Japan Long-Term Energy Outlook

A projection up to 2030 under environmental constraints and energy market changes

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Outline of the Study

[Study Objective]

This research is to depict comprehensively and quantitatively a most feasible future image of energy supply and demand by taking account of the future socioeconomic changes, so that it can serve the request for energy security, market stability and global environment protection.

- Forecast Period :2005-2030
- Forecast Method :Macroeconomic Model, Energy Supply and Demand Model ,etc.

(See next slide)

[Case Setting]

- **Reference Case**

Depicts the future image of energy supply and demand under various assumptions that are most feasible under current situations of economy, society and policies.

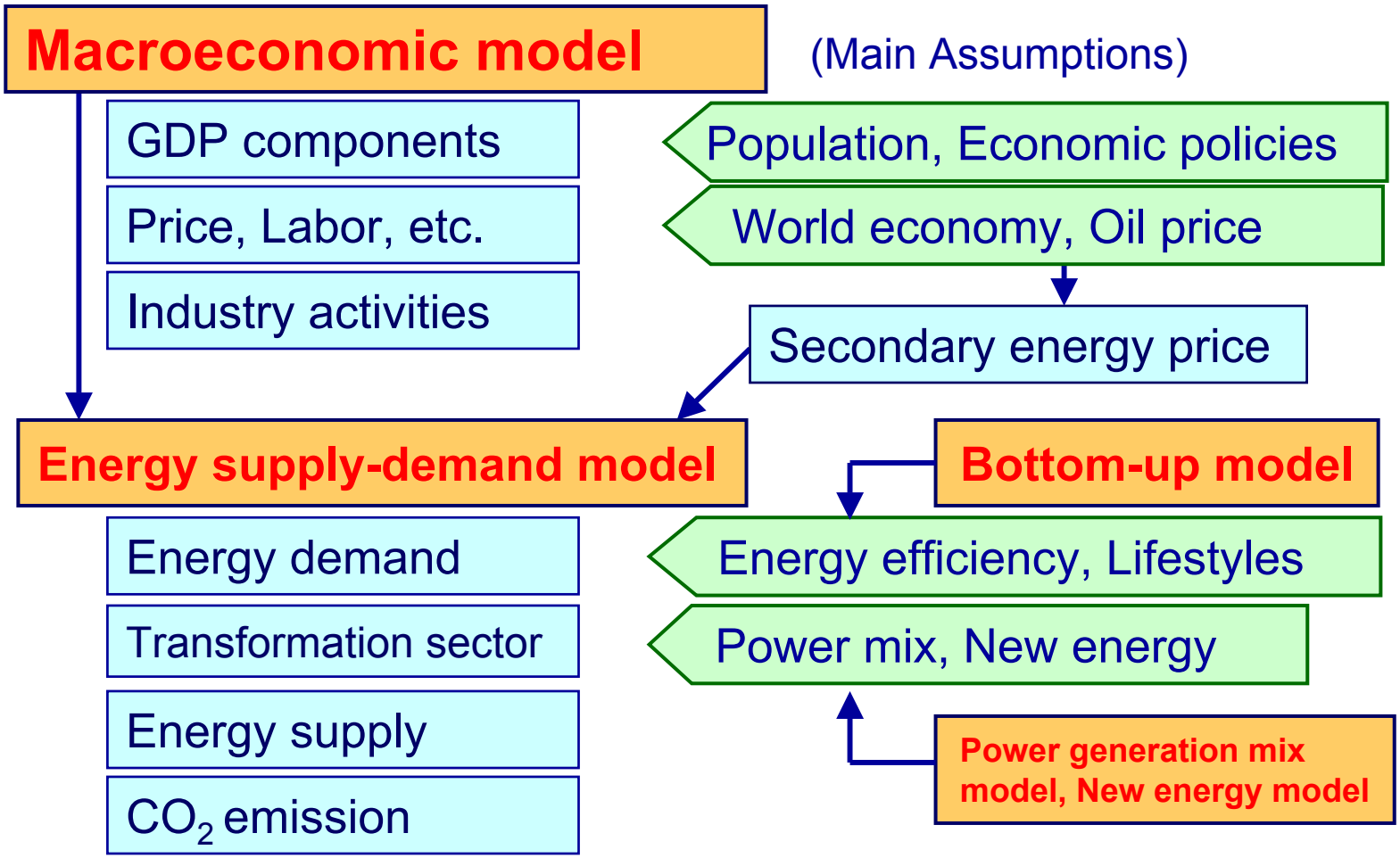
- **Technology Development Case**

Assumes further technology development of energy conservation and new energy, as well as diffusion to the market.

- **Sensitivity Analysis**

Analyzes the impact of factor's change of economy (High Economic Growth Case) and energy prices (High Price Case)

Flow Chart of Model Analysis



■Forecast is conducted by using a group of models among which the Energy supply-demand model is the kernel.

■Factors that affect future energy supply and demand are expressed comprehensively and quantitatively.

Energy Balance Table (FY2004)

Mtoe

Sector			A Coal	B Oil	C Gas	D Hydro, Geother.	E Nuclear	F Electric-ity	G Total
Primary Supply	1	Indigenous Produc.	1	1	3	28	61	0	93
	2	Import	120	274	76	0	0	0	469
	3	Gross Supply	121	275	78	28	61	0	563
	4	Export, etc.	-3	-18	-0	0	0	0	-21
	5	TPES	118	256	78	28	61	0	542
Transformation	6	Public Utilities	-54	-16	-50	-21	-61	80	-121
	7	Others	-19	-17	0	-7	0	16	-26
	8	Loss and Own Use	-3	-14	-2	0	0	-10	-29
Final Consumption	9	TFEC	39	216	26	4	0	87	372
	10	Industry	38	91	10	2	0	36	178
	11	Resi. and Com.	1	35	16	1	0	49	102
	12	Transport	0	90	0	0	0	2	92

Primary Supply

Power Mix

Final Demand

■Depicts the future image of energy supply and demand, based on the energy balance table.

Main Assumptions

- Economic Growth and Population
- Structure
- Imported Energy Prices
- Nuclear Power Generation
- New Energy and Energy Conservation

Main Assumptions (Socioeconomic Structure)

[Population structure]

- Population peaks in FY2004 (128 Million), and thereafter declines.
- The aged ratio (over 65) grows from 19.5% to 29.6% (FY2004-2030).

[GDP growth rate]

- World economy grows at about 3% annually (2004-2030).
- Gradual growth is expected even though the population declines and the aged ratio increases.

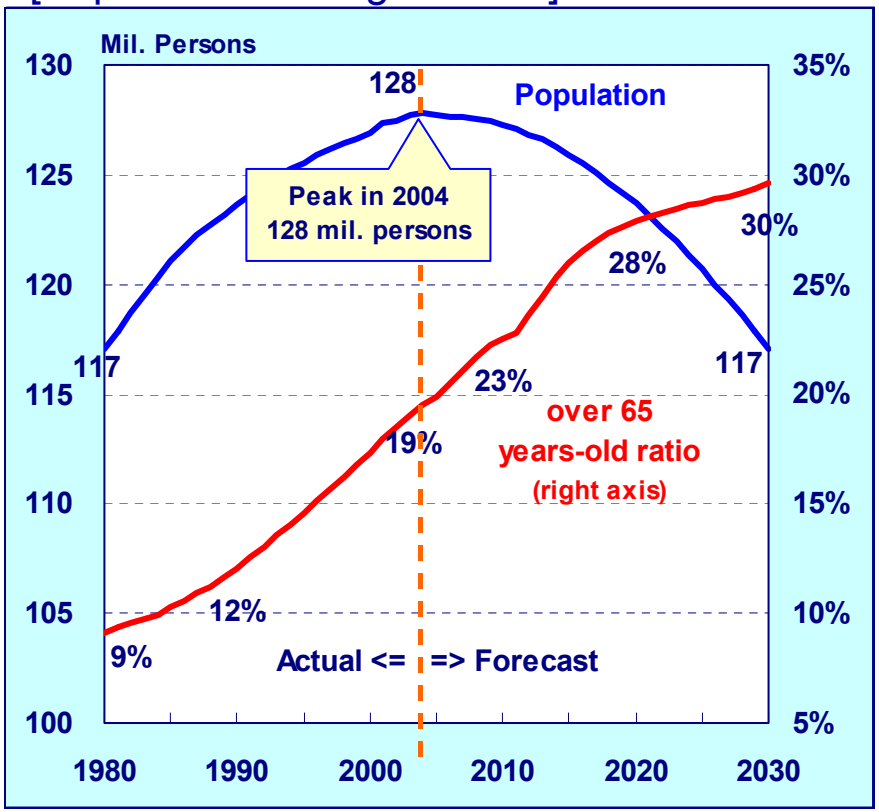
Reference case **2.0%** (FY2004-2010)
1.5% (FY2010-2020)
1.1% (FY2020-2030) FY2004-2030, **1.5%**

[Industrial structure]

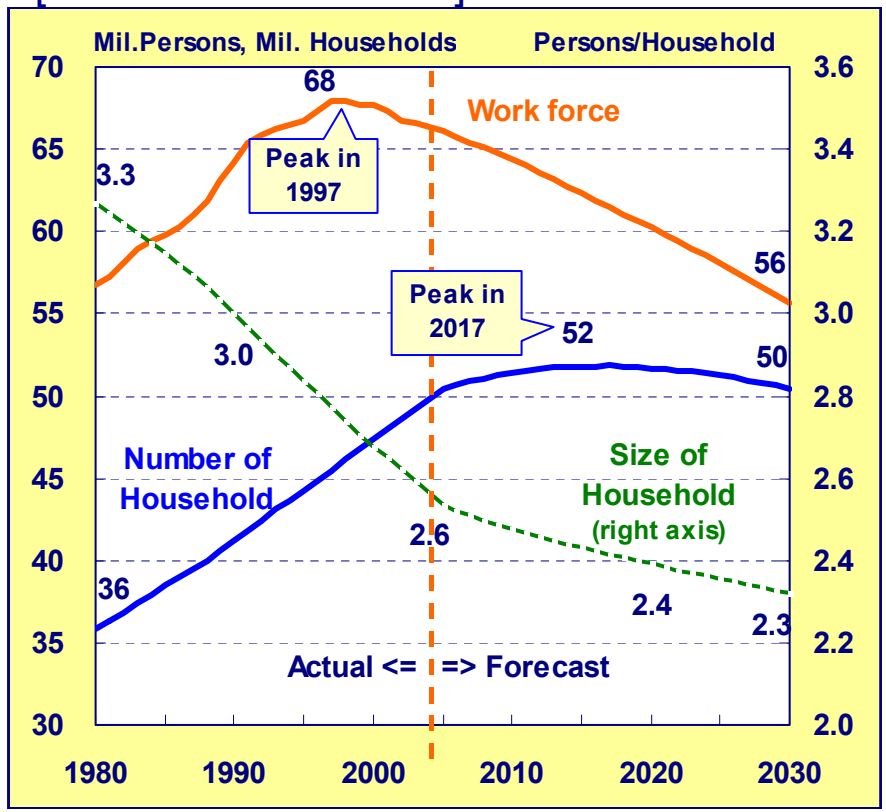
- Progress in services and IT industries
- Shift to higher value-added and higher-level processing and assembly industries

Forecast of Population Structure

[Population and Aged Ratio]



[Household and Labor]



Source: Estimated based on the Middle Case (2002.1) of The National Institute of Population and Social Security Research, and Employment Policy Research Group (2005.7)

■Population peaks in 2004. In 2030, it declines to the level of 1980. The speedy decline can hardly be found in the world elsewhere. 30% of the population will be over 65 years old in 2030.

■Since size of household keeps declining, the total household number remains to increase regardless of the reduction of population. However, the number of household will eventually turn to decline from 2017, since the reduction of population outnumbers the decline of size of household.

<Main Assumptions>

Macro Economy Outlook

	Actual		Forecast			Average Annual Growth Rate (%)			
	FY1990	FY2004	FY2010	FY2020	FY2030	2004/1990	2010/2004	2020/2010	2030/2020
Real GDP (Trillion Yen)	449	526	593	687	770	1.1	2.0	1.5	1.1
Private Consumption	244	298	327	377	420	1.4	1.6	1.4	1.1
Private Investment	83	78	105	135	164	-0.4	5.0	2.6	1.9
Public Demand	92	118	123	133	141	1.8	0.6	0.8	0.6
Exports	36	70	93	120	150	4.7	5.0	2.5	2.3
Imports	34	56	73	97	125	3.7	4.7	2.8	2.6
Nominal GDP (Trillion Yen)	446	496	591	836	1,110	0.8	3.0	3.5	2.9
IIP (CY2000=100)	101.2	100.6	112.3	126.0	138.4	0.0	1.9	1.2	0.9
CPI (CY2000=100)	92.9	98.0	105.1	128.6	154.3	0.4	1.2	2.0	1.8
Real Crude Oil Price ($/b)	23.3	38.7	40.0	42.0	45.0	3.7	0.6	0.5	0.7
Population (Millions)	123.61	127.78	127.29	123.67	117.10	0.2	-0.1	-0.3	-0.5
GDP per Capita (Million Yen)	3.63	4.12	4.66	5.56	6.57	0.9	2.1	1.8	1.7

■GDP growth rate will be 1.5% annually within the forecast period, characterized by the private consumption-led growth.

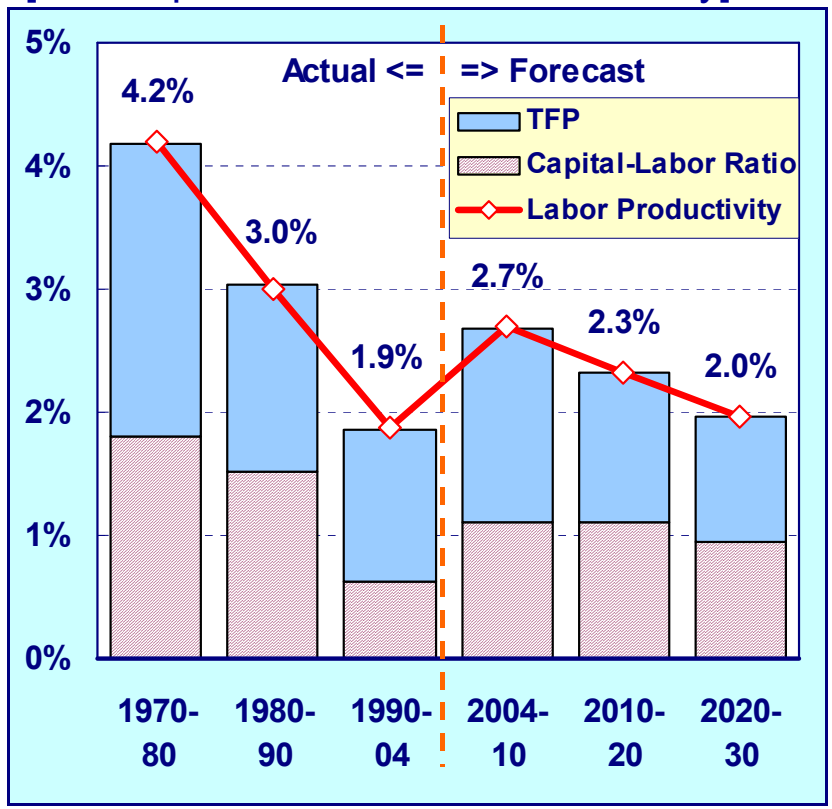
■GDP per capita will remain to grow at about 2% annually, although the GDP growth rate gradually declines.

Economic Growth at Supply Side

[Contribution to GDP Growth (%)]

	GDP Growth Rate	Labor	Capital	TFP
1970-1980	4.4	0.2	1.9	2.4
1980-1990	4.0	0.7	1.8	1.5
1990-2004	1.1	-0.5	0.5	1.2
2004-2010	2.0	-0.5	0.9	1.6
2010-2020	1.5	-0.6	0.8	1.2
2020-2030	1.1	-0.5	0.7	1.0

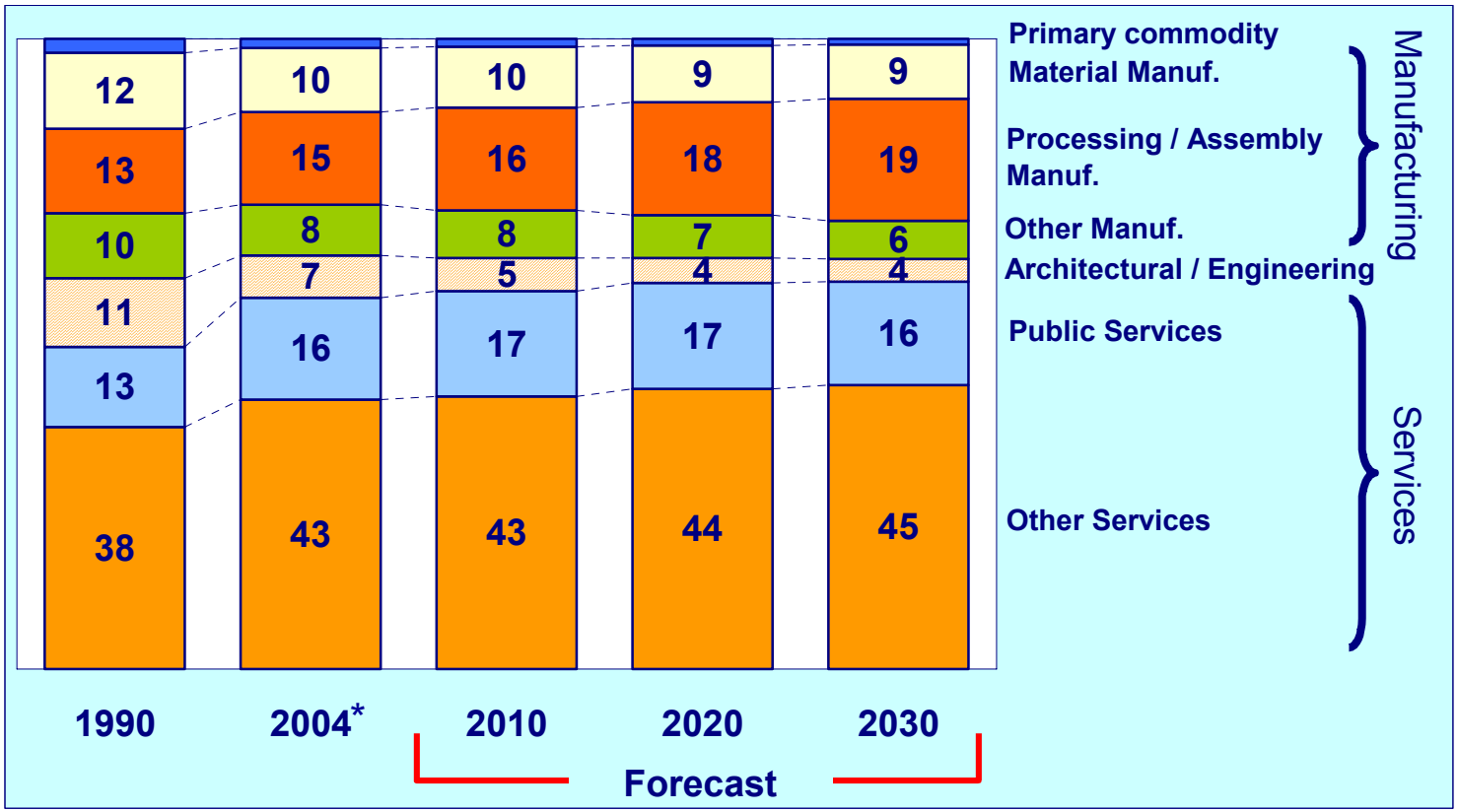
[Decomposition of Labor Productivity]



■Although the population declines and the aged ratio grows, the economy will keep growing, since the labor-saving investment promotes the accumulation of capital equipment and productivity (TFP, Total Factor Productivity).
The labor productivity increases by 2.0-2.7% due to the increase of capital equipment ratio (=Capital/Labor) and TFP.

Change of Industrial Structure

[Production Share by Industry (2000 Price)]



2004*: Estimated

■Service and high value-added industries grow. The share of service industry will be over 60%.

■The share of assembly industry such as electric & electronic industry and transportation equipment industry increases.

Forecast of Production Activity

		Actual		Forecast			Average Annual Growth Rate (%)			
		FY1990	FY2004	FY2010	FY2020	FY2030	2004/1990	2010/2004	2020/2010	2030/2020
IIP (CY2000=100)		101.2	100.6	112.3	126.0	138.4	0.0	1.9	1.2	0.9
Production (Mt)	Crude Steel	111.71	112.90	107.85	97.67	90.34	0.1	-0.8	-1.0	-0.8
	Ethylene	5.97	7.56	6.94	6.27	5.71	1.7	-1.4	-1.0	-0.9
	Cement	86.85	71.68	69.39	65.77	61.25	-1.4	-0.5	-0.5	-0.7
	Paper, Paperboard	28.54	30.87	32.61	34.99	36.39	0.6	0.9	0.7	0.4
IIP, Machinery (CY2000=100)		93.4	105.3	126.6	149.1	171.3	0.9	3.1	1.7	1.4
Household (Millions)		41.16	49.84	51.41	51.70	50.45	1.4	0.5	0.1	-0.2
Floor Space (Billion m^2)		1.29	1.74	1.83	1.93	1.96	2.2	0.8	0.5	0.2
Passenger Traffic (Billion Passenger-km)		1,298.4	1,418.4	1,466.1	1,492.8	1,450.9	0.6	0.6	0.2	-0.3
Freight Traffic (Billion t-km)		546.8	570.0	577.3	581.4	570.2	0.3	0.2	0.1	-0.2

■Although production quantities of high energy intensive industries excluding paper decrease, their production value will increase, due to the shifting toward higher value added.

■The decrease of employment number and the falling birthrate slow down the growth of the commercial floor space of office, school, etc.

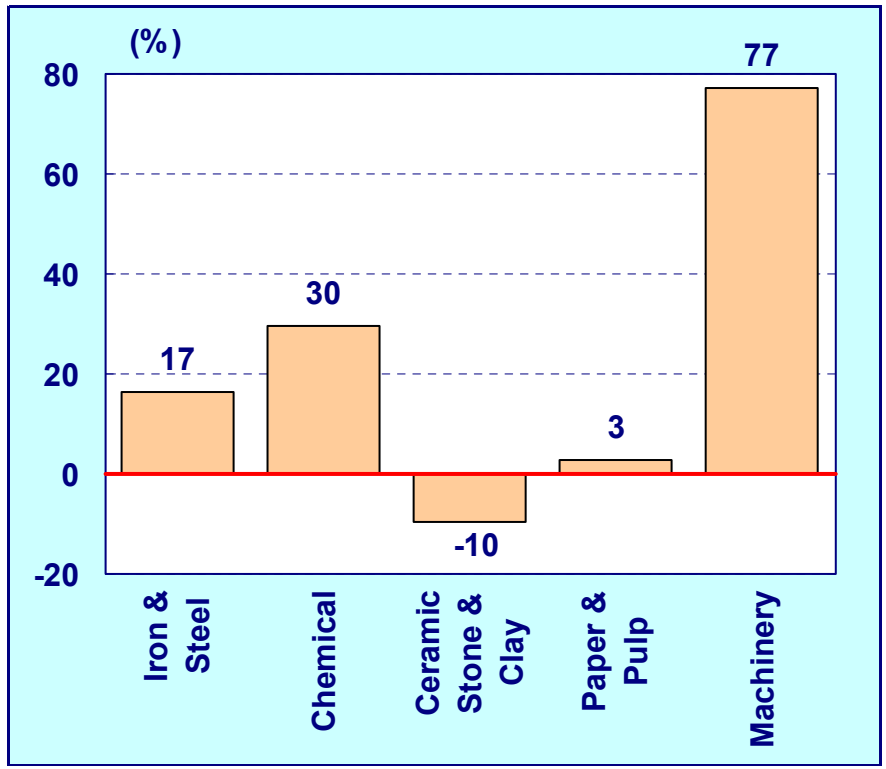
<Main Assumptions>

Shift to Processing & Assembly from Raw Material

[Production Quantity] (Mt, Y2000=100)

	2004	2030	Change Rate
Crude Steel Production	11,290	9,034	-20%
Ethylene Production	756	571	-24%
Cement Production	7,168	6,125	-15%
Paper/Paperboard Production	3,087	3,639	18%
Machinery (IIP)	105	171	63%

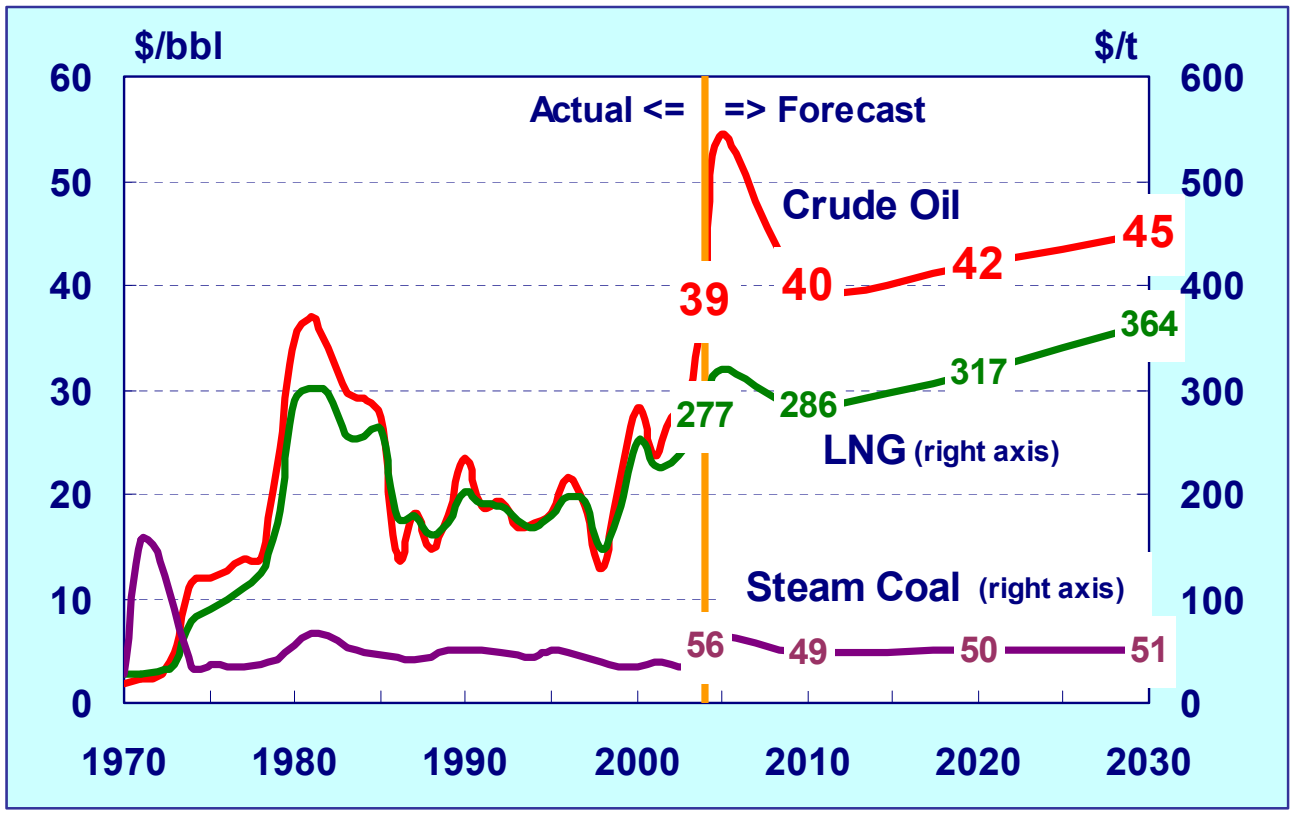
[Change of Production Value (2004-2030)]



■While production of raw material industries decreases due to the saturation of social capital, the production (=IIP) of electrical and electronic, transportation machinery, etc., will increase.

■The value of steel and chemical production whose quantity decrease will still increases, because products of these industries are shifted to higher value added ones.

Prospects of Primary Energy Price



(Note) Future figures are in 2004 Price.

■The current high level of crude oil price (import c.i.f.) will be corrected downward by 2010. From 2010, however, the growing demand of oil consumption mainly prompted by the Asian countries, together with the sluggish of exploration investment will make the world oil market tight again, and the oil price will rise.

■LNG price will increase in the long term, linked with the crude oil price.

■Coal price will level off.

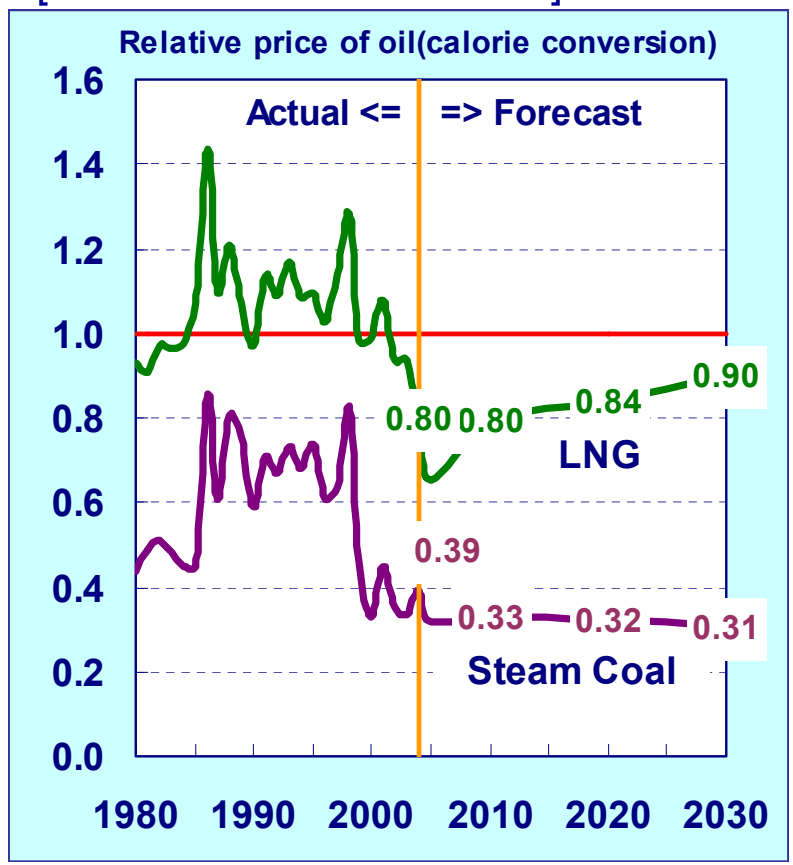
Prospects of Primary Energy Price

[Real and Nominal Price]

		2004	2005	2010	2020	2030
Crude Oil	**real price**	**39**	**54**	**40**	**42**	**45**
$/bbl	nominal price	39	55	45	58	75
LNG	**real price**	**277**	**319**	**286**	**317**	**364**
$/t	nominal price	277	325	322	435	609
Steam Coal	**real price**	**56**	**64**	**49**	**50**	**51**
$/t	nominal price	56	65	55	69	85

(Note) Real price is in 2004 price. The inflation rate is assumed to be 2%.

[Relative Price of Crude Oil]



■The current relative price of LNG compared with crude oil is cheaper due to the sudden jump of the crude oil price. However, they will gradually become close on the thermal basis.

■The relative price of coal will decrease gradually.

Main Assumptions (Domestic Factor: Energy)

[Energy Conservation]

■Both the current situation of technology and energy conservation and the future trend are taken into account.

Industry: energy consumption decreases (Keidanren's Voluntary Action Plan).
Res. & Com.: efficiency such as home electric appliances improves (Top-runner Approach).
Transportation: efficiency of passenger car and truck improves (Top-runner Approach).

[Nuclear Power Generation]

■Both the equipment capacity and capacity factor are assumed to grow to meet the growing demand of electricity.

FY2005 (Actual)	49.58GW (March, 2006). Capacity factor = about 72%	
FY2010	**50.14GW**, 88%	(+1 plant: Tomari#3, -1 plant: Tsuruga#1)
FY2020	**58.72GW**, 88%	(+6 plants)
FY2030	**62.86GW**, 88%	(+3 plants)

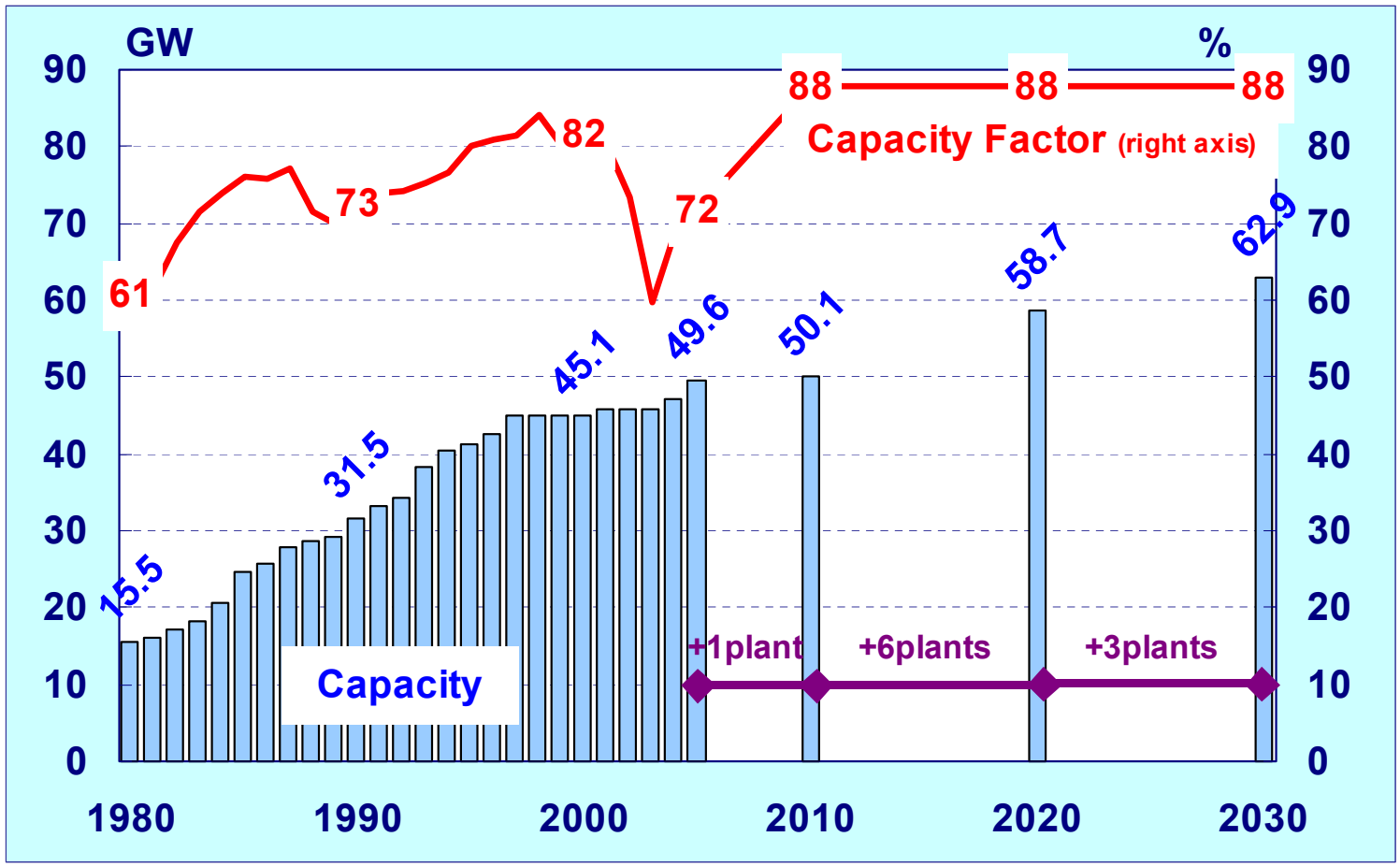
[New Energy]

■The following assumption is based on the current introduction trend and economic rationality.

Reference Case: FY2010 **6.14GL** of crude oil equivalent

FY2030 **12.39GL** (excluding black liquor and scrap)

Nuclear Power Assumption

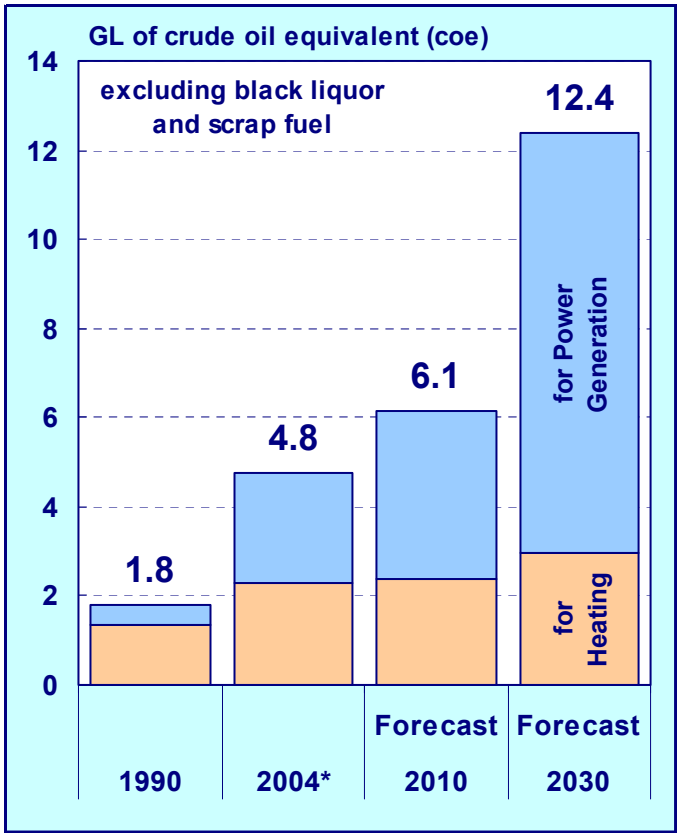


■A relatively smooth growth of capacity is expected. The increment is nearly half of the FY2006 Electricity Supply Plan by METI.

■The utilized capacity, whose the extension of the interval of regular checkup is currently being considered by the government, is assumed to be 88%.

Introduction Amount of New Energy

[Introduction amount]



2004*: Estimated

[Breakdown by Utilization Type]

		2004*		2010		2030	
		GLcoe	Capacity GW	GL	GW	GL	GW
for Power Generation	Photovoltaic Power	0.3	(0.6)	0.8	(3.4)	3.6	(14.8)
	Wind Power	0.4	(0.5)	0.6	(1.5)	2.3	(5.6)
	Waste-Burning Power	1.6	(1.4)	2.1	(1.9)	3.0	(2.8)
	Biomass Power	0.2	(0.2)	0.3	(0.3)	0.5	(0.5)
for Heating	Solar Heating	0.6		0.4		0.3	
	Waste-Burning Heating	1.7		1.7		1.7	
	Biomass	0.0		0.2		0.9	
	Utilization of Untapped Energy	0.0		0.1		0.2	
New Energy Total		4.8 GL		6.1 GL		12.4 GL	
Black Liquor and Scrap Fuel		4.6		4.9		5.5	
Total (incl. black liquor,etc)		9.4 GL		11.0 GL		17.9 GL	

■New energy, excluding black liquor, will become three times as large as current amount.

■Photovoltaic and wind power are main incremental sources. As to heating utilization, solar heating decreases while bio-fuel (E3) for transportation increases.

Outlook of Energy Supply and Demand

Forecast Results of Reference Case

- Primary Energy Supply and Final Energy Consumption
- CO_2 Emission
- Energy Consumption by Sector
- Energy Consumption by Energy Source
- Power Generation Mix
- Japan in Asia

<Reference Case>

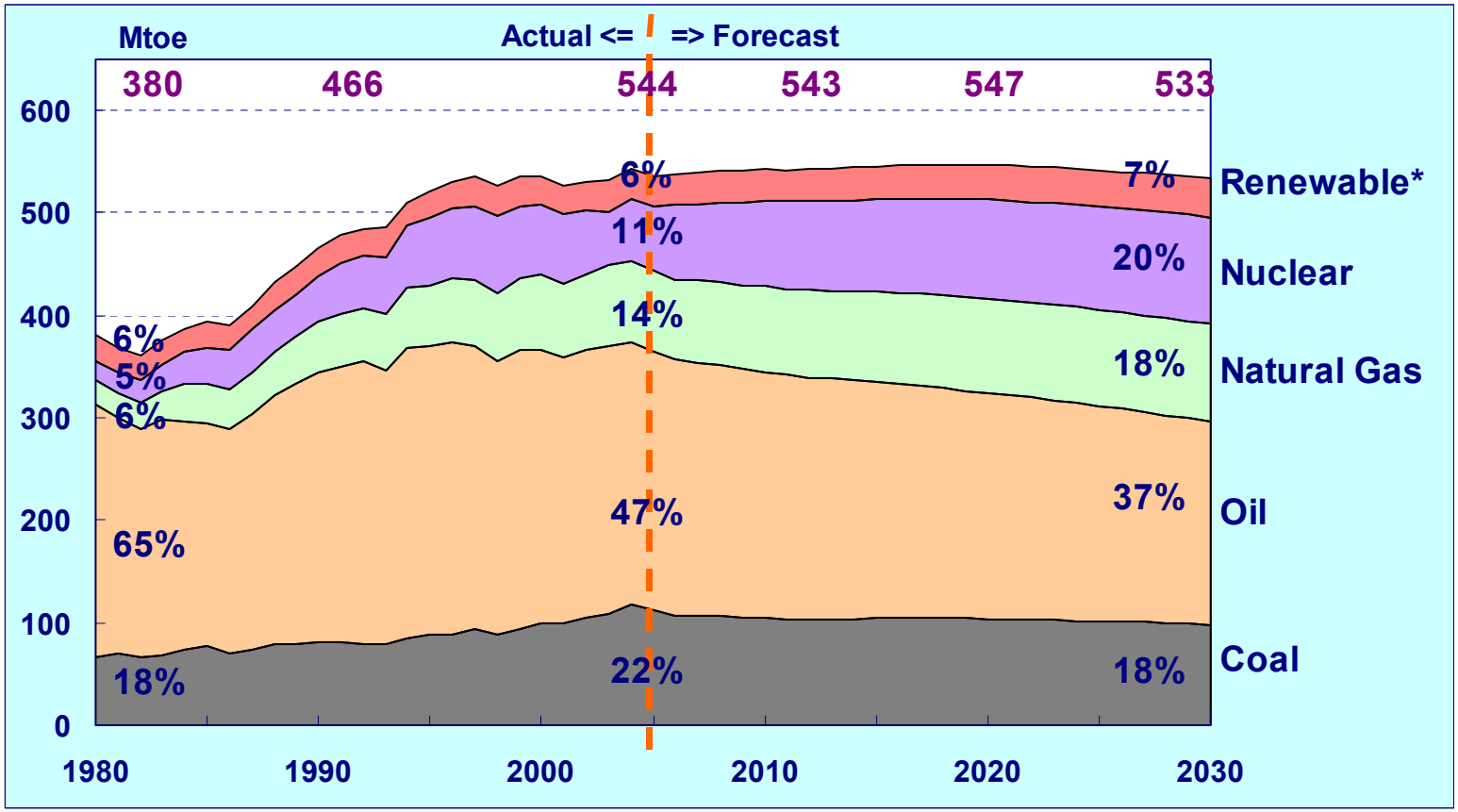
Total Primary Energy Supply

(Mtoe)

	Actual				Forecast						Average Annual Growth Rate (%)			
	FY1990	(%)	FY2004	(%)	FY2010	(%)	FY2020	(%)	FY2030	(%)	2004/1990	2010/2004	2020/2010	2030/2020
Coal	80	17	118	22	104	19	104	19	98	18	2.8	-2.1	0.0	-0.5
Oil	264	57	256	47	241	44	220	40	198	37	-0.2	-1.0	-0.9	-1.1
Natural Gas	49	11	78	14	84	15	92	17	95	18	3.4	1.2	0.9	0.4
Nuclear	46	10	61	11	83	15	97	18	104	20	2.1	5.4	1.6	0.7
Hydro, Geother.	21	4	22	4	21	4	20	4	21	4	0.3	-1.1	0.0	0.1
New Energies	6	1	9	2	10	2	13	2	17	3	2.4	2.8	2.8	2.1
TPES	466	100	544	100	543	100	547	100	533	100	1.1	0.0	0.1	-0.3
GDP (Trillion Yen)	449		526		593		687		770		1.1	2.0	1.5	1.1
TPES per GDP (FY1990=100)	100		99		88		77		67		0.0	-2.0	-1.4	-1.4
CO_2 Emissions (Mt-C)	287		331		311		303		284		1.0	-1.0	-0.3	-0.6
(FY1990=100)	100		115		108.5		105.4		99.0					

<Reference Case>

Forecast of Total Primary Energy Supply



*Renewable energy: hydro, geothermal, new energy, etc.

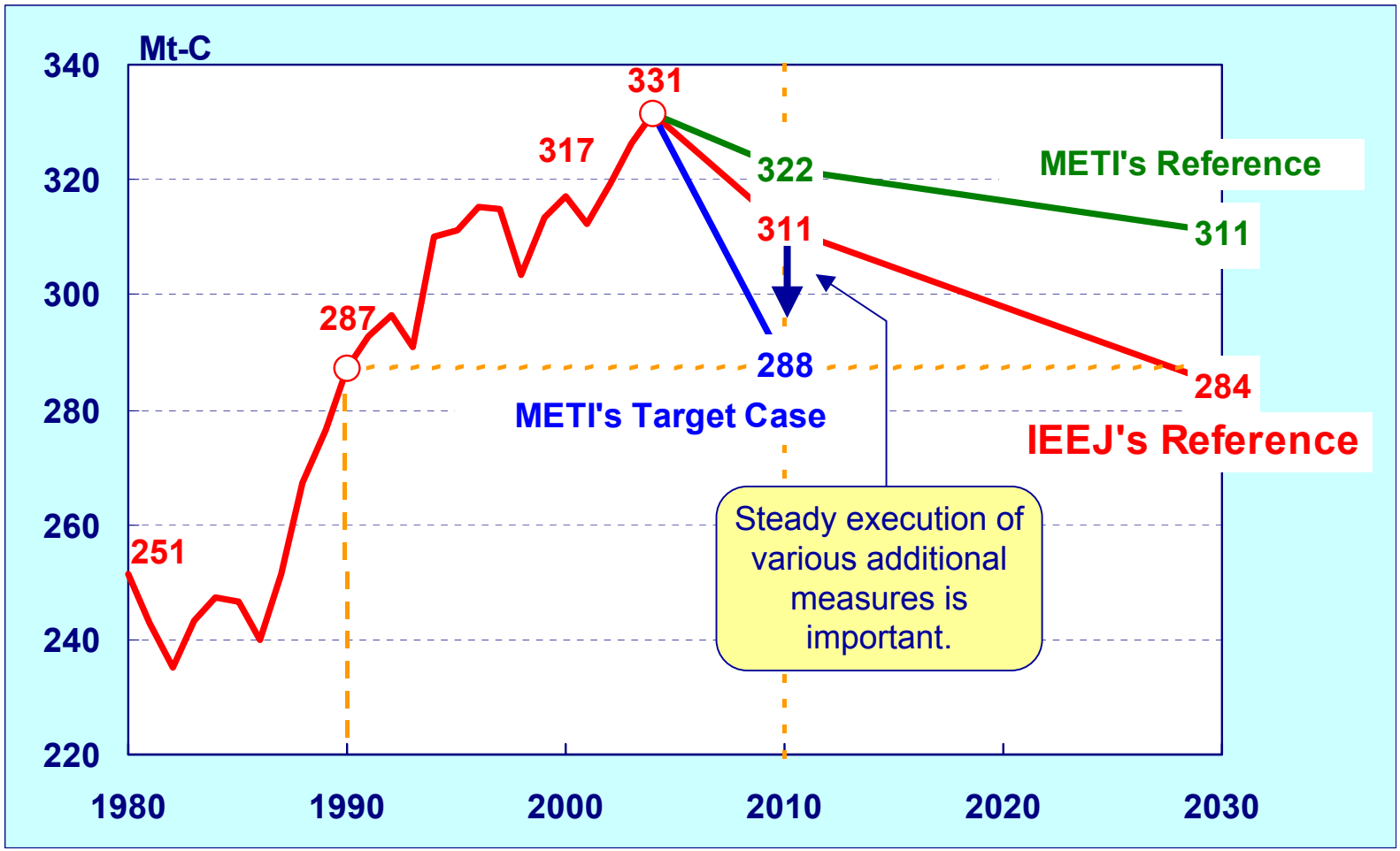
■Although the TPES levels off, its energy structure will change largely.

■Oil demand decreases and oil dependency rate reduces to 37%. But it remains to be the largest energy source. On the other hand, natural gas and nuclear power increase, with coal leveling off.

■Renewables rise to 7% of TPES, with new energy rising from 1.6% to 3.1%.

<Reference Case>

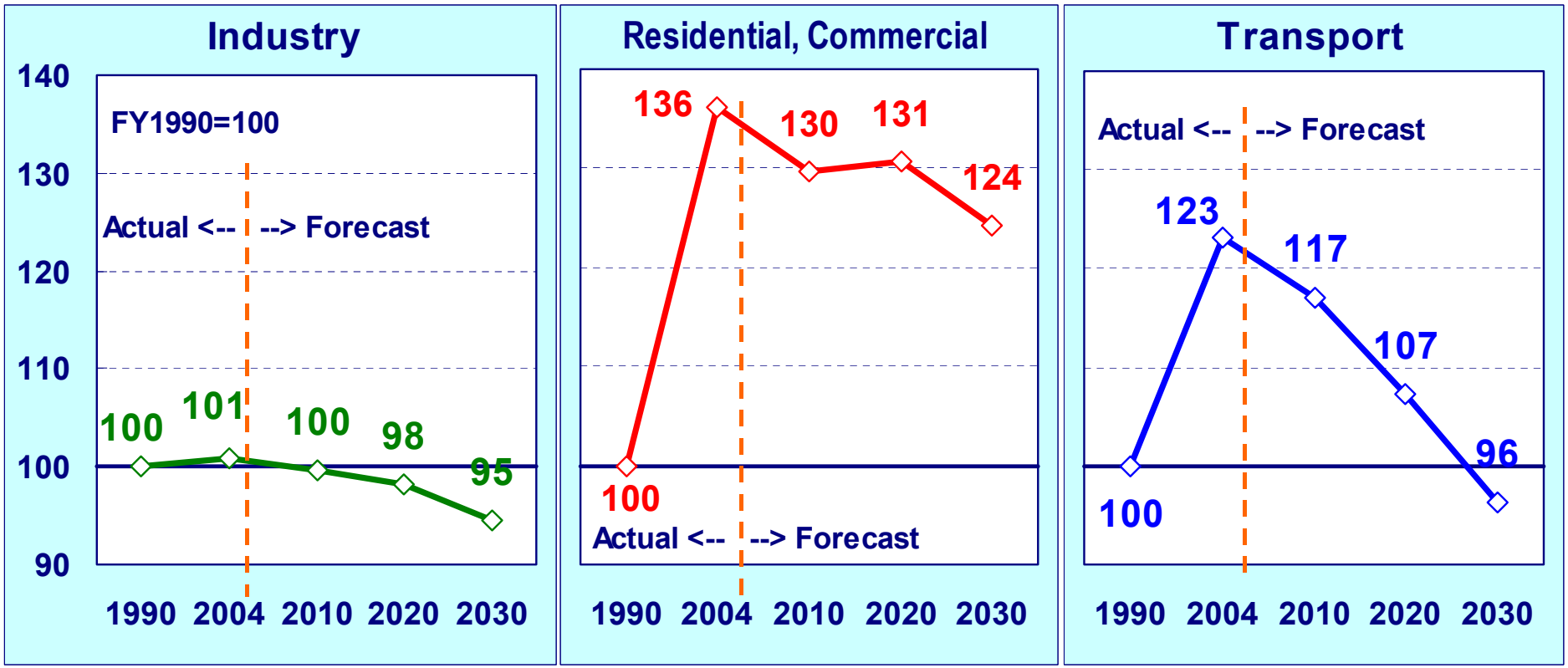
Forecast of CO_2 Emissions from Fuel Combustion



■Although the CO_2 Emission increased sharply in 2003 and 2004, it will decrease in the future, because of the progress of energy conservation policy and the increment of non-fossil energy consumption. In 2030, it will turn to under the emission level of 1990's.

<Reference Case>

CO_2 Emission by Final Demand Sector



Note: CO_2 emission in power sector is distributed to each sector.

■In industry, the synergy effect of the change of both the energy structure in each sector and the industrial structure reduces the CO_2 emission faster than the energy demand.
■In res. & com., CO_2 emission decreases gradually as the result of the fact that energy growth reaches its ceiling due to the improvement of equipment efficiency, decrease of population and CO_2 intensity of electricity, etc..
■In transportation, although CO_2 emission has increased due to the increase of passenger ownership, it will reduce due to higher fuel efficiency gradually.

<Reference Case>

Summary of CO_2 Emission

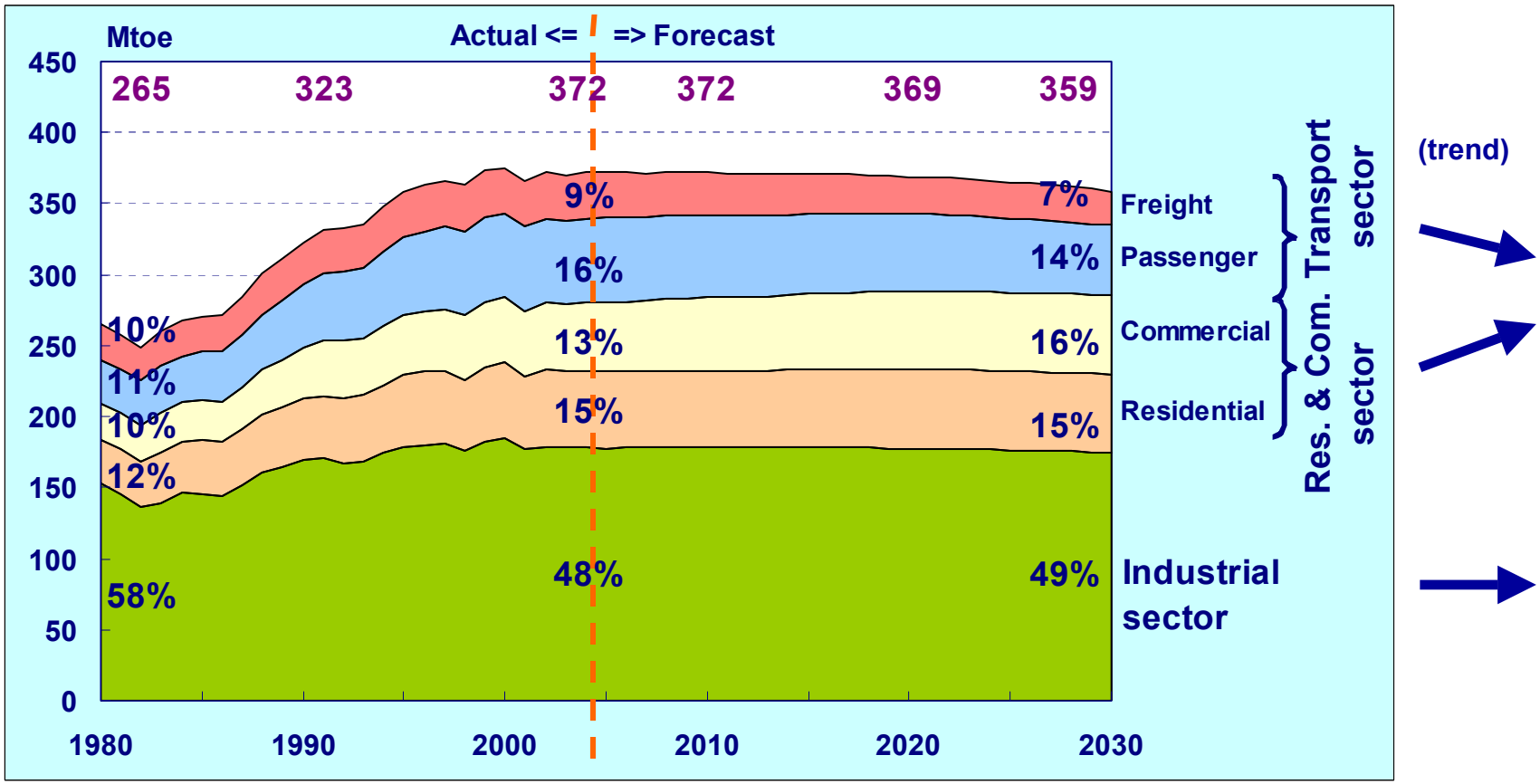
(Mt in carbon equivalent)

	Actual				Forecast						Average Annual Growth Rate (%)			
	FY1990	(%)	FY2004	(%)	FY2010	(%)	FY2020	(%)	FY2030	(%)	2004/1990	2010/2004	2020/2010	2030/2020
Industry	132	46	133	40	132	42	130	43	125	44	0.1	-0.2	-0.1	-0.4
Residential	38	13	50	15	46	15	46	15	43	15	2.0	-1.2	0.0	-0.7
Commercial	33	12	47	14	46	15	46	15	45	16	2.4	-0.4	0.2	-0.3
Passenger	35	12	46	14	45	14	42	14	37	13	2.1	-0.6	-0.7	-1.1
Freight	23	8	25	7	23	7	20	7	18	6	0.5	-1.2	-1.2	-1.0
CO_2 Emissions	287	100	331	100	311	100	303	100	284	100	1.0	-1.0	-0.3	-0.6
(FY1990=100)														
per Capita	100		112		105		105		105		0.8	-1.0	0.0	-0.1
per GDP	100		98		82		69		58		-0.1	-3.0	-1.7	-1.7
per TPES	100		99		93		90		87		-0.1	-1.0	-0.4	-0.4

Note: CO_2 emission in power sector is distributed to each sector.

- CO_2 emission per capita levels off after 2010.
- Both CO_2 emission per GDP and CO_2 emission per TPES continue to decrease.

Forecast of Final Consumption (by Sector)

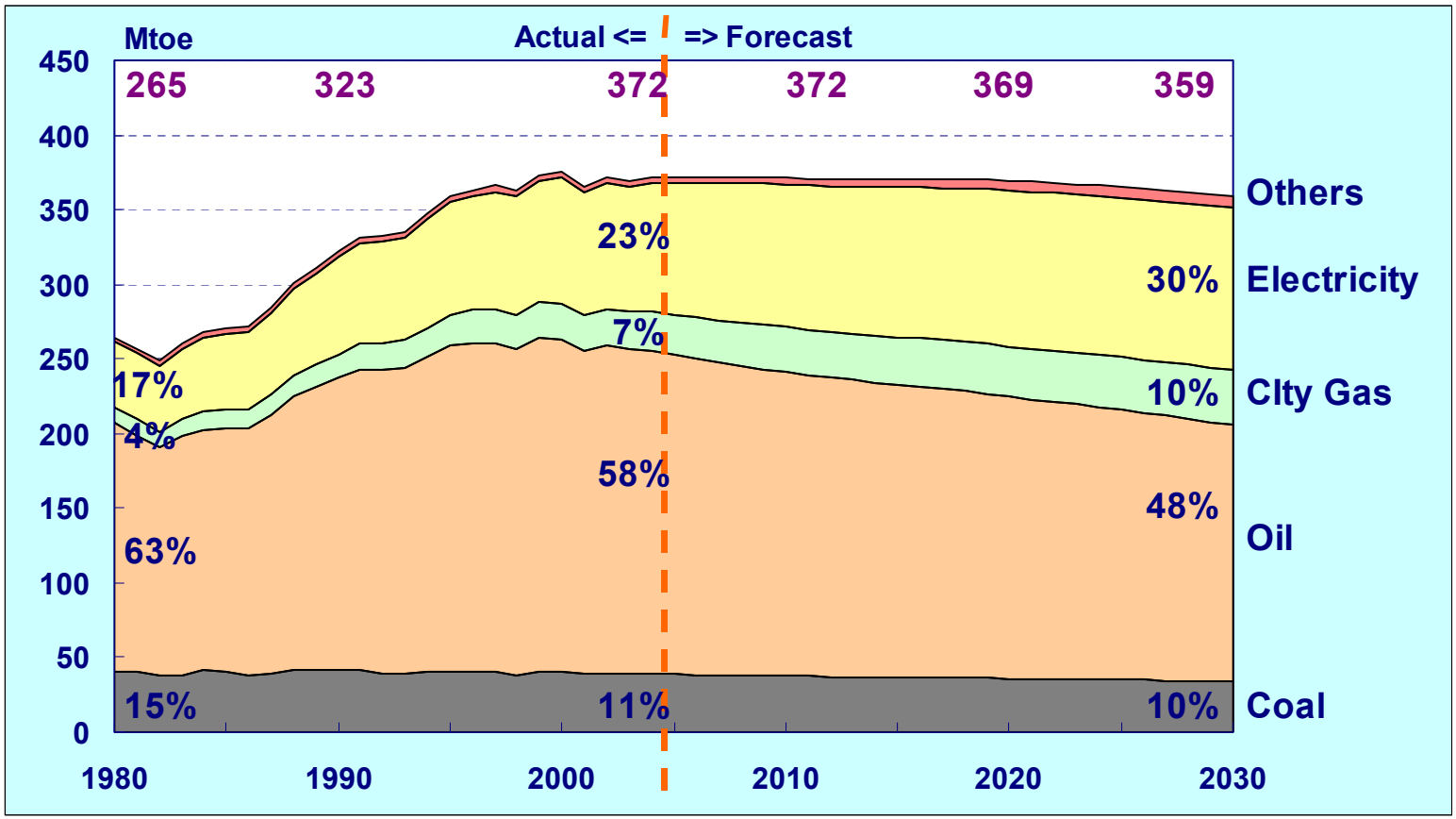


■Final energy consumption will finally turn to decrease after a while of leveling off. (It peaked in 2000 at 375Mtoe).

■In industry, it will level off or decrease slightly. In residential, it slightly increases or levels off. In commercial, it continues to increase. Both the passenger and the freight sector decrease.

<Reference Case>

Forecast of Final Consumption (by Energy)



■Oil demand decreases sharply, due to falling fuel demand in transportation and the shift toward electricity and gas in industry and res.& com. sectors.
■Electricity demand increases faster than any other energy sources, due to the growth of machinery industries and shift toward electricity in residential.
■Coal decreases, due to the falling production of steel and cement.

<Reference Case>

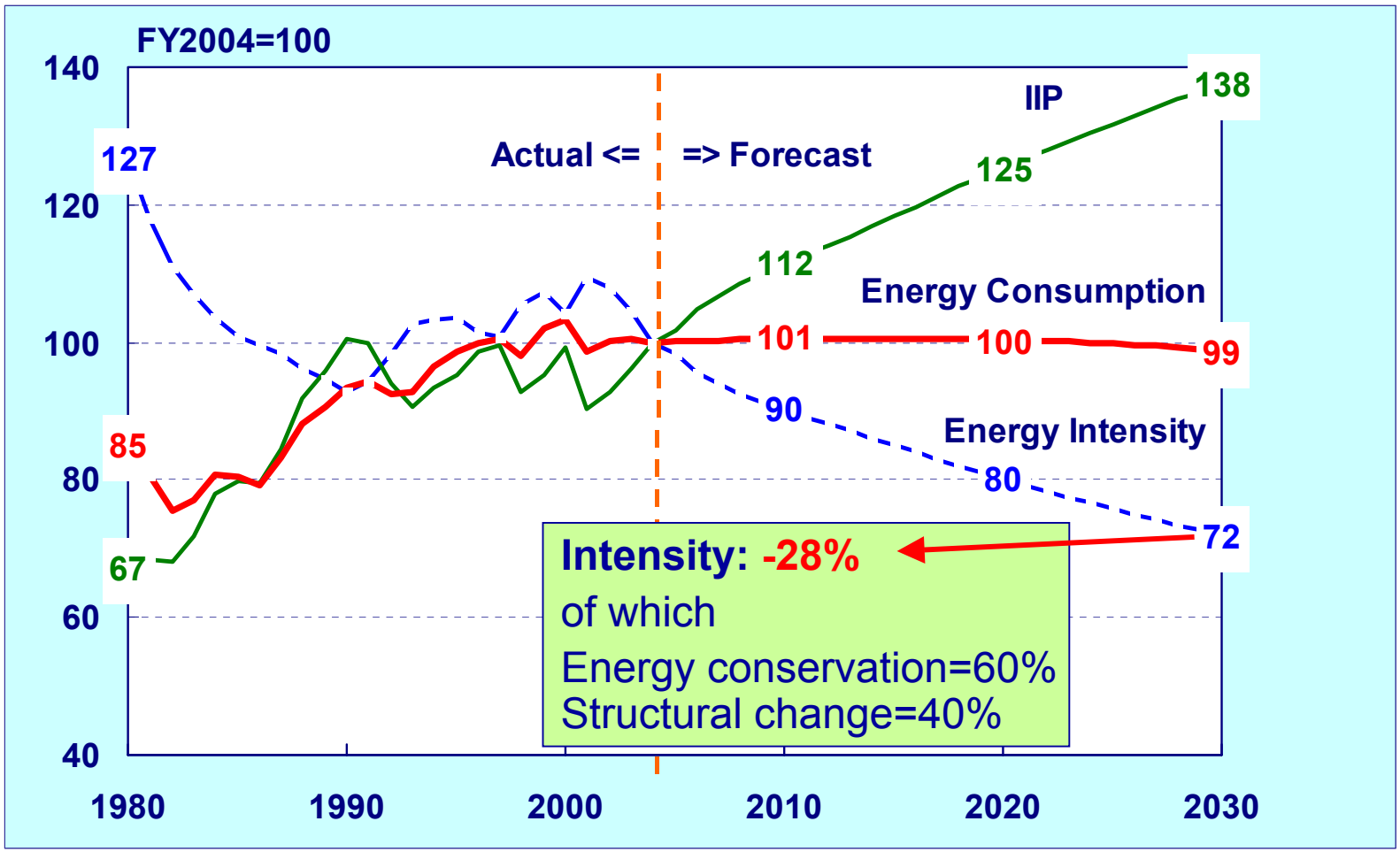
Summary of Final Energy Consumption

(Mtoe)

	Actual				Forecast						Average Annual Growth Rate (%)			
	FY1990	(%)	FY2004	(%)	FY2010	(%)	FY2020	(%)	FY2030	(%)	2004/1990	2010/2004	2020/2010	2030/2020
TFEC	323	100	372	100	372	100	369	100	359	100	1.0	0.0	-0.1	-0.3
(By Sectors)														
Industrial	170	53	178	48	179	48	177	48	175	49	0.3	0.1	-0.1	-0.2
Res. and Com.	79	24	102	27	105	28	110	30	111	31	1.9	0.5	0.5	0.0
Residential	43	13	54	15	54	15	56	15	55	15	1.7	0.0	0.3	-0.1
Commercial	36	11	48	13	51	14	54	15	56	16	2.1	1.1	0.6	0.2
Transport	74	23	92	25	88	24	81	22	73	20	1.5	-0.7	-0.8	-1.0
Passenger	44	14	60	16	58	16	55	15	49	14	2.1	-0.5	-0.5	-1.1
Freight	30	9	32	9	30	8	27	7	24	7	0.5	-1.2	-1.2	-1.0
(By Energy Sources)														
Coal	42	13	39	11	37	10	36	10	34	10	-0.5	-0.7	-0.4	-0.5
Oil	196	61	216	58	204	55	189	51	171	48	0.7	-0.9	-0.8	-1.0
Gas	16	5	26	7	30	8	34	9	37	10	3.7	2.2	1.1	1.0
Electricity	65	20	87	23	96	26	104	28	109	30	2.1	1.6	0.9	0.4
New Energies, etc.	4	1	4	1	5	1	6	2	7	2	-1.6	4.5	3.5	1.3

Industrial Sector

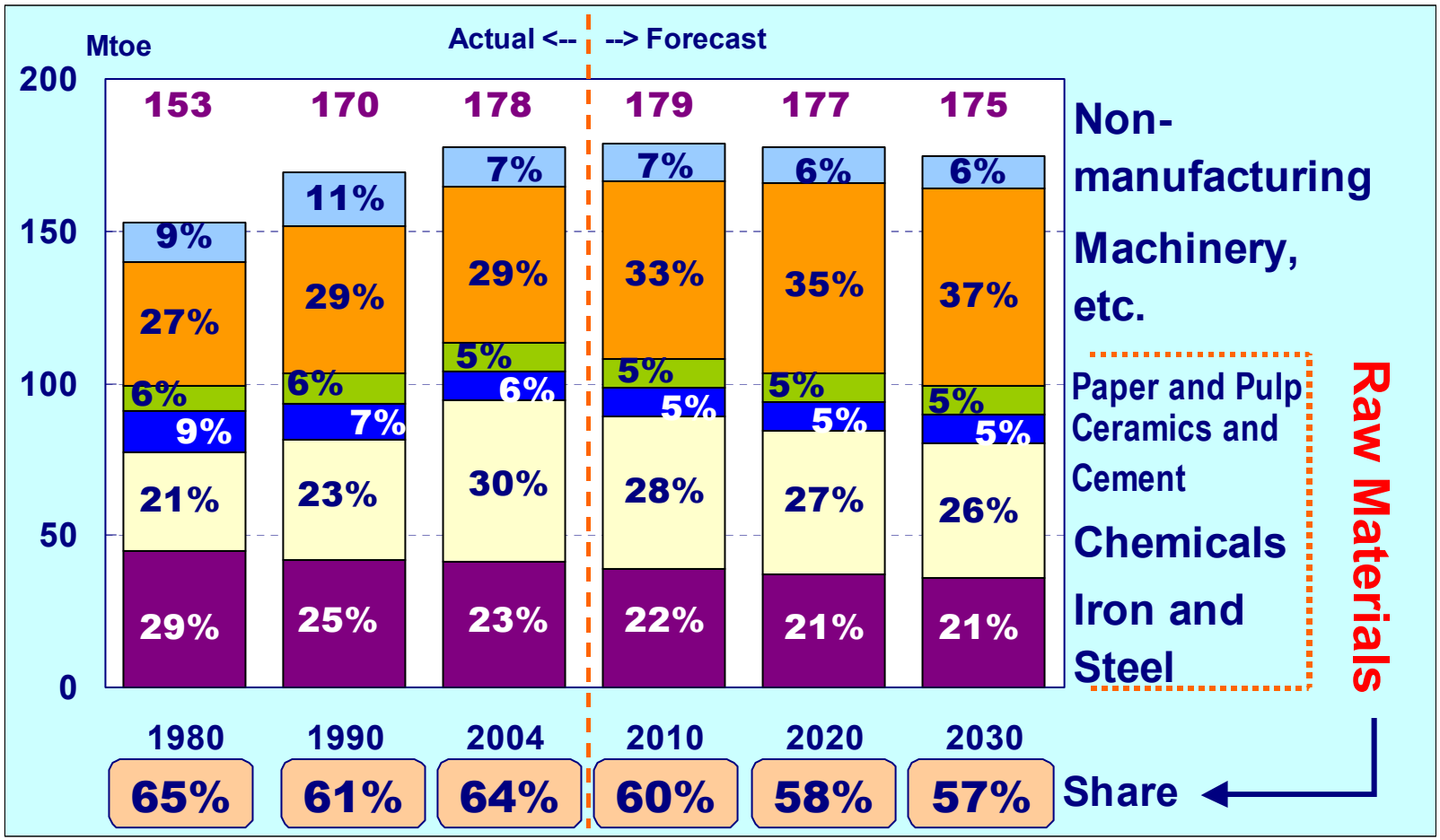
Forecast of Energy Consumption in Industry



■Although the production (IIP) increases, the energy consumption will level off or decrease slightly, since the change of industrial structure and the progress of energy conservation push the energy intensity down.

<Reference Case>

Forecast of Energy Consumption by Industry



■Energy consumption of energy intensive industries such as raw material industries decreases.
■However, energy consumption share of machinery industries increases.

<Reference Case>

Final Consumption of Industry by Energy

(Mtoe)

	Actual				Forecast						Average Annual Growth Rate (%)			
	FY1990	(%)	FY2004	(%)	FY2010	(%)	FY2020	(%)	FY2030	(%)	2004/1990	2010/2004	2020/2010	2030/2020
Coal	41	24	38	21	36	20	35	20	33	19	-0.5	-0.8	-0.5	-0.5
Oil	88	52	91	51	86	48	81	46	76	44	0.2	-0.9	-0.6	-0.6
Gas	5	3	10	6	13	7	15	8	17	10	5.7	3.9	1.7	1.4
Electricity	33	19	36	21	40	23	43	24	43	25	0.8	1.7	0.5	0.2
New Energies, etc.	3	2	2	1	3	2	4	2	5	3	-1.8	5.2	2.8	1.8
Total	170	100	178	100	179	100	177	100	175	100	0.3	0.1	-0.1	-0.2
IIP (FY2000=100)	101.2		100.6		112.3		126.0		138.4		0.0	1.9	1.2	0.9

■Regardless of the shift toward electricity and gas, oil remains to be the main energy source whose share will be over 40%.

■Oil and coal demand which are mainly used in raw material industries decrease.

■Electricity demand grows due to the increase of machinery production. Although the share is still low, city gas demand increases due to environment-oriented trend and convenience.

<ref.> Keidanren's Voluntary Action Plan

[Goal]

To push the CO_2 emission in industry and energy transformation sectors in FY2010 back to the level no higher than FY1990.

[Brief Overview]

- **Voluntary and extensive participation**
  - 35 industrial and energy transformation sectors
  - 23 residential & commercial, and transportation sectors. (in 2005)
- **Indicate each reduction goal in each sector and checked every year**
- **Some sectors have already achieved goals before FY2010.**
- **Sectors such as Paper & pulp, etc., are setting new goals.**

<Reference Case>

<ref.>Major Industries' Goals in Keidanren's VAP

	Target Year	Target (Compared with FY1990)
Nippon Keidanren (Japan Business Federation)	FY2010	CO_2 emissions from the industrial and energy transformation sectors: equal or less
Japan Iron and Steel Federation	FY2010	Energy consumption: -10% In the additional action: -1.5%
Japan Chemical Industry Association	FY2010	Energy intensity: 10%
Japan Paper Association	FY2010	Fossile fuel intensity: -13% CO_2 emission intensity: -10%
Japan Cement Association	FY2010	Energy intensity for producing cement: -3%
Four Major Associations of Electric / Electronic Industries*	FY2010	CO_2 emission intensity: -25%

Note) Japan Electrical Manufacturers' Association, Japan Electronics and Information Technology Industries Association, Communications and Information network Association of Japan, and Japan Business Machine and Information System Industries Association

Residential & Commercial

- Residential
- Commercial

<Reference Case>

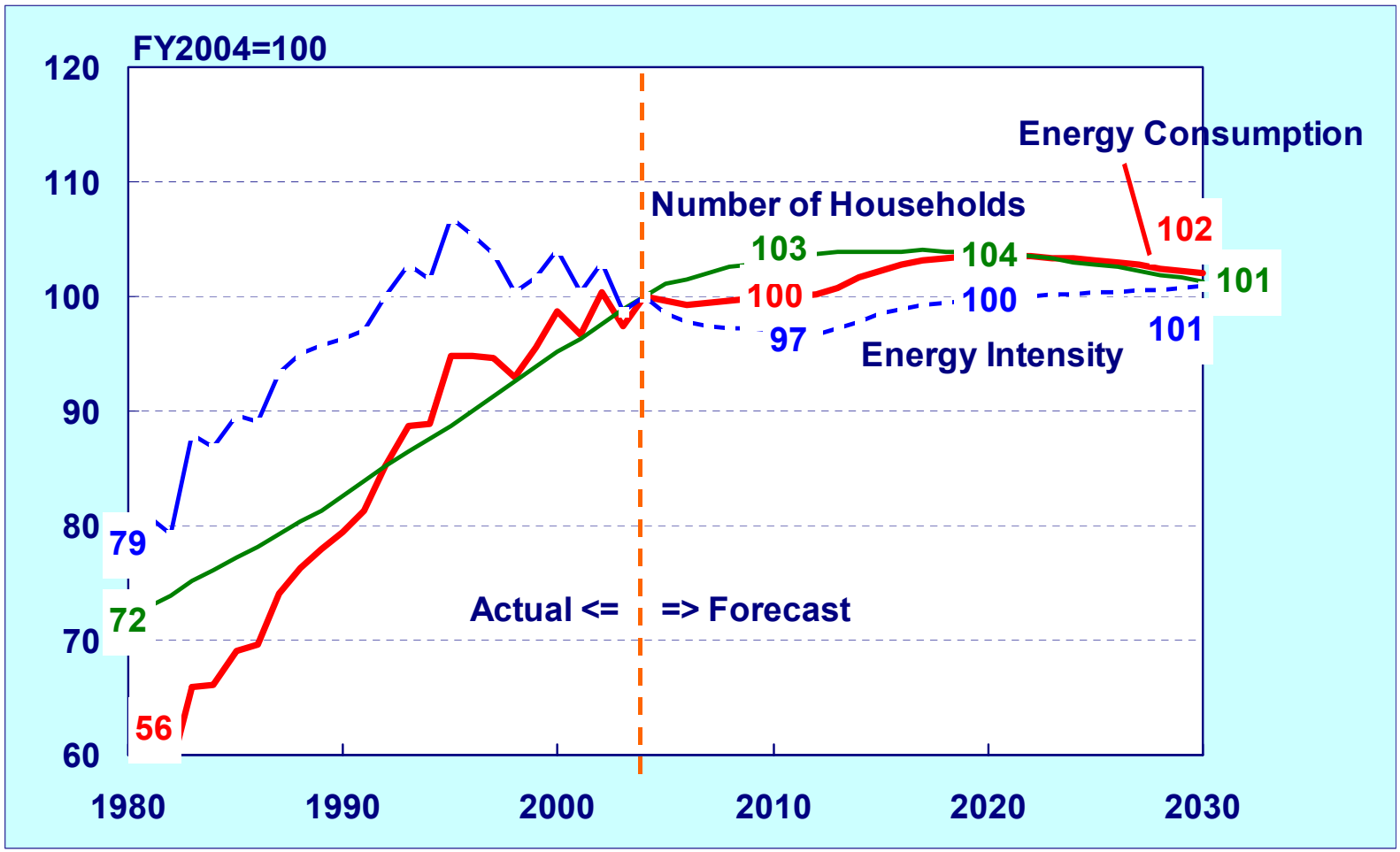
Summary of Residential & Commercial

(Mtoe)

	Actual				Forecast						Average Annual Growth Rate (%)			
	FY1990	(%)	FY2004	(%)	FY2010	(%)	FY2020	(%)	FY2030	(%)	2004/1990	2010/2004	2020/2010	2030/2020
Res. and Com.	79	100	102	100	105	100	110	100	111	100	1.9	0.5	0.5	0.0
Residential	43	54	54	53	54	51	56	51	55	50	1.6	0.0	0.3	-0.1
Commercial	36	46	48	47	51	49	54	49	56	50	2.1	1.1	0.6	0.2
GDP (Trillion Yen)	449		526		593		687		770		1.1	2.0	1.5	1.1
Private Con. (Trillion Yen)	244		298		327		377		420		1.4	1.6	1.4	1.1
Population (Millions)	123.61		127.78		127.29		123.67		117.10		0.2	-0.1	-0.3	-0.5
Aged 65+ (%)	12.0		19.5		22.5		27.9		29.6		3.5	2.5	2.2	0.6
Household (Millions)	41.16		49.84		51.41		51.70		50.45		1.4	0.5	0.1	-0.2
Floor Space (Billion m^2)	1.29		1.74		1.83		1.93		1.96		2.2	0.8	0.5	0.2

<Reference Case>

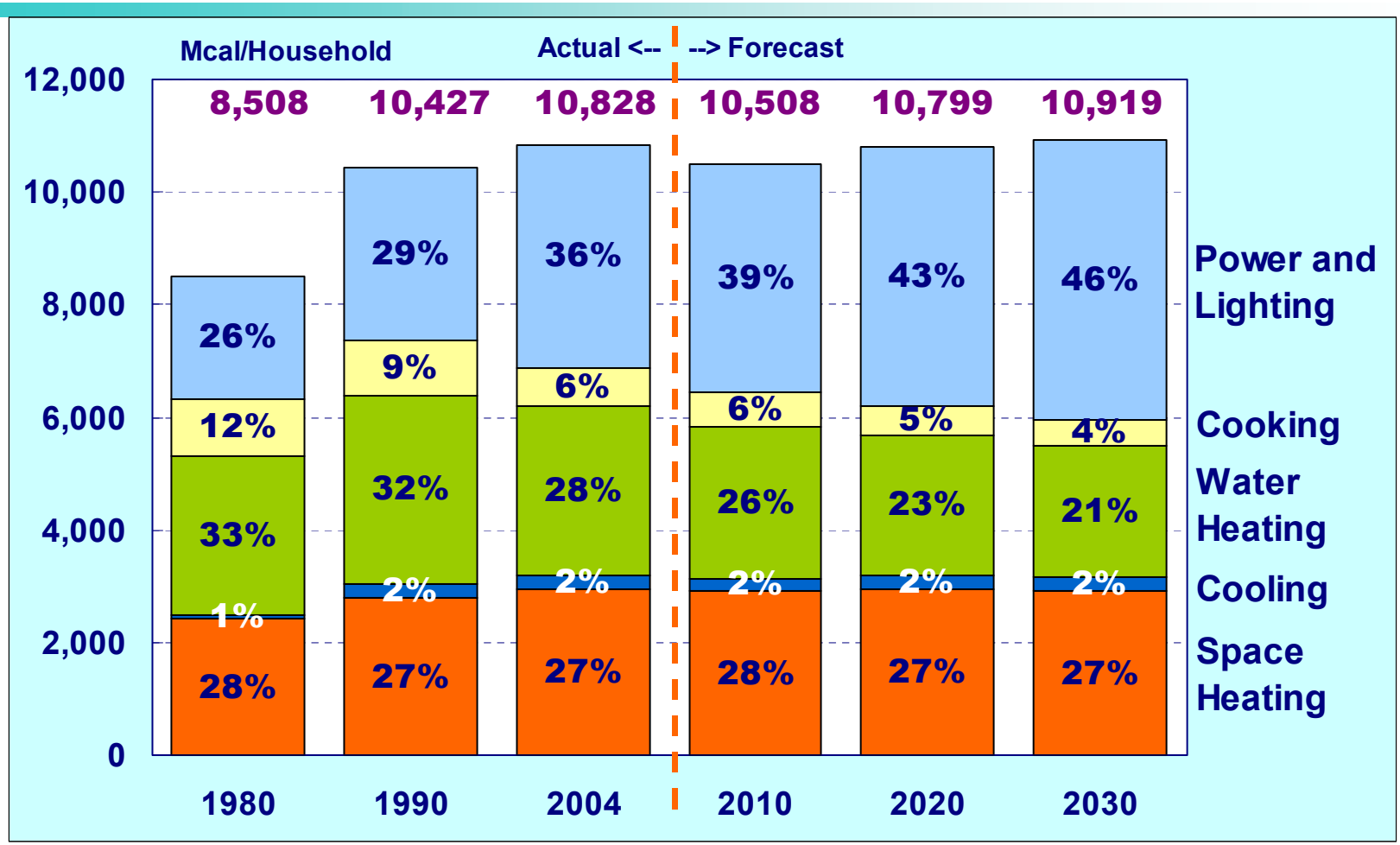
Forecast of Energy Demand in Residential



■Efficiency improvement pace will slow down after making a round of Top-Runner Approach. However, the energy consumption will decrease, partly due to the decrease of household number.

<Reference Case>

Energy Intensity in Residential by End Use



- Use for power and lighting will grow due to the IT progress and pursuit of convenience.
- Although energy demand of cooling and space heating grows, energy saving effect of Top-Runner Approach will greatly slow down its growth rate.
- Energy demand of cooking and water heating turns to reduce due to the falling household member, progress of dinning out and development of women's social participation.

<Reference Case>

Energy Consumption in Residential by Energy Source

(Mtoe)

	Actual				Forecast						Average Annual Growth Rate (%)			
	FY1990	(%)	FY2004	(%)	FY2010	(%)	FY2020	(%)	FY2030	(%)	2004/ 1990	2010/ 2004	2020/ 2010	2030/ 2020
Oil	17	41	20	36	18	34	17	30	14	26	0.9	-1.3	-0.9	-1.6
City Gas	8	18	9	18	9	17	9	16	8	15	1.4	-0.5	-0.4	-0.5
Electricity	16	38	24	45	26	48	30	54	32	58	2.8	1.3	1.4	0.7
New Energies, etc.	1	3	1	1	0	1	0	1	0	1	-5.6	-4.8	-2.8	-0.4
Total	43	100	54	100	54	100	56	100	55	100	1.6	0.0	0.3	-0.1
Household (Millions)	41.16		49.84		51.41		51.70		50.45		1.4	0.5	0.1	-0.2

■Share of electricity grows due to growing demand of power and lightning, and all-electric housing movement.

■City gas demand reduces slightly due to the falling of water heating demand.

■The falling trend of oil demand from 1990's will continue due to the demand decrease of water heating and the shift to electricity and gas in space heating demand.

<ref.>Top-Runner Approach (Residential Equipment)

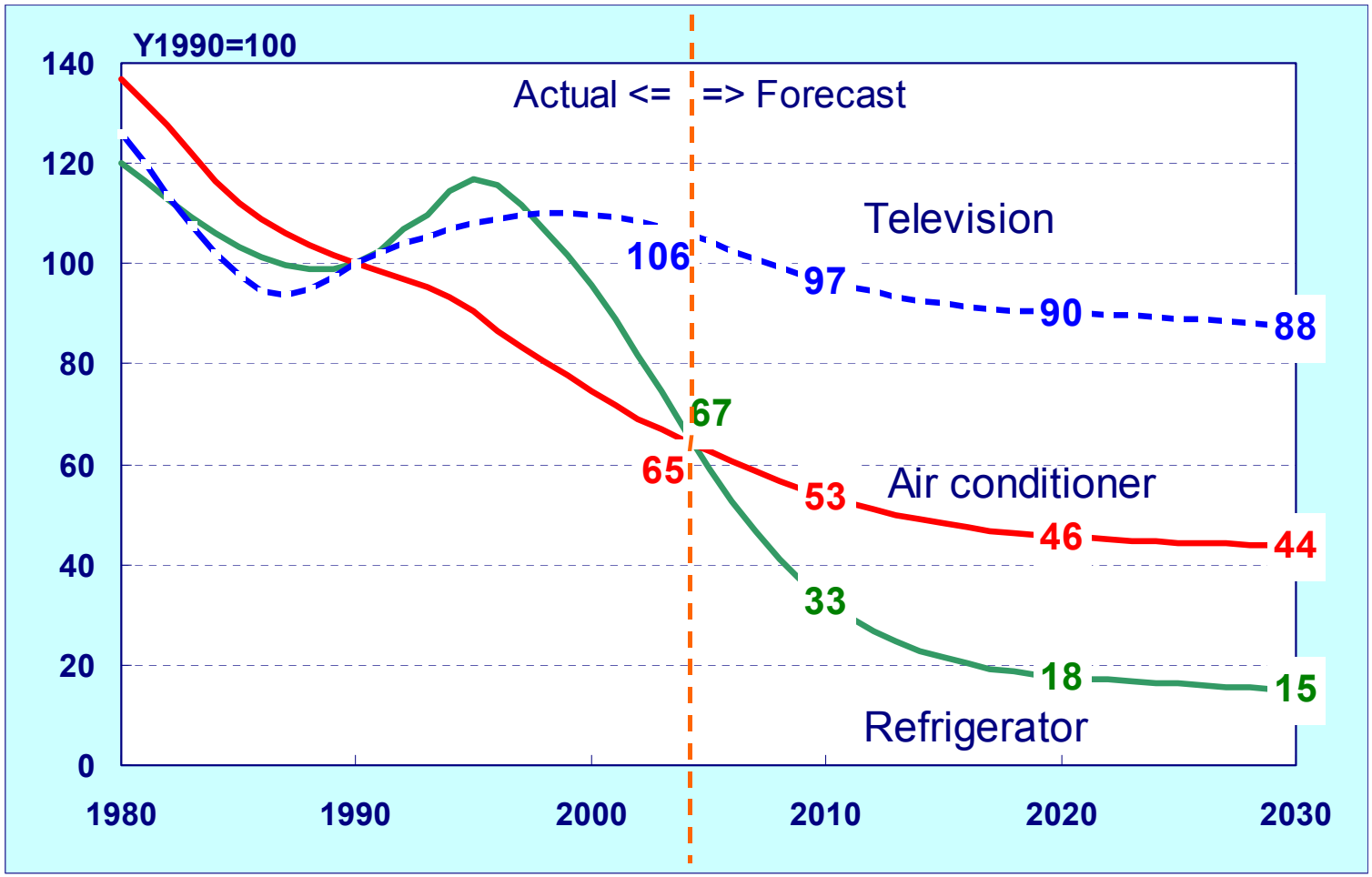
Energy conservation criteria were set up when the Energy Conservation Law was modified in 1998.

- Energy efficient must not be lower than the most advanced equipment among current commercialized commodities.

[Target equipments in residential and commercial]

Listed in 1999	Air Conditioners, Florescent Lights, Video Cassette Recorders, CRT TV Sets, Copying Machines, Computers, Magnetic Disk Units and Electric Refrigerators/Freezers
Listed in 2003	Space Heaters, Gas Cooking Appliances, Gas Water Heaters, Oil Water Heaters, Electric Toilet Seats, Vending Machines and Transformers
Listed in 2006	Electric Rice Cookers, DVD Recorders, Microwave Ovens and Routers TV sets: not only CRT type but LCD and PDP type

Efficiency Assumption of Home Appliance (Stock Base)



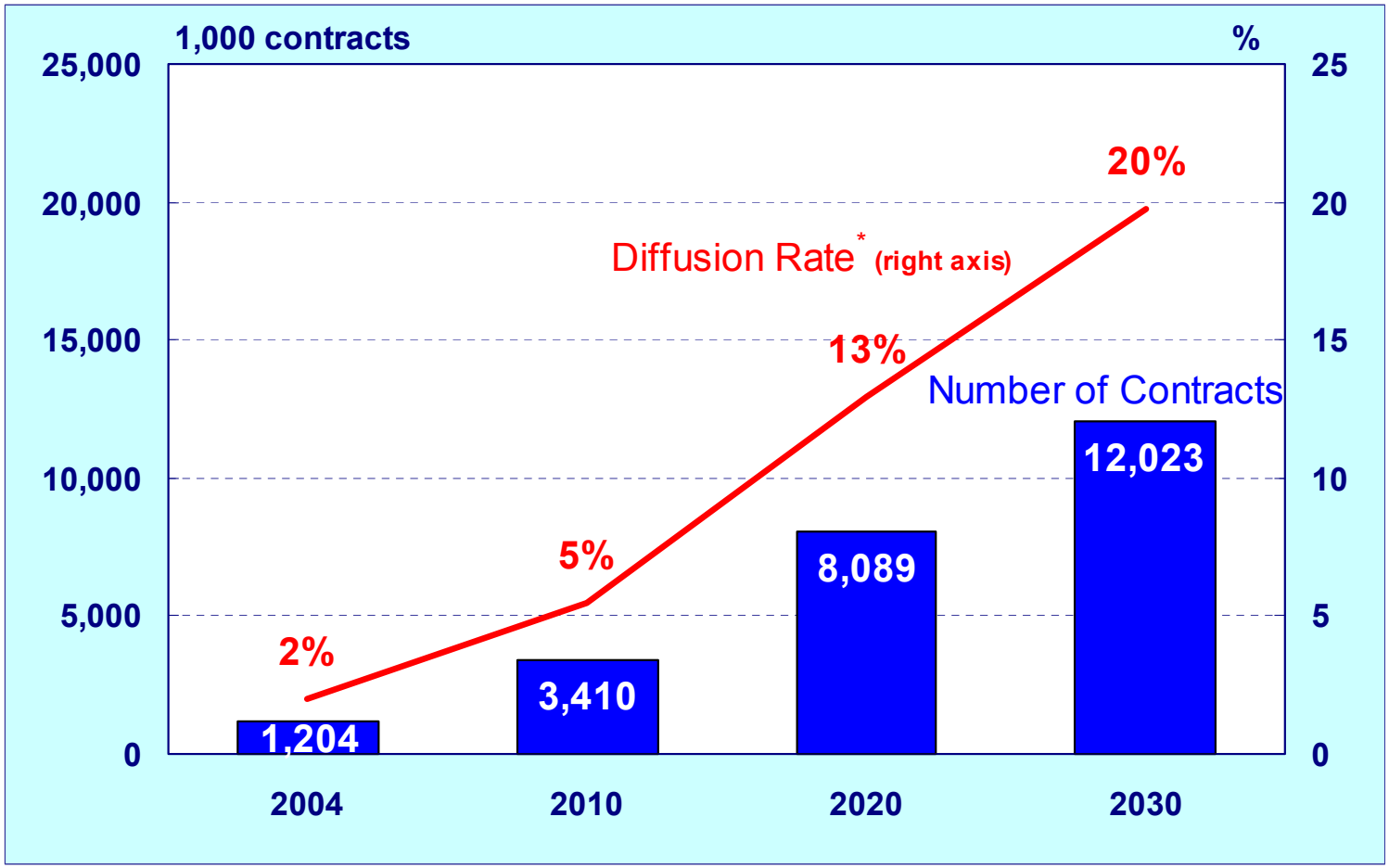
■The efficiency(stock base) of home appliance improves due to the Top-Runner Approach, as well as the replacement from lower efficiency appliance.

Other Energy Conservation Technology in Residential

- Reduction of standby power electricity usage
- High-efficiency water heater
- High-efficiency light
- Energy management (HEMS, BEMS)
- House insulation efficiency and building energy efficiency

etc.

Spread of All Electric Housing

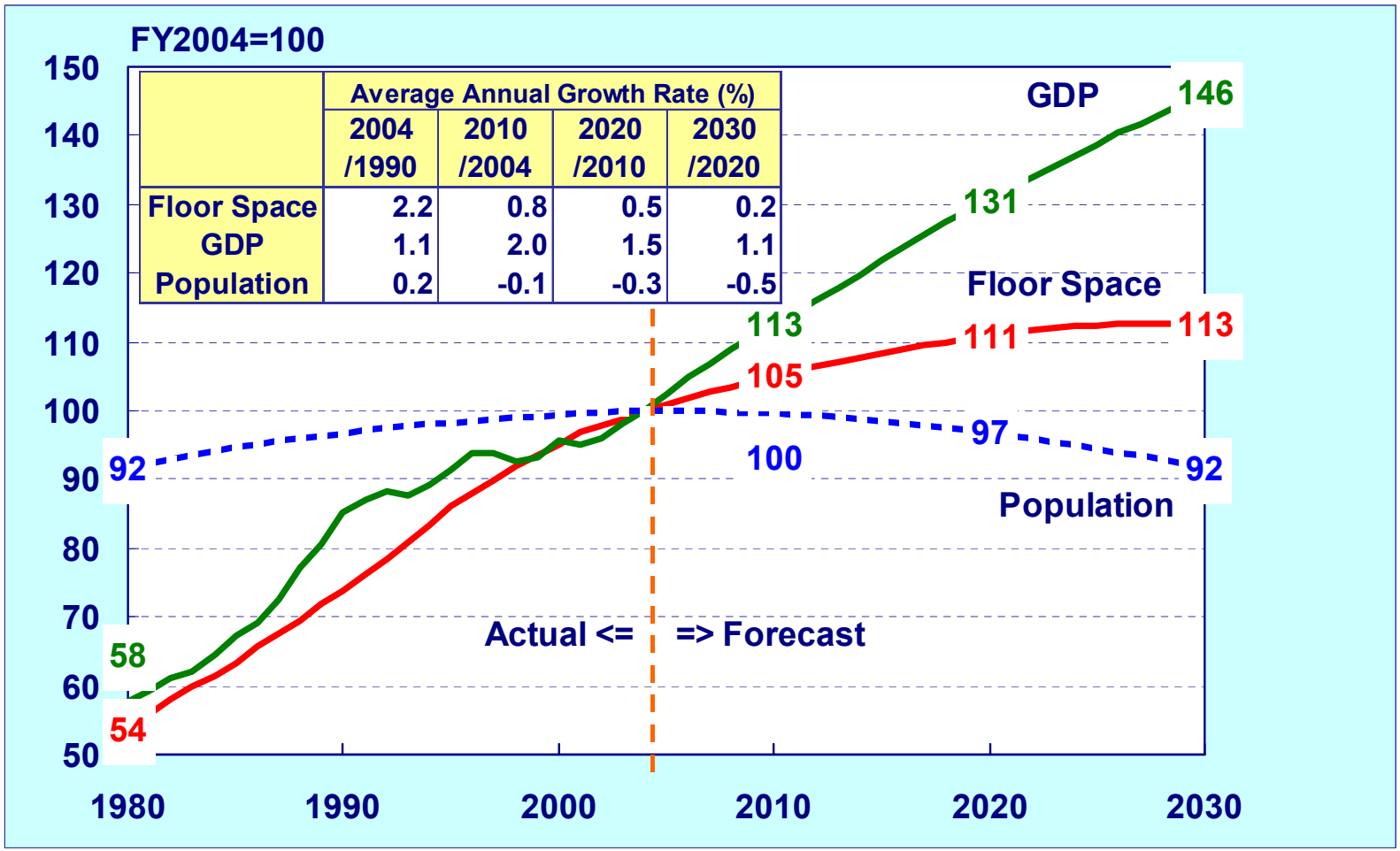


(*) Share of All-electrification contractors with respect to residential lighting A/B + C + lighting optional contract

■Shift toward usage of electricity keeps progressing, due to the efficiency improvement of air conditioner, electric water heater, IH cooking heater, as well as its usage convenience.

■The share of all-electrification grows from current 2% to 20% in 2030.

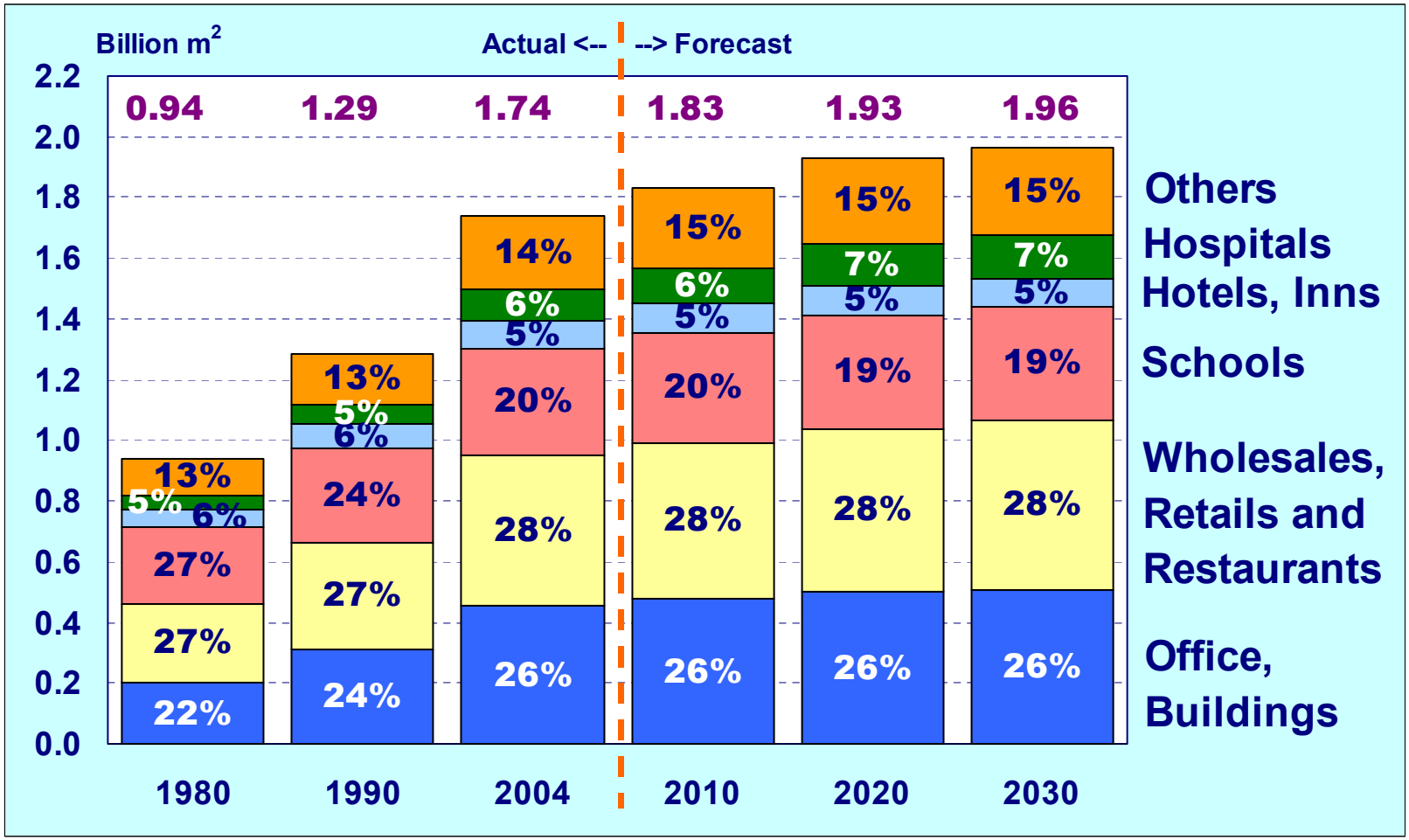
Floor Space in Commercial



- Floor space in commercial has grown faster than GDP, due to the increase of service industries.
- In the future, its growth rate will slow down due to the decrease of population.

<Reference Case>

Floor Space in Commercial



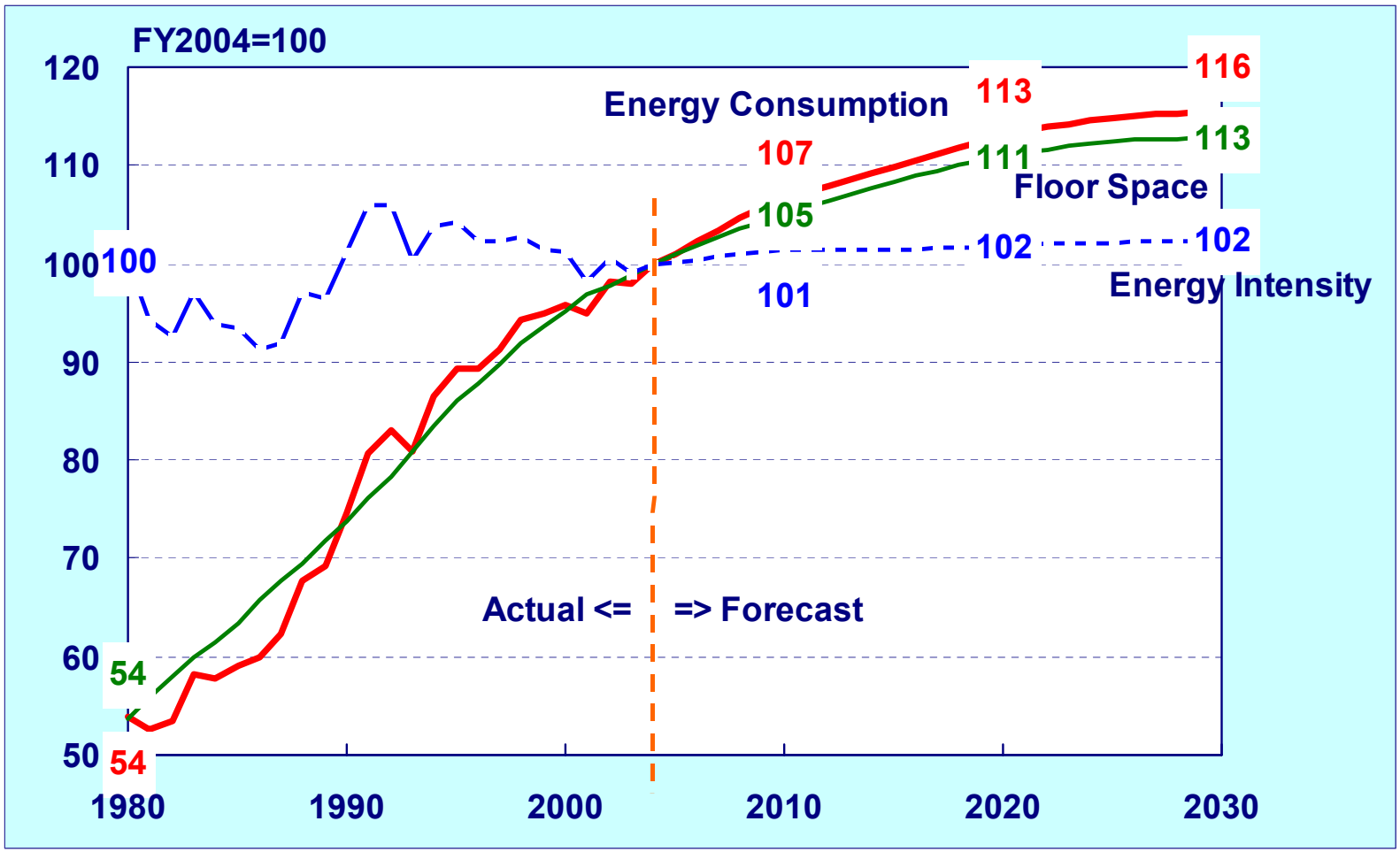
■Although the office building has increased largely, it will eventually cease to grow due to the decrease of population.

■Large-scale retail shops in suburbs are expected to increase.

■Hospital and welfare facilities (included in other service) are expected to increase due to aging society.

<Reference Case>

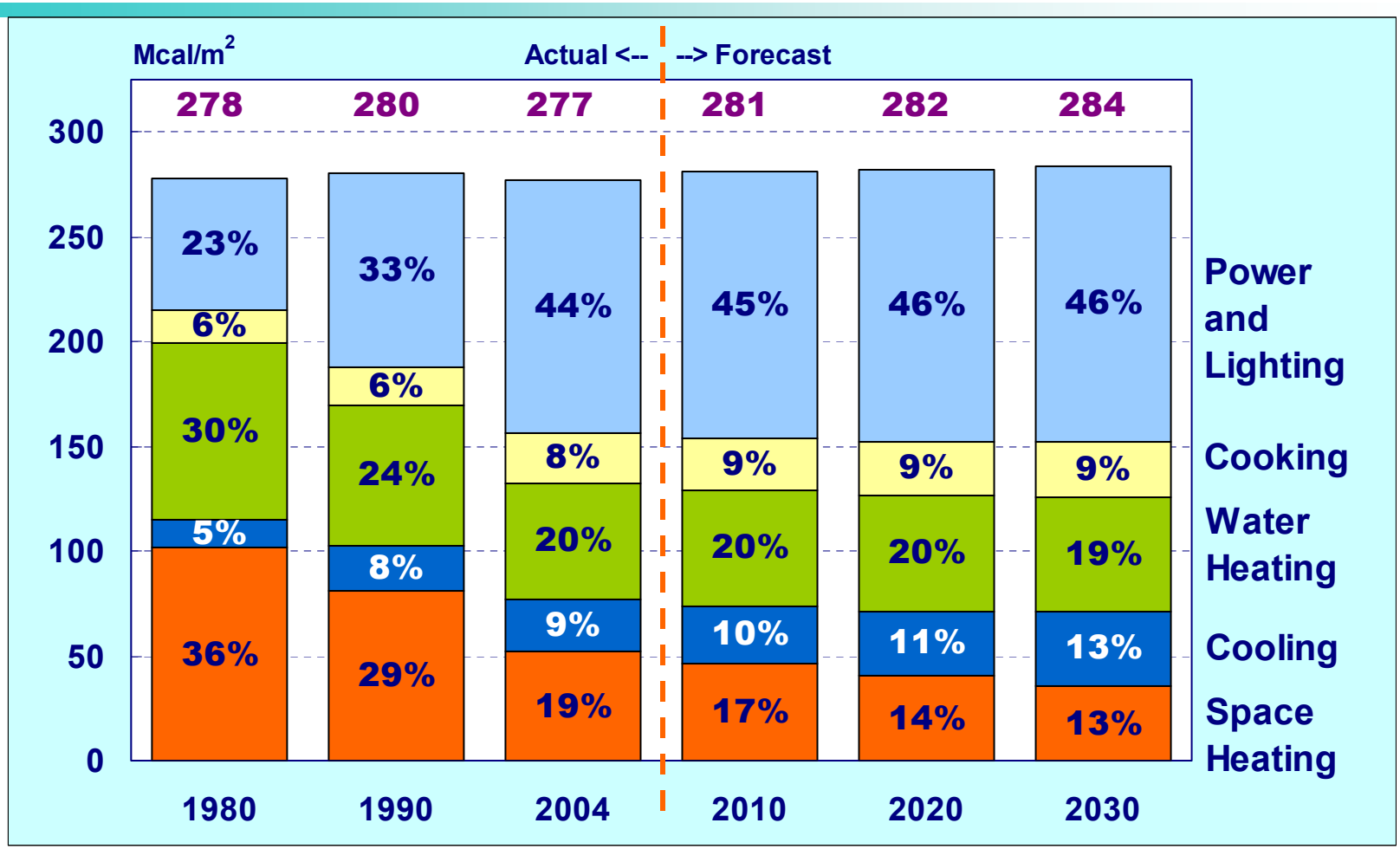
Energy Consumption in Commercial



- The commercial is the only final consumption sector whose energy demand grows during the forecast period.
- Energy intensity (per floor space) levels off.
- Due to the increase of floor space (activity indicator), energy consumption increases.

<Reference Case>

Energy Intensity in Commercial by End Use



■The growth of energy for power and lighting is large due to industrial structure change and IT progress.

■Cooling demand grows due to pursuit of convenience and increase of office equipment.

<Reference Case>

Consumption in Commercial by Energy Source

(Mtoe)

	Actual				Forecast						Average Annual Growth Rate (%)			
	FY1990	(%)	FY2004	(%)	FY2010	(%)	FY2020	(%)	FY2030	(%)	2004/1990	2010/2004	2020/2010	2030/2020
Oil	17	47	15	31	14	27	13	24	11	20	-0.9	-1.2	-0.9	-1.2
City Gas	4	10	7	14	8	16	10	18	10	19	4.8	2.8	1.6	0.8
Electricity	14	40	24	51	27	53	30	54	31	56	3.9	1.8	0.9	0.5
New Energies, etc.	1	3	2	4	2	4	2	4	3	5	3.9	2.6	1.7	1.1
Total	36	100	48	100	51	100	54	100	56	100	2.1	1.1	0.6	0.2
Floor Space (Billion m^2)	1.29		1.74		1.83		1.93		1.96		2.2	0.8	0.5	0.2

- Electricity share continues to increase due to growing power and lighting demand (ex. IT progress).
- Demand of electricity and city gas grows due to growing cooling demand.
- Oil demand falls due to less space heating demand and saturation of water heating demand.

Transportation Sector

- Passenger Sector
- Freight Sector

<Reference Case>

Summary of Transportation Sector

(Mtoe)

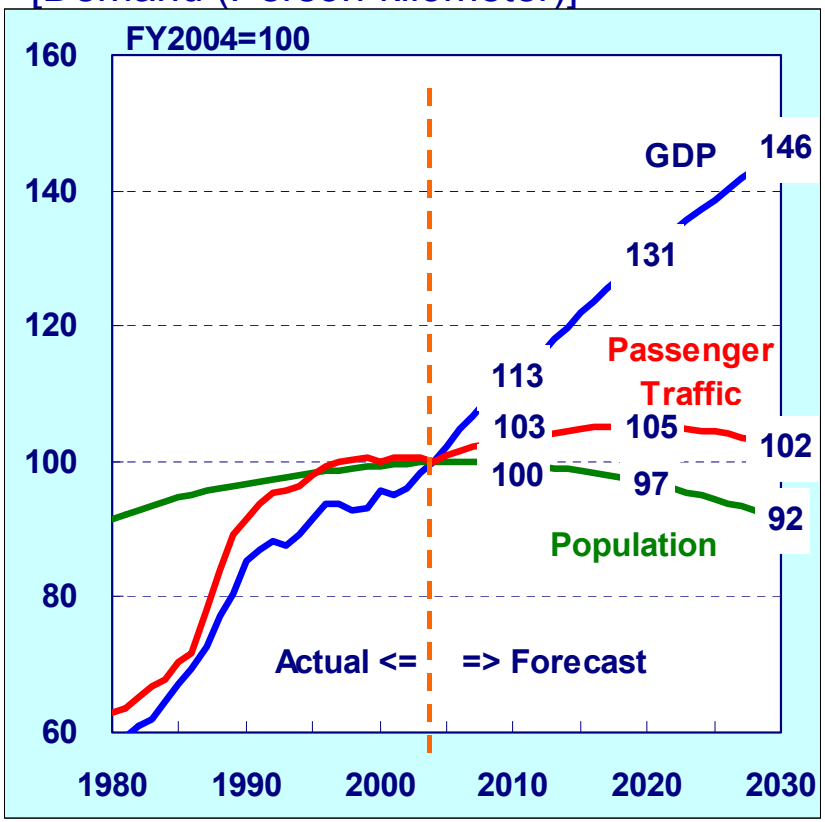
	Actual				Forecast						Average Annual Growth Rate (%)			
	FY1990	(%)	FY2004	(%)	FY2010	(%)	FY2020	(%)	FY2030	(%)	2004/1990	2010/2004	2020/2010	2030/2020
Transport	74	100	92	100	88	100	81	100	73	100	1.5	-0.7	-0.8	-1.0
Passenger	44	60	60	65	58	66	55	67	49	67	2.1	-0.5	-0.5	-1.1
Freight	30	40	32	35	30	34	27	33	24	33	0.5	-1.2	-1.2	-1.0
Automobile	65	88	80	87	76	87	71	87	64	87	1.5	-0.8	-0.8	-1.0
Aviation	3	4	4	5	5	5	5	6	5	7	2.0	1.3	0.6	-0.1
Ship	4	5	5	6	5	5	4	4	3	4	2.5	-2.4	-2.3	-2.2
Railway	2	3	2	2	2	2	2	3	2	3	0.3	0.6	0.0	-0.8
Passenger Traffic (Bill. pkm)	1,298.4		1,418.4		1,466.1		1,492.8		1,450.9		0.6	0.6	0.2	-0.3
Freight Traffic (Bill. tkm)	546.8		570.0		577.3		581.4		570.2		0.3	0.2	0.1	-0.2
GDP (Billion Yen)	449		526		593		687		770		1.1	2.0	1.5	1.1

■Energy demand in both passenger and freight sector decreases.

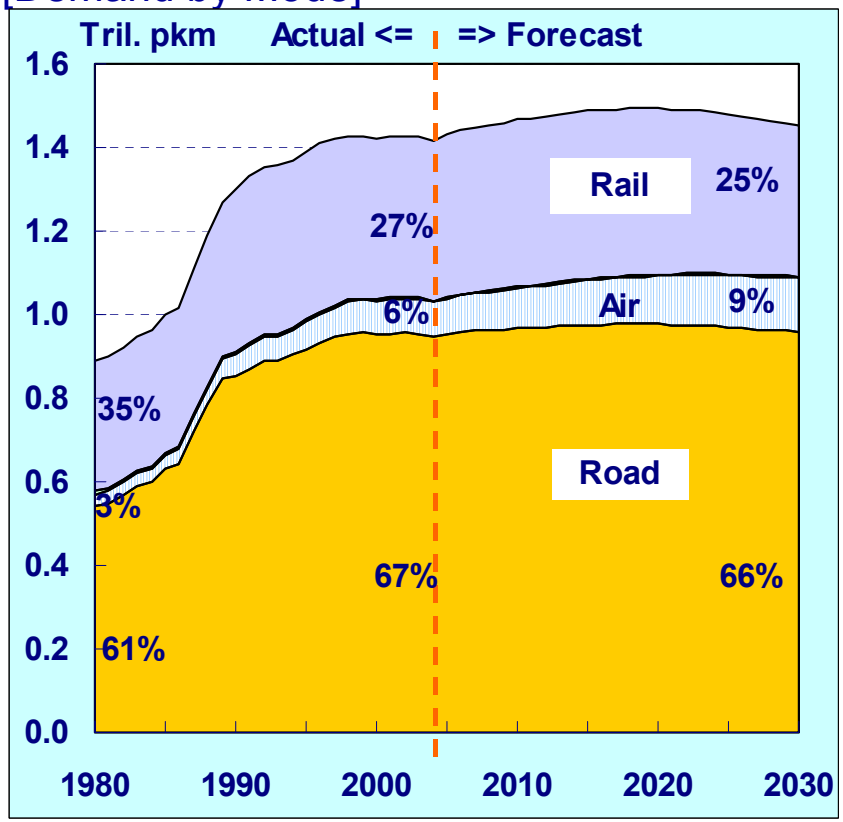
■Accounting for nearly 90% of the total energy consumption, the road sector contributes much to the the energy decrease due to its efficiency improvement.

Demand of Passenger Traffic

[Demand (Person-kilometer)]



[Demand by Mode]

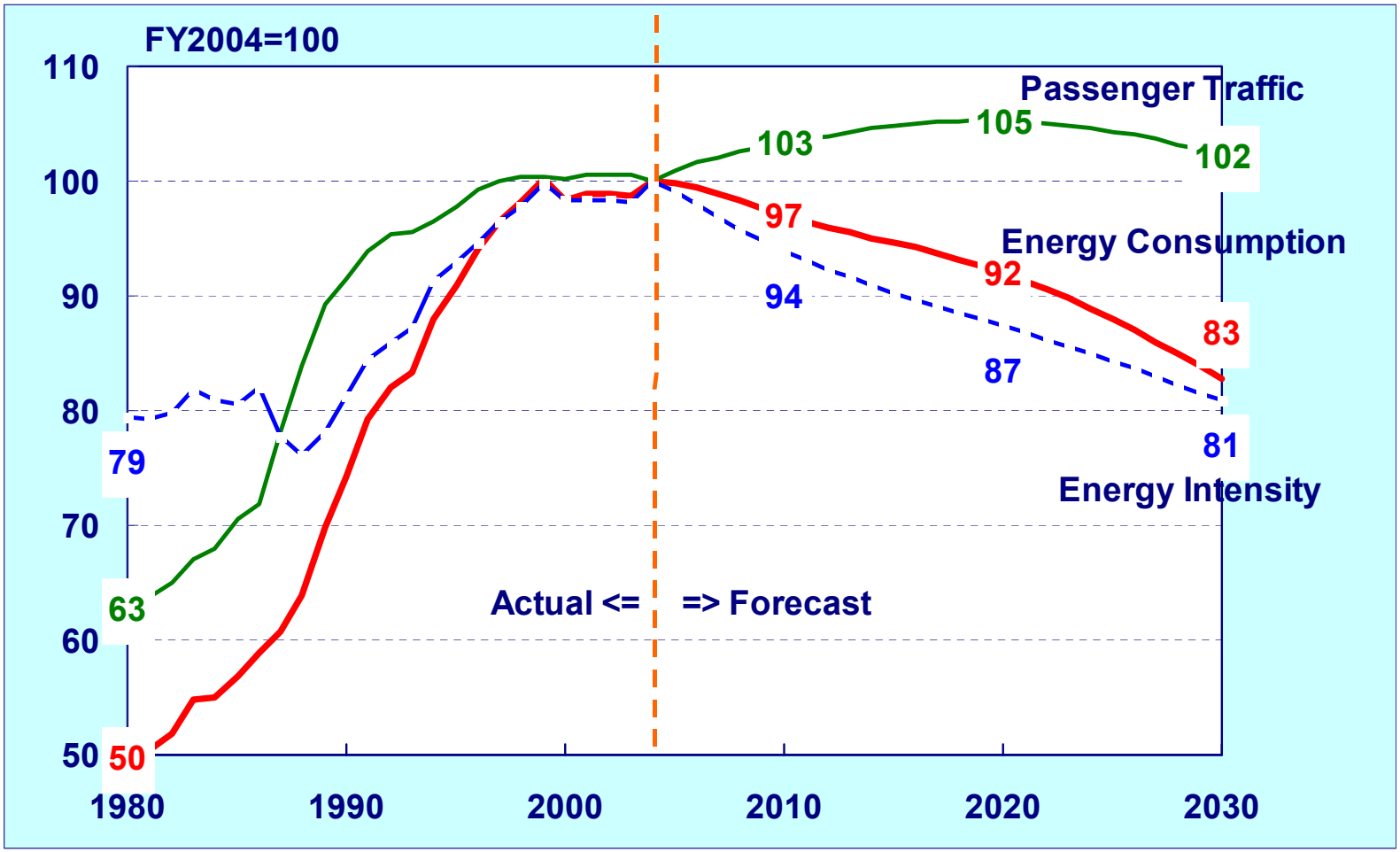


■Passenger traffic demand will increase for a short period of time, but it will eventually turn to decrease from around 2020, due to falling population.

■Road transportation demand will reach its ceiling due to vehicle ownership saturation. Air transportation demand will grow together with the growing living standard. Railway transportation will turn to reduce due to falling labor population.

<Reference Case>

Energy Consumption in Passenger Sector



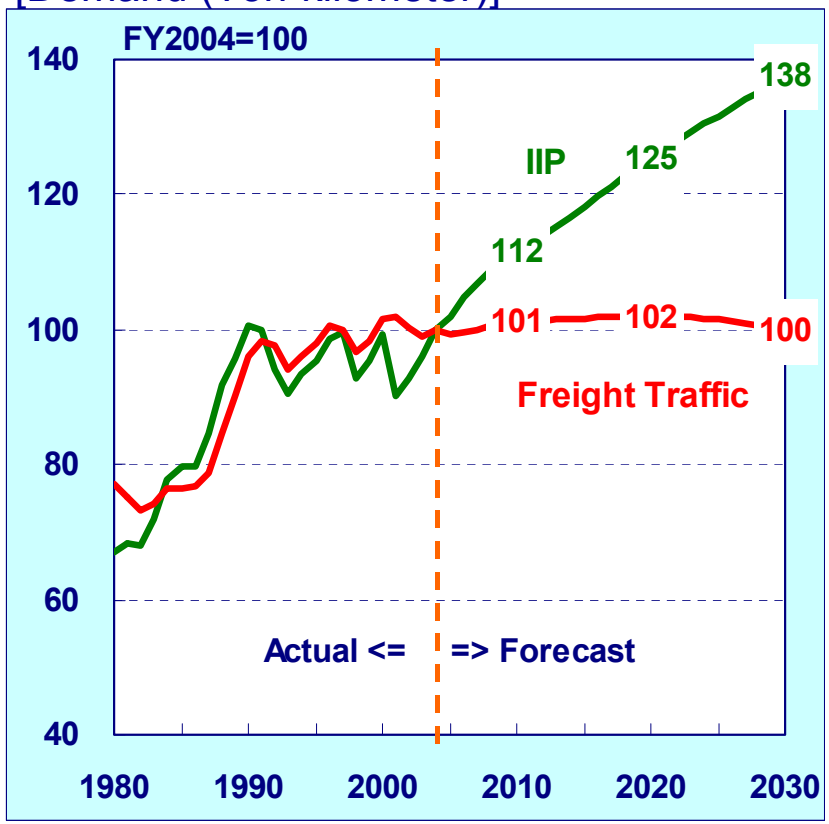
■Passenger traffic demand grows gradually before 2020. However, its energy consumption decreases due to the improvement of energy intensity.

■Energy intensity improvement mainly comes from the improvement of vehicles' fuel efficiency including the spread of hybrid car and structure change of vehicles.

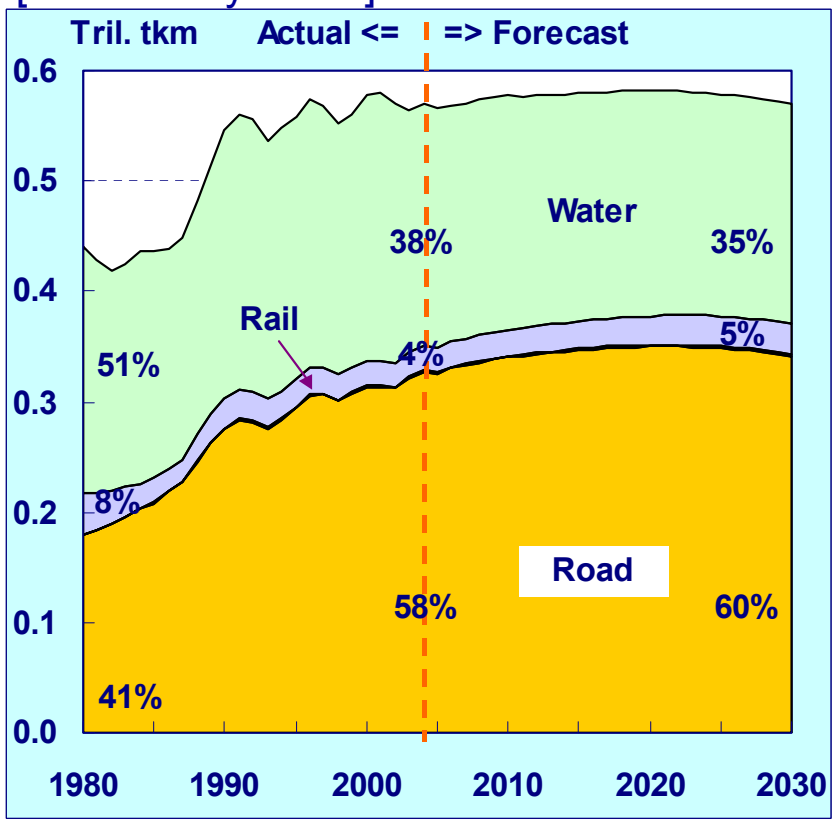
<Reference Case>

Demand of Freight Traffic

[Demand (Ton-kilometer)]



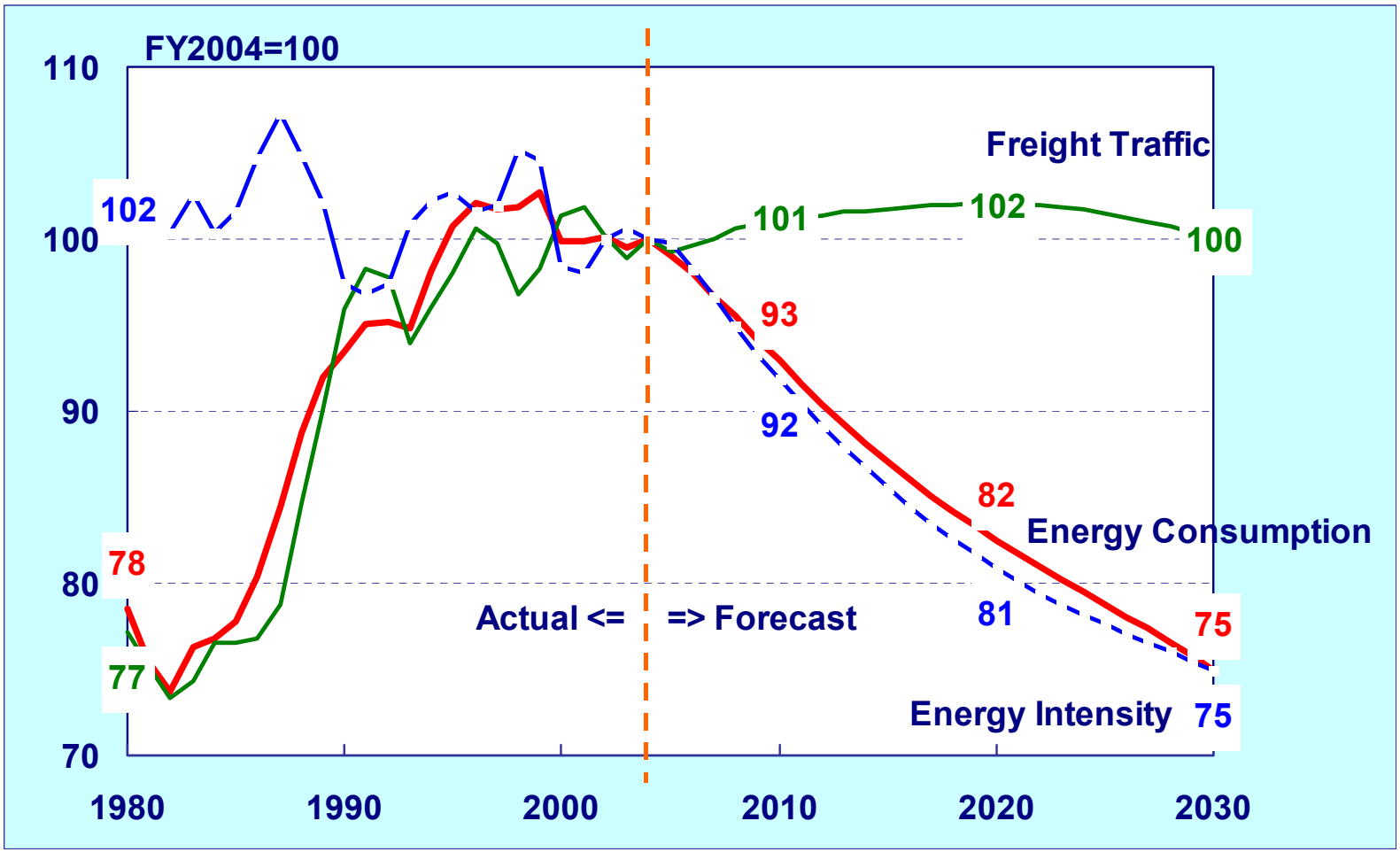
[Demand by Mode]



■Highly related with production activity (IIP), freight demand grows. However, it turns to flatten and finally reduce due to development of high-tech industries and services.

■Truck transportation demand grows up to around 2020 due to the pursuit of high value added service, such as home delivery and cooling-delivery. Ship transportation reduces due to the falling freight demand of raw material industries' products.

Energy Consumption in Freight Sector

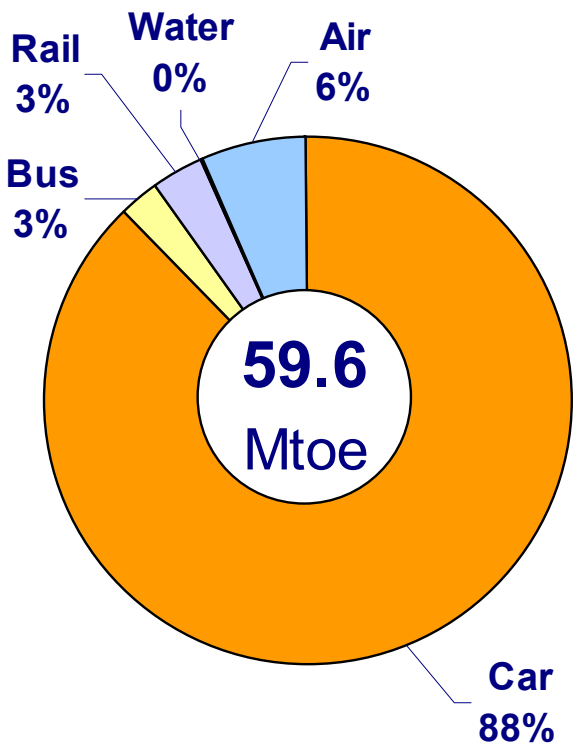


■Although the freight traffic demand grows slightly, its energy demand reduces due to its efficiency improvement.

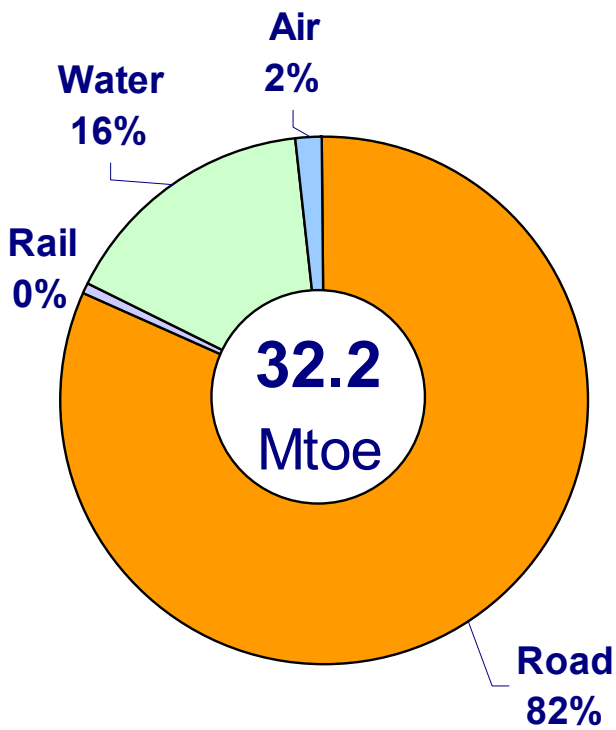
■Efficiency improvement mainly comes from improvement of transportation efficiency and fuel efficiency.

Current Energy Consumption by Transportation Mode (FY2004)

[Passenger Sector]

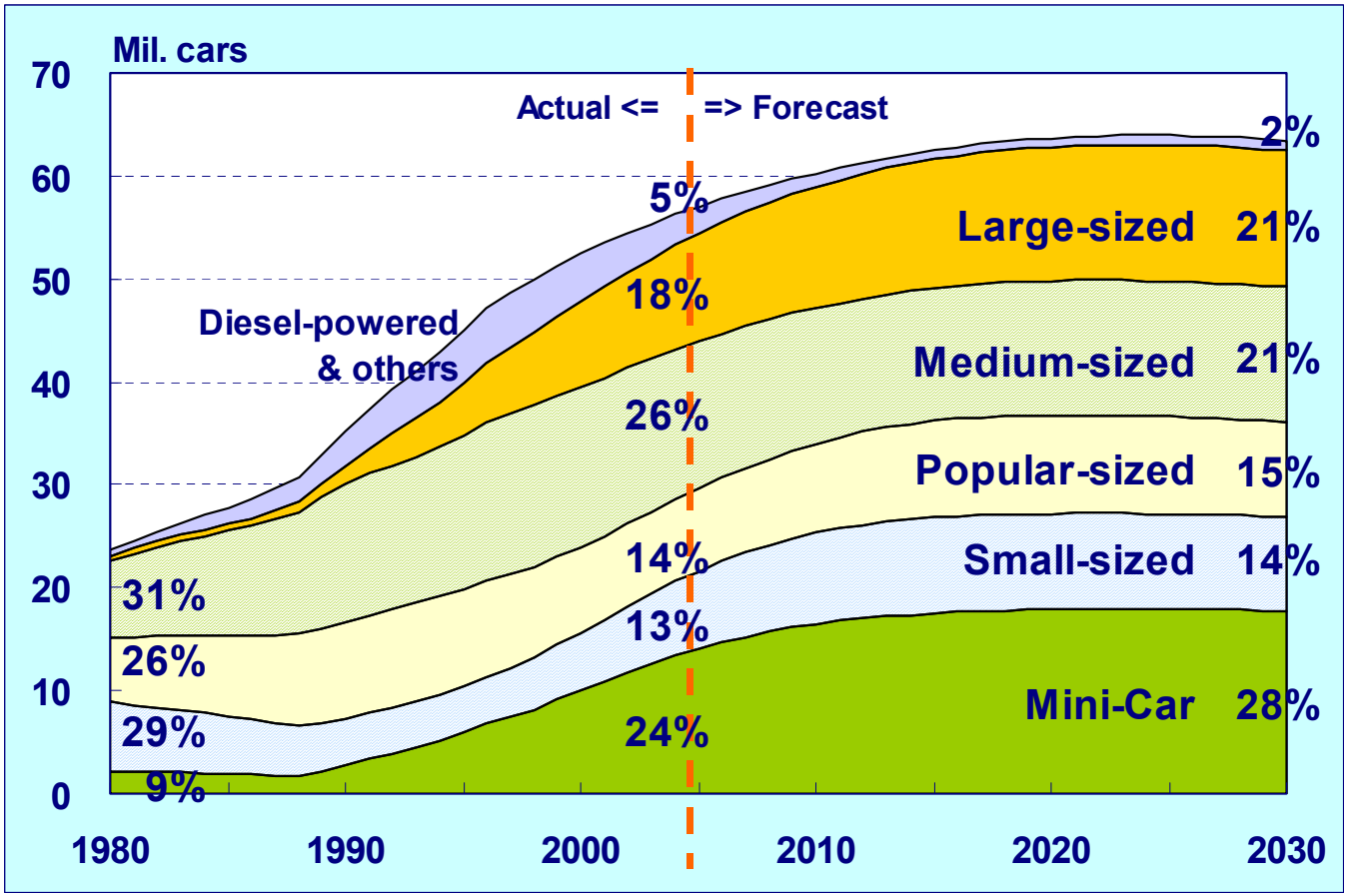


[Freight Sector]



■Accounting for 60-70% of total traffic demand (person-km, ton-km), energy consumption on road accounts for nearly 90% in passenger and over 80% in freight sector.

Ownership of Passenger Car

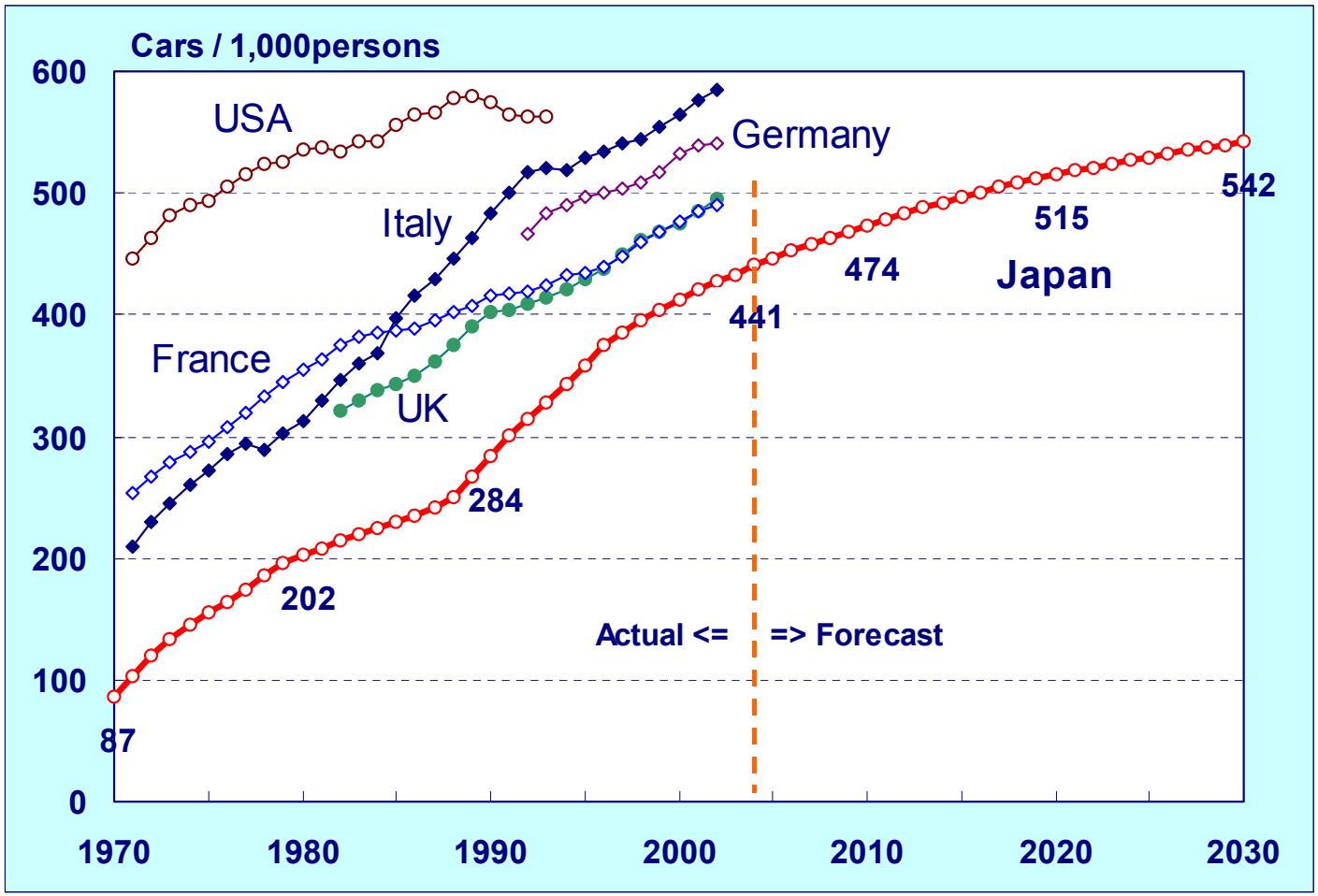


(Note) Car category:
Large: over 2201cc
Medium: 1701-2200cc
Popular: 1401-1700cc
Small: 661-1400cc
Mini: less than 660cc

■Total number of passenger cars peaks in 2024 and turns to reduce, due to ownership saturation and falling population.

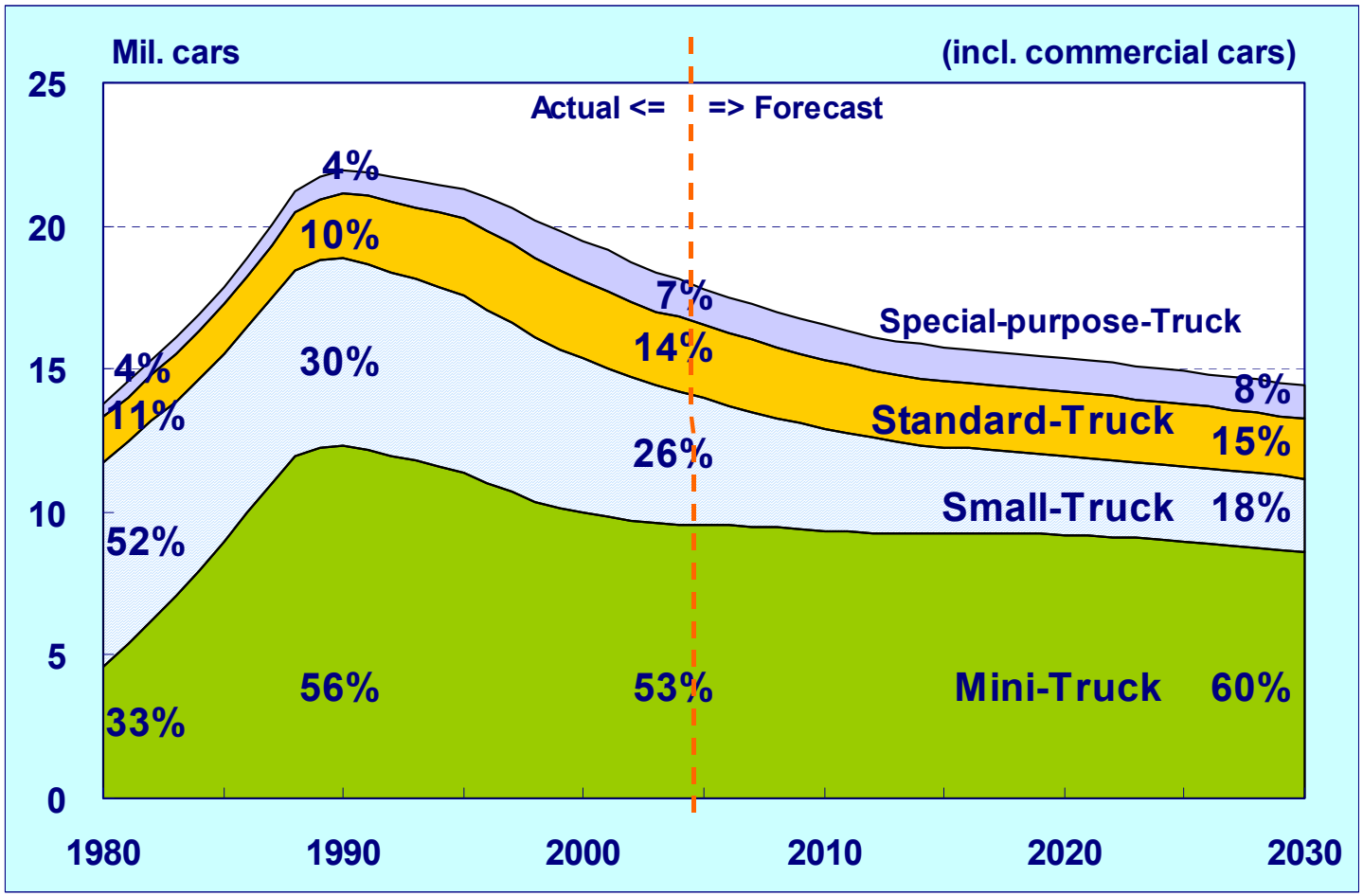
■Share of compact (small and mini) car grows due to the increase of aged and female drivers, while share of large car also increases due to pursuit of luxury with the living standard growing. Bipolar structure progresses.

Ownership Rate of Passenger Car



■Ownership rate (car registration per capita) will catch up with current level in USA and European countries, but it will saturate.

Ownership of Truck



■Freight traffic demand grows till around 2020, but the number of trucks will reduce due to higher transport efficiency.

■Small-truck shifts to standard-truck in order to improve transportation efficiency. Share of mini-truck will also grow due to the door-to-door delivery service for the aged people, and the increase of the Internet sale.

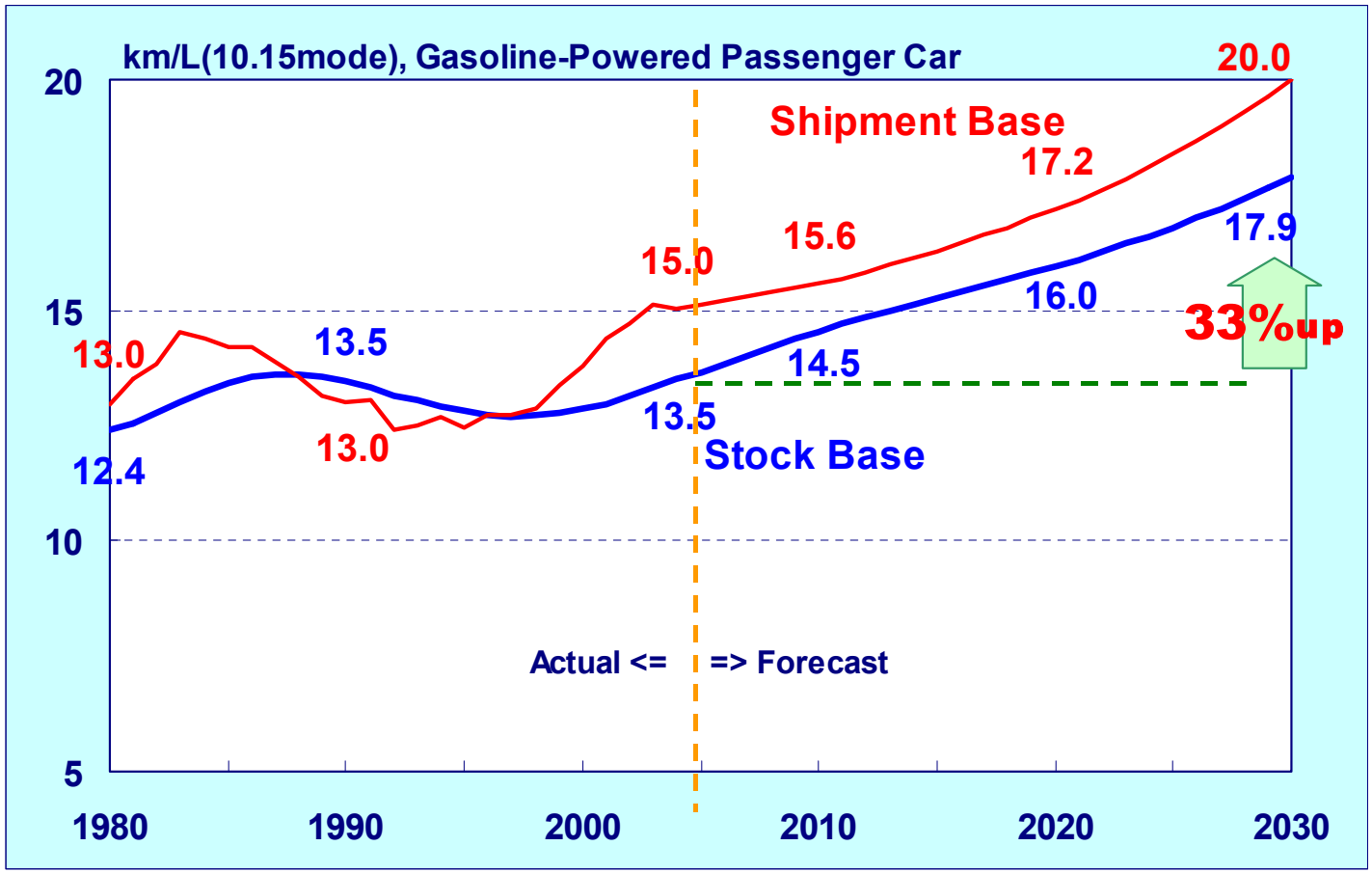
<ref.> Fuel Efficiency Goal (Top runner)

		Efficiency Standards	Target Year	Assumption after Target Year
Passenger Car	Gasoline-powered	Impr. by 22.8% compared with 1995	FY2010	Improvements to the present best available technology level
	Diesel-powered	Impr. by 14.9% compared with 1995	FY2005	
Commercial & Light truck	Gasoline-powered	Impr. by 13.2% compared with 1995	FY2010	
	Diesel-powered	Impr. by 6.5% compared with 1995	FY2005	
Large/Medium Truck	Diesel-powered	Impr. by 12.2% compared with 2002	FY2015	Level-off
Bus	Diesel-powered	Impr. by 12.1% compared with 2002	FY2015	

■Goals for passenger car and small-sized truck will be met probably. Goals for larger truck and bus are newly introduced in 2006.

■Current goals and further improvement are assumed in this projection.

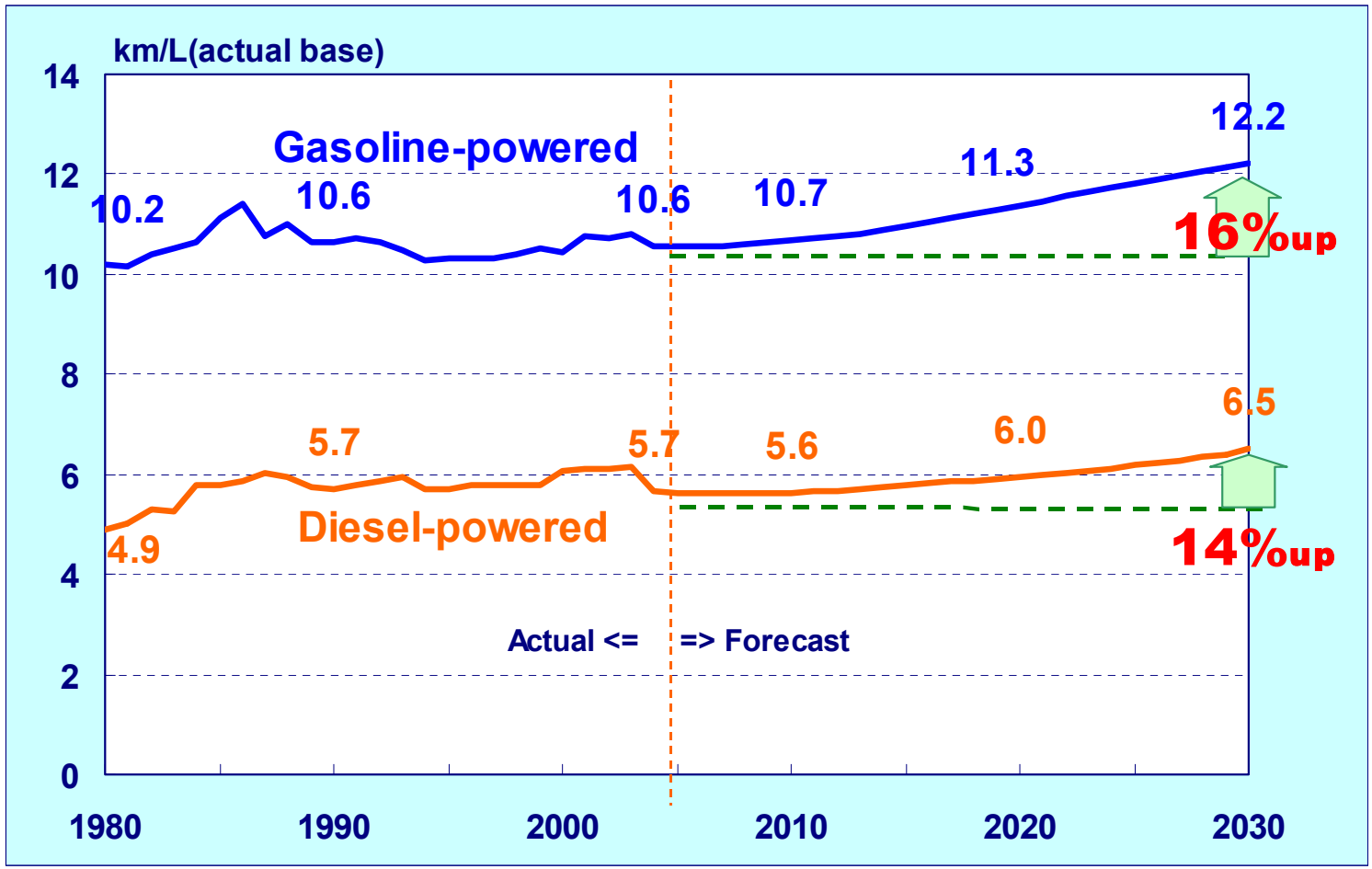
Fuel Efficiency of Passenger Car



■Fuel efficiency of new car (shipment base) reflects the Top-Runner standard and further efficiency improvement (including spread of hybrid car and structure change).

■Stock-base efficiency will improve by 33% in 2030 compared to 2003, due to new cars' high efficiency and structure changes.

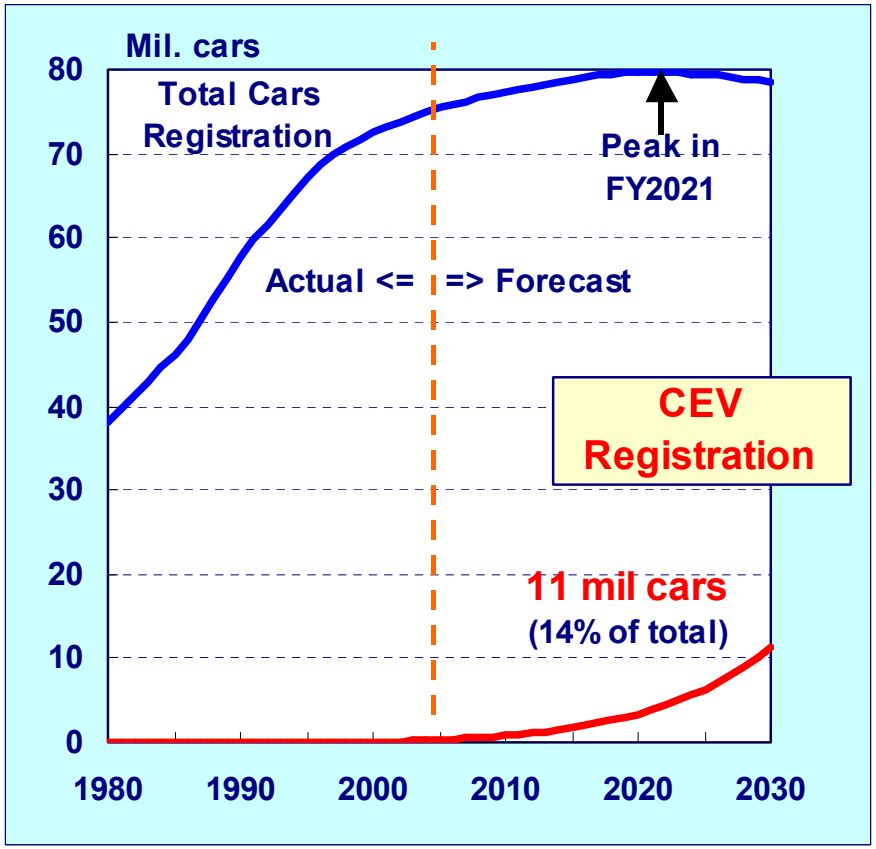
Fuel Efficiency of Truck (Stock Base)



■Truck's fuel efficiency is assumed to improve gradually in the future, though, up to now, government environmental measures were mainly for air pollution problems such as particulate matter(PM) and NO_x.

<Reference Case>

Clean Energy Vehicles(CEV)



(Thousand cars)

	Actual		Forecast		
	FY2003	FY2004	FY2010	FY2020	FY2030
Hybrid Vehicles	133	196	705	3,135	10,673
Fuel Cell Vehicles	0	0	5	30	75
Natural Gas Vehicles	21	25	43	128	342
LPG Trucks	29	31	57	112	149
CEV total	183	252	811	3,405	11,238

■In 2030, CEV's total ownership will reach 11.24 million unit, accounting for 14% of total vehicles. Then, the share of CEV will reach 30% on new sales basis.

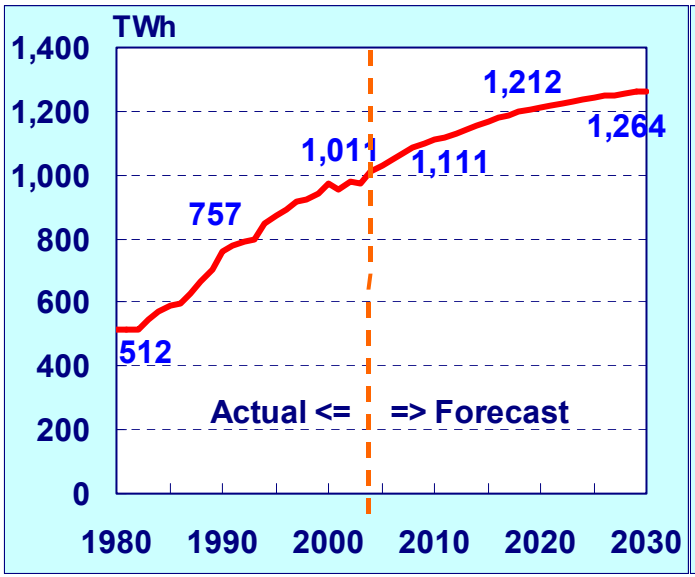
■Hybrid car will be the mainstream, since it has no fuel supply infrastructure constraints and little price difference with conventional vehicles.

Forecast by Energy

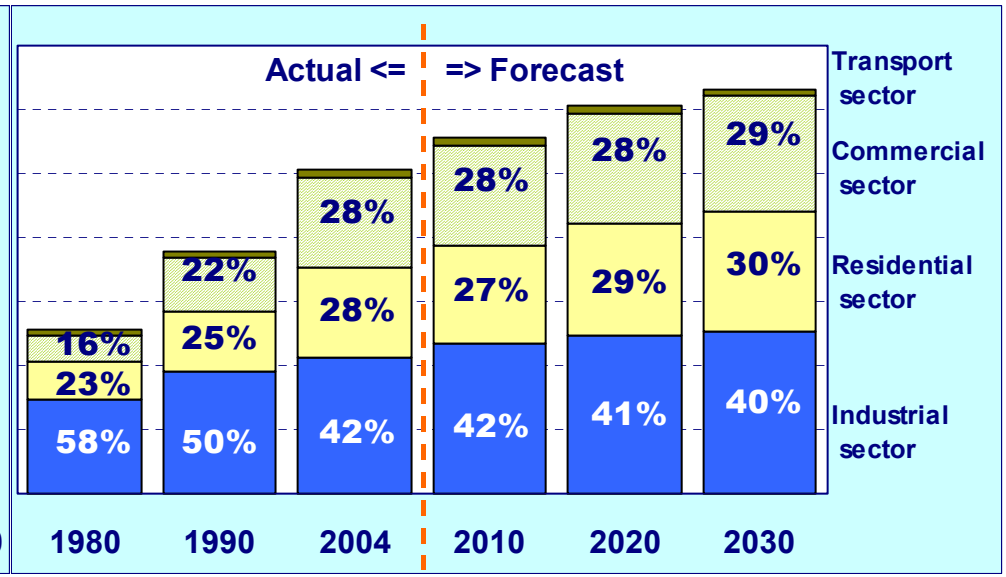
- Electricity Demand & Generation Mix
- Oil Products
- City Gas and LNG
- Coal

Electricity Demand and Sales

[Electricity Demand]



[Electricity Demand by Sector]



(TWh)	Actual		Forecast			Annual Growth Rate (%)			
	FY1990	FY2004	FY2010	FY2020	FY2030	2004/ 1990	2010/ 2004	2020/ 2010	2030/ 2020
Electricity Sales	678	892	983	1,071	1,116	2.0	1.6	0.9	0.4
Lighting	177	273	295	340	362	3.1	1.4	1.4	0.6
Power (*)	501	620	687	732	754	1.5	1.7	0.6	0.3

*including liberalized sector

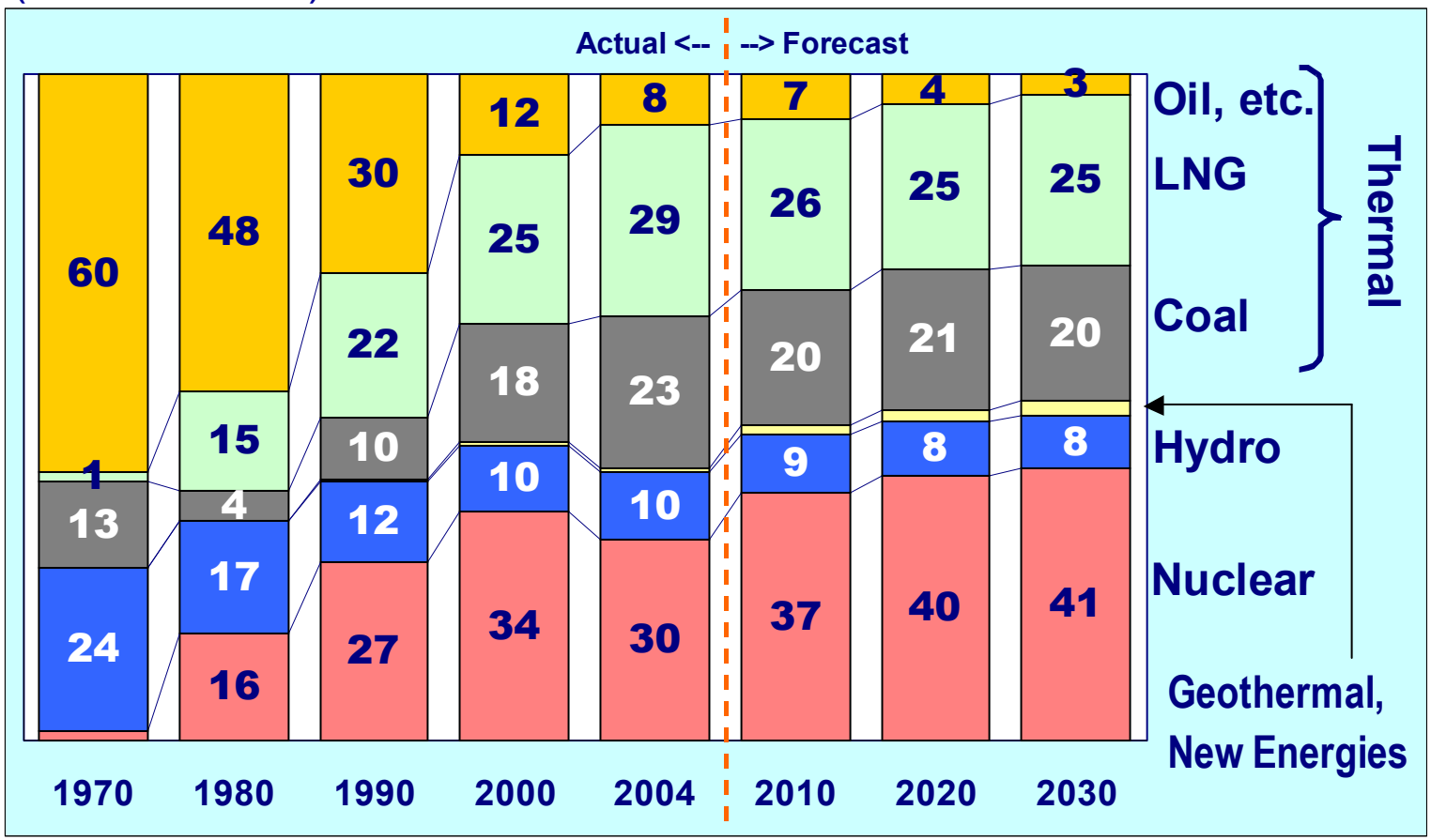
■While the total electricity demand grows, the share of residential and commercial demand grows to nearly 60%.

■The increase of electricity demand in residential, due to growing power and lighting, etc., pushes the whole electricity demand up.

■ The demand in industry also increases due to the shift to machinery industry.

Power Generation Mix

(Public Utilities)



■The share of nuclear power generation grows to 41% due to the increase of both the capacity and its utilization rate.

■Thermal power generation will decrease to less than 50%.

<Reference Case>

Forecast of Power Generation by Source

(Public Utilities)

(TWh)

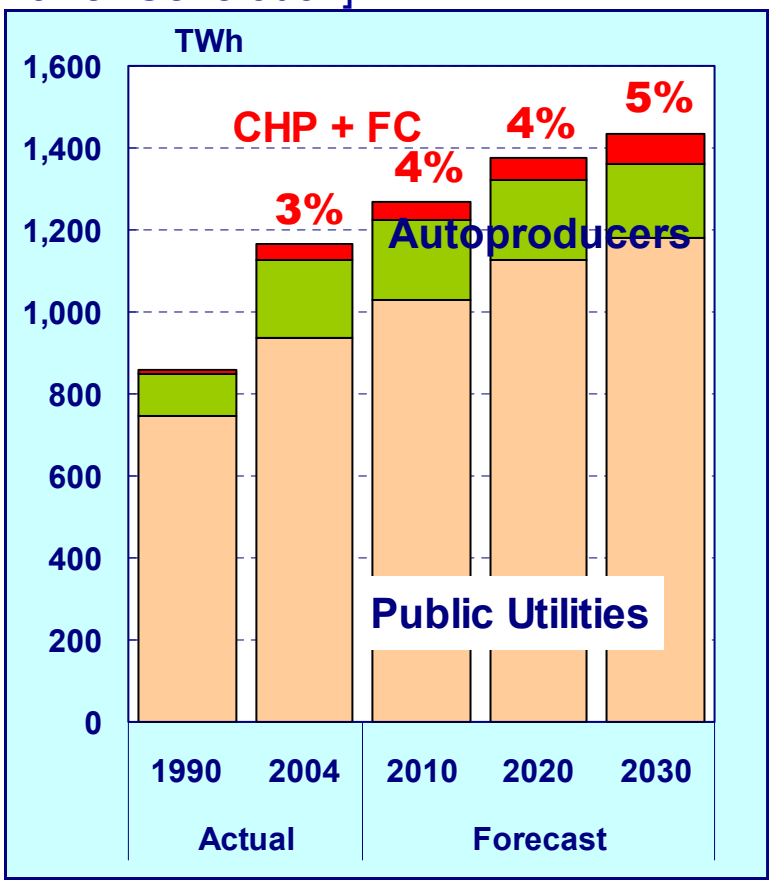
	Actual				Forecast						Average Annual Growth Rate (%)			
	FY1990	(%)	FY2004	(%)	FY2010	(%)	FY2020	(%)	FY2030	(%)	2004/1990	2010/2004	2020/2010	2030/2020
Coal	71	10	216	23	210	20	240	21	242	20	8.2	-0.4	1.3	0.1
LNG	163	22	269	29	266	26	282	25	303	25	3.6	-0.1	0.6	0.7
Oil, etc.	224	30	72	8	69	7	50	4	38	3	-7.8	-0.8	-3.2	-2.7
Thermal	459	61	557	59	545	53	572	50	583	49	1.4	-0.3	0.5	0.2
Nuclear	201	27	282	30	386	37	452	40	484	41	2.4	5.4	1.6	0.7
Hydro	90	12	96	10	92	9	91	8	94	8	0.4	-0.7	-0.1	0.4
Geothermal, etc.	2	0	6	1	15	1	21	2	27	2	8.0	16.1	3.7	2.7
Total Generation	752	100	941	100	1,038	100	1,136	100	1,189	100	1.6	1.7	0.9	0.5

■While the share of coal and LNG power generation decreases, their generated electricity still increases.

■Oil power generation is used mainly in peak periods.

Forecast of Distributed Power Generation

[Power Generation]



[Equipment Capacity] (MW)

		1990	2004	2010	2030
Cogeneration (CHP)	Indus-try	1,673	5,481	6,595	9,653
	Com-mercial	281	1,457	1,825	2,987
	Total	1,954	6,938	8,420	12,640
Fuel Cells	Com-mercial	0	0	7	63
	Resi-dential	0	0	9	82
Grand Total		1,954	6,938	8,436	12,785

■Co-generation will slow down due to the high fuel price and hard competition with the public utilities.

■It would take long time until full-scale spread of fuel cell starts.

<Reference Case>

Forecast of Oil Products Sales

(Million kL)

	Actual				Forecast						Average Annual Growth Rate (%)			
	FY1990	(%)	FY2004	(%)	FY2010	(%)	FY2020	(%)	FY2030	(%)	2004/ 1990	2010/ 2004	2020/ 2010	2030/ 2020
Fuel Oil Sales	218	100	237	100	221	100	202	100	179	100	0.6	-1.1	-0.9	-1.2
Gasoline	45	21	61	26	62	28	60	30	53	30	2.3	0.2	-0.4	-1.1
Naphtha	31	14	49	21	44	20	39	19	35	20	3.2	-1.8	-1.1	-1.1
Jet Fuel	4	2	5	2	5	2	6	3	6	3	2.0	1.3	0.6	-0.1
Kerosene	27	12	28	12	28	13	27	13	23	13	0.3	0.1	-0.5	-1.4
Gas Oil	38	17	38	16	33	15	29	14	26	15	0.1	-2.3	-1.3	-0.9
Fuel Oil A	27	12	29	12	26	12	24	12	22	12	0.5	-1.7	-0.9	-1.0
Fuel Oil B, C	47	21	27	11	22	10	17	9	13	7	-3.9	-2.8	-2.5	-2.8
LPG (Mt)	19		18		19		19		19		-0.3	0.8	0.1	0.1

■Gasoline sales will turn to decrease due to the saturation of passenger cars and improvement of fuel efficiency.
■Naphtha sales will turn to decrease due to the falling ethylene production.
■Oil products will become lighter due to falling heavy oil demand in final demand and power generation.

<Reference Case>

Forecast of City Gas Sales

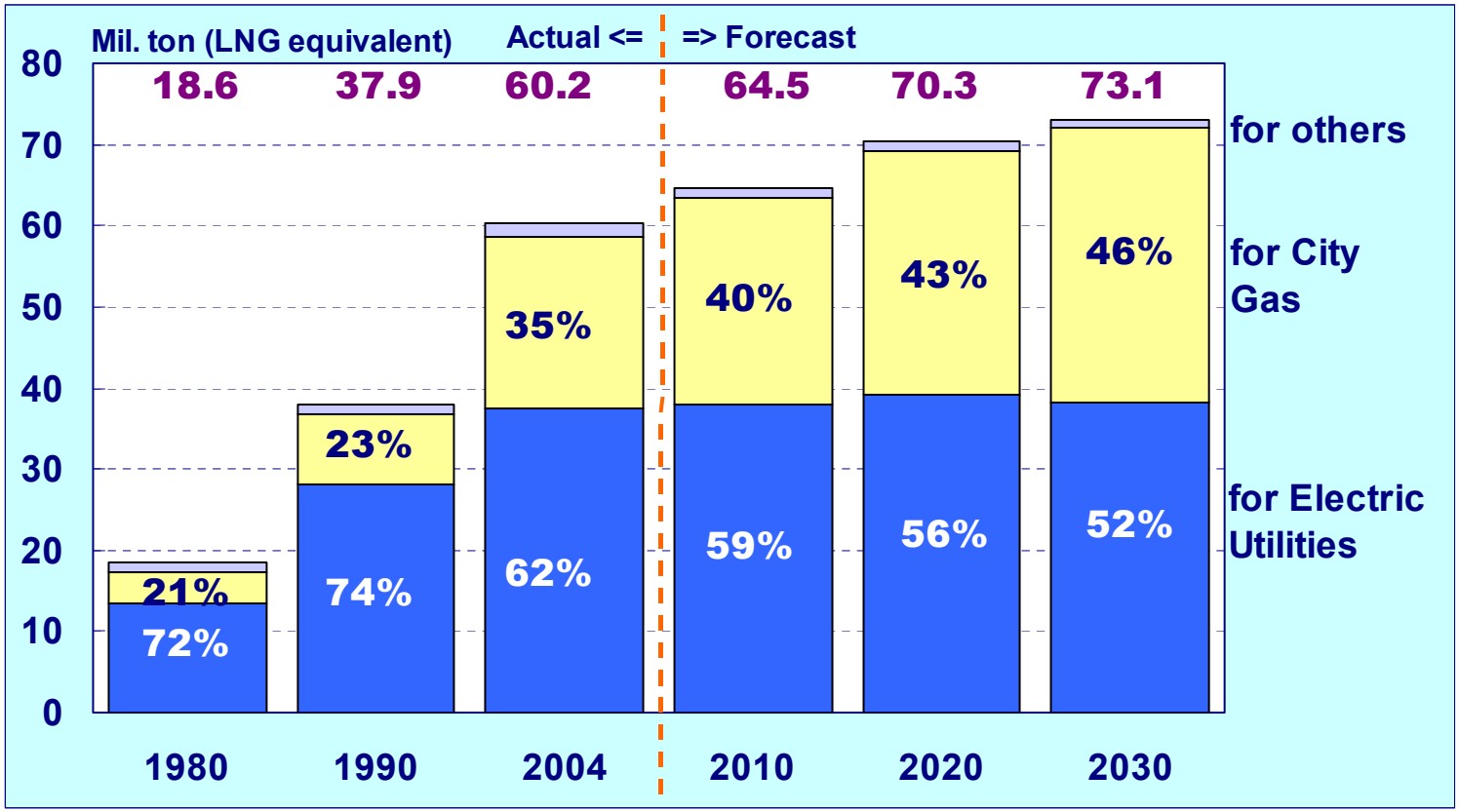
(Billion m^2)

	Actual				Forecast						Average Annual Growth Rate (%)			
	FY1990	(%)	FY2004	(%)	FY2010	(%)	FY2020	(%)	FY2030	(%)	2004/1990	2010/2004	2020/2010	2030/2020
City Gas Sales	15.4	100	30.1	100	36.1	100	41.5	100	45.5	100	4.9	3.0	1.4	0.9
Residential	7.8	51	9.5	31	9.2	25	8.8	21	8.4	19	1.4	-0.5	-0.4	-0.5
Commercial	2.6	17	4.7	16	5.6	16	6.7	16	7.5	16	4.4	3.0	1.8	1.0
Industrial	4.0	26	13.3	44	17.9	50	21.7	52	24.8	55	8.9	5.1	2.0	1.3
Others	1.0	7	2.7	9	3.4	9	4.2	10	4.8	10	7.1	4.0	2.2	1.2

- City gas demand will increase steadily.
- Residential demand will decrease slowly due to the shift to electricity.
- Industry and commercial demand is expected to grow due to the environmental and handling advantages.

<Reference Case>

Forecast of LNG Demand

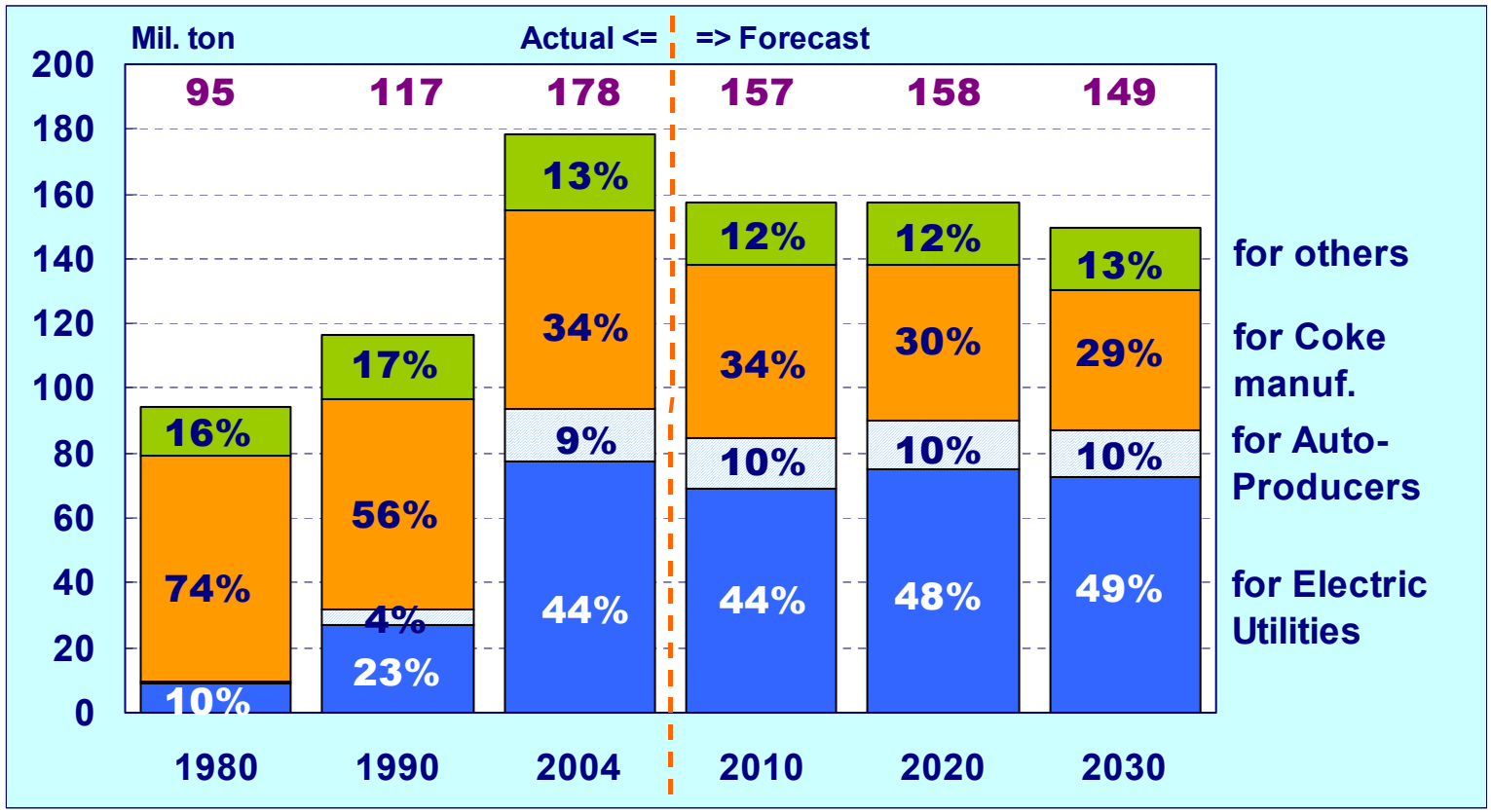


(Note) Including domestic natural gas.

■LNG demand for city gas will increase to meet the growing demand mainly of industry and commercial. In the next 25 years, LNG demand increases by 12.5 Million tons, an amount equivalent to 220 LNG vessel capacity annually.

■Demand for power generation increases slightly due to the efficiency improvement of LNG power generation.

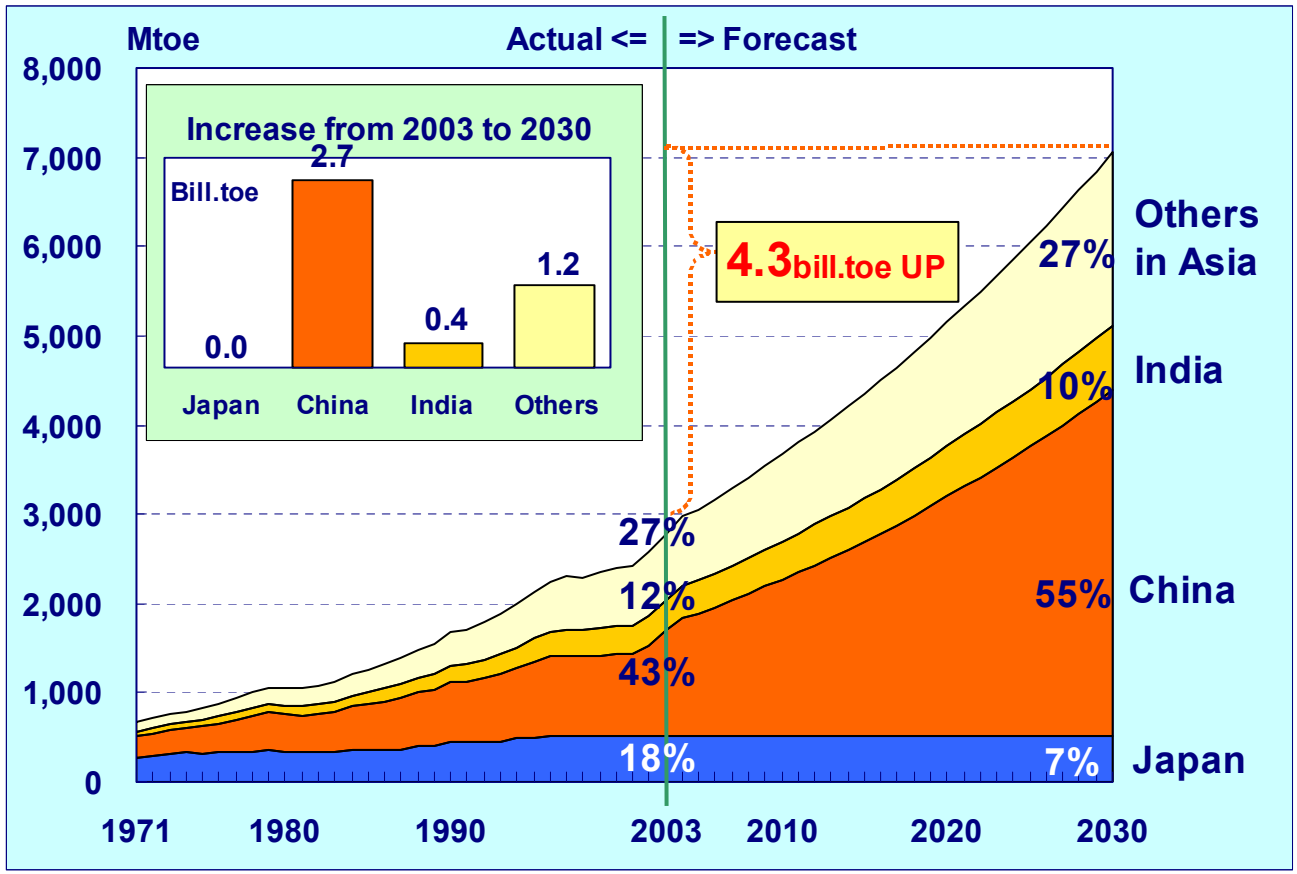
Forecast of Coal Demand



■Coke demand will decrease due to the decrease of blast furnace steel and the increase of pulverized coal rate.

■The coal demand in power generation has grown rapidly but it will level off from now on.

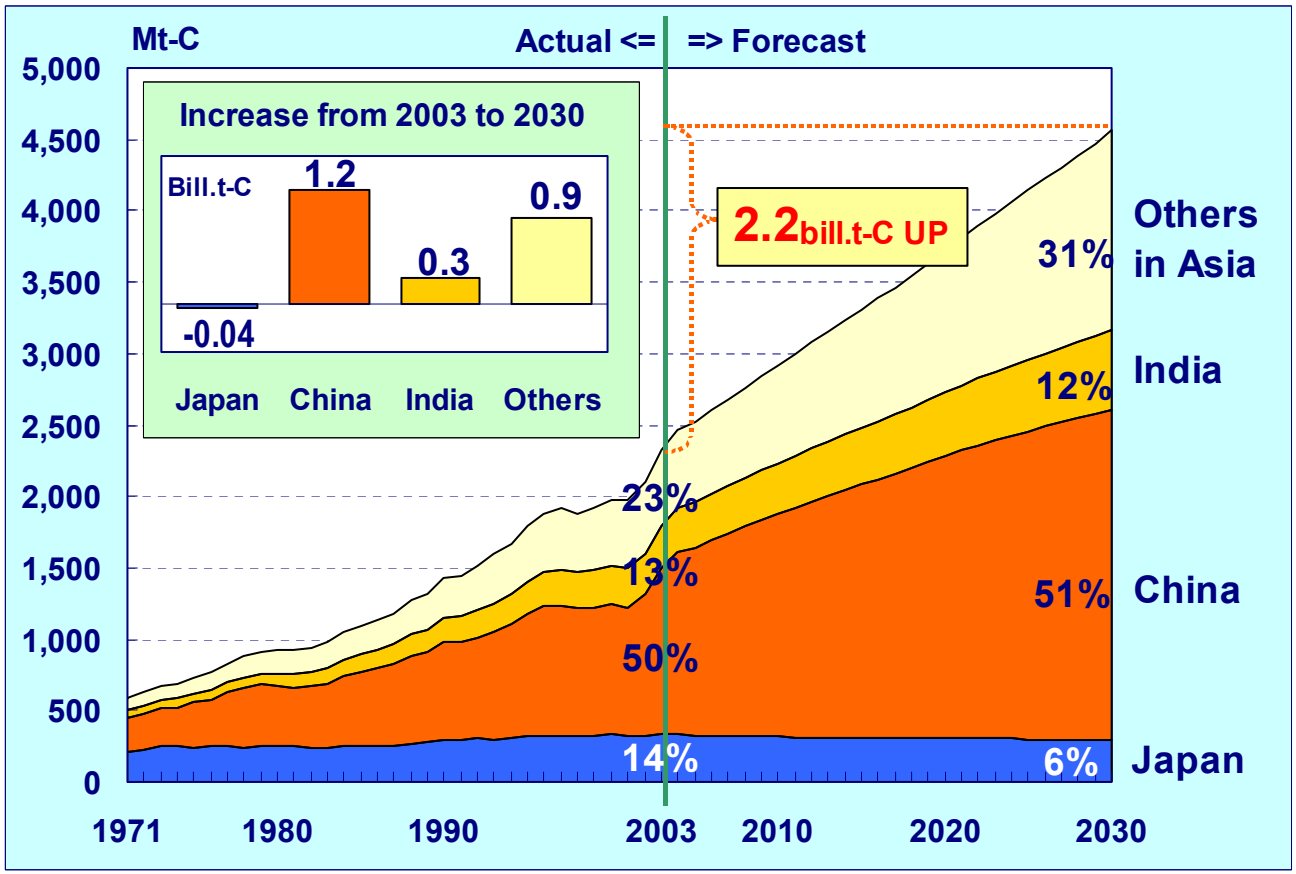
Japan in Asia (Primary Energy Supply)



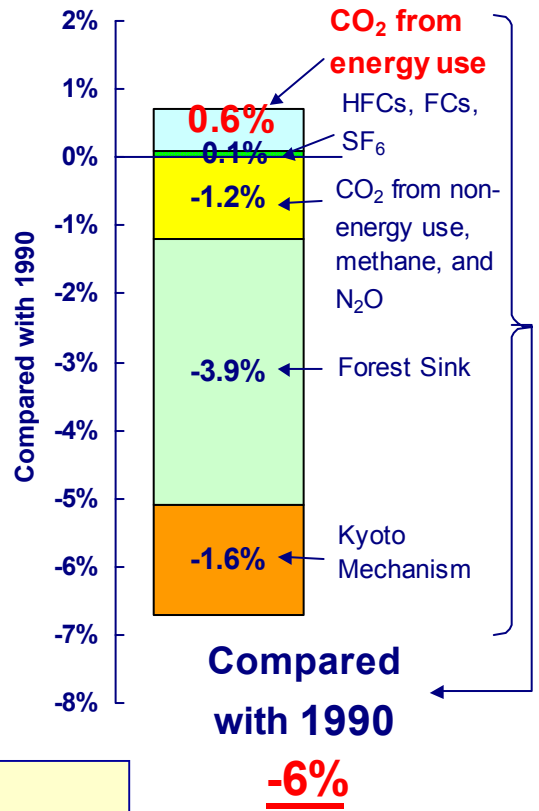
■The share of Japan's energy consumption in Asia will decrease from current 18% to 7%.

■Two third of the Asian increment is from China, and the rest is from India, ASEAN and other developing countries.

Japan in Asia (CO_2 Emission)



Breakdown for GHG Reduction Plan in Japan (2010)



- CO_2 emission in Asia will double between 2003 and 2030.
- Increment in Asia will be about seven times as much as current emission amount of Japan.
- Although emission will turn to decrease, Japan needs more efforts to fulfill the Kyoto Protocol's goal.

The Technology Development Case

- Concept
- Result

Concept of the Technology Development Case

Technology Development Case: Energy use technologies and environment are more advanced than the reference case.

[Final Energy Consumption Sectors]

- Energy use technologies and energy instruments with high efficiency are installed and diffused.
- Future energy conservation technologies are installed.
- Energy management systems work effectively.

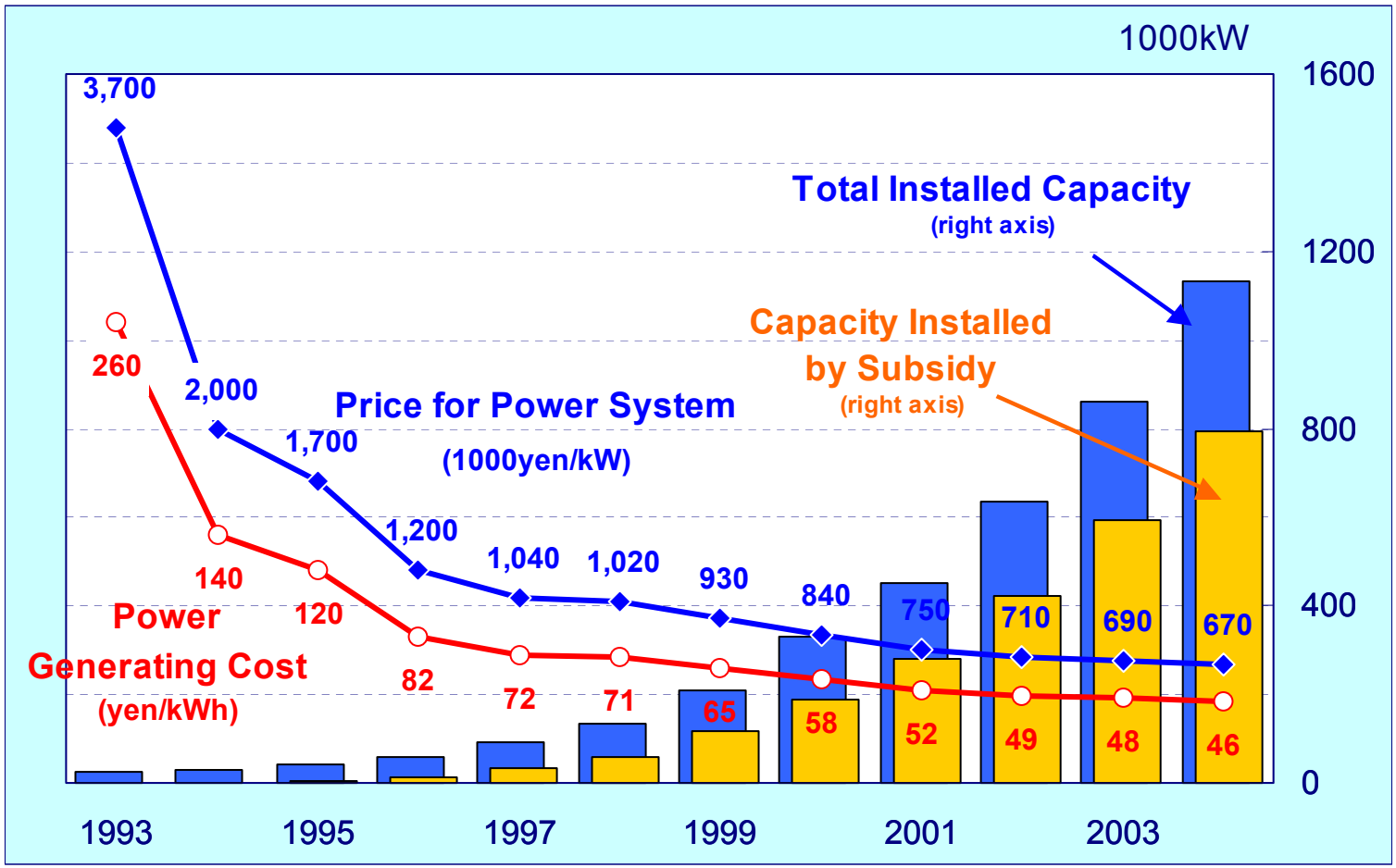
[Power Generation]

- Instalment of distributed power generation system is advanced.
- High efficiency power generation system is promoted.

[New Energies]

- Instalments of photovoltaic, wind power, bio fuels, etc. are advanced.

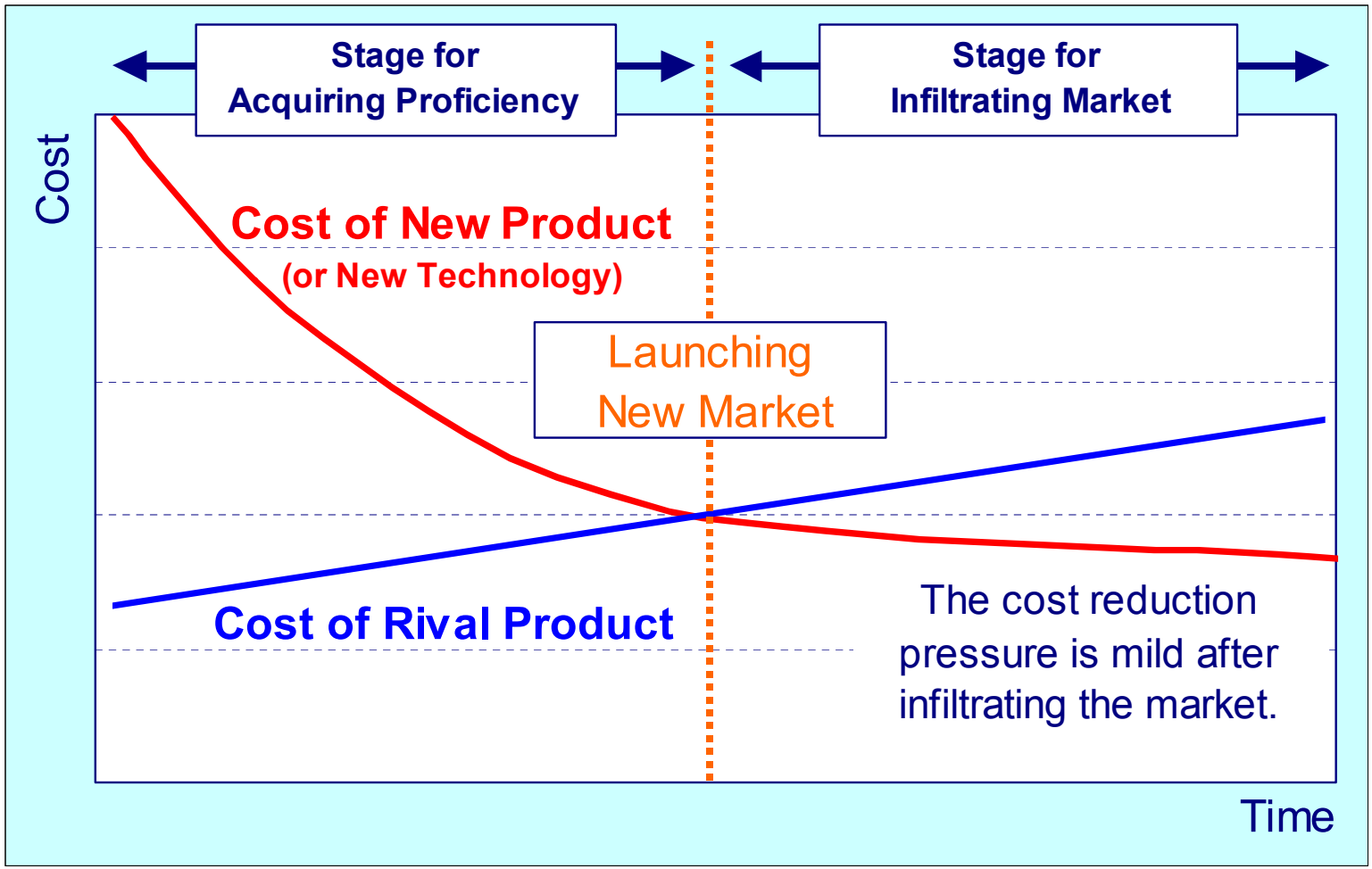
Installed Capacity of Residential Photovoltaic System



(Source) "About strengthening new energies measures in the future (photovoltaic)", Agency for Natural Resources and Energy, November 2005

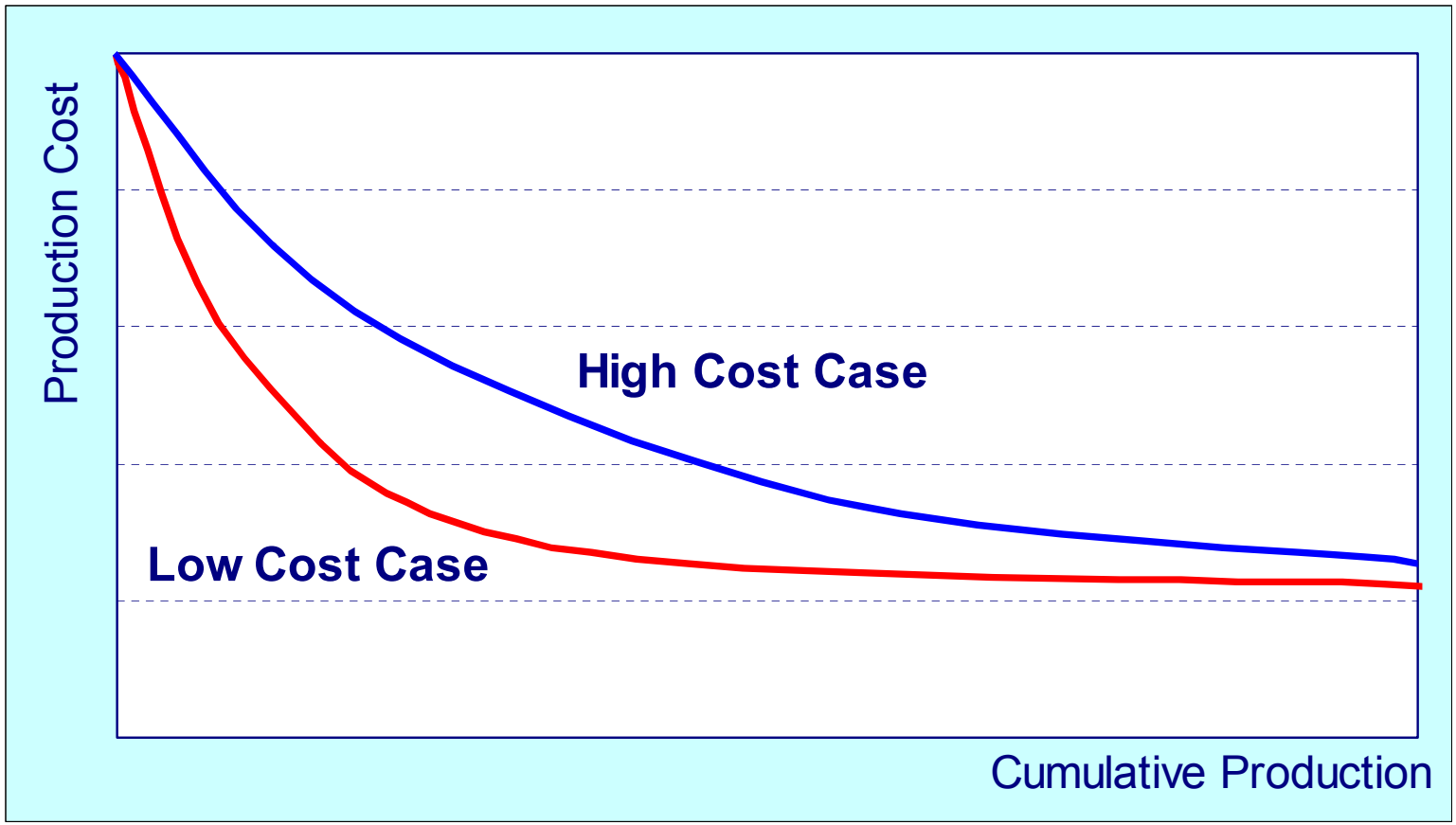
■The installed capacity is developed due to price down of the system.

Concept of the Cost Model



- Increase of production leads to cost reduction.
- Diffusion of new technology starts at a certain price level in competition with rival technology.

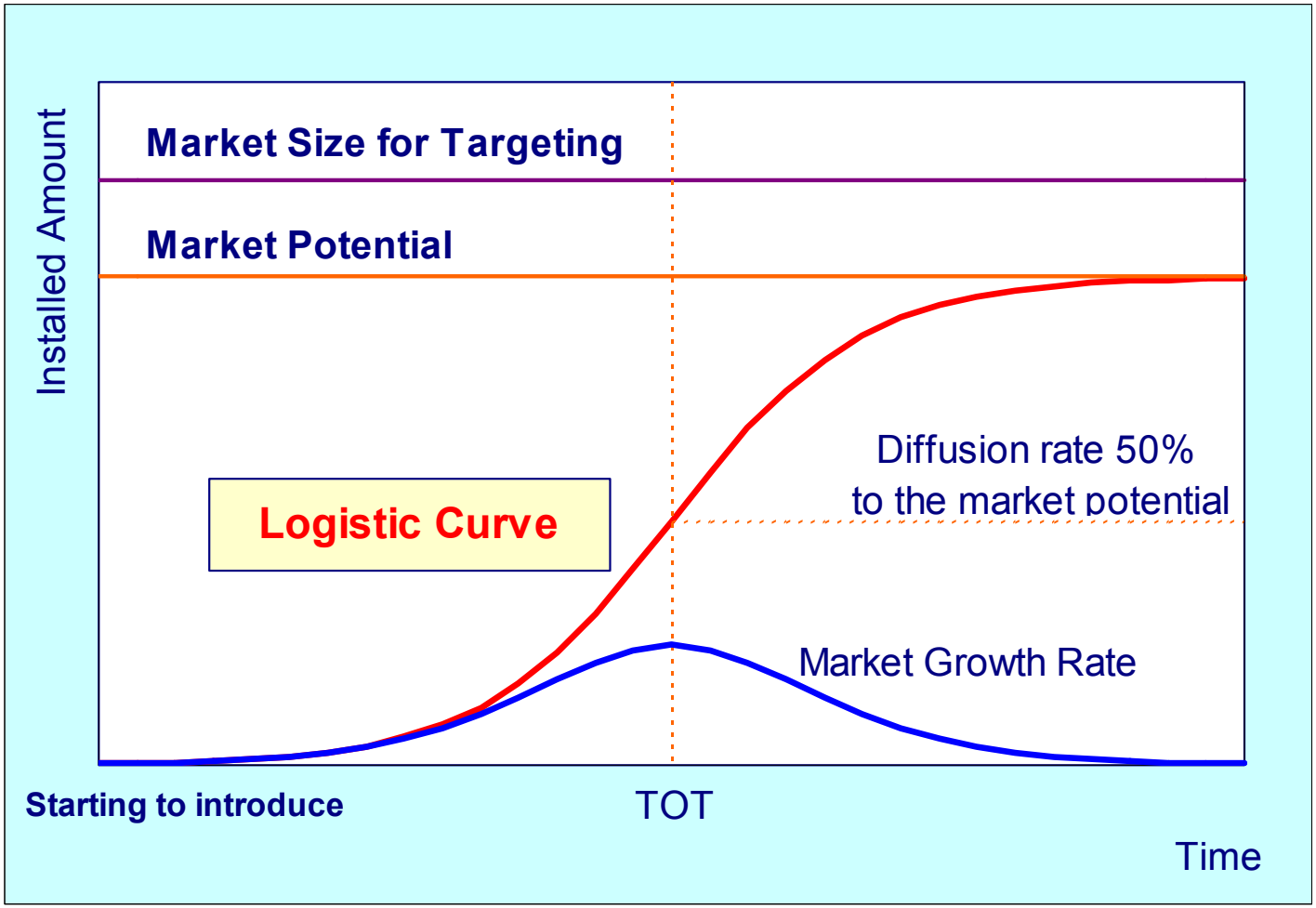
Cumulative Production and Cost



■Two cases are assumed.

- High cost case: Pace of cost reduction is slow.
- Low cost case: Pace of cost reduction is fast.

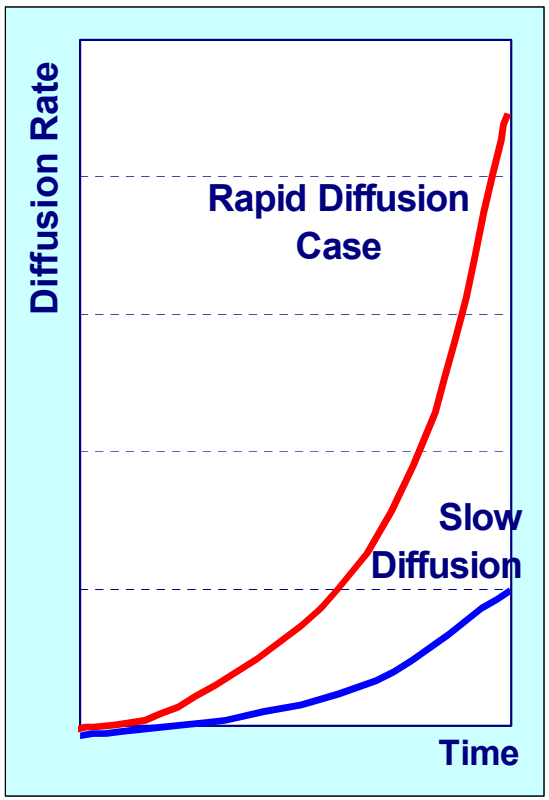
Concept of Installation Model

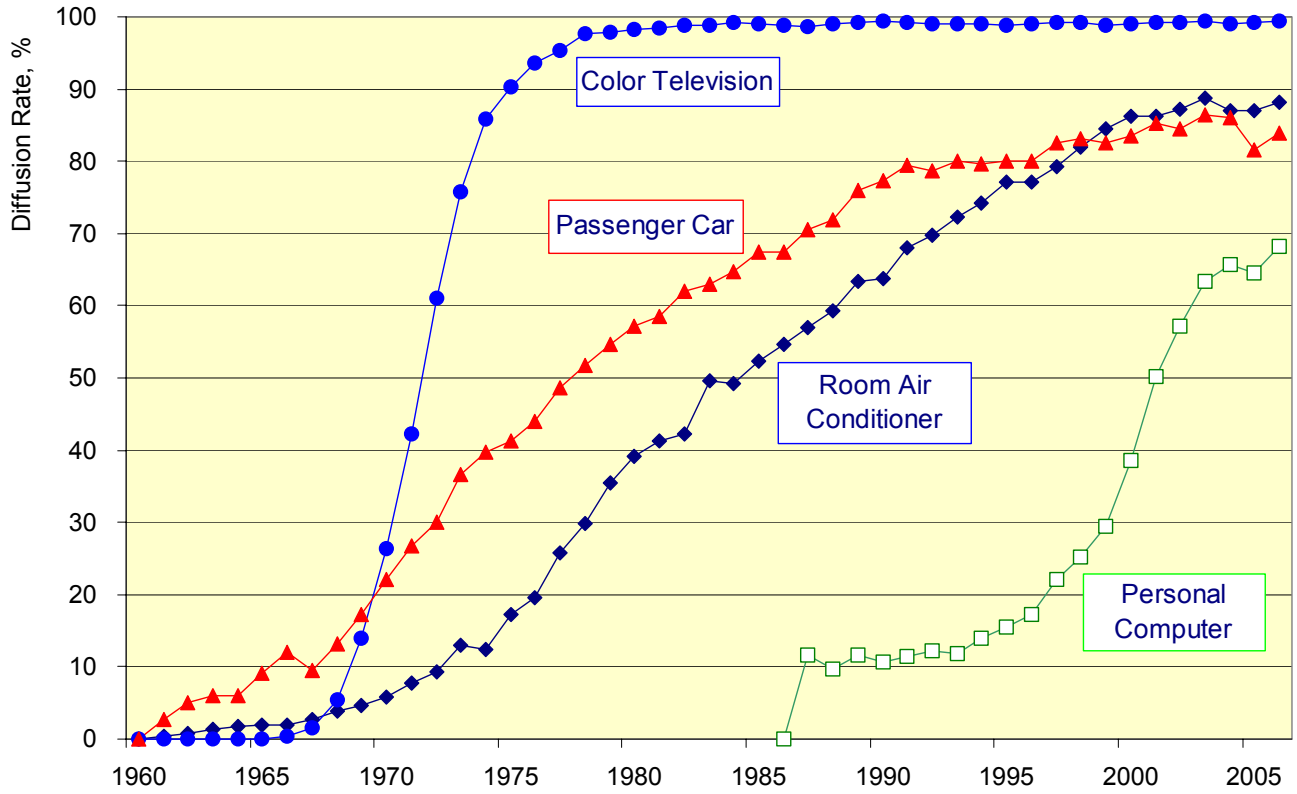


■TOT: Take Over Time. Time for occupying more than 50% of the potential in the market.

■Potential: Supreme amount in the market, which defines the maximum installation amount.

Diffusion Rate: Image and Examples





- Some cases are considerable.
  - Rapid diffusion case: Potential is high and distribution is rapid.
  - Slow diffusion case: Potential is low and distribution is slow.
- Diffusion rate and market potential are affected by various factors.

Installation of New Technologies in Ind. and Com. Sectors

New technologies, being developed or examined now, are installed into markets in the long term (by 2030).

[Examples]

■**Processing in manufacturing**
- Super-extra fine coaxial cable, energy conservation system for machine clamping control, etc.

■**Ultra micro LSI technology**
- extreme-ultraviolet exposure system, most advanced system LSI design, etc.

■**Energy saving technology in PCs, server machines**
- Efficient organic device, mass optical storage technology, etc.

■**Optical communication technology**
- Photonic network technology, intense pulsed light electronics technology, etc.

■**Highly efficient materials, heat insulating materials**
- Nano-composit structure control, etc.

Reference: "Outlook for Energy Supply and Demand in 2030", Advisory Committee for Natural Resources and Energy

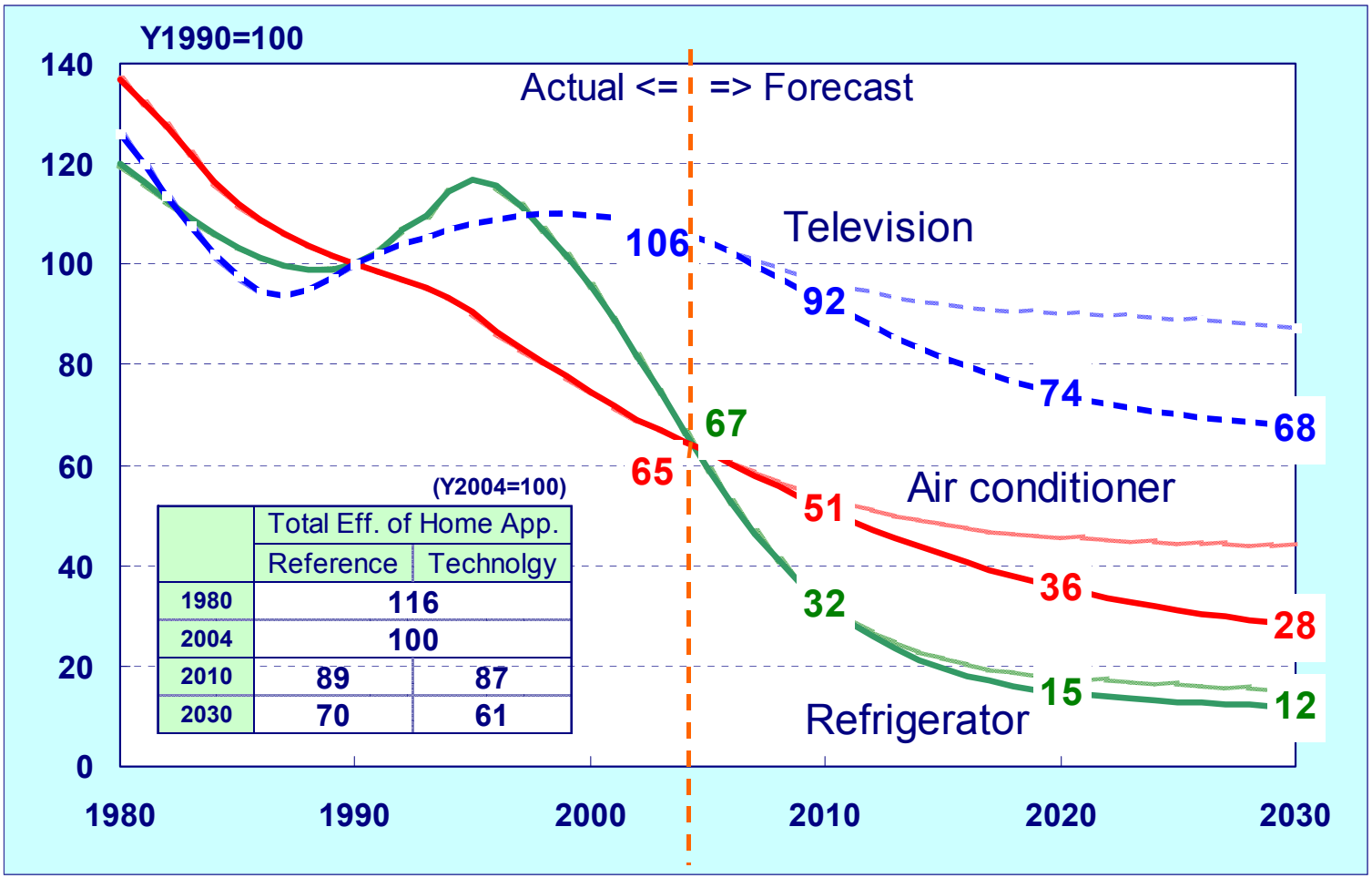
Top Runner Standards of Major Instruments

	Current Target		After the Target Year	Deliberated Next Target	
	Target Year	Energy Conservation Effects		Target Year	Energy Conservation Effects
Refrigerators/ Freezers (kWh/year)	FY2004	-30% compared with FY1998	improving toward the best one sold now	under deliberation	
CRT TV Sets (kWh/year)	FY2003	-16.6% compared with FY1997	improving toward the best one sold now	-	keeping the target
LCD, PDP TV sets (kWh/year)	-	-	-	FY2008	-15.3% compared with FY2004
Air Conditioners (COP)	Refrigera-tion year 2004	-63% compared with FY1997 (Cooling & Heating)	improving toward the best one sold now	Refrigera-tion year 2010	-23% compared with FY2005
Florescent Lights (lm/W)	FY2005	-16.6% compared with FY1997	improving toward the best one sold now		
Gas Water Heaters (Thermal efficiency)	FY2006	-4.1% compared with FY2000	keeping the target		
Oil Water Heaters (Thermal efficiency)	FY2006	-3.5% compared with FY2000	keeping the target		

Considered in the reference case

Considered in the technology case

Assumption of Efficiency of Electric Appliances (in Stock Base)



(Y2004=100)

	Total Eff. of Home App.	
	Reference	Technolgy
1980	116	
2004	100	
2010	89	87
2030	70	61

■LCD television set: Improvement in panel transmittance, electricity saving in backlight fluorescent tube, etc. are expected.
■PDP television set: Improvement in panel structure, luminescence efficiency of fluorescent material, etc. are expected.

Standby Power, High Efficiency Water Heater

[Reduction of Standby Power]

■**VTR**

- Top runner standards. –58.7% in FY2003 compared with FY1997.

■**JEITA** (Japan Electronics and Information Technology Association)**, JEMA** (Japan Electrical Manufacturers' Association)

- Voluntary target "less than 1W" was achieved at the end of FY2003.

■**JRAIA** (Japan Refrigeration and Air Conditioning Industry Association)

- Voluntary target "less than 1W" was achieved at the end of refrigeration year 2004.

■**JGKA** (Japan Industrial Association of Gas and Kerosene Appliances)

- Voluntary target "less than 1W for fan heaters, less than 2W for water heaters by the end of FY2008".

[High Efficiency Water Heater]

■**CO_2 refrigerant heat pump water heater "Eco Cute": Electricity**

- With the principle of heat pump, about 3 times of heat energy as consumed electricity is available (COP=3).

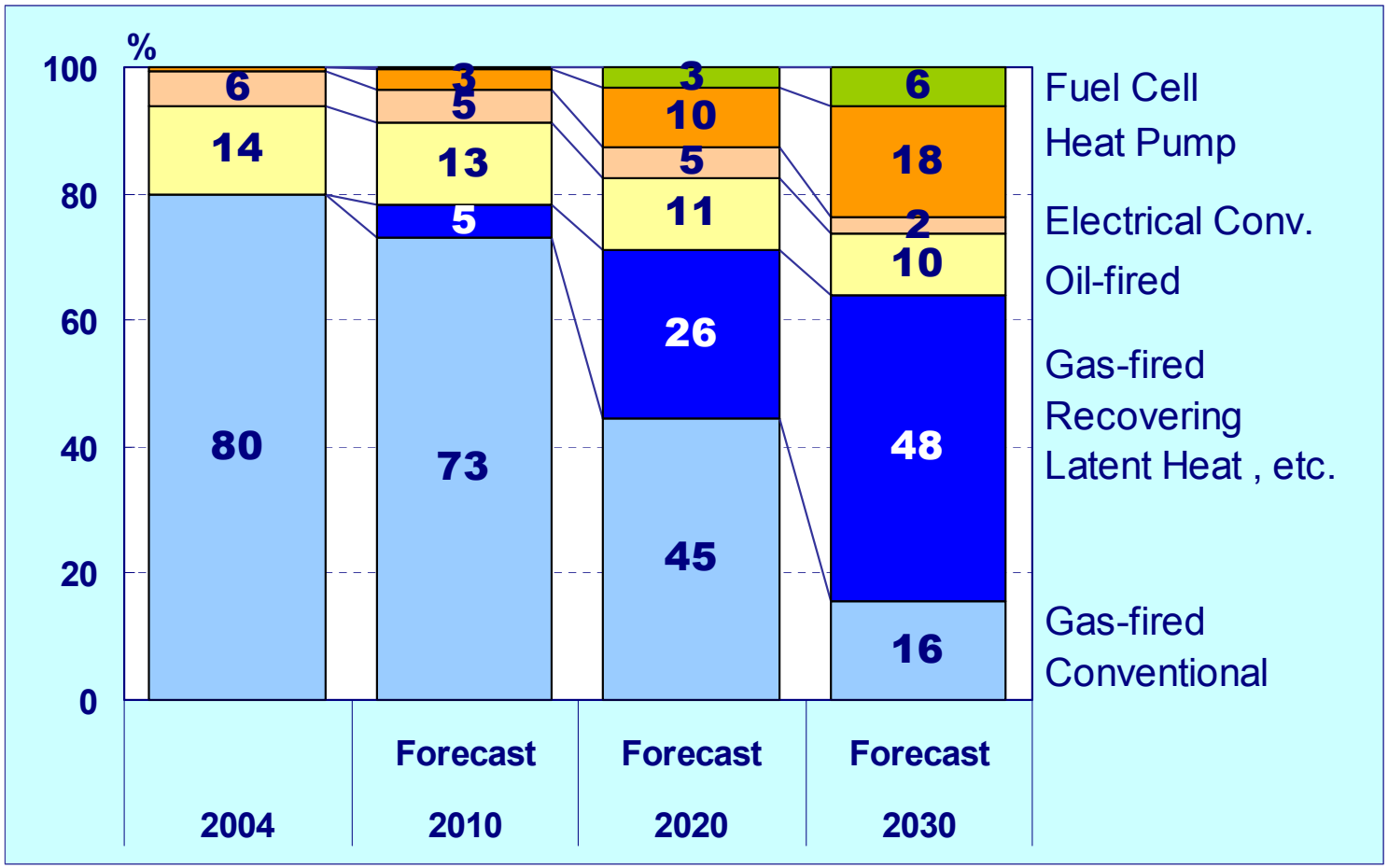
■**Water heater recovering latent heat "Eco Jozu": Gas**

- By preheating with latent heat, increasing thermal efficiency by about 15%.

■**Gas fired engine type water heater "Eco Will": Gas**

- One of gas fired cogeneration systems. Total efficiency is about 80%.

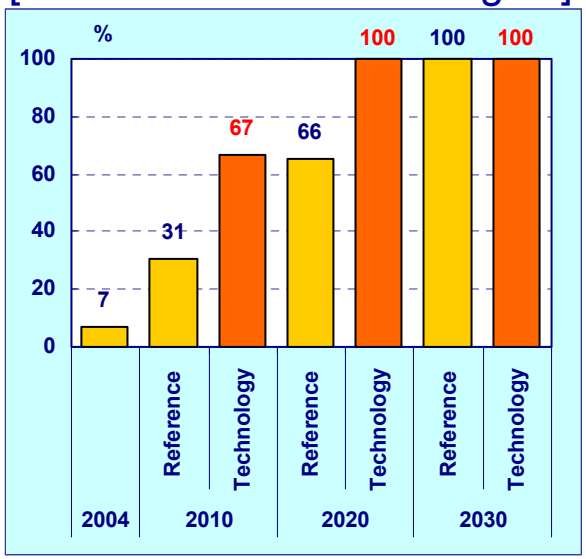
Share of Residential Water Heater Owned



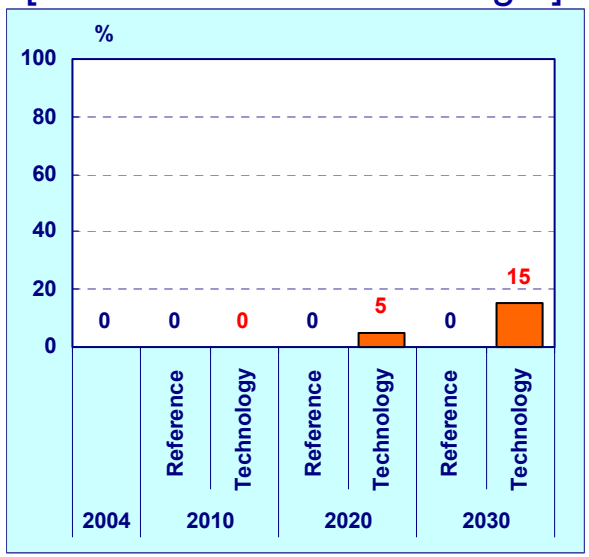
■Assumption:
- Recovering latent heat type occupies 100% in gas fired water heater sold in 2030.
- Heat pump type occupies 100% in electric water heater sold in 2030.

High Efficiency Light, Energy Management

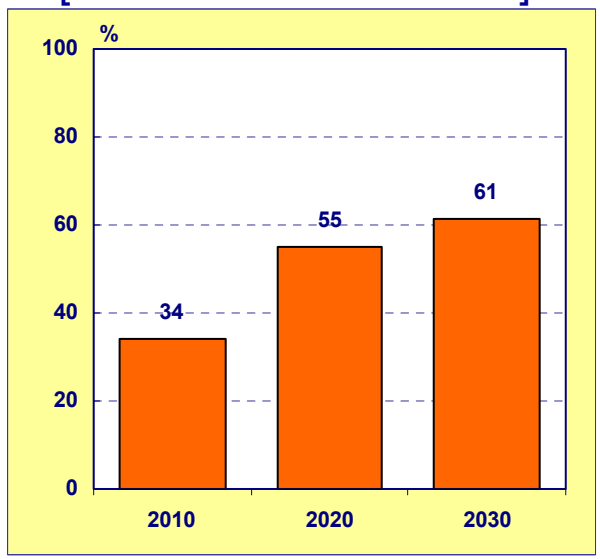
[Diffusion Rate of LED Signal]



[Diffusion Rate of LED Light]



[Diffusion Rate of BEMS]



■LED (Light Emitting Diode) Lighting

- Luminescence efficiency is as same as fluorescent light now and being improved from now on. Because of high cost, LED is not used as general lighting but as traffic signal evaluated in a long life and clear visibility.
- In the technology development case, it is assumed that LED signal will be diffused as fast as in Tokyo, and diffusion of LED general lighting will be started from mid-2010s.

■BEMS (Building Energy Management System), HEMS (Home Energy Management System)

- By IT, BEMS/HEMS manage energy use automatically or remotely.
- Energy conservation by BEMS is assumed 3% in the reference case and 10% in the technology development case respectively. HEMS is assumed that its diffusion is limited in the both cases.

House Insulation, Building Energy Efficiency

[House Heat Insulation]

■**Latest standards("1999 Standard") was introduced by the law revision in 1999.**

- "1999 Standards" is stricter by one level compared with "1992 Standards".
- "1999 Standards" is almost same as standards in European countries or the United States.

■**Target by the government: More than 50% as share of "1999 Standards" in new dwelling started after FY2008.**

[Building Energy Efficiency]

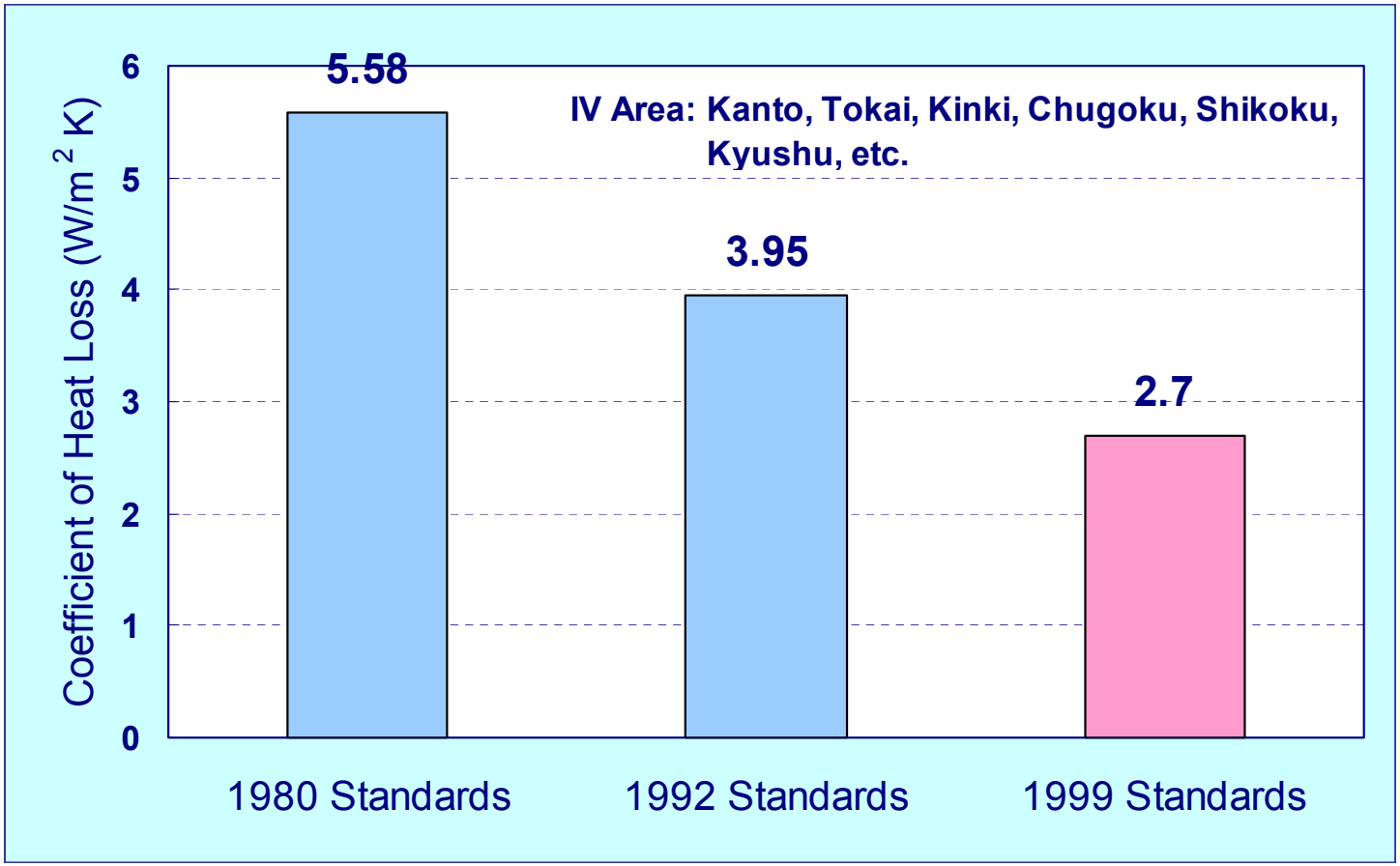
■**The energy conservation law imposes rationalized energy use in buildings, whose floor space is more than 2,000m^2.**

- Prevention of heat loss
- Efficient use of energy for air conditioning, lighting, water heating and lifting.

■**Target by the government: More than 80% as share of compliance building in new building construction started after FY2006.**

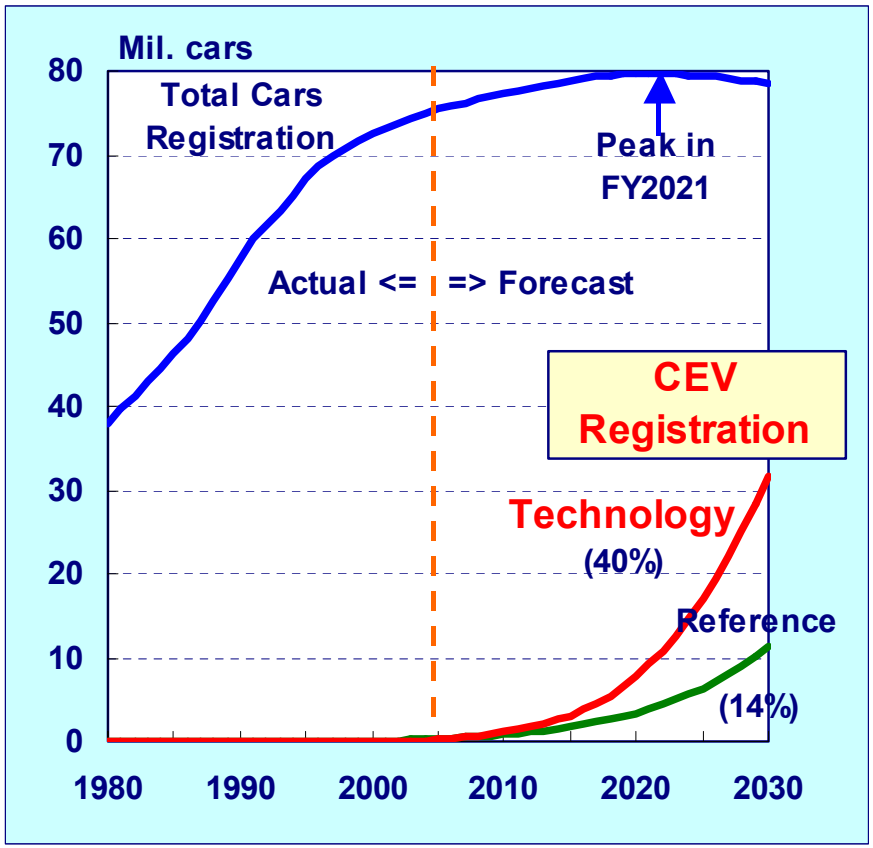
Standard Coefficient of Heat Loss for Residences

(Common for both cases)



- "1999 Standards" is almost same as ones in European countries and the United States.
- Efficiency of residences in stock base improves slowly.
  - Residences have long life.
  - Standard of heat transfer is "nonbinding target" not duty.

Clean Energy Vehicles(CEV)



Upper: Reference / Lower: Technology (1000 units)

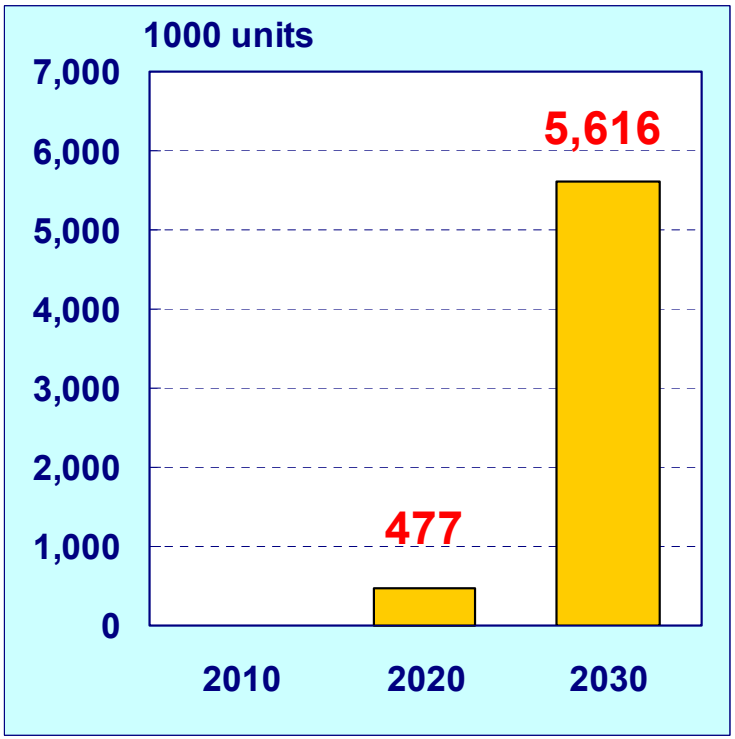
	Actual		Forecast		
	FY2003	FY2004	FY2010	FY2020	FY2030
Hybrid Vehicles	133	196	705	3,135	10,673
			1,009	7,021	25,532
Fuel Cell Vehicles	0	0	5	30	75
			6	477	5,616
Natural Gas Vehicles	21	25	43	128	342
			43	128	342
LPG Trucks	29	31	57	112	149
			57	112	149
CEV total	183	252	811	3,405	11,238
			1,116	7,738	31,638

■The diffusion of hybrid vehicles is accelerated in earlier stage and commonly seen in 2030. Fuel cell vehicles (FCV) also start to be diffused into the market in full swing around 2020, when their prices decline to the rival levels.

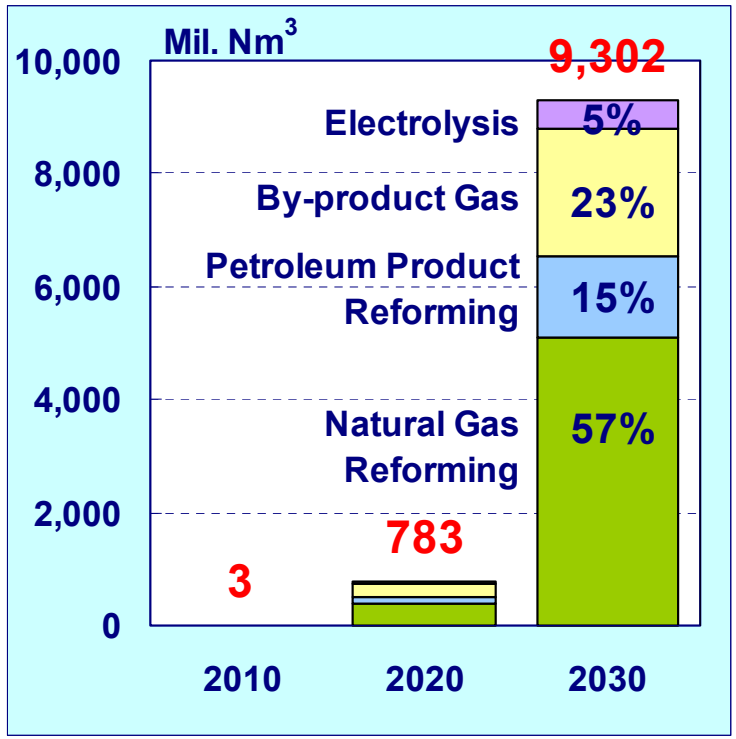
■We assume natural gas vehicles and LPG trucks are the same levels of the Reference because of spread of FCV, which would have economical and environmental advantage.

Fuel Cell Vehicles and Hydrogen supply

[FCV Registration]

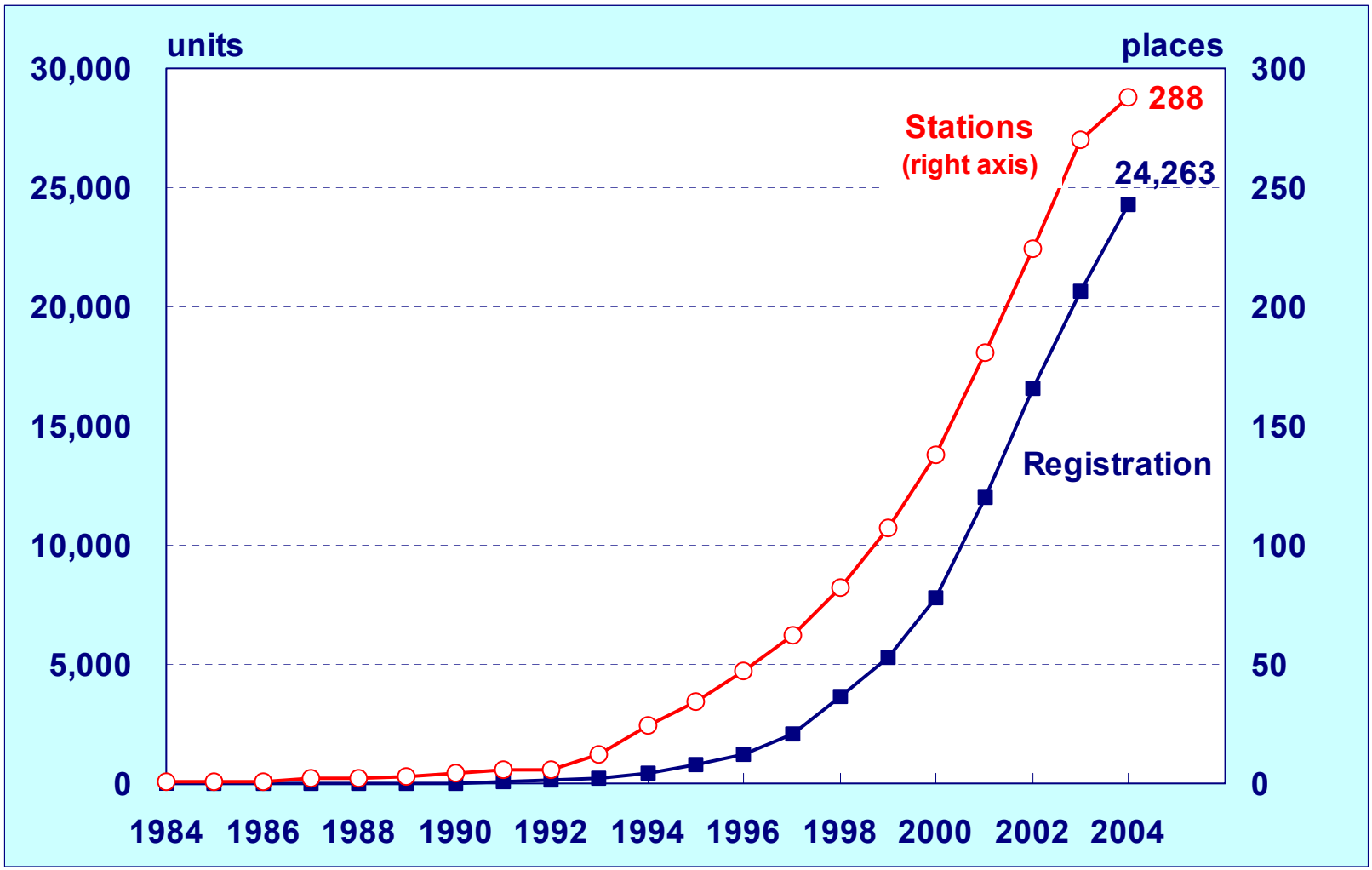


[Hydrogen Supply]



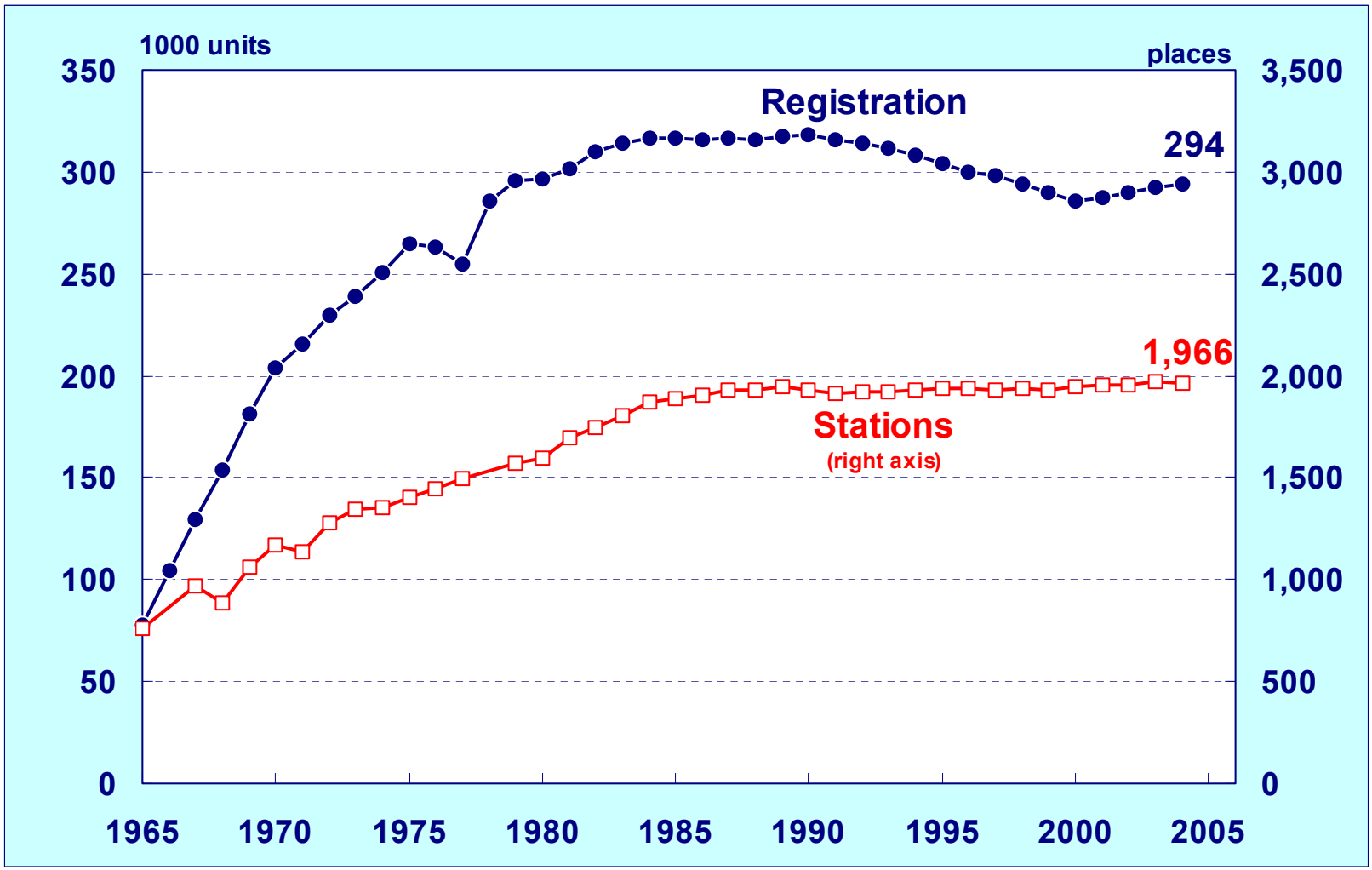
■We assume FCV adopt the Off-board system (filling hydrogen directly), not the On-board system(reforming to hydrogen on the car), whose technology is thought to be difficult.
■The Off-site system mainly adopts the by-product gas, the LNG reforming, and the petroleum product reforming at large-scale concentrated plants, while the On-site system mainly adopts the city gas reforming at each station.
■The electrolysis remains limited due to high production cost. Until 2030, the electrolysis by the renewable energy electric power is not likely.

<ref.> CNG Vehicles and Stations



■It is necessary to expand the number of filling stations as a requirement for the spread of CNGV.

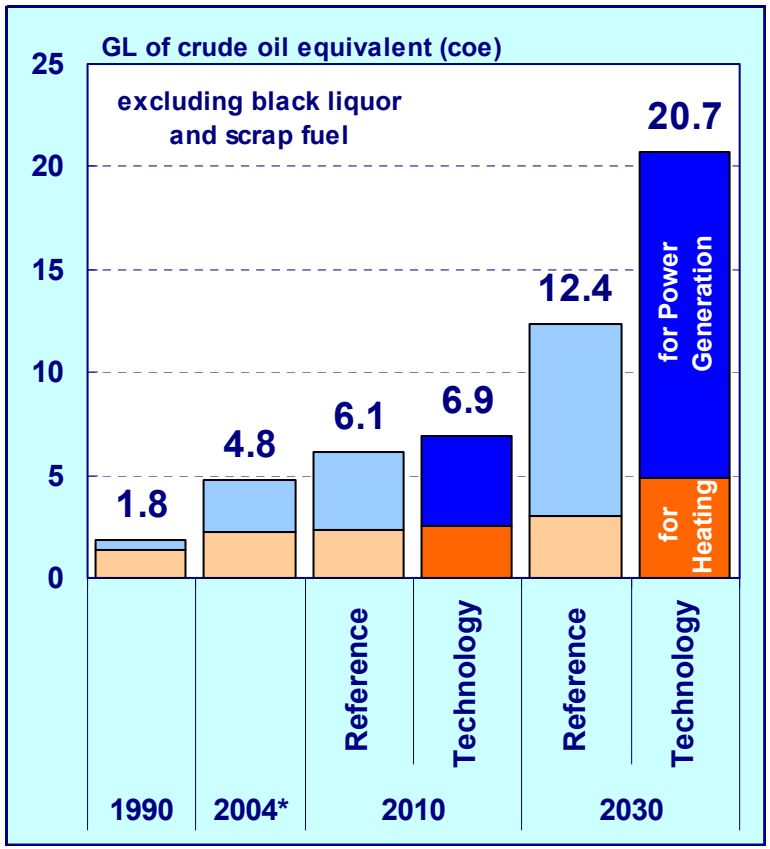
<ref.> LPG Vehicles and Stations



■It might be difficult to popularize LPGV because both registration and filling station have already reached the saturated levels.

New Energy Utilization Outlook

[Utilization Amounts]



[Breakdown]

(GL of crude oil equivalent)

		2004*	2010		2030	
			Refe-rence	Tech-nology	Refe-rence	Tech-nology
for Power Generation	Photovoltaic Power	0.3	0.8	1.3	3.6	8.1
	Wind Power	0.4	0.6	0.7	2.3	4.1
	Waste-Burning Power	1.6	2.1	2.1	3.0	3.1
	Biomass Power	0.2	0.3	0.3	0.5	0.5
for Heating	Solar Heating	0.6	0.4	0.4	0.3	0.4
	Waste-Burning Heating	1.7	1.7	1.8	1.7	1.8
	Biomass	0.0	0.2	0.2	0.9	2.5
	Utilization of Untapped Energy	0.0	0.1	0.1	0.2	0.2
New Energy Total		4.8	6.1	6.9	12.4	20.7
Black Liquor and Scrap Fuel		4.6	4.9	4.9	5.5	5.5
Total (incl. black liquor,etc)		9.4	11.0	11.8	17.9	26.2

2004*: Estimated

■Photovoltaic and wind power generation are mainly progressing. Waste-burning and biomass power generation are the almost same levels of the Reference due mainly to supply restrictions.

■The introduction of biofuels (E10) for automobiles is assumed.

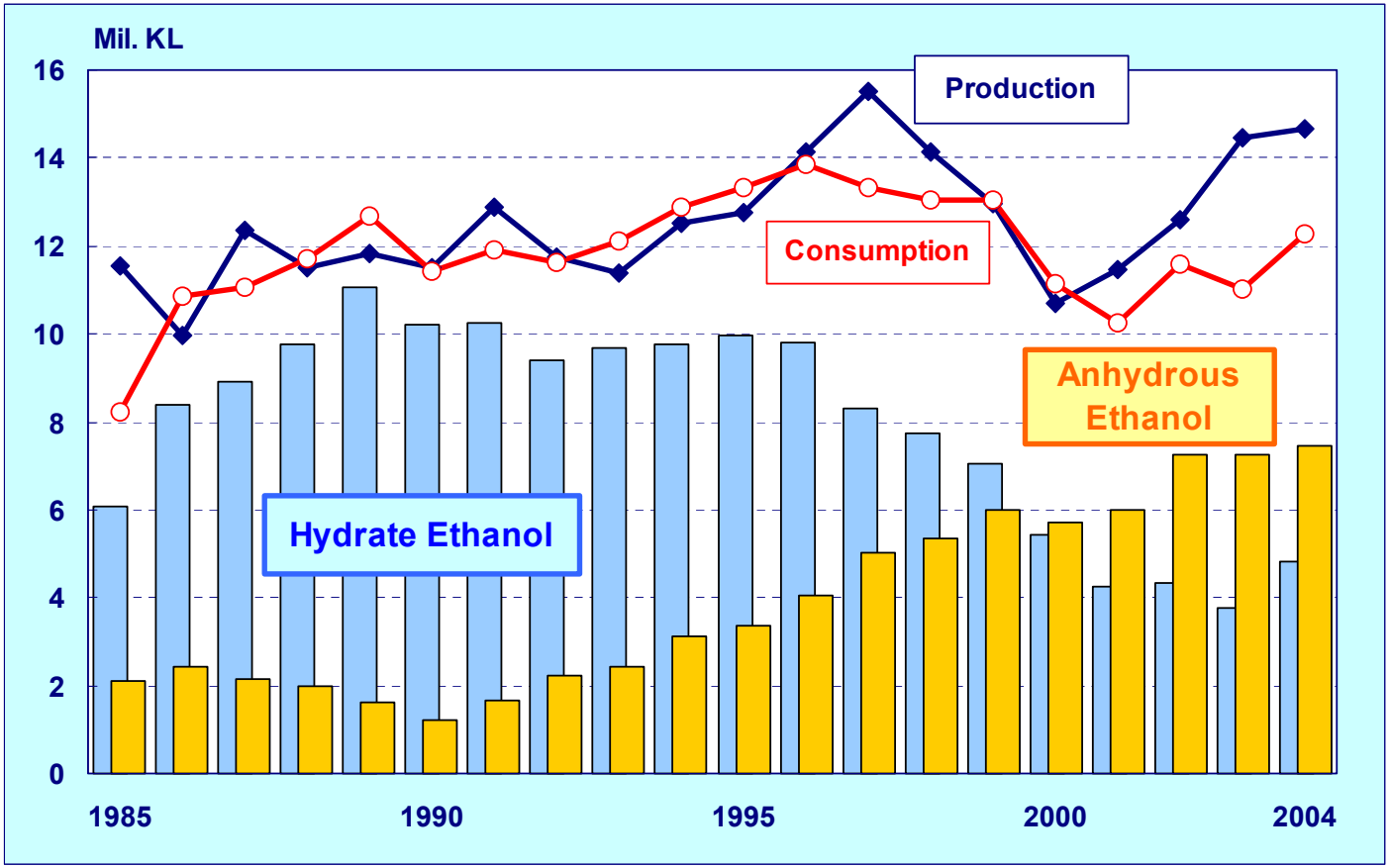
Introduction of Biofuels (Ethanol)

- **Reference Case**
  :Introduction of E3 is assumed after 2010.
  Amount of necessary ethanol:1.6GL
- **Technology Development Case**
  :Introduction of E10 is assumed after 2020.
  Amount of necessary ethanol: 4.6GL

<ref.> Present Condition in Brazil

- The law obliges gasoline sold in Brazil to mix with anhydrous ethanol by 20%.
- Volkswagens sold the first Flex-Fuel Vehicle in March 2003 and now 29 models are on sale. FFV can use gasoline mixing with hydrate ethanol by any ratio.

<ref.> Ethanol Production in Brazil

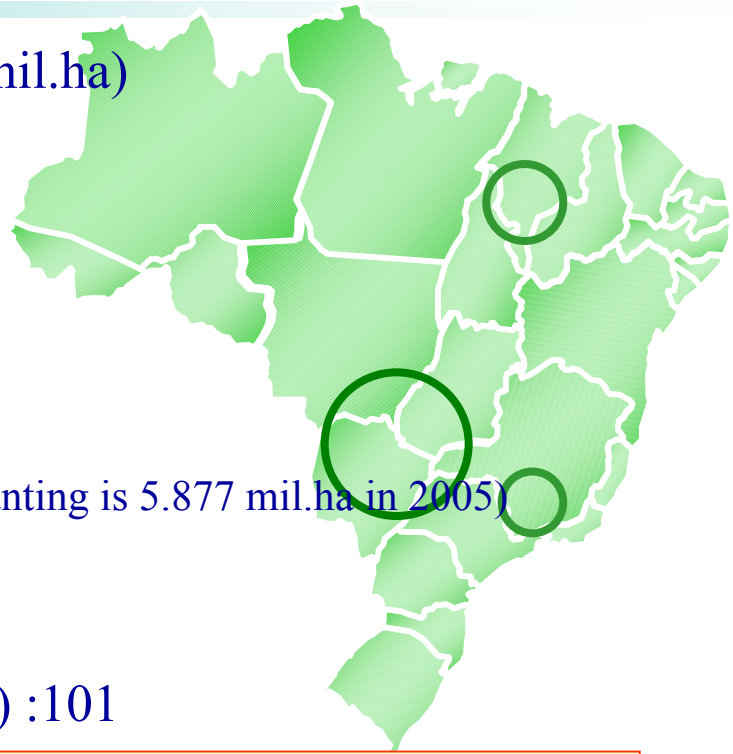


■The ethanol production in Brazil in 2004 is 14.65GL. 12.29GL are for automobile fuel and other 2.27GL are exported.
■Anhydrous ethanol (7.45GL) is for the gasoline mixture, while hydrate ethanol (4.84GL) is for the gasoline substitution.

(note) Ethanol production and export in 2005 seem to have reached 18.49GL and 2.80GL respectively.
Of 436.78 million tons of total sugarcane production, 178.37 million tons were used for ethanol.

<ref.> Acreage for Sugarcane Planting in Brazil

(1)Total Land Area :851 mil.ha (cf. Japan :37.7 mil.ha)
(2)Amazon Forest Area :350
(3)Preservation Region :55
(4)City, River and Road :20
(5)Pasture :220
(6)Farmland for yearly plant :47
(7)Permanent Farmland :15(Acreage for sugarcane planting is 5.877 mil.ha in 2005)
(8)Woodlot :5 Total of (2)-(8) :712
(9)Others(Unsuitable area for farmland) :38
(10)Unused Area(sugarcane production potential) :101



The production increase of one million KL ethanol is possible if unused area is used. But the investment of 120 million dollars or more is required. The distillation facility and the pipelines for transportation are also needed.

Ethanol yield per sugarcane :80L/ton
Ethanol yield per sugarcane farmland :6KL/ha
Investment for sugarcane farmland :$730/ha
Production cost of ethanol :$200/KL=$31.7/BBL(2005, Ministry of Mine and Energy)

Assumption on Power Generation Technology

[Power Fuel Cell]

- The diffusion is expected to be promoted due to cost reduction with technology innovation.
- The diffusion rate for households in 2030 is 6%.

(MW)

	2010	2020	2030
Technology Development	**287**	**2,730**	**4,992**
Reference	16	51	146

[MACC]

MACC: More Advanced Combined Cycle

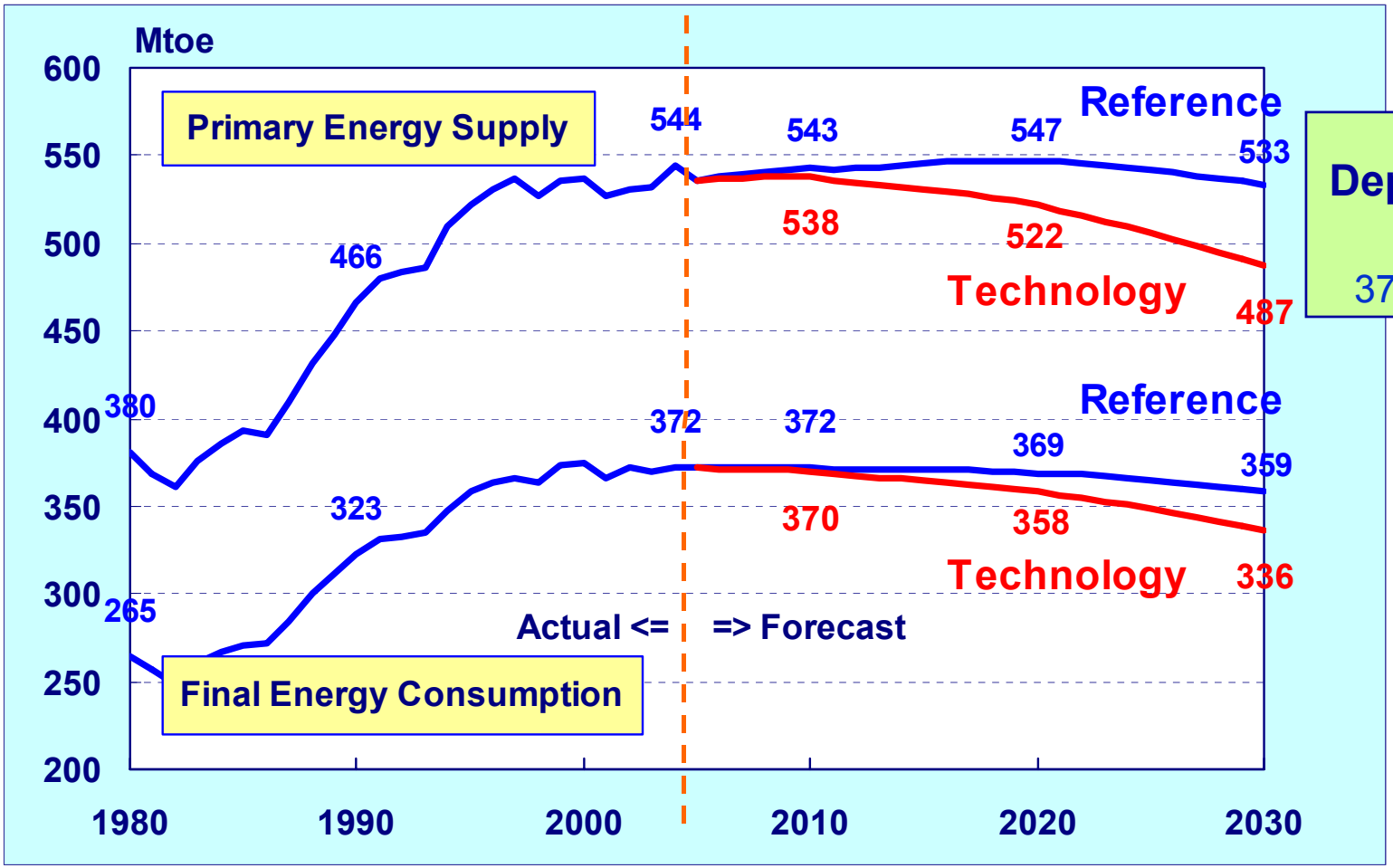
- The power generation efficiency is improved by adjusting the temperature of the gas to 1,450 °C or more.

  - Tokyo Electric Power Company will substitute MACC whose efficiency is about 53% for an old-fashioned LNG thermal power at Kawasaki power station.

Technology Development Case

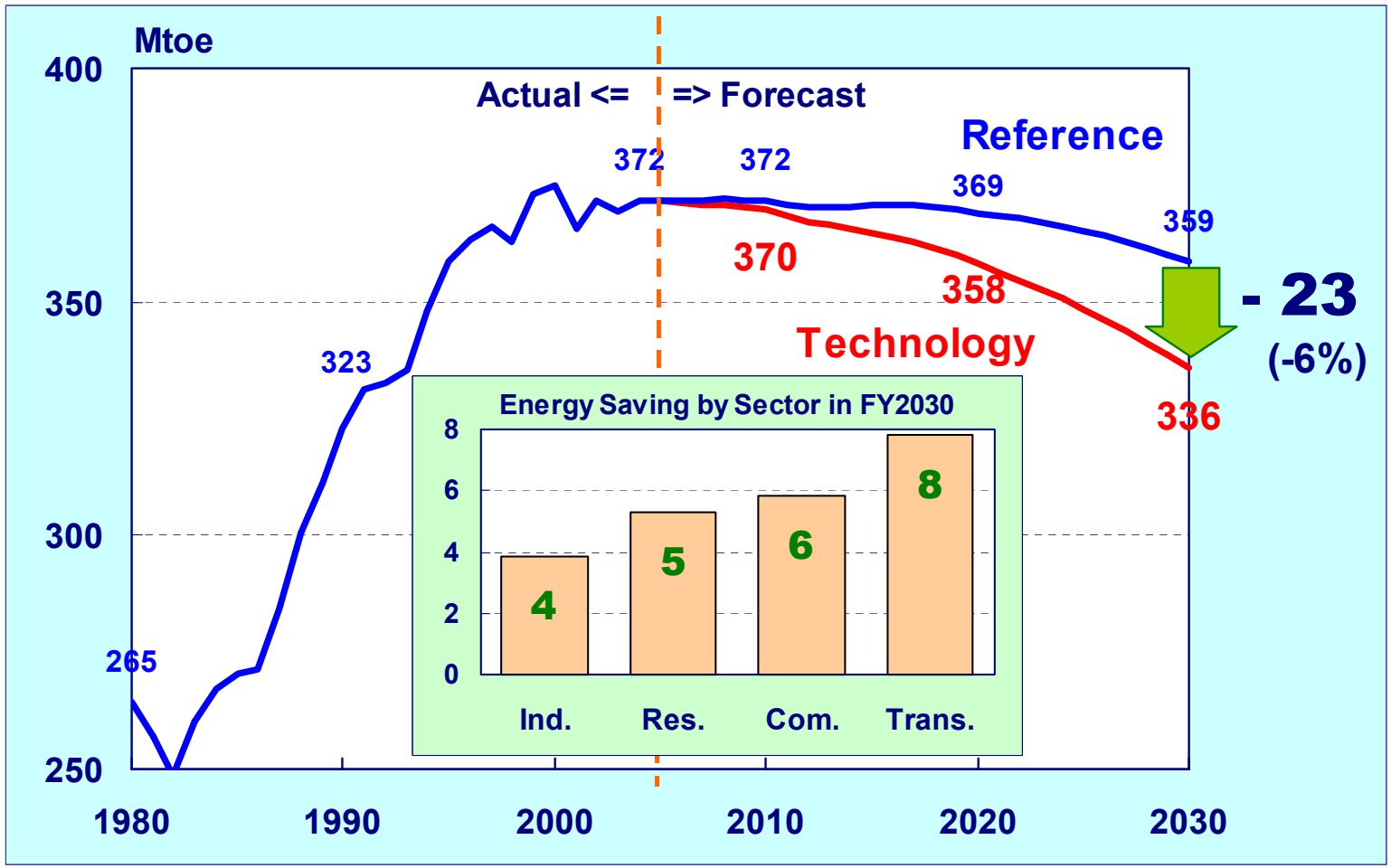
Estimate Result

Primary Energy and Final Energy



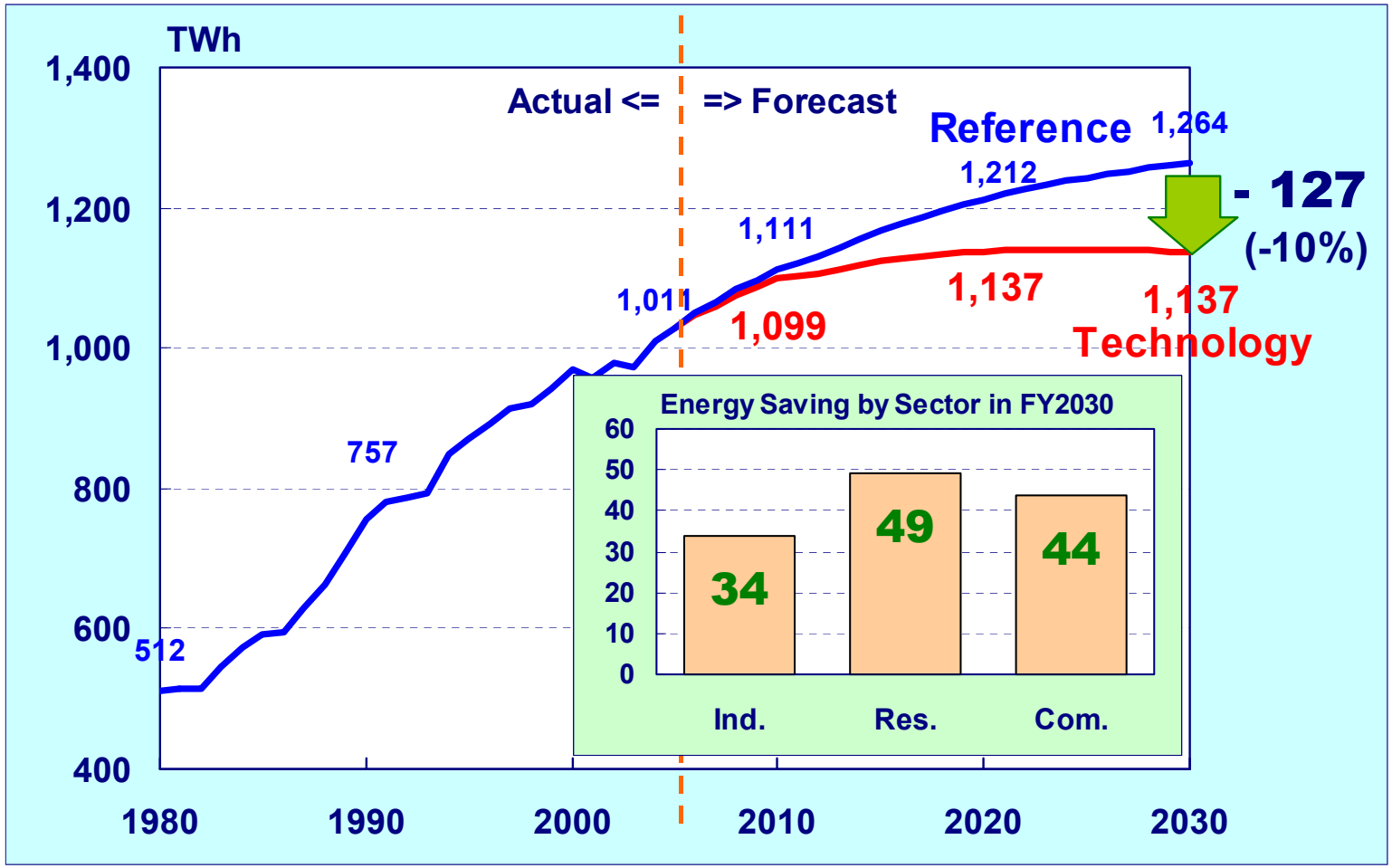
■The effect of technological progress becomes visible gradually after 2010.
■The effect of the primary energy supply is larger than one of the final energy consumption. That would be because efficient use of energy in the transformation sector (ex. saving electricity use, energy conservation in the coke manufacturing and popularization of distributed power generation system) progresses.

Final Energy Consumption



■About one-third of the reduction of energy depends on the transportation sector due mainly to diffusion of the clean energy vehicle.

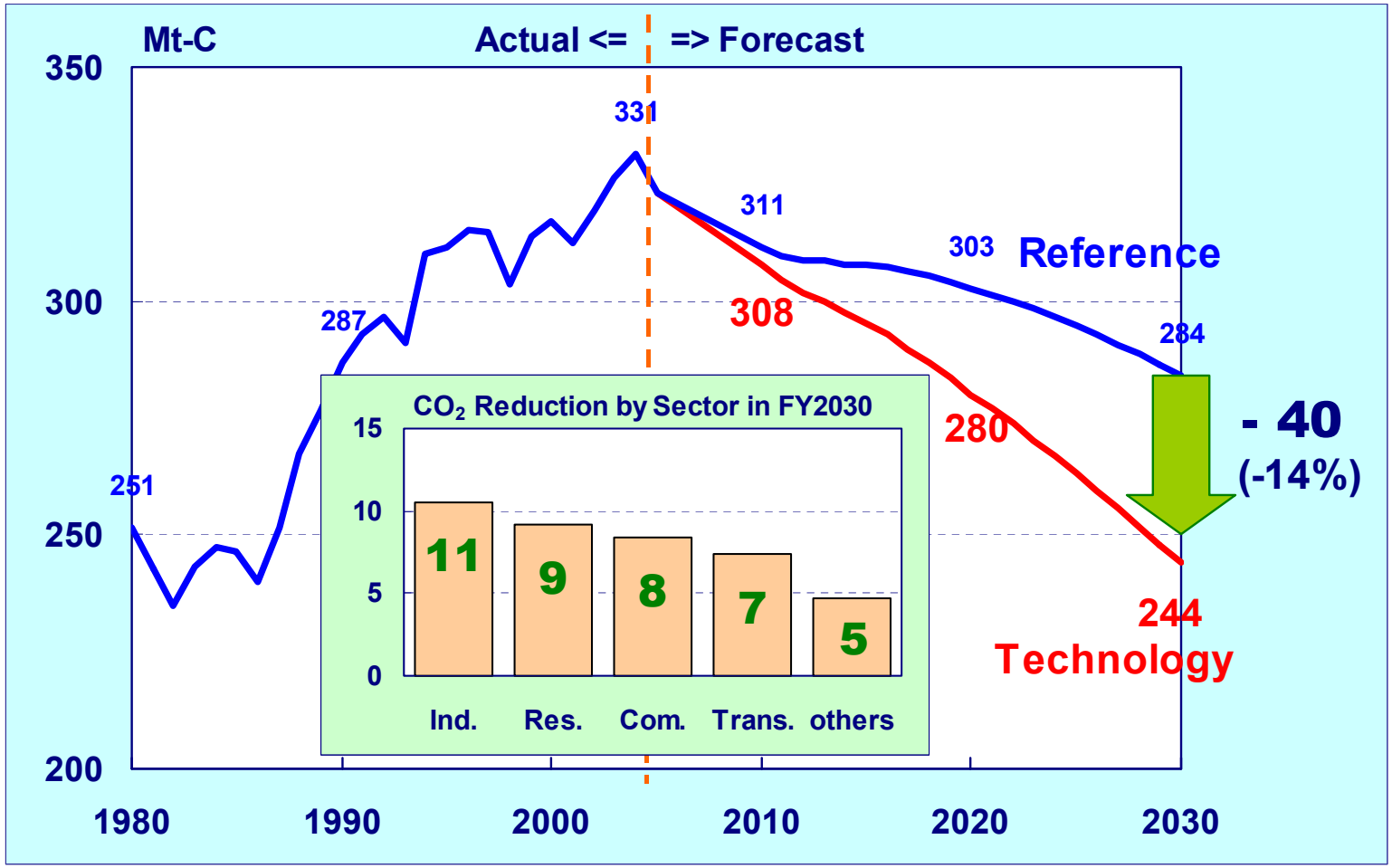
Electricity Demand



■The efficiency improvement of electrical appliances progresses in the residential and commercial sector.

■The electricity demand in Technology Development Case reaches the peak in middle of 2020's.

CO_2 Emission



(note)CO_2 emitted in generating power and manufacturing hydrogen are distributed to each sector.

■The CO_2 emission reductions in the industry sector and the residential and commercial sector are larger than other sectors, because of the electricity demand saving in the sectors and the efficiency improvement in power generation, which have a big impact for primary energy reduction.

Factor Analysis of CO_2 Emission

(annual change rate%)

		FY1973-1990	FY1990-2004	FY2004-2030	
				Reference	Technology
Change of CO_2 emission	ΔC	**0.8**	**1.0**	**-0.6**	**-1.2**
Decarbonization	Δ(C/E)	**-0.7**	**-0.1**	**-0.5**	**-0.8**
Energy Saving	Δ(E/Y)	**-2.1**	**0.0**	**-1.5**	**-1.9**
Economic Growth	ΔY	**3.8**	**1.1**	**1.5**	**1.5**

The change of CO_2 emission is decomposed into the three factors below.

$C = (C/E) * (E/Y) * Y$

$\Delta C = \Delta(C/E) + \Delta(E/Y) + \Delta Y$

Decarbonization ↑ Energy Saving Economic Growth

Sensitivity Analysis

- High Economic Growth Case
- High Oil Price Case

Case Setting

[High Economic Growth Case]

●0.5% point is added to the reference case GDP growth rates for the high economic growth case.

	2010/2004	2020/2010	2030/2020
High Growth	2.5	2.0	1.6
Reference	2.0	1.5	1.1

[High Oil Price Case]

●Crude oil price (Japan import CIF) increases to $60/bbl in real term in 2030.

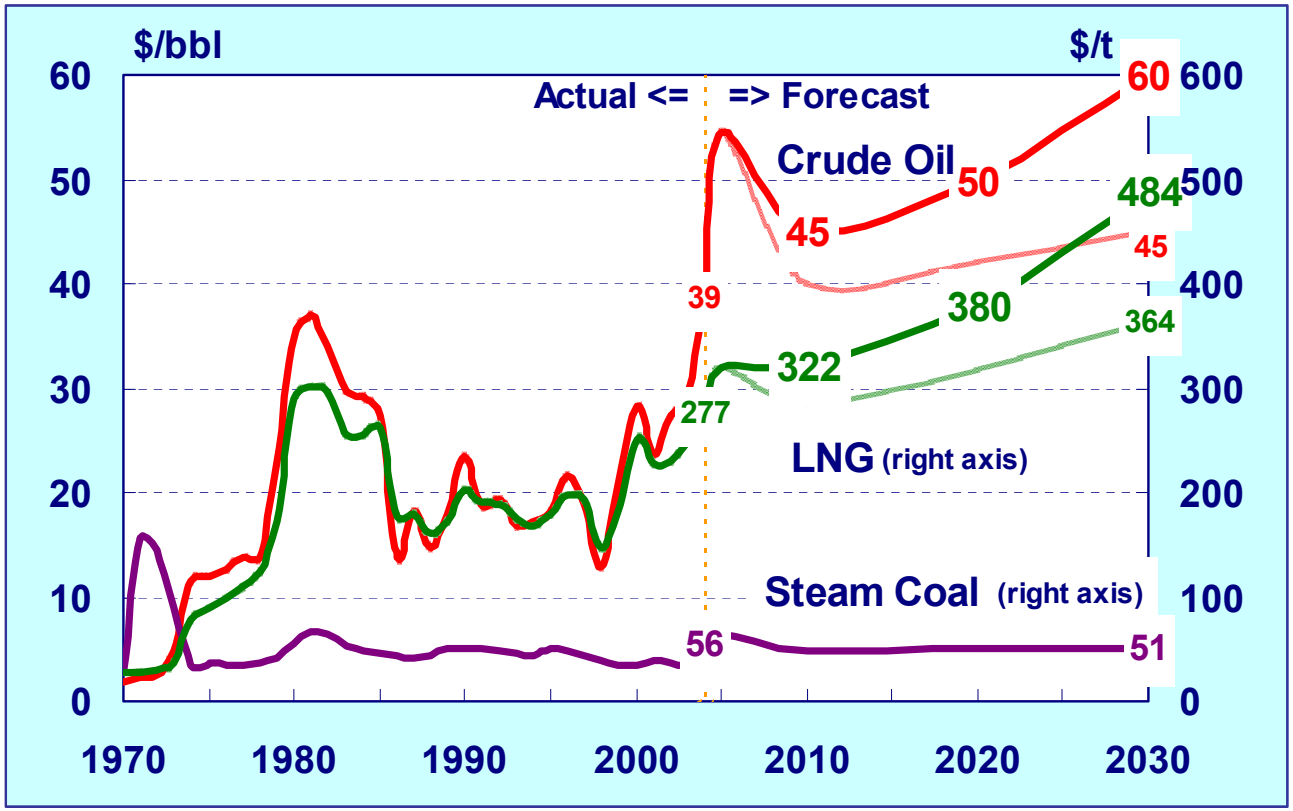
●In addition, LNG price increases, linked to the crude oil price.

(*) Real price is in 2004 price.

		real price				nominal price			
		2004	2010	2020	2030	2004	2010	2020	2030
Crude Oil	High-price	39	45	50	60	39	51	69	100
$/bbl	reference		40	42	45		45	58	75
LNG	High-price	277	322	380	484	277	363	522	810
$/t	reference		286	317	364		322	435	609
Steam Coal	High-price	56	49	50	51	56	55	69	85
$/t	reference		49	50	51		55	69	85

●Increase in energy price reduces GDP growth rate by 0.2% point per annum.

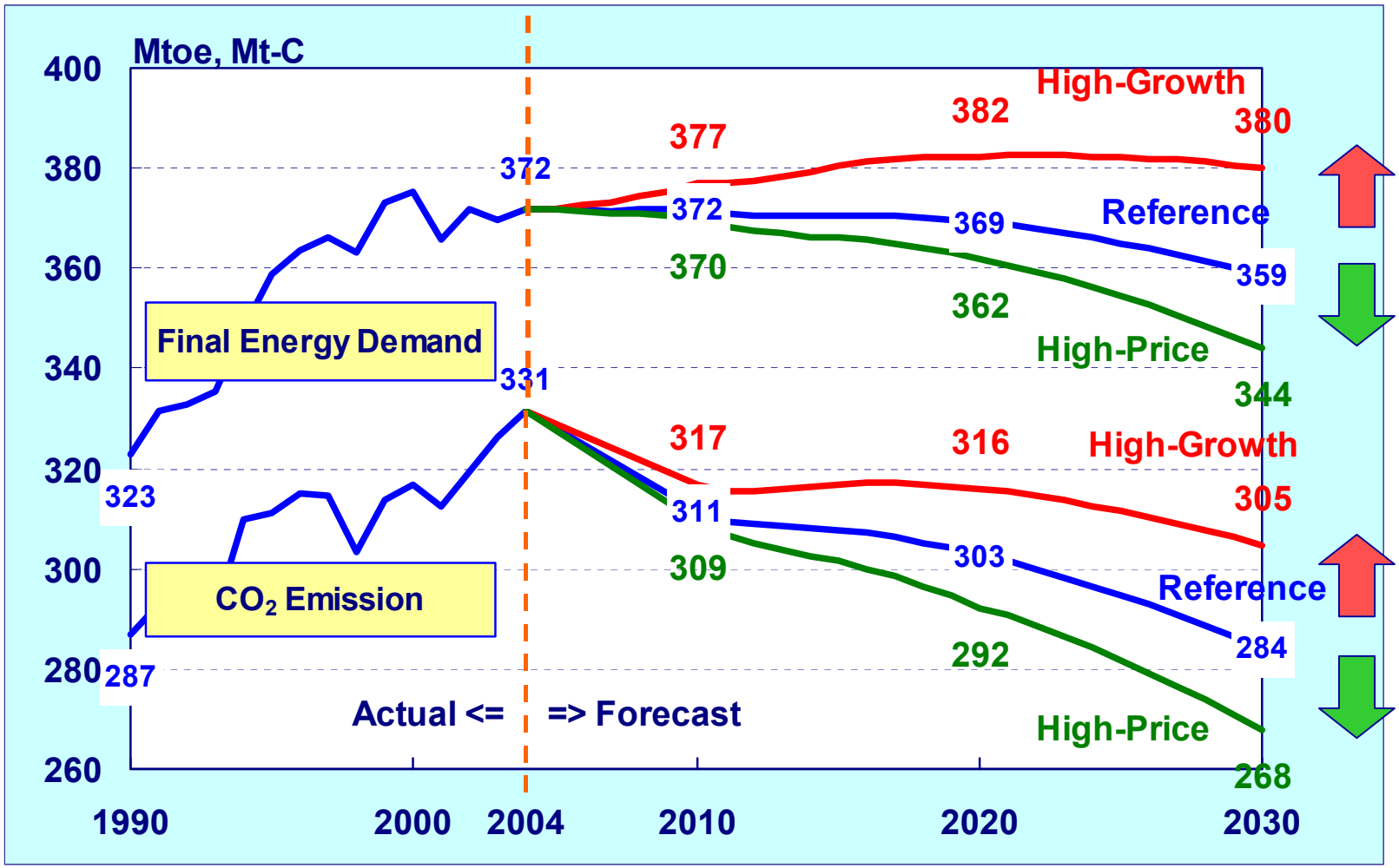
Assumption in the High Oil Price Case



Note: Price in forecast period is in 2004 price.

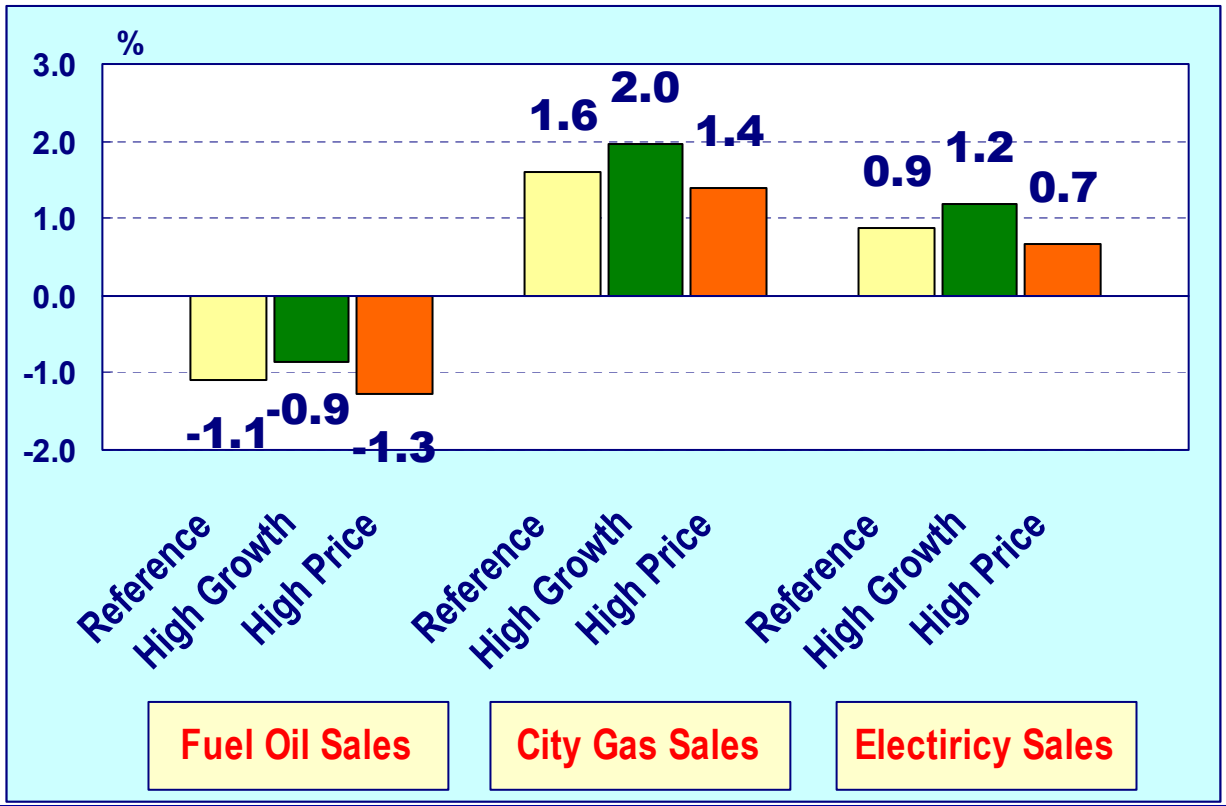
■Because of insufficient investment for oil development, the crude oil market is tightened compared with the reference case.
■Crude oil price and LNG price are higher than in the reference case by 33% in 2030.
■High prices of crude oil and LNG affect coal price a little bit.

Comparisons between Cases (TFEC, CO_2)



Comparisons between Cases (By Energy)

[Average Annual Growth Rate (%) 2004-2030]



■Business sector is more affected by economic growth and prices than households.
■In the high economic growth case, city gas consumption is accelerated in industry, commercial sector and autoproducers of electricity. In addition, electricity demand is increased by growth in machineries production, etc.
■High price case includes economic slowdown effect. In terms of price effect in a narrow sense, reduction in fuel oil sales is notable.

Comparisons between Cases (Summary)

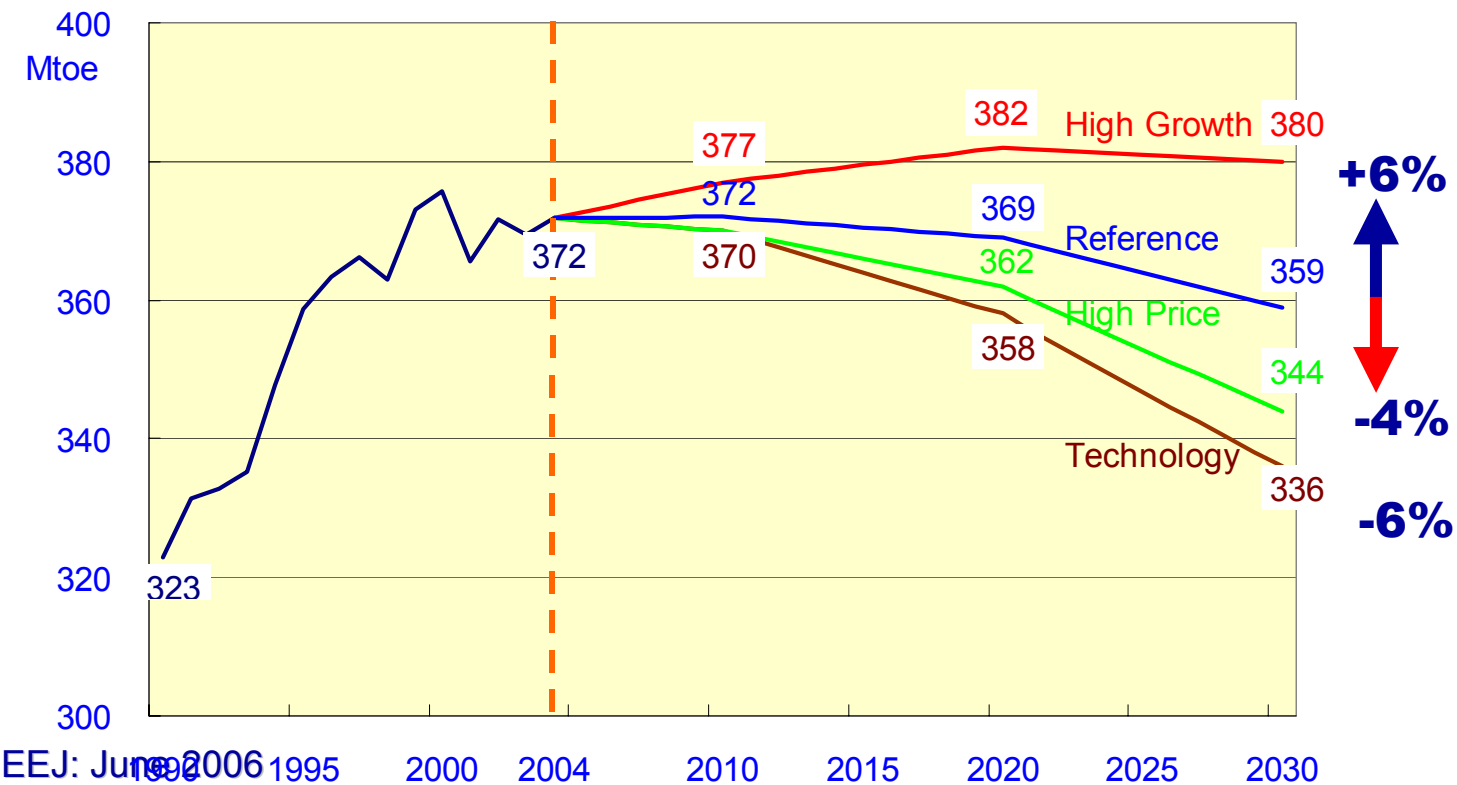
		Actual		Forecast			Divergence Rate from Ref.			Average Annual Growth Rate (%)				
		1990	2004	2010	2020	2030	2010	2020	2030	2004 /1990	2010 /2004	2020 /2010	2030 /2020	2030 /2004
CO_2 Emission Mt-C	Reference	287	331	311	303	284				1.0	-1.0	-0.3	-0.6	-0.6
	Technology			308	280	244	-1.1	-7.4	-14.1		-1.2	-0.9	-1.4	-1.2
	High Growth			317	316	305	1.6	4.4	7.3		-0.8	0.0	-0.4	-0.3
	High Price			309	292	268	-0.7	-3.4	-5.7		-1.1	-0.6	-0.9	-0.8
TPES Mtoe	Reference	466	544	543	547	533				1.1	0.0	0.1	-0.3	-0.1
	Technology			538	522	487	-0.9	-4.7	-8.6		-0.2	-0.3	-0.7	-0.4
	High Growth			551	566	566	1.5	3.5	6.1		0.2	0.3	0.0	0.2
	High Price			539	536	511	-0.6	-2.1	-4.1		-0.1	-0.1	-0.5	-0.2
TFEC Mtoe	Reference	323	372	372	369	359				1.0	0.0	-0.1	-0.3	-0.1
	Technology			370	358	336	-0.5	-3.0	-6.4		-0.1	-0.3	-0.6	-0.4
	High Growth			377	382	380	1.4	3.6	6.0		0.2	0.1	-0.1	0.1
	High Price			370	362	344	-0.5	-2.0	-4.1		-0.1	-0.2	-0.5	-0.3
Fuel Oil Sales Million kL	Reference	218	237	221	202	179				0.6	-1.1	-0.9	-1.2	-1.1
	Technology			221	195	160	-0.3	-3.8	-10.5		-1.2	-1.3	-1.9	-1.5
	High Growth			224	209	189	1.3	3.4	5.7		-0.9	-0.7	-1.0	-0.9
	High Price			220	198	170	-0.7	-2.3	-5.1		-1.3	-1.1	-1.5	-1.3
City Gas Sales Billion m^3	Reference	15.4	30.1	36.1	41.5	45.5				4.9	3.0	1.4	0.9	1.6
	Technology			35.8	38.9	42.9	-0.7	-6.3	-5.6		2.9	0.8	1.0	1.4
	High Growth			36.7	43.7	50.0	1.9	5.3	9.9		3.4	1.7	1.4	2.0
	High Price			35.9	40.5	43.1	-0.5	-2.5	-5.3		2.9	1.2	0.6	1.4
Electricity Sales TWh	Reference	678	892	983	1,071	1,116				2.0	1.6	0.9	0.4	0.9
	Technology			968	988	975	-1.5	-7.8	-12.7		1.4	0.2	-0.1	0.3
	High Growth			998	1,123	1,210	1.6	4.8	8.4		1.9	1.2	0.7	1.2
	High Price			977	1,044	1,061	-0.6	-2.6	-5.0		1.5	0.7	0.2	0.7

Summary and Implications

Summary of Forecasts(1)

●Due to the maturing of the economy, population decrease and progress in energy-saving, final energy consumption decreases. (refer to 106th slide)

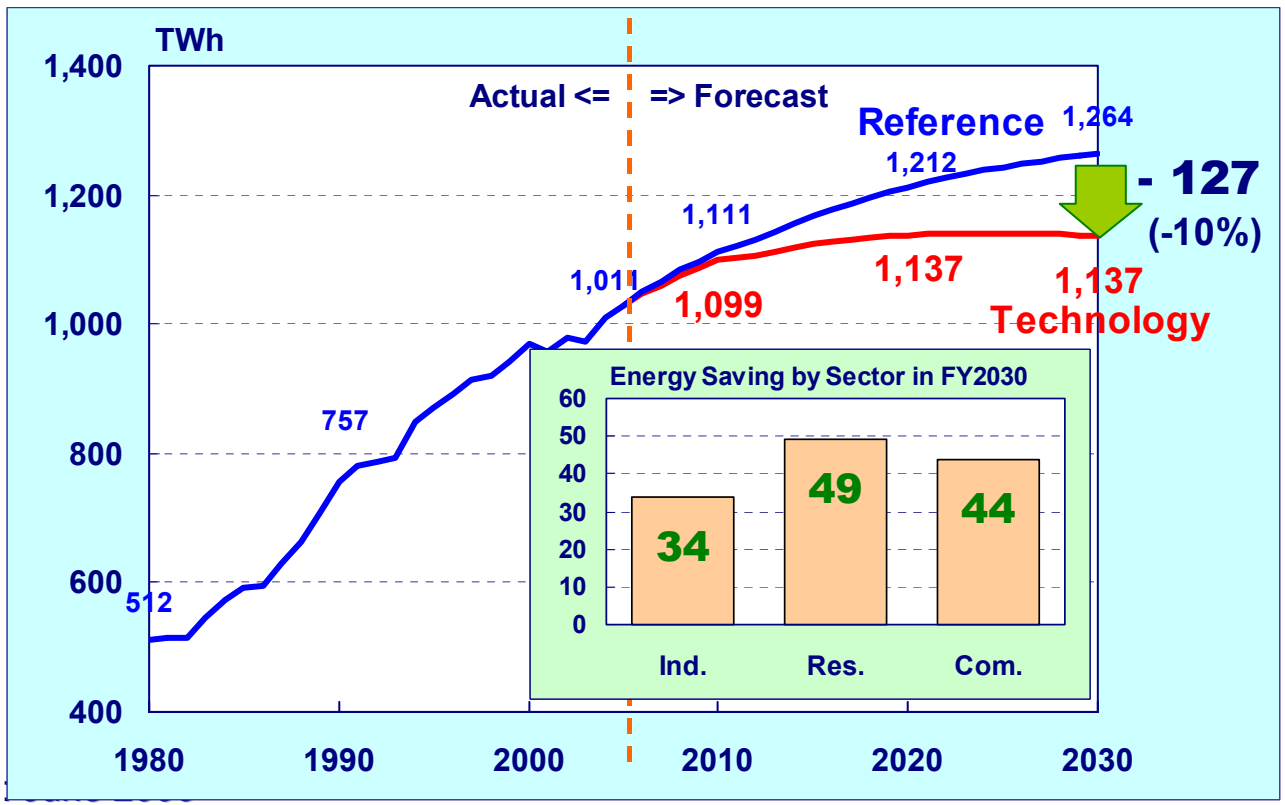
- Final energy consumption peaked in FY2000.
- The consumption in 2030 will be 4% less than the 2004 level.
- Technology; -6%, High growth; +6%, High price; 4%, in 2030 compared with Reference case.



Summary of Forecasts(2)

- **Electricity demand grows due to pursuit of amenity and convenience in res. & com. sector and a shift to process-assemble products in industrial sector, but growth slows down gradually.** (refer to 100th slide)

- With Technology case, the demand will level out after 2020, thanks to further improvement in efficiency of household electric appliances.



Summary of Forecasts(3)

●Gas demand, particularly in industrial and commercial sectors, grows due to such advantages as environmental friendliness and convenience. (refer to 68th and 108th slide)

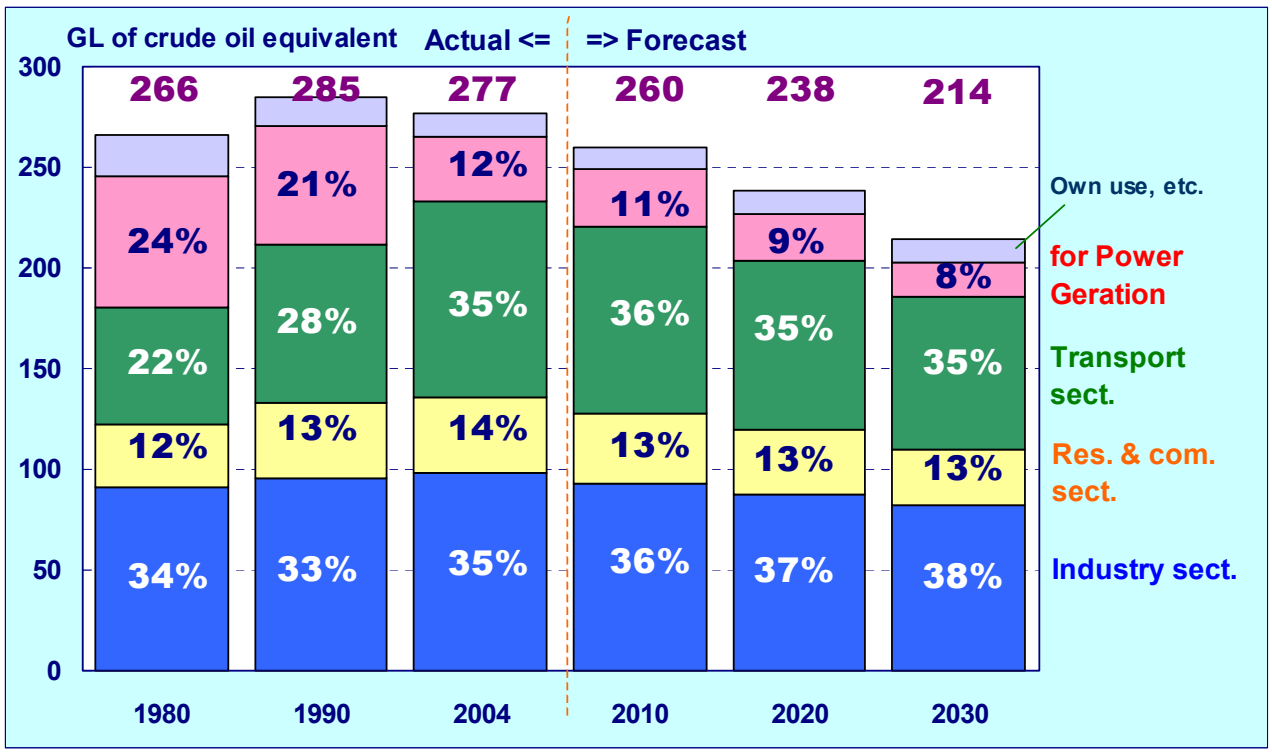
(Bil. m^3)

	Actual				Forecast						Average Annual Growth Rate (%)			
	FY1990	(%)	FY2004	(%)	FY2010	(%)	FY2020	(%)	FY2030	(%)	2004/1990	2010/2004	2020/2010	2030/2020
City Gas Sales	15.4	100	30.1	100	36.1	100	41.5	100	45.5	100	4.9	3.0	1.4	0.9
Residential	7.8	51	9.5	31	9.2	25	8.8	21	8.4	19	1.4	-0.5	-0.4	-0.5
Commercial	2.6	17	4.7	16	5.6	16	6.7	16	7.5	16	4.4	3.0	1.8	1.0
Industrial	4.0	26	13.3	44	17.9	50	21.7	52	24.8	55	8.9	5.1	2.0	1.3
Others	1.0	7	2.7	9	3.4	9	4.2	10	4.8	10	7.1	4.0	2.2	1.2

	Actual		Forecast			Average Annual Growth Rate (%)				
	FY1990	FY2004	FY2010	FY2020	FY2030	2004/1990	2010/2004	2020/2010	2030/2020	2030/2004
Reference	15.4	30.1	36.1	41.5	45.5	4.9	3.0	1.4	0.9	1.6
Technology			35.8	38.9	42.9		2.9	0.8	1.0	1.4
High Growth			36.7	43.7	50.0		3.4	1.7	1.4	2.0
High Price			35.9	40.5	43.1		2.9	1.2	0.6	1.4

Summary of Forecasts(4)

●**Oil demand continues to decrease due to sluggish growth of transport demand and improvement of car fuel efficiency. (277GL or 4.78MB/D in FY2004 to 214GL or 3.69MB/D in FY2030)** (refer to 67th slide)



■Demand for petroleum products in every sector decreases.

■Demand for automobiles fuel, which has grown so far, turns to decrease.

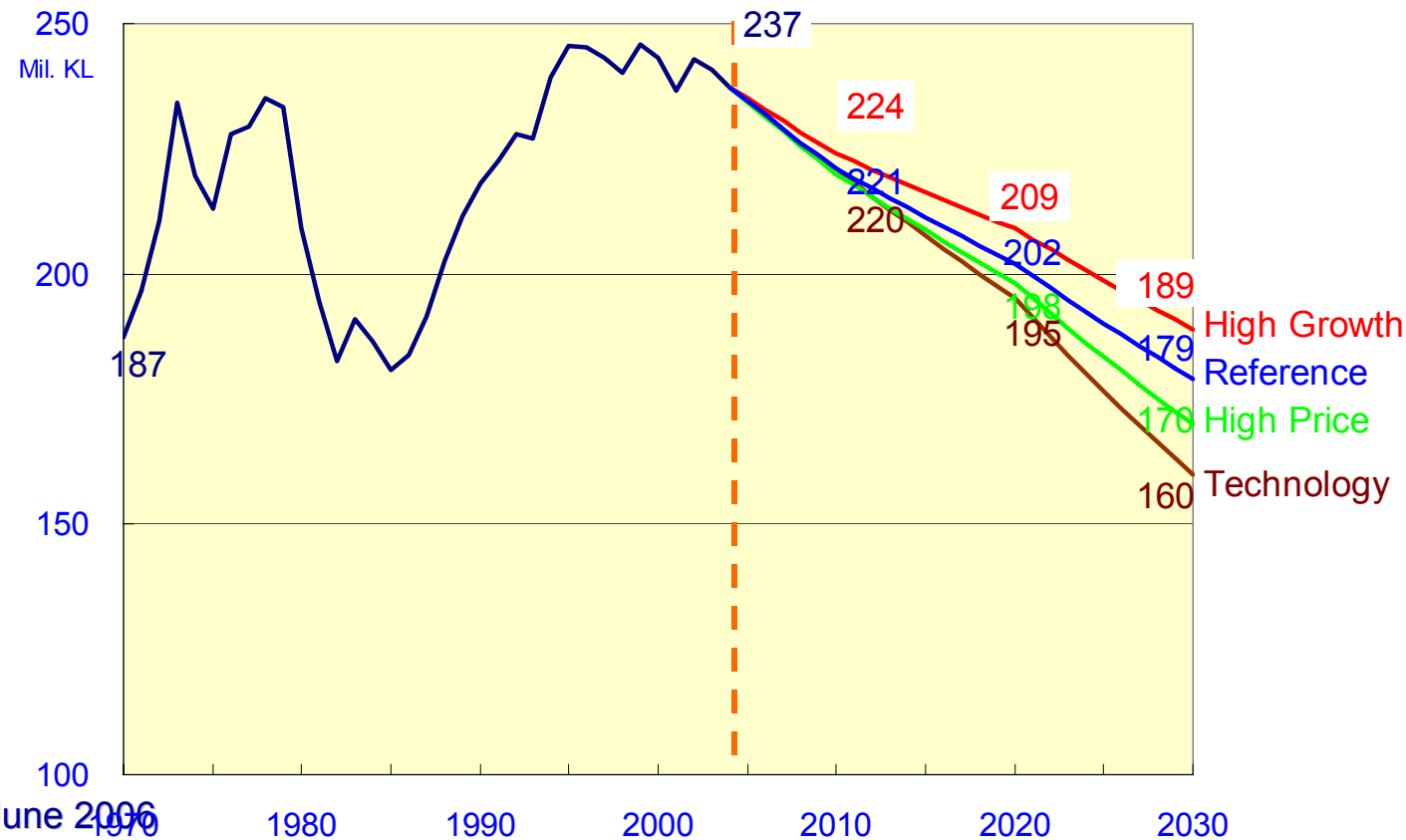
■The shift to demand for electricity and city gas from oil demand in both the industrial and residential and commercial sectors is progressing.

Summary of Forecasts(5)

- **Fuel oil sales decrease to 179GL in FY2030 from 237GL in FY2004.** (refer to 108th slide)

- With Technology case, the demand decreases further, based on the assumption of higher car fuel efficiency.

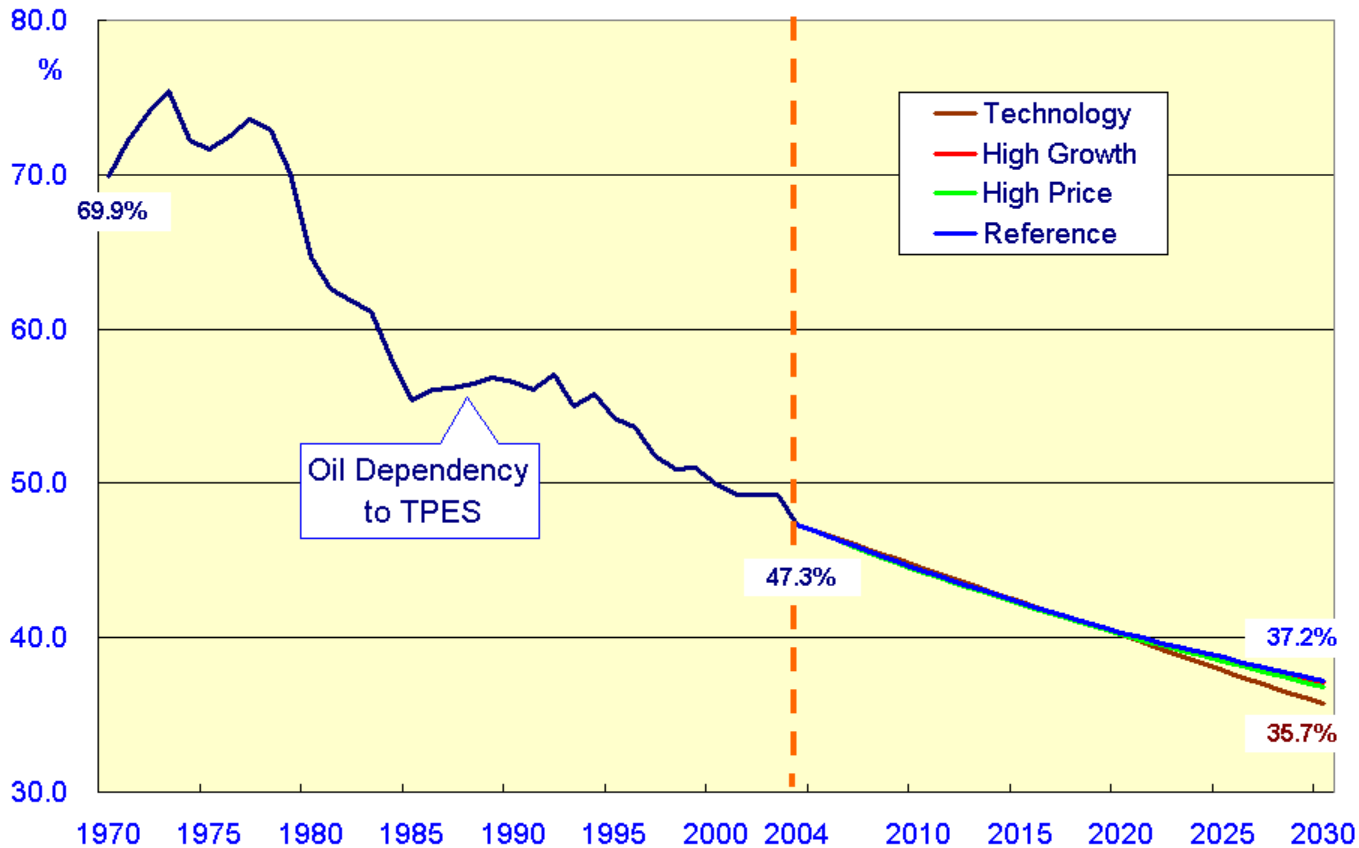
- In 2030 compared with reference case, the sales with High growth case is 10GL more, and with Technology case is 19GL less respectively.



Summary of Forecasts(6)

- **Although dependency on oil drops from the present level of 47% to 37%, Oil continues to be dominant as a primary energy source.** (refer to 20th, 98th slide)

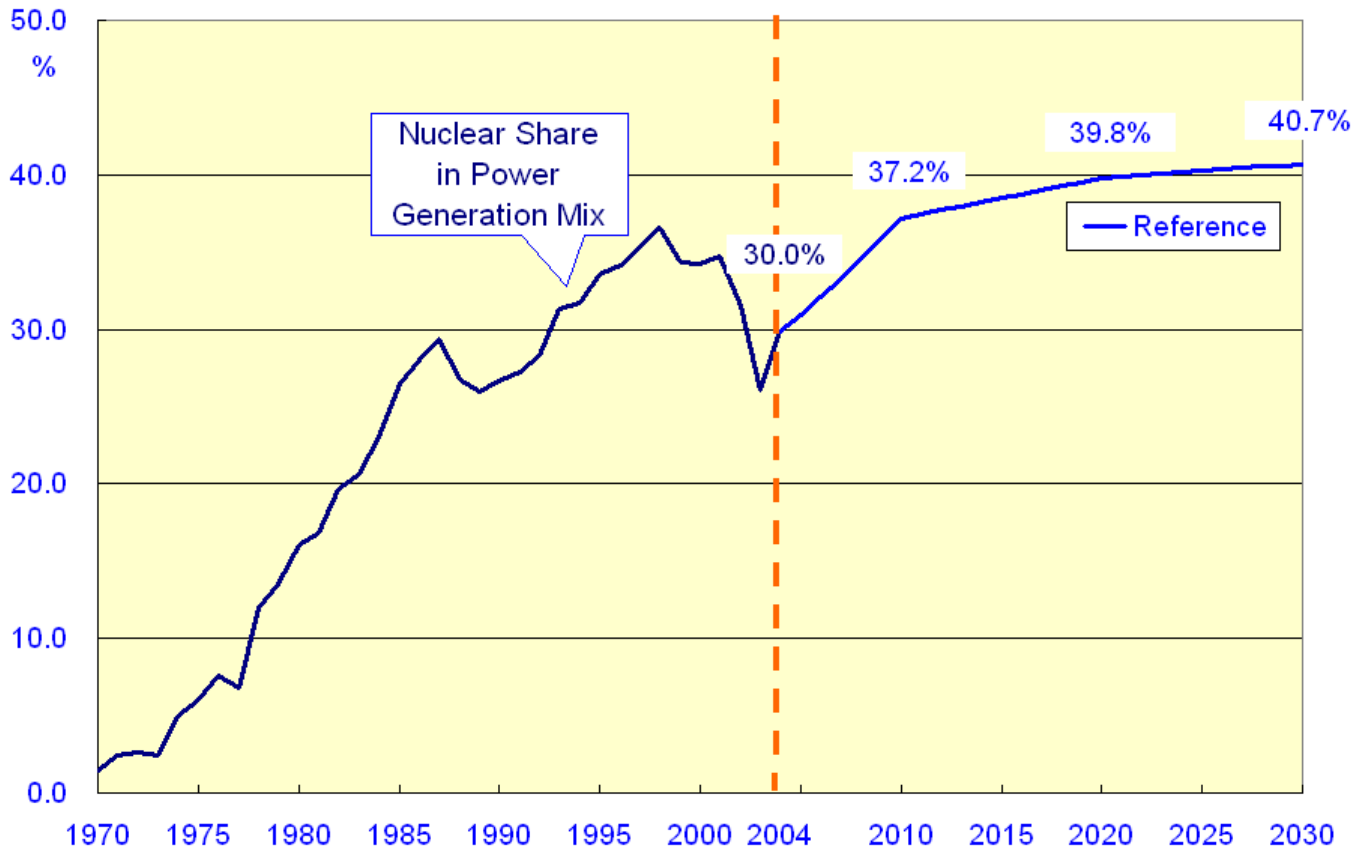
- With Technology case, the dependency drops to 36%.



Summary of Forecasts(7)

●Nuclear power continues to serve as a major role for electric power generation and its proportion in generated electricity reaches 41% in 2030 .
(refer to 65th slide)

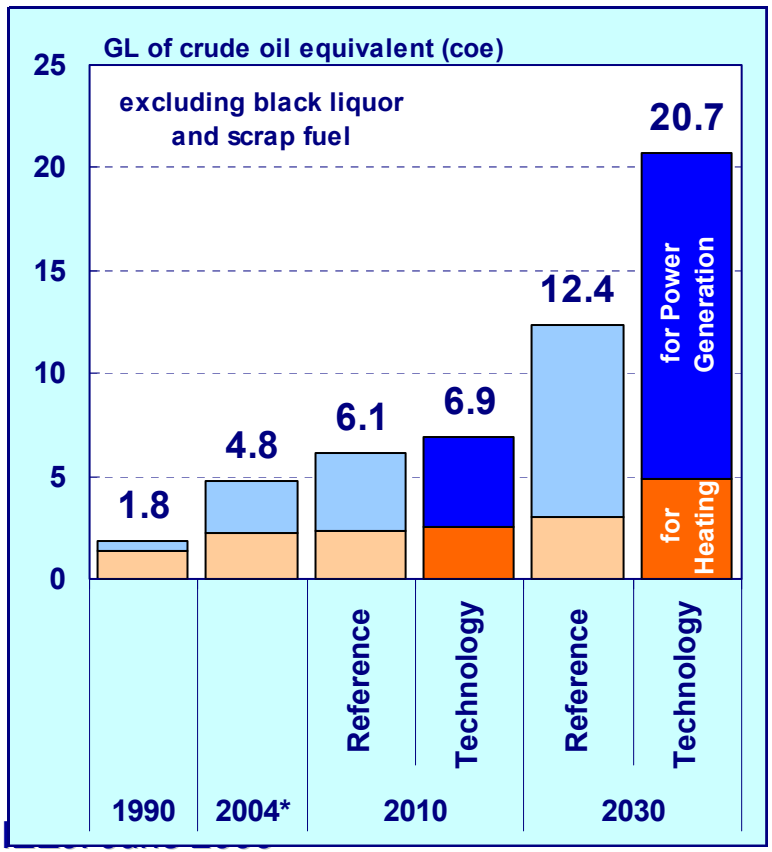
- Technology; 47%, High growth; 38%, High price; 43%(the share in power generation mix)
- They contribute much to improvement of energy self-sufficiency and reduction of GHG emissions.



Summary of Forecasts(8)

●New energy is expected to be 12.39GLcoe in 2030, which are three times the present level, but its proportion is only 2% in TPES. (refer to 92nd slide)

- With Technology case, the energy will be 26.21GL, which means a share of about 5%.
- More full-scale market penetration is expected to take place after 2030.



(GL)

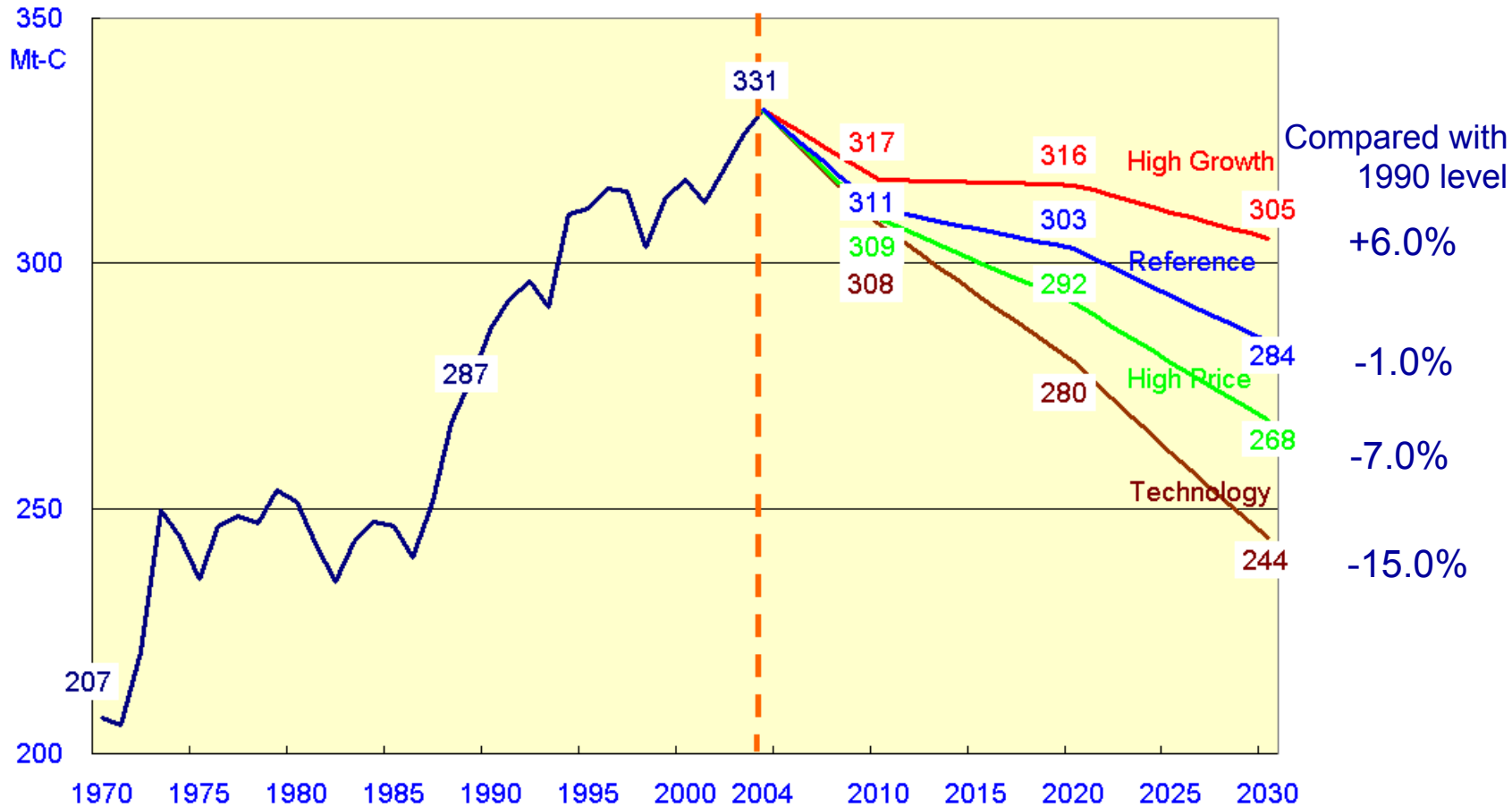
		2004*	2010		2030	
			Refe-rence	Tech-nology	Refe-rence	Tech-nology
for Power Generation	Photovoltaic Power	0.3	0.8	1.3	3.6	8.1
	Wind Power	0.4	0.6	0.7	2.3	4.1
	Waste-Burning Power	1.6	2.1	2.1	3.0	3.1
	Biomass Power	0.2	0.3	0.3	0.5	0.5
for Heating	Solar Heating	0.6	0.4	0.4	0.3	0.4
	Waste-Burning Heating	1.7	1.7	1.8	1.7	1.8
	Biomass	0.0	0.2	0.2	0.9	2.5
	Utilization of Untapped Energy	0.0	0.1	0.1	0.2	0.2
New Energy Total		4.8	6.1	6.9	12.4	20.7
Black Liquor and Scrap Fuel		4.6	4.9	4.9	5.5	5.5
Total (incl. black liquor,etc)		9.4	11.0	11.8	17.9	26.2

2004*: Estimated

Summary of Forecasts(9)

- **After the current peak, CO_2 emission decreases to the level 1.0% less than 1990 level, in line with the falling energy demand and expanding share of non-fossil energy sources.** (refer to 106th slide)

- With Technology case, the emission will be +7.3% in 2010, -15.0% in 2030, compared with 1990 level.



Summary of Forecasts(9 - contd.)

- **With High growth case, CO_2 emission does not reach the 1990 level, even though it decreases after peaking out in 2004.**

- The emission will be +10% in 2010, +6% in 2030, compared with 1990 level.

- **With High price case, CO_2 emission in 2030 is 7% less than 1990 level.**

- The emission will be +8% in 2010, compared with 1990 level.

- **With Technology case, CO_2 emission in 2010 will be only 1% less compared with the reference case, but CO_2 emission in 2030 will be 14% less, which is a big difference.**

- Less consumption of electricity (which significantly reduces primary energy consumption) and higher efficiency achieved by the electric power generation sector contribute much to this reduction in CO_2 emission.

Implications(1)

[Best mix of fossil fuels]

- **OIL is the largest source of energy not only in the past but also in the future.**
  Japan should prepare self-developed oil resources, strengthen cooperative relationships with oil-producing countries and diversify supply sources by giving attention to non-conventional oil resources, biofuels, etc.
- **COAL is available in developed countries, giving stable supply and low cost.**
  Japan should look for effictive ways to use coal despite its high environmental impact.
  For Asian countries, particularly, it is important to use Japan's clean coal technology.
- **GAS demand grows the fastest among fossil fuels.**
  Falling price by bargaining power and flexible supply arrangements are required.
- **Japan should have bargaining power and stable supply of fossil fuels through the best mix.**

[Market deregulation, stable supply and environmental protection]

- As to nuclear, how its role is positioned in liberalization, is a issue.
- The social costs, which are often outside the market, such as the cost of environmental protection and stable supply, should be appropriately shared by players.

Implications(2)

[Environmental and stable supply strategies from a global perspective]

- As to global environmental concerns, a comprehensive strategy at sight of the whole Asian region is required, because Japan's efforts within its territory can have only a limited impact.
- Government should actively help the countries to use Japan's state-of-the-art energy-saving and environmental technologies.

[The Kyoto Protocol]

- Japan should provide for measures of flexible mechanism (Kyoto mechanism) such as CDM from a long-term perspective beyond the Second Commitment Period, as well as make utmost efforts domestically.

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