GHG Reduction Potential and Socio-Economic Impact

-Contribution of AIM to GHG Reduction Target in 2020 in Japan-

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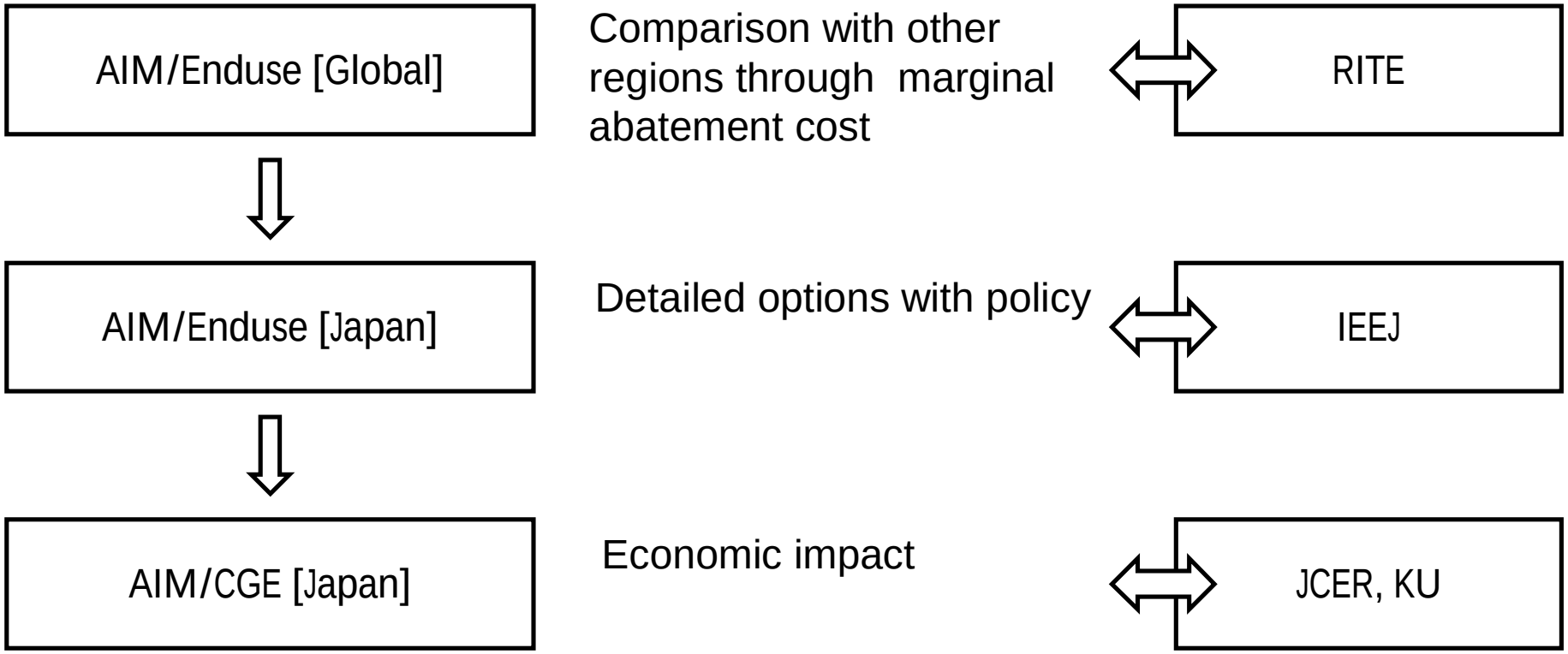
Toward “Middle-term GHG emission reduction target in Japan”

- Initiated by Cabinet Secretariat with MOE and METI
- Open and scientific discussion based on the lessons and reflections from failure at COP3
- Model comparison: AIM, RITE, IEEJ, JCER, KU
- Final decision will be done by the Prime Minister by this June
- Model teams are calculating following options;
  - +6% compared to 1990 level: “continuous effort case” by long-term energy demand forecast (IEEJ)
  - -2〜+7%: equal marginal cost to other country’s target
  - -4%: “maximum effort case” by long-term energy demand forecast (IEEJ)
  - -12〜-1%: 25% reduction by Annex I with equal marginal cost among Annex I
  - -17〜-16%: 25% reduction by Annex I with equal cost per GDP among Annex I
  - -25%

Process and contribution of AIM



The numbers in this presentation are based on the document on January 23.
Now we are updating the simulations.

Overview of Enduse[Global]

Type : Regional Bottom-up optimization model with detail technology selection framework

Components:

Regional energy enduse module coupled with

- Regional energy resource module
- International energy, basic materials balance module
- Regional macro-economy and energy service demand module

- Target Regions : 23 geographical world regions
- Time Horizon : 2000 – 2020
- Target Gas : CO2, CH4, N2O, HFCs, PFCs, SF6

  (expansion of GHGs to BC, OC, SO2, NOx, NMVOC, NH3, etc)
- Target Sectors : multiple sectors

  (Power generation / Industry / Residential / Commercial / Transport / Agriculture / F-gas emissions sector)

Geographical coverage

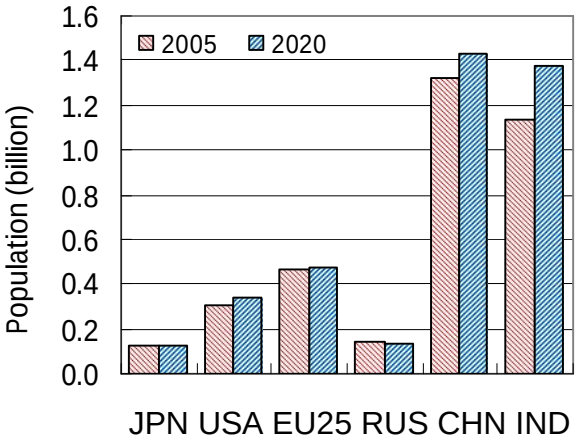
Region	Code	Annex[1)]
1) Japan	JPN	A Ⅰ
2) China	CHN	NA Ⅰ
3) India	IND	NA Ⅰ
4) Indonesia	IDN	NA Ⅰ
5) Korea	KOR	NA Ⅰ
6) Thailand	THA	NA Ⅰ
7) Other South-east Asia	XSE	NA Ⅰ
8) Other South Asia	XSA	NA Ⅰ
9) Middle East	XME	NA Ⅰ
10) Australia	AUS	A Ⅰ
11) New Zealand	NZL	A Ⅰ
12) Canada	CAN	A Ⅰ
13) USA	USA	A Ⅰ

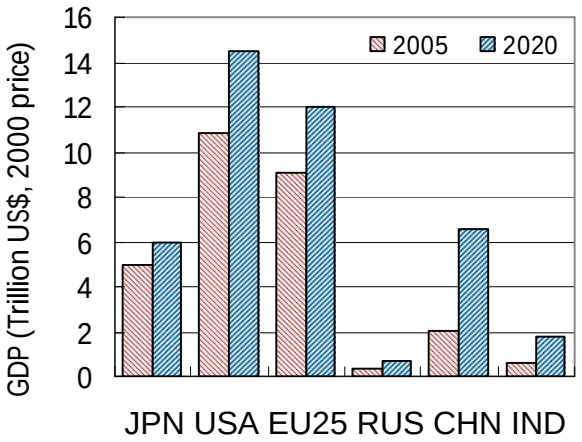
Region	Code	Annex[1)]
12) Canada	CAN	A Ⅰ
13) USA	USA	A Ⅰ
14) EU-15 in Western Europe	XE15	A Ⅰ
15) EU-10 in Eastern Europe	XE10	A Ⅰ
16) Russia	RUS	A Ⅰ
17) Argentine	ARG	NA Ⅰ
18) Brazil	BRZ	NA Ⅰ
19) Mexico	MEX	NA Ⅰ
20) Other Latin America	XLM	NA Ⅰ
21) South Africa	SAF	NA Ⅰ
22) Other Africa	XAF	NA Ⅰ
23) Rest of the World	XRW	NA Ⅰ

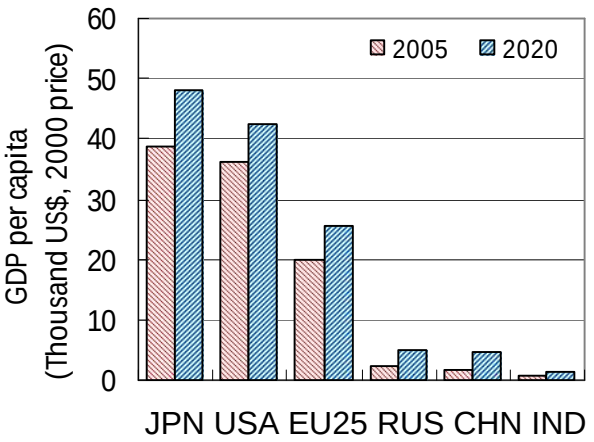
Note A Ⅰ = Annex Ⅰ nations, NA Ⅰ = non-Annex Ⅰ nations

Assumptions (1)

- Population: Medium prospect of UN World Population Prospects 2007 .
- GDP: See below (estimated by JCER and modified by AIM)
- Energy price:
  Nominal crude oil price: 56 $/bbl(in 2005) to 89 $/bbl (in 2020) (estimated by IEEJ)







➢ annual growth rate between 2005 and 2020 (%/year)

	JPN	USA	EU25	RUS	CHN	IND	Annex I	Non Annex I	World
POP	-0.2%	0.9%	0.1%	-0.6%	0.5%	1.3%	0.3%	1.2%	1.1%
GDP	1.3%	1.9%	1.9%	5.0%	8.1%	7.3%	1.9%	5.5%	3.0%
GDP/POP	1.5%	1.0%	1.7%	5.5%	7.6%	6.0%	1.6%	4.2%	1.9%

Assumption (2)

- Each activity level is estimated by using the original econometric model developed by Dr. Akashi

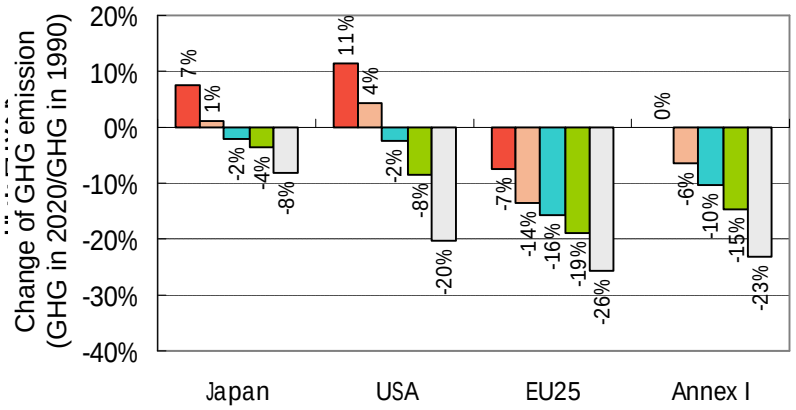
			JPN		USA		EU25		RUS	
			2005	2020	2005	2020	2005	2020	2005	2020
population		mil. people	127.9	124.5	299.8	342.5	461.0	471.5	144.0	132.4
GDP		tri. US$ at 2000 price	4.96	5.99	10.87	14.50	9.10	11.99	0.33	0.68
industry	steel	mil ton	112.5	106.7	94.2	113.9	187.3	225.9	66.1	82.3
	cement	mil ton	68.7	66.7	100.0	113.1	242.5	252.3	48.7	59.2
	other	100 in 2005	100	111	100	121	100	115	100	203
transpor-tation	passenger	bil. person km	1322.7	1243.7	8090.8	9233.7	5147.5	5884.3	833.3	1203.8
	freight	bil ton km	277.6	269.6	4583.9	5215.5	2161.8	2557.2	1473.1	1882.8

		CHN		IND		Non Annex I		Annex I		World	
		2005	2020	2005	2020	2005	2020	2005	2020	2005	2020
population		1320.5	1429.8	1134.4	1379.2	5448.1	6555.3	1089.4	1135.5	6537.5	7690.8
GDP		2.02	6.54	0.61	1.77	9.19	20.62	26.59	35.11	35.78	55.74
industry	steel	355.8	535.9	38.1	99.5	651.9	1059.1	484.8	559.9	1136.8	1619.0
	cement	1012.4	1175.0	142.7	417.9	1821.3	2673.8	483.5	518.5	2304.8	3192.2
	other	100	317	100	305	100	230	100	119	100	156
transpor-tation	passenger	1872.2	2763.8	1095.0	1408.4	9058.9	13661.2	16356.9	18724.4	25415.8	32385.6
	freight	2338.7	3375.9	693.0	874.2	7573.8	10749.4	9382.1	10986.1	16955.8	21735.5

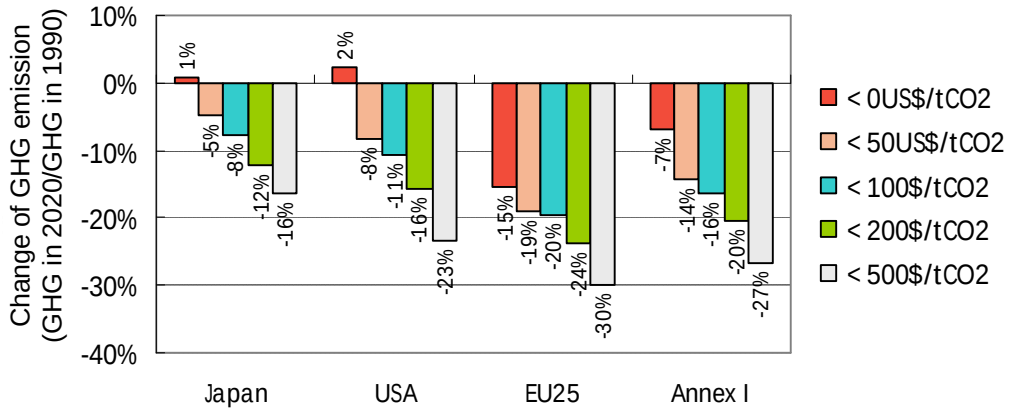
Simulation results: equal MAC among Annex I

MAC is set as ① below 0 US$/tCO2, ② below 50 US$/tCO2, ③ below 100 US$/tCO2, ④ below 200 US$/tCO2, and ⑤ below 500 US$/tCO2

In case of short pay back period



In case of long pay beck period



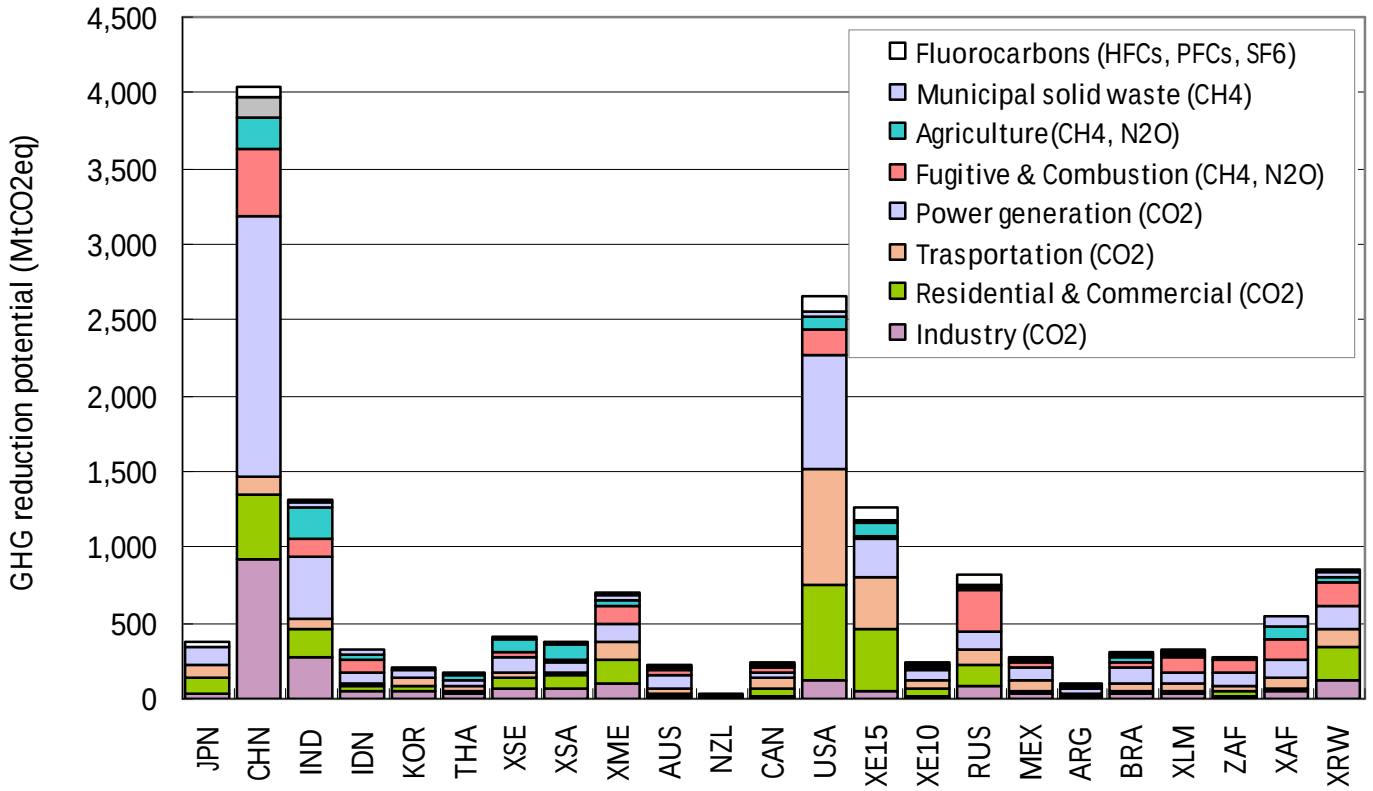
	Short pay back period				Long pay back period			
	Japan	USA	EU25	Annex I	Japan	USA	EU25	Annex I
below 0$/tCO2	1338, 1114	7045, 5462	4712, 3545	16916, 12806	1256, 1033	6471, 4911	4306, 3148	15726, 11679
below 50$/tCO2	1259, 1060	6608, 5136	4401, 3314	15806, 12056	1185, 988	5795, 4354	4120, 3047	14483, 10805
below 100$/tCO2	1217, 1033	6174, 4750	4298, 3239	15143, 11525	1149, 968	5658, 4263	4089, 3040	14139, 10586
below 200$/tCO2	1200, 1022	5792, 4465	4123, 3133	14399, 11002	1095, 920	5325, 4014	3889, 2907	13437, 10082
below 500$/tCO2	1143, 983	5051, 3837	3786, 2882	12960, 9825	1043, 882	4853, 3646	3565, 2662	12358, 9244

Total GHG emissions (MtCO2 eq)，CO2 emissions from energy (MtCO2)

Regional and sectoral GHG emission reduction potential in 2020

Long payback period

Potential in case of less than 100 US$/tCO2



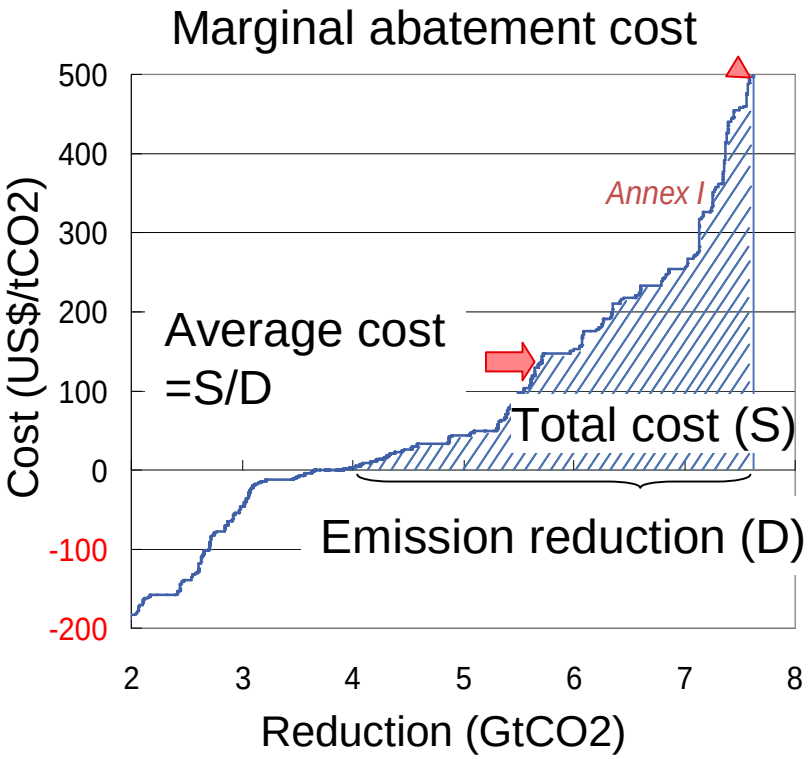
JPN	**Japan**
CHN	**China**
IND	**India**
IDN	**Indonesia**
KOR	**Korea**
THA	**Thailand**
XSE	**Other South-east Asia**
XSA	**Other South Asia**
XME	**Middle East**
AUS	**Australia**
NZL	**New Zealand**
CAN	**Canada**
USA	**USA**
XE15	**Western Europe(15)**
XE10	**Eastern Europe(10)**
RUS	**Russia**
ARG	**Argentine**
BRZ	**Brazil**
MEX	**Mexico**
XLM	**Other Latin America**
ZAF	**South Africa**
XAF	**Other Africa**
XRW	**Rest of the World**

Marginal cost vs average cost

Long pay beck period

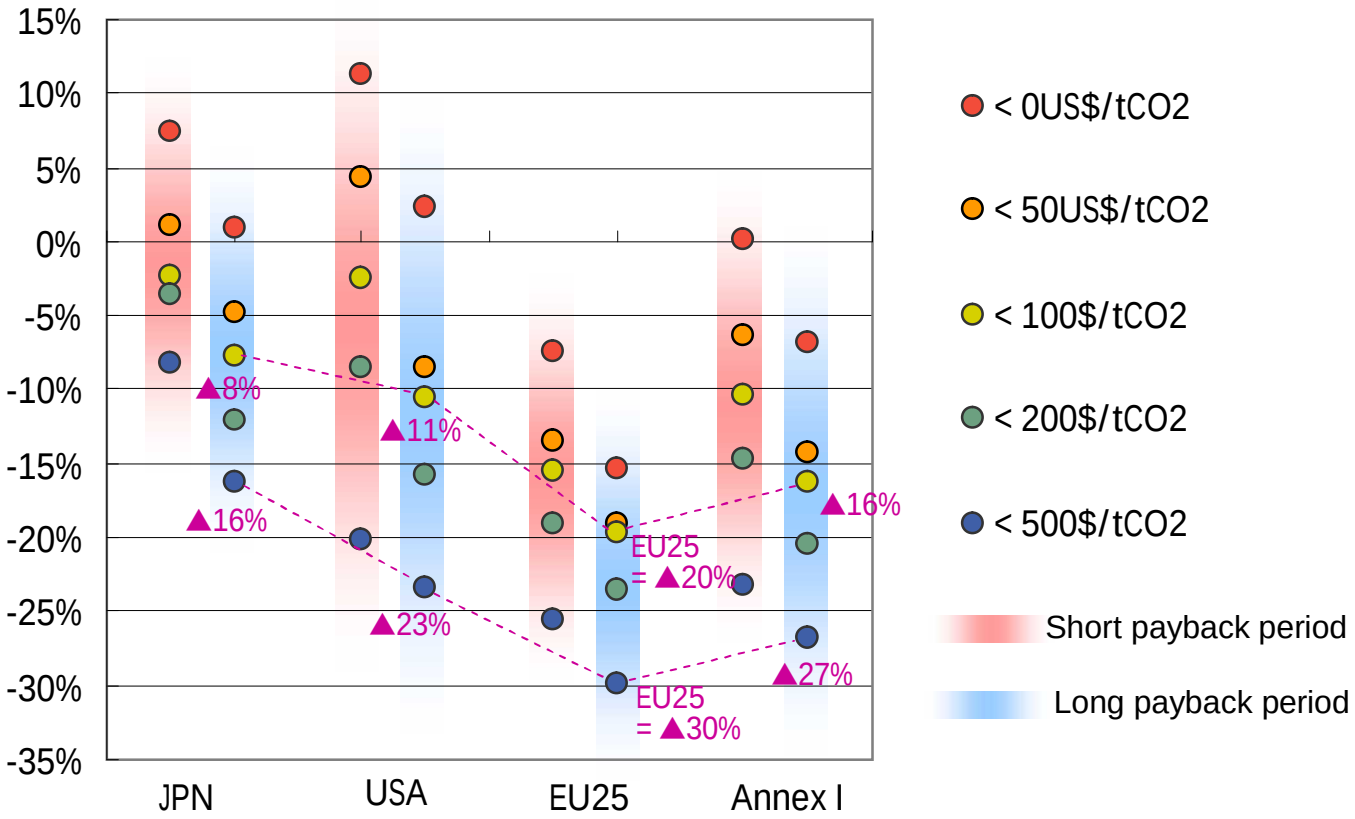
	JPN	USA	EU25	Annex I
Marginal abatement cost (US$/tCO2)	**200**	**200**	**200**	**200**
Total cost in 2020 (Billion US$/yr)	**18**	**104**	**46**	**218**
Average cost (US$/tCO2)	**85**	**70**	**80**	**75**
Total cost / GDP in 2020 (%)	**0.29%**	**0.72%**	**0.39%**	**0.63%**
Emission to 1990 (%)	**-12%**	**-16%**	**-24%**	**-20%**

	JPN	USA	EU25	Annex I
Marginal abatement cost (US$/tCO2)	**500**	**500**	**500**	**500**
Total cost in 2020 (Billion US$/yr)	**33**	**248**	**148**	**566**
Average cost (US$/tCO2)	**127**	**133**	**170**	**146**
Total cost / GDP in 2020 (%)	**0.55%**	**1.71%**	**1.24%**	**1.64%**
Emission to 1990 (%)	**-16%**	**-23%**	**-30%**	**-27%**



Marginal abatement cost curve for Annex I

Comparison among Japan, USA and EU



When JPN and USA reduce GHG emissions with the same level as marginal cost in EU25,

EU25=-20%	JPN=-8%	USA=-11%	(100 US$/tCO2)
EU25=-30%	JPN=-16%	USA=-23%	(500 US$/tCO2)

25% reduction in Annex I

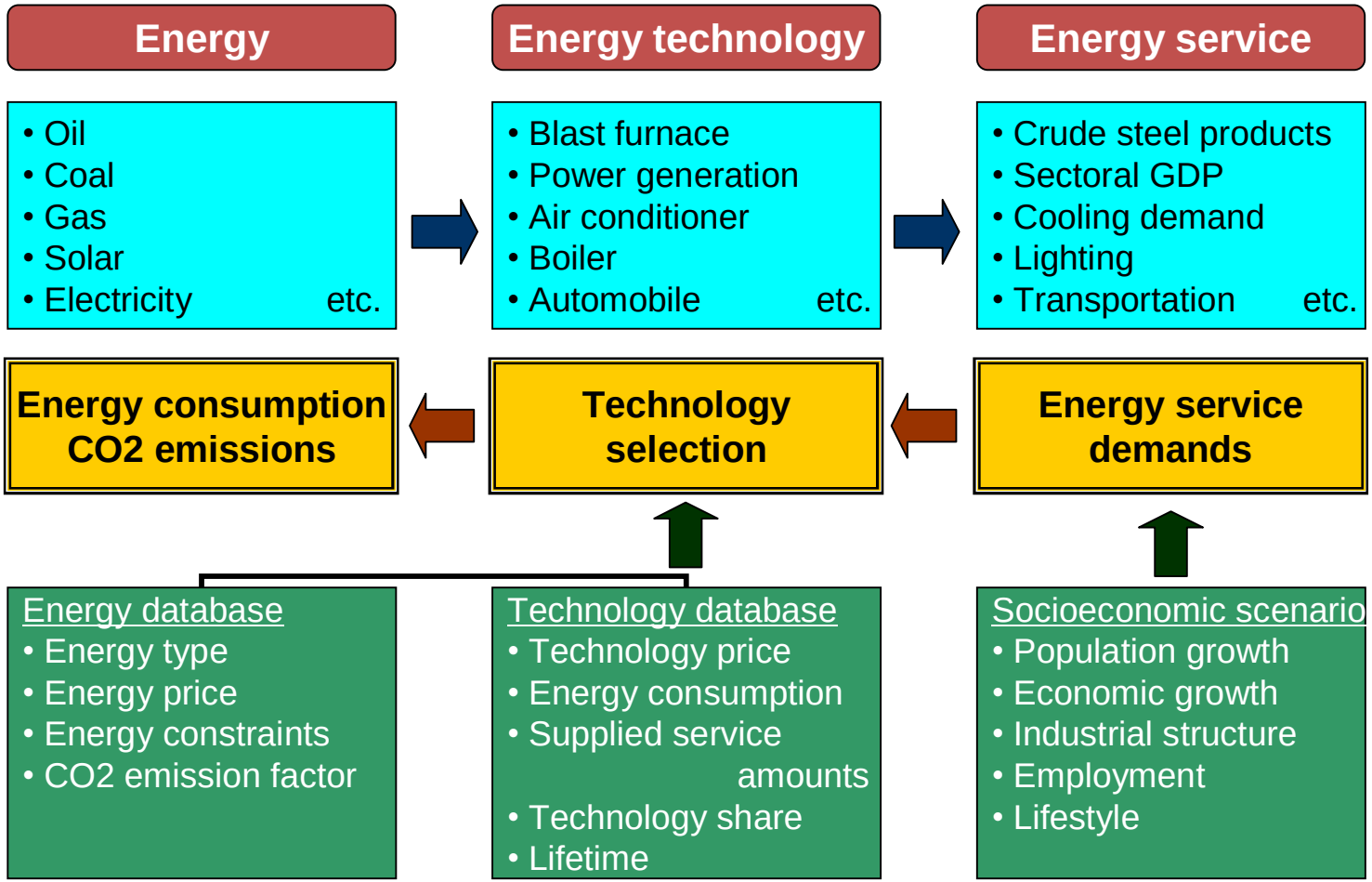
GHG emission in 2020 compared to 1990 level

	JPN	USA	EU25
Equal marginal cost among Annex I	-12[*1] ～-15[*2] %	-22%	-28%
Equal total cost per GDP among Annex I	-17%	-20%	-30%
Equal emission per capita among Annex I	-17%	-17%	-26%

*1: short payback period
*2: long payback period

When GHG emission reduction in Annex I is set to be 25% to 1990 level, GHG emission reduction in Japan is approximately 15%.

Structure of AIM/Enduse[Japan]



Cases for AIM/Enduse [Japan]

Fixed technology case

Technology share and energy efficiency will be fixed after 2005.

		sectors
Stock level	Efficiency in averaged stock level will be fixed.	industry, commercial, transportation except automobile
Flow level	Efficiency in averaged flow level will be fixed.	household and automobile

Policy cases

CO2 emissions reduction policy will be implemented as follows;

Policy I: 8% reduction from 1990 level

Policy II: 15% reduction from 1990 level

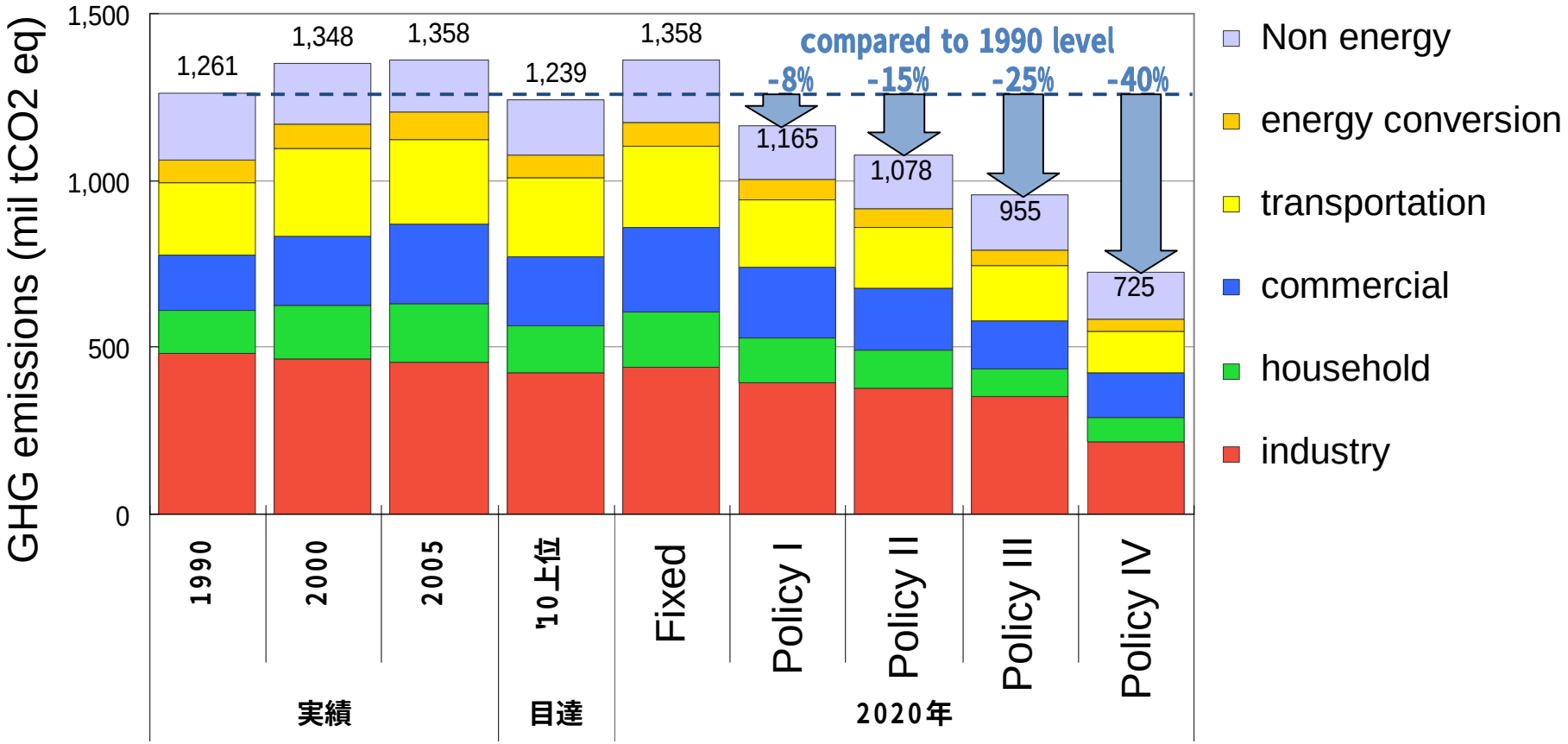
Policy III: 25% reduction from 1990 level

Policy IV: 40% reduction from 1990 level

Assumption of activity level in 2020

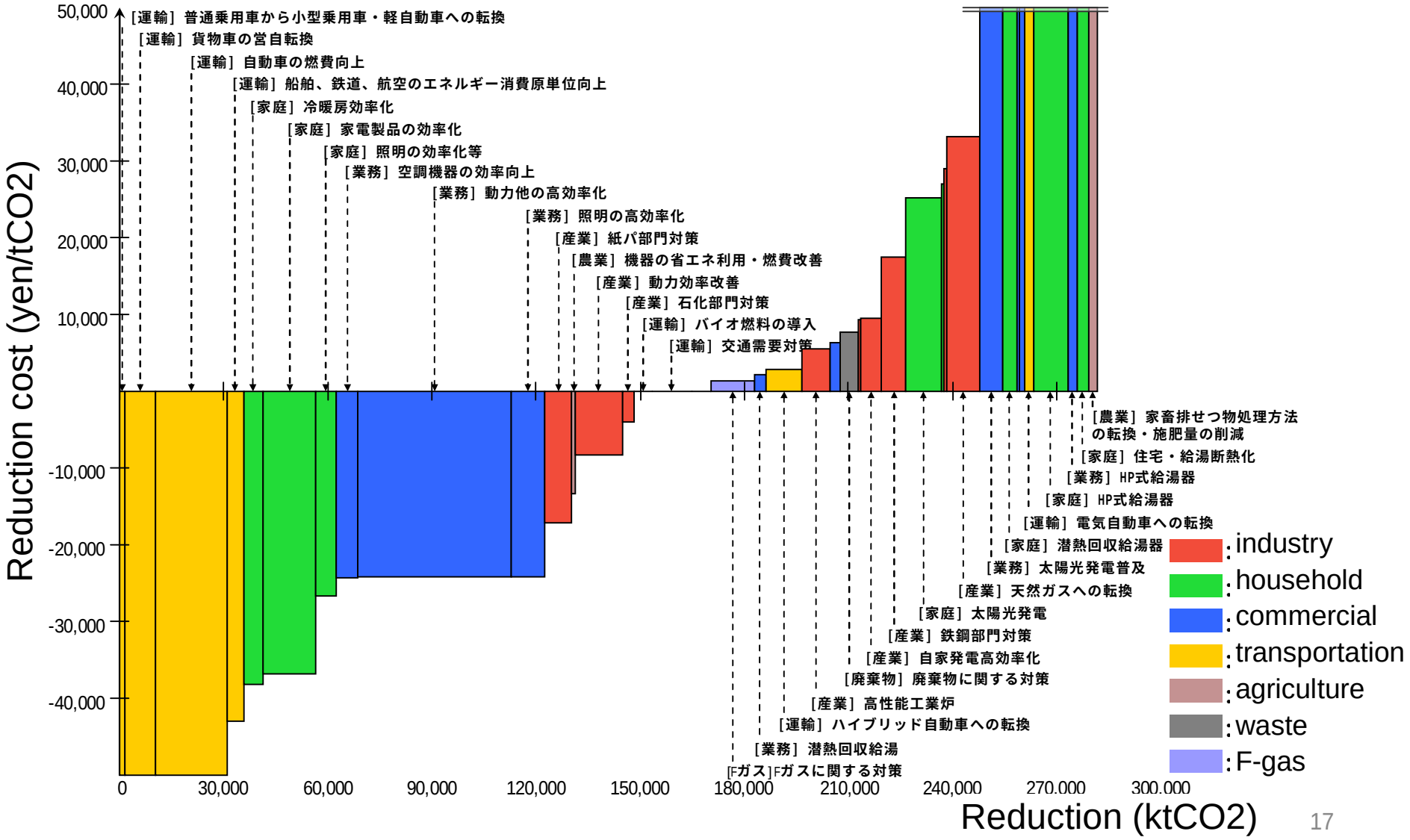
				1990	2000	2005	2020	2020 for policy IV
industry	raw material production	crude steel	10,000 ton	11,171	10,690	11,272	10,697	7,471
		ethylene	10,000 ton	597	757	755	706	494
		cement	10,000 ton	8,685	8,237	7,393	7,179	5,025
		paper and paper board	10,000 ton	2,854	3,174	3,107	3,244	2,271
	production index	food	100 in 2000	100	100	94	93	65
		textile	100 in 2000	185	100	64	54	38
		chemical	100 in 2000	87	100	100	127	89
		non-ferrous metal	100 in 2000	93	100	102	124	87
		machinery	100 in 2000		100	107	149	104
household	number of households		10,000	4,116	4,742	5,038	5,131	5,131
commercial	floor space		million m^2	1,286	1,655	1,764	1,957	1,957
transpor-tation	passenger		100 mil. person km	11,313	12,969	13,042	12,927	11,073
	freight		100 mil ton km	5,468	5,780	5,704	6,275	5,349

GHG emissions in 2020

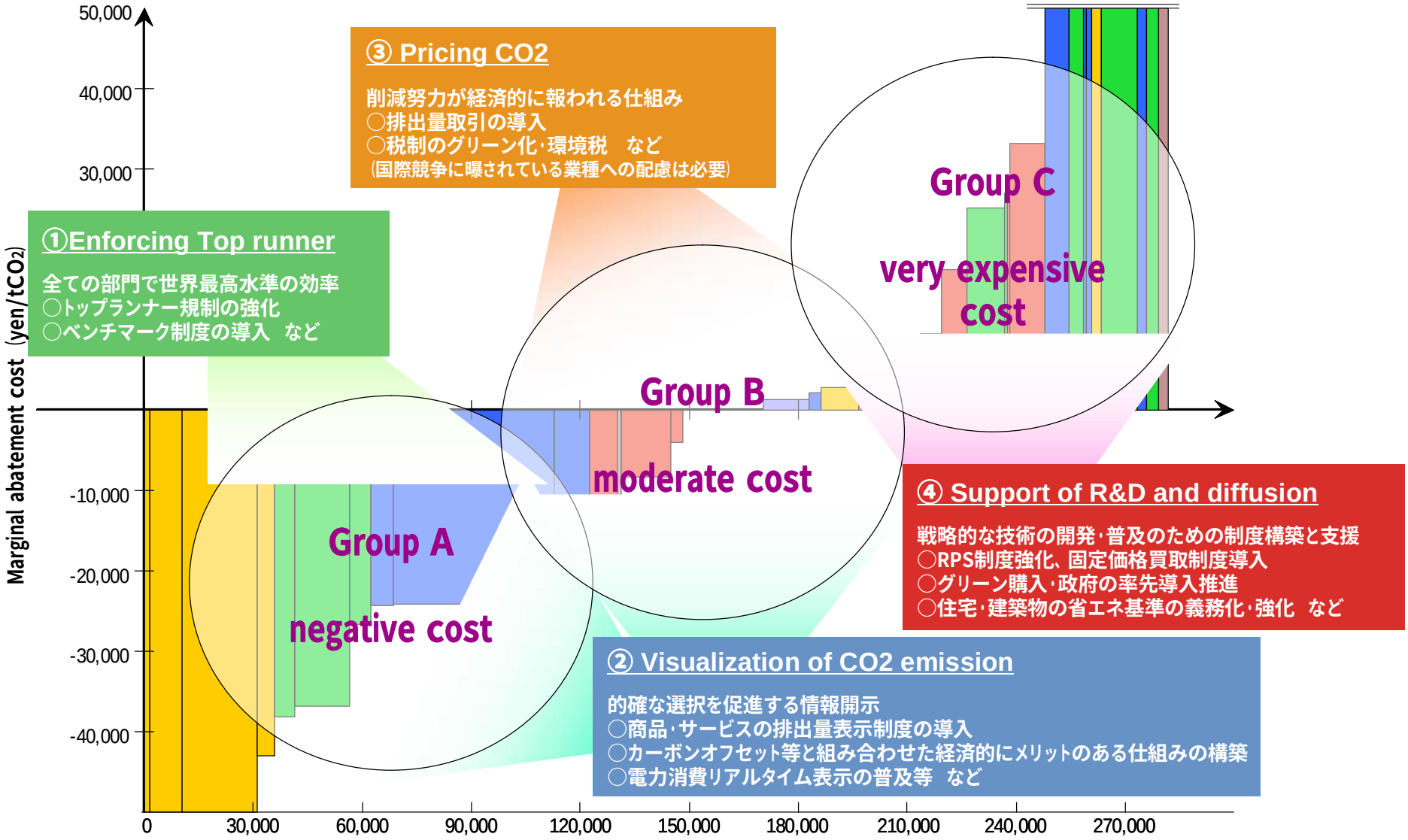


1. 25% reduction of GHG emissions in 2020 compared to 1990 level is technically feasible without any degradation of activity level.
2. In the case of 40% reduction, the activity level should be shrunk.
3. Annual cost (additional cost) to achieve the target:
    1. Policy I: 1.4-1.8 trillion yen
    2. Policy II: 2.3-2.9 trillion yen
    3. Policy III: 5.7-6.9 trillion yen

GHG emission reduction and cost (Policy II)



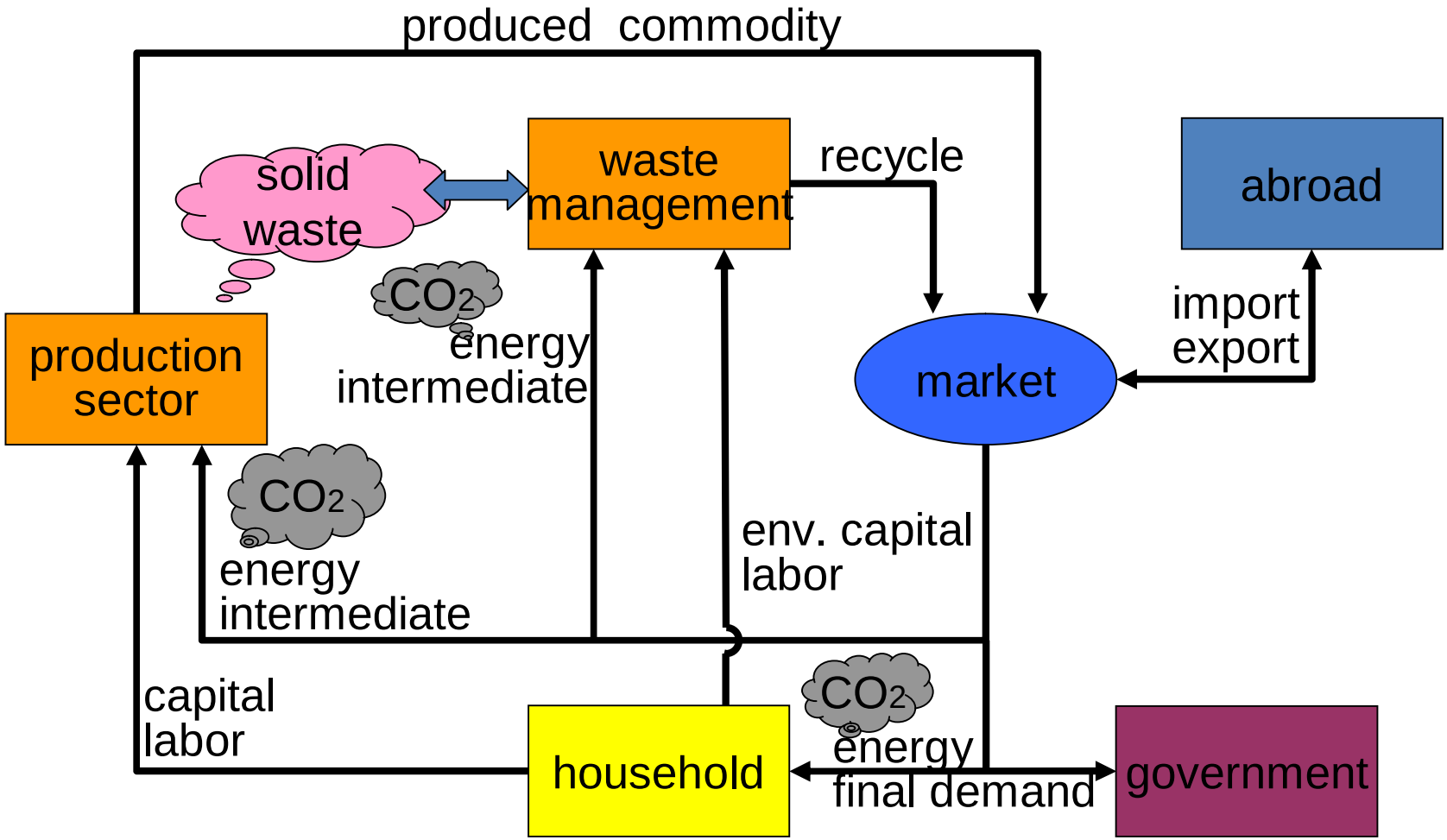
Policies to achieve the target in 2020



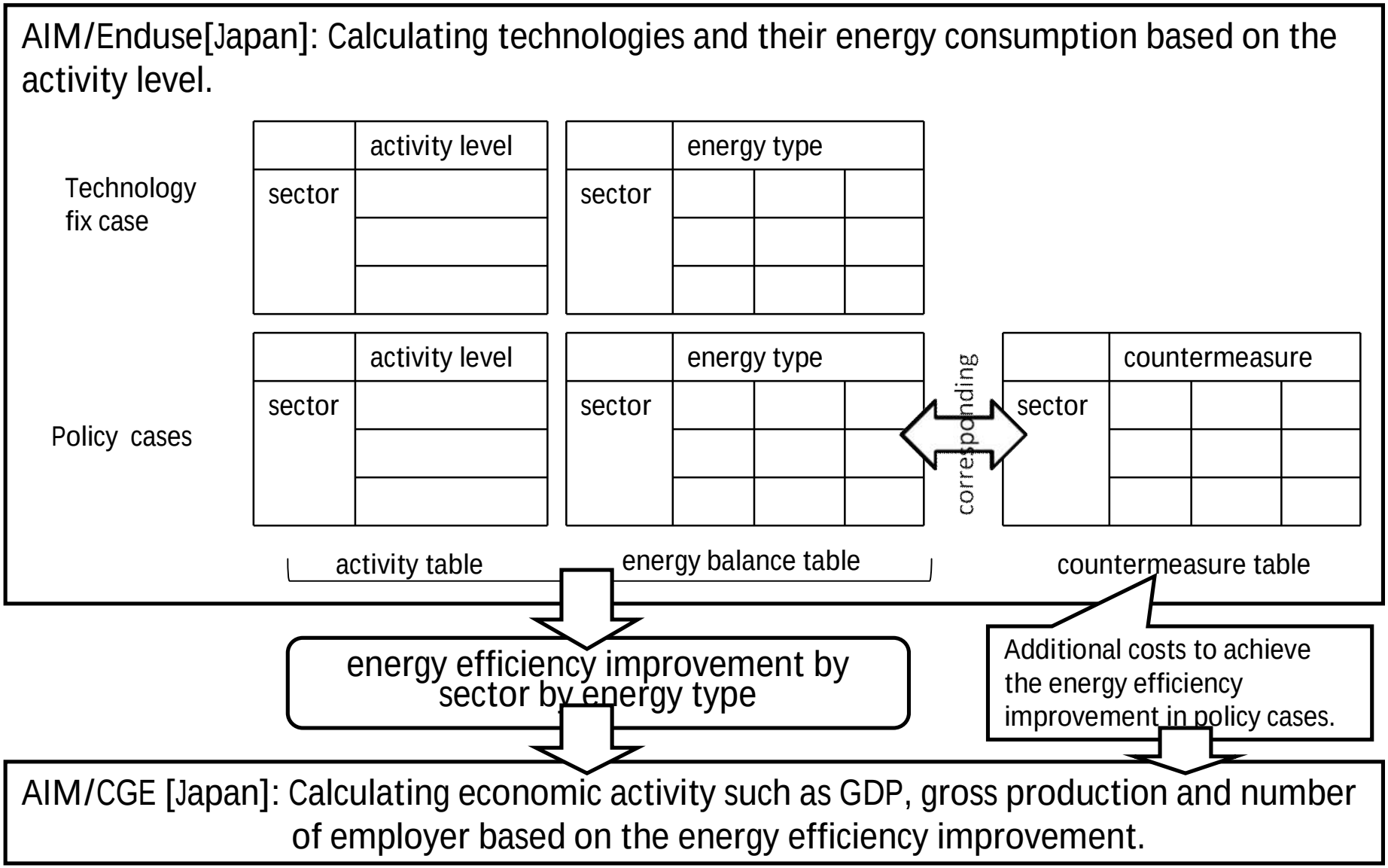
Overview of AIM/CGE [Japan]

- Computable general equilibrium model with recursive dynamics
- More than 100 sectors and commodities
- Benchmark year: 2000
- Time step: 1 year
- Assumptions: Future economic growth, total labor supply, production function, demand function and energy efficiency improvement
- In order to keep consistency with AIM/Enduse [Japan], substitution among energies within 1 year will not occur, and substitution over years reflects the Enduse results.
- Additional costs to reduce CO2 emissions in production sectors are regarded as investment, and they diminish investment for enhancing production capacity (Total investment is fixed).

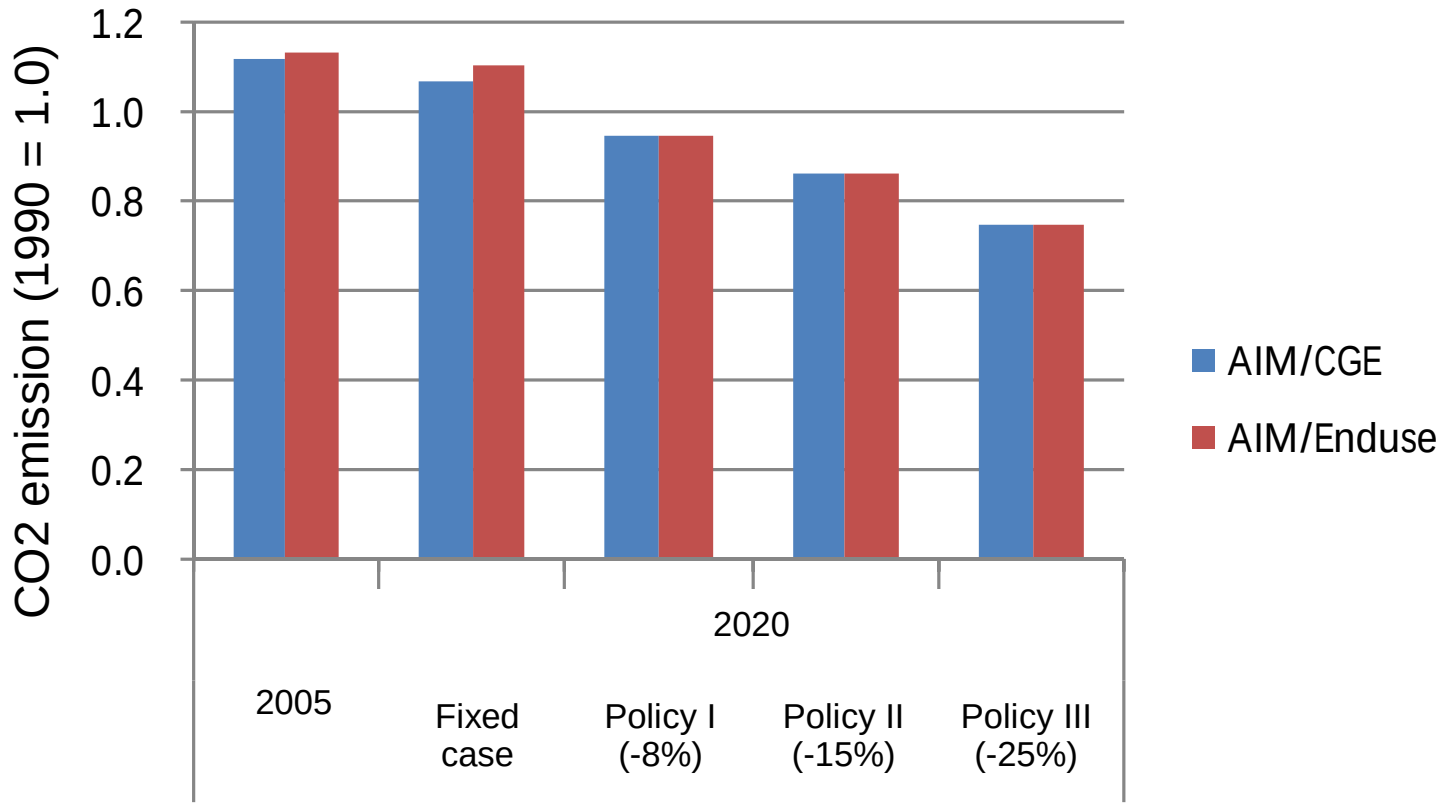
Structure of AIM/CGE



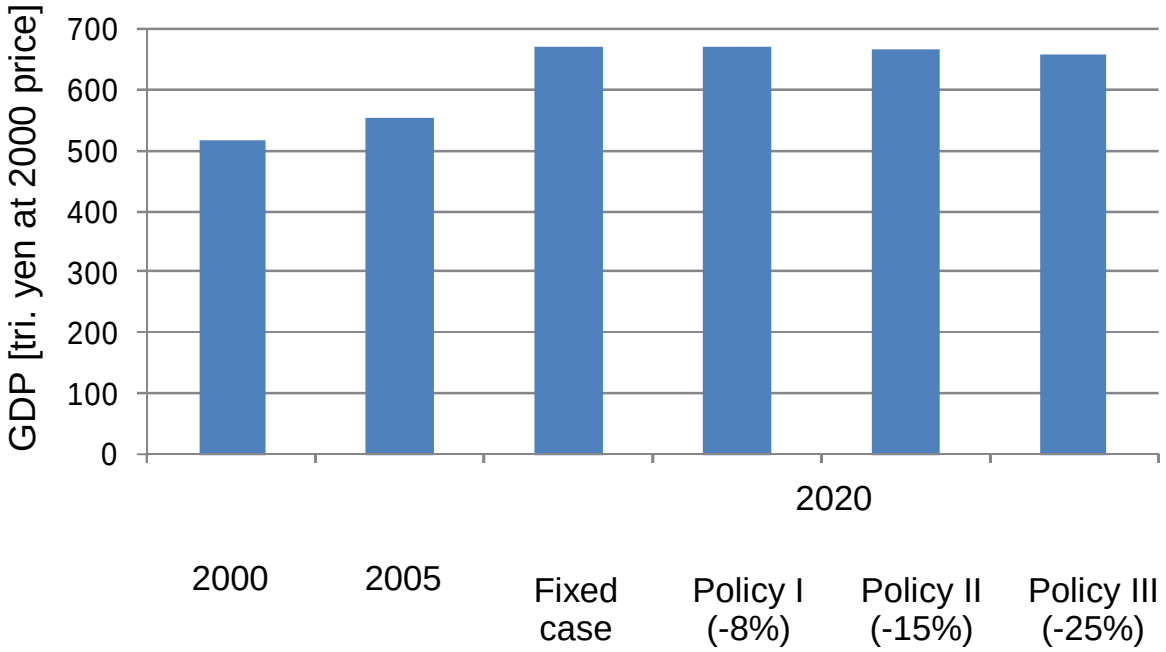
Linkage of AIM/Enduse [Japan] to AIM/CGE [Japan]



Comparison between CO2 emissions in AIM/Enduse[Japan] and AIM/CGE[Japan]



Economic Impact to Japan



	2000	2005	2020			
			Fixed case	Policy I (-8%)	Policy II (-15%)	Policy III (-25%)
real GDP (tri. yen at 2000 price)	520.7	554.9	671.6	670.5	669.4	660.9
annual growth rate between 05 and 20 (%/year)			1.28	1.27	1.26	1.17
GDP change in 2020 to fixed case (%)				-0.16	-0.32	-1.59

* Conditions of import and export are the same among the cases.

Sectoral impact