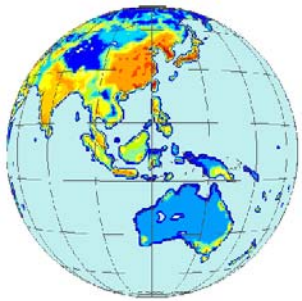


Energy and Climate Change Mitigation in Japan

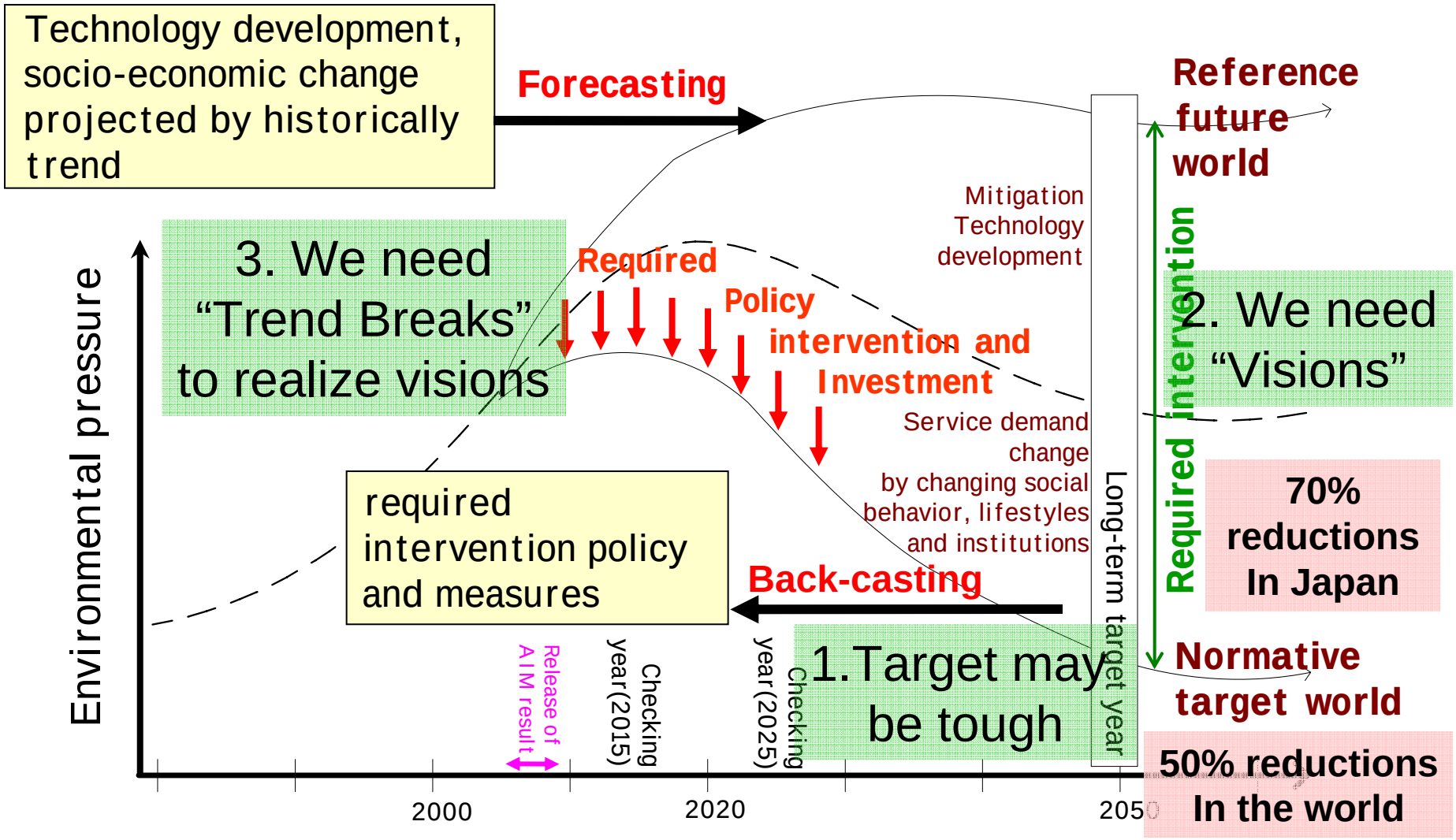
Mikiko Kainuma and Toshihiko Masui
National Institute for Environmental Studies

GTSP Technical Review
Pacific Northwest National laboratory
Washington, May 23, 2007

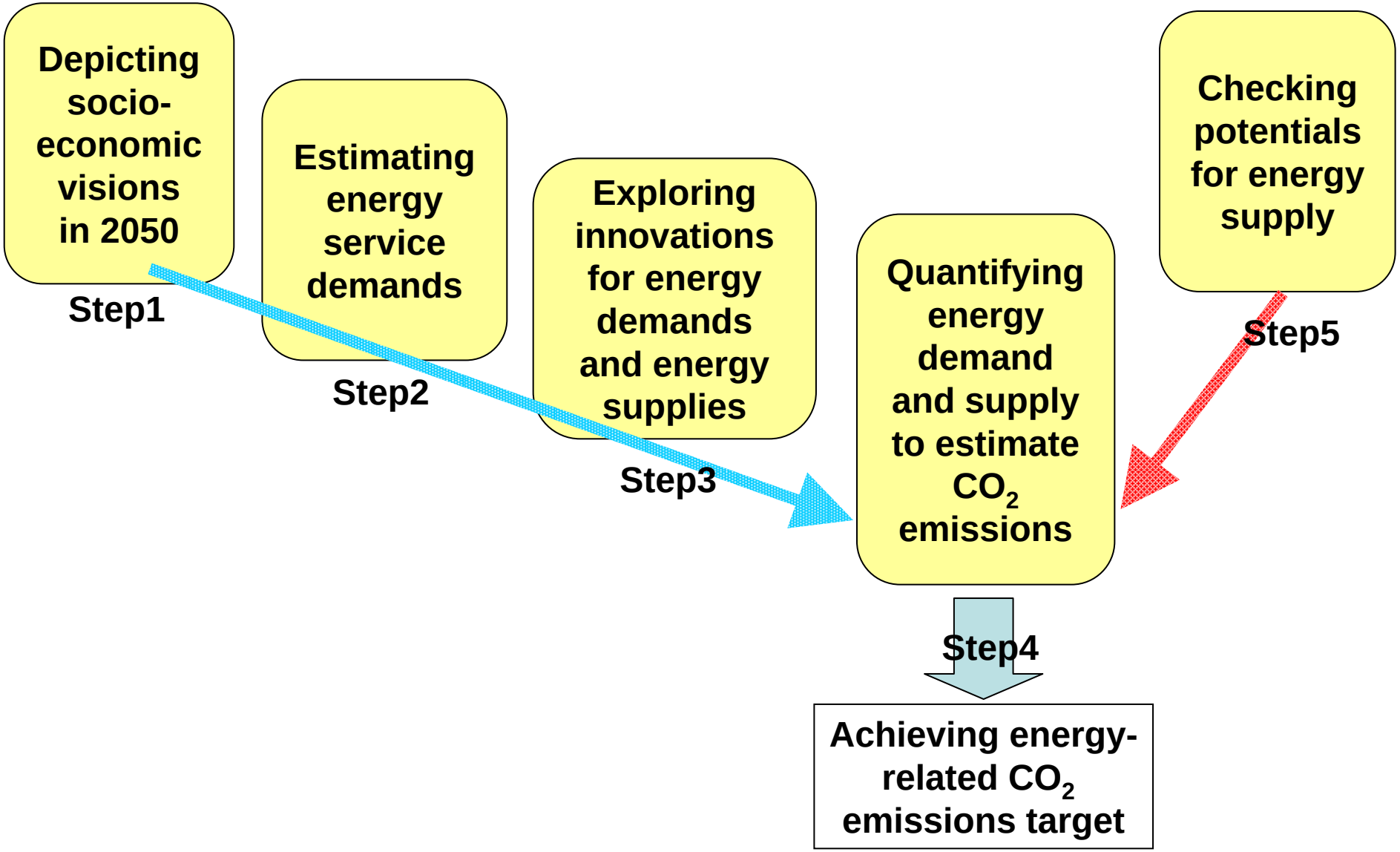
http://2050.nies.go.jp, http://www-iam.nies.go.jp/aim/

A Low-Carbon project

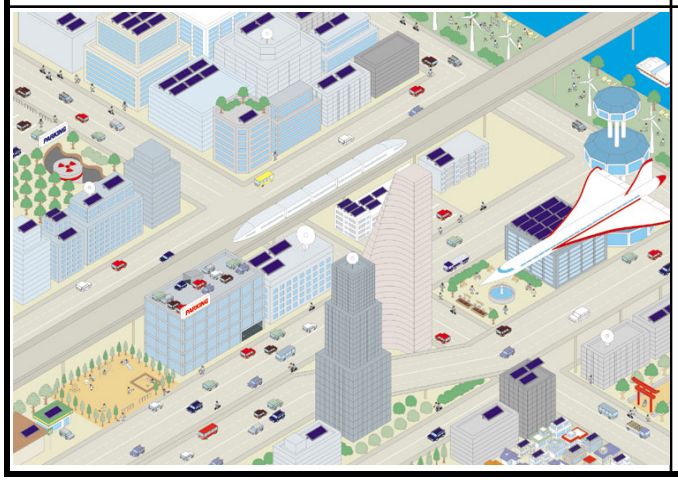
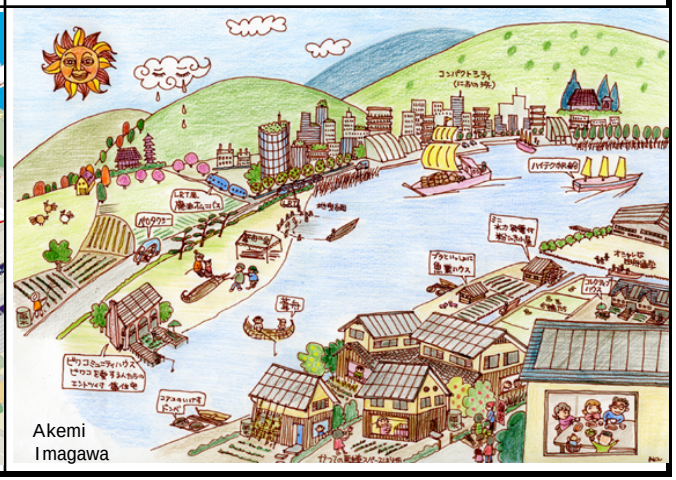
Forecasting from now and Backcasting from future prescribed/normative world



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



Two different visions for societies in 2050 in Japan

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
	

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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.

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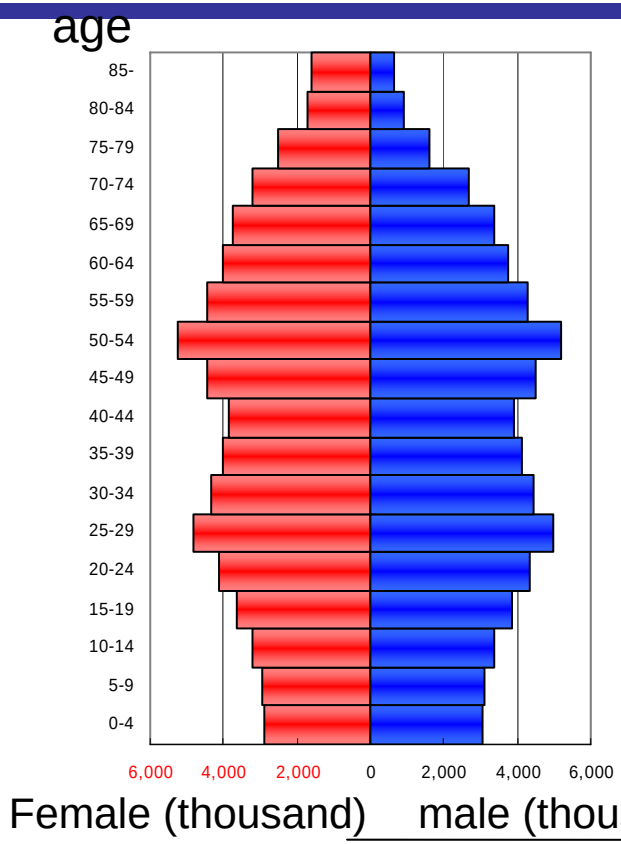
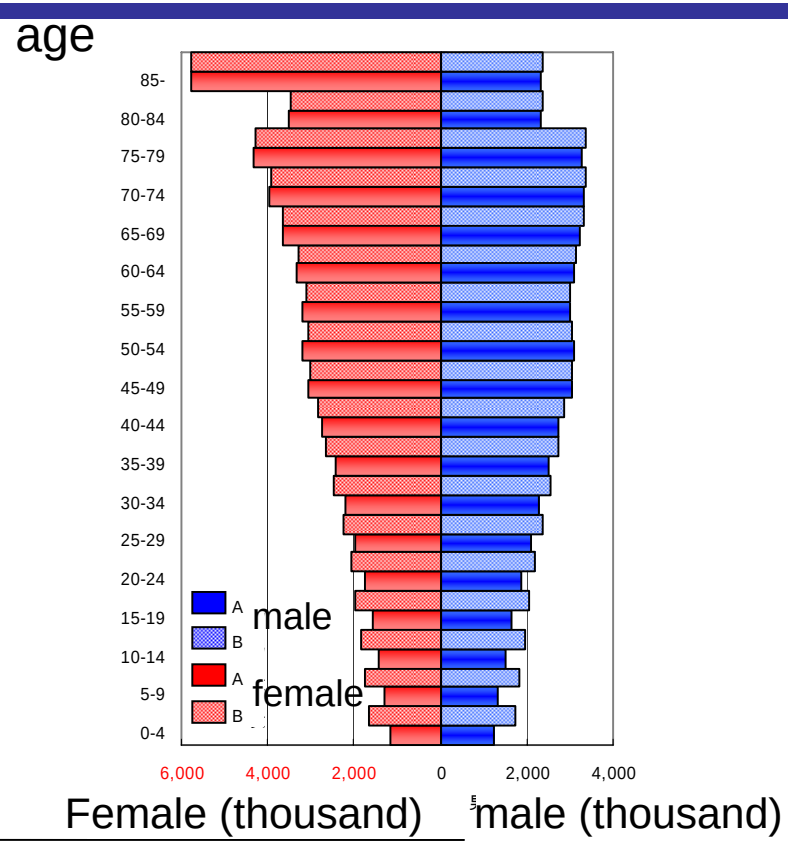
Satsuki and Mei's House reproduced in the 2005 World Expo. Satsuki and Mei are daughters in the film "My Neighbor Totoro". They lived an old house in rural Japan, near which many curious and magical creatures inhabited.

Population and GDP in Japan

Demographic Transitions in Japan: Age/Gender Profile

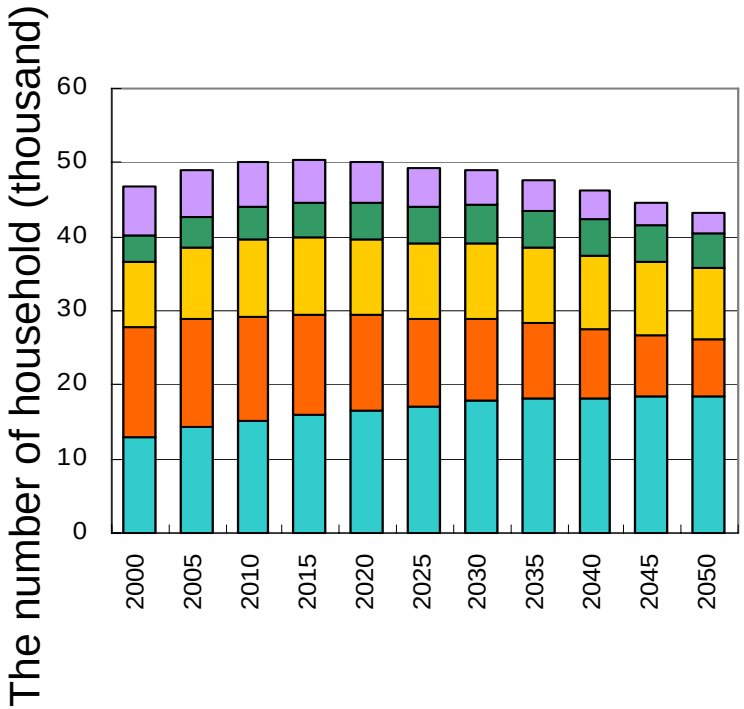




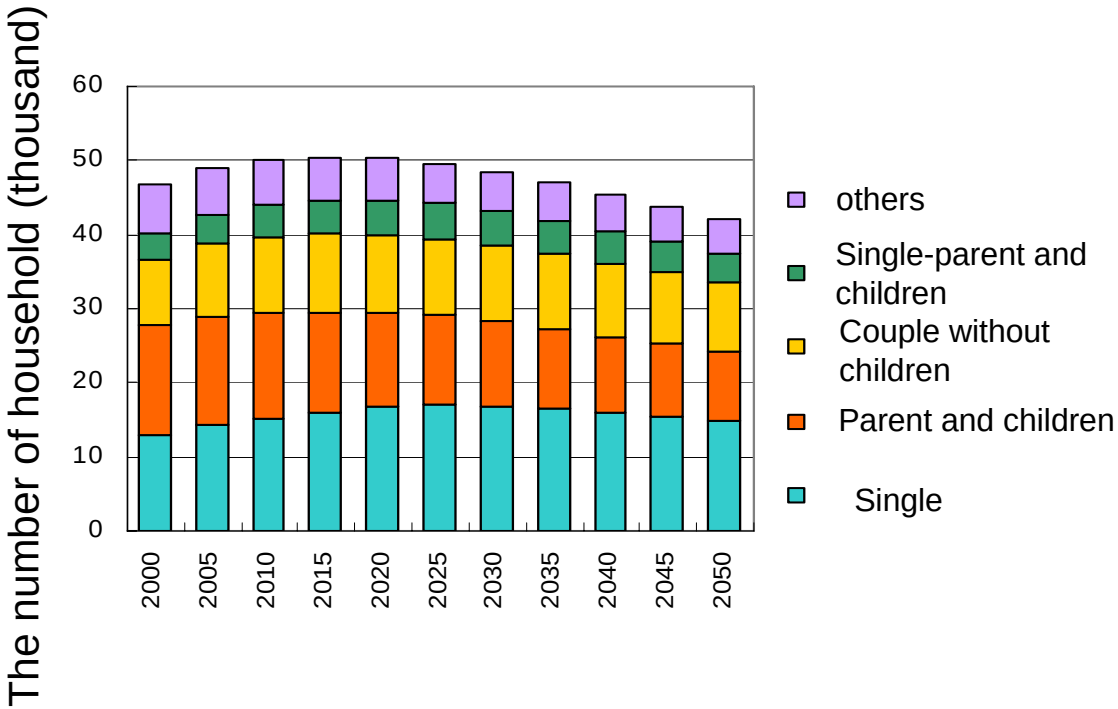
year	2000	2050	
		A	B
Population (million)	126.9	94.5	100.3
Aged population ratio (%)	17.4	38	35.8
Average member of household	2.71	2.19	2.38
Single-person households (%)	27.6	42.6	35.1

Population and GDP in Japan

Demographic Transitions in Japan: household Profile



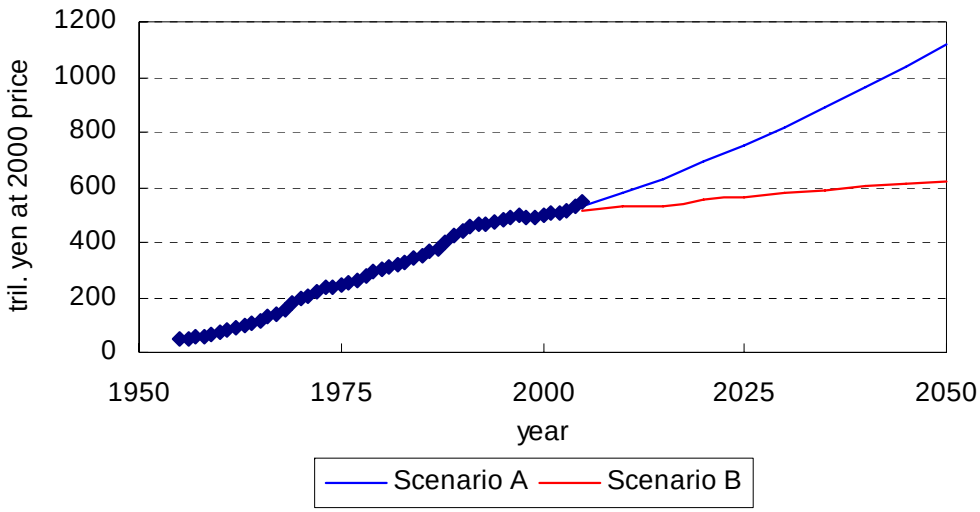
Scenario A



Scenario B

Population and GDP in Japan

GDP projection

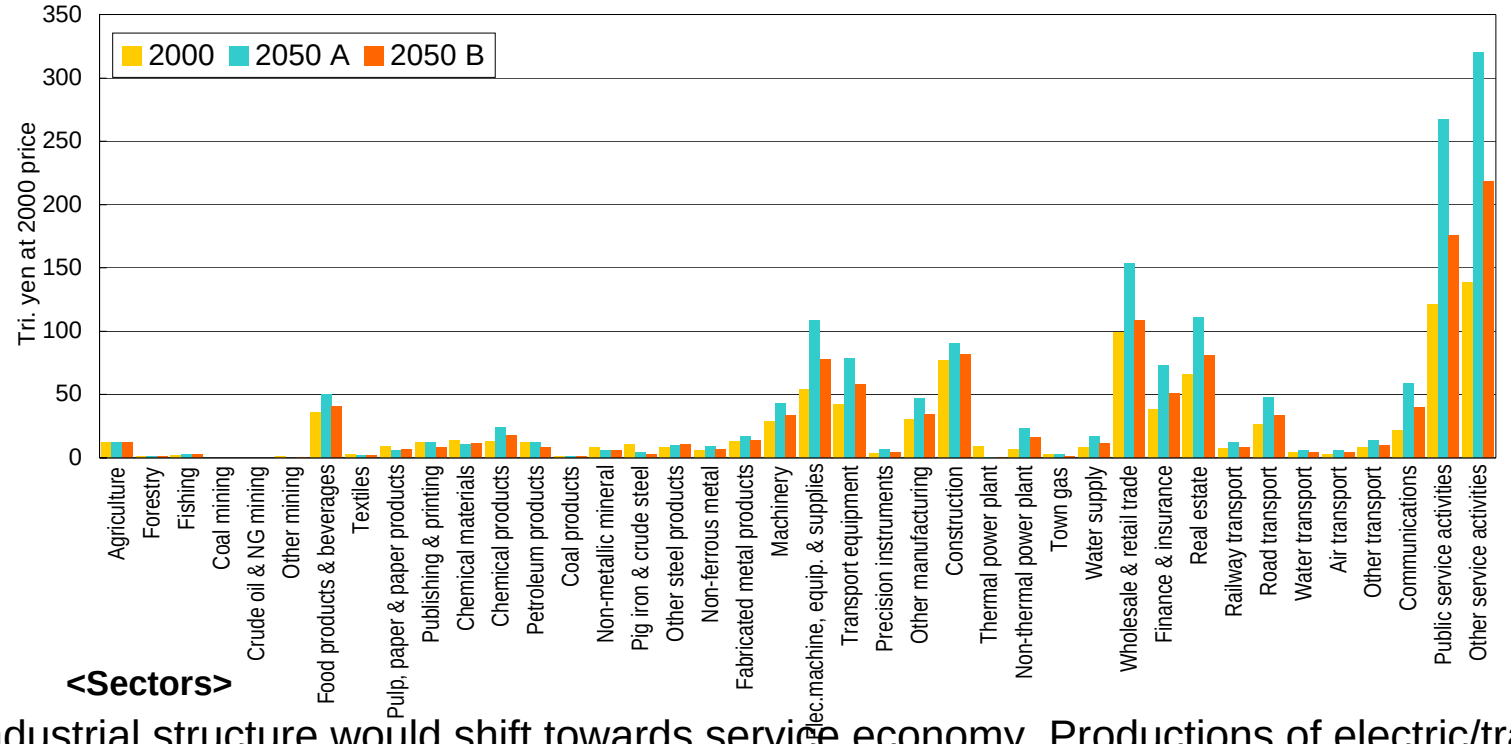


Annual GDP growth rate
- Scenario A: approximately 2% of GDP per capita
- Scenario B: Approximately 1% of GDP per capita

In scenario A, the production of primary industries and secondary industries will increase. Nevertheless, it is estimated that 20% of energy savings can be achieved through reduced output of energy-incentive raw materials and energy efficiency improvements. In scenario B, it is estimated that further 40% of energy reduction is possible by industrial transformations and energy efficiency improvement.

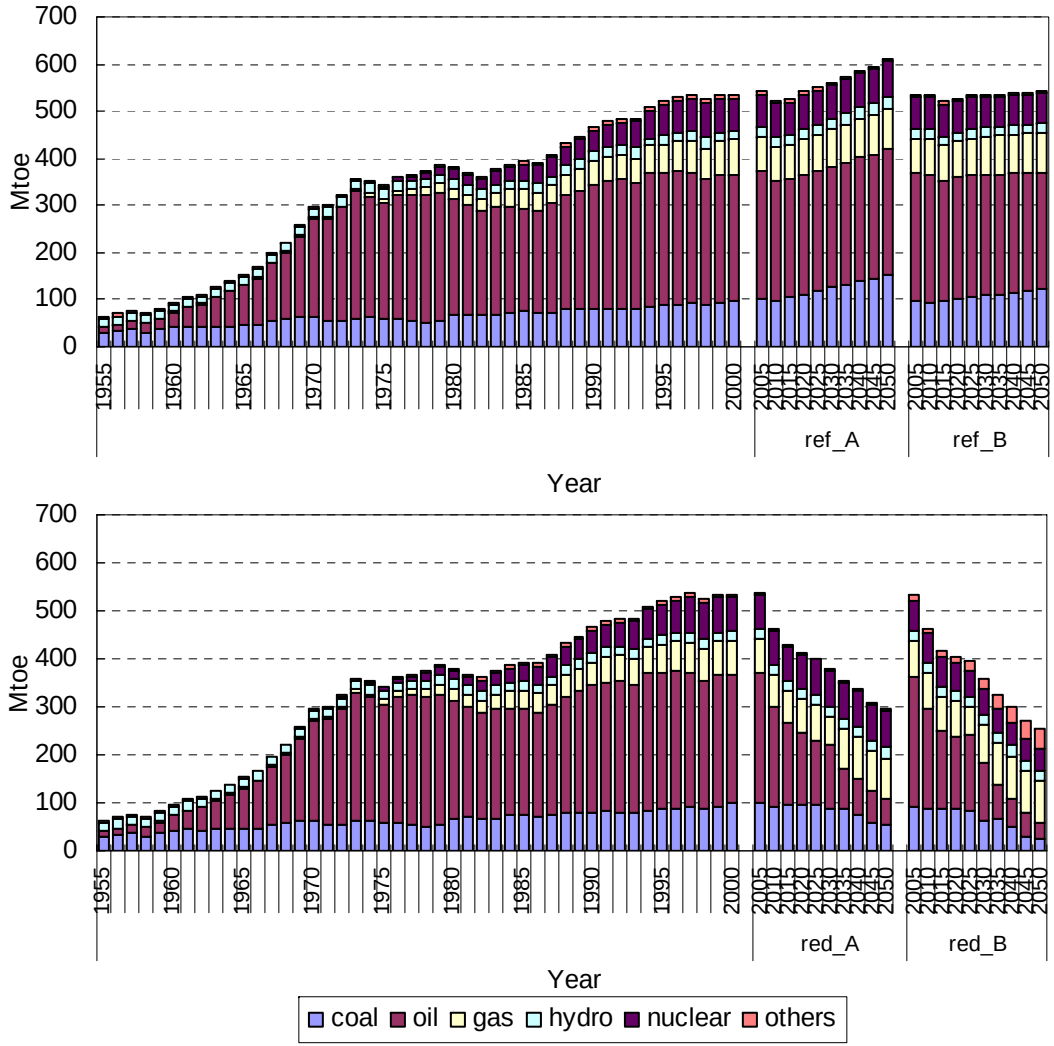
Population and GDP in Japan

Sector-wise productions in 2050



The industrial structure would shift towards service economy. Productions of electric/transport machinery industries would also increase enhancing industrial competitiveness of manufacturing sectors. Social infrastructure would be further developed and the volumes of steel or cement stocked in such infrastructures would increase considerably. An innovative recycling technology would be developed and the stocked materials within the society could be re-used for high-quality purposes. Application of such technologies would lead to improvements in resource usage rates of raw materials.

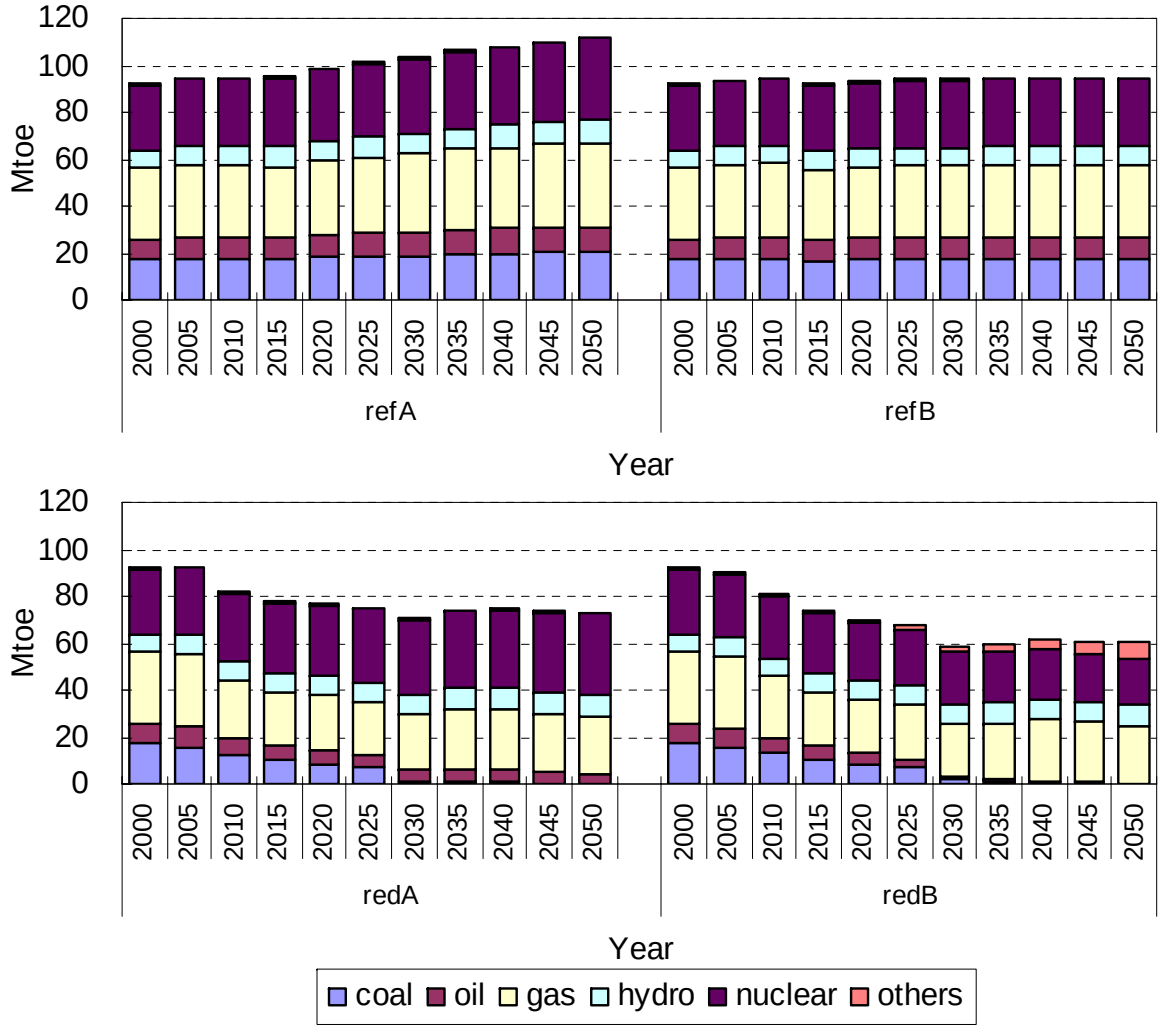
Primary Energy Use in Japan



Reference scenarios

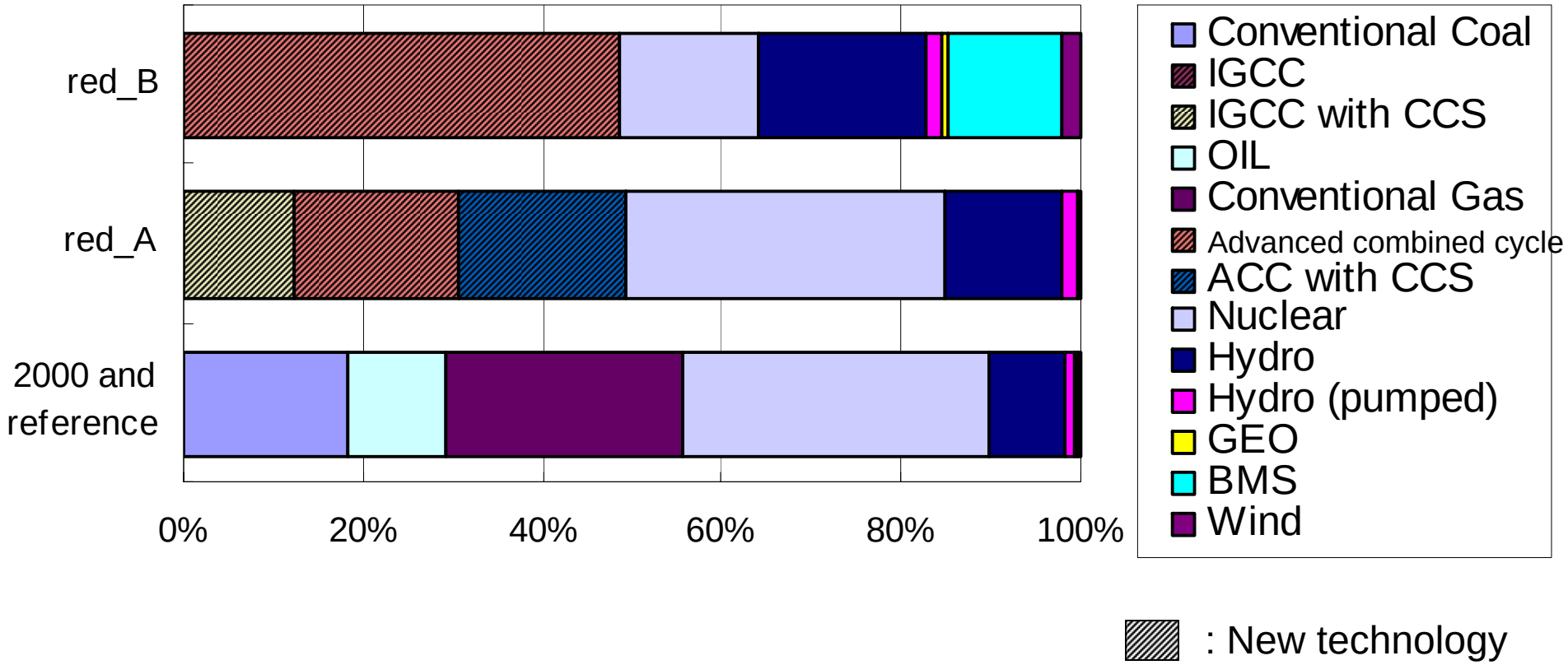
Reduction scenarios

Electricity Generation in Japan



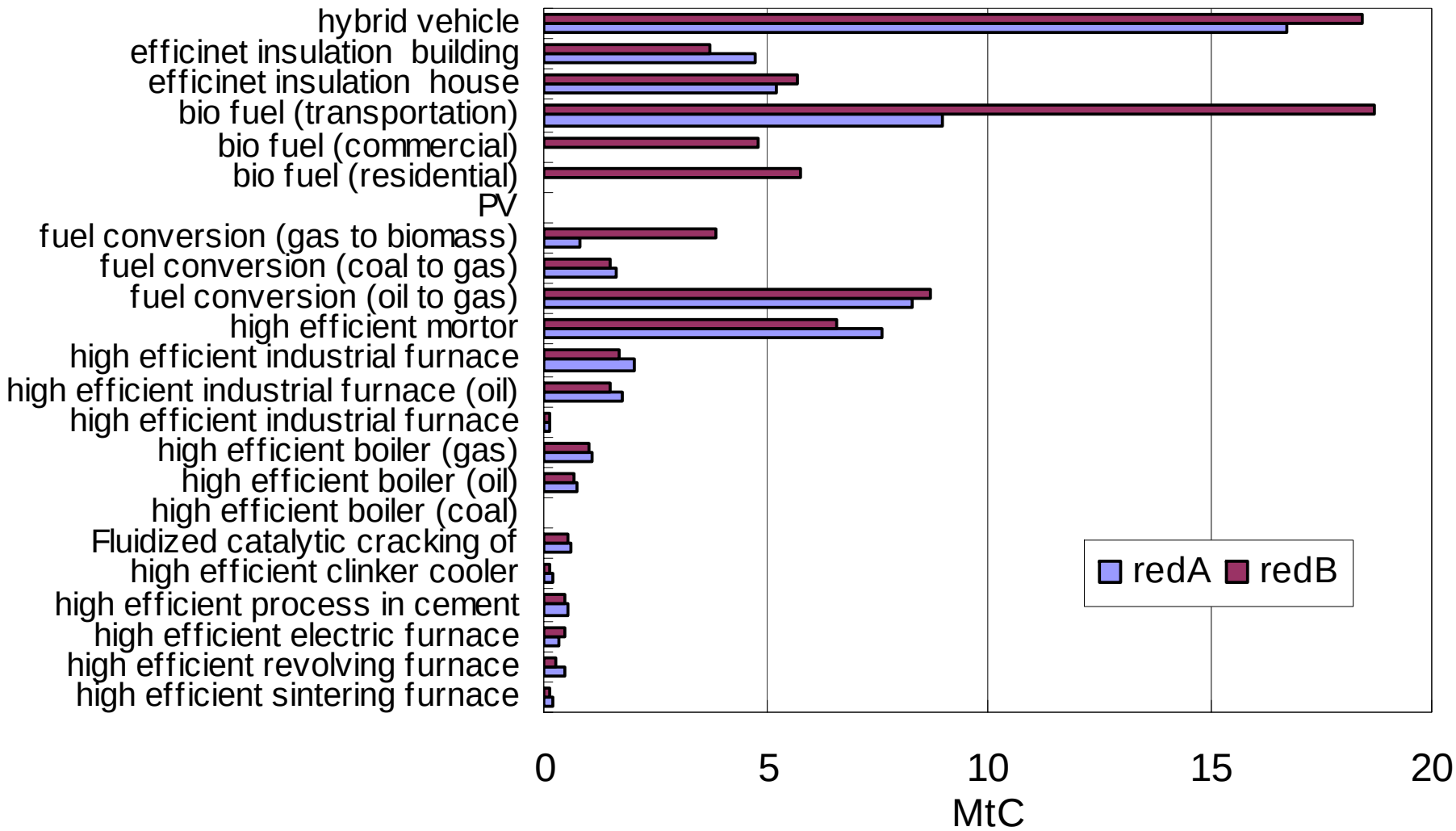
Technology Development and Diffusion in Japan

Technologies in power sector in 2050



Technology Development and Diffusion in Japan

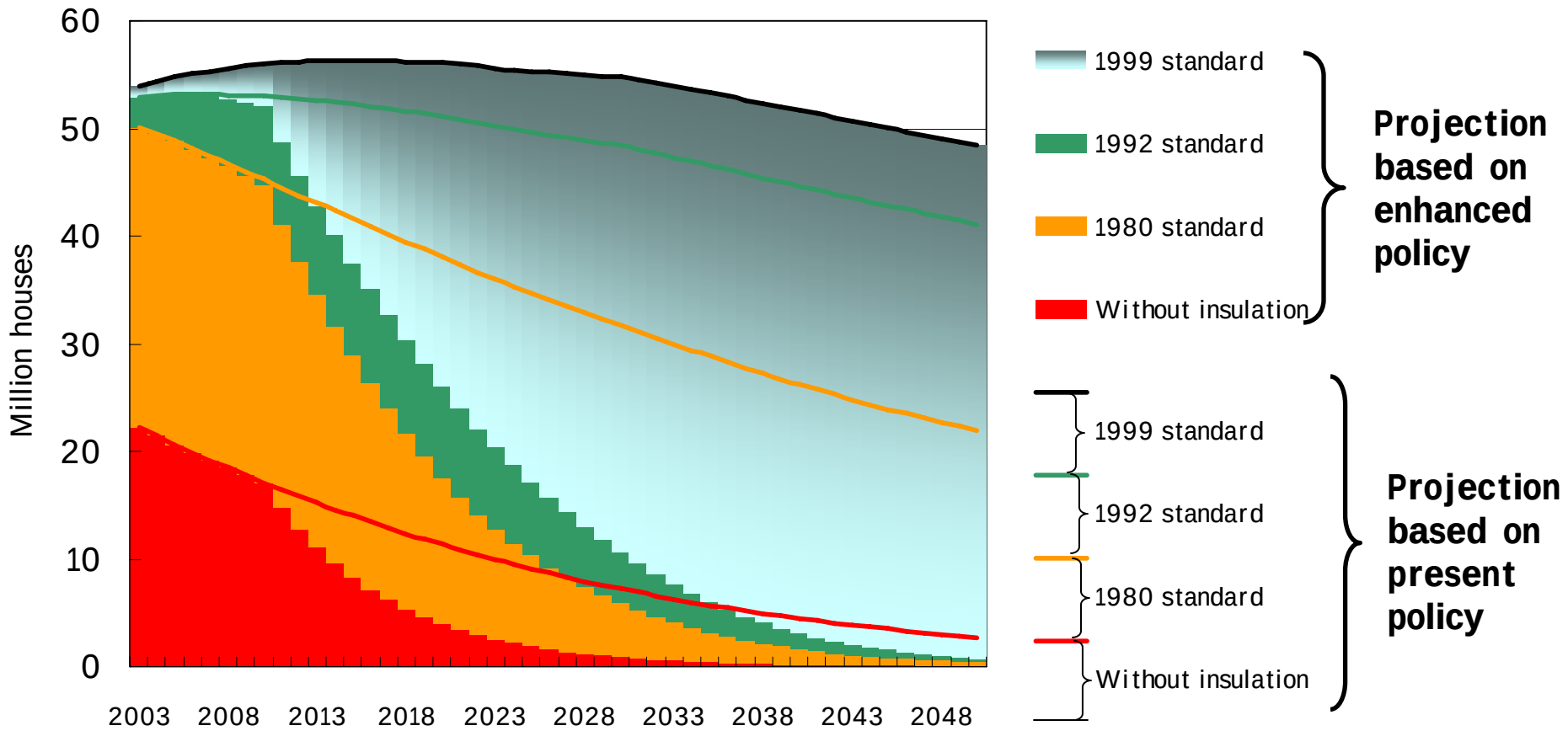
Demand side CO2 reduction by advanced technologies in 2050



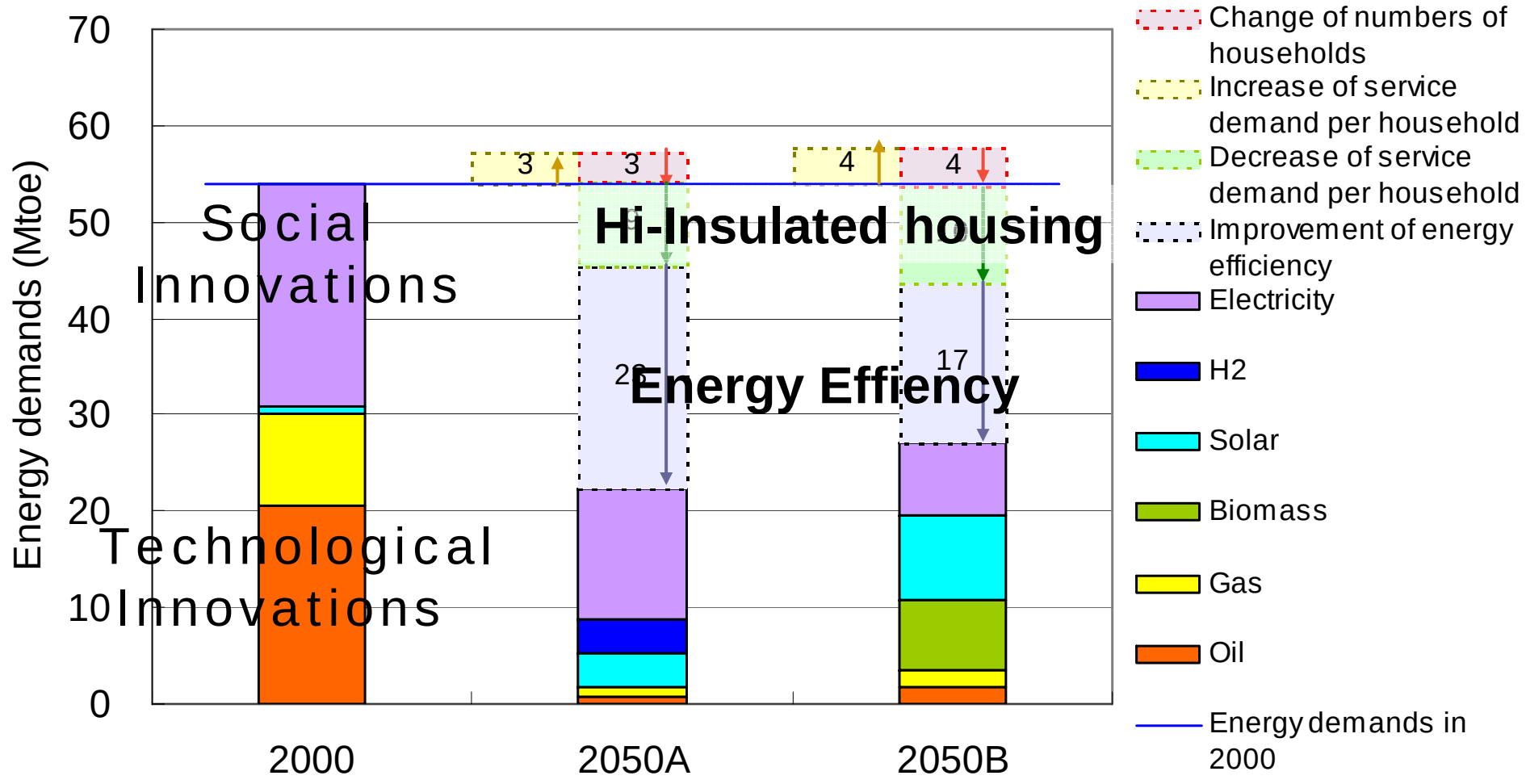
AIM, NIES

PV: one million kW in scenario A; two million kW in scenario B

Projection of residential building stock by insulation level



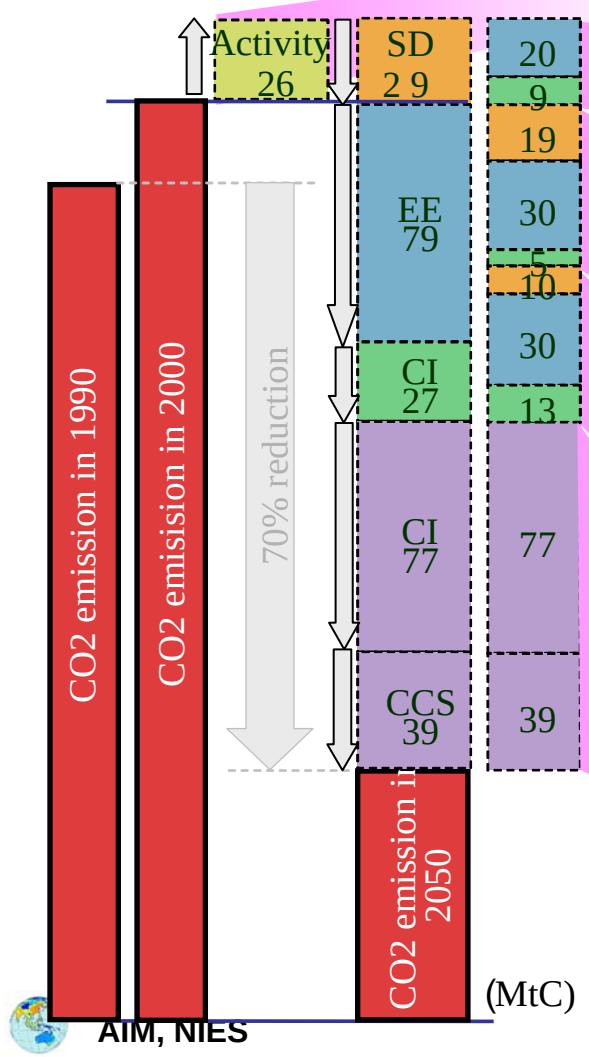
Residential sector
CO2 reduction potential: 50%



Step4

70% CO2 emission reduction by 2050

Scenario A :2050



Main factors to reduce CO2 emissions

[Society]

- Activity
  - High economic growth
  - Decrease of population and number of households

[Industrial]

- Energy Intensity Imp.
  - Energy efficient improvement of furnace and motor etc.
- Carbon Intensity Imp.
  - Fuel switching from coal/oil to natural gas

[Residential and commercial]

- Reduction of service demands
  - High insulation dwelling and building
  - Home/Building energy management system
- Energy Intensity Imp.
  - Efficient air conditioner, Efficient water heater, Efficient lighting system
- Carbon Intensity Imp.
  - Fuel cell system
  - Photovoltaic on the roof

[Transportation]

- Reduction of service demands
  - Intensive land-use, Concentrated urban function
  - Public transportation system
- Energy Intensity Imp.
- Carbon Intensity Imp.
  - Motor-driven mobiles: Electric battery vehicles, Fuel cell battery vehicles

[Energy transformation]

- Carbon Intensity Imp.
  - Nuclear energy
  - Effective use of electricity in night time with storage
  - Hydrogen supply with low carbon energy sources
- CCS
  - Advanced fossil fueled plants + CCS
  - Hydrogen supply using fossil fuel + CCS

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

Forces Shaping Future Technology Deployment (1)

- Political leadership to achieve a low-carbon society should be a main driving force. This is coupled with energy security issues. Both supply-side and demand-side management are essential.
- Energy supply side constraints are limitations of available energy resources and demand-side constraints include preference of energy sources by consumers. These lead to deployment of new technologies.
- Energy demands in industry, transportation, household, and commercial sector in 2050 can be reduced by approximately 40-45% below the 2000 level by accelerating social technological innovations and energy technology development, as well as by developing appropriate infrastructure and by transforming the industrial structure. These can also be driven by private sector investment to increase competitiveness in international markets.

Forces Shaping Future Technology Deployment (2)

- Passenger transport demand reduces due to several factors which include decrease in population, reduction in average trip distance via development of “compact city” aimed at secure and safe society, and promotion of public transportation. More efficient vehicles, such as hybrid vehicles or electric motor vehicles and vehicles with lower carbon intensity fuels will be developed and deployed to support high-quality lifestyle.
- The current average lifetime of dwellings in Japan is around 35 years and most existing dwellings will be rebuilt by 2050. It means that there are many chances to shift to highly-insulated dwellings equipped with new energy-saving appliances.
- In order to achieve a low-carbon society without missing opportunities for various investments on capital formation and technology development, it is necessary to set up the national goals (i.e. the vision of a low-carbon society) at an early stage, establish the abatement schemes, and realize a society that internalizes the negative externalities of carbon dioxide emissions. In this process, it stimulates and accelerated social and technological innovations that help in getting an advantage in international competition in the future low-carbon world.

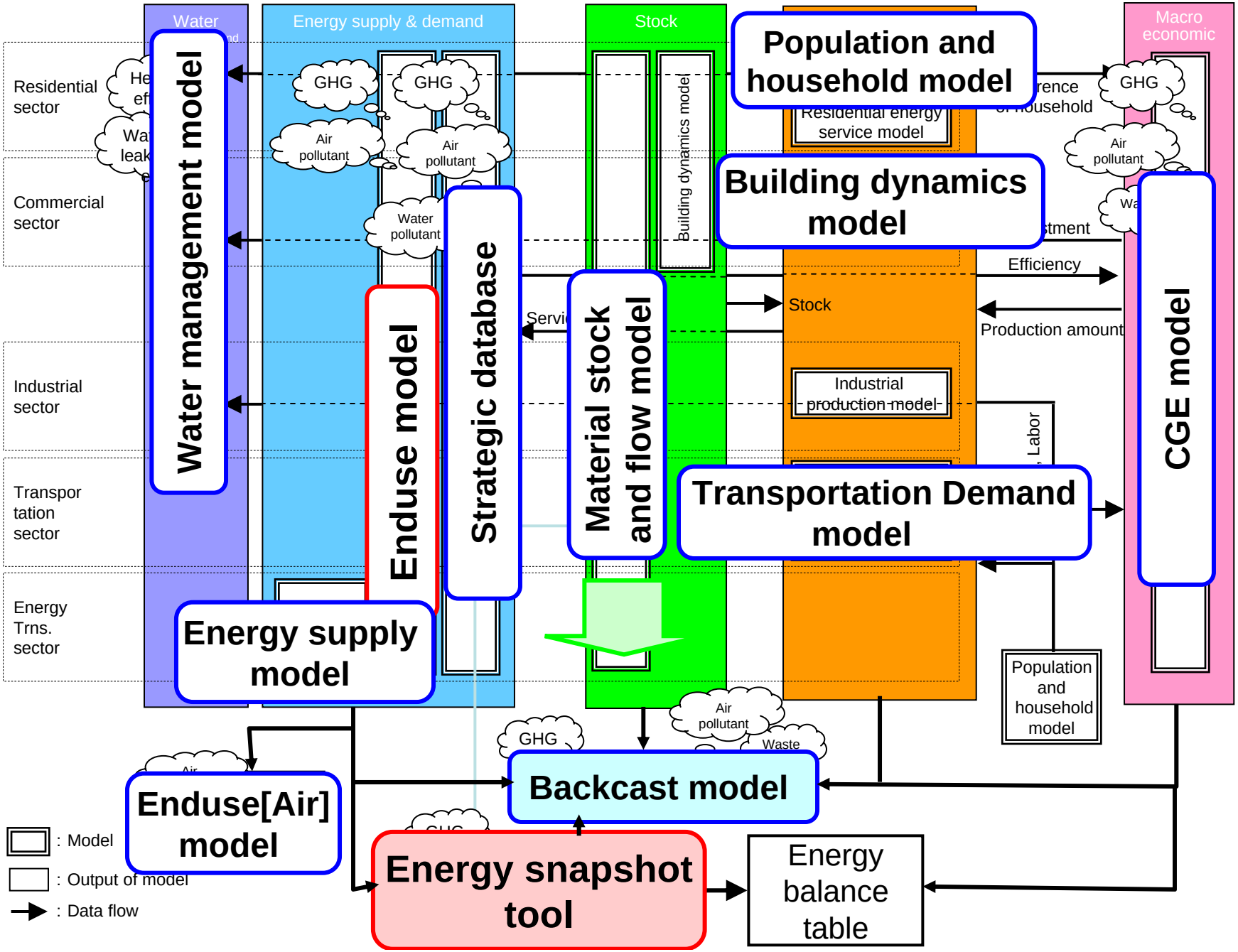
Thank you!

Please visit our web sites for more information!

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

http://www-iam.nies.go.jp/aim/

Models for analyzing low-carbon society and sustainable development



Step2

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	538	1059	(197%)	693	(129%)	Inter-sector and Macro Economic Model
Share of production							
primary	%	1.8%	1.0%		1.4%		
secondary	%	39.9%	32.3%		35.4%		
tertiary	%	58.4%	66.7%		63.3%		
Office floor space	Mil. m^2	1654	2078	(126%)	1739	(105%)	Building dynamics Model & Inter-sector and Macro Economic Model
Travel Passenger volume	bill. p. km	1297	1016	(78%)	794	(61%)	Transportation demand model & Inter-sector and Macro Economic Model
Private car	%	53%	27%		53%		
Public transport	%	40%	62%		34%		
Walk/bycycle	%	8%	8%		13%		
Freight transport volume	bill. t. km	578	525	(91%)	458	(79%)	
Industrial production index		100	142	(142%)	113	(113%)	Inter-sector and Macro Economic Model
Steel production	Mil. t	107	40	(37%)	40	(37%)	
Etylen production	Mil. t	8	4	(50%)	4	(50%)	
Cement production	Mil. t	82	40	(49%)	40	(49%)	
Paper production	Mil. t	32	16	(50%)	27	(85%)	

(%) is a percentage compared with year 2000