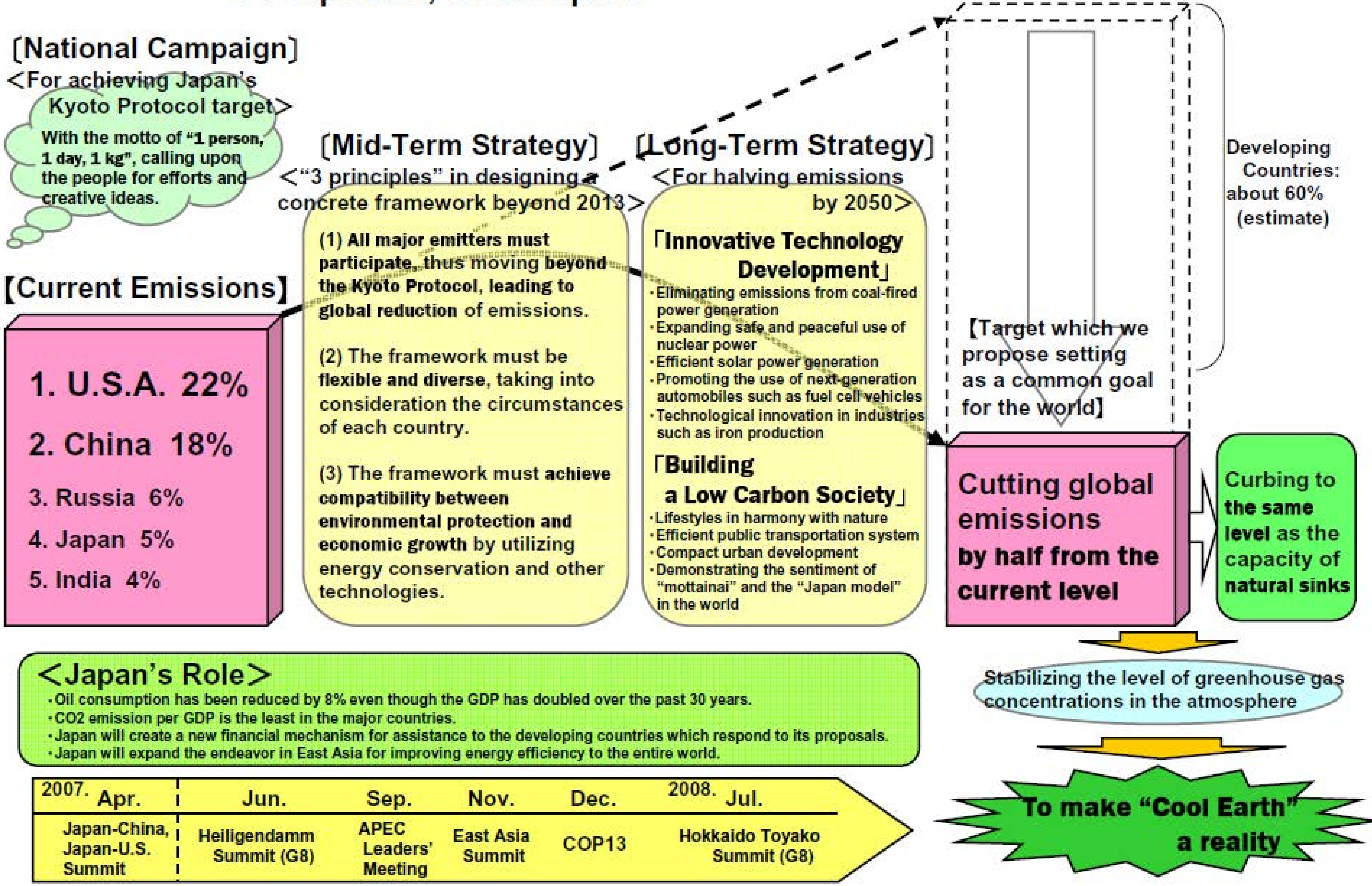
# 2007 AIM Training WS

How to develop residential/transportation scenarios for LCS study

1. how to depict future image of each sector (especially residential sector and transportation sector) and discuss among participants.
2. to show our modeling approach to calculate energy demand in each sector and discuss how to apply our method to each country considering data limitation.
3. develop each country residential/transportation energy demand toward 2050.

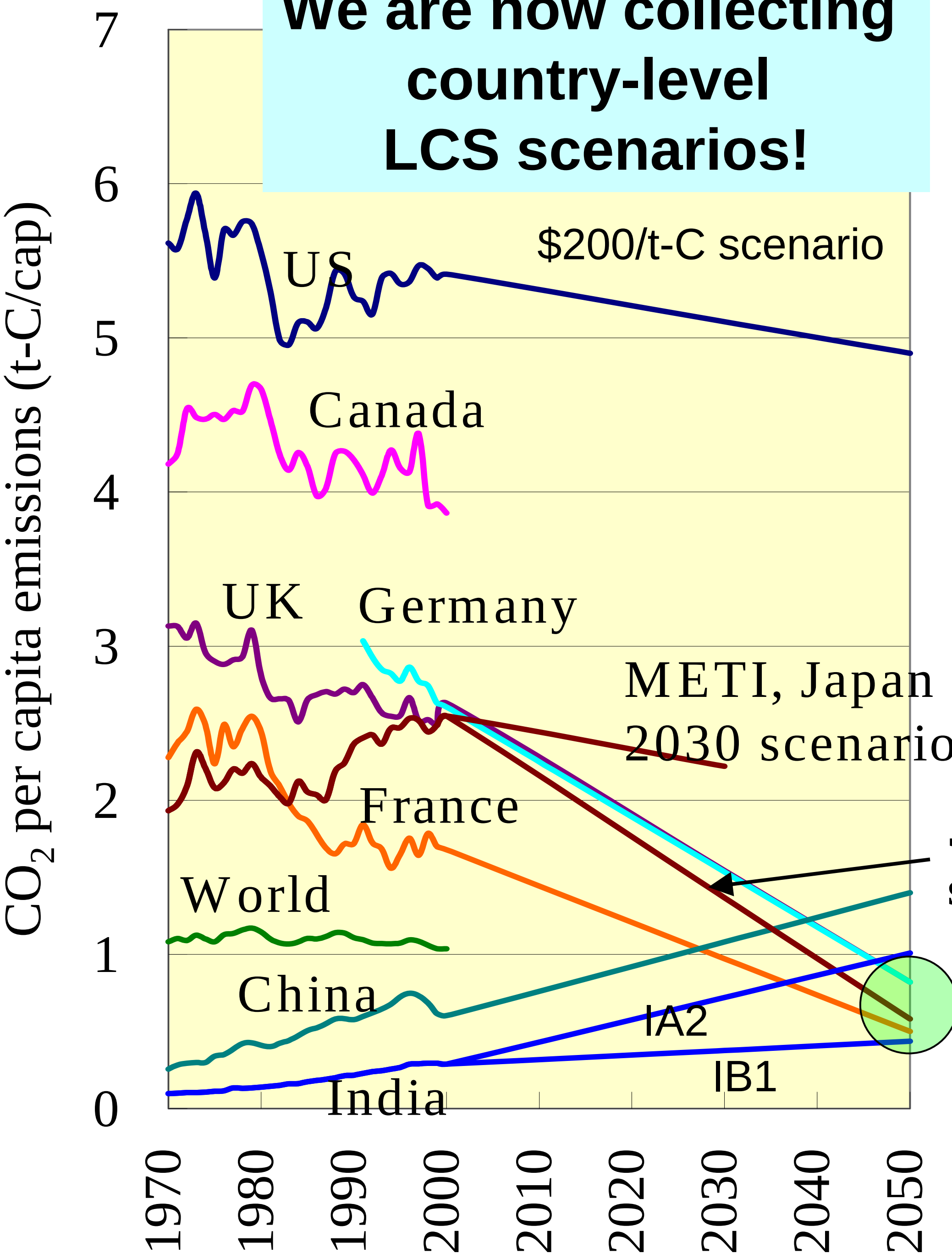
# Invitation to “Cool Earth 50”

## ~ 3 Proposals, 3 Principles ~



# Current per capita $CO_2$ emissions and Target

**We are now collecting country-level LCS scenarios!**




US: delay for tech development, global warming business

EU: Initiatives toward LCS
Japan: Need long-term vision

Developing countries: earlier guidance toward LCS is key

Shuzo Nishioka, Junichi Fujino;
NIES COP11 and COP/MOP1 side event
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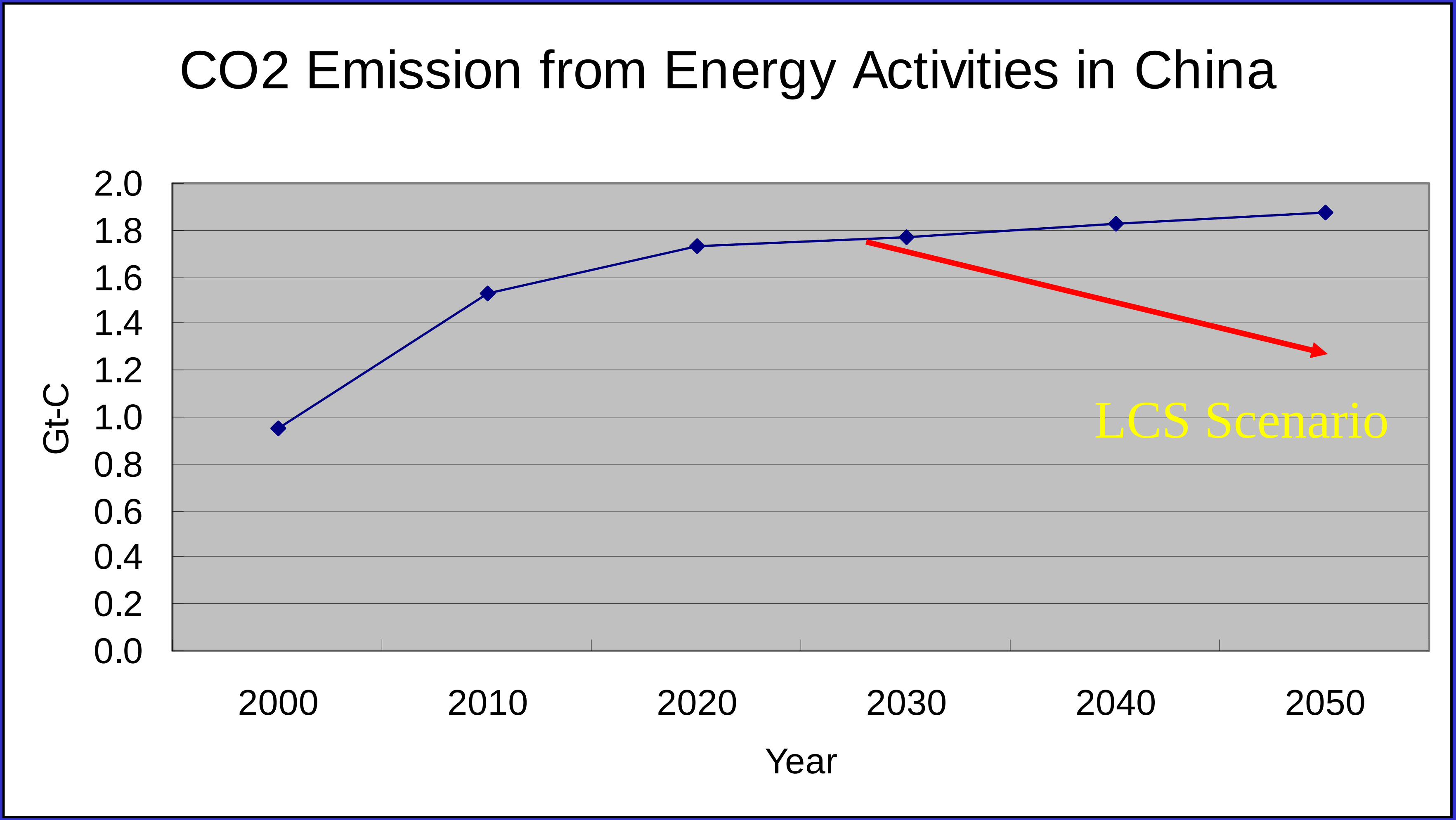
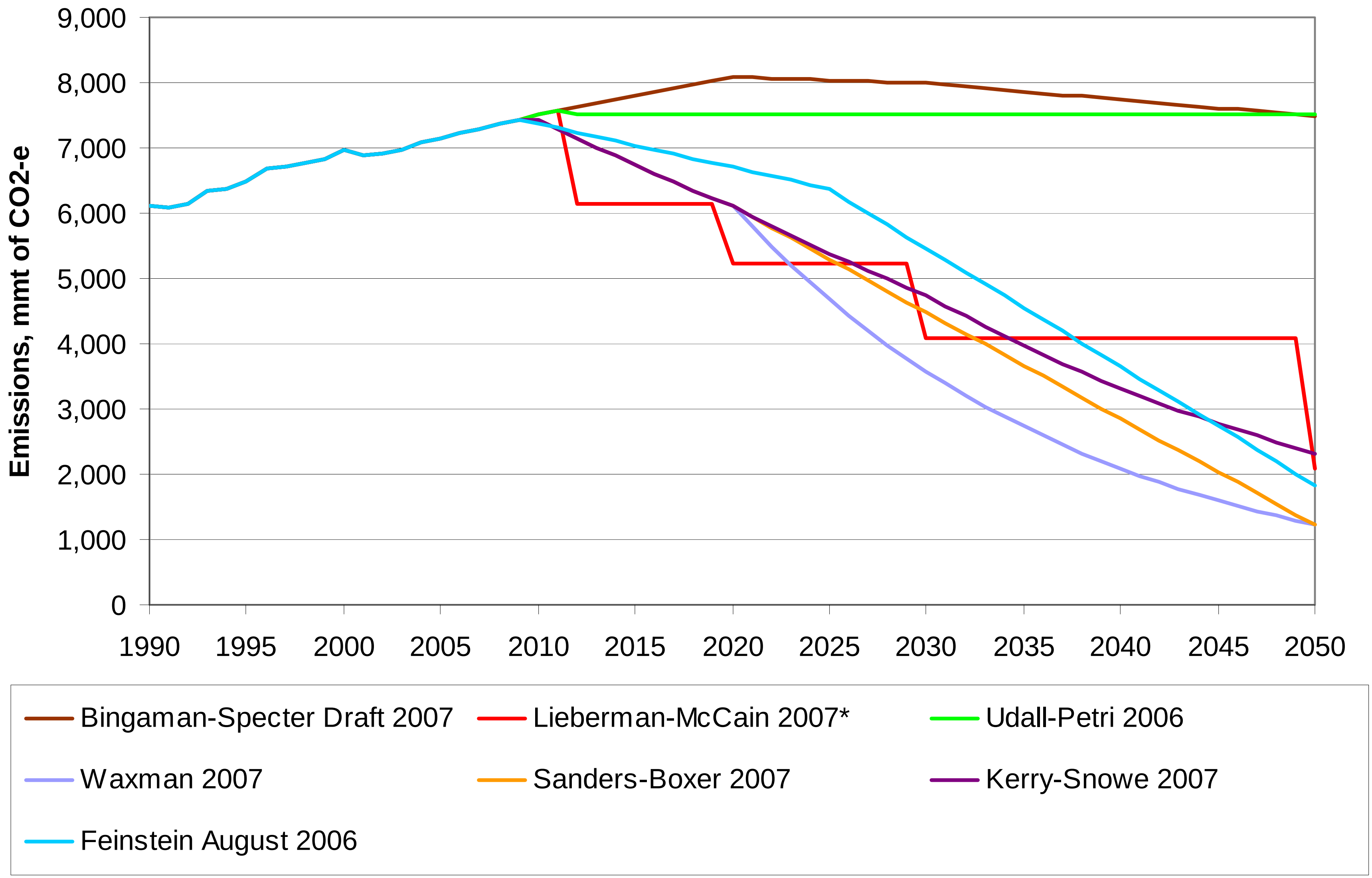



Jiang Kejun, **Low-Carbon Options in China**
EMF 22, Tsukuba, Dec 12-14, 2006

# Reduction Targets




web.mit.edu/globalchange/www/reports.html#pubs

# Why we develop Japan LCS Scenarios?

1. Why we need LCS?
2. Can Japan achieve LCS toward 2050?
3. How to structure global participation?

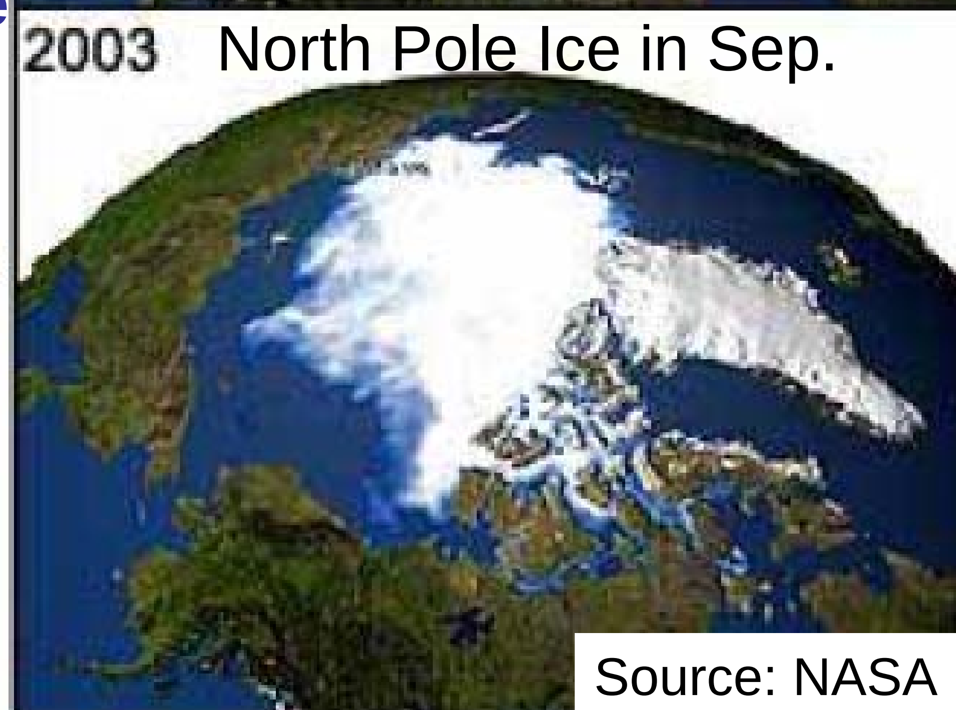
Japan Low Carbon Society 2050

http://2050.nies.go.jp


Himalayan "the abode of snow" Glaciers

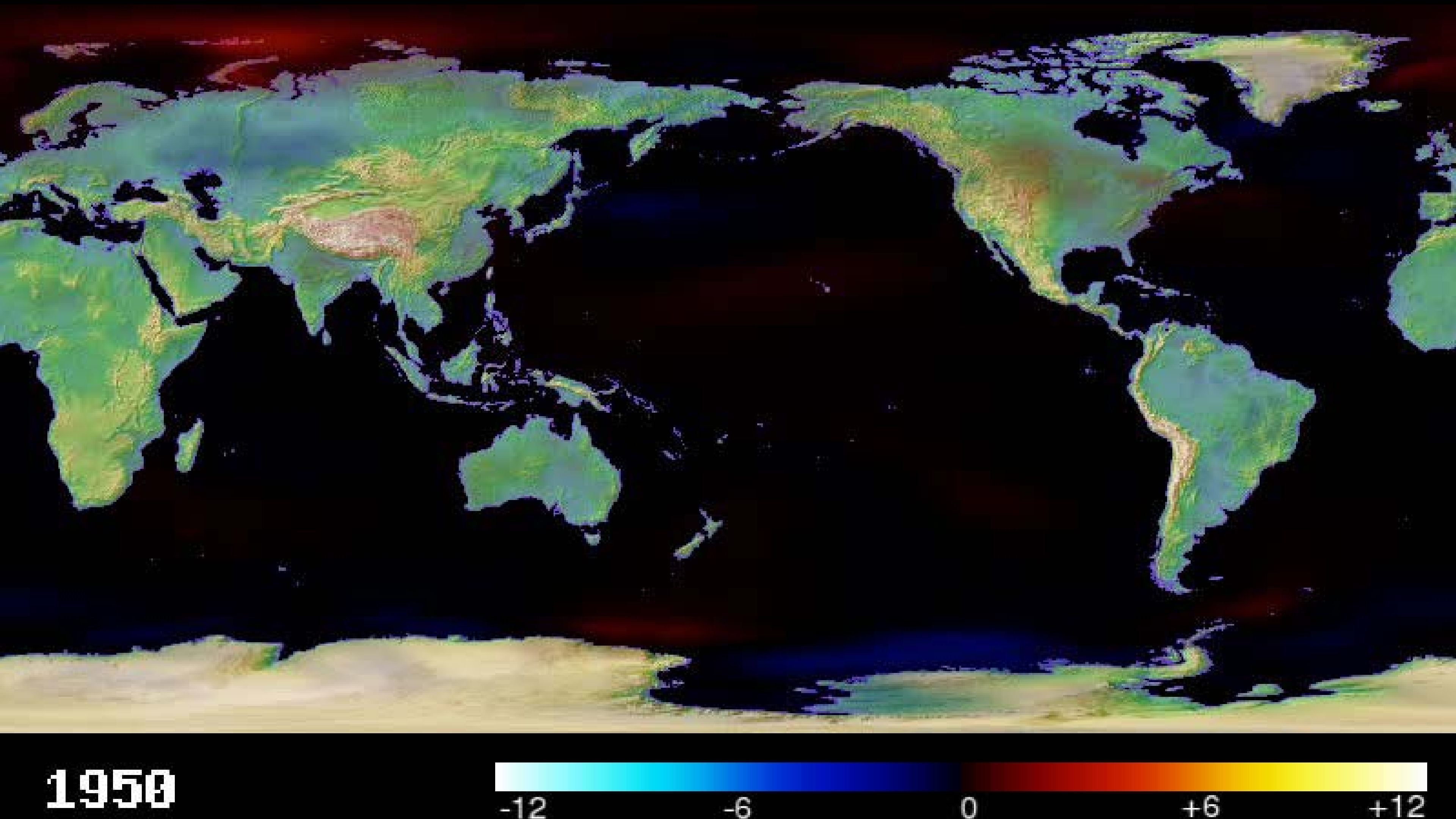


North Pole Ice in Sep.



CCSR/NIES/FRCGC, Japan

# Surface Air Temperature Change (1900=0 ºC)

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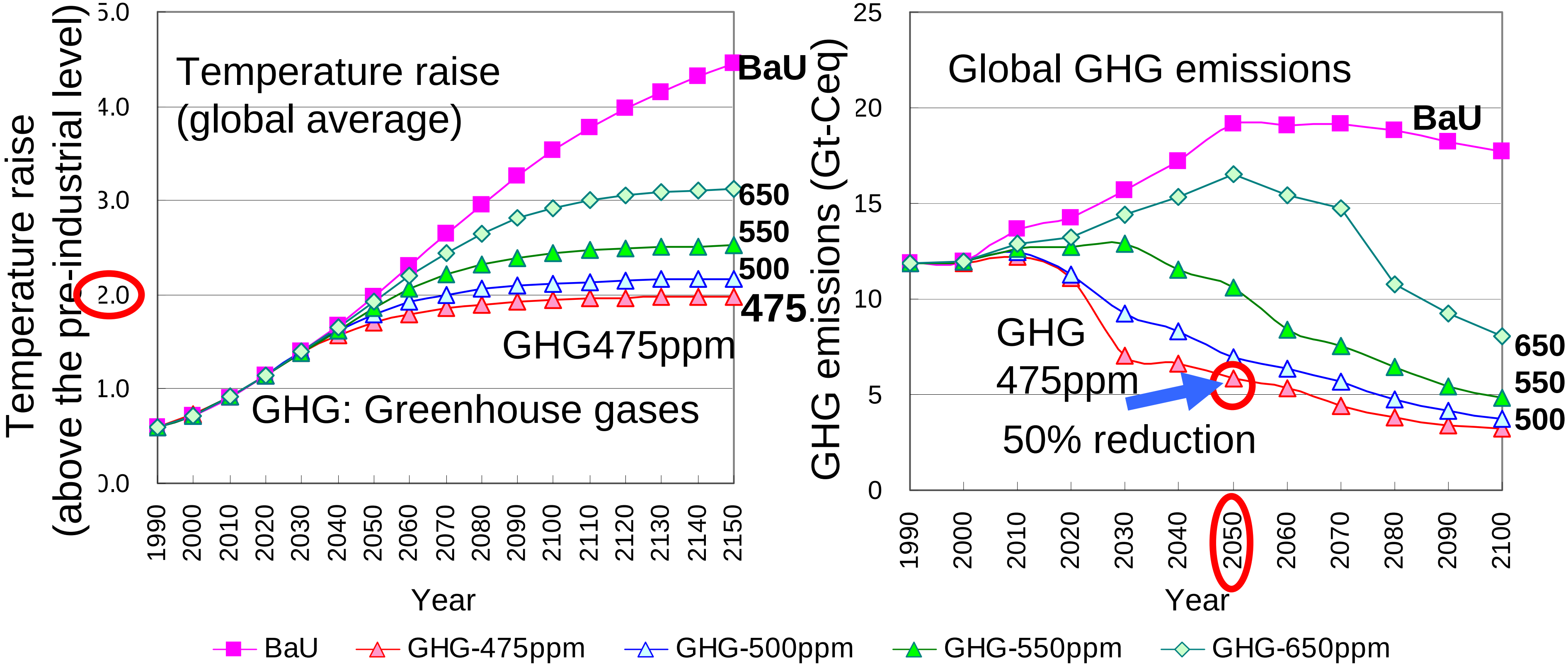



**•It is estimated that around 50% GHG reductions in 2050 are required to control temperature raise below 2C**

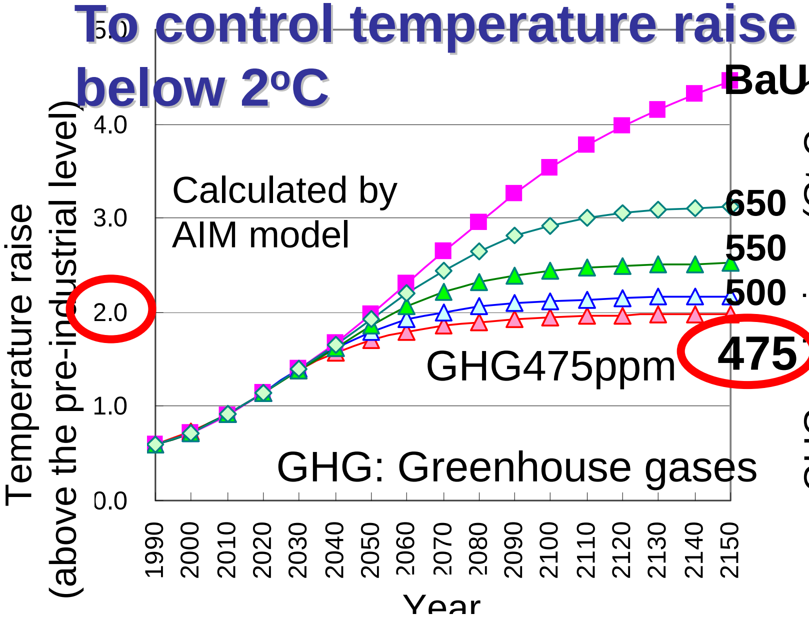
•Japan may be required more reduction (60-80%). Another country-level 2050 scenarios have been studied (UK 60%, Germany 80%, France 75%, and so on).

**•Impacts will be occurred even in 2C temp control.**

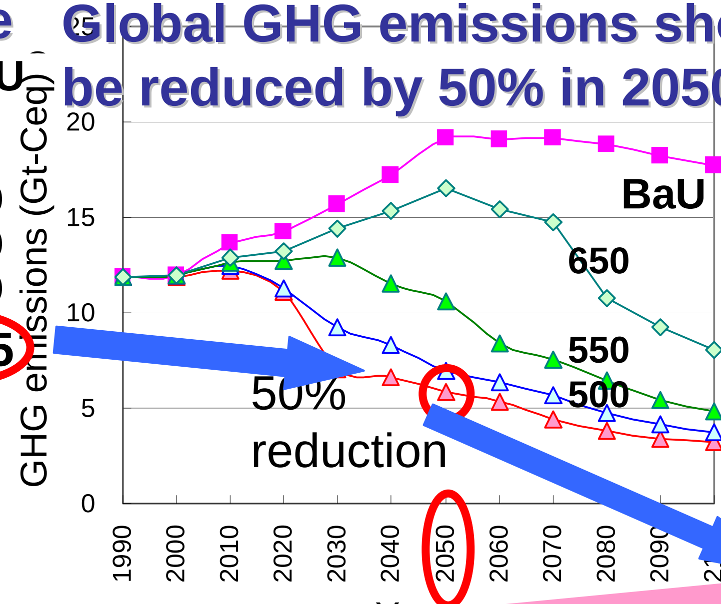
**•Adaptation is necessary.**

Calculated by AIM/Impact[policy] Model

# To control temperature raise below 2ºC




# Global GHG emissions should be reduced by 50% in 2050

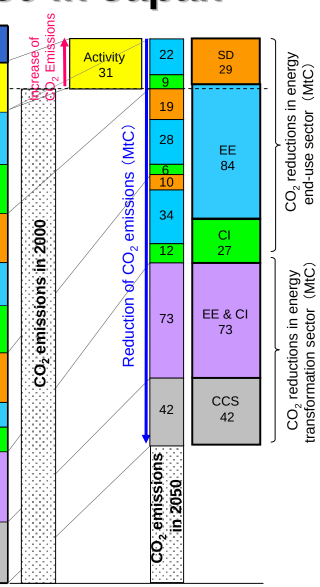



# Japan Low-Carbon Society Project

**Japanese reduction target in 2050**
**60-80%**

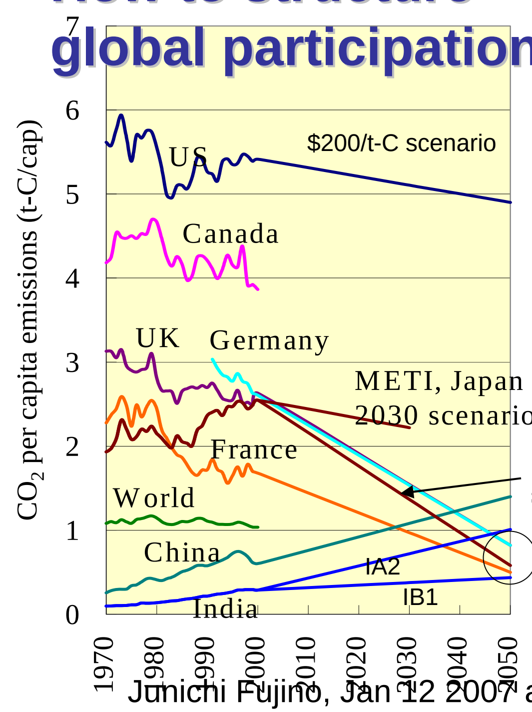
## Possible trend-breaking options to achieve 70% reductions toward 2050 in Japan

| | Main factors to reduce $CO_2$ emissions | Factors Class. |
|---|---|---|
| Soci-ety | • High economic growth<br>• Decrease of population and number of households | Demand growth by activity level change |
| Industrial | • Energy efficient improvement of furnace and motor etc. | Energy Efficiency Imp. (EE) |
| | • Fuel switching from coal/oil to natural gas | Carbon Intensity Imp. (CI) |
| Residential and commercial | • High insulation dwelling and building<br>• Home/Building energy management system | Reduction of service demands (SD) |
| | • Efficient air-conditioner, Efficient water heater, Efficient lighting system<br>• Fuel cell system<br>• Photovoltaic on the roof | Energy Efficiency Imp. (EE)<br>Carbon Intensity Imp. (CI) |
| Trans-portation | • Intensive land-use, Concentrated urban function<br>• Public transportation system | Reduction of service demands (SD) |
| | • Motor-driven mobiles: Electric battery vehicles, Fuel cell battery vehicles | EE & CI |
| Energy Transformation | • Nuclear energy<br>• Effective use of electricity in night time with storage<br>• Hydrogen supply with low-carbon energy sources | Carbon Intensity Imp. (CI) |
| | • Advanced fossil fueled plants + CCS<br>• Hydrogen supply using fossil fuel + CCS | Carbon Capture and Storage (CCS) |




EE: Energy Efficiency Improvement, CI: Carbon Intensity Improvement, SD: Reduction of Service Demand

## How to structure global participation




**Current per capita $CO_2$ emissions and Target**

US: delay for tech development, global warming business

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**Target for Low Carbon Society**

Shuzo Nishioka, Junichi Fujino;
NIES COP11 and COP/MOP1 side event
Global Challenges Toward Low-Carbon Economy (LCE), Dec. 3, 2005

# Large GHG cut is possible in Japan

# How fast we need to reduce GHG emissions

**Total amount**

Per capita activity · Energy Intensity · Carbon Intensity

$$CO_2\ \text{emissions} = \text{Pop} \times \boxed{\frac{\text{Activity}}{\text{Pop}}} \times \boxed{\frac{\text{Energy}}{\text{Activity}}} \times \boxed{\frac{CO_2}{\text{Energy}}}$$

60-80% reductions

Kaya identity

differential

Change rate

Total

integral

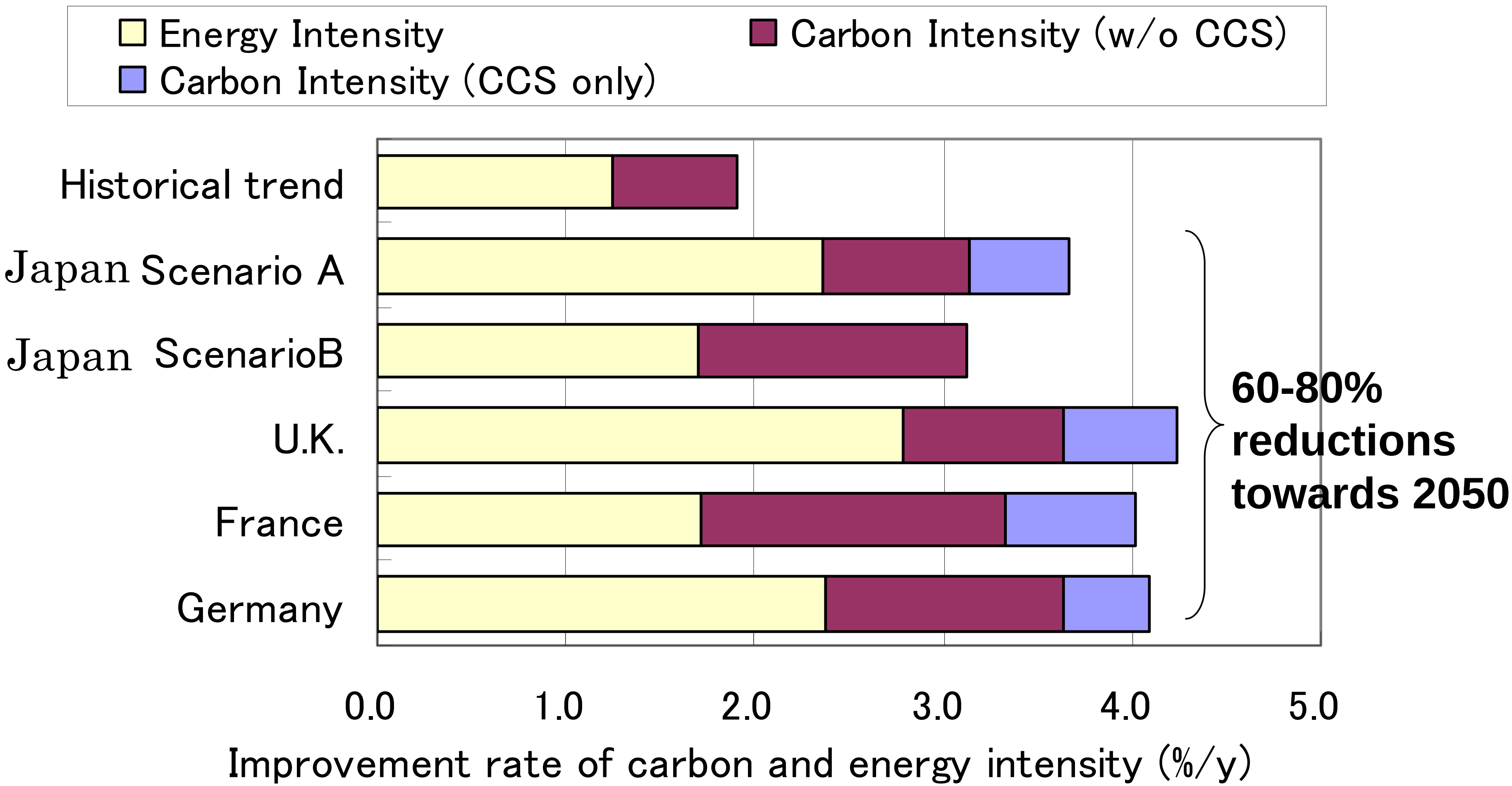
**Change rate = speed**

$$\underset{\text{Change rate}}{CO_2\text{emission}} = \underset{\text{Change rate}}{\text{Pop}} + \boxed{\underset{\text{change rate}}{\left(\frac{\text{Activity}}{\text{Pop}}\right)}} + \boxed{\underset{\text{change rate}}{\left(\frac{\text{Energy}}{\text{Activity}}\right)}} + \boxed{\underset{\text{change rate}}{\left(\frac{CO_2}{\text{Energy}}\right)}}$$

-2~3%/year $\quad \underbrace{\text{-0.5\%/year} \quad \text{1.5\%/year}}_{\text{1\%/year}} \quad \underbrace{\text{Y\%/year} \quad \text{X\%/year}}_{\text{-3~4\%/year}}$

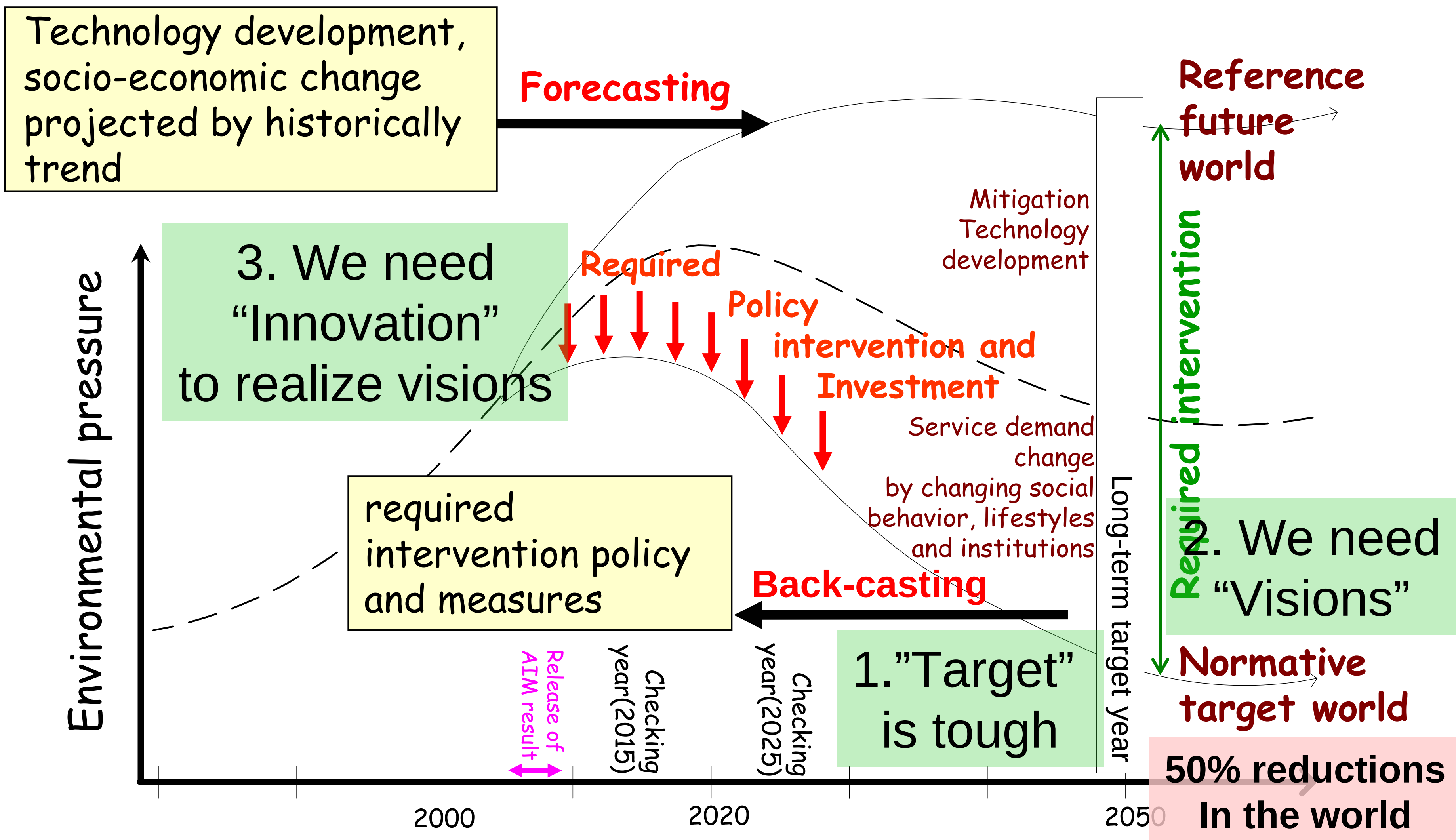
**The case of Japan LCS**

# Required improvement rate of carbon and energy intensity to achieve LCS




**Keep double speed to improve carbon and energy intensity compared as that of the historical record!**

# Forecasting from now and Backcasting from future prescribed/normative world



# Why we develop Japan LCS Scenarios?

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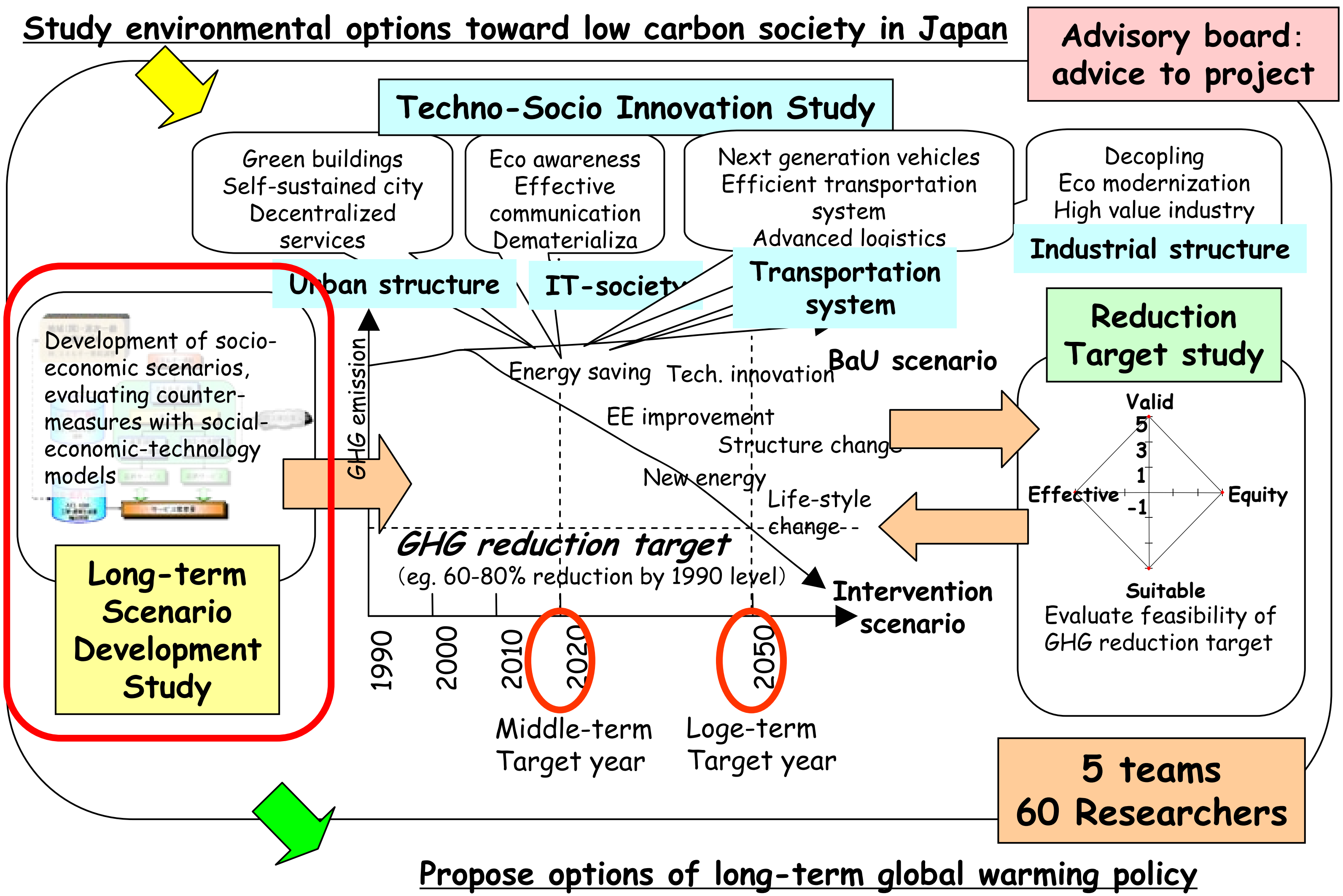
Japan Low Carbon Society 2050

http://2050.nies.go.jp

# Japan Low Carbon Society Scenarios toward 2050

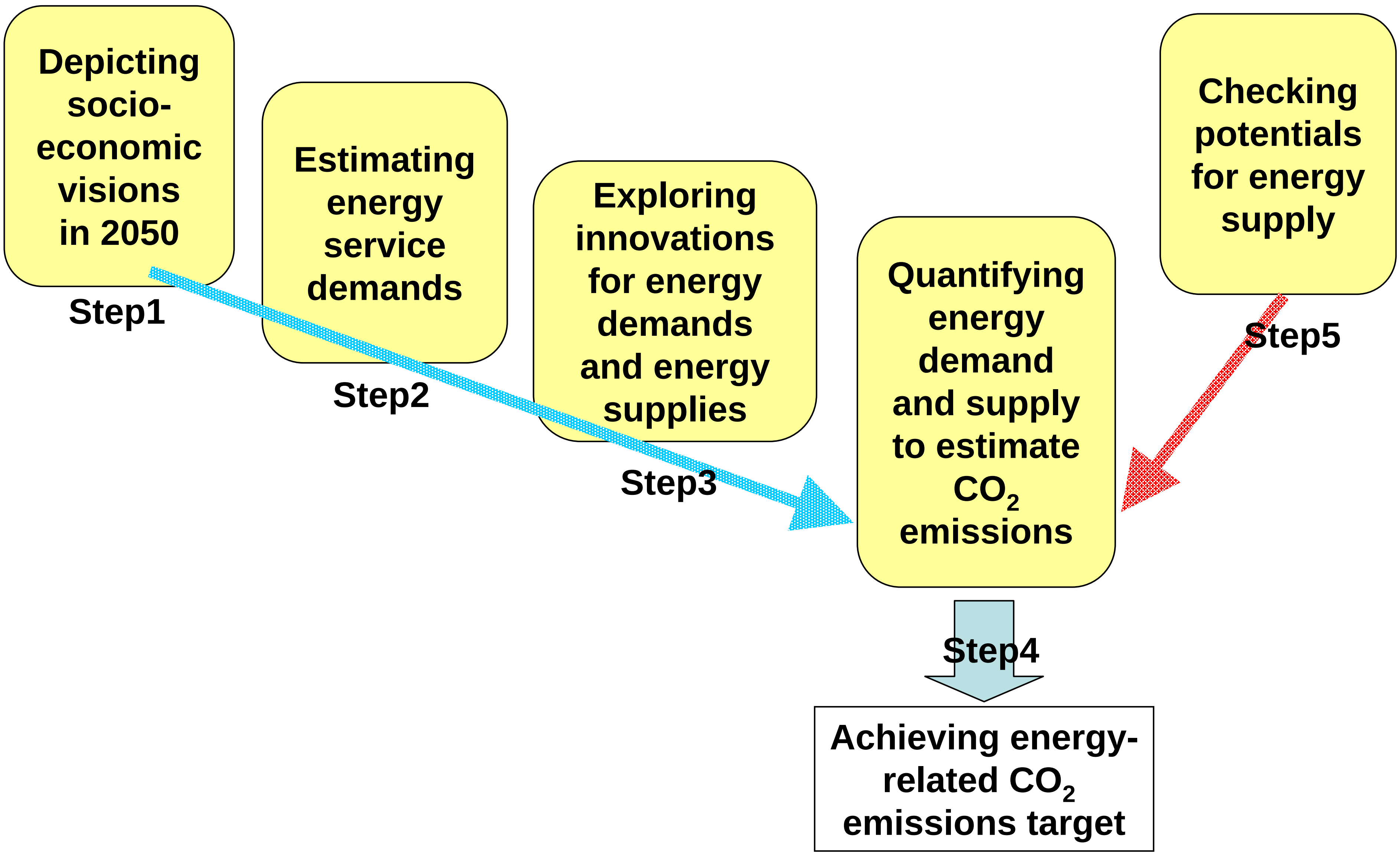
FY2004-2006 (PhaseI),2007-2008 (Phase II)
Global Environmental Research Program, MOEJ



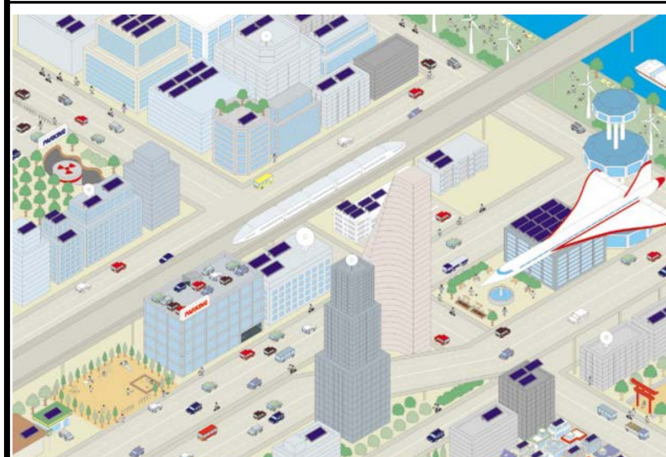

http://2050.nies.go.jp

Japan LCS (Low-Carbon Society) (FY2004-2008)
Research Project supported by
Global Environmental Research Fund, MOEJ

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



# As for LCS visions, we prepared two different but likely future societies

| Vision A "Doraemon" | Vision B "Satsuki and Mei" |
|---|---|
| Vivid, Technology-driven | Slow, Natural-oriented |
| Urban/Personal | Decentralized/Community |
| Technology breakthrough Centralized production /recycle | Self-sufficient Produce locally, consume locally |
| Comfortable and Convenient | Social and Cultural Values |
| 2%/yr GDP per capita growth | 1%/yr GDP per capita growth |
|  |   |

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.

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

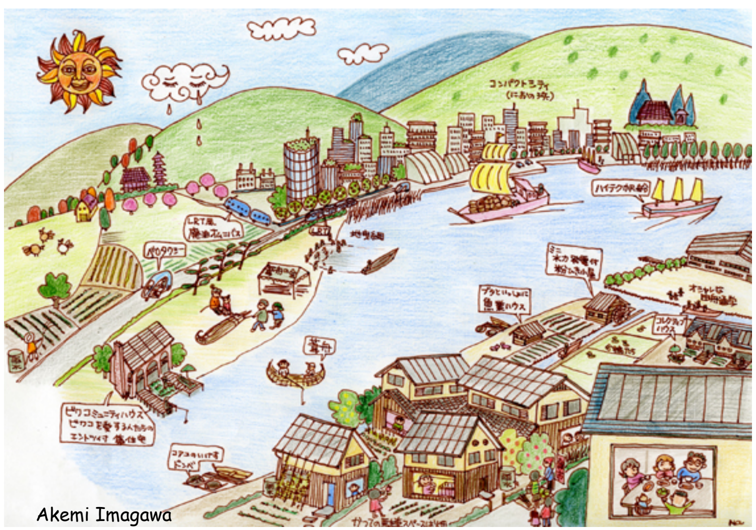
# Scenario A "Doraemon"

**Vivid, Technology-driven**
**Urbanized and Personal**
**Technocentric**
**Centralized production/recycle**
**Pursuit of convenient**

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.

# Scenario B "Satsuki and Mei"

- Slow, natural-oriented
- Decentralized/Community
- Self-sufficient
- Local production for local consumption
- Eco-centric
- Put more focus on social and cultural values




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

# Narrative description of Scenario A

Technical progresses in the industrial sectors are considerably high because of vigorous R&D investments by the government and business sectors. The economic activities as a whole are so dynamic that average annual per capita GDP growth rate is kept at the level of 2%. The other reasons for such high economic growth are high rates of consumption in both business and household sectors.

The employment system has been drastically changed from that in 2000 and equal opportunities for the employment have been achieved. Since workers are employed based on their abilities or talents regardless of their sex, nationality and age, the motivation of the worker is quite high in general.

As many women work outside, the average time spent for housekeeping has decreased. Most of the household works are replaced by housekeeping robots or services provided by private companies. Instead, the time used for personal career development has increased.

The new technologies, products, services are positively accepted in the society. Therefore, purchasing power of the consumer is strong and upgrade cycles of the commodities are short.

Household size becomes smaller and the number of single-member households has increased. Multi-dwellings are preferred over detached houses, and the urban lifestyle is more popular than the lifestyle of countryside.

# Narrative description of Scenario B

Although average annual growth rate of per capita GDP is approximately 1%, people can receive adequate social services no matter where they live. Volunteer works or community based mutual aid activities are the main provider of the services. Since the levels of medical and educational service in the countryside have drastically improved, continuous migration of population from city to countryside has been observed.

The number of family who own detached dwellings has increased. The trend is especially prominent in the countryside. The size of the houses and the floor area per houses has also increased with the increasing share of detached houses.

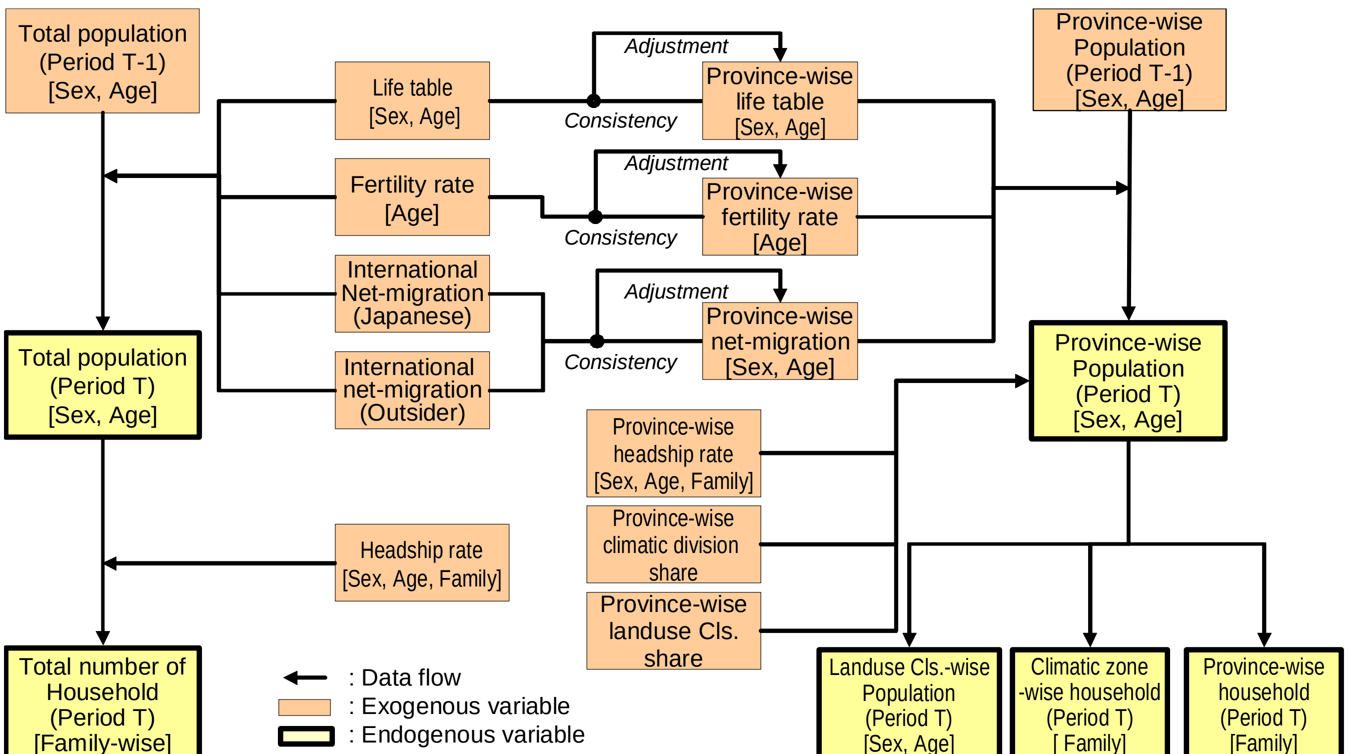
The ways people work have also changed. The practice that husbands work outside and wives work at home is not common anymore. In order to avoid the excessive work of the partner, the couples help each other and secure the income according to their life plan. Housework is shared mainly among family members, but free housekeeping services provided by local community or social activity organizations are also available. As a result of the changes in lifestyle, the time spent within family has increased. The time spent on hobby, sports, cultural activities, volunteer activities, agricultural works, and social activities has also increased.

# LCS Japan Scenarios for Economy and Industry

| Economy | | Scenario A | Scenario B |
|---|---|---|---|
| | Growth rate | ・Per capita GDP growth rate:2% | ・Per capita GDP growth rate:1% |
| | Technological Development | ・High | ・Not as high as scenario A |
| **Industry** | | **Scenario A** | **Scenario B** |
| | Market | ・Deregulation | ・Adequate regulated rules apply |
| | Primary Industry | ・Declining GDP share<br>・Dependent on import products | ・Recovery of GDP share<br>・Revival of public interest in agriculture and forestry |
| | Secondary Industry | ・Increasing add value<br>・Shifting production sites to overseas | ・Declining GDP share<br>・high-mix low-volume production with local brand |
| | Tertiary industry | ・Increase in GDP share<br>・Improvement of productivity | ・Gradual increase in GDP share<br>・Penetration of social activity |

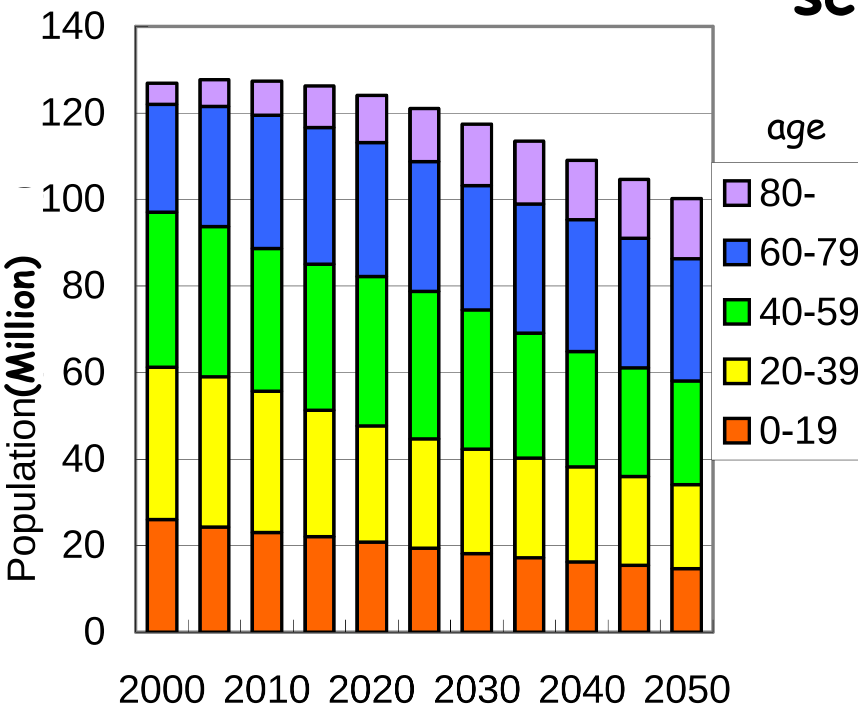
# Population and Household Model

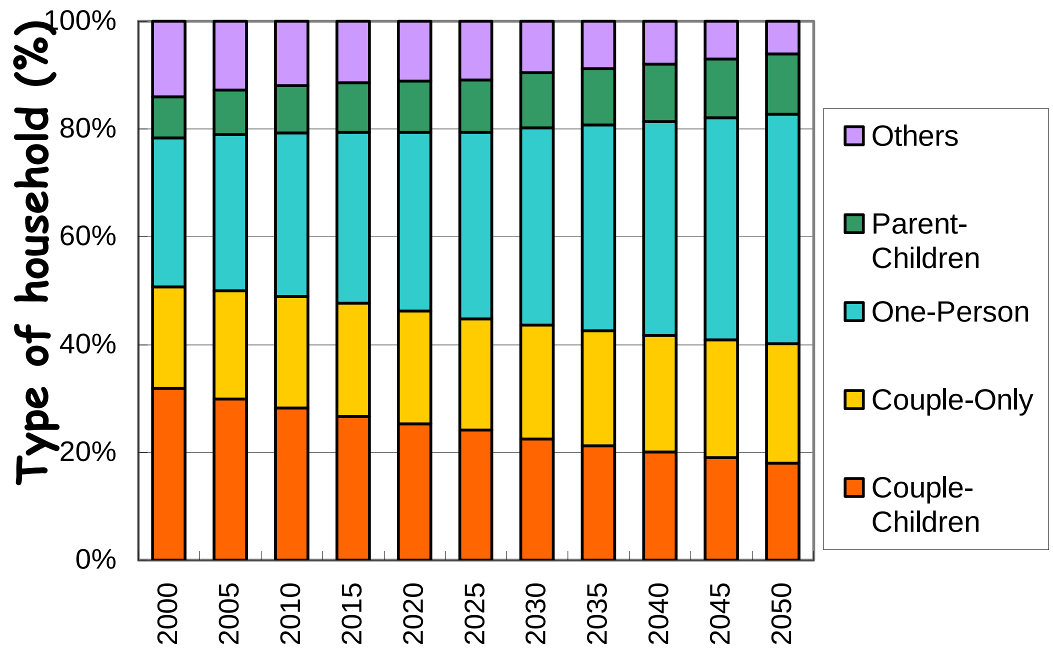
- Drastic change is projected in Japan's population structure by 2050. Downturn in birthrate, depopulation and aging will continue until 2050, and they affect greatly the future vision.
- A <u>cohort component model</u> for population, a <u>household headship rate model</u> for household types, with spatial resolution of provinces, land-use types and climate zones and five family types was developed, and is used to analyze effects of depopulation and changes in family composition on the realization of LCS.




**Flowchart of PHM**

# Projection Japan population and households in scenario A

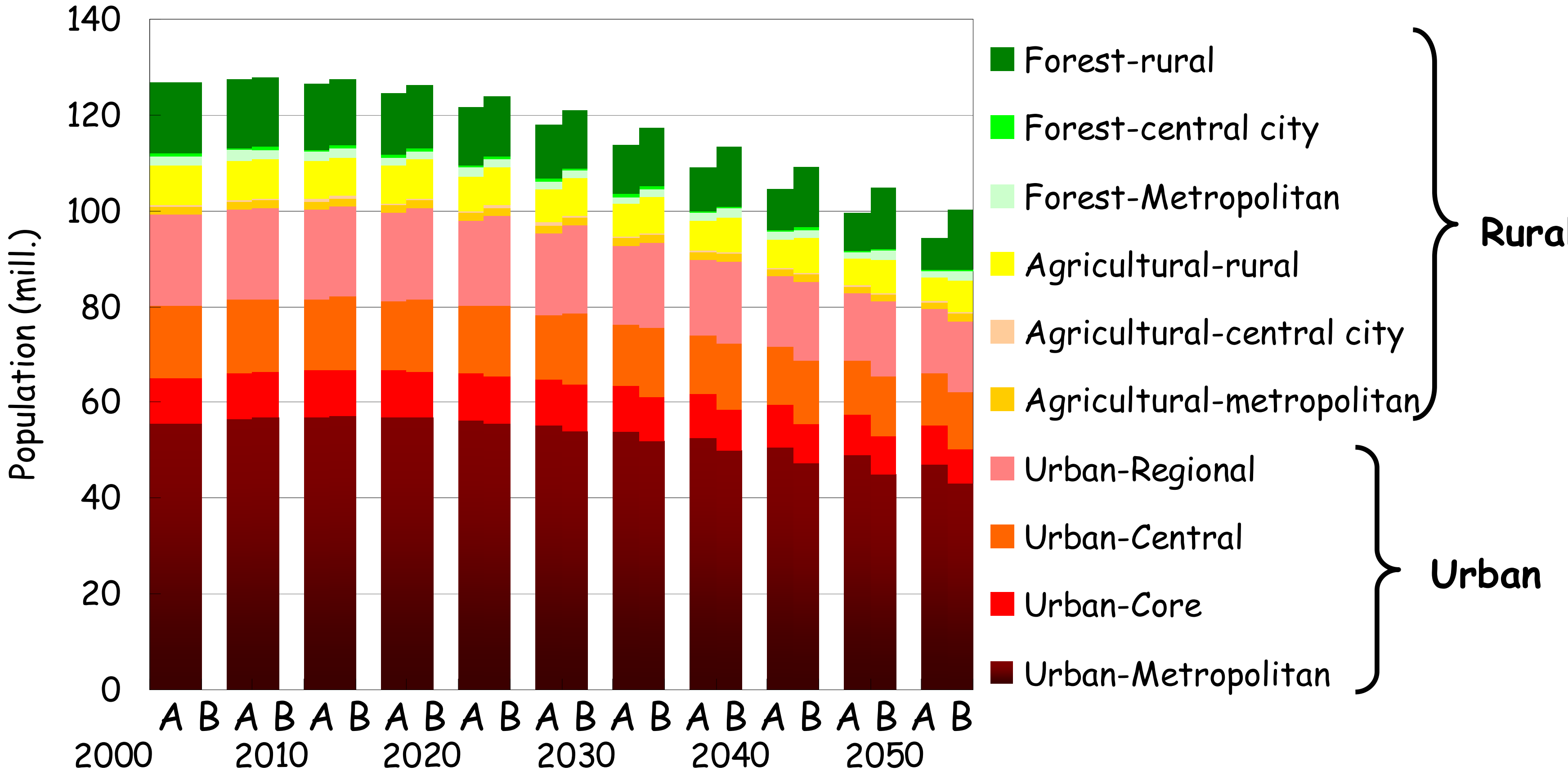



| year | 2000 | 2050 A | 2050 B |
|---|---|---|---|
| Population (million) | 126.9 | 94.5 | 100.3 |
| Aged population ratio (%) | 17.4 | 38.0 | 35.8 |
| Average number of household | 2.71 | 2.19 | 2.38 |
| Single-person households (%) | 27.6 | 42.6 | 35.1 |

http://2050.nies.go.jp

# Projection of urbanization



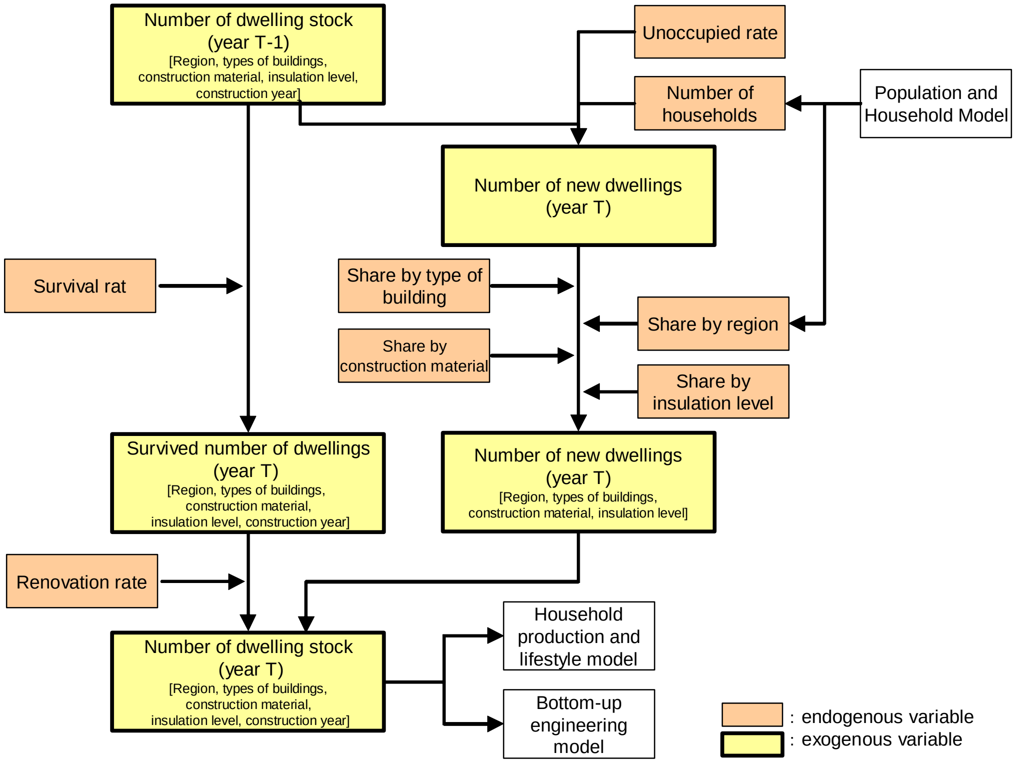

| year | 2000 | 2050 A | 2050 B |
|---|---|---|---|
| Population (million) | 126.9 | 94.5 | 100.3 |
| Urban population(%) | 78.1 | 84.2 | 76.7 |
| Agricultural area population(%) | 8.2 | 7.1 | 8.5 |
| Forest area population(%) | 13.7 | 8.7 | 14.8 |

# Building Dynamics Model

- Enhancement of building insulation is very effective countermeasures. 60% of the heating demand from the residential sector can be cut down, if appropriate insulation systems are installed. Besides, configuration of buildings in urban and rural area affects social energy efficiency greatly.

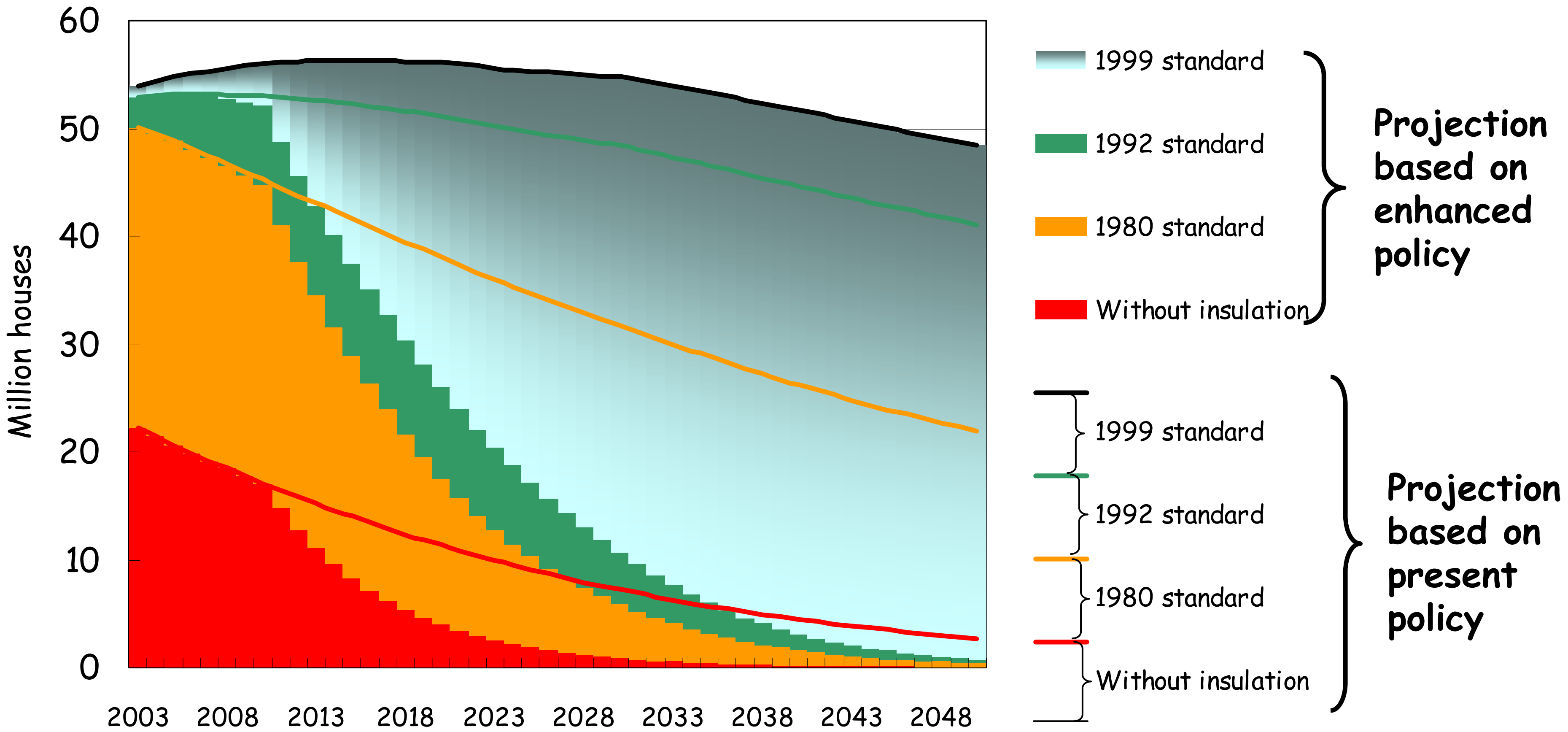
- In order to take account these factors, a model of building dynamics (BDM) was developed.

- It is a cohort model with a spatial resolution of climate zones, four heat insulation levels, four residential building types, and six commercial building types.




Flowchart of BDM (residential)

# Projection of residential building stock by insulation level



# Passenger Transportation Demand Model

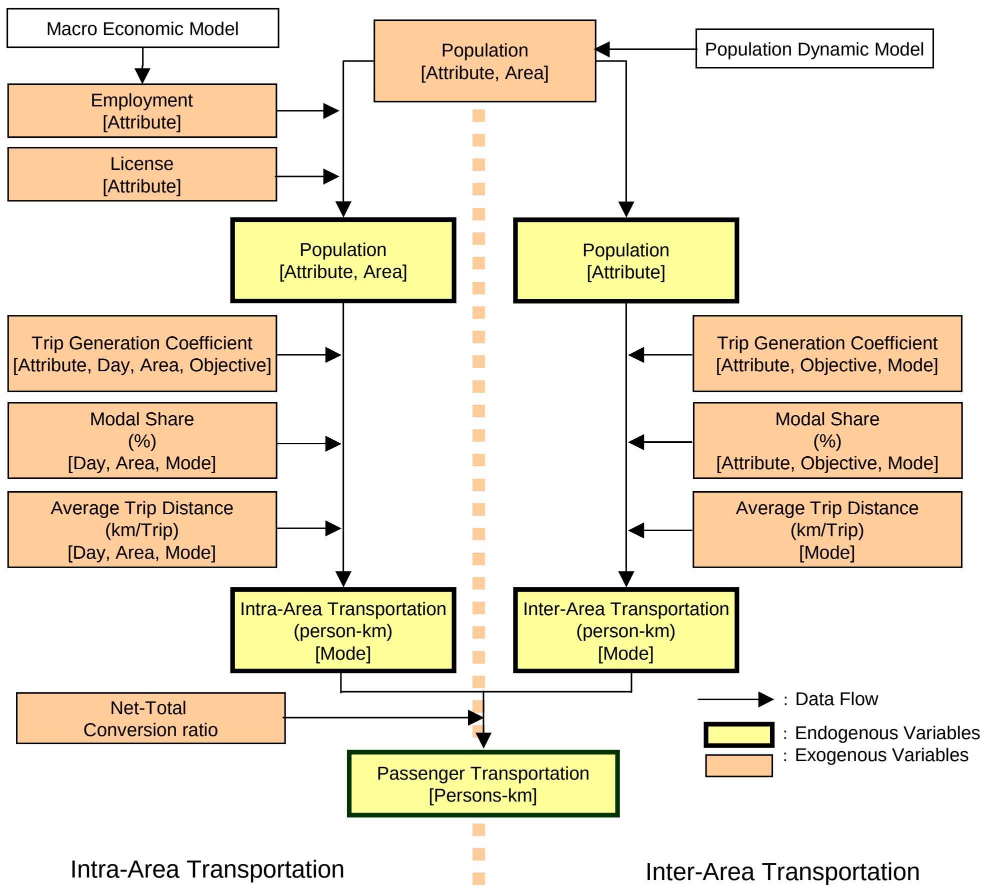
- Many effective countermeasures exist related with transportation. Modal shift from private motor vehicles to mass transit systems, urban planning towards compact cities, transportation substitution with diffusions of teleworking and virtual communication systems and so on.

- Passenger Transportation Demand Model (PTDM) can simulate transportation demand associated with changes in population distribution, people's activity patterns, modal shares and average trip distances.

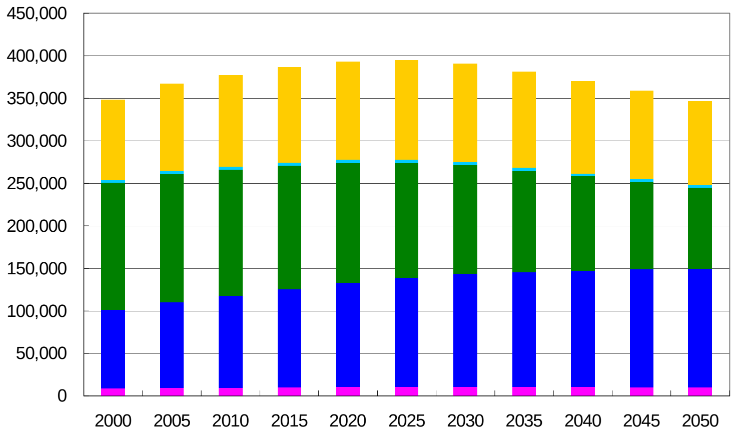
- The demands in this model are divided into two types,

  1)Intra-regional transportation within the daily living area,
  2)Inter-region transportation between the daily living areas,

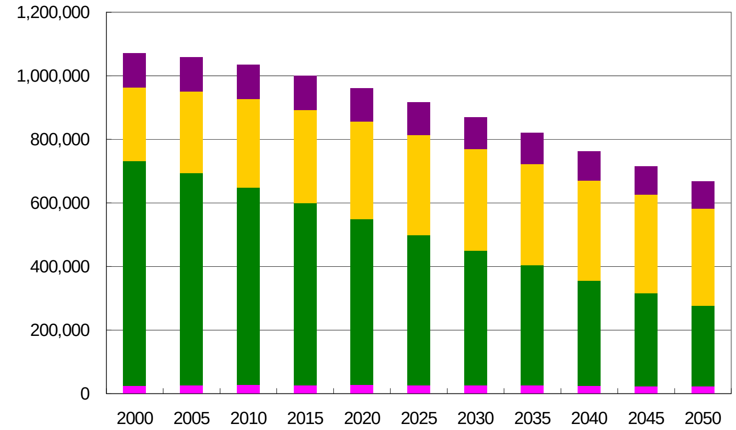
  and they are calculated separately.



# Passenger Transportation Demand Model (2) Scenario A




Inter-region transportation demand by mode of transportation (mil. person-km)

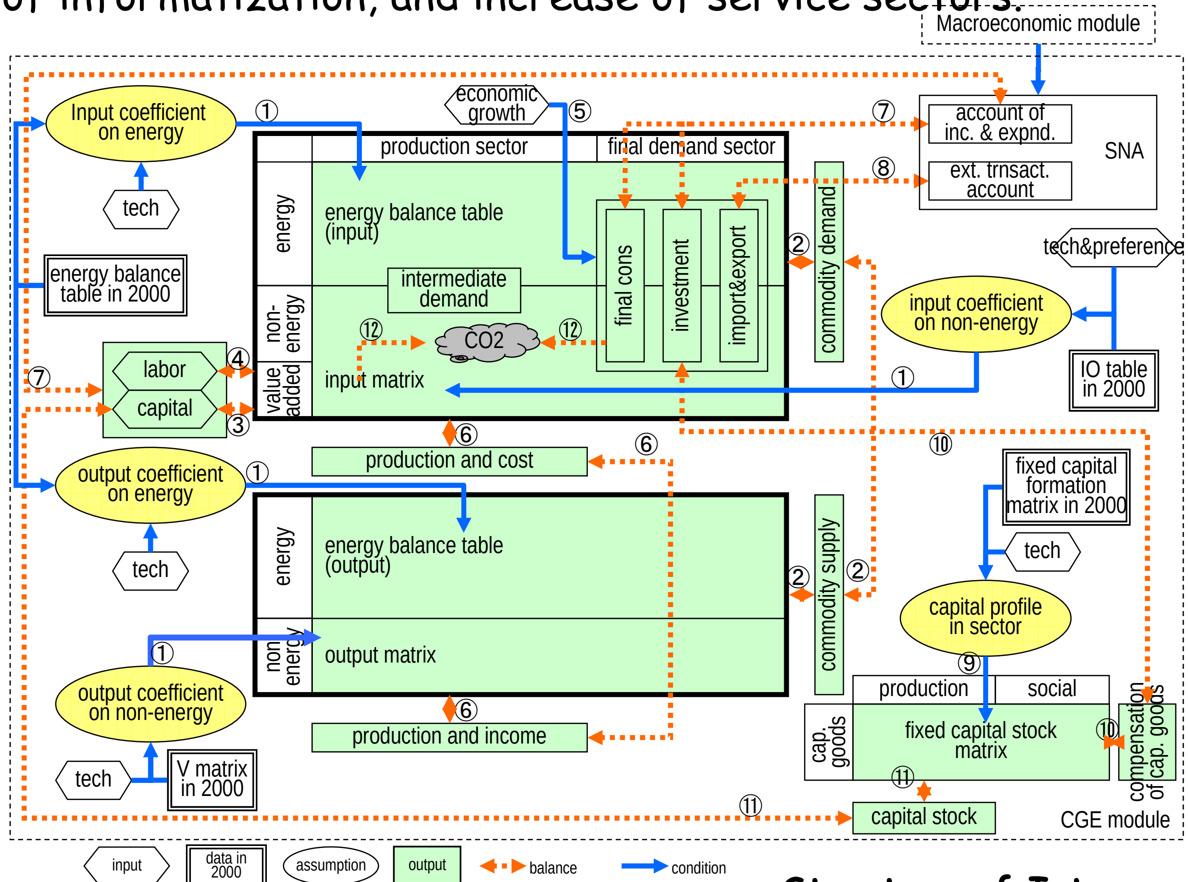



Intra-region transportation demand by mode of transportation (mil. person-km)

- Coupled with population decrease, and intensive decreasing policy of average trip distance, such as the compaction of neighborhood communities causes significant decrease of intra-regional transportation demand.
- In addition, the share of railways transportation will increase rapidly due to the promotion of modal shift from car to train.

# Inter-sector and Macro Economic Model

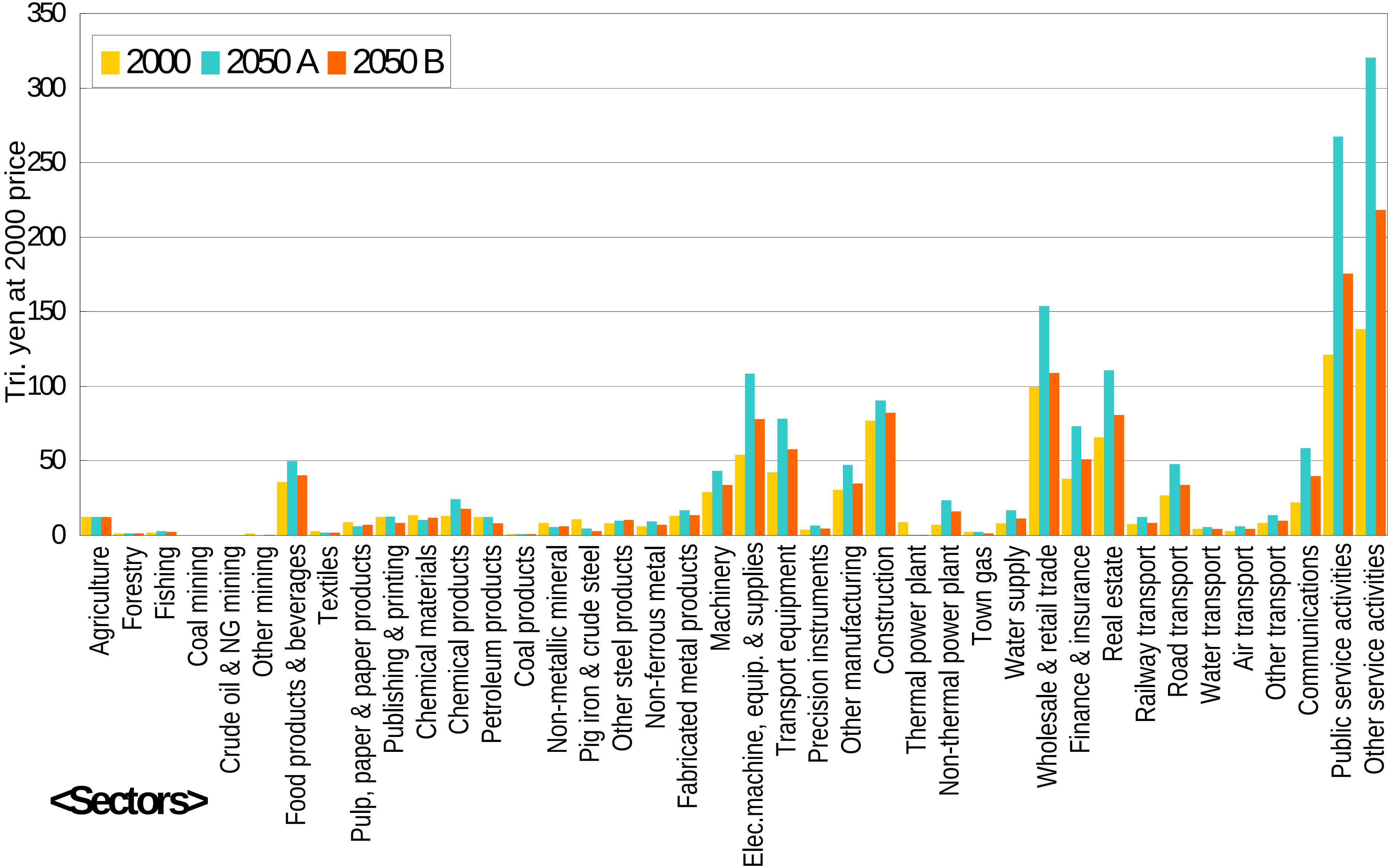
- Projecting macro economic activity, sectoral production, and also taking account the countermeasures proposed in the individual models, we developed "Inter-sector and Macro Economic Model (IMEM)", which consists of a sequential dynamic general equilibrium module and a macroeconomic module.
- The model can be used to estimate national and sectoral economic activities, the impacts of energy efficient and dematerialization technologies in industrial sectors, development of informatization, and increase of service sectors.

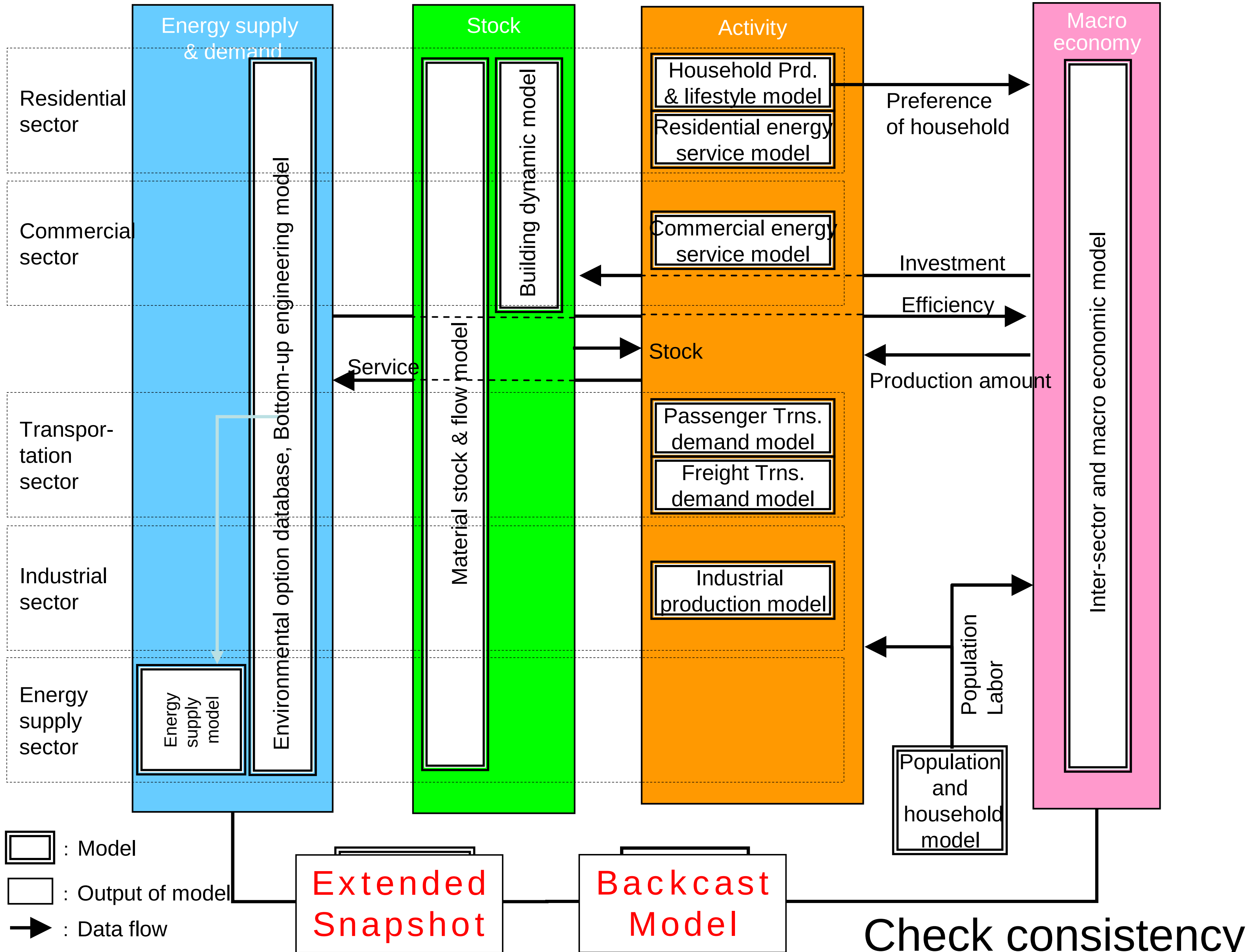



① production function
② commodity market
③ capital market
④ labor market
⑤ calculation of GDE
⑥ expenditure and income in production sector
⑦ expenditure and income in household and government
⑧ assumption of import and export
⑨ fixed capital stock matrix
⑩ investment goods market
⑪ capital stock
⑫ $CO_2$ emissions

**Structure of Inter-sector Module**

# Industrial Structure Change in 2050, Japan
# calculated by Inter-sector and Macro Economic Model






**AIM (Asia-Pacific Integrated Modeling) for Japan LCS scenarios**

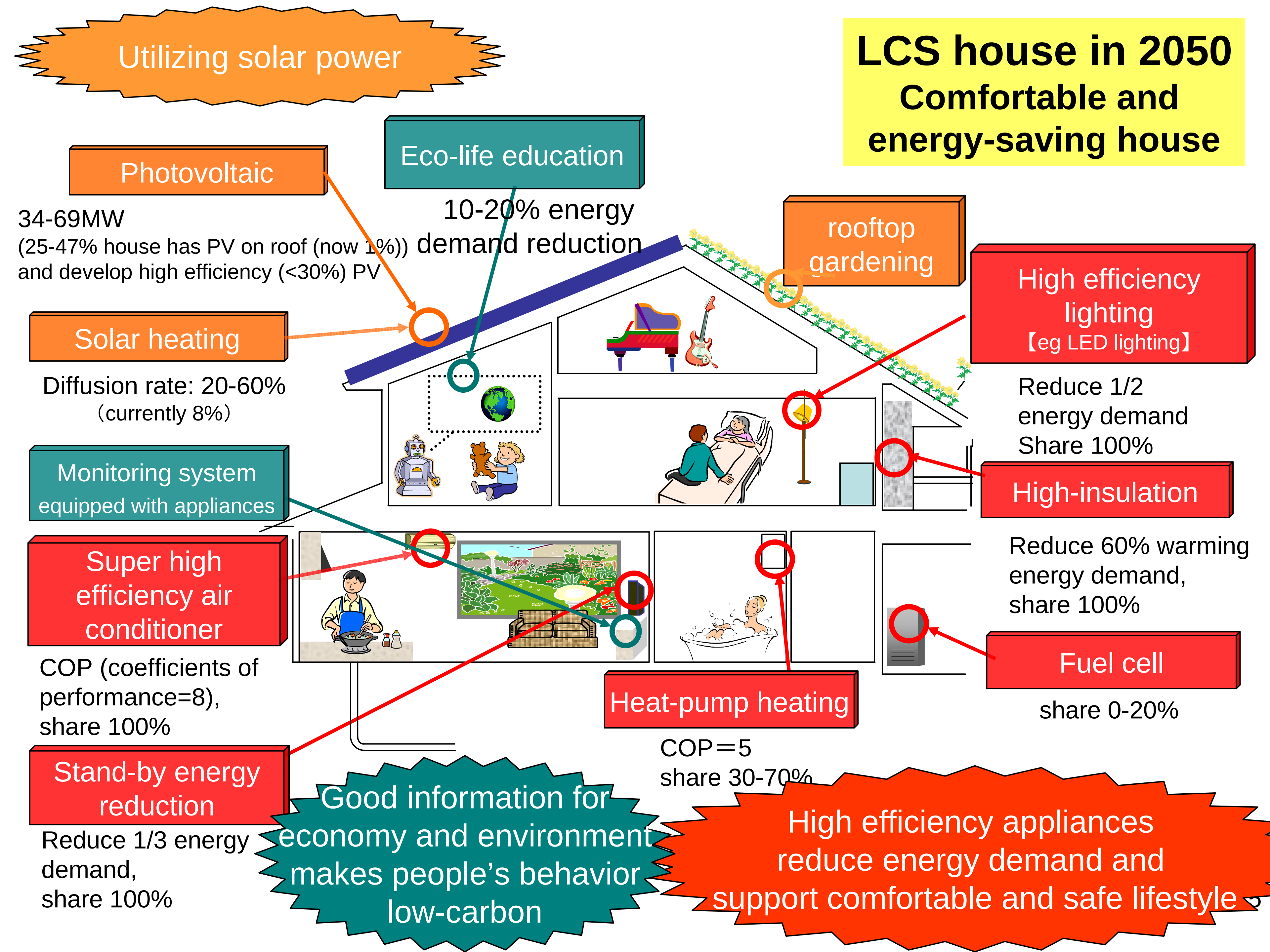
# Quantification of Scenario A and B in 2050

| year | unit | 2000 | 2050 A | | 2050 B | | model |
|---|---|---|---|---|---|---|---|
| Population | Mil. | 127 | 94 | (74%) | 100 | (79%) | Population and Household model |
| Household | Mil. | 47 | 43 | (92%) | 42 | (90%) | |
| Average number of person per household | | 2.7 | 2.2 | | 2.4 | | |
| GDP | Tril.JPY | 519 | 1,080 | (208%) | 701 | (135%) | Inter-sector and Macro Economic Model |
| Share of production | | | | | | | |
| primary | % | 2% | 1% | | 2% | | |
| secondary | % | 28% | 18% | | 20% | | |
| tertiary | % | 71% | 80% | | 79% | | |
| Office floor space | $Mil.m^2$ | 1654 | 1,934 | (117%) | 1,718 | (104%) | Building dynamics Model & Inter-sector and Macro Economic Model |
| Travel Passenger volume | bill. p·km | 1,297 | 1045 | (81%) | 963 | (74%) | Transportation demand model & Inter-sector and Macro Economic Model |
| Private car | % | 53% | 32% | | 51% | | |
| Public transport | % | 34% | 52% | | 38% | | |
| Walk/bycycle | % | 7% | 7% | | 8% | | |
| Freight transport volume | bill. t·km | 570 | 608 | (107%) | 490 | (86%) | |
| Industrial production index | | 100 | 126 | (126%) | 90 | (90%) | Inter-sector and Macro Economic Model |
| Steel production | Mil.t | 107 | 67 | (63%) | 58 | (54%) | |
| Etylen production | Mil.t | 8 | 5 | (60%) | 3 | (40%) | |
| Cement production | Mil.t | 82 | 51 | (62%) | 47 | (57%) | |
| Paper production | Mil.t | 32 | 18 | (57%) | 26 | (81%) | |

( %) is a percentage compared with year 2000

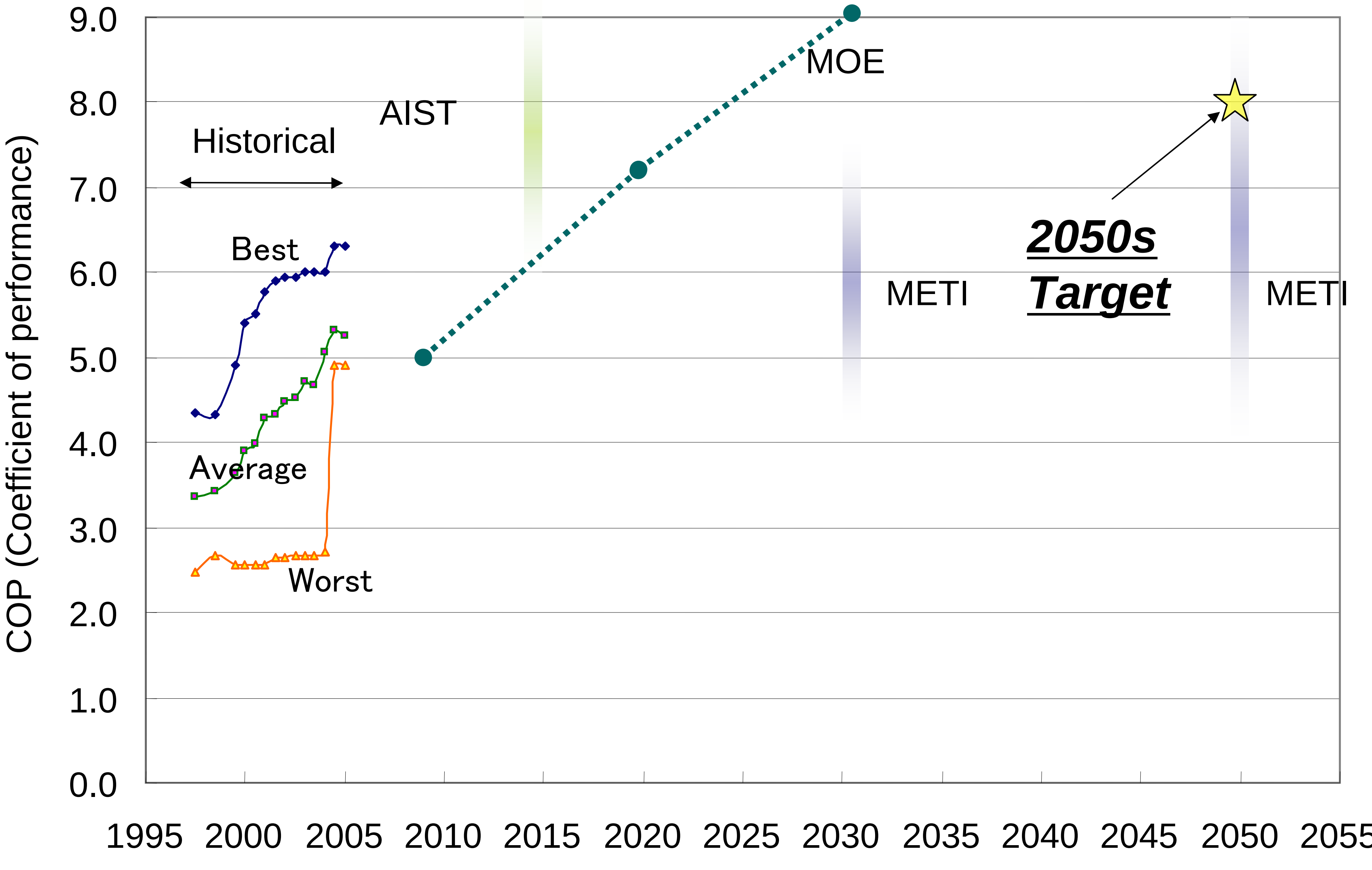
# Key technological countermeasures in the Environmental Option Database

| Sector | Technology |
|---|---|
| Residential & Commercial | Efficient air conditioner, Efficient electric water heater, Efficient gas/oil water heater, Solar water heater, Efficient gas cooking appliances, Efficient electric cooling appliances, Efficient lights, Efficient visual display, Efficient refrigerator, Efficient cool/hot carrier system, Fuel cell cogeneration, Photovoltaic, Building energy management system (BEMS), Efficient insulation, Eco-life navigation, Electric newspaper/magazine etc. |
| Transportation | Efficient reciprocating engine vehicle, Hybrid engine vehicle, Bio-alcohol vehicle, Electric vehicle, Plug-in hybrid vehicle, Natural gas vehicle, Fuel cell vehicle, Weight reduction of vehicle, Friction and drag reduction in vehicle, Efficient railway, Efficient ship, Efficient airplane, Intelligent traffic system (ITS), Real-time and security traffic system, Supply-chain management, Virtual communication system etc. |
| Industrial | Efficient technologies for boiler, industrial furnace, Independent Power Plant (IPP), coke oven, and other innovations like Eco-cement, Fluidized catalytic cracking of naphtha, Methane coupling, and Gasification of black liquid. |
| Energy Transformation | Efficient coal-fired generation (IGCC, A-PFBC, Co-combustion with biomass etc), Efficient gas-fired generation, Efficient biomass-fired generation, Wind generation (On-shore, Off-shore), Nuclear power generation, Hydro power generation, By-product hydrogen, Natural gas reforming hydrogen production, Biomass reforming hydrogen production, Electrolysis hydrogen production, Hydrogen station, Hydrogen pipeline, Hydrogen tanker, CCS (Carbon Capture and Storage), etc. |

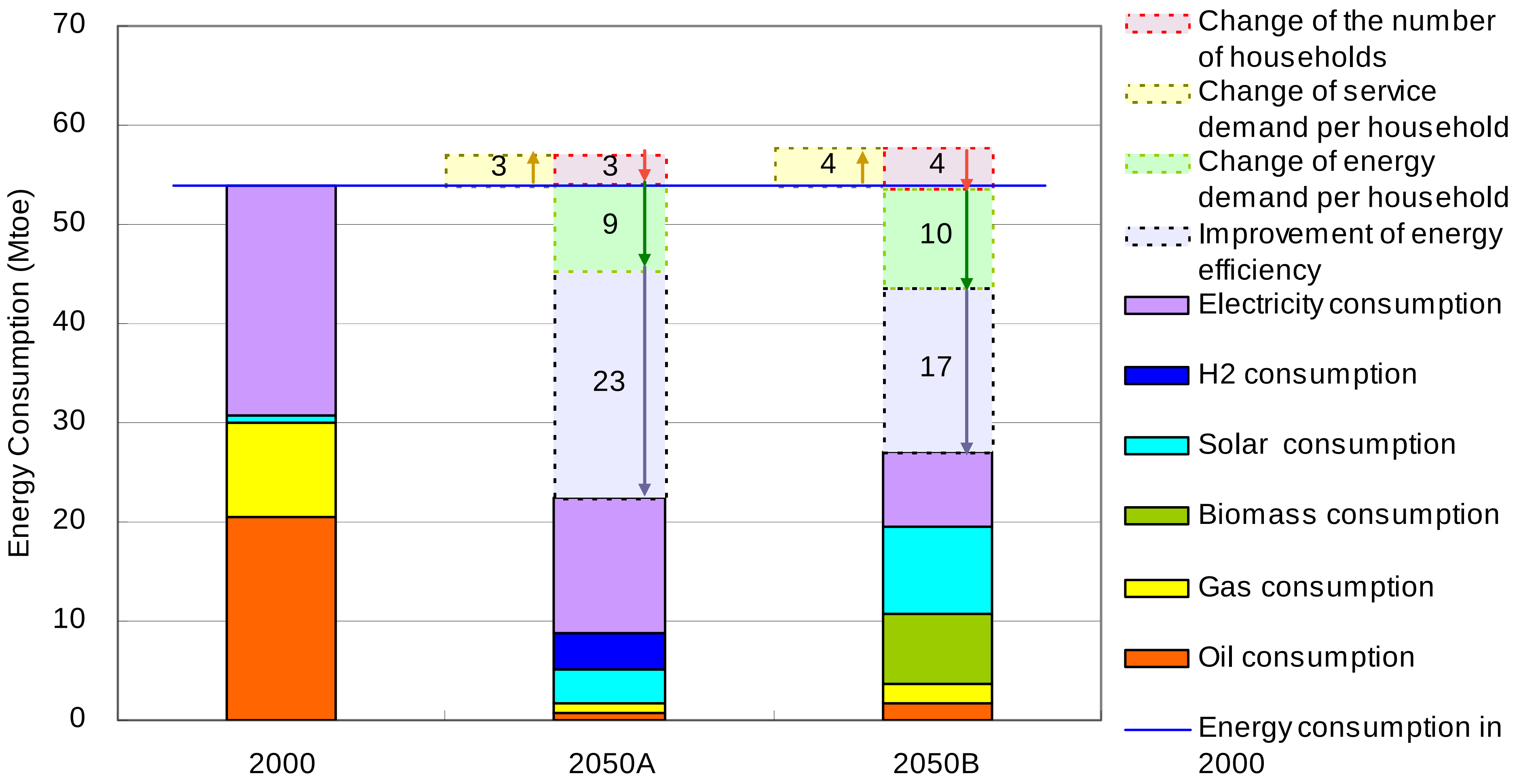


Utilizing solar power
LCS house in 2050
Comfortable and energy-saving house
Photovoltaic
34-69MW
(25-47% house has PV on roof (now 1%))
and develop high efficiency (<30%) PV
Eco-life education
10-20% energy demand reduction
rooftop gardening
High efficiency lighting
【eg LED lighting】
Reduce 1/2 energy demand
Share 100%
Solar heating
Diffusion rate: 20-60%
(currently 8%)
Monitoring system equipped with appliances
High-insulation
Reduce 60% warming energy demand,
share 100%
Super high efficiency air conditioner
COP (coefficients of performance=8),
share 100%
Fuel cell
share 0-20%
Heat-pump heating
COP=5
share 30-70%
Stand-by energy reduction
Reduce 1/3 energy demand,
share 100%
Good information for economy and environment makes people's behavior low-carbon
High efficiency appliances reduce energy demand and support comfortable and safe lifestyle

# Projected energy efficiency improvement: Air-conditioners for cooling and heating



# 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

*Achieving a Sustainable Low-Carbon Society*
*Session 10: Delivering elements of a low carbon society*
*Opportunities for low-carbon transport: (June 15th 2007 )*

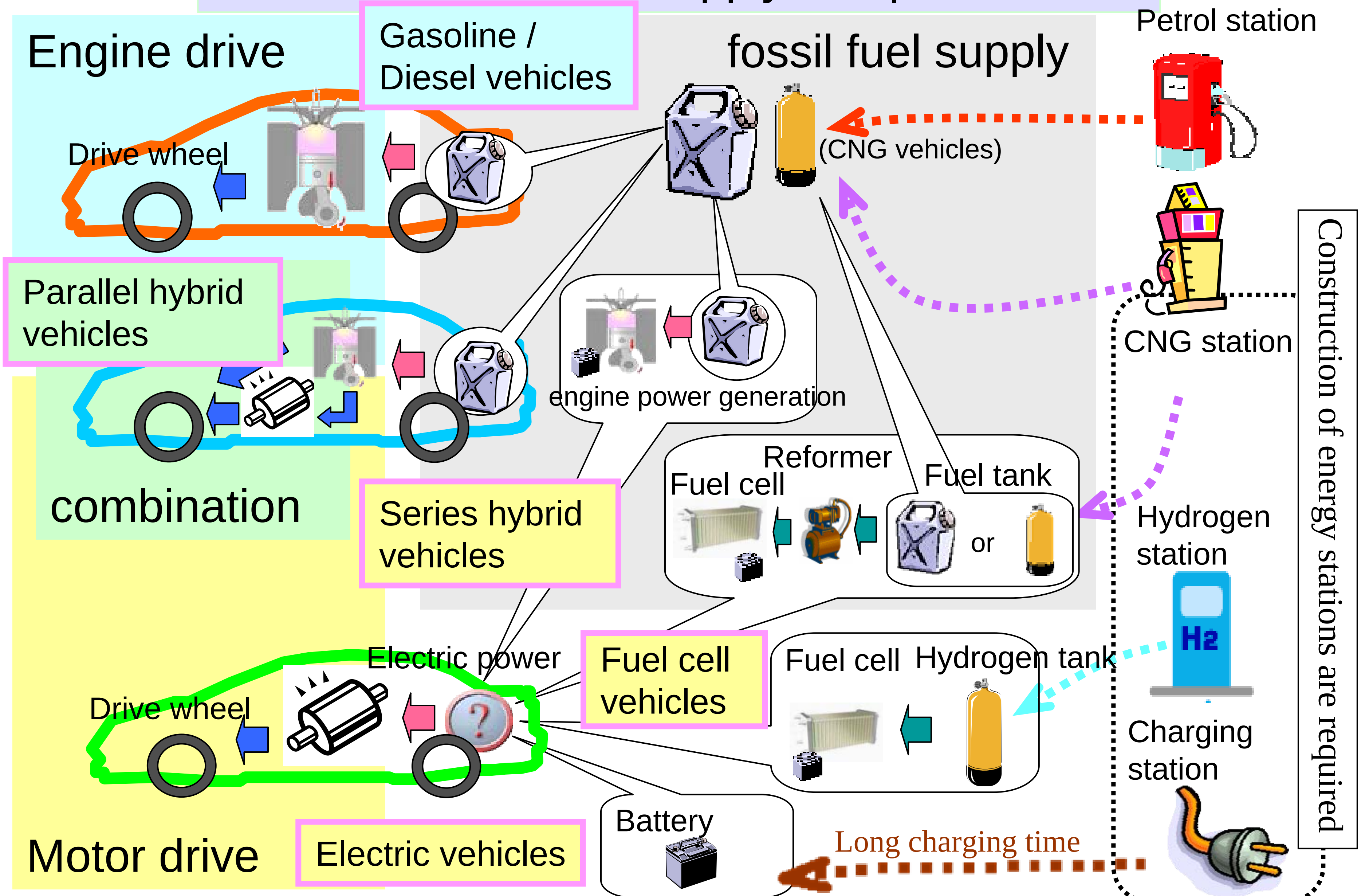
# Long-term $CO_2$ reduction strategy of transport sector in view of technological innovation and behavioural change


**Yuichi Moriguchi**
**Team Leader, Transport Subproject, JLCS2050**

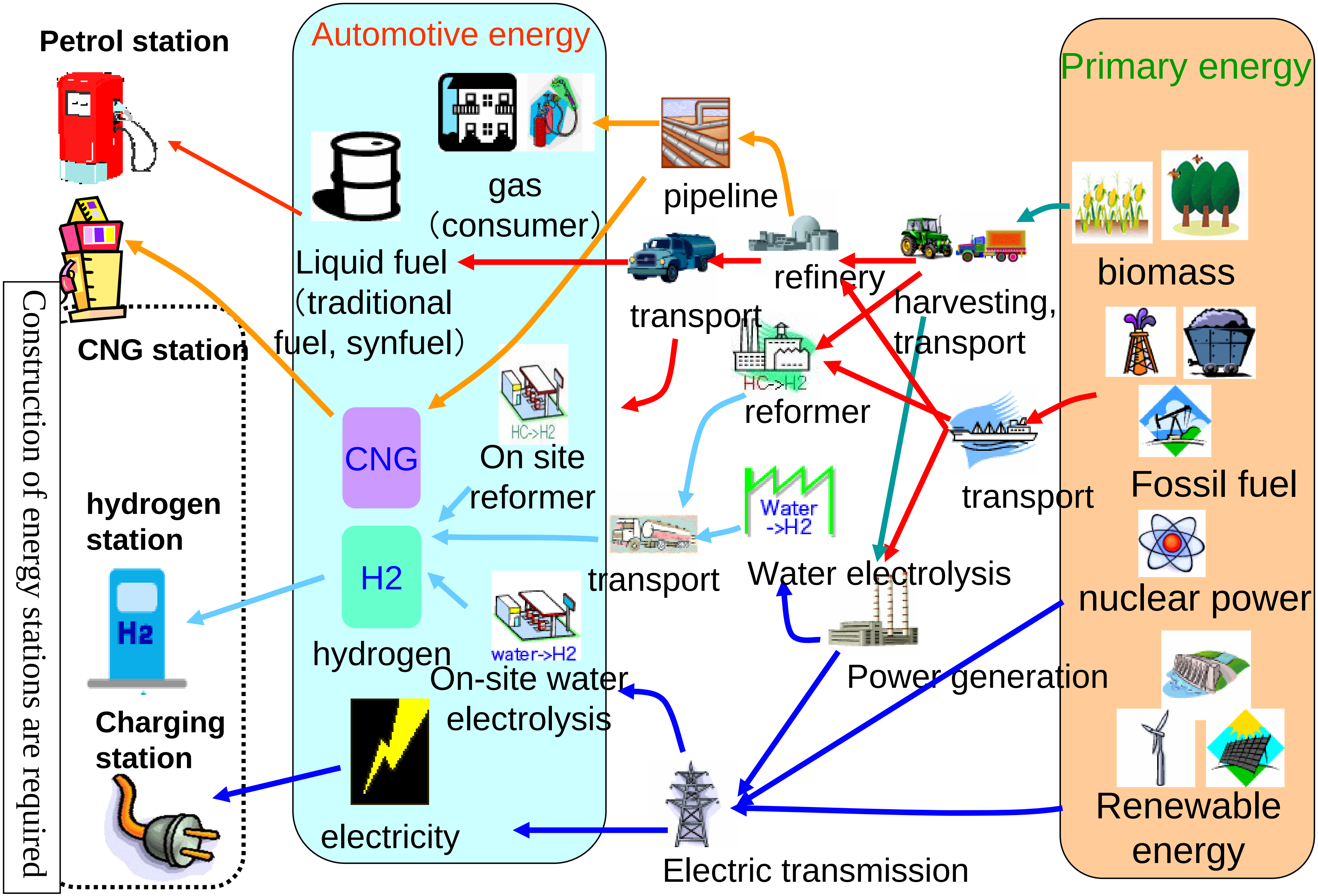
**Director, Research Center for Material Cycles and Waste Management, NIES**
**Chair, OECD/EPOC/WGEIO**

# Automotive technologies altering engine-drive vehicles

## Combination of fuel supply and power-train



# Paths from primary energy to automotive energy



# Combination of countermeasures which reduce 20% each could cause over 70% reduction as total

Demand management
e.g. by information-communication technology
[transport-service per capita]

**(1-0.2)x(1-0.2)x(1-0.2)x(1-0.2)x(1-0.2)x(1-0.2)=0.26**

Modal shift to reduce $CO_2$ EF per passenger-km or ton-km

Improve fuel economy
[Fuel consumption per vehicle-km]

$$\frac{CO_2}{capita} = \frac{TransServ}{capita} \times \frac{Pkm(Tkm)}{TransServ} \times \sum_{Mode}\left(\frac{Vkm}{Pkm(Tkm)} \times \boxed{\frac{Fuel}{Vkm} \times \frac{CO_2EF}{Fuel}}\right)$$

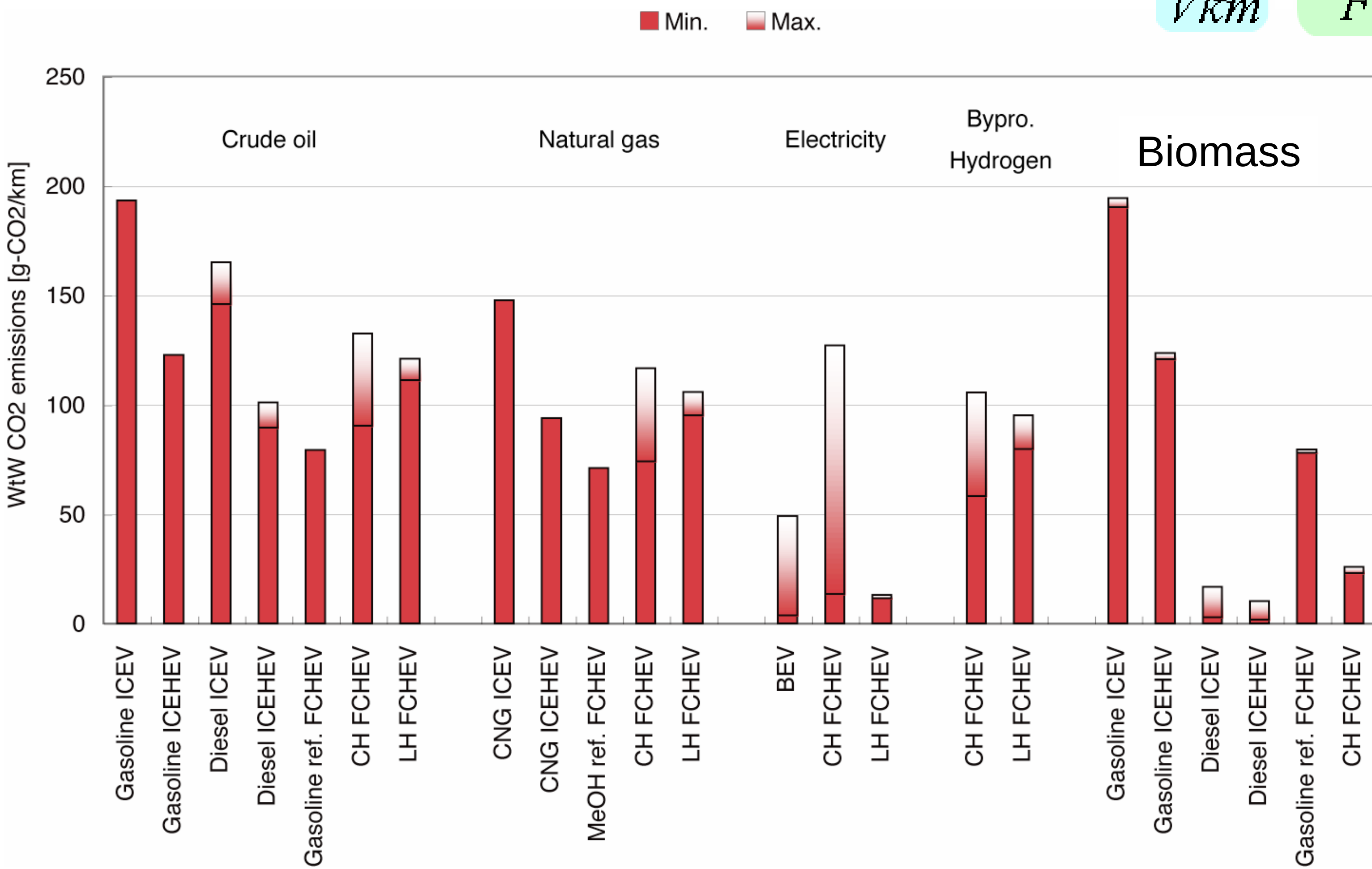
Improve load factor
[vehicle-km per Pkm(Tkm)]

Improve accessibility
[passenger-km or ton-km per transport-service]

Introduce low carbon energy
[$CO_2$ emission factor per fuel consumption]

# Well to wheel $CO_2$ emissions

$$\frac{Fuel}{Vkm} \quad \frac{CO_2EF}{Fuel}$$




- Although $CO_2$ emissions from FCEV are less than HV, FCEV has got problems to be solved such as FC durability, FCEV cost and the way to produce and supply hydrogen. Therefore, wide spread of HVs is thought to be one of the feasible and effective measures in 2020.

JHFC(2007)

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Improve load factor
[vehicle-km per Pkm(Tkm)]

Improve accessibility
[passenger-km or ton-km per transport-service]

Introduce low carbon energy
[$CO_2$ emission factor per fuel consumption]

# TOD (Transit Oriented Development) in local city


Toyama Light Rail(2006.4.26-)

- Lack of public transport for cities of less population than one millions.
- It has been difficult to manage LRT because “self-supporting accounting system” was required.
- Upgrading from traditional tram has started.

# Combination of countermeasures which reduce 20% each could cause over 70% reduction as total

**(1-0.2)x(1-0.2)x(1-0.2)x(1-0.2)x(1-0.2)x(1-0.2)=0.26**

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[Fuel consumption per vehicle-km]

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Improve load factor
[vehicle-km per Pkm(Tkm)]

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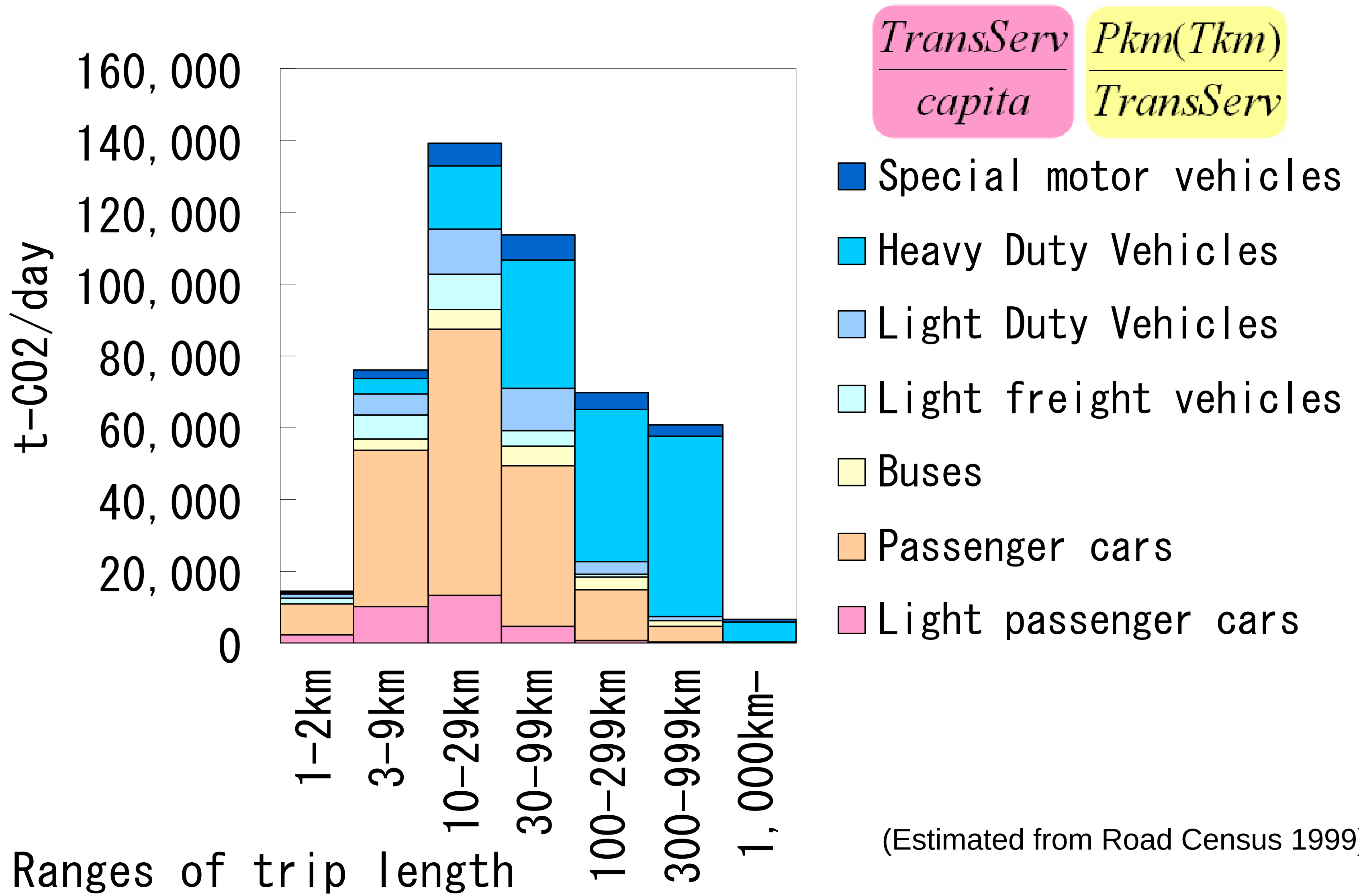
[passenger-km or ton-km per transport-service]

Introduce low carbon energy
[$CO_2$ emission factor per fuel consumption]

# $CO_2$ emissions of each vehicle category by trip length ranges




(Estimated from Road Census 1999)

# Combination of countermeasures which reduce 20% each could cause over 70% reduction as total

Demand management
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**(1-0.2)x(1-0.2)x(1-0.2)x(1-0.2)x(1-0.2)x(1-0.2)=0.26**

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Improve load factor
[vehicle-km per Pkm(Tkm)]

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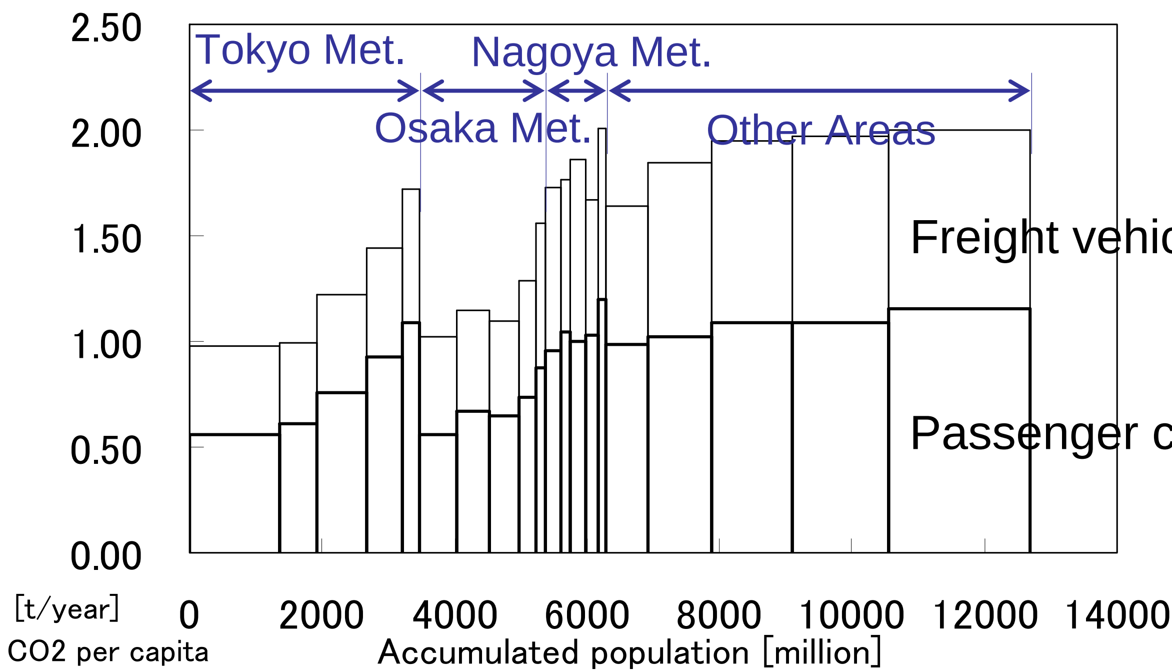
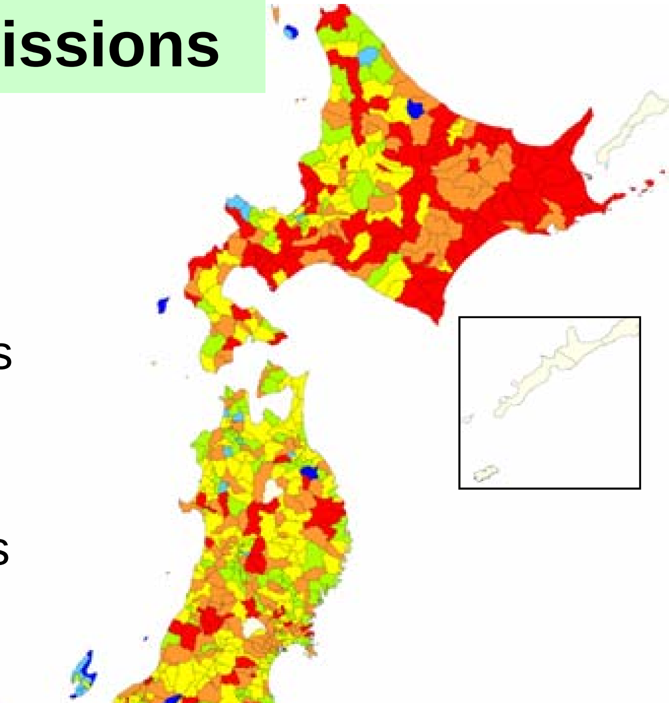
[passenger-km or ton-km per transport-service]

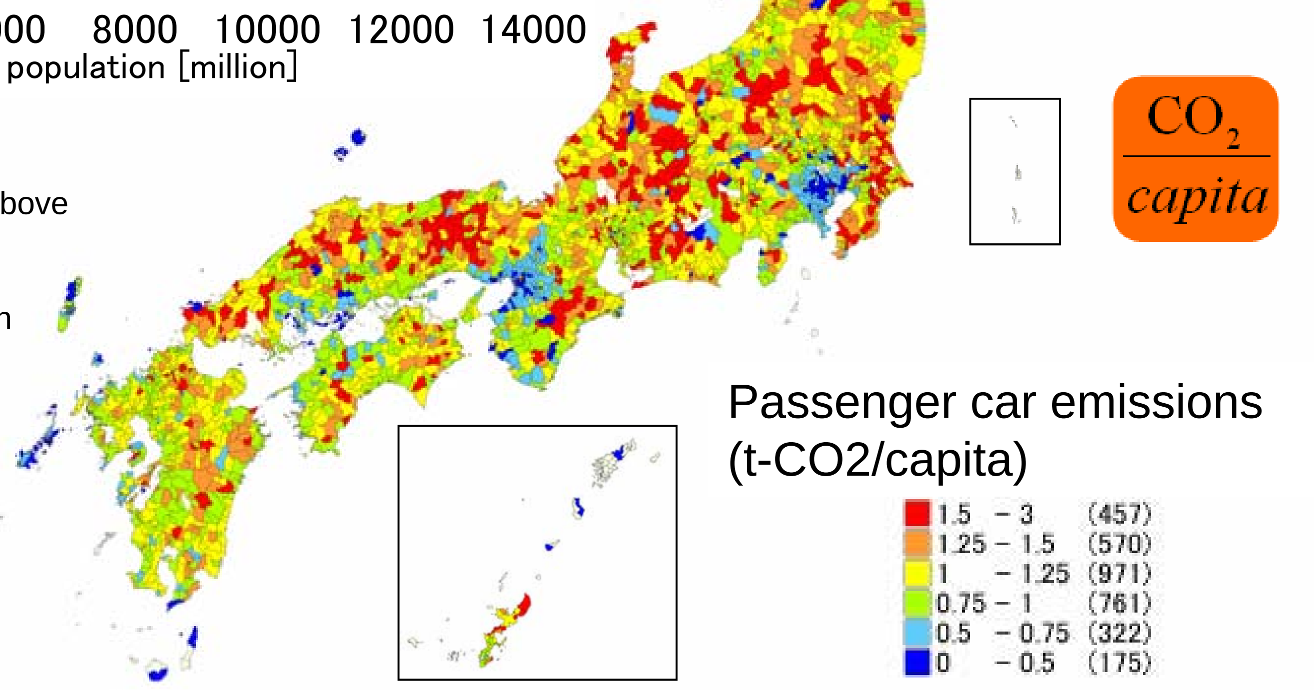
Introduce low carbon energy
[$CO_2$ emission factor per fuel consumption]

# Estimated regional automotive $CO_2$ emissions

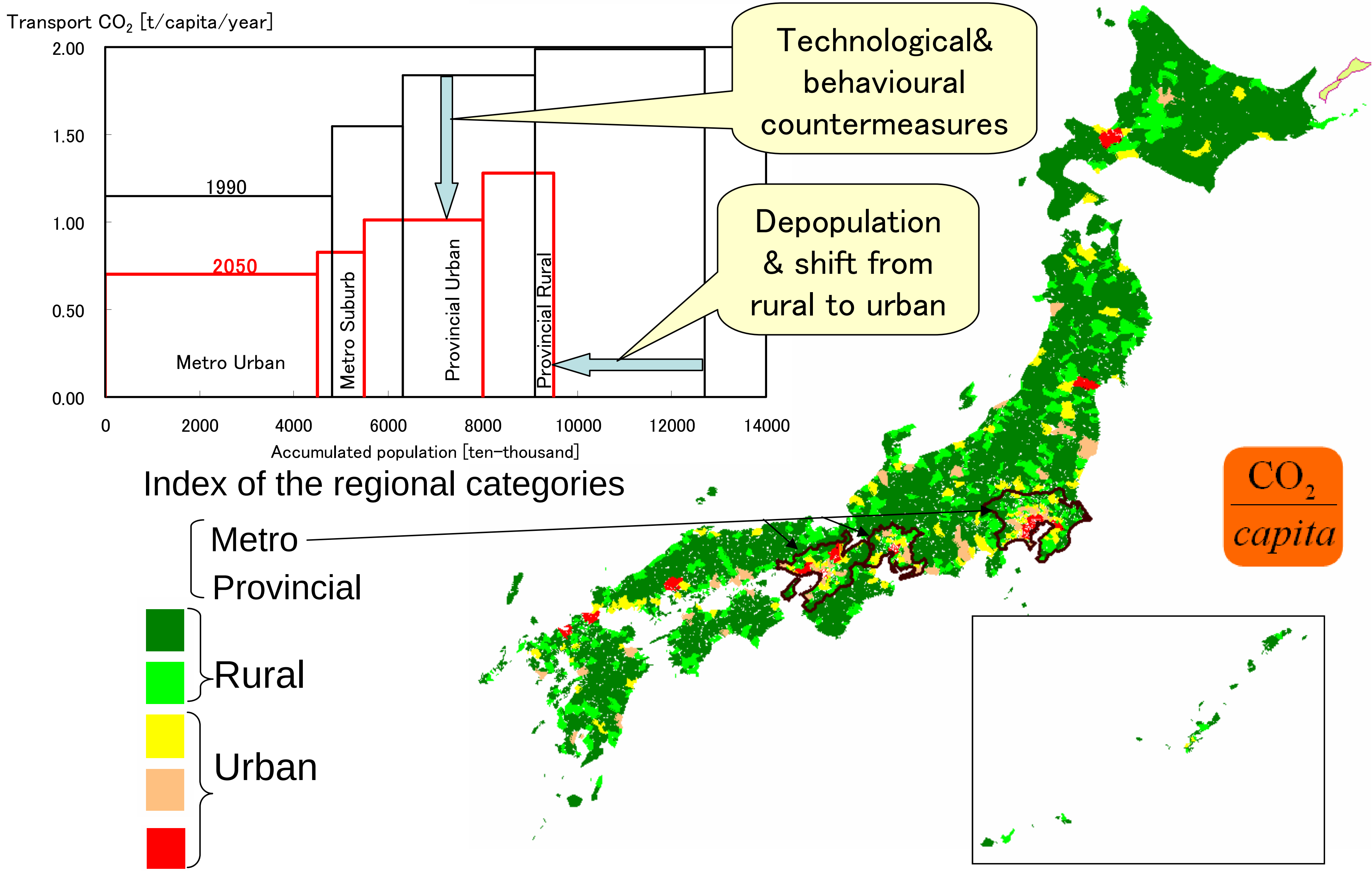



Each Area is categorized in
1. Major cities
2. Cities with a pop of 0.5 million and above
3. Cities with a pop of 0.3 and above
4. Cities with a pop of 0.1 and above
5. Cities with a pop less than 0.1 million
6. Counties





# LCS2050: a draft vision (Regional emissions)



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Improve load factor
[vehicle-km per Pkm(Tkm)]

Improve accessibility
[passenger-km or ton-km per transport-service]

Introduce low carbon energy
[$CO_2$ emission factor per fuel consumption]

# New concepts for personal mobility

$$\frac{Vkm}{Pkm(Tkm)} \quad \frac{Fuel}{Vkm} \quad \frac{CO_2EF}{Fuel}$$

the Segway Human Transporter

Yamaha EC-02

Kawamura cycle KE

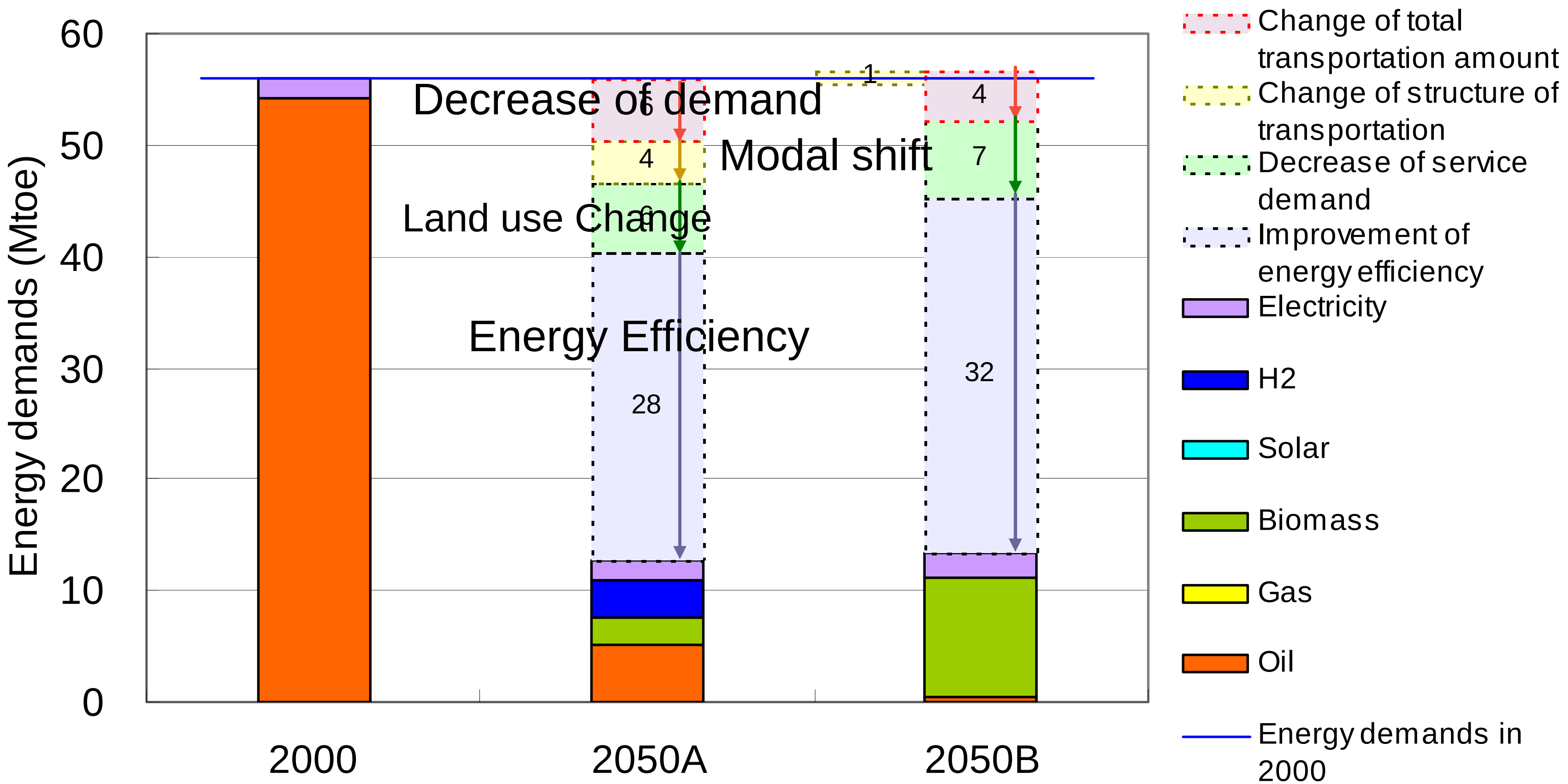
Toyota i-Swing

(catalog information)

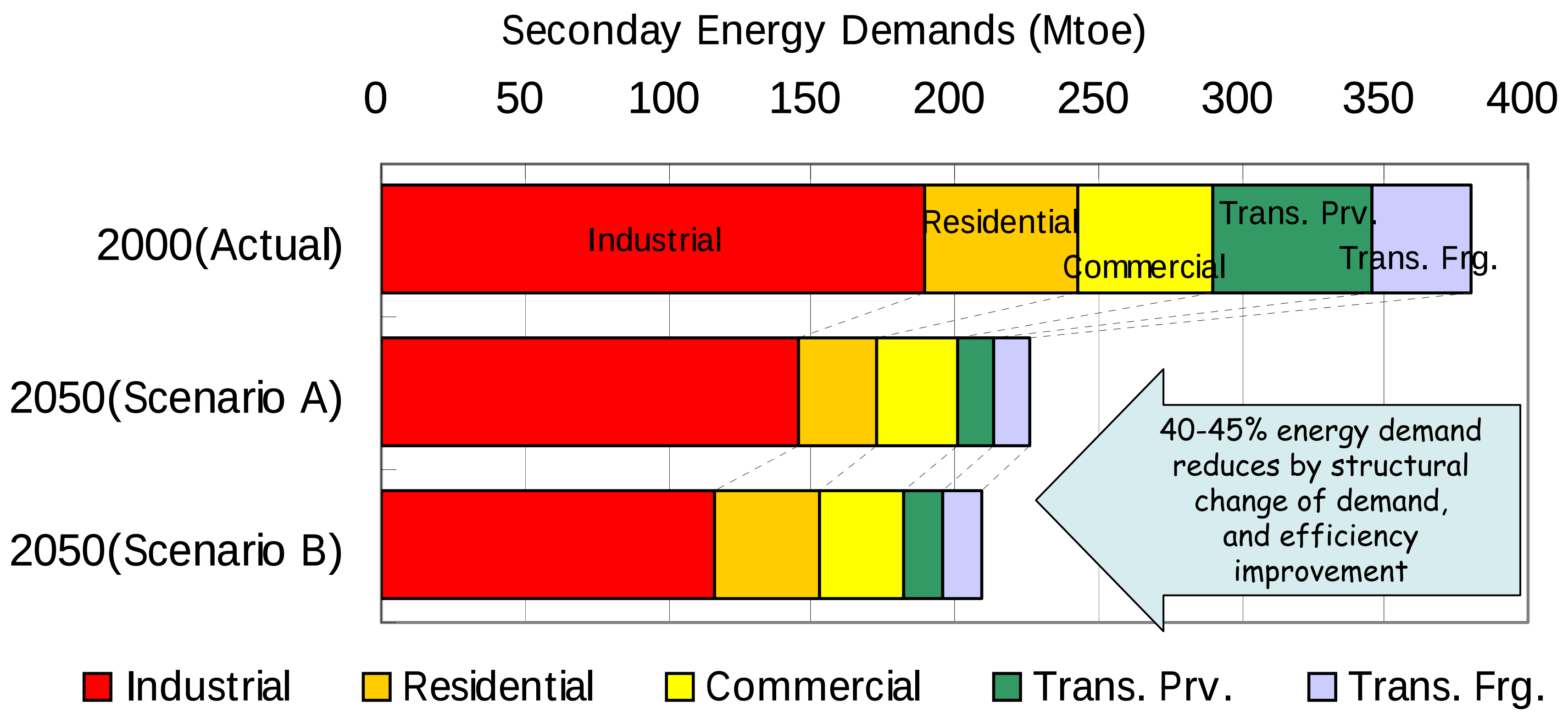
# LCS2050: a draft vision

| | | Metro Urban | Metro Suburb | Provincial Urban | Provincial Rural | total |
|---|---|---|---|---|---|---|
| $\frac{TransServ}{capita}$ | Compact neighborhood | △less room for improve. | ○ Rehabilitation | ○ Rehabilitation | ○Compact Settlement | 217−>63Mt<br>To 1990<br>− 71%<br>Index:<br>◎: − 30%<br>○: − 20%<br>△: − 10%<br>×: no room<br>※Freight and regional transports are to be considered. |
| $\frac{Pkm(Tkm)}{TransServ}$ | Compact city | △City center renewal | × | △City center renewal | × | |
| $\sum_{Mode}$ | Enhance public transit | × passenger<br>△freight | △Park & Ride etc. | ○LRT | △van pool, shared taxi | |
| $\frac{Vkm}{Pkm(Tkm)}$ | Improve load efficiency | △Utilize small vehicles | △Utilize small vehicles | △Enhance sharing | × | |
| $\frac{Fuel}{Vkm}$ | Improve fuel consumption | ◎Urban mode | ◎Urban mode | ○local mode | ○local mode | |
| $\frac{CO_2EF}{Fuel}$ | Low carbon energy | △less room for improve | ○ | ○ | ○ | |
| $\frac{CO_2}{capita}$ | pop(million) | 46→45 | 15→10 | 27→25 | 35→15 | 124→95 |
| | t-$CO_2$/capita | 1.27→0.56 | 1.72→0.62 | 2.04→0.68 | 2.20→1.01 | 1.76→0.67 |

# Passenger transportation
# $CO_2$ reduction potential: 80%



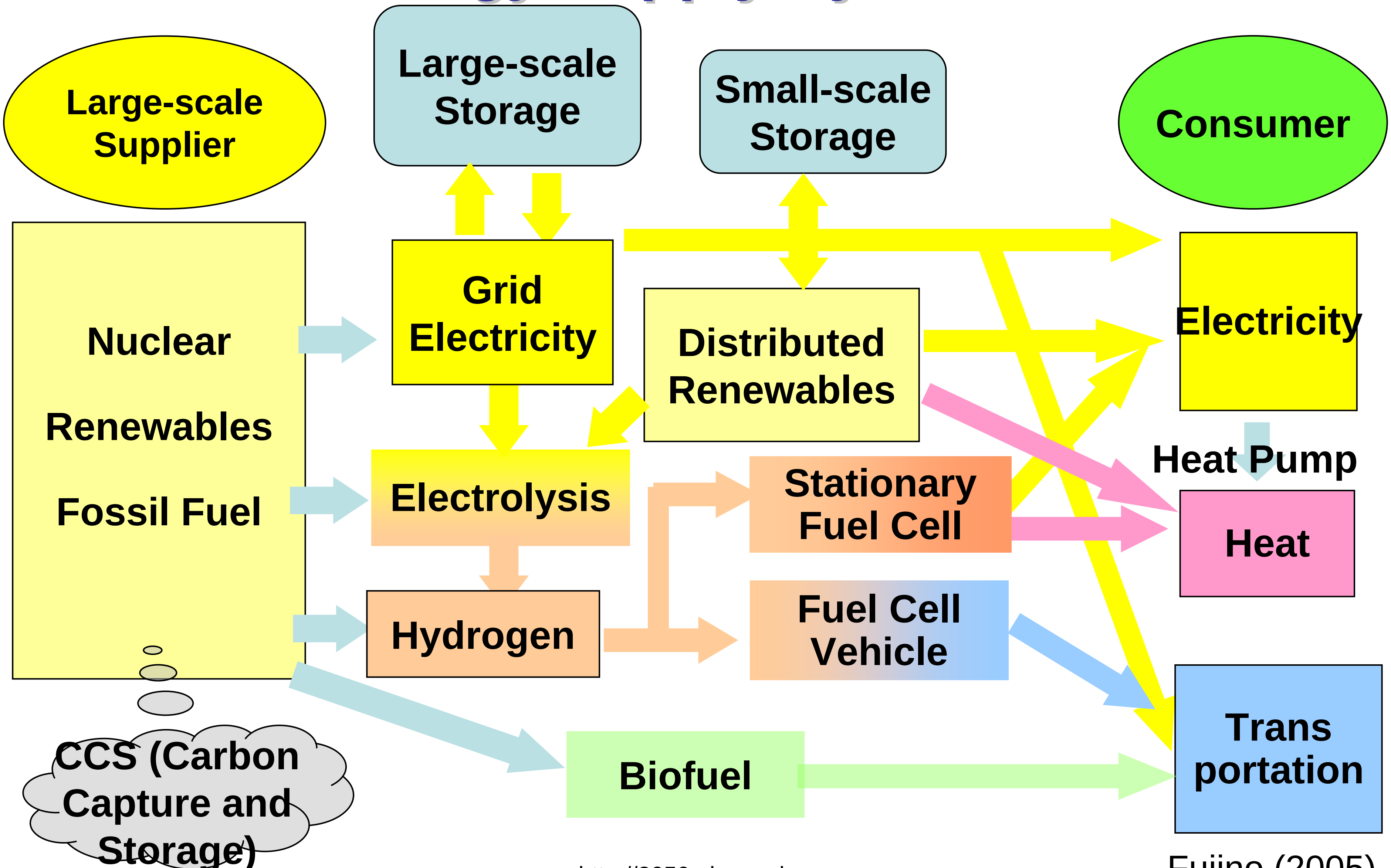
# Energy demands for achieving 70% reduction of $CO_2$ emissions




Trans.Prv.: Transportation (Private), Trans.Frg.: Transportation (Freight)

**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%**

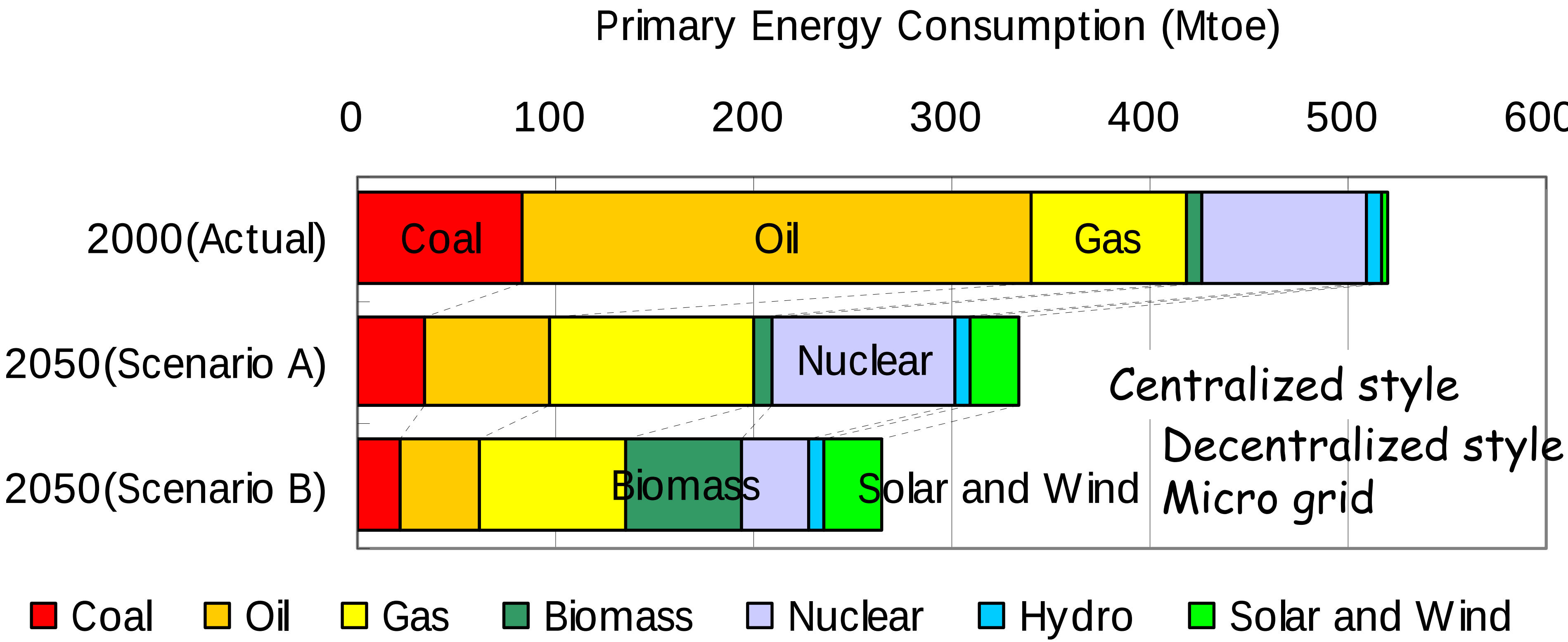
# What is Low Carbon Energy Supply System?




http://2050.nies.go.jp

Fujino (2005)

# Energy supply for achieving 70% reduction of $CO_2$ emissions

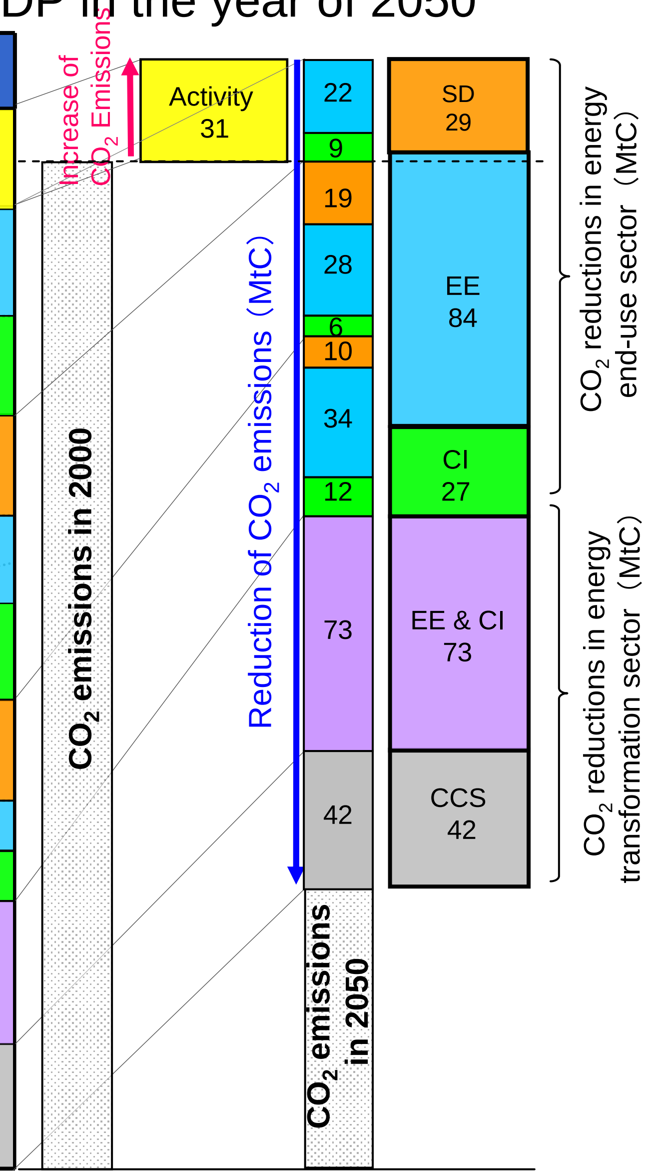


http://2050.nies.go.jp/interimreport/20070215_report_e.pdf

# 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 1% of GDP in the year of 2050

| | Main factors to reduce $CO_2$ emissions | Factors Class. |
|---|---|---|
| Society | • High economic growth<br>• Decrease of population and number of households | Demand growth by activity level change |
| Industrial | • Energy efficient improvement of furnace and motor etc. | Energy Efficiency Imp. (EE) |
| | • Fuel switching from coal/oil to natural gas | Carbon Intensity Imp. (CI) |
| Residential and commercial | • High insulation dwelling and building<br>• Home/Building energy management system | Reduction of service demands (SD) |
| | • Efficient air-conditioner, Efficient water heater, Efficient lighting system<br>• Fuel cell system<br>• Photovoltaic on the roof | Energy Efficiency Imp. (EE)<br>Carbon Intensity Imp. (CI) |
| Trans-portation | • Intensive land-use, Concentrated urban function<br>• Public transportation system | Reduction of service demands (SD) |
| | • Motor-driven mobiles: Electric battery vehicles, Fuel cell battery vehicles | EE & CI |
| Energy Transformation | • Nuclear energy<br>• Effective use of electricity in night time with storage<br>• Hydrogen supply with low-carbon energy sources | Carbon Intensity Imp. (CI) |
| | • Advanced fossil fueled plants + CCS<br>• Hydrogen supply using fossil fuel + CCS | Carbon Capture and Storage (CCS) |




EE: Energy Efficiency Improvement, CI: Carbon Intensity Improvement, SD: Reduction of Service Demand

# LCS has many co-benefits:

- Avoid climate change such as extraordinary climate change, positive feedback.
- Use disposal resources efficiently to reduce risks and avoid battles.
- Develop LCS innovation to support global sustainable development.
- Build safe and sound society considering land-use and city planning for ordinary citizens.

**We need good institutions to enhance people who has efforts for these activity**

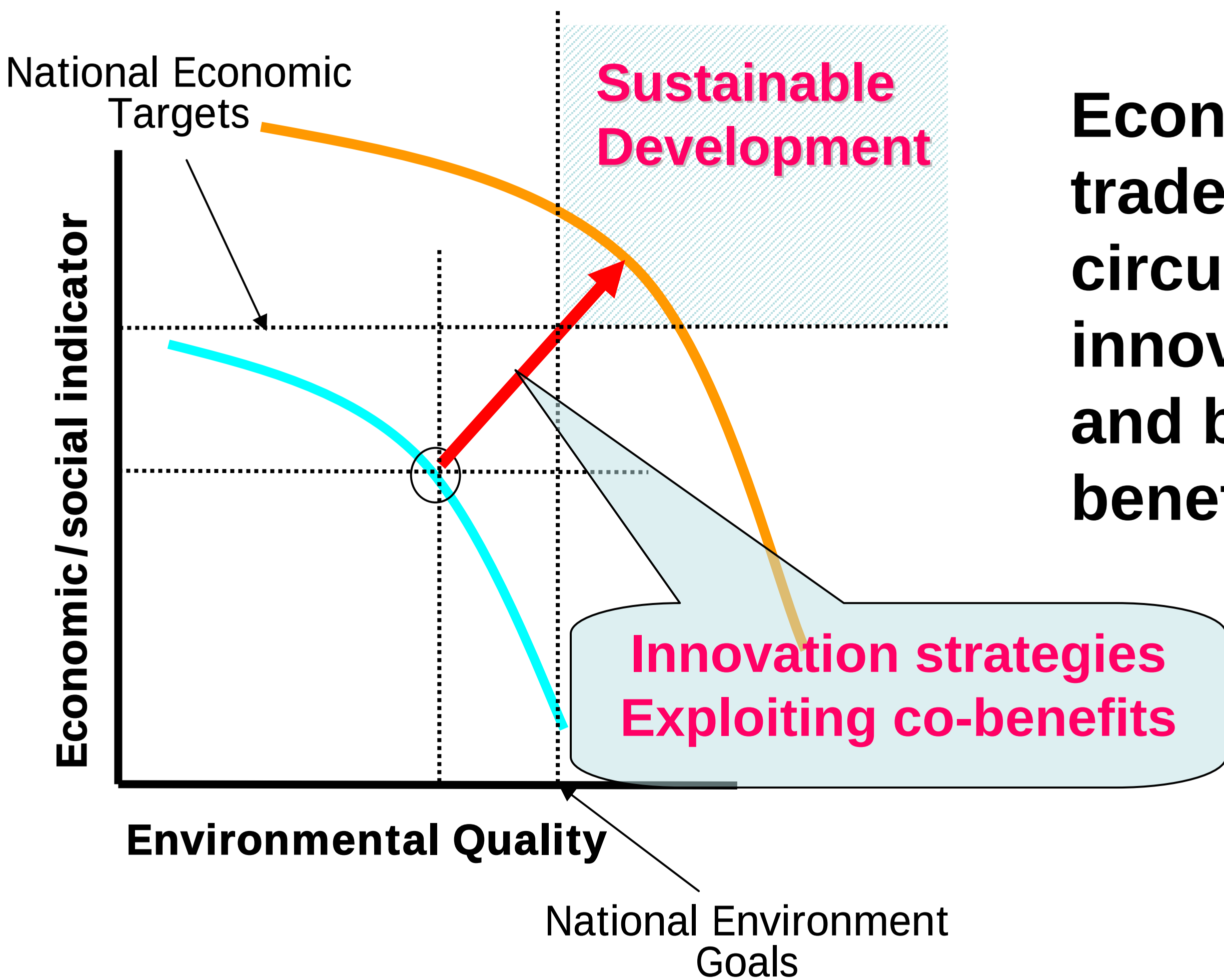
# Why we develop
# Japan LCS Scenarios?

1. Why we need LCS?
2. Can Japan achieve LCS toward 2050?
3. How to structure global participation?

Japan
Low Carbon
Society 2050

http://2050.nies.go.jp

**"Aligning sustainable development & climate change actions can reduce the burden and facilitate the transition to stabilization. LCS is technologically and economically feasible."**




**Economy-environment trade-off can be circumvented with innovative strategies and by exploiting co-benefits**

# 1st workshop on Japan – UK Joint Research Project Developing visions for a Low Carbon Society (LCS) through sustainable development

54 Participants from 19 countries and 6 international organizations;
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

**A First workshop was held in Tokyo, June13-16, 2006.**

# Japan-UK Joint Research Project
# LCS through Sustainable Development for Global Participation

**A First workshop was held in Tokyo, June14-16, 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

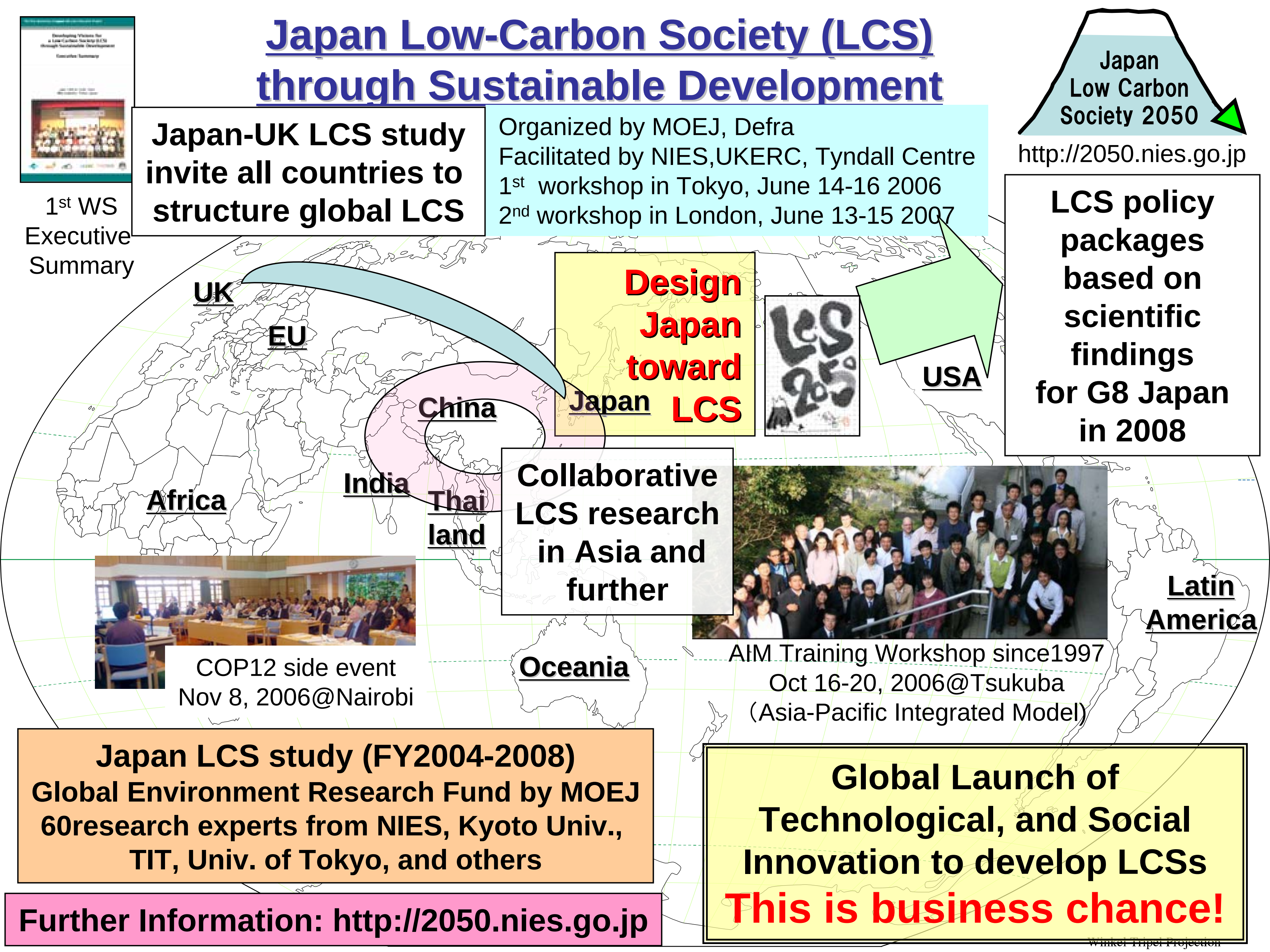
**G8 Gleneagles 2005**

**G8 Japan July 2008**

**A Second workshop was held in London, June13-15, 2007.**

**A Third workshop will be held in Japan, Feb13-15, 2008.**

**Developing and Diffusing Innovations for our good life and LCS through SD**



Japan Low-Carbon Society (LCS)
through Sustainable Development
1st WS
Executive
Summary
Japan-UK LCS study
invite all countries to
structure global LCS
Organized by MOEJ, Defra
Facilitated by NIES,UKERC, Tyndall Centre
1st workshop in Tokyo, June 14-16 2006
2nd workshop in London, June 13-15 2007
Japan
Low Carbon
Society 2050
http://2050.nies.go.jp
LCS policy
packages
based on
scientific
findings
for G8 Japan
in 2008
Design
Japan
toward
LCS
UK
EU
China
Japan
India
Thai
land
Africa
USA
Oceania
Latin
America
Collaborative
LCS research
in Asia and
further
COP12 side event
Nov 8, 2006@Nairobi
AIM Training Workshop since1997
Oct 16-20, 2006@Tsukuba
(Asia-Pacific Integrated Model)
Japan LCS study (FY2004-2008)
Global Environment Research Fund by MOEJ
60research experts from NIES, Kyoto Univ.,
TIT, Univ. of Tokyo, and others
Global Launch of
Technological, and Social
Innovation to develop LCSs
This is business chance!
Further Information: http://2050.nies.go.jp
Winkel Tripel Projection

# Why we develop Japan LCS Scenarios?

1. Why we need LCS?
2. Can Japan achieve LCS toward 2050?
3. How to structure global participation?

Japan Low Carbon Society 2050

http://2050.nies.go.jp

# Two stages of making LCS's scenarios

Stage one: 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 policy measures and packaging the measures

Stage two : Construction of a policy roadmap toward the Low Carbon Society

1) Design of policy roadmaps toward the Low Carbon Society
2) Feasibility analysis of the roadmaps considering uncertainties involved in element policies
3) Analysis of robustness of the roadmap caused by societal, economical and institutional uncertainties and acceptability

# What do you want to do now for our future?

Christmas Concert of Yoko Fujino's Piano Class on Dec 23, 2005

# Further Information:

## Japan 2050 LCS homepage

**http://2050.nies.go.jp**

## Japan Scenarios towards Low-Carbon Society (LCS) -Feasibility study for 70% CO2 emission reduction by 2050 below 1990 level- (2007.2)

**http://2050.nies.go.jp/interimreport/20070215_report_e.pdf**

## Aligning Climate Change and Sustainability - Scenarios, modeling and policy analysis – (2007.3)

**http://www-cger.nies.go.jp/publication/I072/I072.pdf**

## Proceedings of the First Workshop of Japan-UK Joint Research Project “Developing Visions for a Low-Carbon Society through Sustainable Development” (2007.1)

**http://www-cger.nies.go.jp/publication/I071/I071.pdf**