

**Short-term Energy Supply and Demand Outlook:  
Forecast Through Fiscal Year 2004 and Sensitivity Analysis**

by

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**Introduction**

This report attempts to forecast Japan's energy supply and demand during the current economic recovery in fiscal year (FY) 2003<sup>1</sup> and FY 2004 thereafter. There exist, however, a number of uncertain factors that could possibly affect the results of such a forecast, both in and outside the country. We will, therefore, postulate the most likely future economic conditions as the reference case and treat two factors (i.e., crude oil prices and real GDP) as variable parameters, with additional consideration to the timing when operation of nuclear power plants, which are currently out of operation, will be resumed. The results of such a comparative analysis will then be utilized to evaluate the varied impacts of these variable factors on the country's energy supply and demand.

The report comprises three chapters: the first chapter reviews the Japanese economic outlook through FY 2004 that underlies our energy supply and demand forecast; in the second chapter, the forecast for domestic energy supply and demand based on growth and production assumptions in the preceding chapter will be analyzed by primary energy supply, final energy demand (analyses based on energy balance tables), and type of energy consumed (analysis based on supply side data); finally, chapter three describes the outcome of sensitivity analyses to the two aforementioned factors and the impact of a situation where the operation of the suspended nuclear power plants resumes earlier or later than previously expected.

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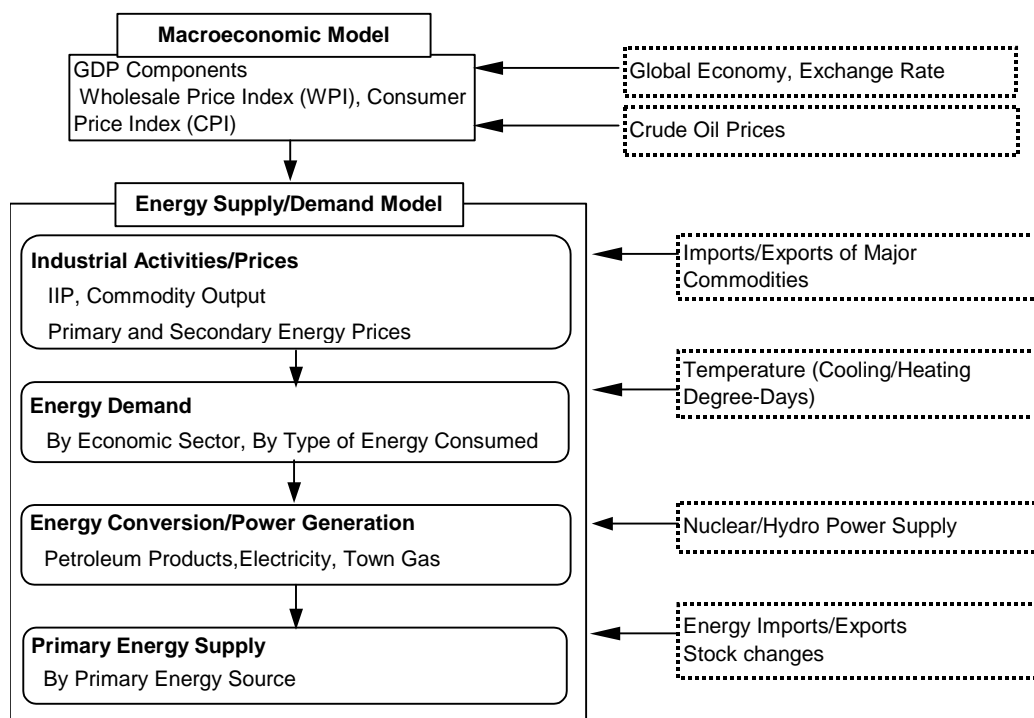
<sup>1</sup> Fiscal year (FY) runs from April to March.

## 1. Projections of Key Economic Indicators for FY 2003 and 2004

### 1-1 Framework for Making Short-term Forecast<sup>2</sup>

In deriving the forecast mentioned herein, two econometric models are utilized: 1) macroeconomic model and 2) energy supply/demand model (Exhibit 1-1) complemented by a qualitative analysis of varied energy supply and demand determinants.

Exhibit 1-1: Diagram of Models and Forecast Process



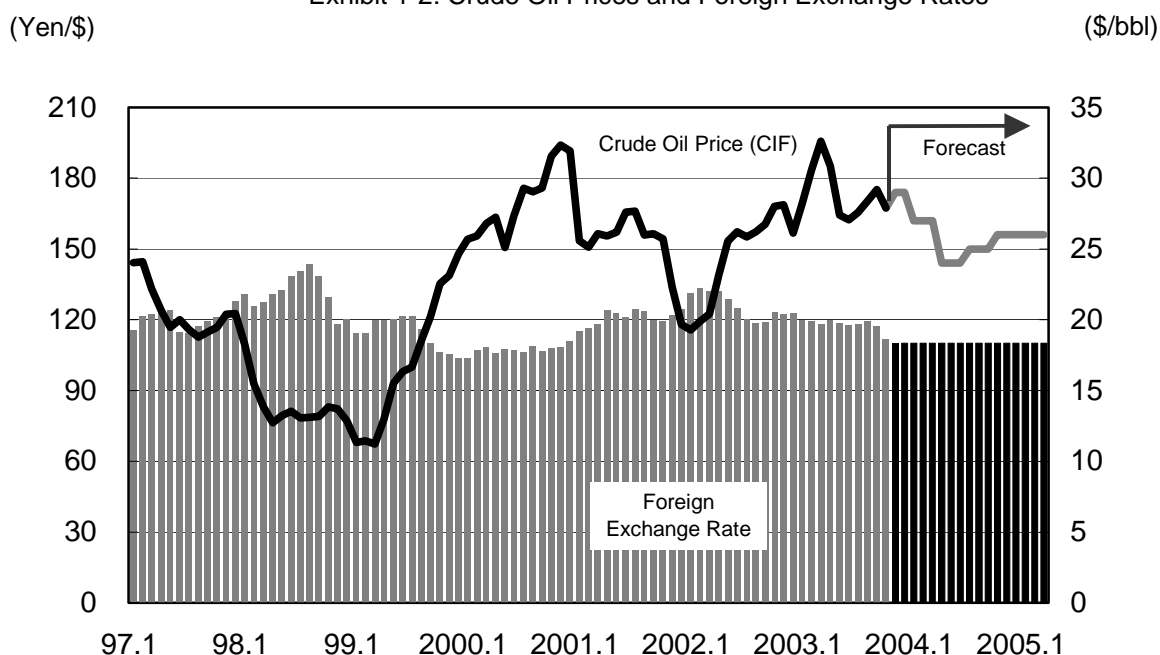
Key assumptions that are made for the projections are as follows (Exhibit 1-2): the crude oil prices will move around an average of US\$25 per barrel (CIF, imported) in FY 2004, given easier conditions in the international oil market of late; the yen is held constant at 110 yen per US dollar<sup>3</sup>; as for temperatures, which exert measurable influences on energy supply and demand, the levels of both heating and cooling degree-days are held at their averages over the past 10 years<sup>4</sup>.

<sup>2</sup> This forecast is as of December 16, 2003.

<sup>3</sup> This assumption has been made in reference to Ken Koyama, PhD, "Outlook for World Oil Market and Crude Prices in 2004," *IEEJ*, December 22, 2003.

<sup>4</sup> Heating degree-days refer to the aggregate sum of the differences between the daily average temperature and 14 °C on such days when the former is lower than the latter and cooling degree-days refer to the aggregate sum of the differences between the daily average temperature and 22 °C on such days when the former is higher than 24°C.

Exhibit 1-2: Crude Oil Prices and Foreign Exchange Rates



(Source: Ministry of Finance, Monthly Trade Bulletin (Nihon Boeki Geppo), forecast by IEEJ)

### 1-2 Macroeconomic Outlook

We assume that the Japanese economy will have its positive growth trend extended into FY 2003 from the previous year and achieve an annual real GDP growth rate of 2.3% (Table 1-1). CPI is likely to decline for the fifth consecutive year, reflecting the non-abating nature of deflationary pressure. Private business investment for the year is forecast to increase by 11.8%, a large jump after two years of decline. Private final consumption expenditure, however, is estimated to remain subdued, inching up by 0.6% in the year, due to the persistent slackness in the labor market and depressed consumer confidence. Housing investment will likely level off after a bump in demand in the first half of FY 2003 due to the termination of the home mortgage-related tax breaks, which was then expected to end at the end of the calendar year. As a result of the combination of the above-mentioned factors and else, domestic private demand is expected to make a positive contribution to real GDP growth of 2.3 percentage points. Public capital formation (i.e., public investment) is estimated to decline by 11.5% in the fiscal year, while general government final consumption expenditure is seen to increase by 0.8%. Public demand, in total, is estimated to make a negative contribution to real GDP growth of -0.6 percentage points. Exports, led by double-digit growth in exports to China and the other parts of Asia, will likely grow by 7.8% year-on-year. As external demand exceeds import that is also expected to increase in line with domestic demand, the net export will contribute to real GDP growth by 0.6% points.

In FY 2004, the current economic recovery is expected to continue, but so is the

deflationary trend. We expect household final consumption expenditure to show lackluster performance with an annual growth of 1.0% as the labor market conditions are unlikely to improve greatly. The growth in private business investment, on the other hand, is estimated at 6.5%, continuing a strong trend for the second year. Public investment will remain in tight control, and it is seen declining by 3.2%. Strength in exports to the rest of Asia will likely be sustained and external demand is expected to make a contribution to real GDP growth of 0.4 percentage points. Combining all the relevant factors, we expect the Japanese economy to expand for the third straight year in FY 2004 with a real GDP growth of 1.7% over the preceding year.

Table 1-1: Macroeconomic outlook (reference case)

(Units:: 1995 prices in billions of yen)

	FY 2001 (Actual)	FY 2002 (Actual)			FY 2003 (Forecast)			FY 2004 (Forecast)
		1st Half	2nd Half	Total	1st Half	2nd Half	Total	
Real gross domestic expenditures (Real GDP)	530,370 (-1.2)	263,902 (0.1)	272,707 (2.2)	536,609 (1.2)	269,481 (2.1)	279,644 (2.5)	549,125 (2.3)	558,406 (1.7)
Domestic private demand	398,428 (-0.9)	198,458 (-1.1)	201,844 (2.1)	400,302 (0.5)	203,672 (2.6)	209,084 (3.6)	412,757 (3.1)	419,179 (1.6)
Private final consumption expenditures	294,449 (1.3)	147,110 (1.1)	150,376 (0.9)	297,486 (1.0)	147,801 (0.5)	151,508 (0.8)	299,309 (0.6)	302,218 (1.0)
Private housing investment	18,938 (-7.8)	9,501 (-1.9)	9,033 (-2.3)	18,534 (-2.1)	9,422 (-0.8)	9,118 (0.9)	18,540 (0.0)	18,377 (-0.9)
Private plant & equipment investment	87,023 (-3.5)	39,801 (-8.9)	44,368 (2.3)	84,168 (-3.3)	43,742 (9.9)	50,324 (13.4)	94,066 (11.8)	100,169 (6.5)
Domestic public demand	121,869 (0.2)	58,594 (0.9)	63,447 (-0.6)	122,042 (0.1)	57,245 (-2.3)	61,831 (-2.5)	119,076 (-2.4)	119,581 (0.4)
Government final consumption expenditures	87,752 (2.7)	44,376 (2.5)	45,195 (1.6)	89,571 (2.1)	44,631 (0.6)	45,664 (1.0)	90,295 (0.8)	91,739 (1.6)
Public fixed capital formation	34,175 (-5.2)	14,212 (-4.3)	18,249 (-5.5)	32,461 (-5.0)	12,581 (-11.5)	16,156 (-11.5)	28,738 (-11.5)	27,830 (-3.2)
Net exports of goods & services	10,073 (-22.2)	6,850 (40.5)	7,416 (42.6)	14,266 (41.6)	8,563 (25.0)	8,729 (17.7)	17,292 (21.2)	19,647 (13.6)
Exports of goods & services	55,600 (-7.2)	30,311 (9.2)	31,973 (14.9)	62,284 (12.0)	32,827 (8.3)	34,316 (7.3)	67,142 (7.8)	71,423 (6.4)
Imports of goods & services (Nominal GDP)	45,527 (-3.1)	23,461 (2.5)	24,557 (8.5)	48,018 (5.5)	24,263 (3.4)	25,587 (4.2)	49,850 (3.8)	51,776 (3.9)
Nominal gross domestic expenditure (Nominal GDP)	500,920 (-2.4)	246,018 (-1.1)	251,629 (-0.2)	497,647 (-0.7)	246,031 (0.0)	252,067 (0.2)	498,098 (0.1)	498,238 (0.0)
Industrial production index (Base year 2000 = 100)	90.8 (-9.2)	91.9 (-0.1)	94.6 (5.7)	93.3 (2.7)	93.3 (1.6)	98.3 (3.8)	95.8 (2.7)	99.2 (3.6)
Domestic corporate goods price index (Base year 2000 = 100)	97.1 (-2.4)	95.8 (-2.1)	95.2 (-1.1)	95.5 (-1.6)	94.9 (-0.9)	94.9 (-0.4)	94.9 (-0.6)	94.3 (-0.7)
Consumer price index (Base year 2000 = 100)	98.9 (-1.0)	98.5 (-0.9)	98.1 (-0.4)	98.3 (-0.6)	98.2 (-0.3)	98.1 (-0.1)	98.1 (-0.2)	98.0 (-0.1)
Foreign exchange rate (¥/\$)	125.1 (13.2)	123.1 (0.8)	120.7 (-5.8)	121.9 (-2.6)	118.0 (-4.2)	110.0 (-8.8)	114.0 (-6.5)	110.0 (-3.5)
Crude Oil Price (CIF) (\$/bbl)	23.8 (-15.5)	25.7 (-3.5)	29.0 (37.9)	27.3 (14.8)	28.6 (11.1)	28.0 (-3.4)	28.3 (3.4)	25.3 (-10.7)
Crude Oil Price (CIF) (¥/KL)	18,688 (-4.5)	19,933 (-2.7)	21,998 (30.3)	20,965 (12.2)	21,168 (6.2)	19,437 (-11.6)	20,302 (-3.2)	17,539 (-13.6)

Note: Numbers in parentheses denote year-to-year rates of change in percentage.

Source: Cabinet Office, Preliminary Estimates of National Expenditure (Kokumin Shotoku Tokei Sokuho), forecast by IEEJ

### 1-3 Manufacturing Outlook

In FY 2003, Japan's economy continued to perform well with export-oriented industries leading the way. Some weaknesses, however, are observed in parts of the basic materials industry (Table 1-2). Due to the on-going strength in Asian exports and growing demand from the domestic auto industry, steel production is expected to remain high at around 109.7 million tonnes. Petrochemical industry has also been experiencing strong demand from domestic and Asian customers with ethylene output reaching 7.3 million tonnes, or a level slightly above that of the previous year.

Table 1-2: Industrial outlook (reference case)

		FY 2001 (Actual)	FY 2002 (Actual)			FY 2003 (Forecast)			FY 2004 (Forecast)
			1st Half	2nd Half	Total	1st Half	2nd Half	Total	
Commodity output volume (in thousands of	Steel	102,065 (-4.5)	54,630 (4.7)	55,161 (10.6)	109,791 (7.6)	55,458 (1.5)	54,260 (-1.6)	109,718 (-0.1)	108,712 (-0.9)
	Paper & paperboards	30,352 (-4.4)	15,377 (0.7)	15,391 (2.0)	30,768 (1.4)	15,164 (-1.4)	15,326 (-0.4)	30,490 (-0.9)	30,639 (0.5)
	Cement	75,908 (-5.2)	33,840 (-7.6)	37,108 (-5.6)	70,948 (-6.5)	33,252 (-1.7)	36,354 (-2.0)	69,606 (-1.9)	68,000 (-2.3)
	Ethylene	7,205 (-4.8)	3,504 (-1.4)	3,779 (3.4)	7,283 (1.1)	3,502 (-0.1)	3,827 (1.3)	7,329 (0.6)	7,386 (0.8)
Manufacturing indicators (Base year 1995 = 100)	Food	96.5 (-2.5)	97.3 (-0.9)	94.5 (-0.4)	95.9 (-0.7)	96.1 (-1.2)	93.9 (-0.6)	95.0 (-0.9)	94.9 (-0.1)
	Textile	64.1 (-9.3)	59.4 (-10.6)	56.8 (-8.2)	58.1 (-9.4)	54.6 (-8.0)	53.0 (-6.6)	53.8 (-7.3)	51.2 (-4.8)
	Non-ferrous metals	104.7 (-1.1)	100.7 (-2.2)	112.8 (5.9)	106.8 (1.9)	102.1 (1.3)	114.6 (1.6)	108.3 (1.5)	110.7 (2.2)
	Metals & machinery	96.4 (-14.7)	99.0 (0.9)	103.7 (9.6)	101.3 (5.2)	103.0 (4.0)	108.9 (5.0)	105.9 (4.5)	111.6 (5.4)
	Miscellaneous manufacturing	86.1 (-6.5)	84.0 (-3.3)	86.4 (1.3)	85.2 (-1.0)	83.3 (-0.8)	87.0 (0.8)	85.1 (-0.0)	85.6 (0.6)

Note: Numbers in parentheses denote year-to-year rates of change in percentage.

Source: omnibus data, forecast by IEEJ

Cement production is estimated to be down 1.9% per annum on account of the decrease in public works, and paper and paperboard production is expected to show a year-to-year decline of 0.9% due mainly to lower shipment levels of corrugated cardboard containers for transport. Overall industrial production is forecast to grow two consecutive years, increasing by 2.7% from the previous year.

In FY 2004, manufacturing activities are expected to maintain their strength continuously led by capital spending and exports. Steel production is estimated to be at approximately 108.7 million tonnes, a decrease of 0.9% from the previous year. Ethylene production will likely come in at around 7.4 million tonnes, an increase of 0.8%, and cement output is expected to fall by 2.3% due to a further decline in public investment, while private business investment will continue to grow. Industrial production, as a whole, is forecast to rise by 3.6%, mainly driven by a continuation of the robust performance of electronic equipment and other machinery industries.

## 2. Energy Supply and Demand Outlook for FY 2003 and 2004

### 2-1 Outlook for Domestic Primary Energy Supply

Domestic energy supply for FY 2003 is forecast to be almost flat, down 0.2% from the previous year, as the cool summer weather more than offset the impact of continuing economic growth (Table 2-1, Exhibit 2-1). By energy source, the start-up of new generation facilities will increase coal-fired power generation, and coal-based energy supply is estimated to rise by 3.7% for the year. Petroleum-based energy supply is also likely to increase for the second straight year by 1.1% due to higher electricity generation from oil. Natural gas-based energy supply is forecast to increase by 5.6% as a combined result of higher town gas use and increased levels of gas-fired power generation.

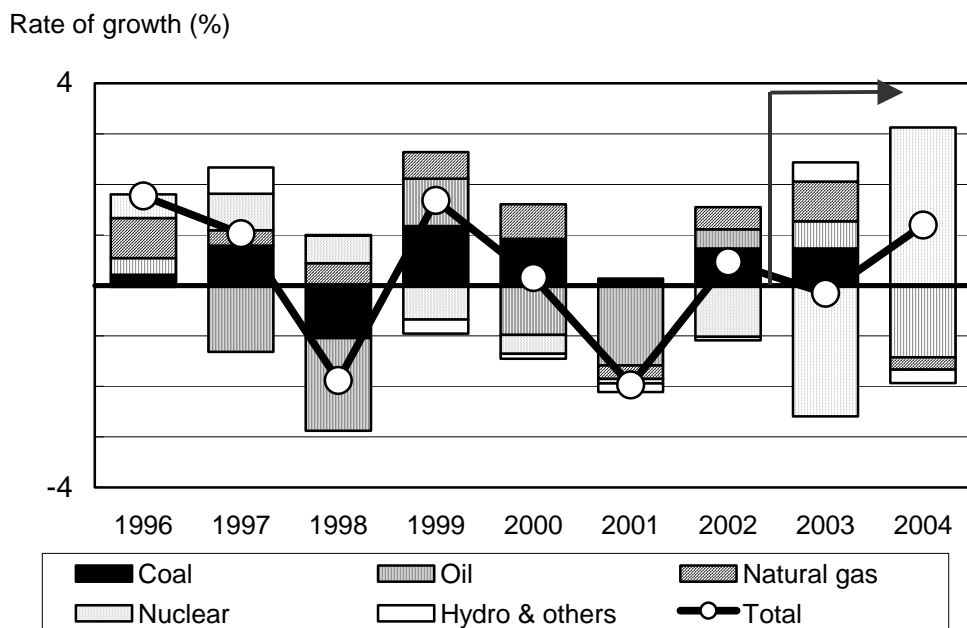
Table 2-1: Domestic primary energy supply outlook (reference case)

(Units:  $10^{10}$  kcal = 1,000 TOE)

	FY 2001 (Actual)	FY 2002 (Actual)			FY 2003 (Forecast)			FY 2004 (Forecast)
		1 <sup>st</sup> Half	2 <sup>nd</sup> Half	Total	1 <sup>st</sup> Half	2 <sup>nd</sup> Half	Total	
Coal	99,348 (0.8)	50,596 (-0.5)	52,581 (8.4)	103,177 (3.9)	53,020 (4.8)	54,009 (2.7)	107,029 (3.7)	107,056 (0.0)
Oil	258,682 (-3.2)	114,771 (-5.3)	145,919 (6.1)	260,690 (0.8)	119,079 (3.8)	144,441 (-1.0)	263,519 (1.1)	256,029 (-2.8)
Natural gas	72,006 (-1.9)	34,716 (-6.2)	39,588 (13.2)	74,304 (3.2)	38,066 (9.7)	40,379 (2.0)	78,446 (5.6)	77,158 (-1.6)
Hydro	18,638 (-3.2)	10,927 (2.3)	7,247 (-8.9)	18,174 (-2.5)	12,788 (17.0)	7,470 (3.1)	20,258 (11.5)	18,911 (-6.6)
Nuclear	68,770 (-0.7)	36,480 (6.7)	26,965 (-22.0)	63,445 (-7.7)	23,250 (-36.3)	26,536 (-1.6)	49,786 (-21.5)	66,212 (33.0)
Others	7,024 (-4.2)	3,566 (1.0)	3,556 (1.7)	7,122 (1.4)	3,522 (-1.2)	3,527 (-0.8)	7,048 (-1.0)	6,987 (-0.9)
Total	524,468 (-2.0)	251,056 (-2.5)	275,856 (3.3)	526,912 (0.5)	249,725 (-0.5)	276,360 (0.2)	526,085 (-0.2)	532,353 (1.2)
						44 (2.5)	549,125 (2.3)	558,406 (1.7)
GDP intensity								9 )

Source: IEEJ (Numbers fo

Exhibit 2-1: Domestic primary energy supply outlook (By primary energy source)



Source: same as table 2-1

Hydropower generation will likely register a large year-on-year increase of 11.5% due to record-high water levels. Nuclear power generation, on the other hand, is expected to fall by as much as 21.5% due to lower capacity utilization as a result of the long-term suspension of operation at certain nuclear power stations.

In FY 2004, a fall in steel and cement production will cause coal-based energy supply to stay flat. Petroleum-based energy supply will likely decrease by 2.8% due to a fall-off in oil-fired power generation as suspended nuclear power stations resume operation. Despite an increased use in town gas, natural gas-based energy supply is forecast to be down 1.6%, as gas-fired power generation will be lower than the previous year's level. Hydropower generation is seen declining by 6.6% with the water flow rate returning to the average year levels from highs in FY 2003. Finally, nuclear power generation is expected to be 33% higher, as capacity utilization will rebound from the lows in the previous year. As a result of the above, domestic primary energy supply is forecast to increase by 1.2% in FY 2004.

**2-2 Outlook for Final Energy Consumption**

We forecast final energy consumption in FY 2003 to be down 0.2% year-on-year (Table 2-2, Exhibit 2-2). Consumption in the industrial sector will likely be almost flat with the preceding year's level, as the positive impact of a production recovery in auto- and IT-related industries will be offsetting the drag from the cold summer. In the household sector, energy consumption is expected to decline by 0.4% due to lower demand for cooling and air/water heating from the cold summer and winter warmer

than last, respectively. Gradual economic recovery will make commercial demand increase by 0.6% on the back of a in spite of lower air conditioning consumption in summer. Consumption in the transport sector will likely be 1.2% lower; fuel demand for passenger transport by cars and others will remain firm notwithstanding the unseasonable weather that typically discourages people to travel, e.g., cold temperatures and high precipitation in summer, but freight transport fuel demand will decrease by 1.2% in response to the lower vehicle count and improved fuel economy of diesel trucks.

Table 2-2: Final energy consumption outlook (reference case)

(Units:  $10^{10}$  kcal = 1,000 TOE)

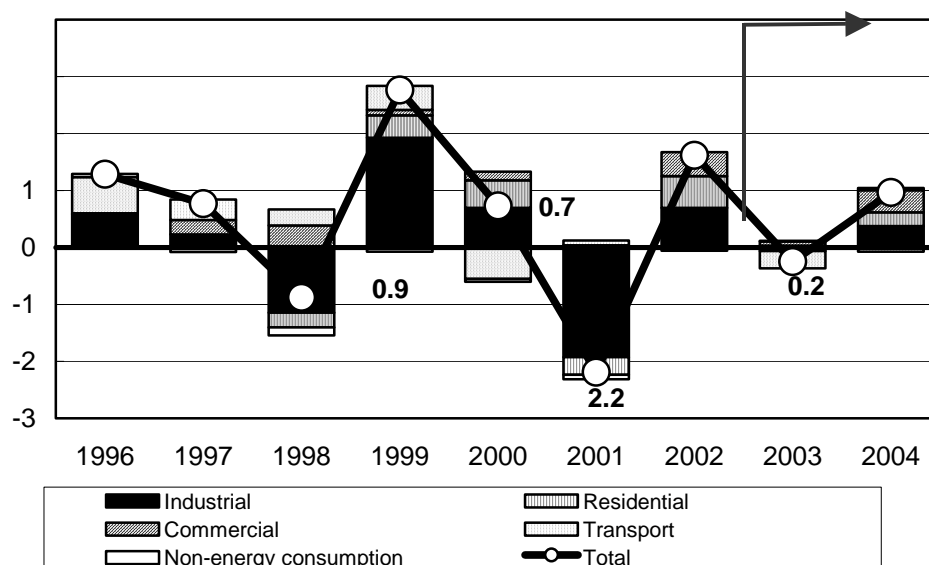
	FY 2001 (Actual)	FY 2002 (Actual)			FY 2003 (Forecast)			FY 2004 (Forecast)	
		1 <sup>st</sup> Half	2 <sup>nd</sup> Half	Total	1 <sup>st</sup> Half	2 <sup>nd</sup> Half	Total		
By economic sector	Industrial Sector	170,853 (-4.1)	82,353 (-0.3)	91,067 (3.2)	173,420 (1.5)	82,179 (-0.2)	91,376 (0.3)	173,555 (0.1)	174,950 (0.8)
	Residential & Commercial Sector	98,723 (-1.0)	43,138 (-0.2)	59,170 (6.6)	102,308 (3.6)	43,697 (1.3)	58,642 (-0.9)	102,340 (0.0)	104,697 (2.3)
	Residential sector	52,221 (-2.2)	20,285 (-1.7)	33,969 (7.5)	54,254 (3.9)	20,689 (2.0)	33,326 (-1.9)	54,015 (-0.4)	54,930 (1.7)
	Commercial sector	46,502 (0.3)	22,853 (1.2)	25,201 (5.4)	48,054 (3.3)	23,009 (0.7)	25,316 (0.5)	48,325 (0.6)	49,767 (3.0)
	Transport sector	91,050 (0.3)	45,561 (-0.6)	45,499 (0.6)	91,059 (0.0)	44,618 (-2.1)	45,324 (-0.4)	89,941 (-1.2)	89,659 (-0.3)
	Non-energy consum	6,879 (-4.0)	3,008 (-4.2)	3,661 (-2.1)	6,669 (-3.1)	3,006 (-0.1)	3,692 (0.8)	6,698 (0.4)	6,830 (2.0)
By type of energy consumed	Coal and others	39,629 (-4.2)	19,992 (0.3)	20,229 (2.7)	40,221 (1.5)	19,983 (-0.0)	20,080 (-0.7)	40,063 (-0.4)	39,882 (-0.5)
	Petroleum products	217,898 (-1.8)	98,873 (-1.3)	121,164 (2.9)	220,037 (1.0)	98,021 (-0.9)	120,283 (-0.7)	218,304 (-0.8)	219,517 (0.6)
	Town gas								9 )
	Electricity								4 )
	Others								3 )
								)	

Sou  
Note



Exhibit 2-2: Final Energy Consumption Outlook  
(Contribution by economic sector)

Rate of growth (%)



Source: same as table 2-2

In FY 2004, we see industrial energy demand growing at 0.8% year-on-year. Demand from the household sector is forecast to be up 1.7%, with an assumption of more normalized weather patterns. Commercial demand is seen rising by 3.0% for the same reason. Transport consumption, however, is projected to fall again by 0.3% due to continued weakness in fuel demand for freight transport. With demand from the three sectors combined, we forecast final energy consumption will record a positive year-to-year growth rate of 1.0%.

### 2-3 Energy Demand Outlook by Type of Energy Consumed

#### 2-3-1 Electricity

The total amount of electricity sold in FY 2003 by electric utilities is expected to increase by 0.4% from the previous year (Table 2-3). Residential usage will likely decrease by 0.1% due to unseasonable weather and other factors, but commercial demand is forecast to increase by 0.9% on the back of economic expansion. Demand from large users (for use under specified contracts of 2,000 kW or more) is forecast to be up 1.1% with increased industrial usage of electricity led by machinery industry.

Table 2-3: Electricity demand outlook by type of use (reference case)

(Units:: millions of kWh)

	FY 2001 (Actual)	FY 2002 (Actual)			FY 2003 (Forecast)			FY 2004 (Forecast)	
		1st Half	2nd Half	Total	1st Half	2nd Half	Total		
Small-to medium-user demand (not under specified contracts)	Lighting use	254,470 (-0.0)	124,662 (0.9)	138,777 (6.0)	263,439 (3.5)	122,726 (-1.6)	140,501 (1.2)	263,227 (-0.1)	268,562 (2.0)
	Power use	358,303 (-1.5)	185,949 (-0.8)	176,456 (3.2)	362,405 (1.1)	183,495 (-1.3)	179,692 (1.8)	363,187 (0.2)	371,235 (2.2)
	Commercial use	159,197 (0.8)	84,044 (0.3)	78,508 (4.1)	162,552 (2.1)	83,782 (-0.3)	80,311 (2.3)	164,093 (0.9)	167,725 (2.2)
	Small users	112,049 (-3.2)	58,058 (-1.9)	54,303 (2.8)	112,361 (0.3)	56,387 (-2.9)	55,273 (1.8)	111,660 (-0.6)	114,296 (2.4)
	High voltage B and others	87,057 (-3.1)	43,847 (-1.3)	43,645 (2.3)	87,492 (0.5)	43,326 (-1.2)	44,108 (1.1)	87,434 (-0.1)	89,215 (2.0)
	Lighting & power total	612,773 (-0.9)	310,611 (-0.1)	315,233 (4.4)	625,844 (2.1)	306,221 (-1.4)	320,193 (1.6)	626,414 (0.1)	639,797 (2.1)
Large-user demand (under specified contracts)	231,602 (-3.5)	120,613 (0.7)	116,475 (4.1)	237,088 (2.4)	120,988 (0.3)	118,656 (1.9)	239,644 (1.1)	244,035 (1.8)	
The total amount of electricity sold	844,374 (-1.6)	431,224 (0.1)	431,707 (4.4)	862,931 (2.2)	427,210 (-0.9)	438,849 (1.7)	866,059 (0.4)	883,832 (2.1)	

Note: Numbers in parentheses denote year-to-year rates of change in percentage

Source: Ministry of Economy, Trade and Industry, *Monthly Electricity Survey and Statistics (Denryoku Cyosa Tokei Geppo)*, forecast by IEEJ

Turning to FY 2004, we expect residential demand to turn up, absent adverse weather conditions, with a year-to-year increase of 2.0%. Commercial demand is likely to grow further by 2.2%. Demand from large users will also likely increase by 1.8% with higher manufacturing activities. The net of these segment demands is a forecast of a 2.1% increase in the total amount of electricity sold, an increase for the third consecutive year.

### 2-3-2 Town Gas

The total amount of town gas sold in FY 2003 is forecast to be up 4.7% (Table 2-4). Demand for residential use will likely increase by 1.4% as a combined result of elevated water heating demand in summer due to lower water temperatures and diminished demand in winter due to warmer weather conditions. Industrial demand is expected to rise by 9.1% with particular strength in the areas of power generation (by cogeneration equipment users and electric utilities). Commercial and other usage will both likely be up 1.2% and 3.3% on account of higher water heating demand in summer and increased installation of HVAC equipment.

Table 2-4: Town gas demand outlook (reference case)

(Units:: millions of m<sup>3</sup>/10,000 kcal)

	FY 2001	FY 2002 (Actual)			FY 2003 (Forecast)			FY 2004
	(Actual)	1st Half	2nd Half	Total	1st Half	2nd Half	Total	(Forecast)
Residential	9,355 (-1.4)	3,632 (-0.4)	6,040 (5.8)	9,673 (3.4)	3,906 (7.5)	5,906 (-2.2)	9,812 (1.4)	9,917 (1.1)
Commercial	4,104 (1.1)	2,194 (2.3)	2,152 (9.8)	4,346 (5.9)	2,271 (3.5)	2,129 (-1.1)	4,400 (1.2)	4,614 (4.9)
Industrial	9,763 (4.5)	5,282 (10.5)	5,741 (15.2)	11,023 (12.9)	5,795 (9.7)	6,236 (8.6)	12,031 (9.1)	12,624 (4.9)
Others	2,183 (3.0)	1,103 (4.1)	1,289 (14.7)	2,392 (9.6)	1,162 (5.3)	1,309 (1.6)	2,472 (3.3)	2,690 (8.8)
The total amount of town gas sold	25,406 (1.6)	12,212 (5.0)	15,222 (10.5)	27,434 (8.0)	13,134 (7.6)	15,580 (2.4)	28,714 (4.7)	29,845 (3.9)

Note: Numbers in parentheses denote year-to-year rates of change in percentage.

Source: Ministry of Economy, Trade and Industry, *Monthly Gas Industry Statistics (Gasu Jigyo Tokei Geppo)* et al., forecast by IEEJ

In FY 2004, despite the expectation that gas demand for power generation would stabilize, industrial demand will likely continue to grow at an estimated 4.9% clip. The growth in residential gas demand is expected to be somewhat slower at 1.1% after a spike in the previous year. Commercial and other usage of gas is expected to stay on a growth path, due partly to increased penetration of gas air-conditioning (cooling). The total amount of town gas sold in FY 2004, as a net result, is forecast to increase by 3.9%.

### 2-3-3 Petroleum Products

The sales of fuel oils in FY 2003 are expected to grow for the second straight year at a rate of 0.3% (Table 2-5). Gasoline consumption will likely be almost flat with an increase of 0.4% and influenced by unseasonable weather conditions, e.g., cold summer, and other factors. In expectation of a winter warmer than the last, demands for kerosene and grade A fuel oil is seen slipping by 1.5% and 0.1%, respectively. Gas oil consumption is likely to continue to fall in line with declining freight volume. Despite a decrease in industrial demand, consumption of grade B and C crude oils combined is expected to increase for the second consecutive year by 9.1%. This is due to a hike in oil demand for power generation use, as a result of the long-term suspension of operation at certain nuclear power stations.

Looking to FY 2004, we expect gasoline consumption to show modest growth, but the fall in demand for gas oil to persist. Numbers for kerosene and grade A fuel oil will have an easier, positive comparison against warm winter in the previous year. The high volume of ethylene production will increase naphtha output. Consumption of grade B and C crude oils will drop against a tough year-on-year comparison. As a result, the sales of fuel oils in FY 2004 are expected to decline by 1.4%.

Table 2-5: Outlook on domestic demand for petroleum products/fuel oils (reference case)

(Units: in thousands of kiloliters)

	FY 2001 (Actual)	FY 2002 (Actual)			FY 2003 (Forecast)			FY 2004 (Forecast)
		1 <sup>st</sup> Half	2 <sup>nd</sup> Half	Total	1st Half	2nd Half	Total	
Gasoline	58,817 (0.8)	30,544 (1.8)	29,375 (2.0)	59,918 (1.9)	30,485 (-0.2)	29,678 (1.0)	60,164 (0.4)	60,813 (1.1)
Naphtha	46,032 (-3.5)	23,054 (3.8)	25,530 (7.2)	48,585 (5.5)	22,550 (-2.2)	25,801 (1.1)	48,352 (-0.5)	48,720 (0.8)
Jet fuel	4,998 (8.5)	2,316 (-5.3)	2,290 (-10.3)	4,605 (-7.9)	2,167 (-6.4)	2,356 (2.9)	4,522 (-1.8)	4,627 (2.3)
Kerosene	28,506 (-4.7)	7,474 (-1.6)	23,152 (10.7)	30,626 (7.4)	7,730 (3.4)	22,427 (-3.1)	30,157 (-1.5)	30,953 (2.6)
Gas oil	40,925 (-2.0)	19,665 (-3.4)	19,833 (-3.5)	39,498 (-3.5)	18,782 (-4.5)	19,236 (-3.0)	38,018 (-3.7)	36,948 (-2.8)
Grade A fuel oil	29,302 (-0.7)	13,018 (1.1)	17,119 (4.2)	30,136 (2.8)	13,144 (1.0)	17,009 (-0.6)	30,152 (0.1)	30,532 (1.3)
Grade B & C fuel oil	27,613 (-12.0)	12,038 (-16.4)	17,480 (32.2)	29,518 (6.9)	15,031 (24.9)	17,183 (-1.7)	32,214 (9.1)	27,467 (-14.7)
Grade C fuel oil for power generation	8,686 (-25.4)	3,151 (-39.2)	7,693 (119.4)	10,844 (24.8)	6,376 (102.3)	7,196 (-6.5)	13,572 (25.2)	7,928 (-41.6)
The total amount of fuel oils sold	236,192 (-2.9)	108,108 (-1.6)	134,778 (6.7)	242,887 (2.8)	109,889 (1.6)	133,690 (-0.8)	243,579 (0.3)	240,060 (-1.4)

Note: Numbers in parentheses denote year-to-year rates of change in percentage

Source: Ministry of Economy, Trade and Industry, *Monthly Statistics on Resources and Energy (Shigen Enerugi Tokei Geppo)* et al., forecast by IEE.

### 3. Impacts of Parameter Changes on Energy Supply and Demand in FY 2004

#### 3-1 Sensitivity Analysis

In order to see varied impacts of parameter changes on energy supply and demand, we conducted a sensitivity analysis to such changes focusing on the outcome for FY 2004.

In a sensitivity analysis, we change key exogenous variables to see impacts on energy demand incurred by those changes. One at a time is changed while holding the other assumptions constant as they were in the reference case. The analysis herein focuses on such variables that are considered to involve higher levels of uncertainty in the short-term, namely crude oil prices and real GDP, and evaluate various impacts their changes could have on general economic activities and, specifically, energy supply and demand, in FY 2004 (Exhibit 3-1, Table 3-1).

Exhibit 3-1: Diagram of sensitivity analysis

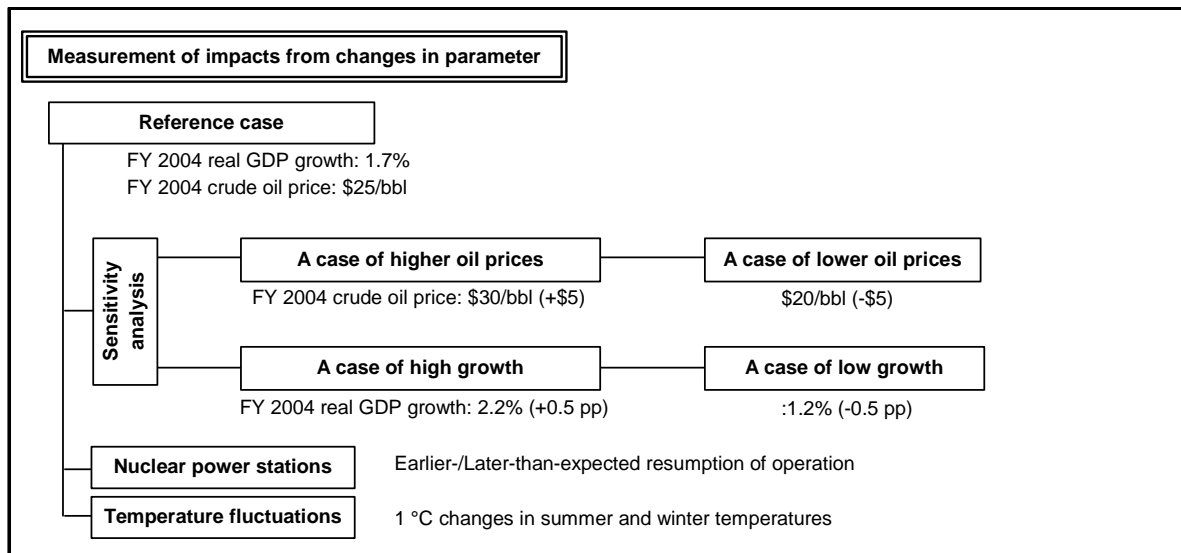


Table 3-1: Results of sensitivity analysis

	Case	FY 2003	FY 2004		Difference from reference case	
				Rate of y-o-y growth (%)	Change	Change in growth rate (pp)
Real GDP (1995 prices in trillions of yen)	Reference	549.1	558.4	( 1.7)		
	Higher oil prices		556.8	( 1.4)	-1.6	(-0.3)
	Lower oil prices		559.9	( 2.0)	1.4	( 0.3)
	Higher growth		561.2	( 2.2)	2.7	( 0.5)
	Lower growth		555.8	( 1.2)	-2.7	(-0.5)
CPI (base year 2000 = 100)	Reference	98.1	98.0	(-0.1)		
	Higher oil prices		98.1	(-0.0)	0.1	( 0.1)
	Lower oil prices		98.0	(-0.2)	-0.1	(-0.1)
	Higher growth		98.1	(-0.1)	0.0	( 0.0)
	Lower growth		98.0	(-0.1)	-0.0	(-0.0)
Domestic primary energy supply (in million kiloliters of crude oil equivalent)	Reference	568.7	575.5	( 1.2)		
	Higher oil prices		573.9	( 0.9)	-1.6	(-0.3)
	Lower oil prices		577.1	( 1.5)	1.5	( 0.3)
	Higher growth		576.9	( 1.4)	1.3	( 0.2)
	Lower growth		574.0	( 0.9)	-1.5	(-0.3)
Final energy consumption (in million kiloliters of crude oil equivalent)	Reference	402.7	406.6	( 1.0)		
	Higher oil prices		405.2	( 0.6)	-1.4	(-0.4)
	Lower oil prices		408.0	( 1.3)	1.4	( 0.3)
	Higher growth		407.7	( 1.2)	1.1	( 0.3)
	Lower growth		405.3	( 0.6)	-1.3	(-0.3)
The total amount of electricity sold (in 100 millions of kWh)	Reference	8,661	8,838	( 2.1)		
	Higher oil prices		8,833	( 2.0)	-4.9	(-0.1)
	Lower oil prices		8,843	( 2.1)	4.5	( 0.1)
	Higher growth		8,849	( 2.2)	10.7	( 0.1)
	Lower growth		8,828	( 1.9)	-10.1	(-0.1)
The total amount of town gas sold (in millions of m3/10,000 kcal)	Reference	28,714	29,845	( 3.9)		
	Higher oil prices		29,777	( 3.7)	-67.7	(-0.2)
	Lower oil prices		29,910	( 4.2)	64.9	( 0.2)
	Higher growth		29,926	( 4.2)	80.9	( 0.3)
	Lower growth		29,763	( 3.7)	-82.3	(-0.3)
The total amount of fuel oils sold (in ten thousands of kiloliters)	Reference	24,358	23,988	(-1.5)		
	Higher oil prices		23,897	(-1.9)	-91.0	(-0.4)
	Lower oil prices		24,108	(-1.0)	120.2	( 0.5)
	Higher growth		24,094	(-1.1)	106.3	( 0.4)
	Lower growth		23,897	(-1.9)	-91.4	(-0.4)

### 3-1-1 A Case of Higher Oil Prices

The case is defined as that where the crude oil prices will move around an average of US\$30 per barrel (CIF, imported) in FY 2004, a level \$5 higher than \$25/bbl assumed in the reference case. This would result in a projected real GDP growth rate of 1.4% year-on-year, which is lower than that in the reference case by 0.3 percentage points. What is worth noting is that the Japanese economy is less dependent on oil than it was at the times of the two oil crises, and it is less prone to the adverse effects of higher oil prices.

As for the impacts on energy balances, growth in domestic primary energy supply would be 0.3 percentage points lower at an increase of 0.9%, while that in final energy consumption would be 0.4 percentage points lower at an increase of 0.6%, both compared against the reference case.

### **3-1-2 A Case of Lower Oil Prices**

The case is defined as that where the crude oil prices will move around an average of US\$20 per barrel (CIF, imported) in FY 2004, a level \$5 lower than \$25/bbl assumed in the reference case. This would result in a projected real GDP growth rate of 2.0% year-on-year, which is higher than that in the reference case by 0.3 percentage points.

As for the impacts on energy balances, growth in domestic primary energy supply would be 0.3 percentage points higher at an increase of 1.5%, while that in final energy consumption would be 0.3 percentage points higher at an increase of 1.3%, both compared against the reference case.

### **3-1-3 A Case of High Growth**

The case is defined as that where the real GDP growth rate will be 2.2% in FY 2004, a level 0.5 percentage points higher than the 1.7% assumed in the reference case. This could possibly be caused by ripple effects through which higher production and capital spending in export-oriented industries positively influence the performance of other industries and, in due time, levels of consumption.

As for the impacts on energy balances, growth in domestic primary energy supply would be 0.2 percentage points higher at an increase of 1.4%, while that in final energy consumption would be 0.3 percentage points higher at an increase of 1.2%, both compared against the reference case.

### **3-1-4 A Case of Low Growth**

The case is defined as that where the real GDP growth rate will be 1.2% in FY 2004, a level 0.5 percentage points lower than 1.7% assumed in the reference case. This could possibly be caused by a decline in exports due to a slowdown in the US and/or Asian economies, as well as a decrease in domestic demand, especially private business investment.

As for the impacts on energy balances, growth in the domestic primary energy supply would be 0.3 percentage points lower at an increase of 0.9%, while that in final energy consumption would be 0.3 percentage points higher at an increase of 0.6%, both compared against the reference case.

### 3-2 Contingency Scenarios

#### 3-2-1 Resumption of operation of nuclear power plants

While there is still uncertainty as to when operation of nuclear power plants under suspension will be resumed, we have assumed two contingencies: earlier-than-expected resumption and later-than-expected resumption, and then analyzed their impacts on energy balance (i.e., fuel demand for thermal power generation) and on CO<sub>2</sub> emission levels.

In the reference case, it was assumed that one-half of suspended nuclear power stations would resume operation in the summer of 2004 and the other half in the fall. The scenario of earlier-than-expected resumption assumes that the resumption would be three months earlier, while that of later-than-expected resumption assumes that it would be three months later. We will, then, analyze the influences of the respective scenarios (Table 3-2).

Table 3-2: Contingency scenarios regarding the resumption of operation of nuclear power plants under long-term suspension

	Plants currently under inspection or already inspected	Plants currently under repair
Reference case	resume operation in summer 2004	resume operation in fall 2004
Earlier-than-expected resumption (by three months)	resume operation in spring 2004	resume operation in summer 2004
Later-than-expected resumption (by three months)	resume operation in fall 2004	resume operation in winter 2004

Earlier-than-expected resumption would result in a decline in demand for grade C fuel oil of approximately 4 million kiloliters (kl) and a decrease in CO<sub>2</sub> emissions by 4 million tons carbon equivalent (MtC), both compared against the reference case. Later-than-expected resumption would result in a rise in demand for grade C fuel oil of approximately 5 million kiloliters (kl) and an increase in CO<sub>2</sub> emissions by 4 million tons carbon equivalent (MtC), both compared against the reference case (Table 3-3).

Table 3-3: Influences of different scenarios regarding full resumption of nuclear power generation

		Nuclear power generation (excluding Fugen)		Fuel demand for thermal power generation (in millions of kiloliters of grade C fuel oil equivalent)	CO <sub>2</sub> emission (in million tons of carbon equivalent)
		Electricity generated in 100 millions of kWh	Capacity utilization %		
FY 2001	Actual	3,175	80.3	108	312
FY 2002	Actual	2,941	73.4	115	318
FY 2003	Forecast	2,316	57.8	126	326
FY 2004	Reference case	3,080	76.9	114	319
	Earlier-than-expected resumption	3,283	81.9	110	316
	(Changes from reference case)	(203)	(5.1)	(-4)	(-3)
	Later-than-expected resumption	2,837	70.8	120	323
	(Changes from reference case)	(-243)	(-6.1)	(5)	(4)



### 3-2-2 Temperature Fluctuations

We have also analyzed the influences of temperature fluctuations in summer and winter on energy demand by consumer type and by type of energy consumed (Table 3-4). We have assumed a case where summer temperatures in the July–September period are 1°C higher than the average year and one where winter temperatures in the January–March period are 1°C lower than the average year.

3-3: Influences of different scenarios regarding full resumption of nuclear power generation

		Nuclear power generation (excluding Fugen)		Fuel demand for thermal power generation (in millions of kiloliters of grade C fuel oil equivalent)	CO <sub>2</sub> emission (in million tons of carbon equivalent)
		Electricity generated in 100 millions of kWh	Capacity utilization %		
FY 2001	Actual	3,175	80.3	108	312
FY 2002	Actual	2,941	73.4	115	318
FY 2003	Forecast	2,316	57.8	126	326
FY 2004	Reference case	3,080	76.9	114	319
	Earlier-than-expected resumption	3,283	81.9	110	316
	(Changes from reference case)	(203)	(5.1)	(-4)	(-3)
	Later-than-expected resumption	2,837	70.8	120	323
	(Changes from reference case)	(-243)	(-6.1)	(5)	(4)

Under such scenarios, a hotter summer would cause domestic primary energy supply and final energy consumption to increase by 0.6 percentage points and 0.5 percentage points, respectively, compared against the reference case. It would also increase the sales of electricity, town gas, and fuel oils by 0.8, 0.5, and 1.3 percentage points each. A colder winter would, on the other hand, cause both domestic primary energy supply and final energy consumption to increase by 0.6 percentage points. As for its consumption breakdown, an increase in demand for town gas would be most notable with its sales jumping up by 2.4 percentage points, as such temperature changes in winter would greatly affect both air- and water-heating demand.

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