The 8th Workshop on GHG Inventories in Asia (WGIA8)

– Capacity building for measurability, reportabiity and verifiability –

Vientiane, Lao PDR

13-16 July, 2010

Bridge the Gap

between Statistics, Inventories and Projections in Asia

- Mitigation Analysis by the AIM Models -

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Center for Global Environmental Research (CGER),

National Institute for Environmental Studies(NIES),

Japan

AIM

ASIA-PACIFIC INTEGRATED MODEL

NIES JAPAN

CGER

Outline of presentation

1. Overview of AIM projects

- ✓ Top-down approach & bottom-up approach
- ✓ Japan Low-Carbon Society scenarios toward 2050
- ✓ Asia Low-Carbon Society scenarios toward 2050

2. Gap between inventories and projections

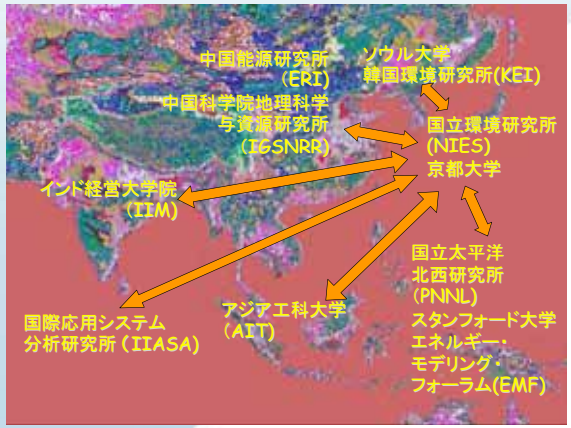
- ✓ Essential to enforce MRV(Measurable, Reportable, Verifiable) for GHG projections
- ✓ Overview of relation of inventory and projections

3. Examples of mitigation scenario analysis

- ✓ Japan's mid-term target
- ✓ Japan's long-term target

AIM research network

AIM = Asia-Pacific Integrated Model

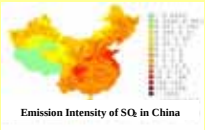


China
Energy Research Institute, National Development and Reform Commission
Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Science
India
Indian Institute of Management
Thailand
Asian Institute of Technology
Korea
Seoul National University
Korea Environment Institute

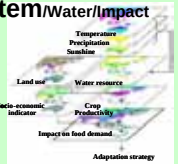
AIM model family

AIM Model Development

AIM/ Energy/Technology/Country
A bottom-up technology selection model of energy use and emissions at country and local level



AIM/ Ecosystem/Water/Impact
A set of ecosystem models, including a vegetation dynamics model, a water resource model, an agricultural productivity model and a health impact model

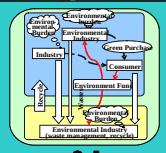


AIM/Bottom-up
A bottom-up technology & land use model for Asia-Pacific region

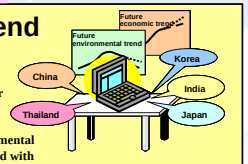
AIM Family

AIM/Top-down
A general-equilibrium-type world economic model

AIM/Material
An environment-economy interacted model with material balance and recycling process modules



AIM/Trend
Developed as a **communication** platform in order **to construct** **Asia**-pacific regional environmental outlook supported with **multi**-regional environment-economic CGE model



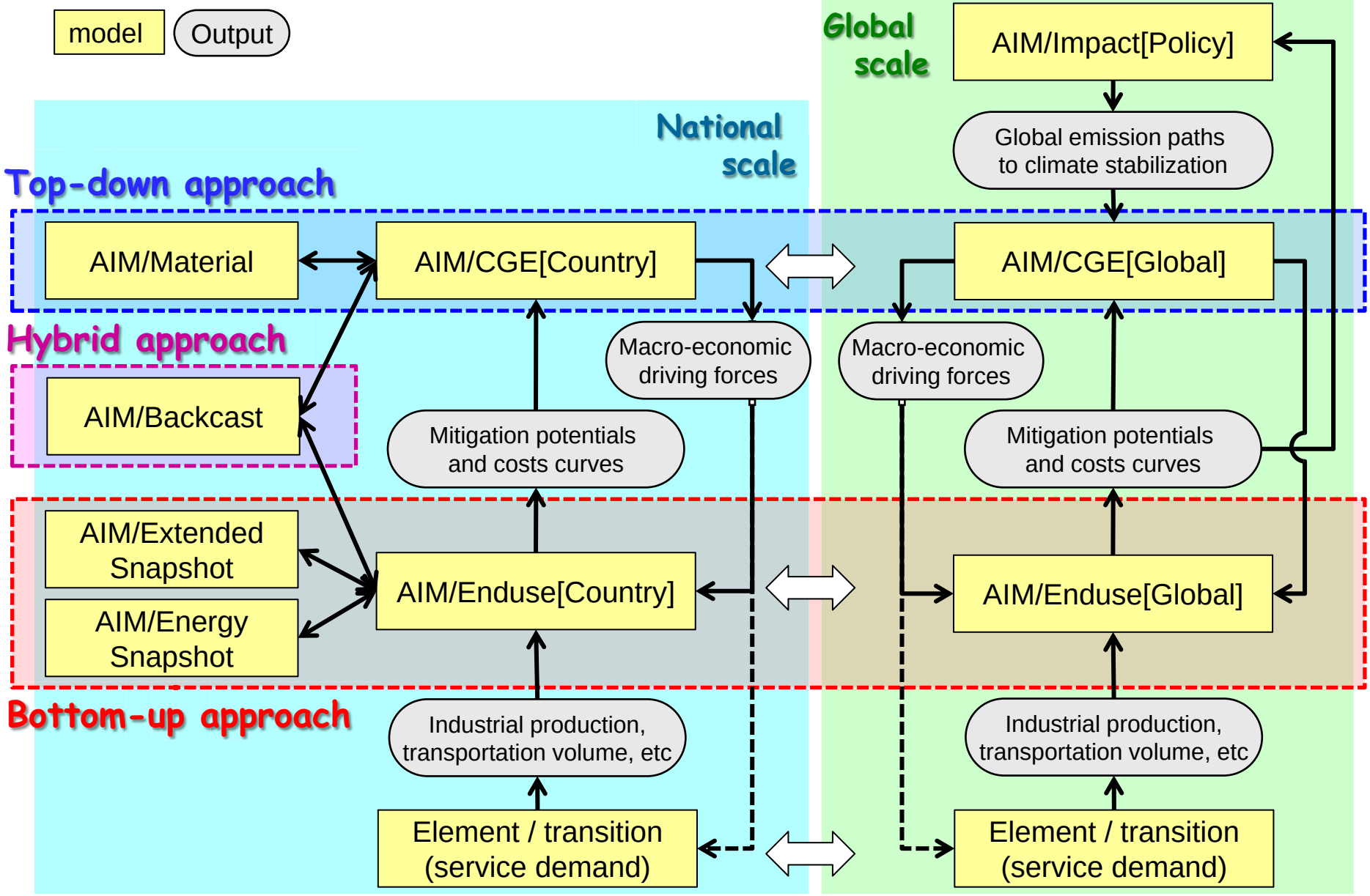
Strategic Database

Institution, Management, Technology, Adaptation Database

Scenario Assessment

Model Base
Strategy Option Base
Index Base

AIM family for mitigation analysis



Bottom-up & top-down approaches

Bottom-up : analysis on sector- or technology-wise impacts

AIM/Enduse model

- This model can assess individual technologies under the detail technology selection framework and evaluate GHG emissions and mitigation costs.
- This model is a partial equilibrium model on energy (i.e. optimization model)

AIM/Energy Snapshot tool (AIM/ESS)

- This tool is an accounting type and can assess energy balance and CO_2 emission among sectors simultaneously.
- This is a snapshot tool at a certain temporal point (i.e.non-optimization model).

AIM/Extended Snapshot tool (AIM/ExSS)

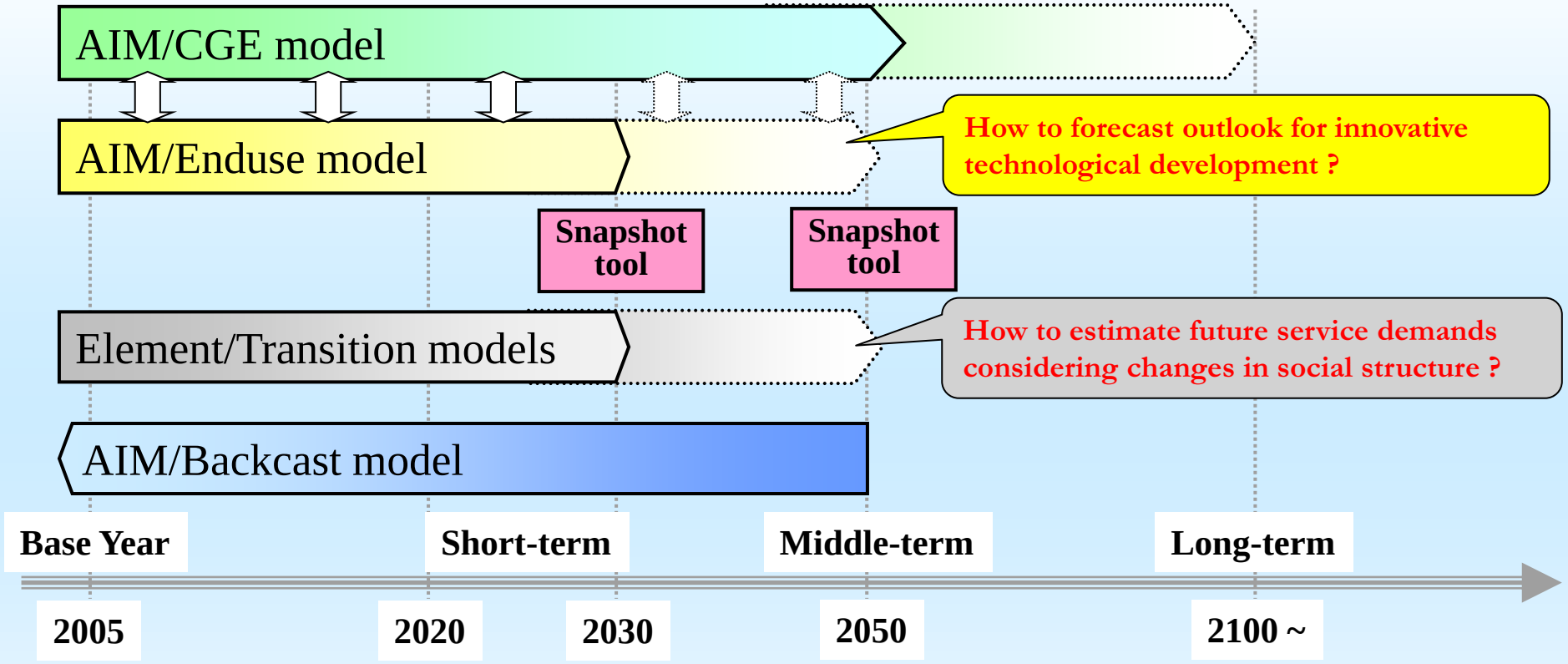
- This tool is an accounting type and can assess monetary balance, material balance, energy balance and CO_2 emission among sectors simultaneously.
- This is a snapshot tool at a certain temporal point (i.e., non-optimization model).

Top-down : analysis on economic impacts

AIM/CGE model

- This model draws the balanced macro economy, based on social conditions such as population, technology and preference, countermeasures.
- This model is a Computable General Equilibrium model (i.e. optimization model)

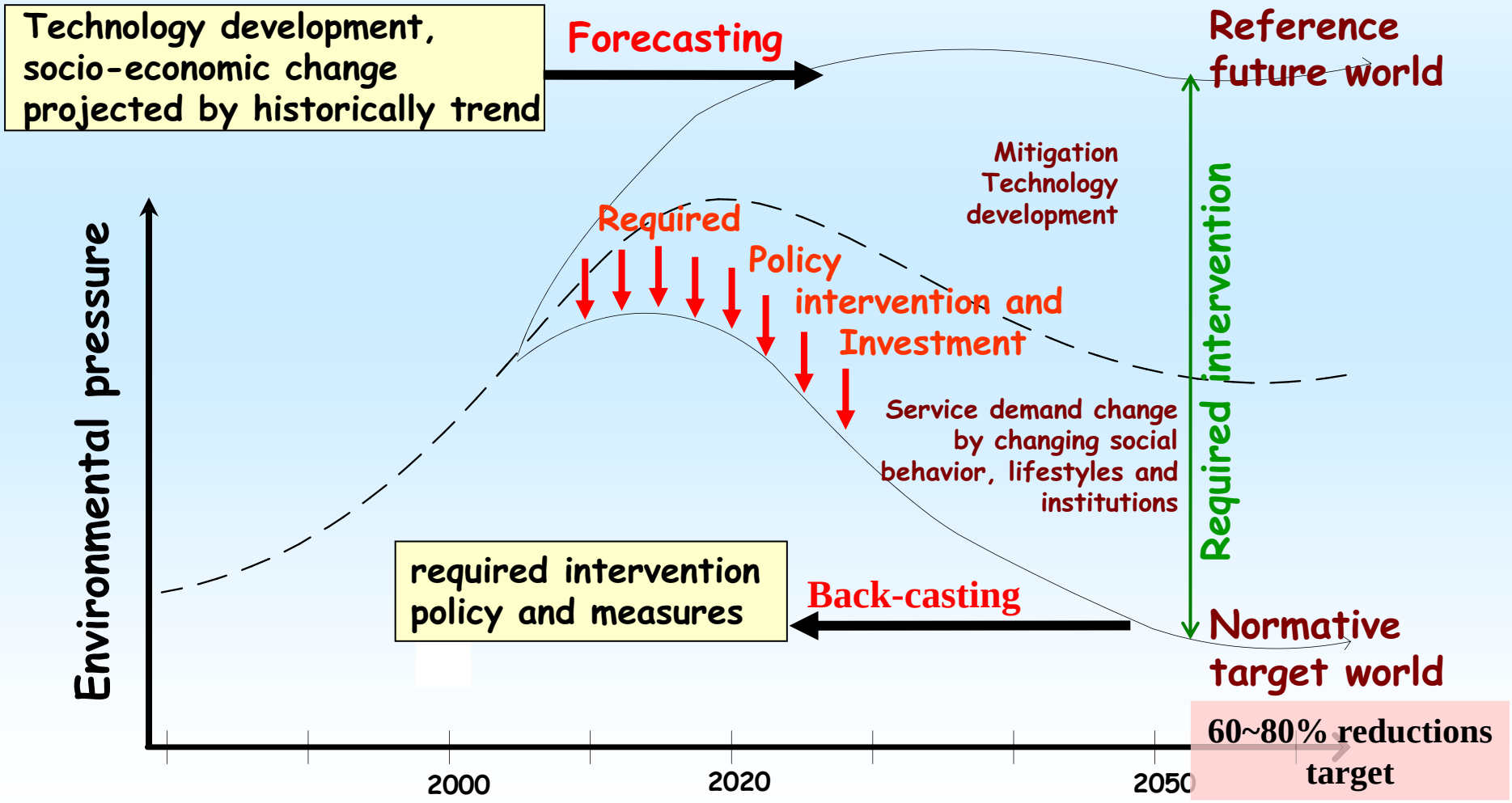
Temporal scale of mitigation analysis



- **Due to data constraints of future technology information and service demands, Enduse model analyzes scenarios with horizons of 2030, and up to 2050 at most.**
- **To utilize Enduse model for Low Carbon Society scenario study toward 2050, it is essential to discuss outlook for innovative technological development and future service demands considering changes in social structure.**

Japan Low-Carbon Society Scenarios toward 2050

During FY2004-2008, funded by Global Environmental Research Program, MOEJ
(project leader: Shuzo Nishioka)



Steps towards Japan 2050 LCS scenarios

- 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 CO_2 emissions

Outcome 1) Feasibility study for 70% CO_2 emission reduction by 2050 below 1990 level

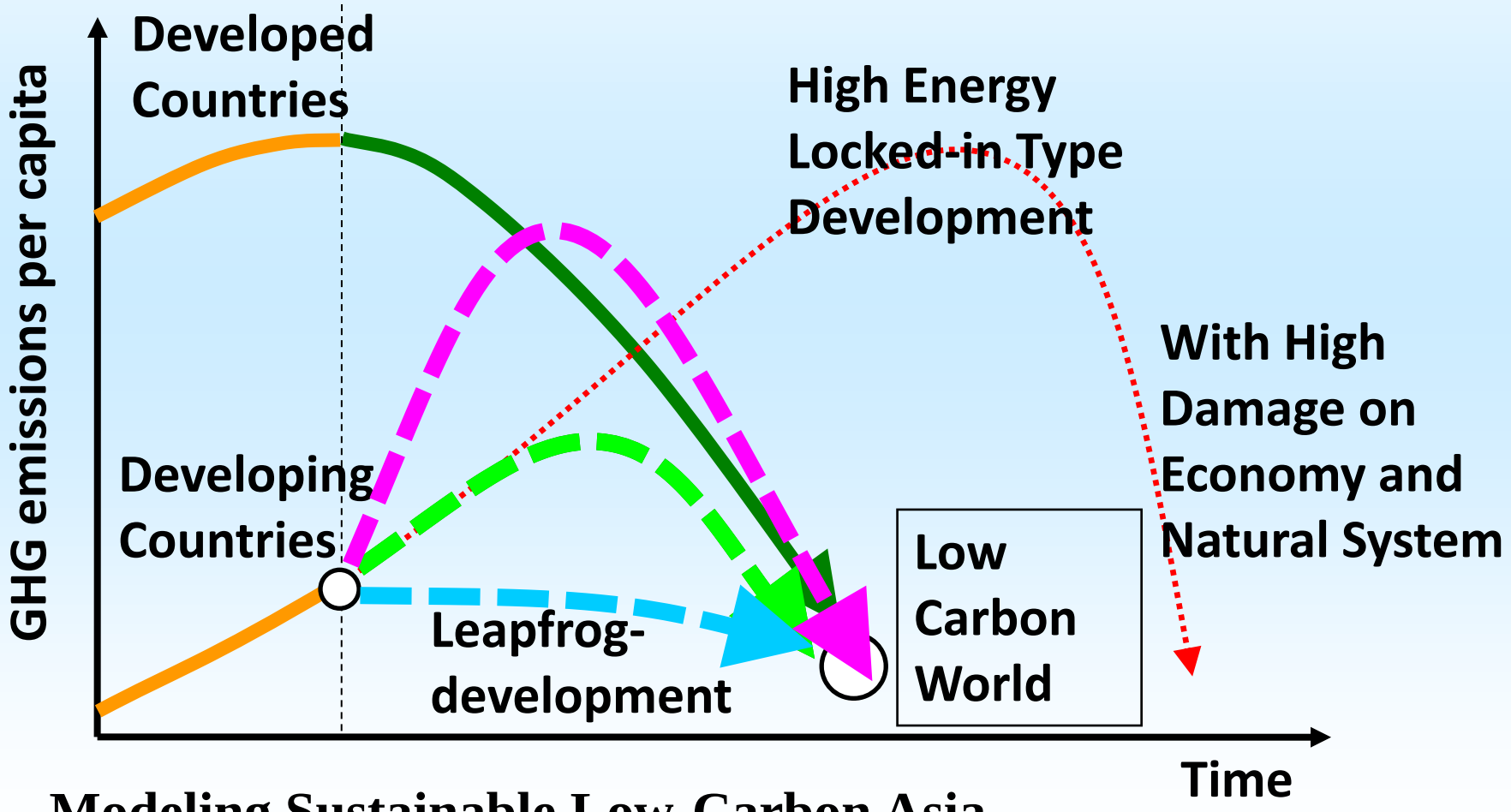
Investigating "When and Which options and How much" of each options should be introduced in order to achieve the goal"

Outcome 2) Roadmap and Dozen Actions toward LCS

http://2050.nies.go.jp/index.html

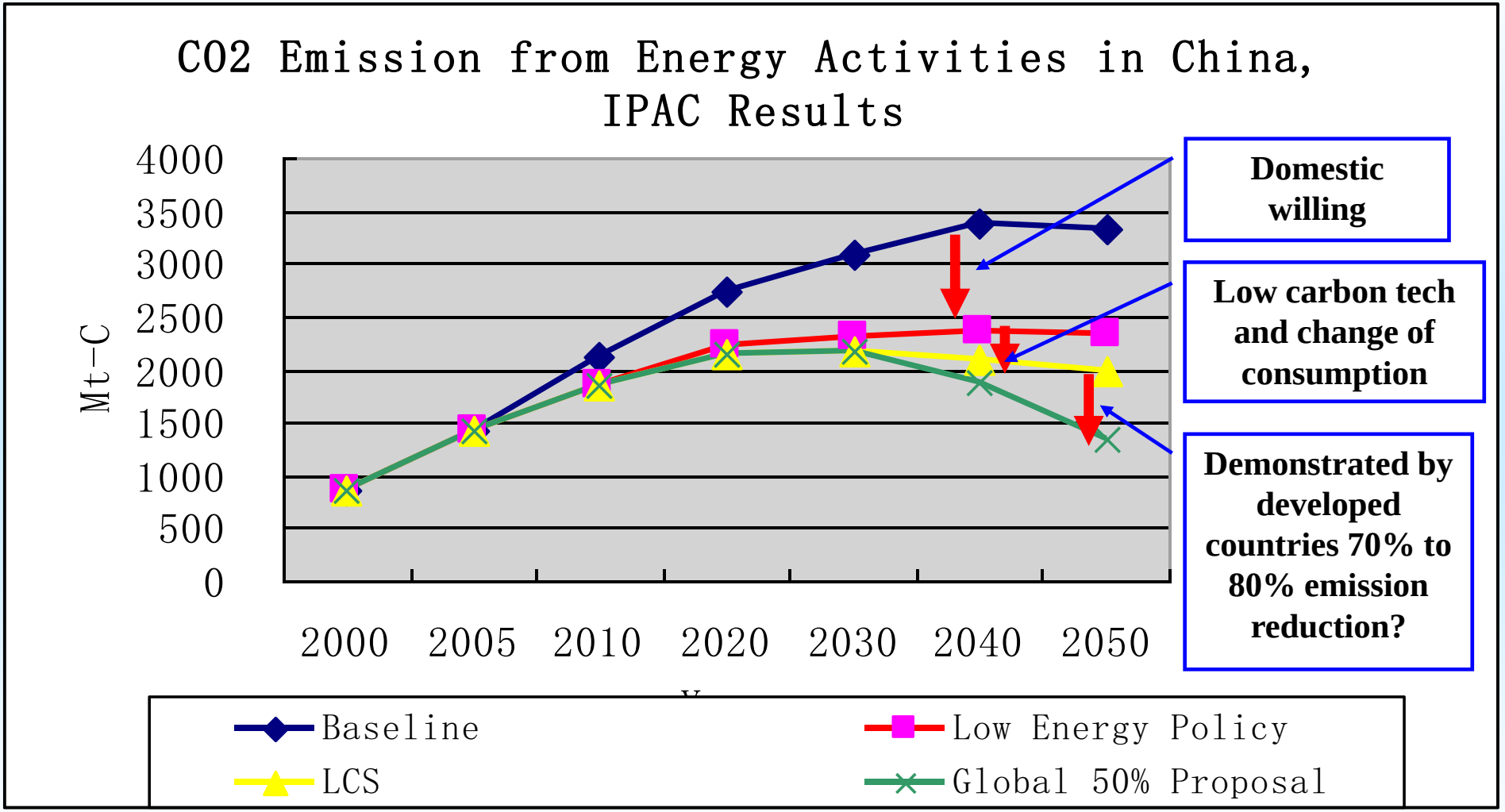
Asia Low-Carbon Society scenarios

We have 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



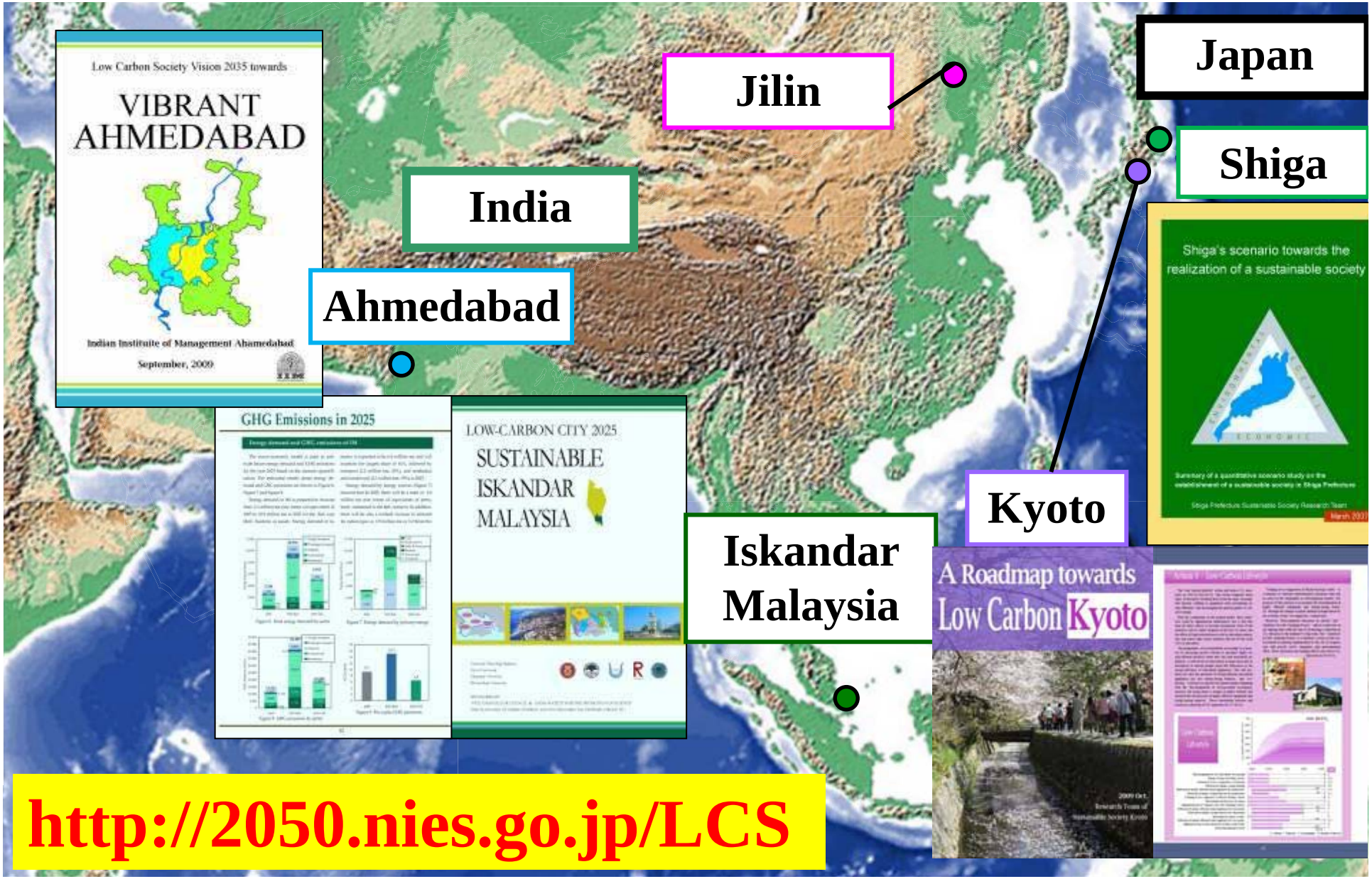
Modeling Sustainable Low-Carbon Asia

Example of LCS scenarios in China

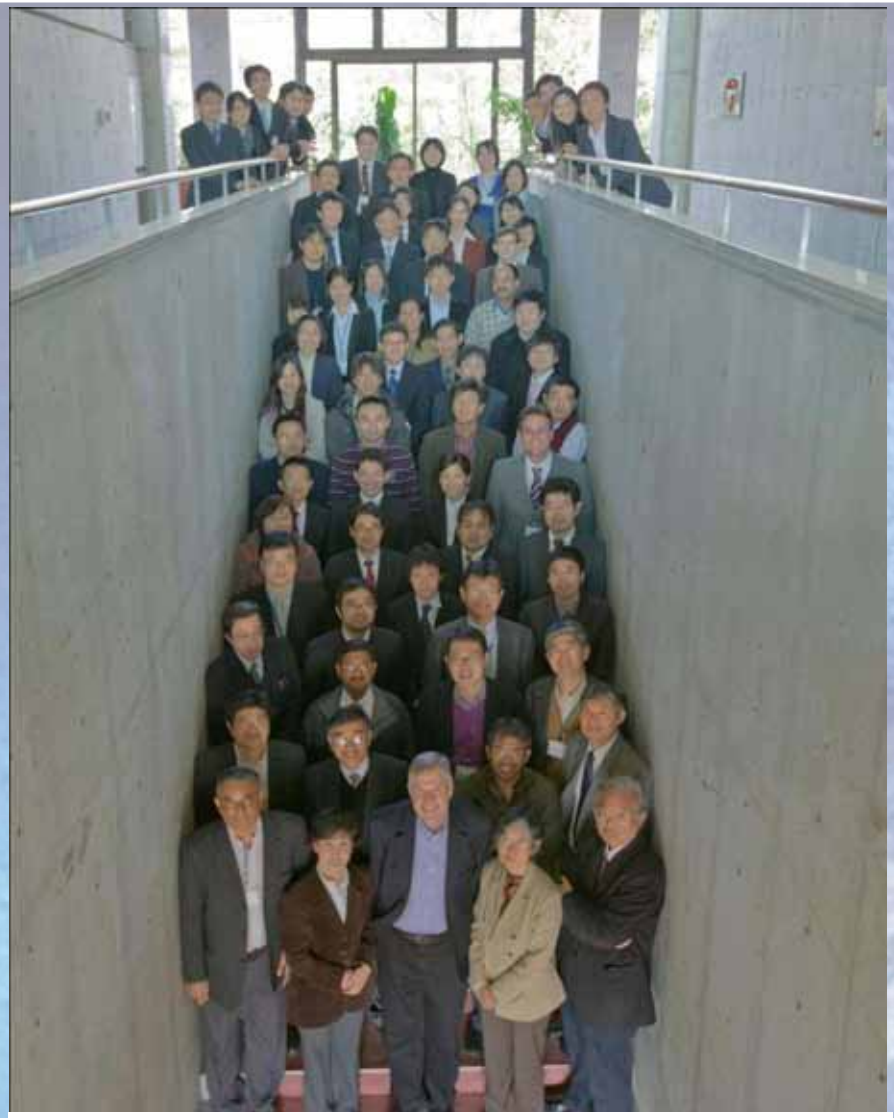


Source) Dr. Jiang Kejun (Energy Research Institute, China). "Low Carbon Societies in China: Scenario and Road Map", The 13rd AIM International WS, Tsukuba (2008)

LCS Scenarios for ASIA: countries and cities



AIM international workshop



Photograph at the 15th AIM International WS
at Tsukuba on February 20-22, 2010

- Japan
- China
- India
- Thailand
- Korea
- Malaysia
- Indonesia
- Nepal
- USA
- Brazil
- New Zealand

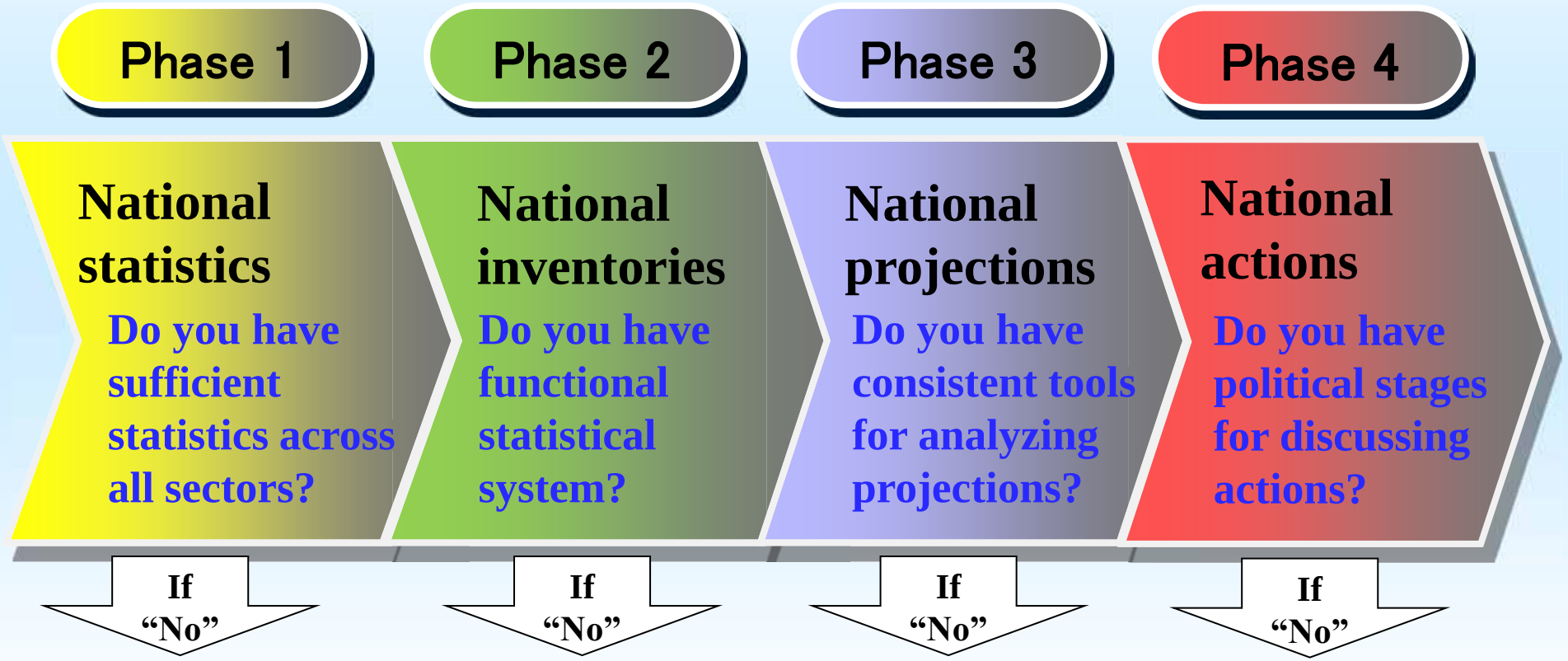
AIM
ASIA-PACIFIC INTEGRATED MODEL

Gap between inventory and projections

- Why inventory is essential?
- What is the gap between inventory and projections?
- How inventory is expanded to projections?

Bridge the gap
- statistics, inventories, projections & actions-

It is essential to enforce MRV(Measurable, Reportable, Verifiable) for analyzing national GHG projections and mitigation actions.



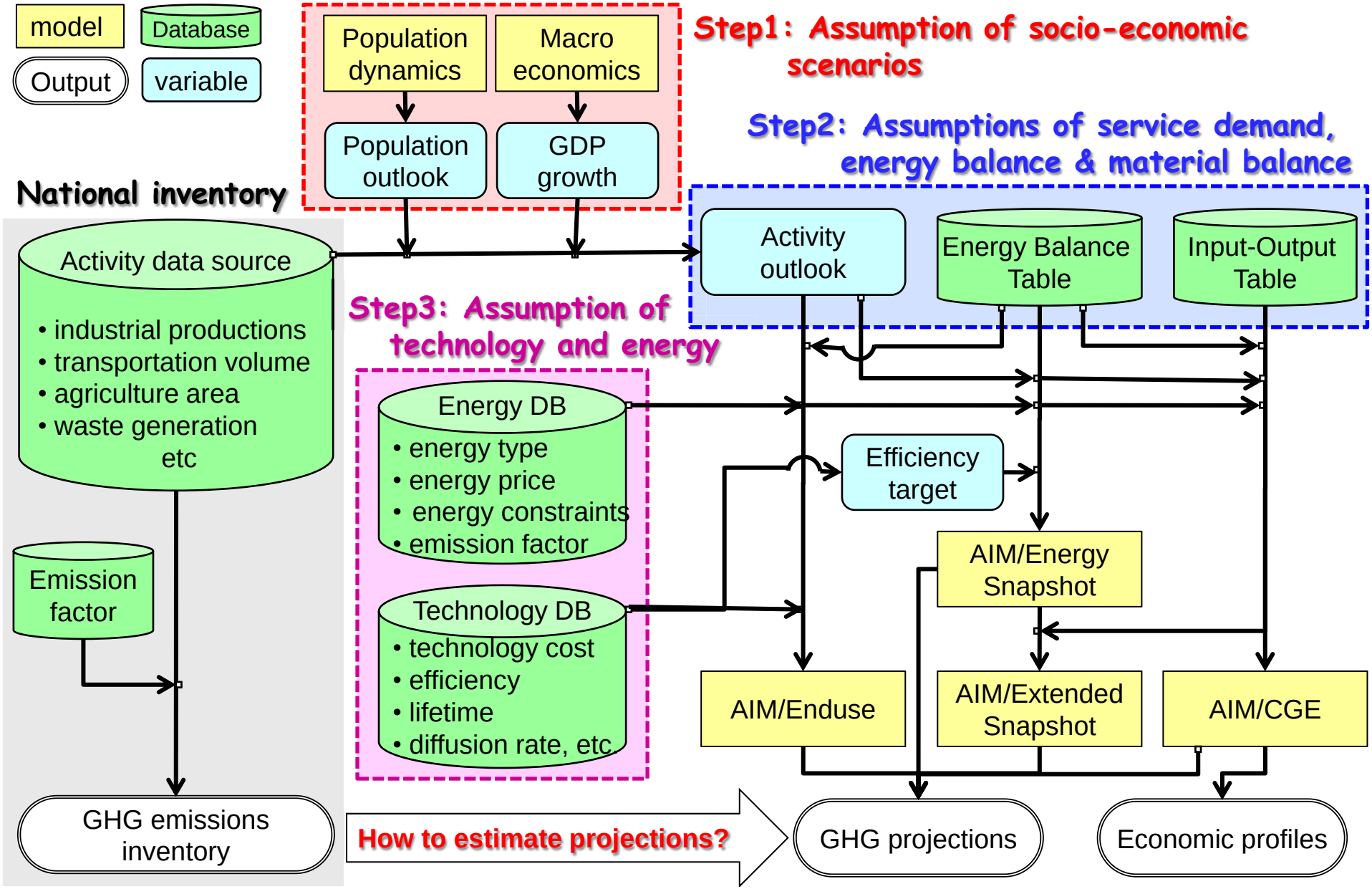
Necessary to enforce measurable statistical systems

Necessary to enforce reportable & verifiable inventory network

Necessary to get various data and skills for analysis

Necessary to enforce communication of policies and actions

Expansion of inventory to projections



Examples of mitigation scenario analysis

- Japan's mid-term target
- Japan's long-term target

Japan's mid-term target

- **On June 10th 2009, the former 92nd Prime Minister ASO Taro announced the Japan's mid-term target as a 15% reduction from the 2005 level by 2020.**

⇩ **Change of government on September 16th 2009**

- **Japan's mid-term target was re-announced by the former 93rd Prime Minister HATOYAMA Yukio on September 22nd, 2009.**

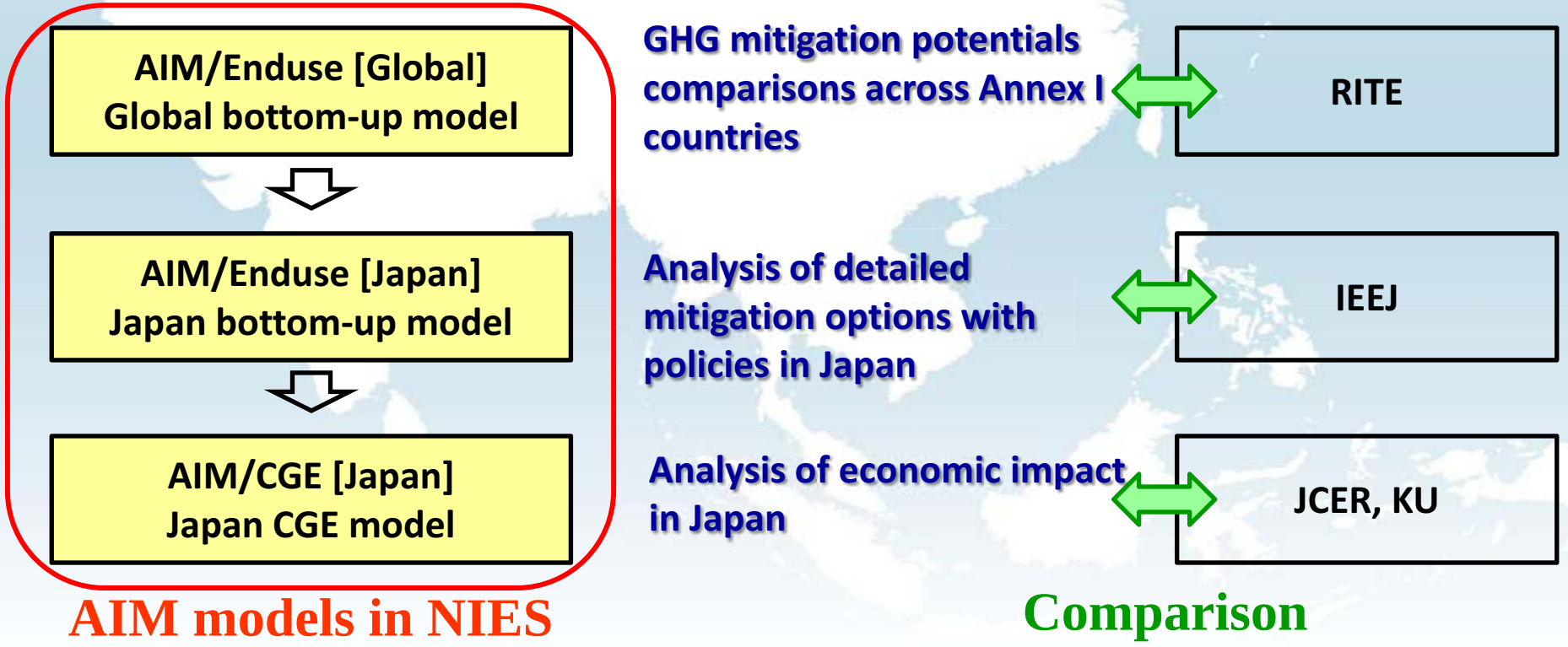
25 % reduction target from the 1990 level by 2020

	Current Mid-term target	Former Mid-term target	Kyoto target
Target Year	2020	2020	2008 - 2012
Base Year	1990	2005 (1990)	1990
Domestic reduction	**Totally 25%**	15 % (8%)	0.6%
Carbon sinks		-	3.8%
Credits		-	1.6%

Note) Japan's Kyoto target (6% reduction) includes carbon sinks and credits through the Kyoto mechanisms.

Process and contribution of AIM models to the Japan's mid-term target

- [October 2008 ~ April 2004] Committee of the Japan's mid-term target in council for global warming under the cabinet secretary of the former 92nd Prime Minister Aso.
- [October 2009 ~ December 2009] Taskforce assembly in council for global warming under the cabinet secretary of the former 93rd Prime Minister Hatoyama.
- [December 2009 ~ ongoing] Committee of the mid- to long-term roadmap under the Ministry of Environment



Case settings and socio-economic assumptions

- **Case settings (domestic target from the 1990 level, without carbon sinks and credits)**

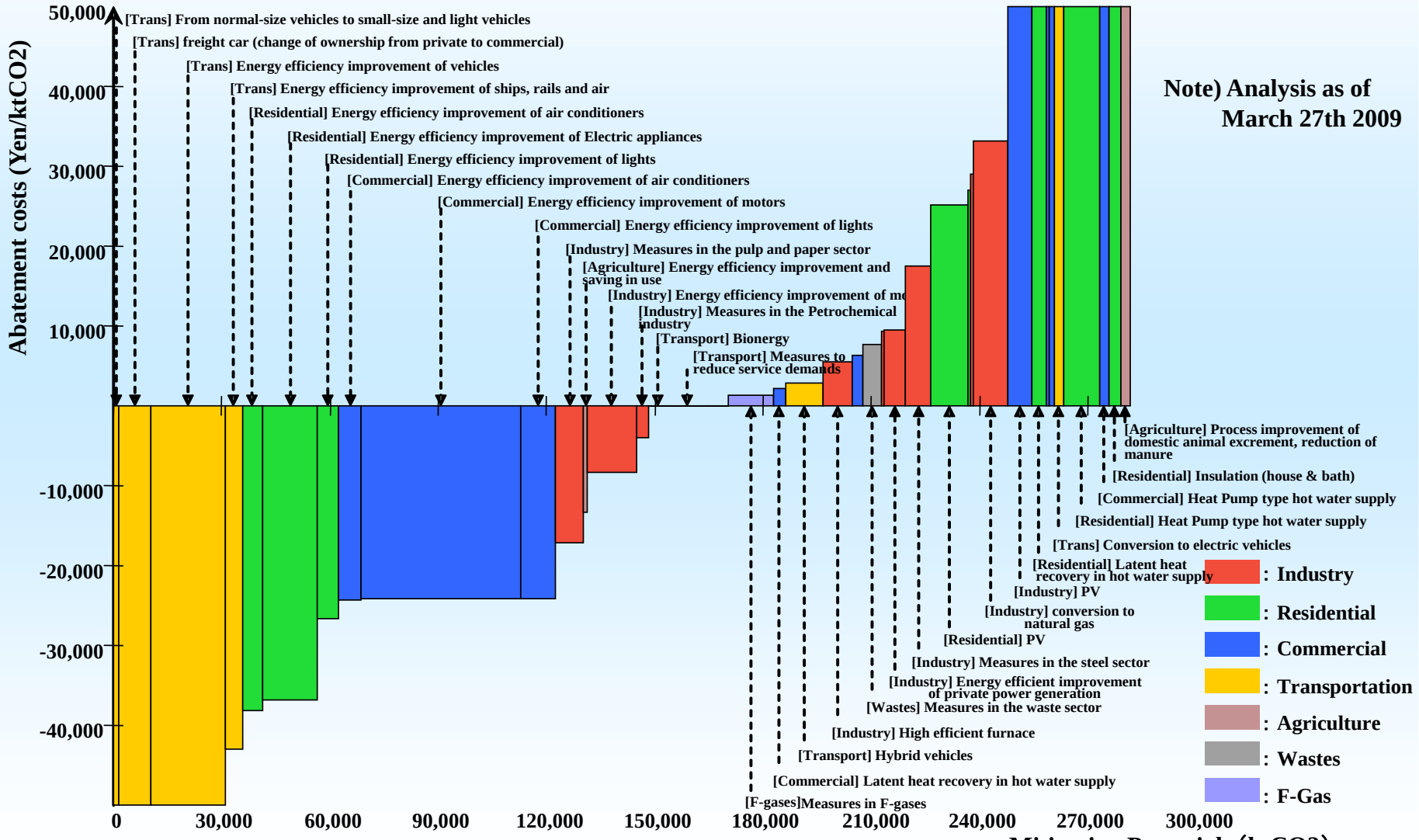
Case 0 : 3 % increase , Case 1 : 7 % reduction, Case 2 : 15% reduction, Case 3 : 25% reduction

- **Socio-economic assumptions in 2020 are based on as follows**

				2005	2020
Population			Million	127.9	124.5
GDP			2000 US $	4.96	5.99
Industry	Material production	Steel production	Million ton	112.72	119.66
		Ethylene production	Million ton	7.55	7.06
		Cement production	Million ton	73.93	66.99
		Paper and pulp production	Million ton	31.07	32.44
	Industrial production index	Food production	2005 (fiscal year)=100	99.5	87.2
		Chemical production	2005 (fiscal year)=100	99.5	116.6
		Non-ferrous metal production	2005 (fiscal year)=100	100.7	103.3
		Machinery production	2005 (fiscal year)=100	101.5	136.2
		Others	2005 (fiscal year)=100	100.0	94.0
Residential	Number of households		Million households	50.38	51.31
Service	Office floor space		Million m^2	1764	1957
Transport	Passenger transport volume		Billion person-km	1304.2	1292.7
	Freight transport volume		Billion ton-km	570.4	611.2

Note) Above assumptions were set as of March 27th 2009, Committee of the Japan's mid-term target in council for global warming under the cabinet secretary of the former 92nd Prime Minister ASO.

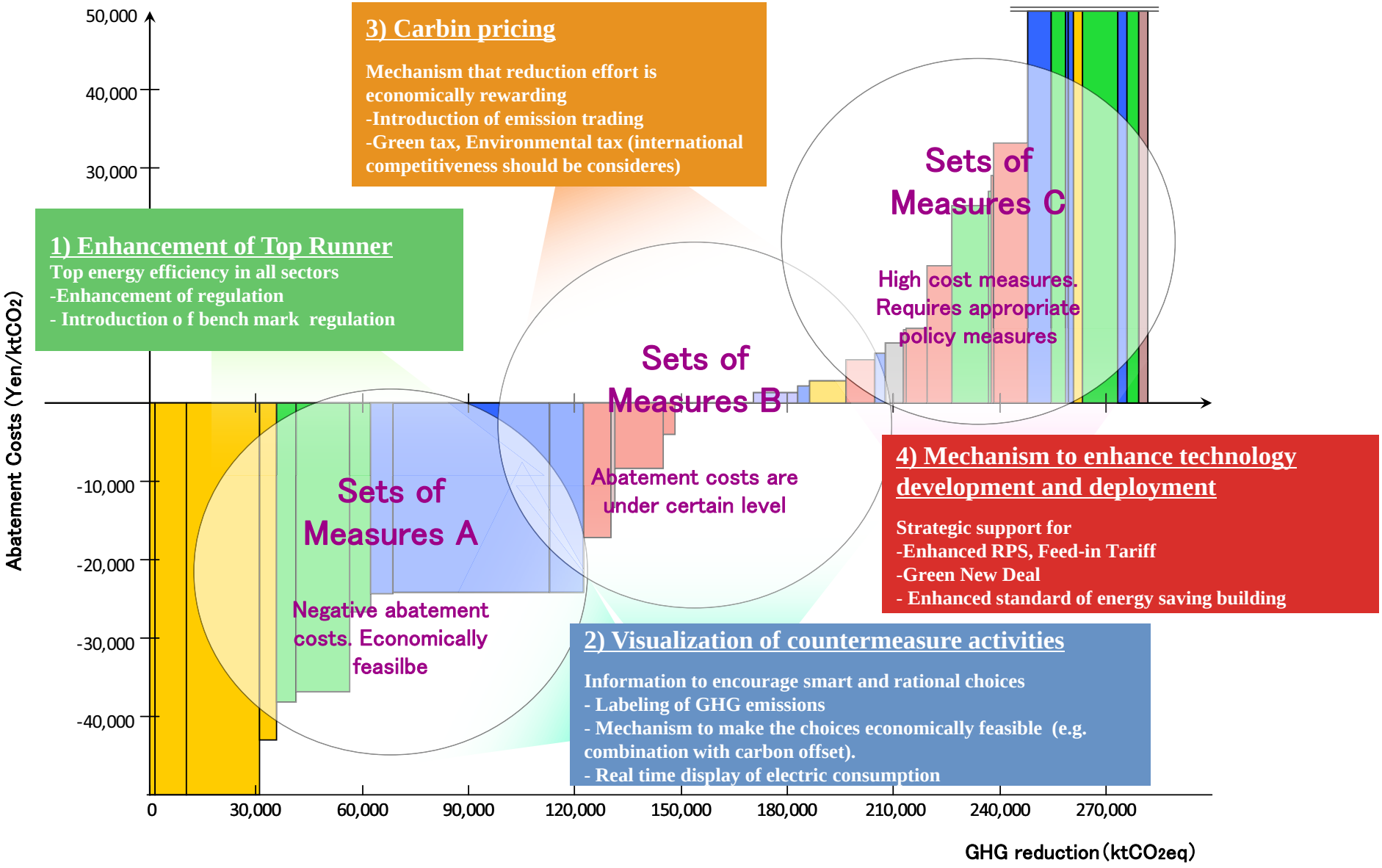
Example of abatement costs to reduce GHG emissions in 2020 by a bottom-up analysis



Note) Analysis as of March 27th 2009

Note: Above scenario is Case 2 and payback time is set as 3 years, except for insulation and PV as 10 years. Mitigation potential is compared to the emissions in the Frozen Case

Four sets of countermeasures



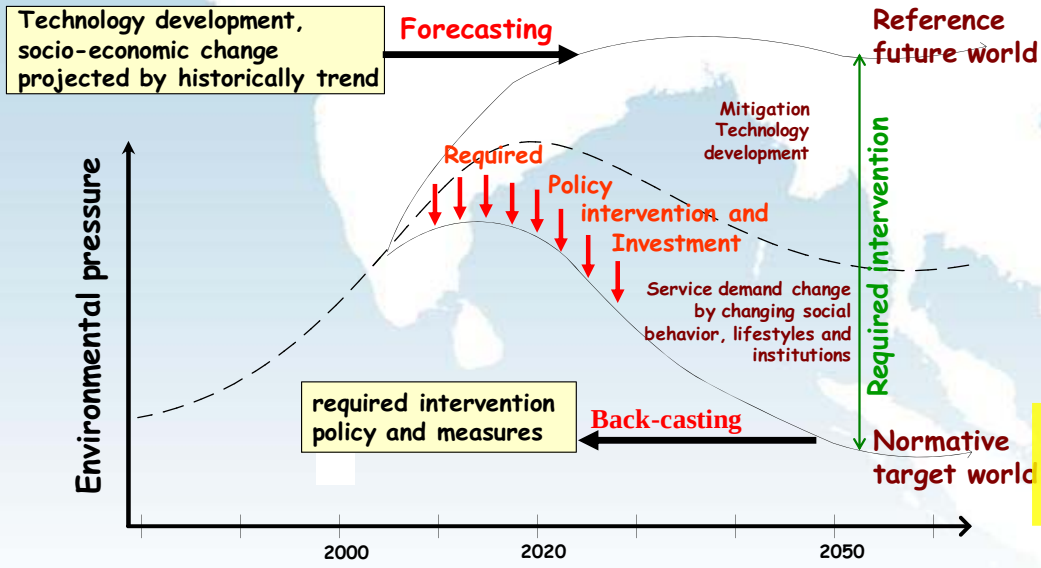
Japan's long-term target

2007.5.24
90th Prime Minister,
ABE, Shinzo

2008.6.29
91st Prime Minister,
FUKUDA, Yasuyuki

"I propose setting a long-term target of cutting **global emissions by half** from the current level **by 2050** as a common goal for the entire world. "

"**Japan** will set a long-term goal of reducing, **by 2050, 60-80%** of its current level of emissions. "

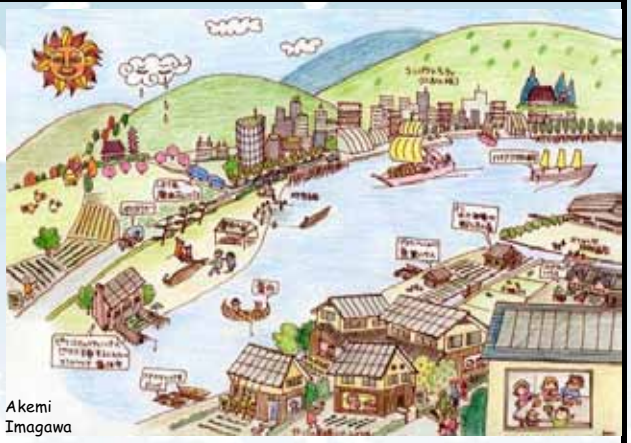


This governmental announcement was one of results of "**Japan Low-Carbon Society Scenarios toward 2050**" project.

60~80% reductions target in 2050

Depicting socio-economic visions in 2050

Step1-1: Depiction of narrative visions in 2050

Vision A	Vision B
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
	

http://2050.nies.go.jp

Socio-economic assumptions

Step1-2: Quantification of narrative visions in 2050

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

http://2050.nies.go.jp

Assumptions of energy balance and material balance

Step2: Settings of energy balance

2006FY	100	200	400	450	600	700	800		900
2006FY	石 炭 TJ	原 油 TJ	天然ｶﾞｽ TJ	都市ｶﾞｽ TJ	原子力発電 TJ	電 力 TJ	熱 TJ		合 計 TJ
1000 一次ｴﾈﾙｷﾞｰ	4805862	9115108	3600591	0	2656403	0	0		23770374
1100 国内産出	0	32712	148485	0	2656403	0	0		4299732
1200 輸 入	4805862	9082396	3452106	0	0	0	0		19470643
1500 総供給	4805862	9115108	3600591	0	2656403	0	0		23770374
1600 輸 出	-59	0	0	0	0	0	0		-1009087
1700 供給在庫変動	0	-189967	145407	0	0	0	0		-62158
1900 国内供給	4805802	8925141	3745998	0	2656403	0	0	供給側	22699129
2000 ｴﾈﾙｷﾞｰ転換	-4290961	-9194777	-3695962	1325410	-2656403	3537558	713925		-6916851
2800 純転換部門計	-4353652	-9165887	-3622118	1343461	-2656403	3920737	718088		-6093486
5000 最終ｴﾈﾙｷﾞｰ消費	420204	0	67853	1325410	0	3537369	713925		15977238
6000 産 業	396274	0	67145	220649	0	1188635	689756		7165572
6100 非製造業	174	0	3392	26636	0	10561	0		518435
6500 製造業計	396100	0	63753	193912	0	1178074	689756		6647137
6520 ﾊﾟﾙﾌﾟ紙板紙	0	0	205	1223	0	127183	242205		389386
6550 化 学	8063	0	32238	6556	0	173877	246660		2415096
6570 窯業土石	159450	0	385	1170	0	78735	9376		354157
6580 鉄 鋼	247897	0	24397	63549	0	259649	95019		1760773
6600 機 械	1	0	3872	26698	0	312961	0		377227
6700 重複補正	-23947	0	-642	-1193	0	-24253	-80253		-143737
6900 他業種･中小製造業	1879	0	0	60621	0	94354	129127		1086569
7000 民 生	23930	0	708	1104862	0	2280318	24169		5060629
7100 家 庭	0	0	0	428969	0	1006537	1286		2104917
7500 業務他	23930	0	708	675892	0	1273781	22883		2955712
8000 運 輸	0	0	0	0	0	68415	0		3751037
8100 旅 客	0	0	0	0	0	64846	0		2272524
8500 貨 物	0	0	0	0	0	3568	0		1478512
9000 最終ｴﾈﾙｷﾞｰ用途消費	420204	0	51223	1325410	0	3537369	713925		14088598
9500 非ｴﾈﾙｷﾞｰ利用	0	0	16630	0	0	0	0		1859710

Source: Comprehensive Energy Statistics by METI (2007)

Note) The Energy Balance table is also used for National GHGs Inventory Report of JAPAN

Step3: Assumption of technology

Depiction of 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

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%

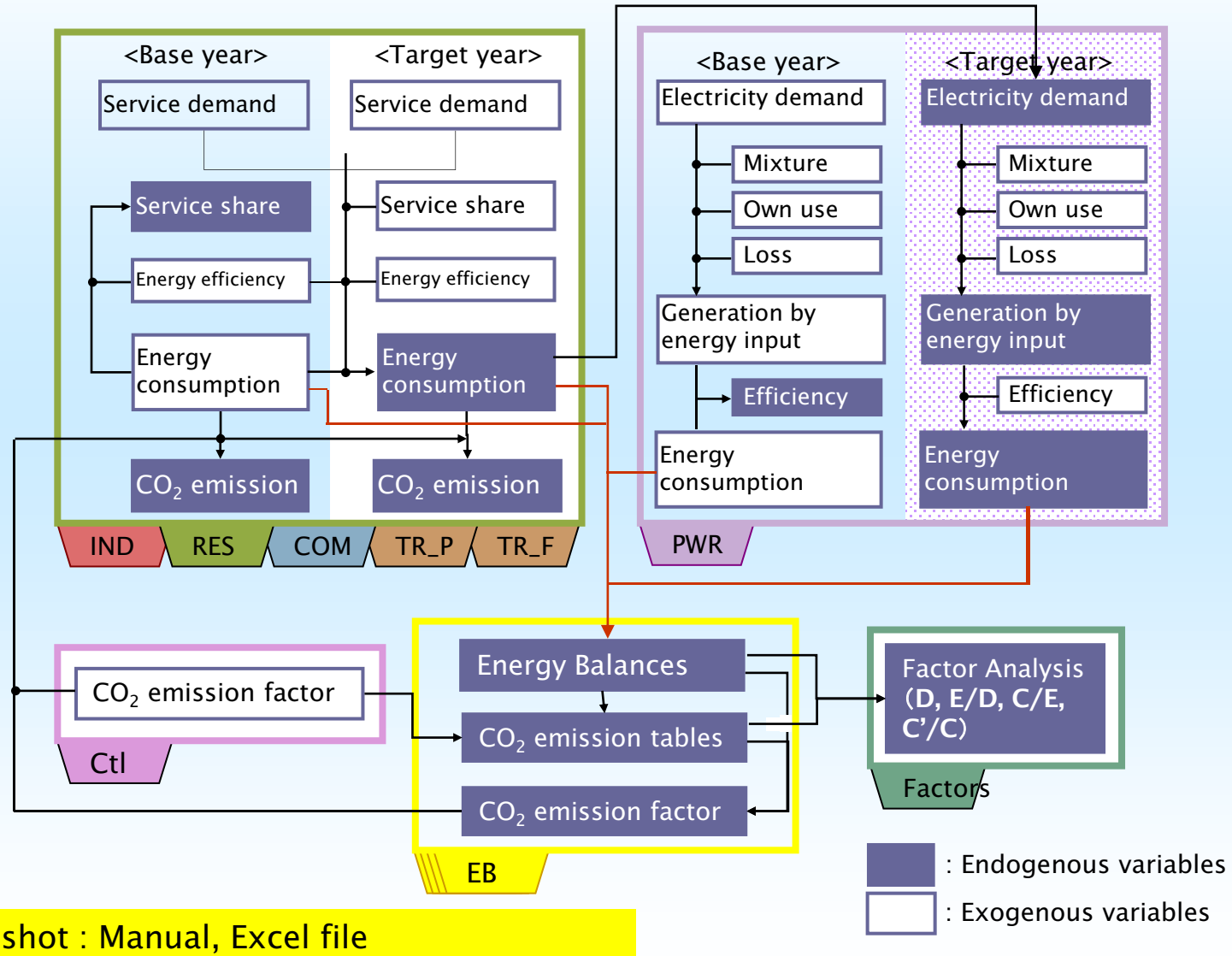
Stand-by energy reduction

Reduce 1/3 energy demand, share 100%

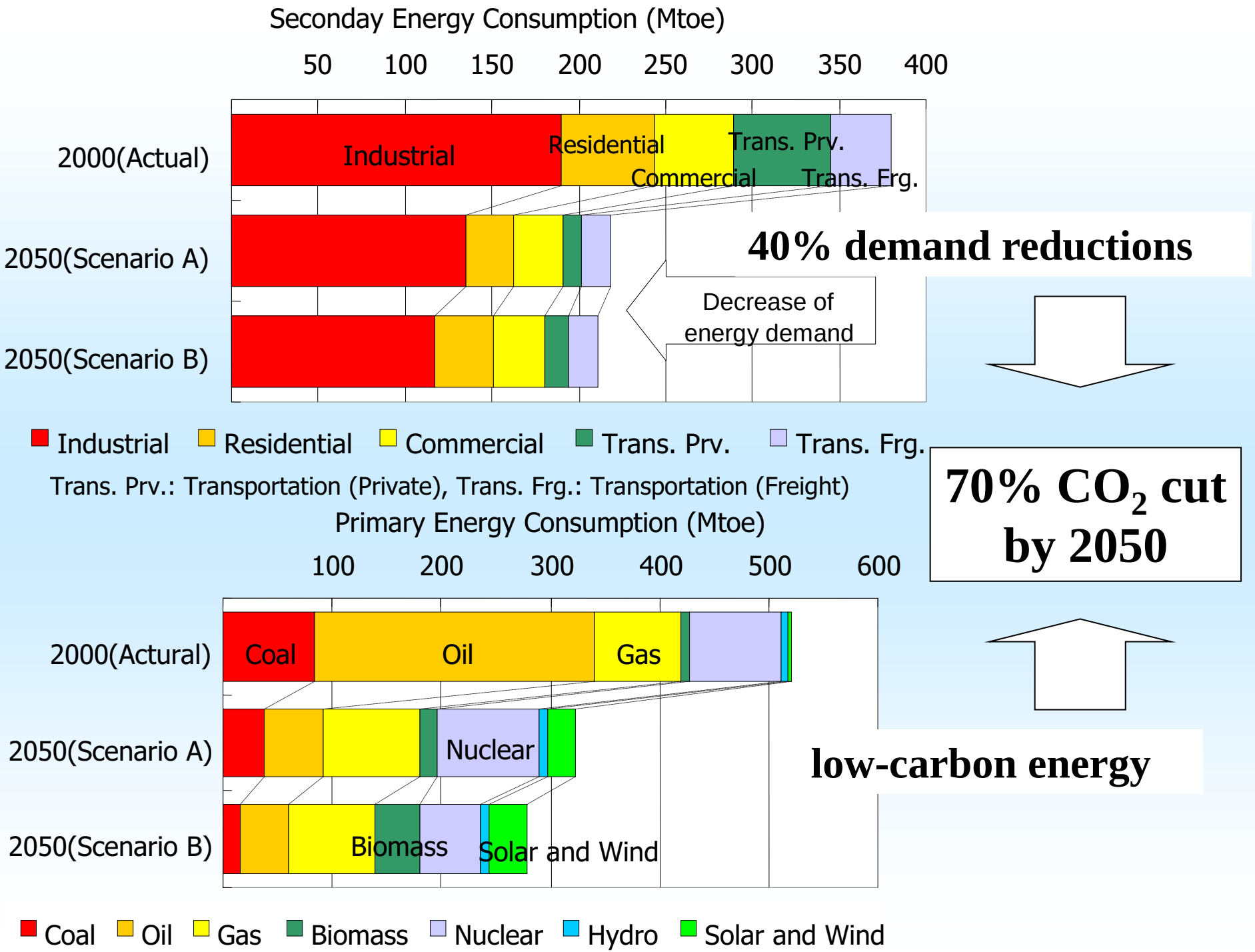
Good information for economy and environment makes people's behavior low-carbon

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

Example of AIM models for LCS study - outline of AIM/Energy Snapshot tool -



Energy Snapshot : Manual, Excel file
http://www-iam.nies.go.jp/aim/datalibrary.htm

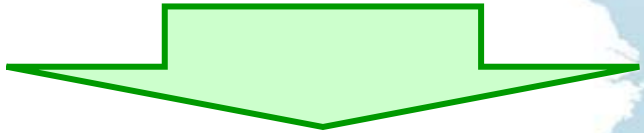

Seconday Energy Consumption (Mtoe)
50
100
150
200
250
300
350
400
2000(Actual)
2050(Scenario A)
2050(Scenario B)
Industrial
Residential
Commercial
Trans. Prv.
Trans. Frg.
Decrease of energy demand
40% demand reductions
Industrial
Residential
Commercial
Trans. Prv.
Trans. Frg.
Trans. Prv.: Transportation (Private), Trans. Frg.: Transportation (Freight)
Primary Energy Consumption (Mtoe)
100
200
300
400
500
600
2000(Actural)
2050(Scenario A)
2050(Scenario B)
Coal
Oil
Gas
Nuclear
Biomass
Solar and Wind
70% CO_2 cut by 2050
low-carbon energy
Coal
Oil
Gas
Biomass
Nuclear
Hydro
Solar and Wind

Expectation for national inventories in Asia

For estimating future GHG emissions, national inventories are important because database used for inventories are necessary as

- **base-year data of GHG emissions,**
- **basic dataset for estimating baseline activity levels,**
- **time-series data of diffusion rate of mitigation options**

etc



Thus, it is expected to enforce availability of various statistics across all sectors such as

- ☐ **sufficient statistics in time-series**
- ☐ **consistent energy balance table, input-output table**
- ☐ **diffusion ratio of mitigation options such as removal device, recovery device, decomposition device, etc.**
- ☐ **detailed socio-economic information such as urbanization rate, ownership ratio of electrical products and automobiles, etc.**

Asia-Pacific Integrated Model(AIM)
http://www-iam.nies.go.jp/aim/index.htm

Japan Low Carbon Society Scenarios toward 2050
http://2050.nies.go.jp/index.html

2050 Low-Carbon Society Scenarios in Asia
http://2050.nies.go.jp/LCS/