Japan's Long-Term Energy Demand and Supply Outlook

A projection up to 2020 assuming environmental constraints and market-liberalization

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- Summary

Study Framework (1)

- Purpose
  - Given the requirement for the simultaneous achievement of energy supply stability, environmental preservation, and efficiency (i.e., market liberalization), we aim to systematically and quantitatively describe realistic energy futures while paying due attention to changes in social and economic structures.
- Projection period: 2000-2020
- Projection methods:

  Macro economic model,

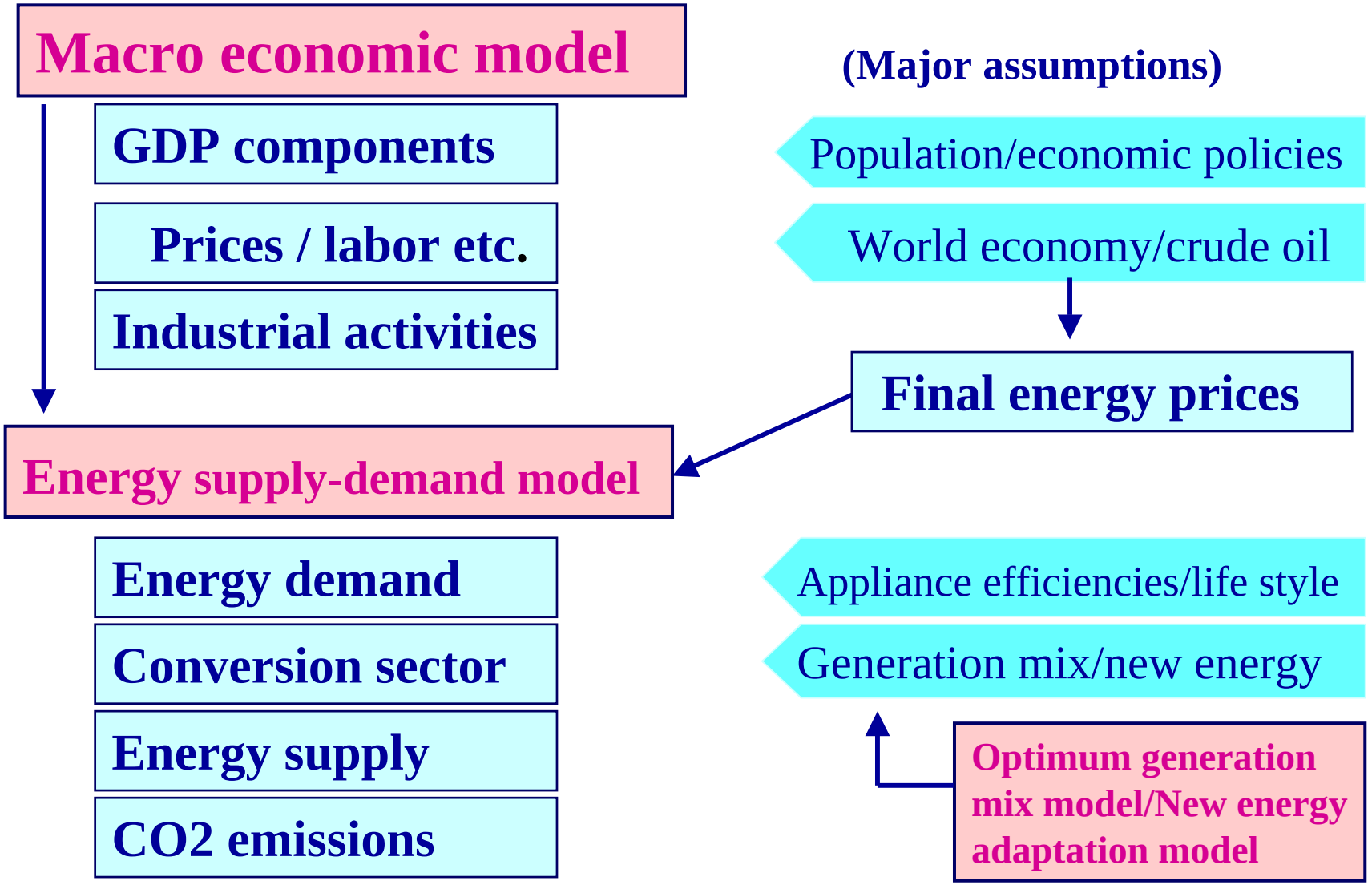
  Energy supply and demand model, etc.

Study Framework (2)

Cases:

- Reference case
  - Reflects current economic and social situations as well as policies.Predicts energy supply/demand under most realistic assumptions.
- Low-growth case
  - Structural recession will continue. Economy will be stagnant until 2010.
- Enhanced environmental measures case (Policy Case)
  - Further energy conservation will be achieved. Use of new energy will increase further (roughly the goal set by the government).

Model flow



We ascertain factors, influencing future energy supply and demand, together with various causal relationships in a quantitative and consistent way.

Energy Balance Table (FY2000)

(MTOE)

Sector			A Coal	B Oil	C Gas	D Hidro & others	E Nuclear	F Electri-city	G Total
Primary Energy Supply	1	Domestic Production	2	1	2	27	69	0	101
	2	Import	99	289	71	0	0	0	458
	3	Total Primary Energy Supply	100	289	73	27	69	0	559
	4	Export, etc.	-2	-22	0	0	0	0	-24
	5	Domestic Primary Energy Supply	99	267	73	27	69	0	535
Energy Conversion	6	Electric Utilities	-50	-32	-51	-24	-69	93	-134
	7	Others	-4	-5	4	1	0	0	-4
	8	Own Use & Losses	-3	-9	-2	0	0	-9	-21
Final Energy Consumption	9	Total	41	222	25	4	0	83	376
	10	Industry	40	96	10	3	0	37	185
	11	Residential & Commercial	1	37	15	2	0	45	100
	12	Transport	0	89	0	0	0	2	91

The figure of primary supply

Power production composition

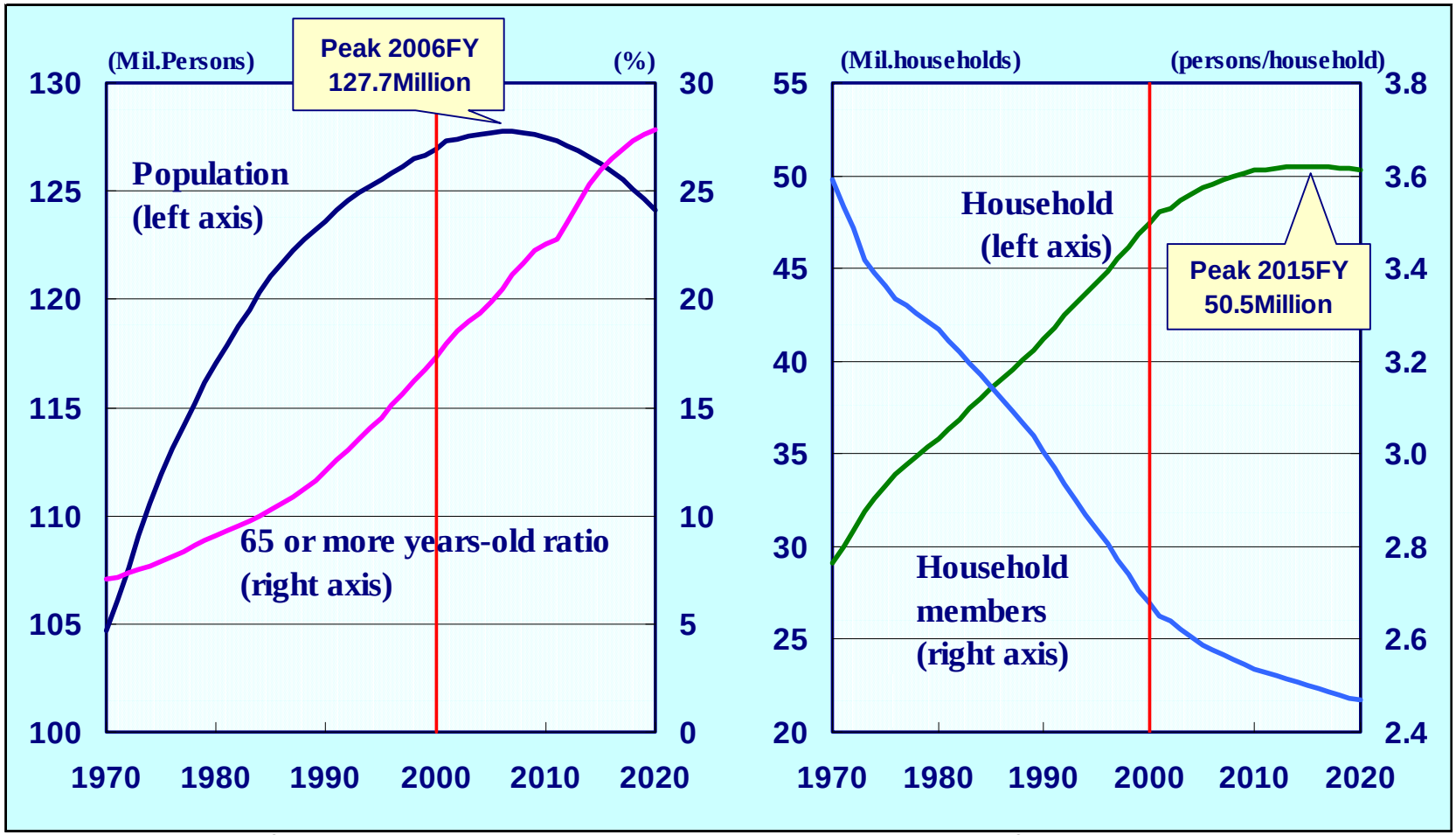
Final-demand structure

Based on energy balance tables, we show supply-demand balances in detail for each sector and source in the future.

Major Assumptions (Socioeconomic Structure)

- **Population structure**
  - Population peaks at 128 million in 2006, and thereafter declines.
  - Proportion of the aged (65 and above) in population increases from 17.3% to 27.8% (FY2000-2020).
- **GDP growth rate**
  - Reference case — FY 2000-2010: 1.5% per year; FY 2010-2020: 1.1% per year
  - Low-growth case — FY 2000-2010: 0.5% per year; FY 2010-2020: 0.9% per year
- **Industrial structure**
  - Shift from material industry toward assembly.
  - Becomes increasingly oriented toward services and IT.

Population and Household Trends



Source: Population forecast is the medium variant by the National Institute of Population and Social Security Research, 2002. Number of households is estimated by the Institute of Energy Economics, Japan (IEEJ).

Population peaks in 2006. Aging in Japan will be rapid, unprecedented in the world.
Aging of the population >>> Energy consumption and potential growth

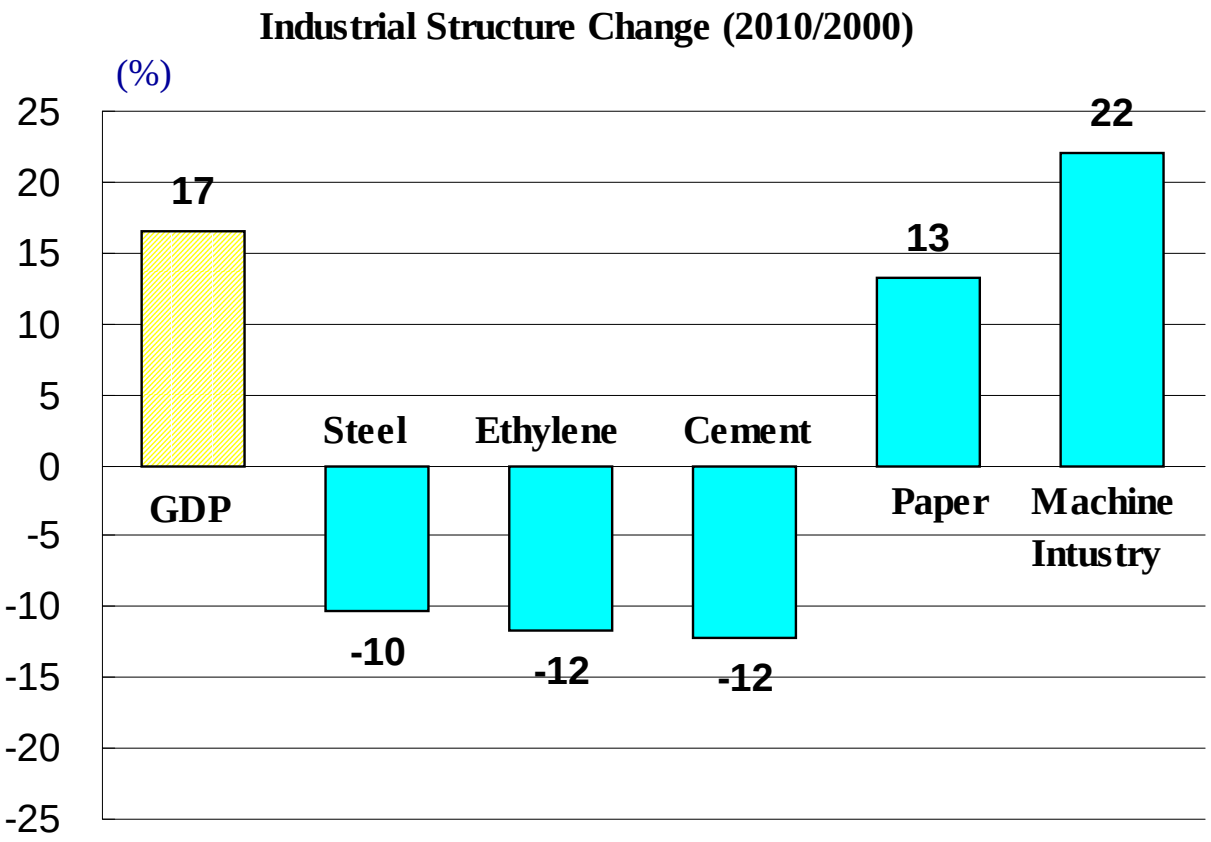
Macro Economy Outlook [reference case]

	Actual		Forecast		Growth rate(%)		
	1990FY	2000FY	2010FY	2020FY	2000 /1990	2010 /2000	2020 /2010
GDP (trillion yen)	470	536	624	697	1.3	1.5	1.1
Private demand	369	400	477	533	0.8	1.8	1.1
Public demand	94	125	129	131	2.9	0.3	0.2
Net exports	7	13	19	32	6.2	3.8	5.8
CPI(1995=100)	92.9	99.9	106.7	112.6	0.7	0.7	0.5
Crude oil price($/bbl)	22.8	28.4	25.6	37.1	2.2	-1.0	3.8
IIP(1995=100)	105.9	104.7	119.0	133.0	-0.1	1.3	1.1
Steel product(1,000t)	111,710	106,901	95,917	90,431	-0.4	-1.1	-0.6
Ethylene (1,000t)	5,966	7,566	6,679	6,678	2.4	-1.2	-0.0
Cement (1,000t)	86,893	80,068	70,284	68,020	-0.8	-1.3	-0.3
Paper (1,000t)	28,538	31,742	35,955	39,863	1.1	1.3	1.0
Machinery (1995=100)	106.3	113.3	138.3	161.3	0.6	2.0	1.6

Economic growth will be powered mostly by private demand.

Industrial Structure [reference case]

- Shift from material industry to assembly



2000FY ⇨ 2010FY

Crude steel

107 Mt ⇨ 96 Mt

(Row GDP: 90Mt)

Ethylene

7.6 Mt ⇨ 6.7 Mt

(Row GDP: 6Mt)

Machinery

22% up

(Row GDP: 8% up)

Major Assumptions (Domestic Factors: Energy)

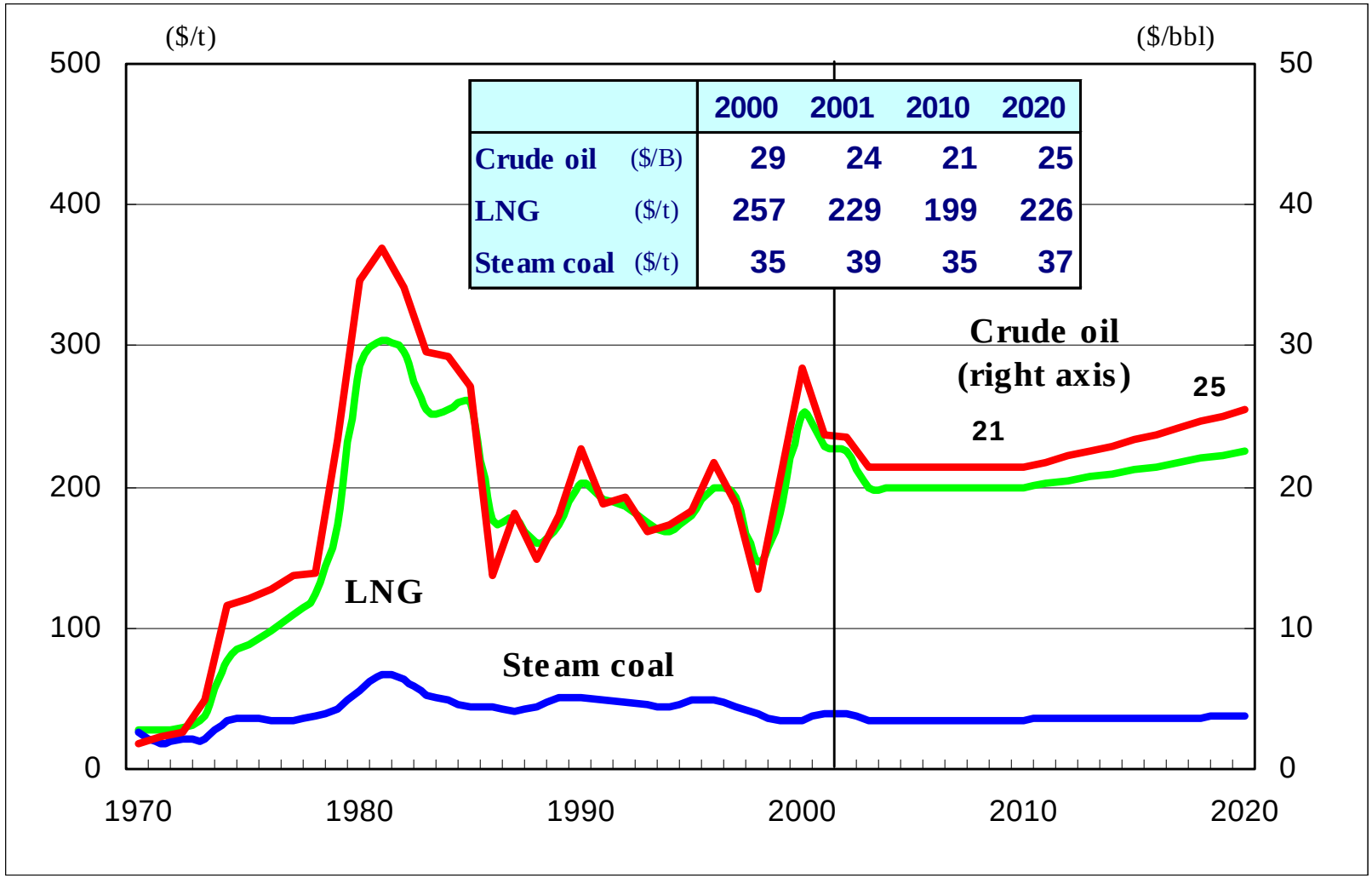
- Energy Conservation
  - Progress made in currently considered energy conservation measures
    - Industry sector: Reduced energy consumption by each category(Keidanren Voluntary Action)
    - Residential and commercial sector: Improvement in home electrical appliance efficiency (Top Runner standard scheme)
    - Transport sector: Improved car and truck mileage (Top Runner stand.)
- Nuclear Generation Capacity
  - Anticipates delays in realizing construction plans
    - End of March 2002: 45,910 MW
    - FY 2010: 51,900 MW (five more units)
    - FY 2020: 61,500 MW (seven more units)
- New Energy Use
    - 4 million kl (crude oil equivalent) in 2010, 5 million kl in 2020
    - For Policy case, 13 million kl in 2010 and 17 million kl in 2020

Major Assumptions (Overseas-related Factors)

- World Economy
  - Moderate growth (2.8% in 2000-2020)
    - Asian economies will lead economic growth (5.3% in the same period)
- Crude Oil Prices
  - Gradually increasing trend after 2010
    - 2010: US$21/bbl (2001 prices)
    - 2020: US$25/bbl (2001 prices)
  - Growth of coal and LNG prices will be lower than those of oil

Primary Energy Price Outlook

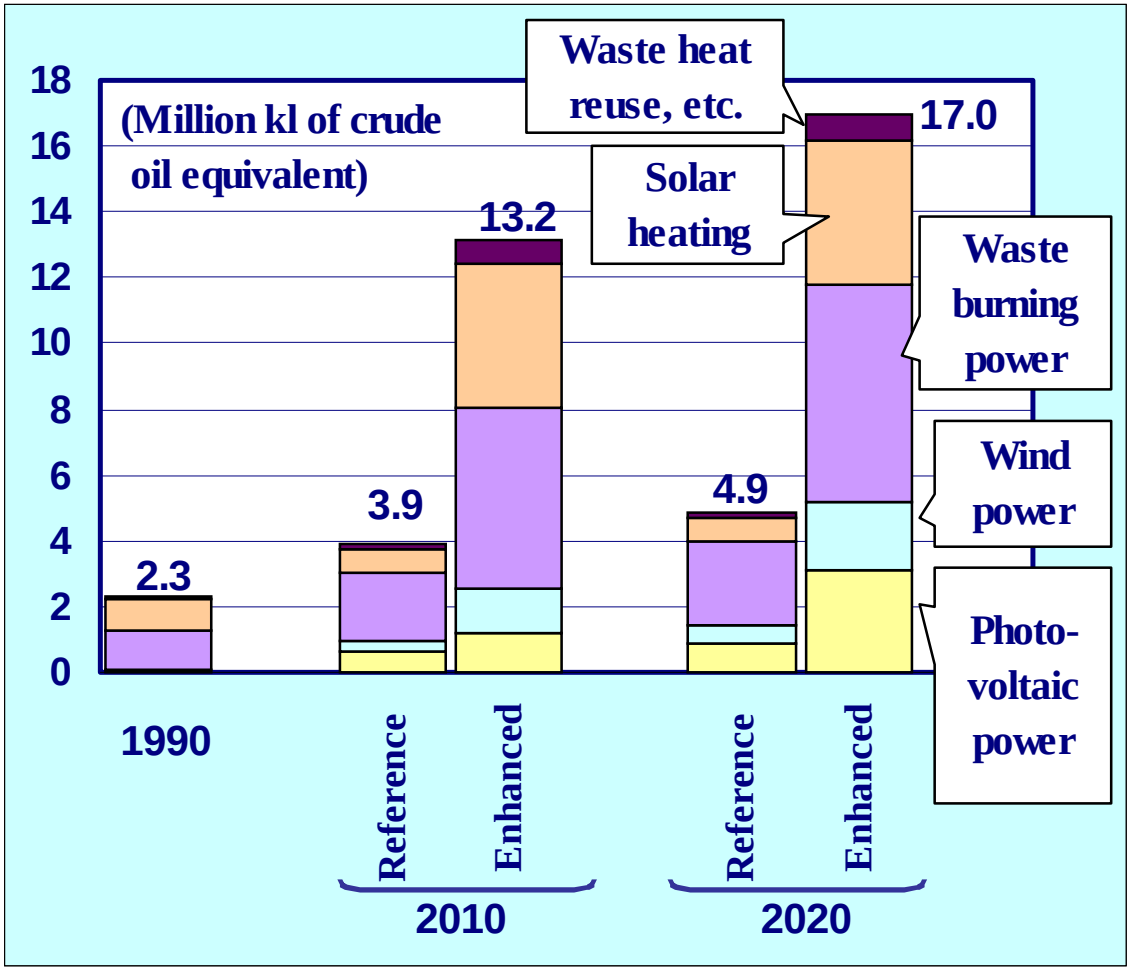
(Forecasted figures are in 2001 prices)



		2000	2001	2010	2020
Crude oil	($/B)	29	24	21	25
LNG	($/t)	257	229	199	226
Steam coal	($/t)	35	39	35	37

Note: Assumed based on IEA, *World Energy Outlook 2002*.

New Energy Utilization Outlook



(Upper:Reference/Lower:Enhanced)

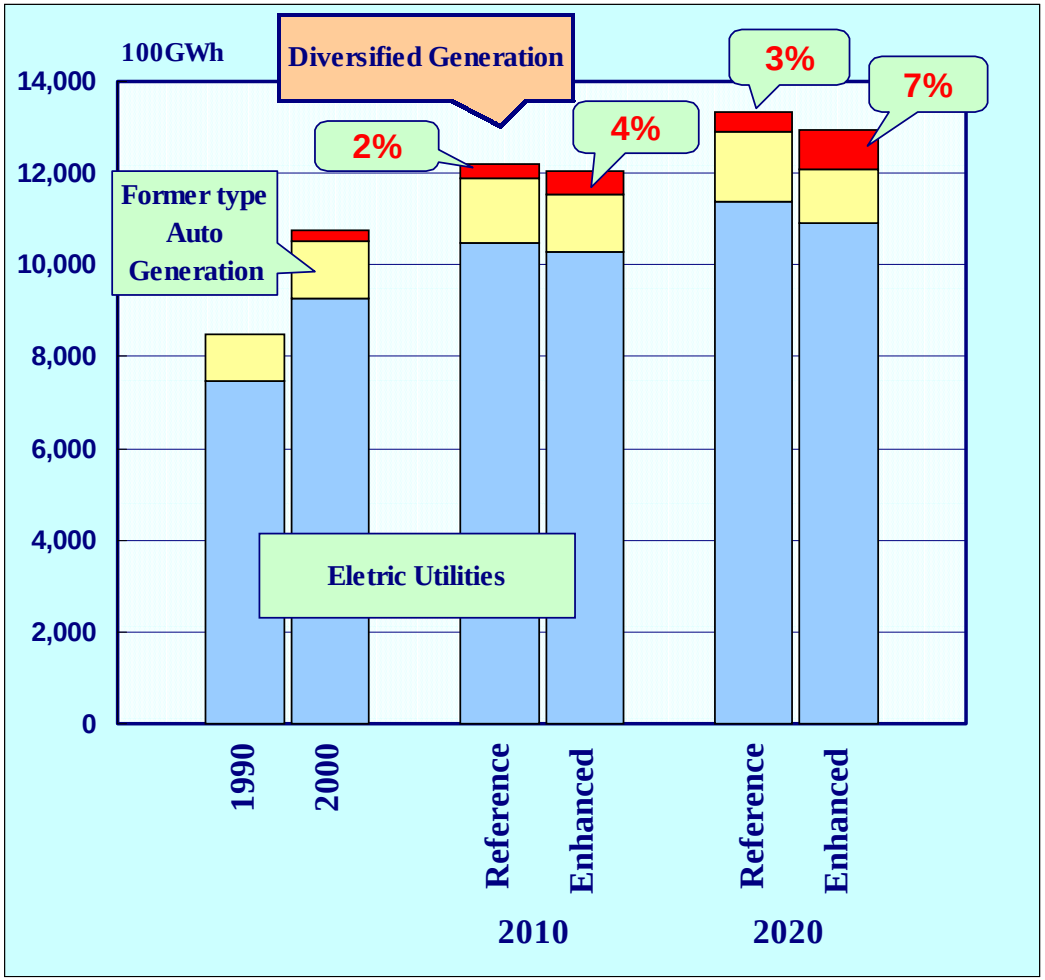
	1999	2010	2020
Photovoltaic power (10MW)	21	254	365
		482	1,271
Wind power (10MW)	8	78	123
		300	470
Waste burning power (10MW)	90	175	219
		417	498
Solar heating (Million kl)	1.0	0.7	0.7
		4.4	4.4
Waste heat reuse, etc. (Million kl)	0.1	0.1	14.9
		0.7	0.8
Total (Million kl)	23.0	3.9	4.9
		13.2	17.0

Note 1: The figure above does not include black liquor.

Note 2: Figures for 2010 are based on “continued on-going effort case/targets” by the Advisory Committee for Energy (2001). Some figures, including those for 2010 and onwards, are estimated by the IEEJ.

Diversified Generation Outlook

[Electric power generation]



(Upper:Reference/Lower:Enhanced, 10MW)

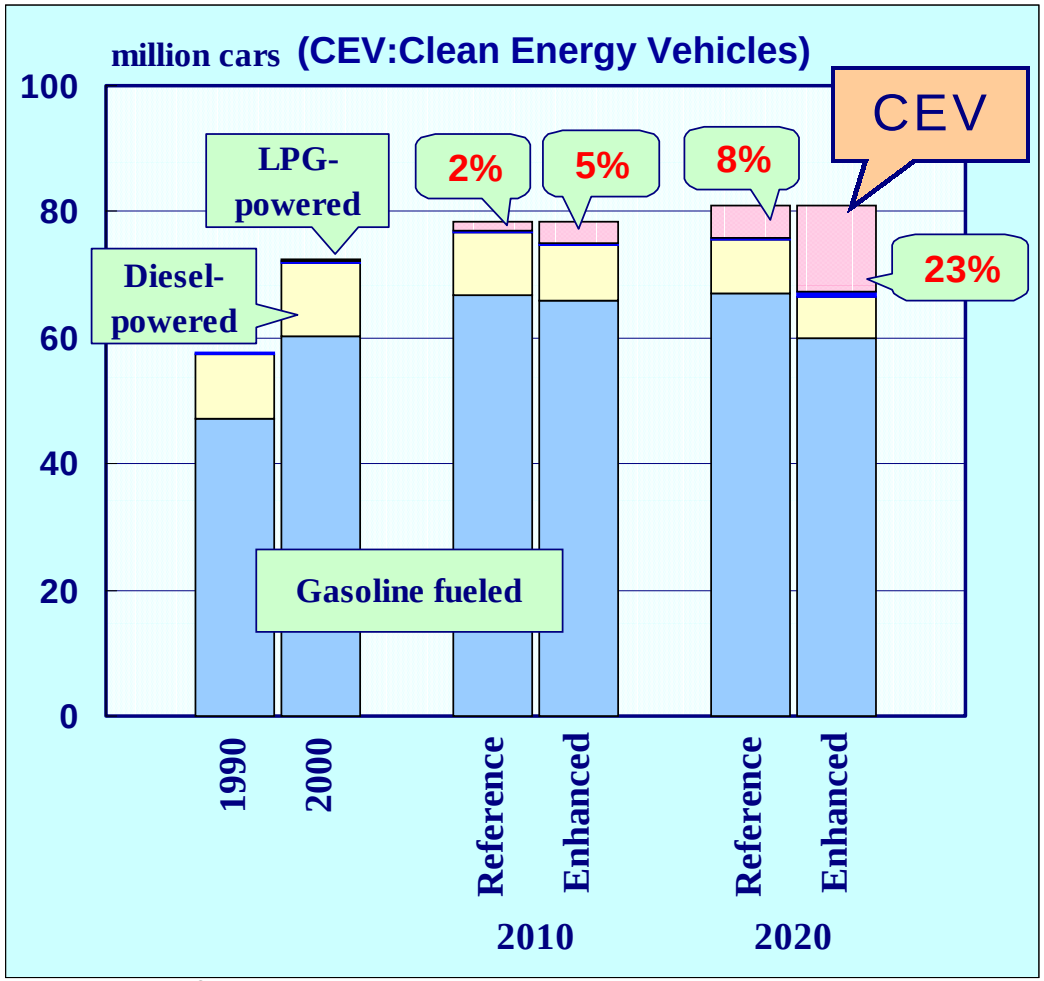
		2000	2010	2020
Cogeneration	Industrial use	437	521	569
			760	829
	Commercial use	111	166	229
			242	334
Fuel Cells	Households use	0	2	120
			120	570
	Commercial use	0	2	90
			90	440
Commercial use total		111	168	319
			332	774
Diversified Generation total		548	692	1,008
			1,212	2,172

Note: Figures for cogeneration in 2010 are based on “continued on-going effort case/targets” by the Advisory Committee for Energy (2001). Figures for fuel cells are based on the Fuel Cell Application Strategy Committee (2001). Some figures, including those for 2010 and onwards, are estimates by the IEEJ.

Clean Energy Vehicle Fleet Growth

[Vehicle stock]

(Upper:Reference/Lower:Enhanced, Million cars)



	2000	2010	2020
Hybrid vehicles	0.1	1.1	4.4
		1.8	7.0
Electric vehicles	0.0	0.0	0.0
		0.1	0.3
Natural gas vehicles	0.0	0.2	0.3
		1.0	1.0
Methanol vehicles	0.0	0.0	0.0
		0.2	0.4
Fuel cell vehicles	0.0	0.0	0.4
		0.1	5.0
CEV total	0.1	1.3	5.1
		3.2	13.7

Note: Figures for 2010 are based on the outlook/targets by the New Energy Sub-Committee, Advisory Committee for Energy (2001). Figures for fuel-cell vehicles are based on the Fuel Cell Application Strategy Committee (2001). Some figures, including those for hybrid vehicles as well as those for 2010 and onwards, are estimated by the IEEJ.

Projection Results Overview

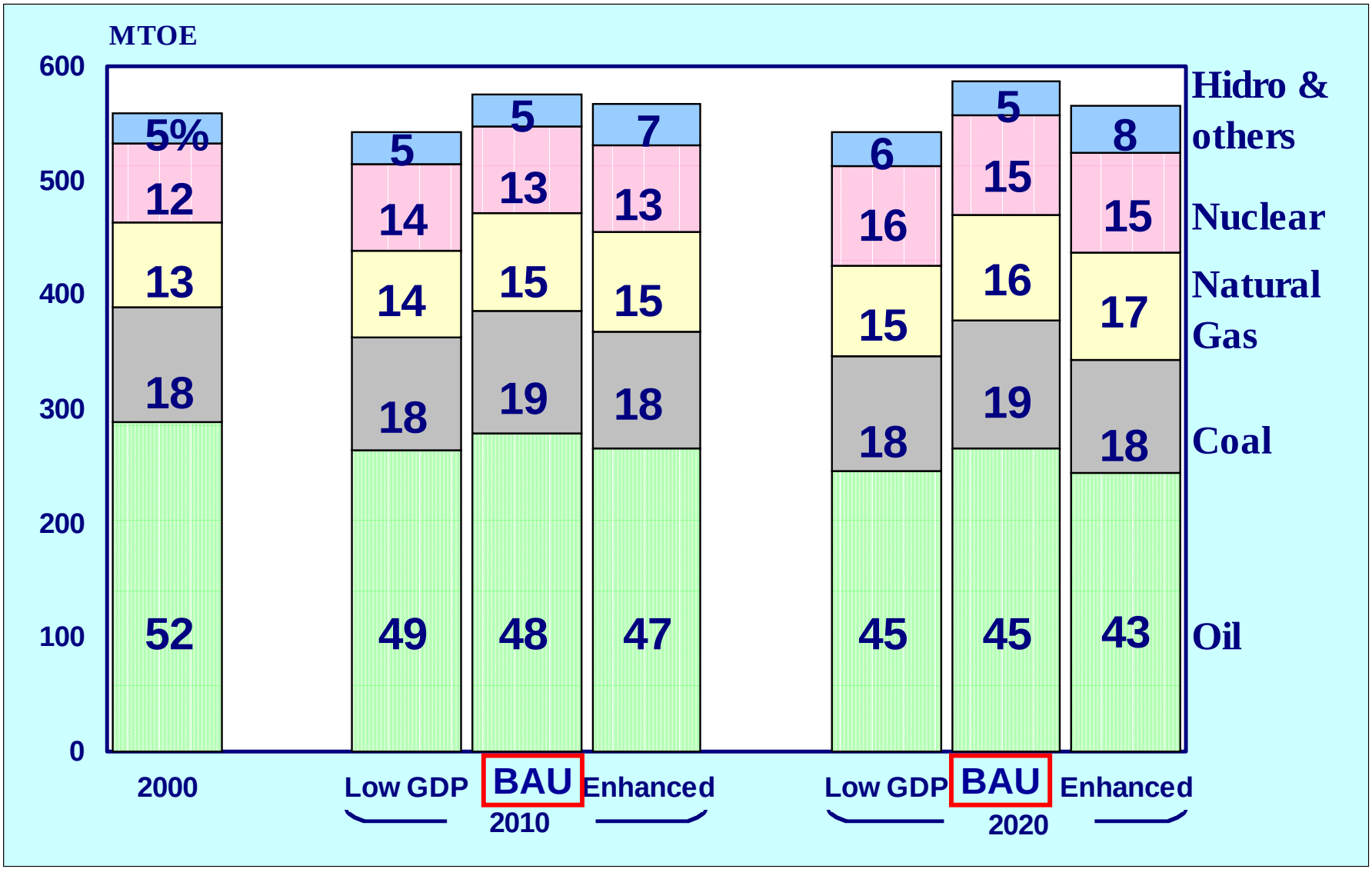
Total Primary Energy Supply [reference case]

(MTOE)

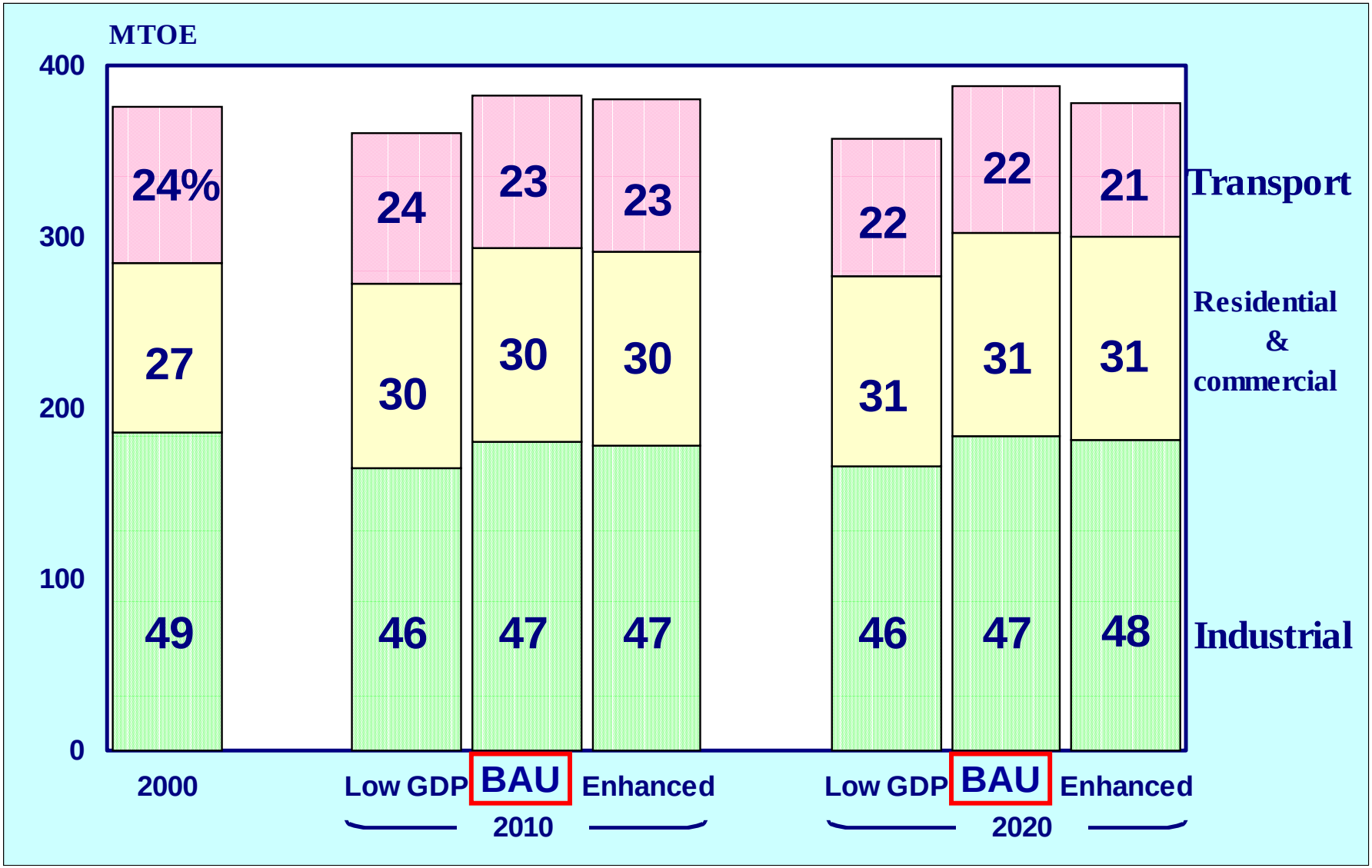
	Actual				Forecast				Growth Rate(%)		
	1990FY	Ratio (%)	2000FY	Ratio (%)	2010FY	Ratio (%)	2020FY	Ratio (%)	2000 /1990	2010 /2000	2020 /2010
Coal	81	16.6	100	17.9	108	18.7	111	18.9	2.2	0.7	0.3
Oil	284	58.3	289	51.8	279	48.4	266	45.4	0.2	-0.4	-0.5
Natural Gas	49	10.1	73	13.1	86	14.9	93	15.8	4.1	1.6	0.8
Nuclear	46	9.4	69	12.4	75	13.1	87	14.8	4.3	0.9	1.4
Hydro, Geothermal	21	4.3	20	3.6	20	3.5	20	3.5	-0.4	0.1	0.0
New energy	6	1.3	6	1.2	8	1.4	9	1.6	0.4	2.0	1.8
Total Primary Supply	486	100.0	559	100.0	576	100.0	586	100.0	1.4	0.3	0.2
REAL GDP(Tririon Yen)	470		536		624		697		1.3	1.5	1.1
Energy/GDP(1990=100)	100		101		89		81		0.1	-1.2	-0.9
CO2 Emissions(MtC)	287		316		325		323		1.0	0.3	-0.1
Compared with 1990	-		10 %up		13 %up		12 %up				

Oil dependency rate will decline, but oil will still account for a major share. Shares for natural gas and coal will increase.

Primary Supply: Comparison of Cases



Final Demand: Comparison of Cases

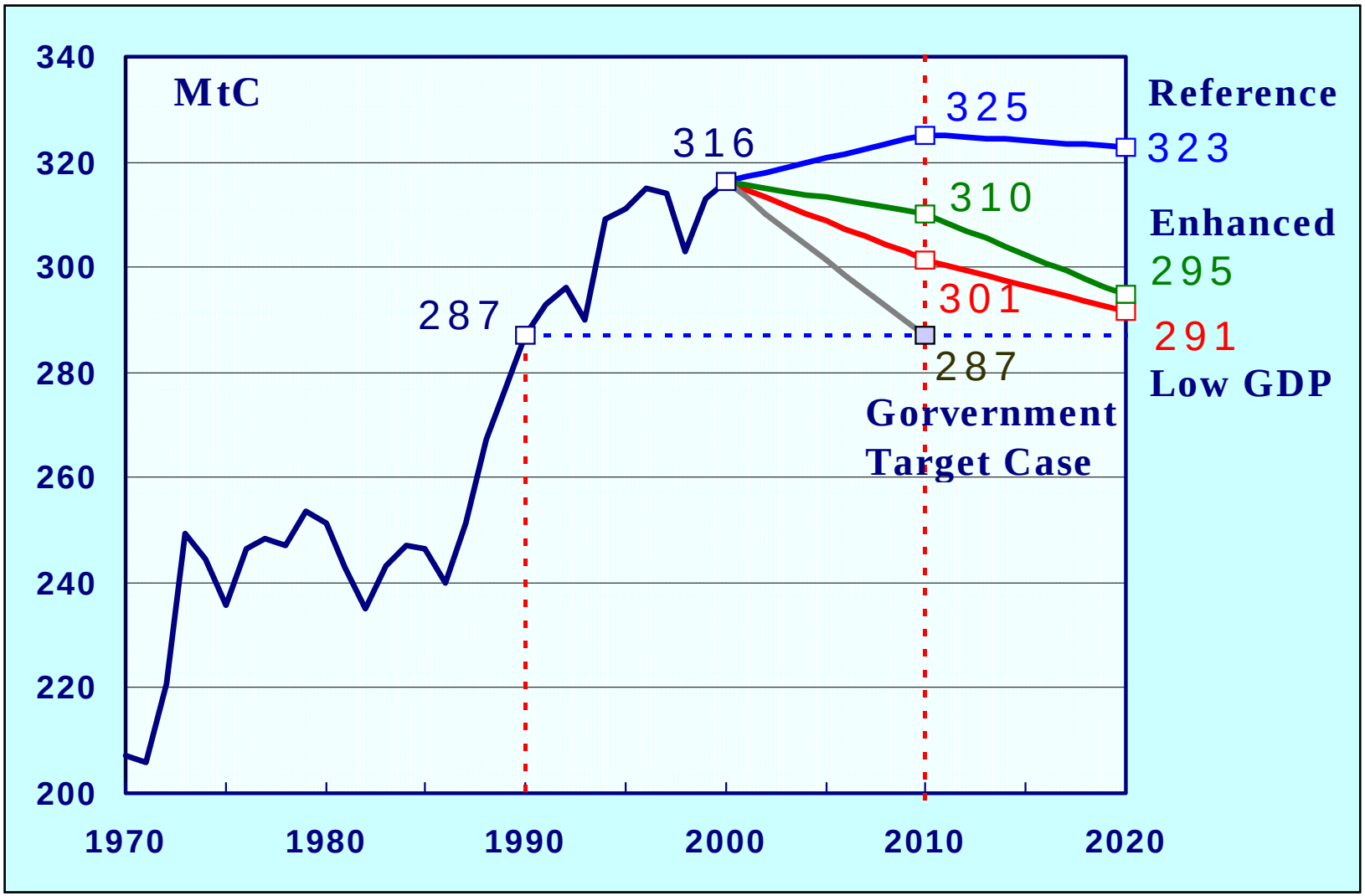


Summary: Comparison of Cases

(MTOE / CO2:MtC)

	Actual		IEEJ								METI			
	2000FY		2010FY				2020FY				2010FY			
			Low GDP		Reference		Enhanced		Low GDP		Reference		Enhanced		Reference		Policy	
		%		%		%		%		%		%		%		%		%
Oil	289	52	264	49	279	48	266	47	246	45	266	45	243	43	258	45	251	45
Coal	100	18	99	18	108	19	102	18	100	18	111	19	100	18	126	22	105	19
Natural Gas	73	13	76	14	86	15	87	15	80	15	93	16	94	17	76	13	77	14
Nuclear	69	12	75	14	75	13	75	13	87	16	87	15	87	15	86	15	86	16
Hydro, Geothermal	20	4	20	4	20	4	20	4	20	4	20	3	20	4	19	3	19	4
New Energy	6	1	8	1	8	1	17	3	9	2	9	2	21	4	9	2	18	3
Total Primary Supply	559		542		576		567		542		586		565		575		557	
CO2 Emissions	316		301		325		310		291		323		295		307		287	
Compared with 1990 (=287)	10 %UP		5 %UP		13 %UP		8 %UP		2 %UP		12 %UP		3 %UP		7 %UP		0 %UP	
Industrial sector	185	49	165	46	180	47	179	47	166	46	183	47	181	48	173	46	171	46
Res. & Com. sectors	100	27	108	30	113	30	112	30	111	31	119	31	118	31	116	31	111	30
Transport sector	91	24	87	24	90	23	89	23	80	22	85	22	79	21	88	23	87	24
Total Final Demand	376		360		383		380		358		388		378		378		370	

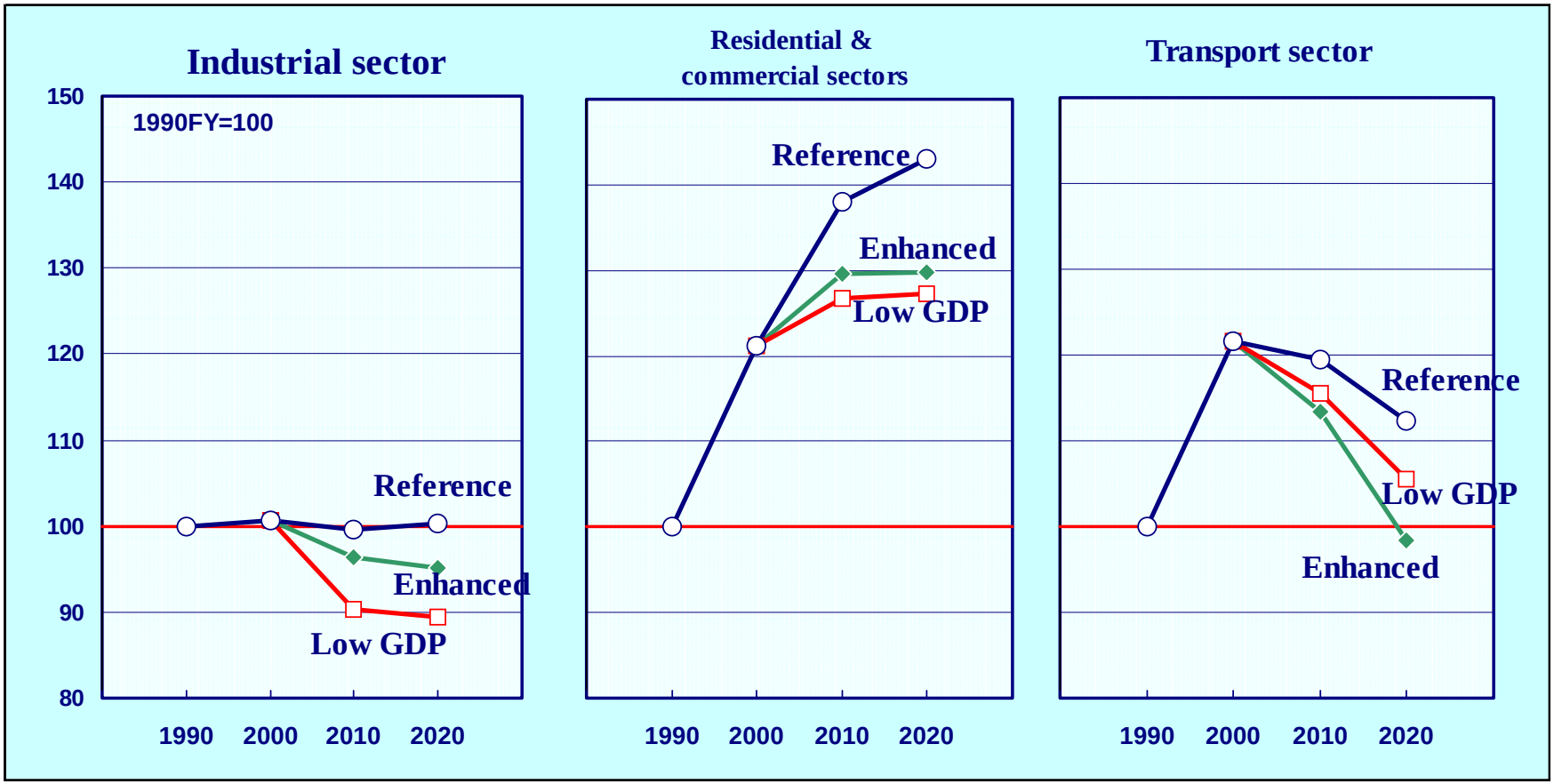
Outlook for CO2 Emissions



In all cases, CO2 emissions will exceed the target set under the Kyoto Protocol (287 MtC). Emissions will peak in 2010 (reference case).

CO2 Emissions by Final Demand Sector

Power production CO2 emissions are allocated to each demand sector.



Industrial sector emissions will be lower than the 1990 baseline in each case.However, residential and commercial sector emissions will rise.Transport sector emissions peak in 2000, and thereafter decline.

Final Energy Demand (by Sector) [reference case]

(MTOE)

	Actual				Forecast				Growth Rate(%)		
	1990FY	Ratio (%)	2000FY	Ratio (%)	2010FY	Ratio (%)	2020FY	Ratio (%)	2000 /1990	2010 /2000	2020 /2010
Industrial sector	170	52.5	185	49.3	180	46.9	183	47.2	0.9	-0.3	0.2
Residential & commercial sectors	79	24.4	100	26.5	113	29.6	119	30.7	2.4	1.3	0.5
Residential	43	13.3	53	14.2	59	15.3	60	15.4	2.2	0.9	0.2
Commercial	36	11.2	46	12.3	55	14.3	59	15.4	2.6	1.7	0.9
Transport sector	74	23.0	91	24.1	90	23.5	85	22.0	2.0	-0.1	-0.5
Passenger	44	13.7	58	15.5	59	15.3	56	14.4	2.7	0.1	-0.5
Freight	30	9.3	33	8.7	31	8.2	29	7.6	0.8	-0.4	-0.7
Total Demand	323	100.0	376	100.0	383	100.0	388	100.0	1.5	0.2	0.1

Industry sector demand will gradually decrease, while residential and commercial sector demand will increase. Japan's final energy mix will approach to that of the US and Europe.

Final Energy Demand (by Source) [reference case]

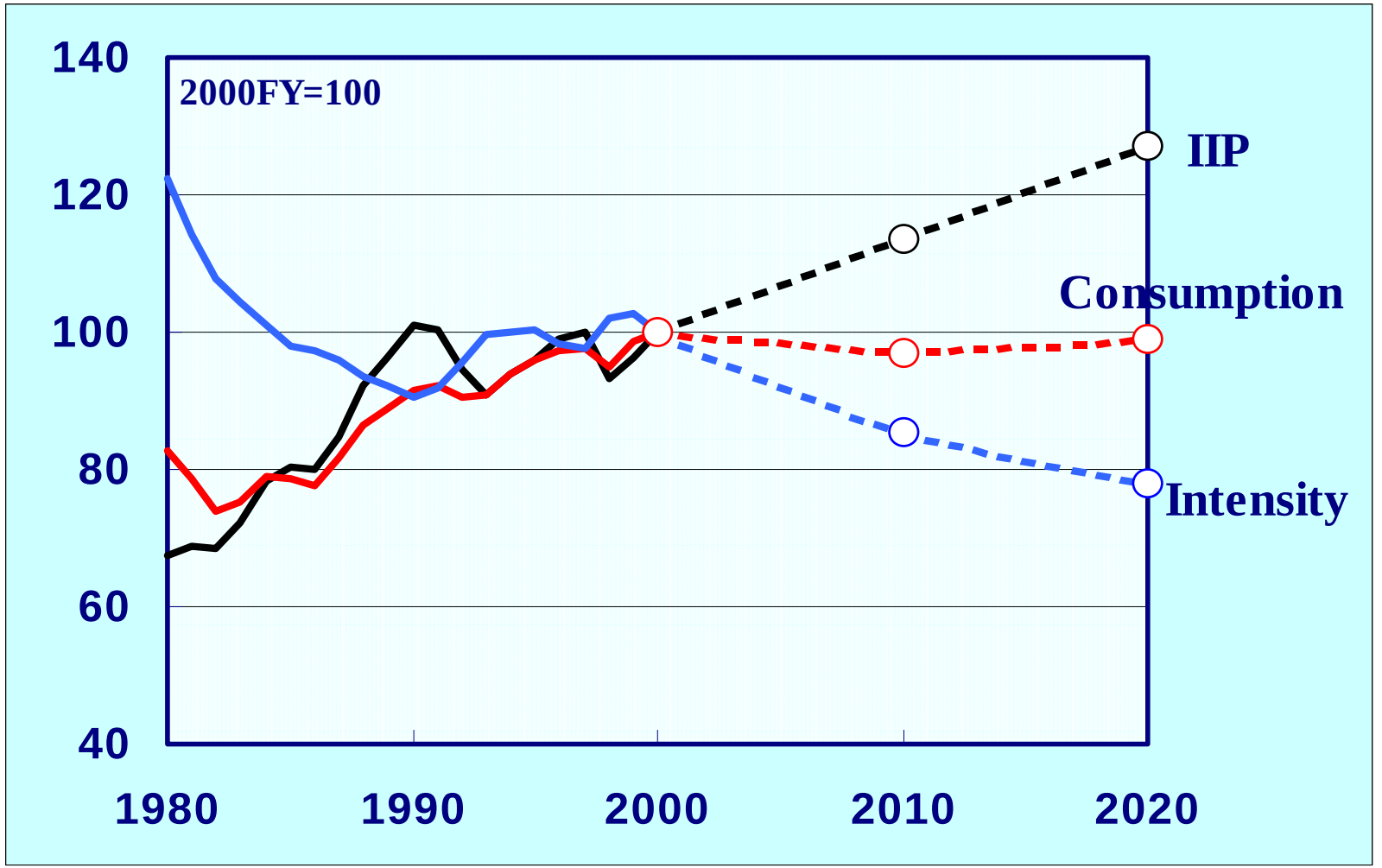
(MTOE)

	Actual				Forecast				Growth Rate(%)		
	1990FY		2000FY		2010FY		2020FY		2000 /1990	2010 /2000	2020 /2010
		Ratio (%)		Ratio (%)		Ratio (%)		Ratio (%)			
Coal and the like	42	13.0	41	11.0	38	9.8	36	9.2	-0.1	-0.9	-0.5
Oil	196	60.6	222	59.1	216	56.4	209	54.0	1.3	-0.3	-0.3
Town gas	15	4.7	25	6.6	29	7.6	32	8.3	4.9	1.6	1.1
Electric power	65	20.2	83	22.2	95	24.9	104	27.0	2.5	1.4	0.9
New energy	5	1.6	5	1.2	5	1.2	5	1.3	-1.1	-0.0	0.7
Total Demand	323	100.0	376	100.0	383	100.0	388	100.0	1.5	0.2	0.1

Shift to high-value-added economy, increased demand in the residential and commercial sector, and other factors will accelerate electrification and gasification.

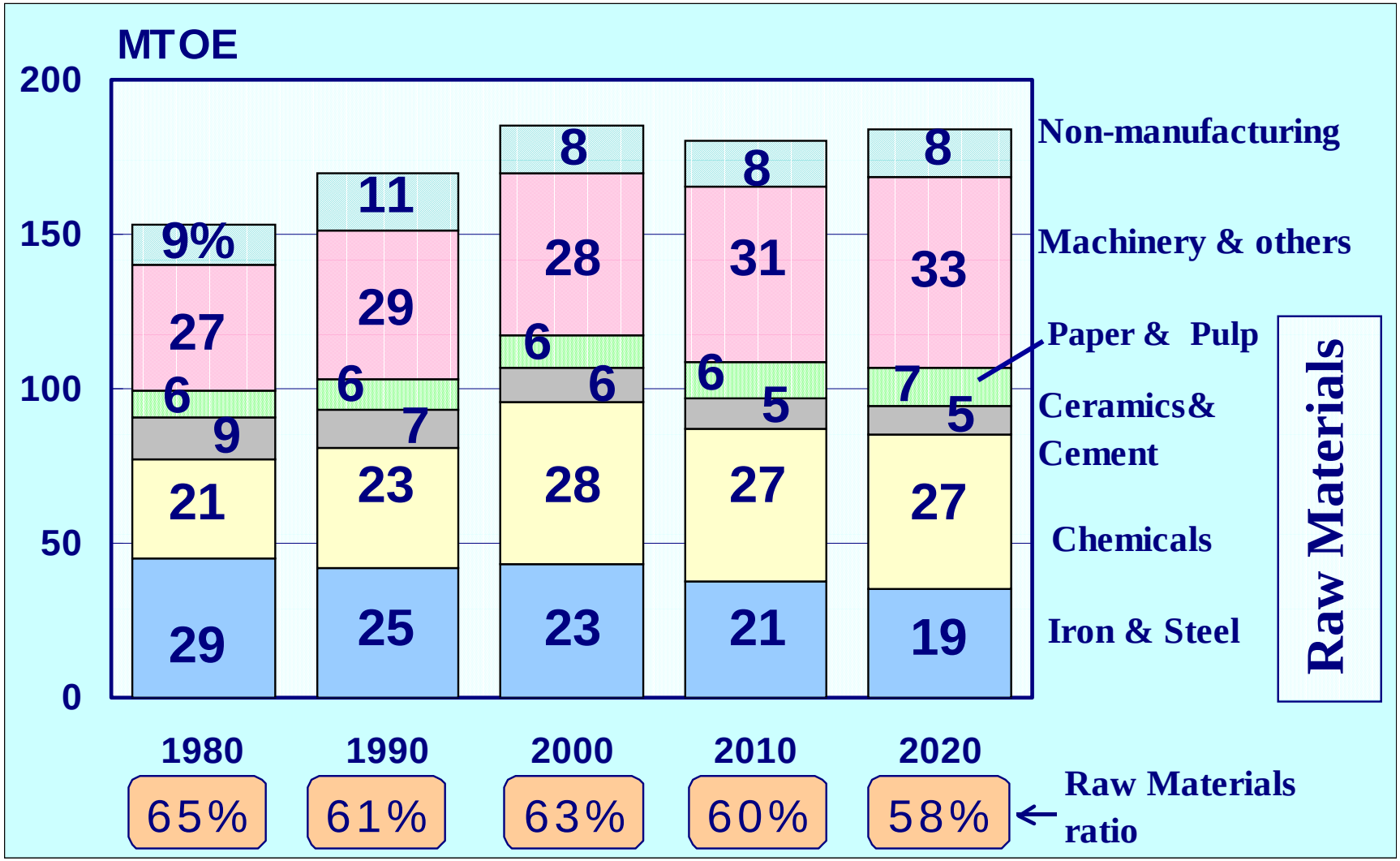
Final Energy Demand (Industrial Sector)

[reference case]



Increase in production will be offset by progress in energy conservation.
Energy consumption will level off.

Final Energy Demand by Industry [reference case]



Assembly industries, such as the machinery industry, will increase their share.

Industry Sector Energy Demand by Source

[reference case]

(MTOE)

	Actual				Forecast				Growth Rate(%)		
	1990FY		2000FY		2010FY		2020FY		2000 /1990	2010 /2000	2020 /2010
		Ratio (%)		Ratio (%)		Ratio (%)		Ratio (%)			
Coal and Coke	41	24.2	40	21.8	37	20.5	35	19.1	-0.2	-0.9	-0.5
Petroleum products	88	52.1	96	51.8	90	50.0	90	49.4	0.8	-0.7	0.1
Town gas	4	2.3	9	5.0	11	6.4	13	7.3	8.8	2.2	1.5
Electric power	33	19.3	37	19.8	38	21.4	41	22.5	1.1	0.5	0.7
New energy	4	2.1	3	1.6	3	1.7	3	1.7	-1.4	-0.1	0.3
Total	170	100.0	185	100.0	180	100.0	183	100.0	0.9	-0.3	0.2
IIP (1995=100)	105.9		104.7		119.0		133.0		-0.1	1.3	1.1

Shift towards electrification and gasification will proceed, but oil will still account for half of industrial sector energy demand.

Keidanren Voluntary Action Plan

Reduction Targets for Major Industries

	Target year	Energy conservation in target year
Iron & Steel (JISF)	2010FY	Reducing the amount of energy consumed by 10% compared with 1990FY
Chemicals (JCIA)	2010FY	Reducing energy input per unit output by 10% compared with 1990FY
Paper & Pulp (JPA)	2010FY	Reducing purchased energy input per unit output by 10% compared with 1990FY
Cement (JCA)	2010FY	Reducing energy input per unit output by 3% compared with 1990FY

Features of the Keidanren Voluntary Action Plan

-Declares to "strive to reduce CO2 emissions by the industry and conversion sectors below their 1990 levels in FY2010," and sets reduction goal for each industry category.

-Participation by wide range of industries in voluntary effort (34 industries in the manufacturing sector and 15 industries in the commercial and transport sectors as of October 2002).

Residential and Commercial Sector

- Residential Sub-Sector
- Commercial Sub-Sector

Residential and Commercial Sector Overview

[reference case]

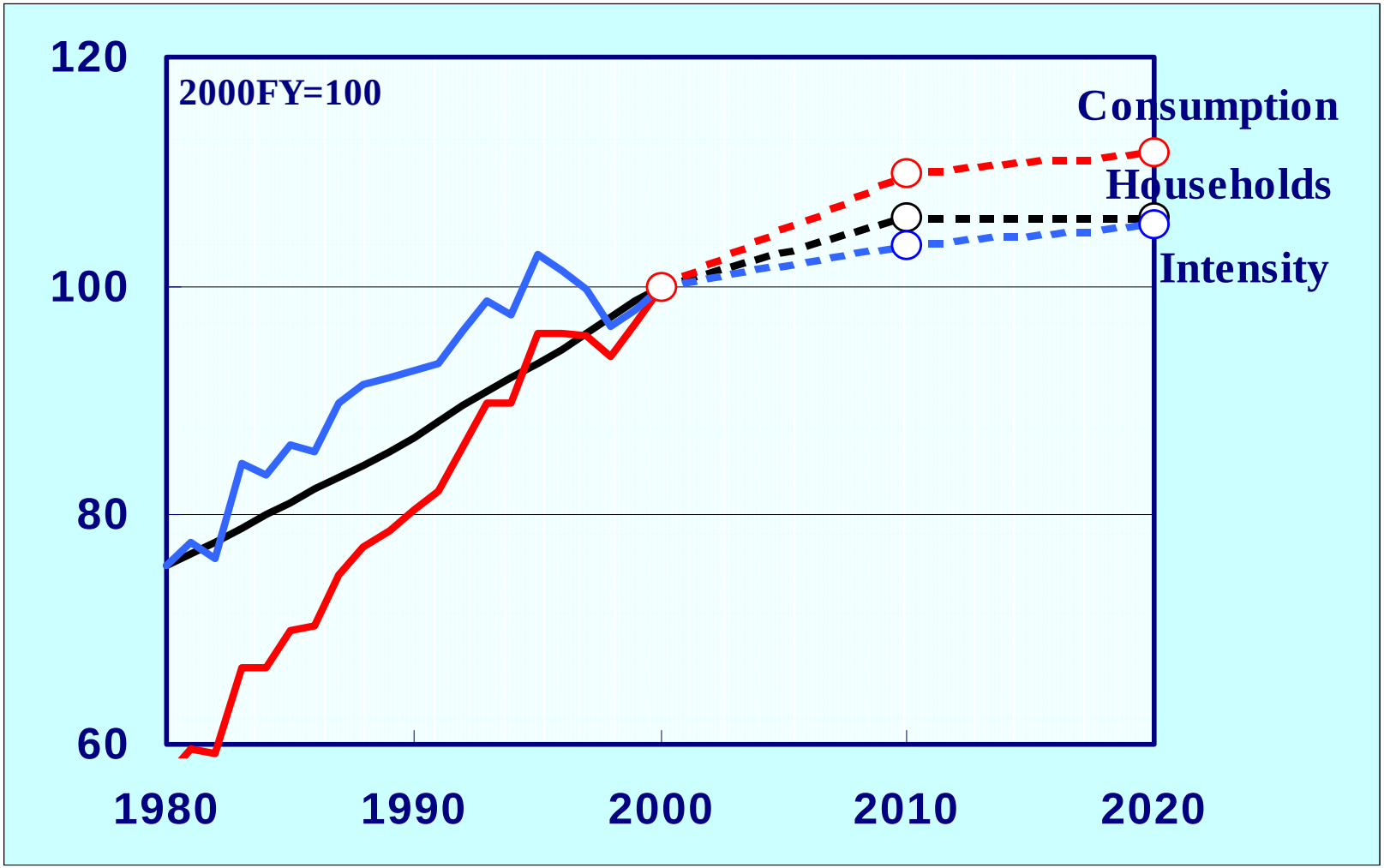
(MTOE)

	Actual				Forecast				Growth Rate(%)		
	1990FY	Ratio (%)	2000FY	Ratio (%)	2010FY	Ratio (%)	2020FY	Ratio (%)	2000 /1990	2010 /2000	2020 /2010
Residential & commercial	79	100.0	100	100.0	113	100.0	119	100.0	2.4	1.3	0.5
Residential	43	54.4	53	53.5	59	51.8	60	50.1	2.2	0.9	0.2
Commercial	36	45.6	46	46.5	55	48.2	59	49.9	2.6	1.7	0.9
GDP(trillion yen)	470		536		624		697		1.3	1.5	1.1
Private Consumption	249		290		343		376		1.5	1.7	0.9
Population(million)	123.6		126.9		127.5		124.1		0.3	0.0	-0.3
Proportion of the aged (%)	12.1		17.4		22.5		27.8		-	-	-
House hold (million)	41.2		47.4		50.3		50.3		1.4	0.6	0.0
Floor space(100million m^2)	12.8		16.5		19.2		20.9		2.6	1.5	0.8

Commercial sector energy consumption will keep increasing due to trend toward service economy, increasing floor space, etc.

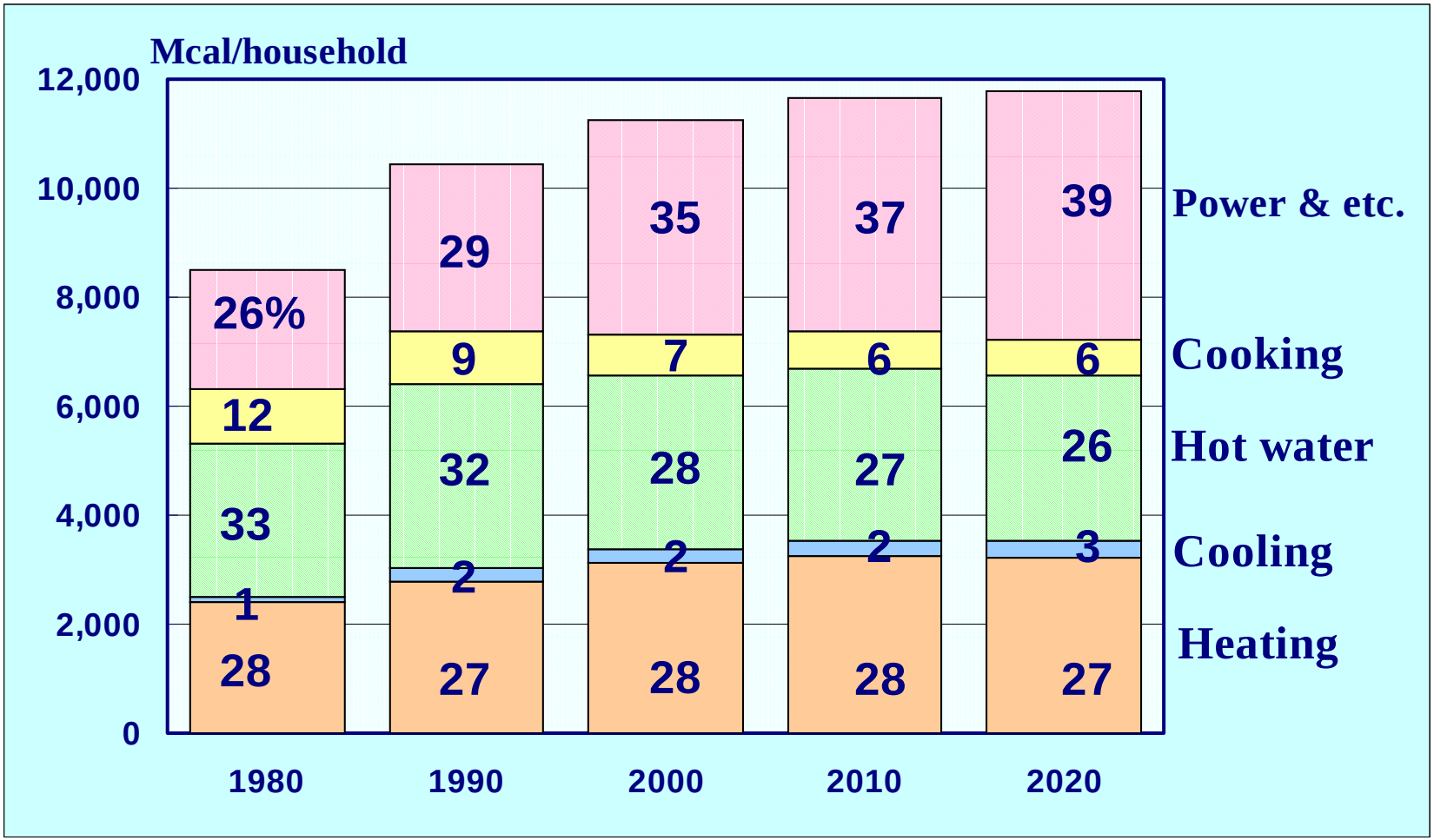
Residential Sector Energy Consumption

[reference case]



Residential Sector Energy Intensity by End Use

[reference case]



Due to increasing IT utilization, "motive power, etc." will grow. Due to energy conservation efforts such as the Top Runner standards scheme, the growth of this sub-sector's intensity will be fairly moderate.

Residential Sector Energy Demand by Source

[reference case]

(MTOE)

	Actual				Forecast				Growth Rate(%)		
	1990FY		2000FY		2010FY		2020FY		2000 /1990	2010 /2000	2020 /2010
		Ratio (%)		Ratio (%)		Ratio (%)		Ratio (%)			
Oil	17	40.7	20	37.8	21	35.6	19	32.3	1.5	0.3	-0.8
Town gas	8	18.1	9	17.8	10	16.8	10	16.9	2.0	0.4	0.2
Electricity	16	38.1	23	42.7	27	46.4	30	49.6	3.4	1.8	0.8
New energy	1	3.1	1	1.7	1	1.2	1	1.1	-4.0	-2.4	-0.3
Total	43	100.0	53	100.0	59	100.0	60	100.0	2.2	0.9	0.2
Households	41.2		47.4		50.3		50.3		1.4	0.6	0.0

The trend toward electrification in various activities is reflected.

Top Runner Standards for Consumer Appliances

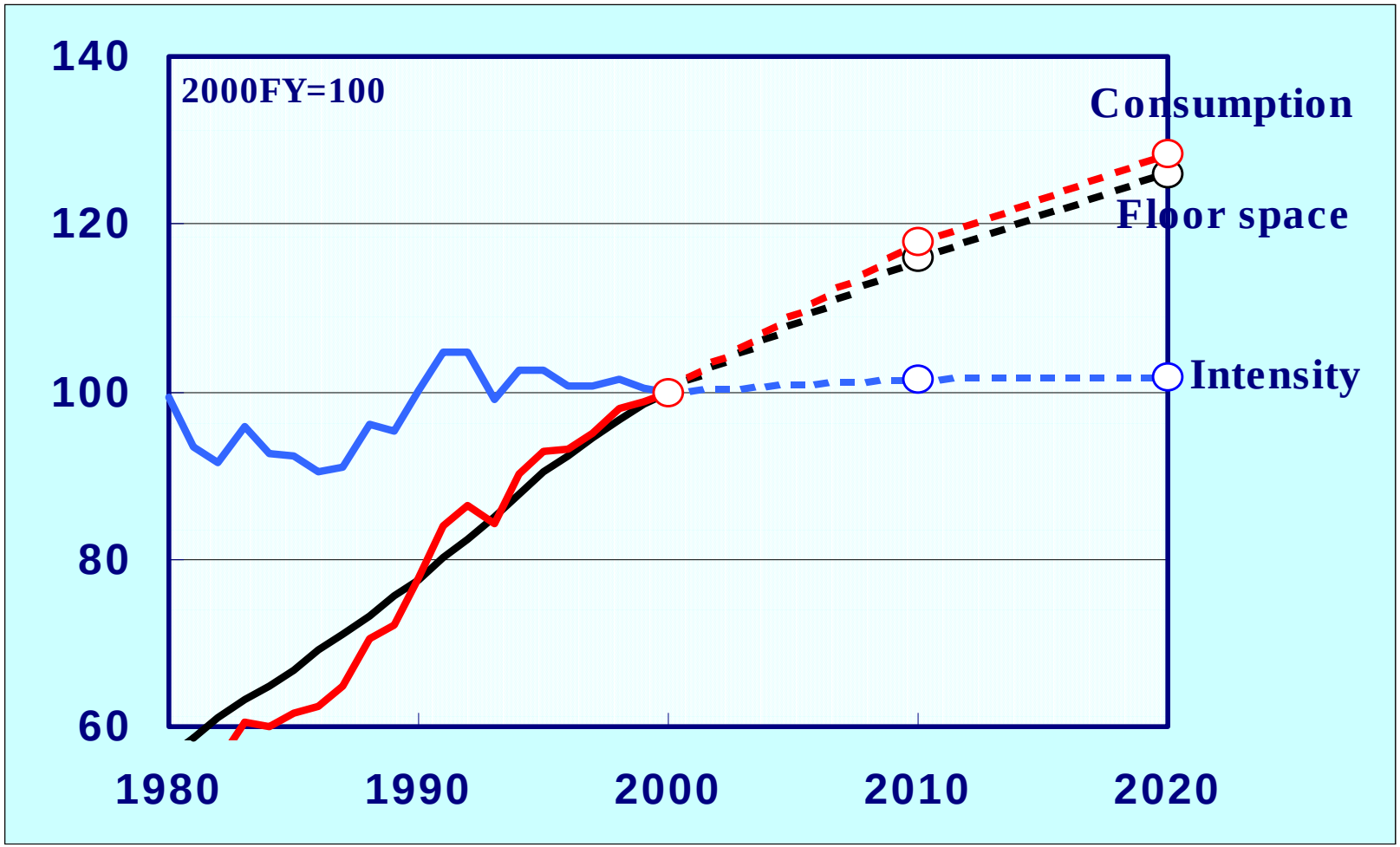
	Target year	Improvements in efficiencies in target year
Refrigerator (kWh/year)	2004FY	By 30% compared with 1998FY
TV (kWh/year)	2003FY	By 16.6% compared with 1997FY
Air conditioner (COP)	2004FY(*1)	By 63% compared with 1997FY for both cooling and heating
	2007FY(*2)	By 14% compared with 1997FY for cooling
Lighting apparatus (lm/W)	2005FY	By 16.6% compared with 1997FY

Note 1: Separate wall-mounted type below 4 kW.
Note 2: Other than separated wall-mounted type below 4 kW.

Through the Top Runner Standards scheme, efficiencies of consumer appliances will improve.

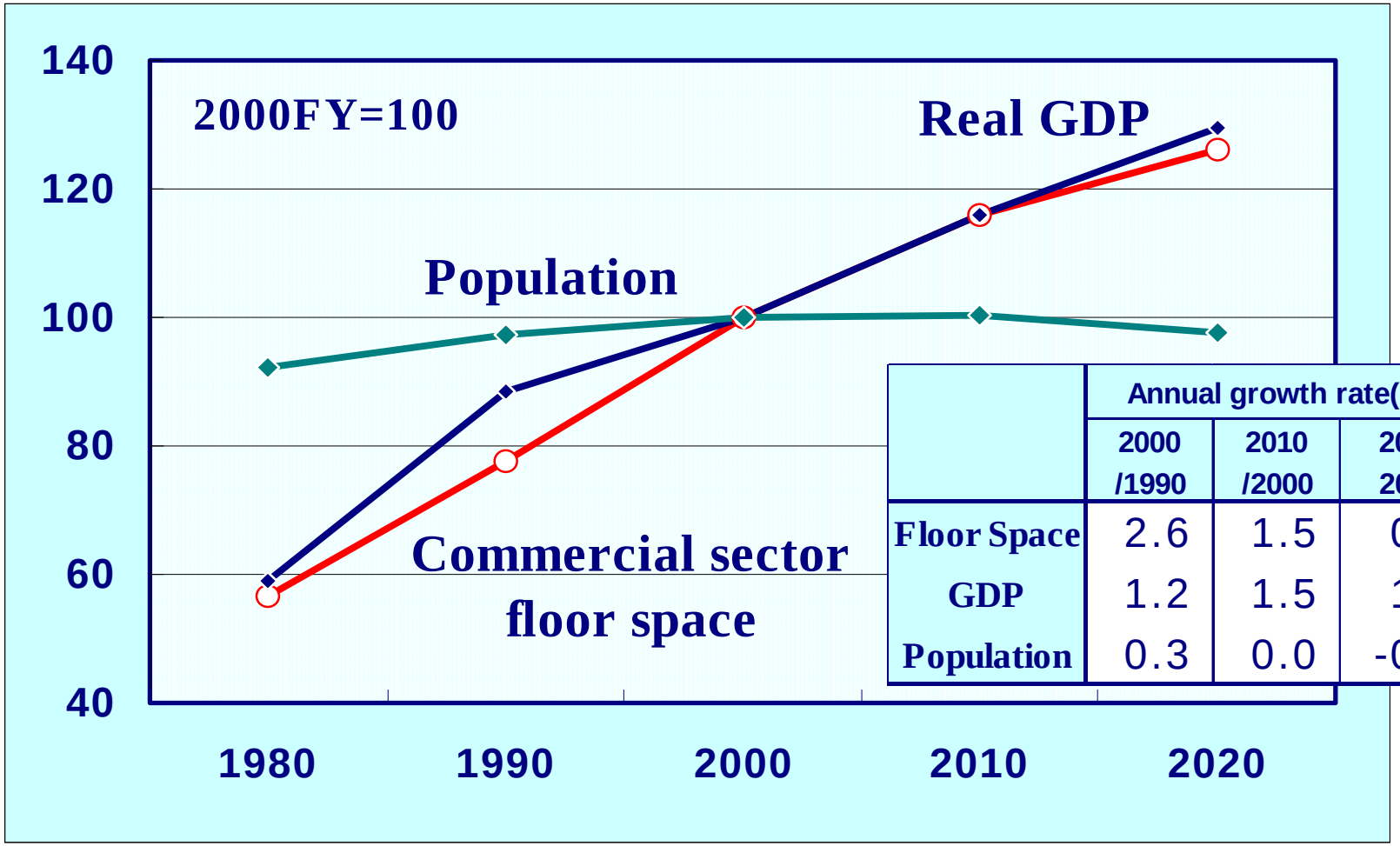
Commercial Sector Energy Consumption

[reference case]



Energy intensity (per unit floor space) will remain roughly constant.

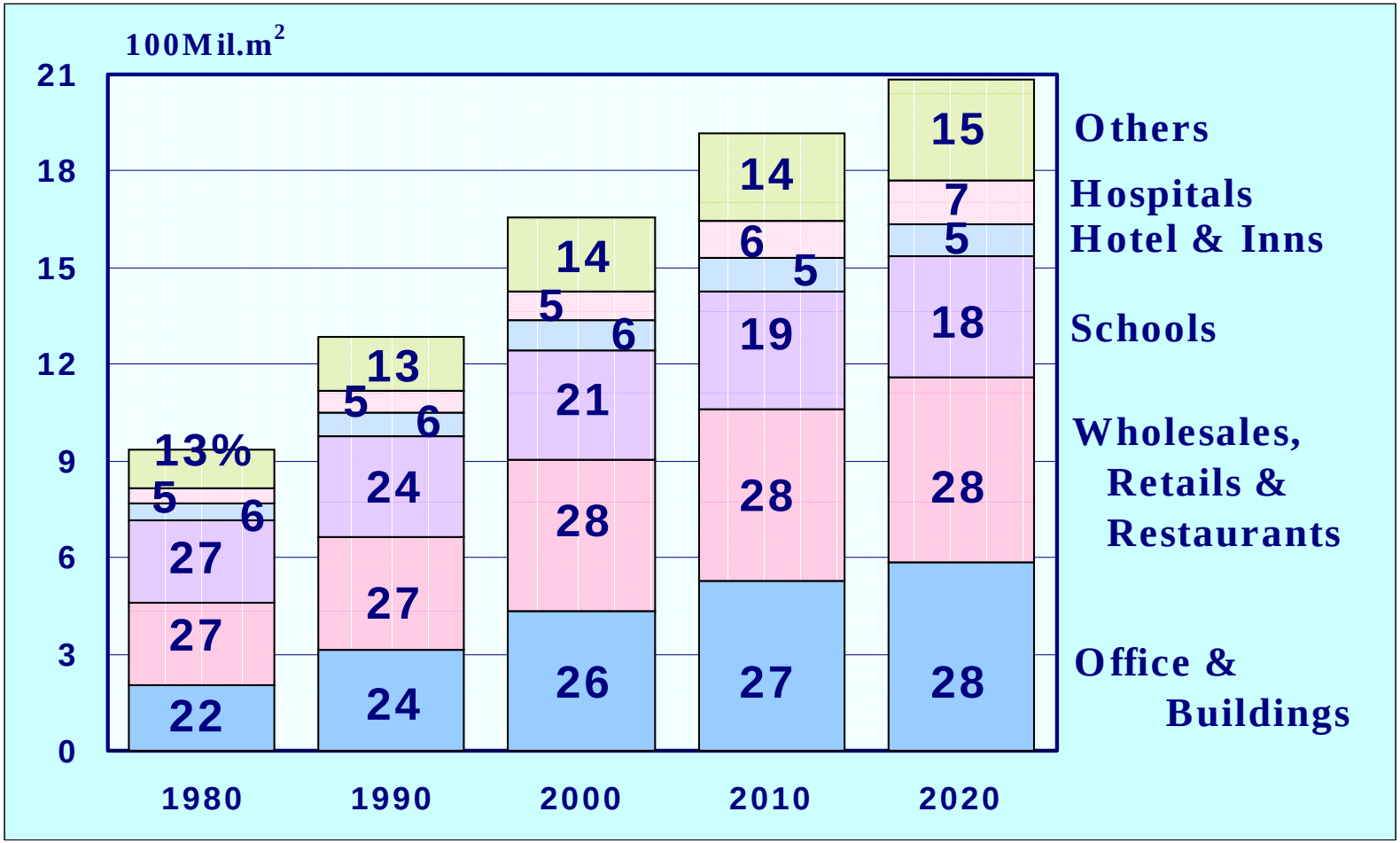
Commercial Sector Floor Space [reference case]



	Annual growth rate(%)		
	2000 /1990	2010 /2000	2020 2010
Floor Space	2.6	1.5	0.8
GDP	1.2	1.5	1.1
Population	0.3	0.0	-0.3

Growth rate of commercial sub-sector floor space has been higher than GDP growth. However, it will slow due to population decline and other factors.

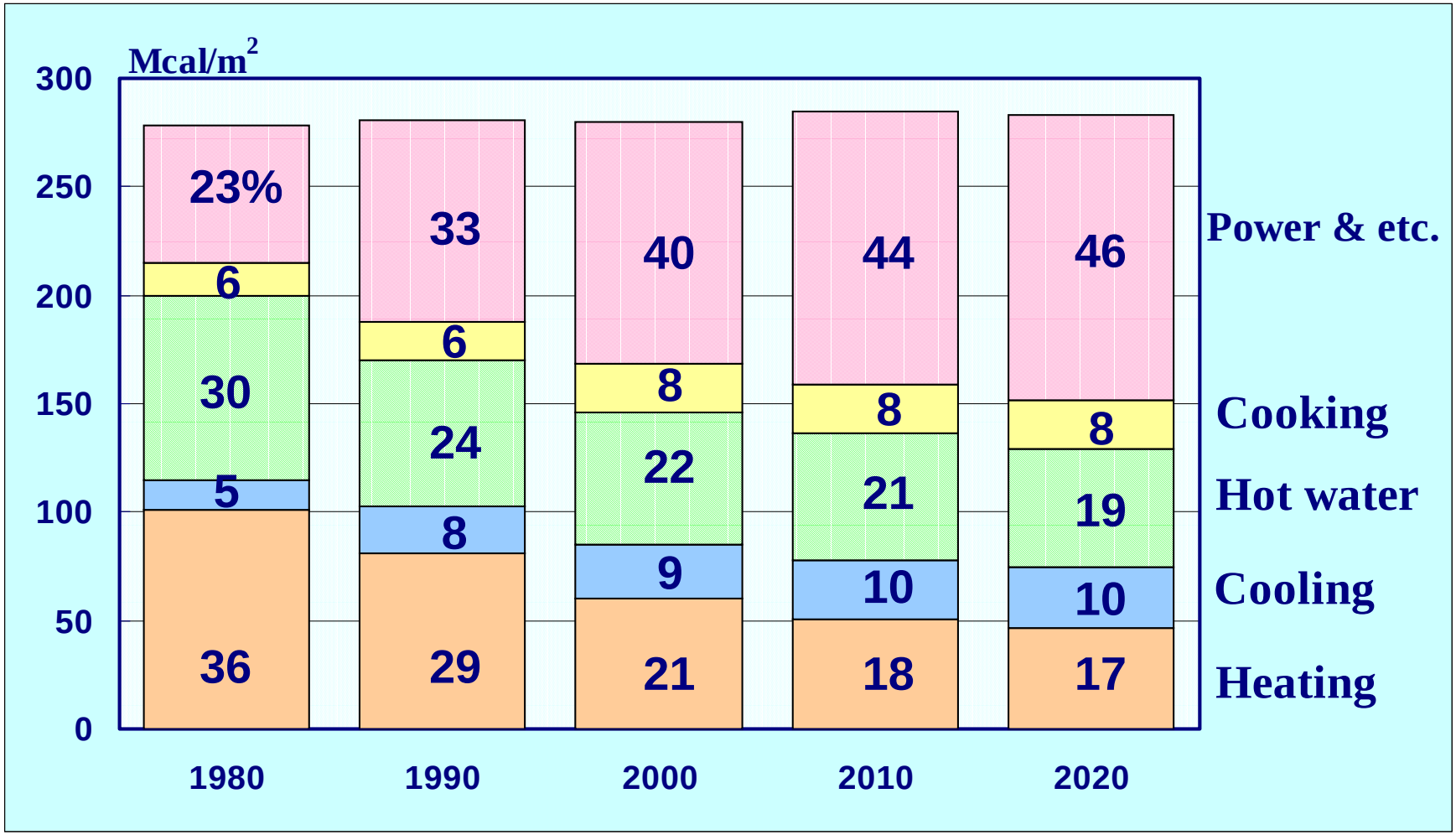
Floor Space by Trade Categories [reference case]



Due to the trend toward the service economy, the growth rate for "office buildings" will be high. Due to population aging, the growth rate for "other services" (e.g., facilities for social welfare for the aged), "hospitals" and the like will be high. The share for "schools" will decline, due to the trend toward fewer children.

Commercial Sector Energy Intensities by End Use

[reference case]



Due to changes in commercial sector business makeup as well as increasing IT utilization, "motive power, etc." (includes lighting) will show strong growth.

Commercial Sector Energy Demand by Source

[reference case]

(MTOE)

	Actual				Forecast				Growth Rate(%)		
	1990FY	Ratio (%)	2000FY	Ratio (%)	2010FY	Ratio (%)	2020FY	Ratio (%)	2000 /1990	2010 /2000	2020 /2010
Oil	17	47.5	17	36.4	18	32.2	17	28.9	-0.1	0.4	-0.2
Town gas	4	9.8	6	12.8	8	14.1	9	15.0	5.4	2.6	1.5
Electricity	14	39.7	22	47.3	28	50.8	32	53.2	4.4	2.4	1.3
New energy	1	3.0	2	3.5	2	2.9	2	2.9	4.0	-0.2	0.8
Total	36	100.0	46	100.0	55	100.0	59	100.0	2.6	1.7	0.9
Floor space(100 million m^2)	12.8		16.5		19.2		20.9		2.6	1.5	0.8

Electrification and gasification will progress.

Transport Sector

- Passenger Sub-Sector
- Freight Sub-Sector

Transport Sector Overview

[reference case]

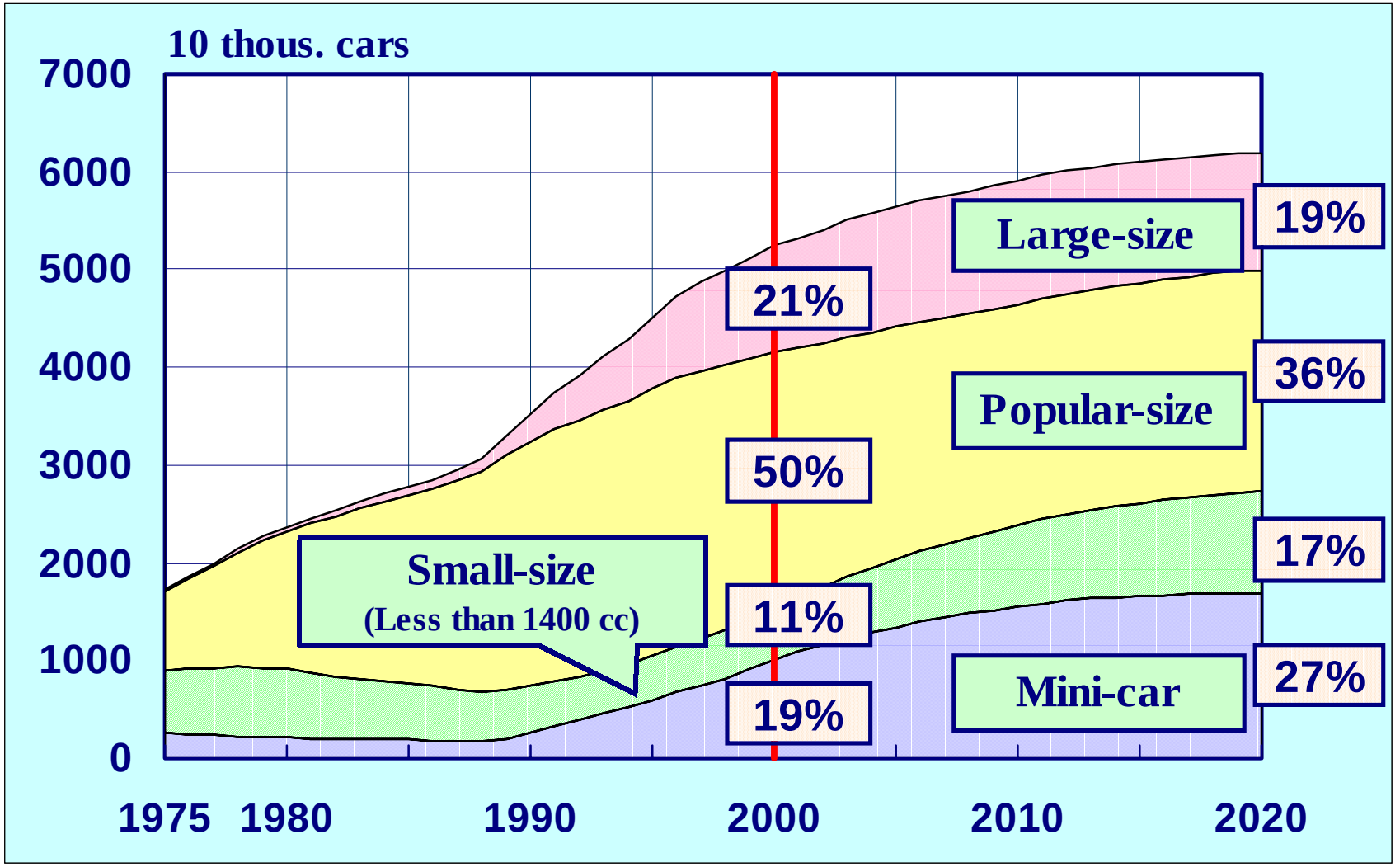
(MTOE)

	Actual				Forecast				Growth Rate(%)		
	1990FY	Ratio (%)	2000FY	Ratio (%)	2010FY	Ratio (%)	2020FY	Ratio (%)	2000 /1990	2010 /2000	2020 /2010
Transport	74	100.0	91	100.0	90	100.0	85	100.0	**2.0**	**-0.1**	**-0.5**
Passenger	44	59.6	58	64.0	59	65.1	56	65.6	**2.7**	**0.1**	**-0.5**
Freight	30	40.4	33	36.0	31	34.9	29	34.4	**0.8**	**-0.4**	**-0.7**
Automobile	65	87.9	79	87.2	78	86.9	73	86.1	**1.9**	**-0.1**	**-0.6**
Air	3	4.4	4	4.5	5	5.3	5	6.0	**2.2**	**1.6**	**0.7**
Ship	4	5.0	5	6.0	5	5.5	5	5.5	**3.9**	**-1.0**	**-0.6**
Railway	2	2.7	2	2.3	2	2.3	2	2.4	**0.1**	**0.1**	**0.0**
Passenger traveled	1,296		1,420		1,525		1,566		**0.9**	**0.7**	**0.3**
Freight traveled	547		578		563		546		**0.6**	**-0.3**	**-0.3**
GDP(trillion yen)	470		536		624		697		**1.3**	**1.5**	**1.1**

Due to improvements in mileage and transport efficiency, energy consumption will decline after years of increasing.

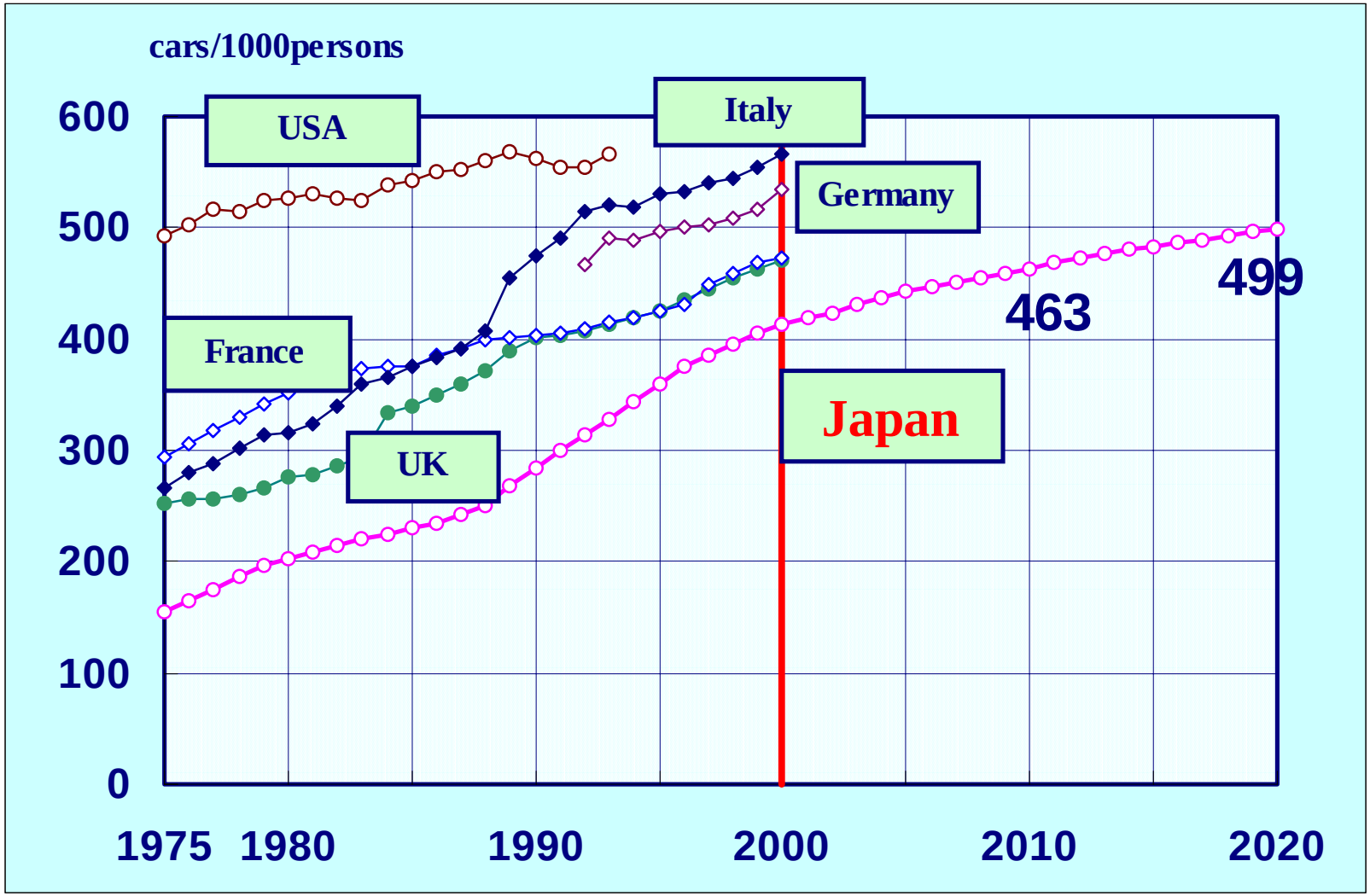
Passenger Vehicle Fleet Composition

[reference case]



Passenger vehicle ownership will become saturated. Due to population aging and an increase in female drivers, small vehicles will increase.

Passenger Vehicle Ownership Rate [reference case]



Although growth of the ownership rate will slow down, it will reach the level of European countries.

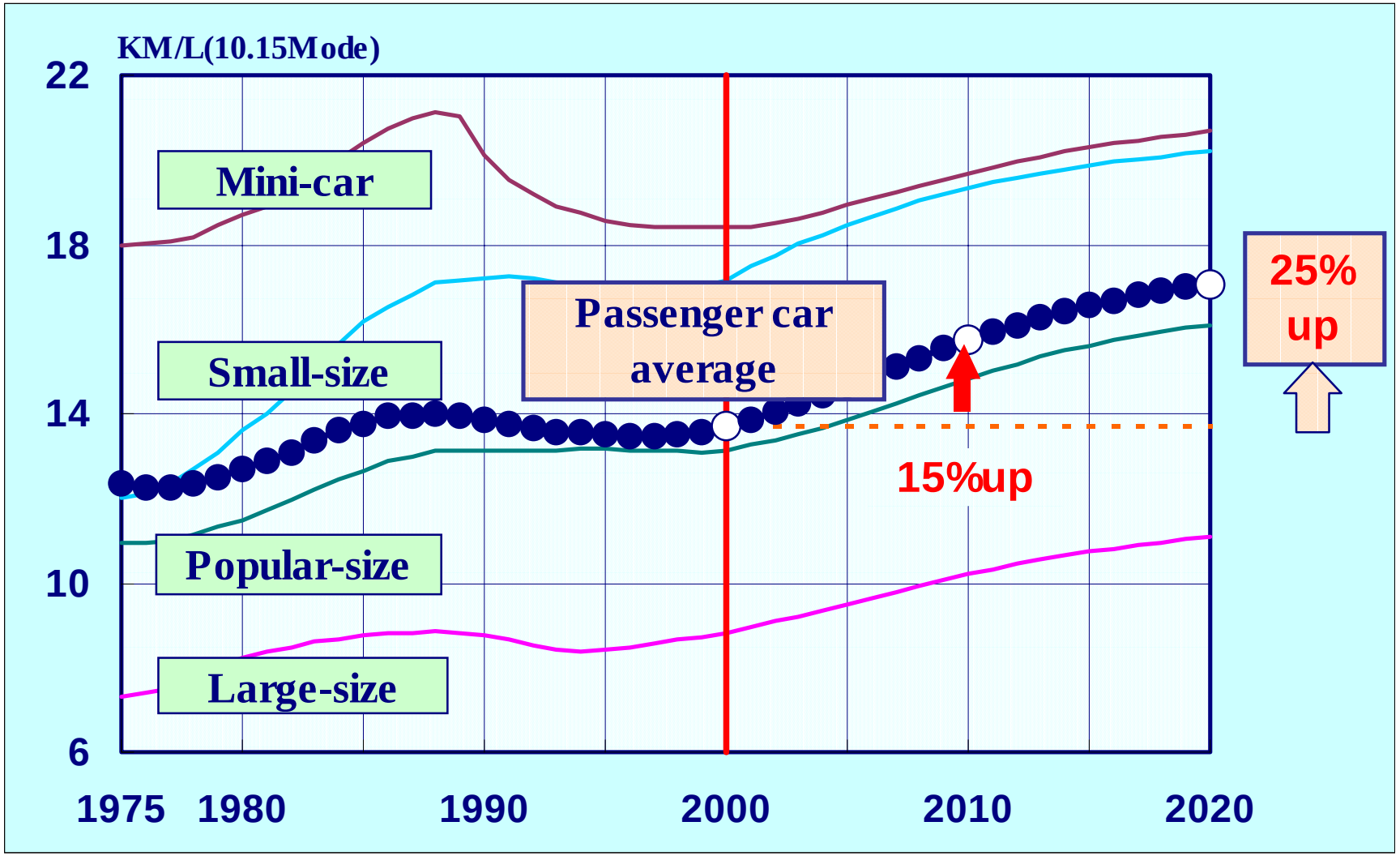
Vehicle Mileage Standards

	Target year	Improvements in mileage in target year
Gasoline fueled passenger cars	2010FY	By 22.8% compared with 1995FY
Diesel-powered passenger cars	2005FY	By 14.9% compared with 1995FY
Gasoline fueled trucks	2010FY	By 13.2% compared with 1995FY
Diesel-powered trucks	2005FY	By 6.5% compared with 1995FY

Note: Refers to freight with total weight equal to or below 2.5 tons.

Each automaker is expected to accelerate the schedule to FY2005 in achieving targets.

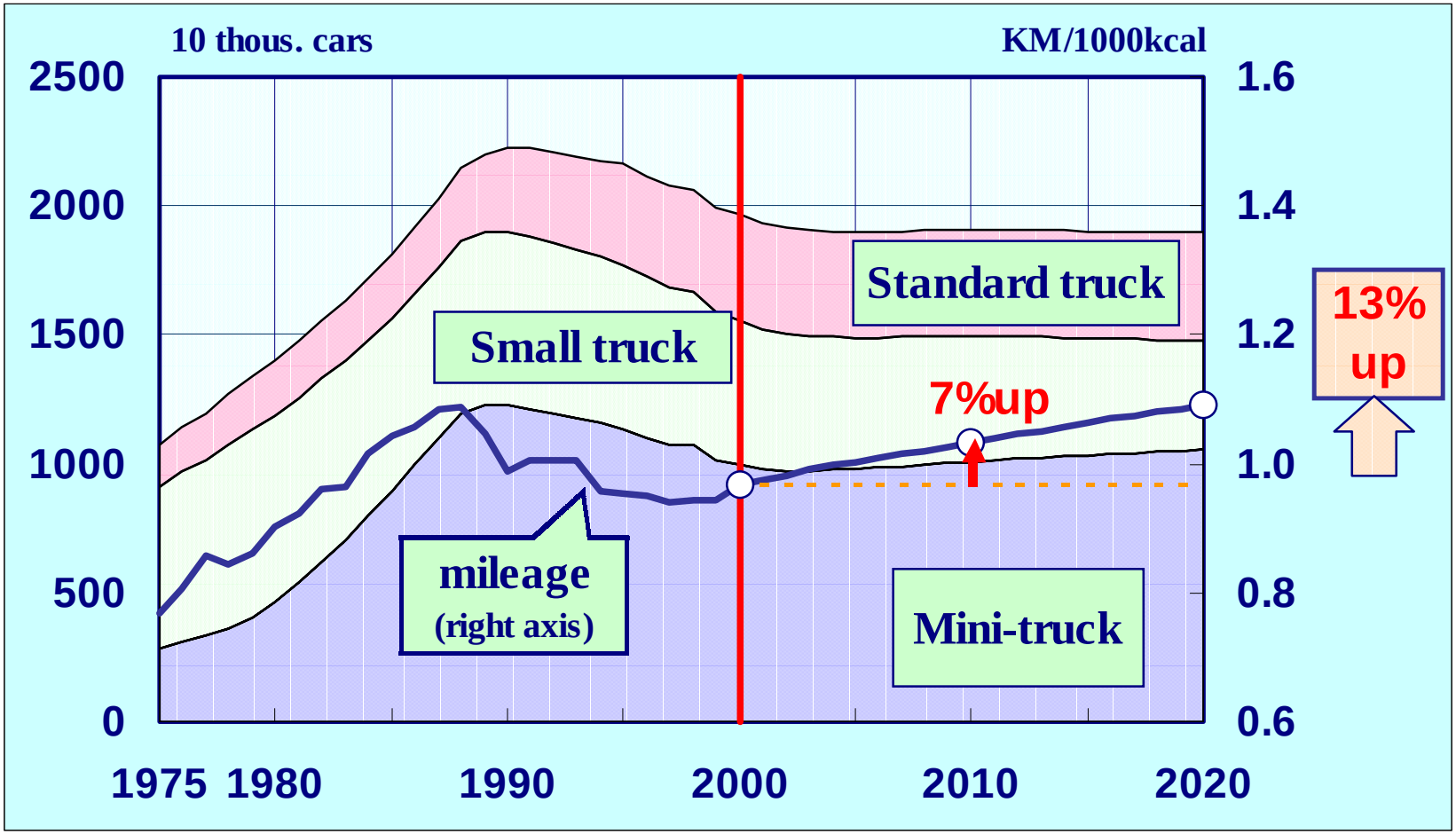
Passenger Vehicle Mileage [reference case]



Due to improved mileage in each class as well as the trend toward smaller vehicles, overall mileage will improve by 25% in 2020.

Composition of Truck Fleet and Overall Mileage

[reference case]



Due to small cargo deliveries, the light truck share will increase. Due to the improvement in mileage in each class, as well as the trend toward smaller vehicles, overall mileage will improve by 13% in 2020.

Demand Outlook by Energy Industry

- Oil Demand
- Gas Demand
- Electric Power Demand
- Generating Mix

Oil Demand Outlook

[reference case]

(Million KL)

	Actual				Forecast				Growth Rate(%)		
	1990FY		2000FY		2010FY		2020FY		2000 /1990	2010 /2000	2020 /2010
		Ratio (%)		Ratio (%)		Ratio (%)		Ratio (%)			
Fuel oil total	218	100.0	243	100.0	233	100.0	223	100.0	1.1	-0.4	-0.4
Gasoline	45	20.5	58	24.0	61	26.2	59	26.3	2.7	0.5	-0.4
Naphtha	31	14.4	48	19.6	42	18.2	42	18.9	4.3	-1.1	-0.1
Jet Fuel	4	1.7	5	1.9	5	2.3	6	2.6	2.1	1.6	0.7
Kerosene	27	12.2	30	12.3	29	12.3	27	12.0	1.1	-0.4	-0.7
Gas Oil	38	17.3	42	17.2	37	15.8	34	15.1	1.0	-1.2	-0.9
Fuel Oil A	27	12.4	30	12.1	30	13.1	32	14.4	0.9	0.3	0.5
Fuel Oil BC	47	21.4	31	12.9	28	12.0	24	10.7	-3.9	-1.2	-1.6
LPG (Mt)	19		18		21		22		-0.3	1.1	0.5

Gas Demand Outlook

[reference case]

(100Mil.m^3)

	Actual				Forecast				Growth Rate(%)		
	1990FY	Ratio (%)	2000FY	Ratio (%)	2010FY	Ratio (%)	2020FY	Ratio (%)	2000 /1990	2010 /2000	2020 /2010
Residential	78	50.5	95	37.9	98	30.0	101	26.6	2.0	0.4	0.2
Commercial	26	16.7	41	16.2	51	15.4	59	15.6	4.7	2.2	1.6
Industrial	40	26.2	93	37.4	149	45.4	178	47.1	8.8	4.8	1.8
Excluding power generation use	40	26.2	93	37.0	127	38.7	156	41.2	8.7	3.2	2.1
Others	10	6.6	21	8.5	30	9.1	40	10.6	7.6	3.5	3.0
Total	154	100.0	250	100.0	328	100.0	379	100.0	5.0	2.7	1.4
Excluding power generation use	154	100.0	249	99.7	306	93.3	357	94.2	5.0	2.1	1.5

Electric Power Demand Outlook [reference case]

(1000GWh)

	Actual			Forecast				Growth Rate(%)		
	1990FY	2000FY		2010FY		2020FY		2000 /1990	2010 /2000	2020 /2010
			Ratio (%)		Ratio (%)		Ratio (%)			
Lighting use	-	255	29.7	307	31.6	330	31.3	-	1.9	0.7
Power use	-	364	42.4	415	42.8	459	43.6	-	1.3	1.0
Commercial use	-	158	18.4	202	20.8	230	21.9	-	2.5	1.3
Small-scale use	-	116	13.5	123	12.6	132	12.5	-	0.6	0.7
High power supply voltage B & other uses	-	90	10.5	91	9.4	97	9.2	-	0.1	0.6
Demand for use not under specified contracts	-	618	72.0	722	74.4	789	74.9	-	1.6	0.9
Demand for use under specified of 2,000 kW or more	-	240	28.0	249	25.6	264	25.1	-	0.4	0.6
Total demand	678	858	100.0	971	100.0	1,054	100.0	2.4	1.2	0.8

Power Production by Energy Source

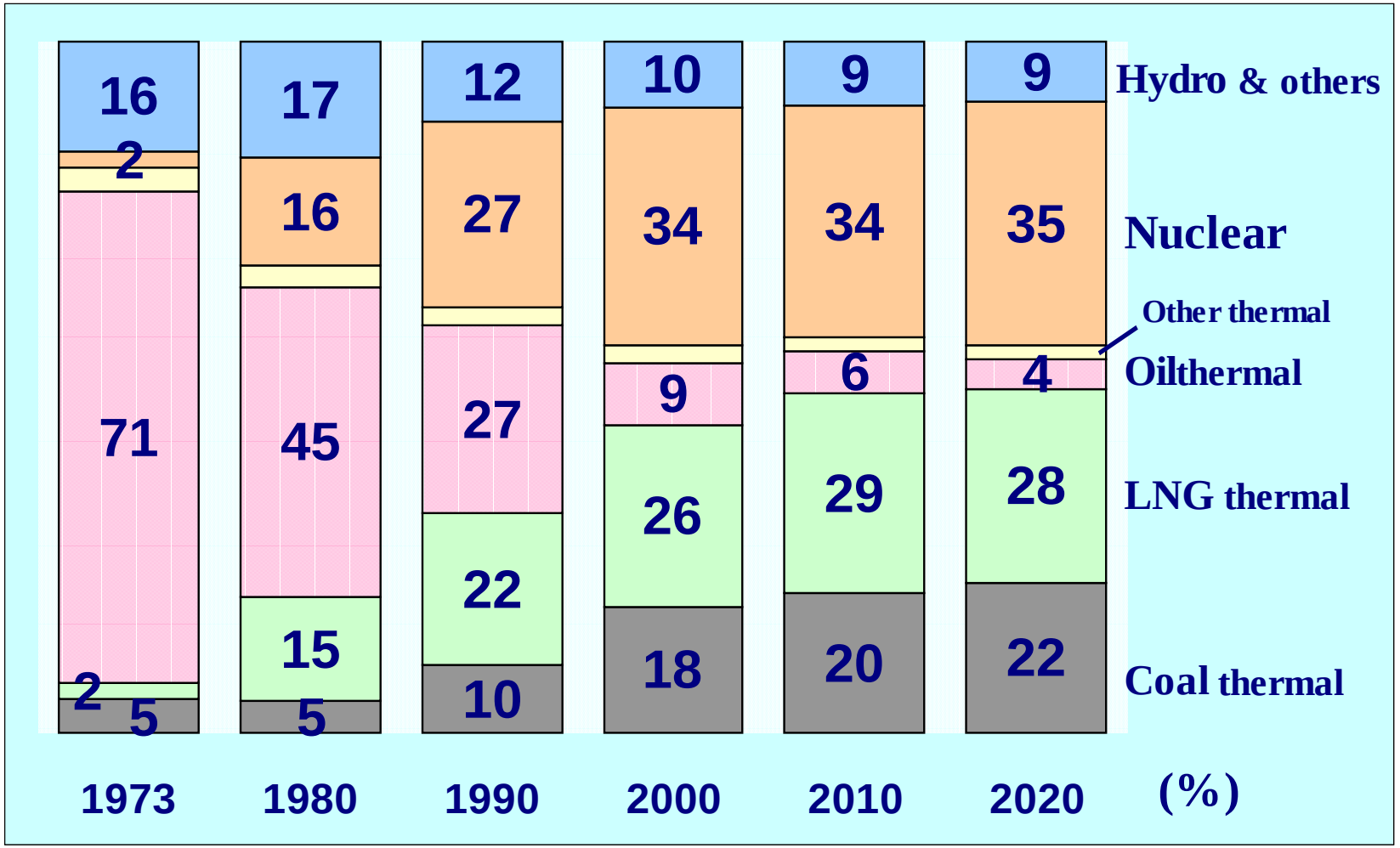
[reference case]

(1000GWh)

		Actual				Forecast		Annual growth rate(%)		
		1973FY	1980FY	1990FY	2000FY	2010FY	2020FY	2000 /1990	2010 /2000	2020 /2010
Thermal	Coal	21	25	75	170	213	246	8.6	2.3	1.5
	LNG	9	78	165	246	301	319	4.1	2.0	0.6
	Oil	293	231	203	84	64	50	-8.4	-2.8	-2.5
	Others	14	16	21	23	23	23	1.1	0.0	0.0
Nuclear		10	82	201	321	351	404	4.8	0.9	1.4
Hydro & others		65	86	87	90	95	98	0.3	0.5	0.3
Total		412	518	753	936	1,047	1,139	2.2	1.1	0.9

Generating mix by Energy Source

[reference case]



Nuclear will continue to be the largest share. Coal and LNG shares will increase.

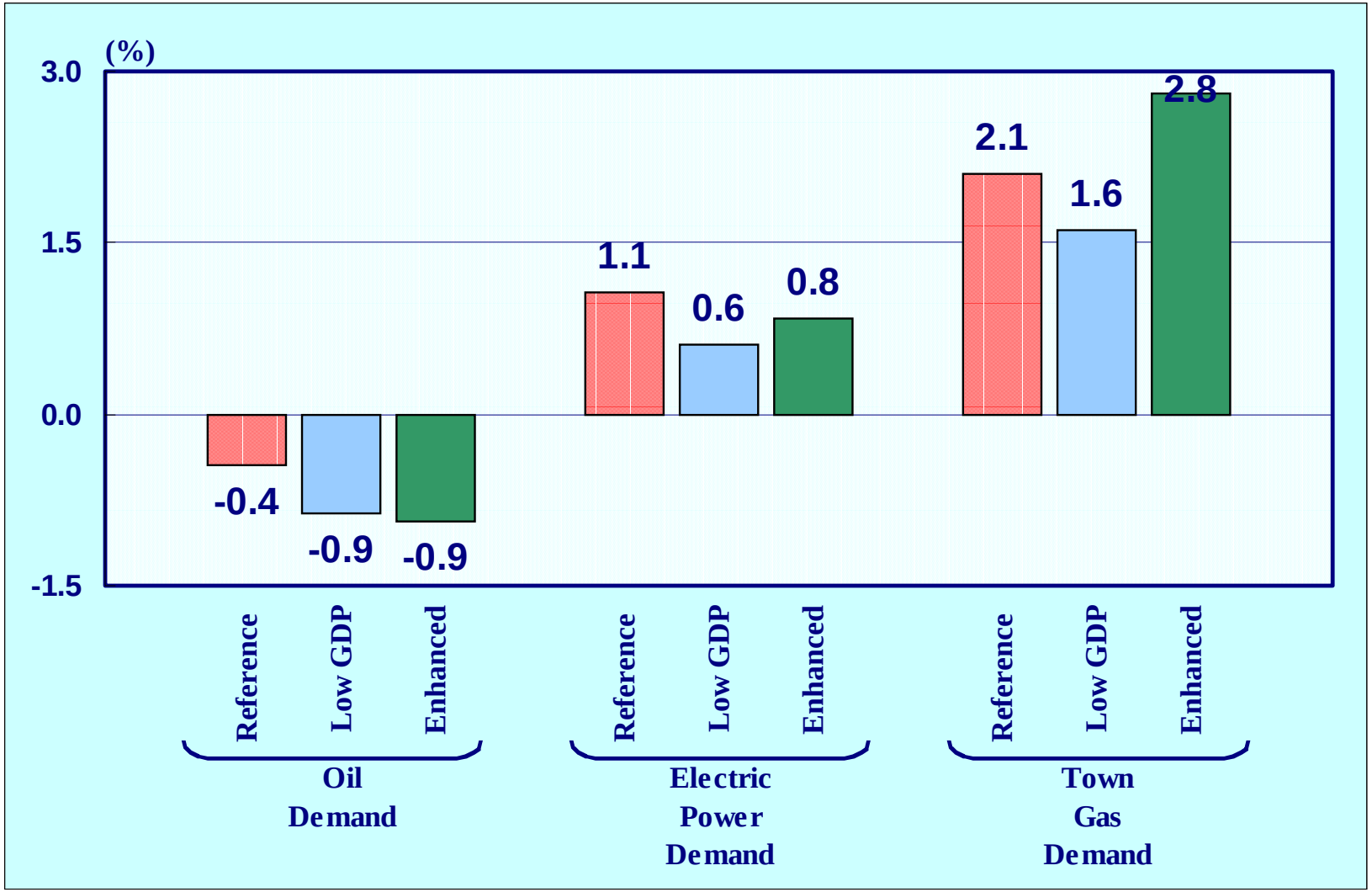
- Case Comparison of Sensitivity Analysis
- Prospects for Asia

Case Comparison Results I

	Case	Actual 2000	Forecast 2010	Forecast 2020	Rate of Divergence from Reference 2010	Rate of Divergence from Reference 2020	Annual Growth Rate(%) 2010/2000	Annual Growth Rate(%) 2020/2010
CO2 emissions (MtC)	Reference	316	325	323	-	-	0.3	-0.1
	Low GDP		301	291	-7.3	-9.7	-0.5	-0.3
	Enhanced		310	295	-4.6	-8.7	-0.2	-0.5
	Adding Nuclear		318	316	-2.2	-2.1	0.1	-0.1
Primary Energy (MTOE)	Reference	559	576	586	-	-	0.3	0.2
	Low GDP		542	542	-5.8	-7.5	-0.3	0.0
	Enhanced		567	565	-1.5	-3.6	0.2	-0.0
Final Energy Demand (MTOE)	Reference	376	383	388	-	-	0.2	0.1
	Low GDP		360	358	-6.0	-7.7	-0.4	-0.1
	Enhanced		380	378	-0.8	-2.4	0.1	-0.0
Oil Demand (Million KL)	Reference	243	233	223	-	-	-0.4	-0.4
	Low GDP		219	204	-6.0	-8.3	-1.0	-0.7
	Enhanced		221	201	-5.1	-9.6	-0.9	-0.9
Electric Power Demand (Billion kWh)	Reference	838	953	1,038	-	-	1.3	0.9
	Low GDP		885	947	-7.1	-8.7	0.6	0.7
	Enhanced		937	991	-1.7	-4.5	1.1	0.6
Town Gas Demand (100 Million m3)	Reference	250	328	379	-	-	2.7	1.4
	Low GDP		304	345	-7.3	-8.9	2.0	1.3
	Enhanced		358	435	9.0	14.8	3.6	2.0

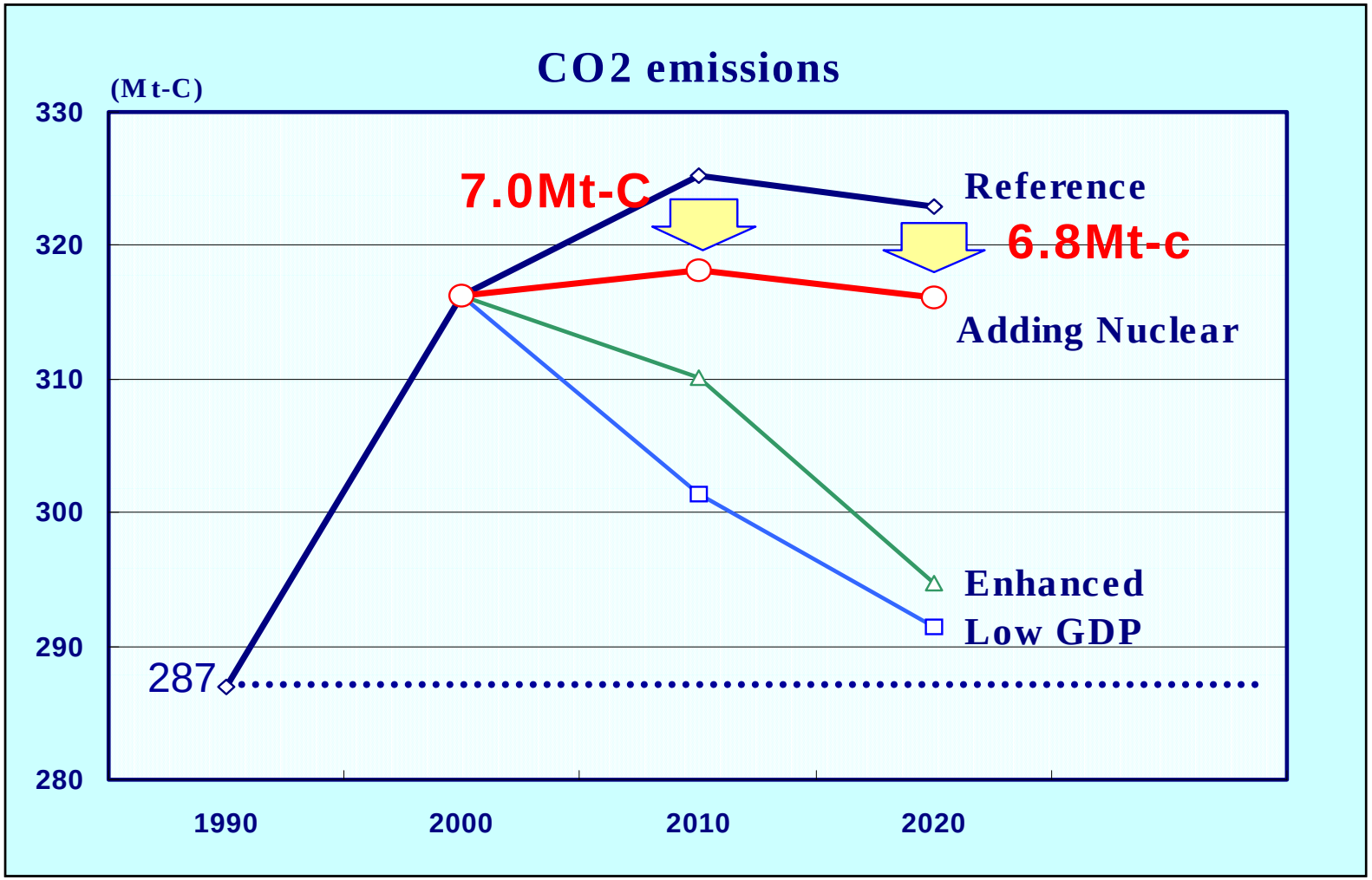
Case Comparison Results II

Average annual growth (2000-2020)

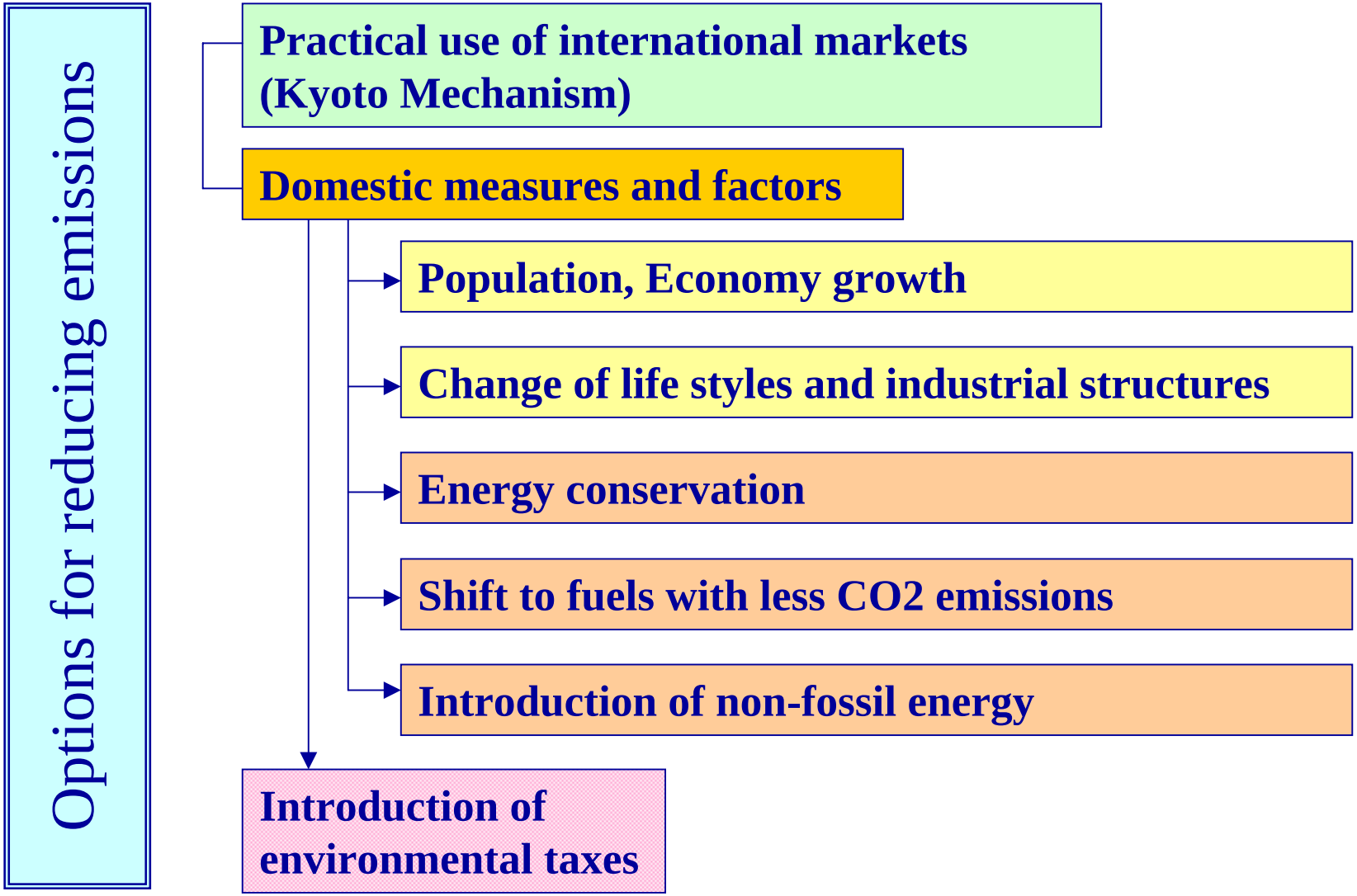


Impacts of Adding Nuclear Units

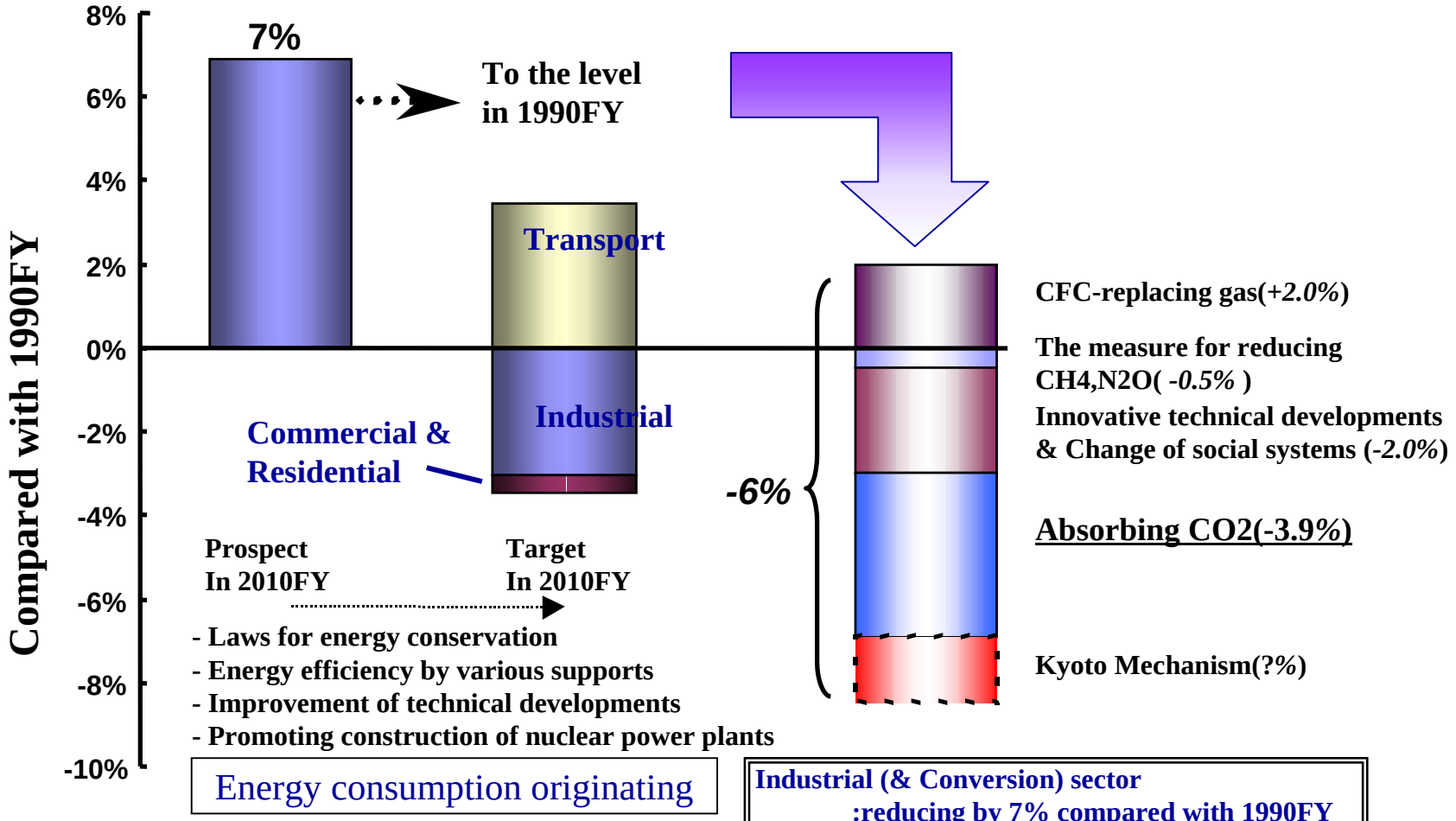
Nuclear Acceleration Case: Reference Case + five more units (6500 MW) for FY2010



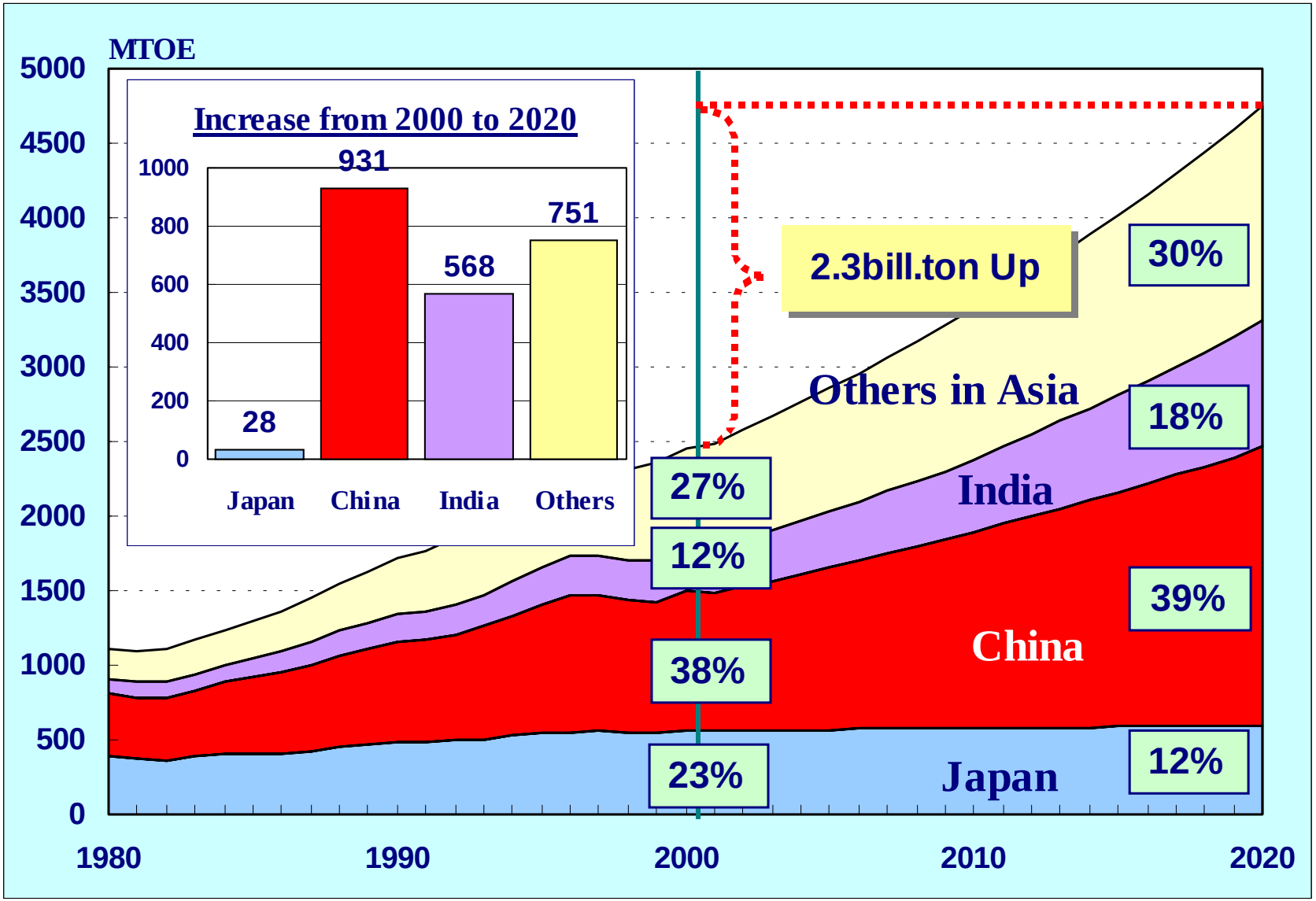
Options for Reducing CO2 Emissions



Reduction Goals under the Guideline of Measures to Prevent Global Warming

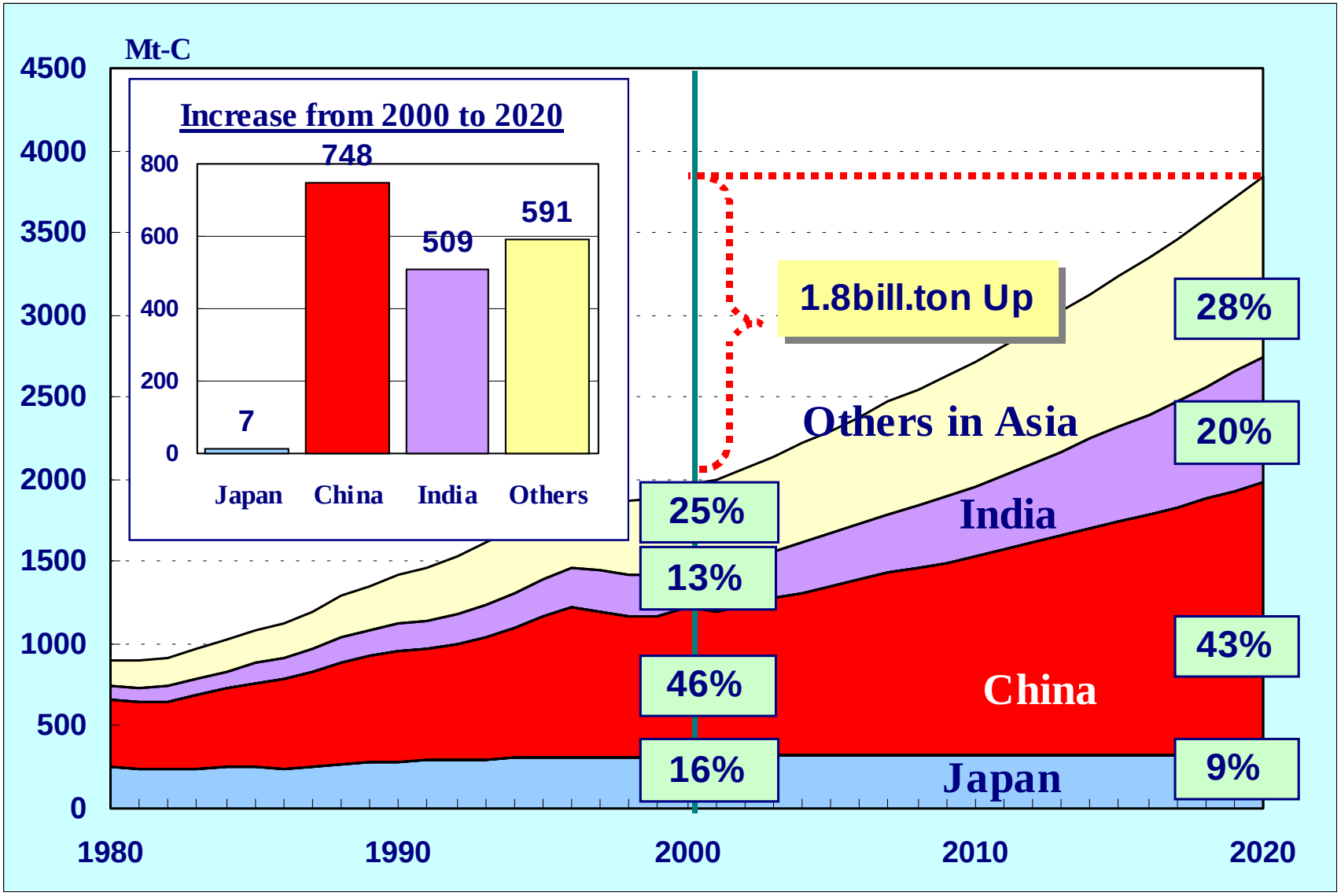


Japan in Asian Region: Primary Energy Supply



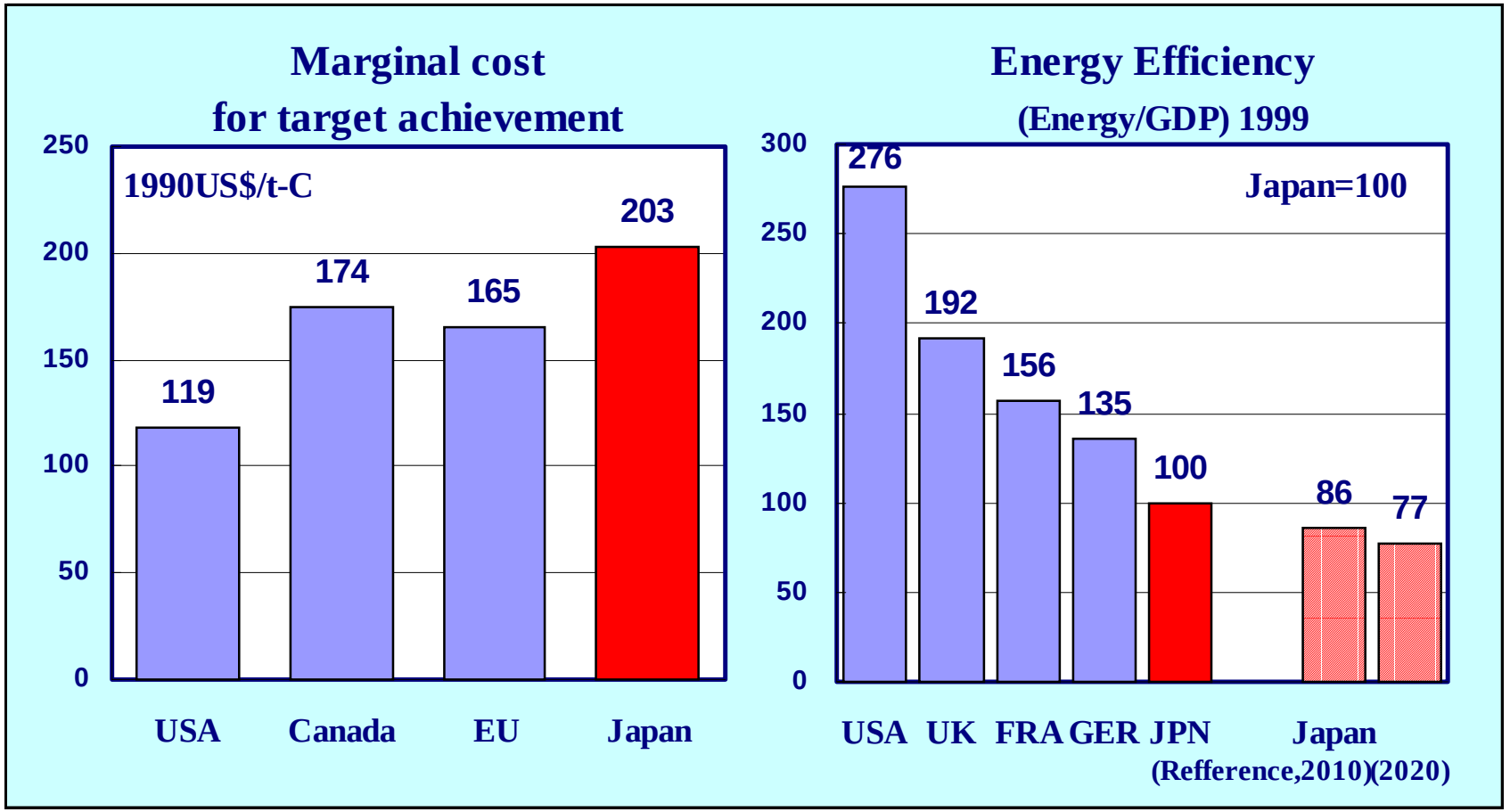
Source: Estimated by EMDC/IEEJ.

Japan in Asian Region: CO2 Emissions



Source: Estimated by EMDC/IEEJ.

Costs of Reducing CO2 Emissions, and Energy Efficiency by Each Country



Note: Indicates marginal costs assuming that each country will achieve targets under the Kyoto Protocol only through domestic measures.

Source: European Commission, Economic Foundations for Energy Policy, 1999.

Summary

- What is the Best Fossil Fuel Mix?
- Liberalization vs. Supply Stability
  and Environmental Preservation
- Actions Based on International Perspective
- Cooperation between the Government
  and the Private Sector
- Expedite Technological Development

- Nature of This Projection

[The Best Fossil Fuel Mix]

Oil Currently oil accounts for the largest share of entire fossil consumption and this will remain unchanged. Reliance on Middle East oil could increase. Given that possibility, it is important to continue securing self-developed crude oil and enhancing cooperation with Middle Eastern countries, and the government has a major role. In addition, oil demand is expected to grow in Asia, and solidarity among Asian countries will have desirable impacts.

Coal Coal should not be excluded from the fuel mix simply because of its large environmental burden. Since coal has the advantages of stable supply and low cost, its effective and efficient utilization should be promoted. This is important not only for Japan but also for all of Asia with its abundant coal resources, and Japan as a technology-savvy nation can play a pivotal role in this arena.

Gas Utilization of gas is expected to grow most rapidly among fossil fuels. To realize this expectation, the economic efficiency of gas should be improved in such respects as reduced LNG import costs based on Japan's bargaining power, transition to a flexible supply system, and reduced domestic sales costs through further streamlining. Since gas has been competing against oil, its prices have been linked to crude oil prices. However, coal will emerge as an important competitor for gas in the future.

In any case, having various fossil fuel mix options is important because Japan can increase pricing power for competing fuels and therefore enhance energy supply stability.

[Liberalization, Supply Stability, and Environmental Preservation]

- In the midst of globalization and increasing structural reform pressure on the Japanese economy, the liberalization of energy markets is necessary and unavoidable.
- To begin with, the market mechanism tends to seek economic rationality for the relatively short term, but energy matters require a long-term view. For this reason, some aspects of the market mechanism do not perfectly fit into Japan's energy situations (and if a market has defects, speculation will be accelerated, benefiting only a few and harming many).
- Should stability or efficiency be considered more important? We have to contemplate a system suitable for each country. An extreme ideology regarding the market mechanism as a general panacea is no solution. How should one reconcile efficiency with environmental constraints and energy supply stability? There should be a Japanese way of solving the problem (Japan differs from resource-rich America in that the market mechanism might be a tool for the “haves”).

- Especially in need of investigation is the question of nuclear power's role in the midst of liberalization. Nuclear power has played an important role in reducing oil dependency and increasing energy security. This role will remain in future (nuclear power is a vital means of achieving energy security and solving global environmental problems at the same time).
- It is difficult for the market mechanism to properly incorporate social costs for environmental preservation and securing a stable energy supply. The ways in which such costs are incorporated should be clarified, along with the associated burden-sharing mechanism among the government, suppliers, and populace.
- Promoting nuclear power development makes it necessary to assure transparency and safety while endeavoring to further improve its economic efficiency. Further, nuclear must be given a suitable role in national energy policy, and it is necessary to show how the government and the private sector can cooperate, including how they should share the burden.

[Global Perspective for Tackling Environmental Problems and Stabilizing Energy Supply]

- Japan's domestic policy measures have limitations in overcoming environmental obstacles. Energy demand is expected to glow globally, particularly in Asia. Technology transfer and other measures could reduce the environmental burden much more.
- Assuming a global perspective is not equivalent to the simple-minded view that Japan should take responsibility for developing countries. International cooperation can be viewed as major business opportunities made available by environmental constraints. Japan is on the cutting edge in energy conservation and environmental technology. It is important for resource-poor Japan to support its economy with its inexhaustible supply of technology.
- Many new technologies require vast amounts of money and a long time to penetrate the market, and the private sector alone would not be able to bear the burden. Therefore cooperation between the government and the private sector is essential.
- In addition, cooperation among Asian countries as a whole may lead to enhanced bargaining power, joint energy resource development, and a cooperative response to energy security, thereby benefiting not only Japan, but also the region as a whole.

[Kyoto Protocol]

- The Kyoto Protocol is not the only measure of global warming, and we should not misunderstand the essence of the issue. However, we cannot breach our commitments. If we stick to the idea that commitments made under the Kyoto Protocol should be attained only though domestic measures, it will be dangerous and unrealistic.
- To begin with, economic realities do not guarantee that numerical targets will be attained mainly through domestic policies. In addition to flexibility mechanisms under the protocol, the government should prepare measures that have a long-term view and that look ahead to the second commitment period.

Nature of This Projection

- While maintaining logical and quantitative consistency, this projection presents calculation results obtained with certain assumptions. Given various future uncertainties, projected figures are sensitive to assumptions. To give readers supplementary information, we have conducted a sensitivity analysis on parameters for "economic growth," "energy technology" and "enhanced nuclear development." It is hoped that this projection will serve as a reference for considering and discussing future energy demand.