Final Energy Consumption and Greenhouse Gas Emissions in Tokyo

(FY 2012)

March 2015

Bureau of Environment
Tokyo Metropolitan Government

Contents

Note: Values in this report have been rounded, and the sum of indicated values may not agree with the indicated total.

1 Tokyo in the World

- Figure 1-1 indicates energy-derived CO_2 emissions in major countries.
- Japan emits the fifth largest quantity after China, USA, India and Russia, accounting for 3.9% of the global emissions. Emissions from Tokyo are at the same level as Austria, Singapore, Finland, etc.
- The scale of final energy consumption also proves that Tokyo is a major consumer of energy, equivalent to the size of an European state, such as Denmark, Norway, and Portugal.

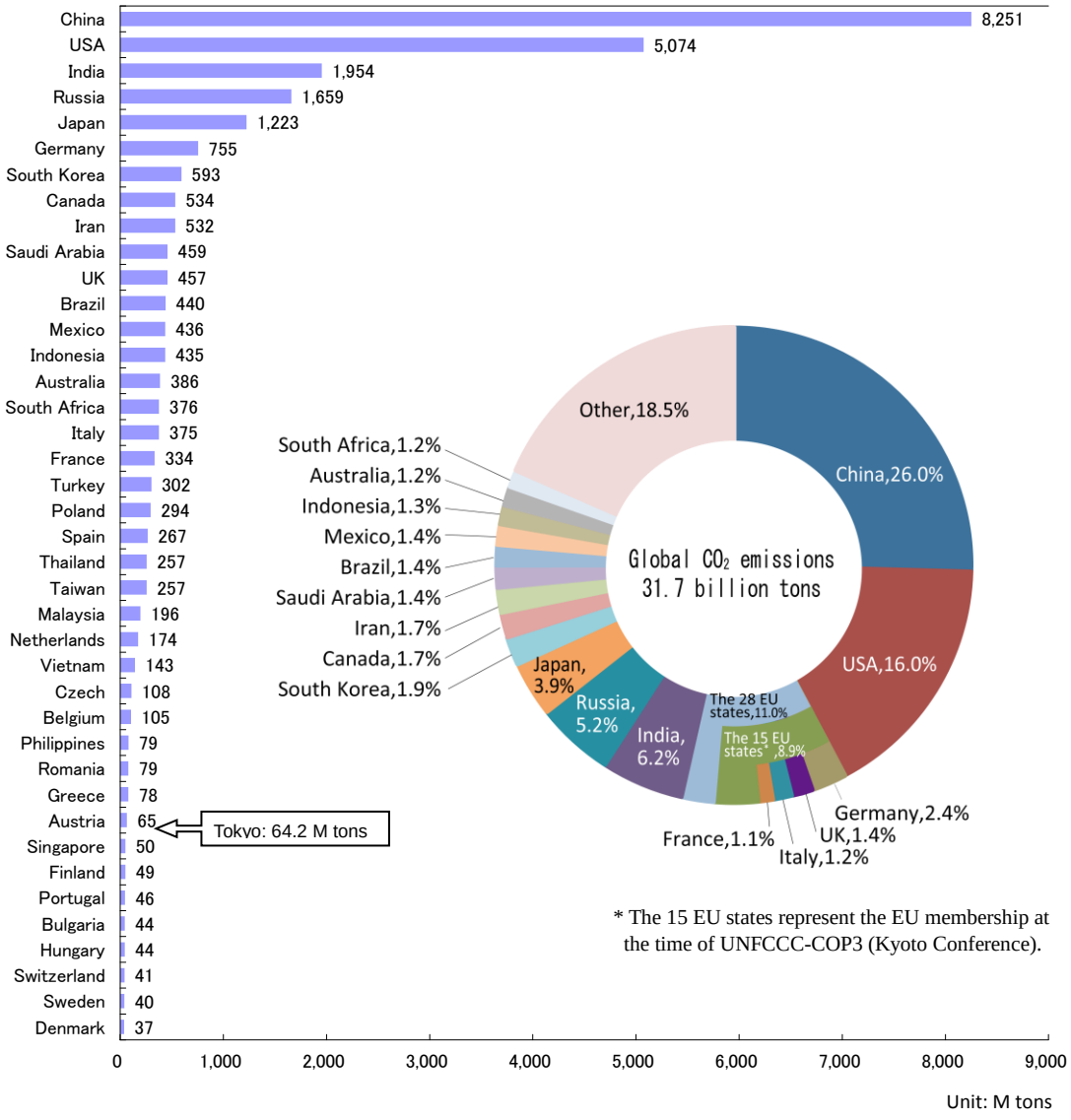


Figure 1-1 Energy-derived CO_2 emissions by country (2012)

Note: The figure indicates the 20 largest emitters, from China (1st place) to Poland (20th place), and other selected major countries.
Sources: IEA, "CO_2 Emissions From Fuel Combustion Highlights (2014 Edition)", and Ministry of the Environment, "Energy-derived CO_2 Emissions in the World"

2 Final Energy Consumption

2.1 Concepts for Calculation

- This chapter clarifies the state of energy consumption as the main cause of CO_2 emissions in Tokyo.
- Figure 2-1 indicates the flow of energy in Japan. First, the primary energy supply of petroleum, coal, natural gas, etc., is undertaken through domestic production or importation. By way of the power generation/conversion sectors (power plants, petroleum refineries, etc.), final energy consumption is undertaken by consumers.
- In this survey, energy consumption on the demand side (i.e. final energy consumption) in the industrial/commercial/residential/transport sectors in Tokyo is calculated.
- For the calculation methods for final energy consumption, an overview is indicated in Reference Material 1 (pages 36 to 38).

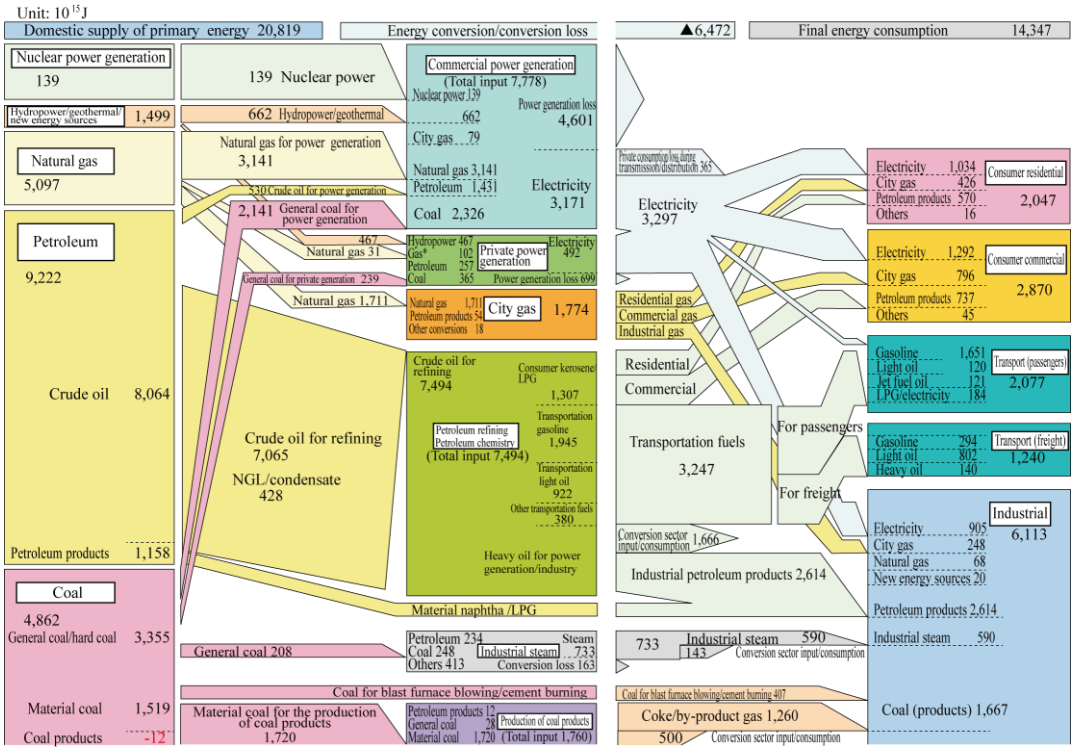


Figure 2-1 Domestic Energy Balance and Flow (Overview) (FY 2012)
Source: Agency for Natural Resources and Energy, "Energy White Paper 2014"

Table 2-1 Heat conversion factors used in this survey (FY 2012)

(Unit: GJ/Specific unit)

Fuel	Specific unit	Heat conversion factor	Remarks
Electricity	MWh	3.6	Secondary energy conversion
City gas	1000 m^3	45.0	See materials of Tokyo Gas
Other fuels (gasoline, kerosene, light oil, LPG, etc.)			See the energy balance table, Agency for Natural Resources and Energy, "Comprehensive Energy Statistics"

Note: Secondary energy conversion is conducted for electricity, from the perspective of calculating final energy consumption on the demand side, excluding losses in power generation, transmission, distribution, etc.

2.2 Final Energy Consumption

2.2.1 Entire Tokyo

▼ The final energy consumption in Tokyo in FY 2012 stood at 671 PJ, which was 16% reduction from 801 PJ in FY 2000, and 1% reduction from 677 PJ in FY 2011.

▼ Respective increase rates vs. FY 2000 for the industrial, commercial, and transport sectors stood at -37%, -4%, and -38%, while consumption in the residential sector increased by + 5%.

▼ Since FY 2000, a decrease in gasoline and other fuel oils has substantially contributed to overall reduction in final energy consumption. Although electric consumption had been on an increasing trend, the behavior of power conservation took root in FY 2011 and after, and power consumption has remained at the same level as FY 2000 since then.

Table 2-2 Final energy consumption by sector in Tokyo, and increases up to FY 2012

	Final energy consumption (PJ)					Increase rate (%)			
	FY 2000	FY 2005	FY 2010	FY 2011	FY 2012	Vs. 2000	Vs. 2005	Vs. 2010	Vs. 2011
Industrial sectors	97	81	70	63	61	- 36.6%	- 24.3%	- 13.0%	- 3.3%
Commercial sectors	245	274	260	233	237	- 3.6%	- 13.6%	- 8.9%	1.6%
Residential sectors	202	217	221	212	212	5.2%	- 2.1%	- 4.0%	0.3%
Transport sectors	257	219	172	169	161	- 37.5%	- 26.4%	- 6.3%	- 4.6%
Final consumption sectors total	801	790	723	677	671	- 16.2%	- 15.1%	- 7.2%	- 0.8%

Note 1: The residential sector does not include fuel consumption by family cars, which is included in the transport sector.
Note 2: In the transport sector, the scope of calculation for automobiles includes traffic in Tokyo, while that for railway, vessels, and airlines includes service in Tokyo.

Table 2-3 Final energy consumption by fuel type in Tokyo, and increases up to FY 2012

	Final energy consumption (PJ)					Increase rate (%)			
	FY 2000	FY 2005	FY 2010	FY 2011	FY 2012	Vs. 2000	Vs. 2005	Vs. 2010	Vs. 2011
Electricity	296	316	323	290	293	- 0.9%	- 7.1%	- 9.3%	1.0%
City gas	187	211	197	188	188	0.6%	- 11.0%	- 4.4%	0.2%
LPG	33	26	19	21	17	- 46.9%	- 34.6%	- 11.0%	- 16.7%
Fuel oil	284	236	183	177	172	- 39.5%	- 27.2%	- 6.2%	- 2.7%
Other	2	0	0	1	0	- 75.4%	44.4%	207.3%	- 56.9%
Total	801	790	723	677	671	- 16.2%	- 15.1%	- 7.2%	- 0.8%

Note: Fuel oils: gasoline, kerosene, light oil, heavy oil A/B/C, and jet fuel; Other: oil coke, coal coke, natural gas, etc.

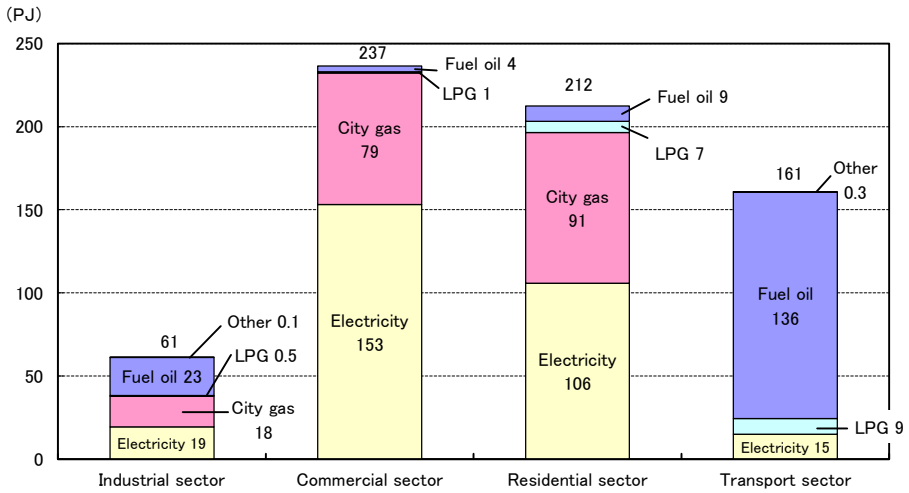


Figure 2-2 Final energy consumption by sector in Tokyo (FY 2012)

2.2.1-1 Final Energy Consumption by Sector in Entire Tokyo

- In the composition in FY 2012, the commercial sector took up the largest share (35%), followed by the residential sector (32%), transport sector (24%), and industrial sector (9%).
- As for sectoral trends in the composition since FY 2000, the commercial sector and the residential sector indicates an increasing trend, while the industrial sector and the transport sector have been showing a decreasing trend.

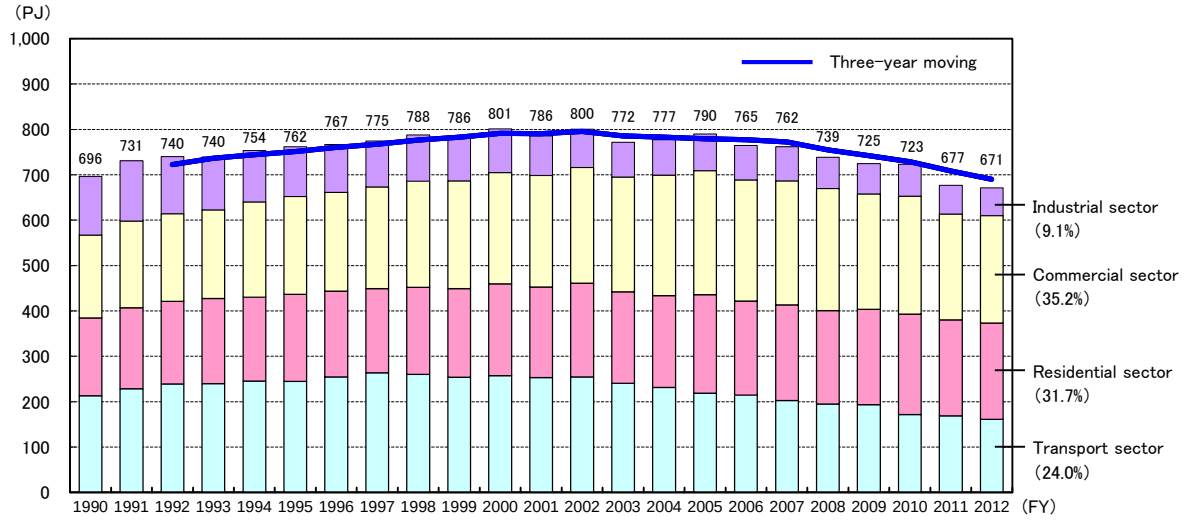


Figure 2-3 Trends in final energy consumption by sector in Tokyo

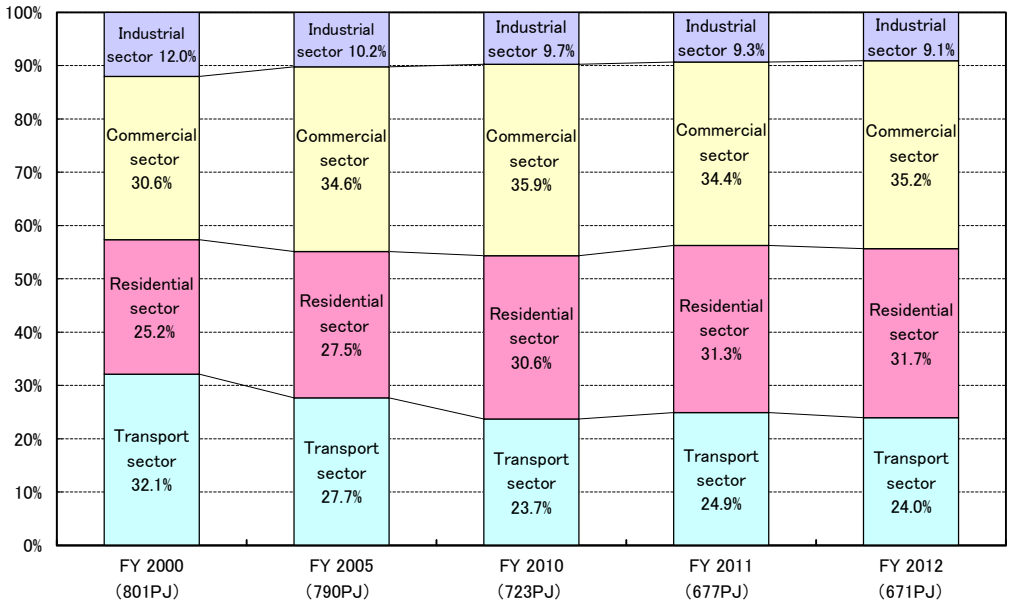


Figure 2-4 Composition ratios in final energy consumption by sector in Tokyo

2.2.1-2 Final Energy Consumption by Fuel Type in Entire Tokyo

- In the fuel type composition in FY 2012, electricity took up the largest share (44%), followed by city gas (28%) and fuel oil (26%).

- Since FY 2000, the share of electricity has been increasing. While the share of electricity temporarily decreased in FY 2011 due to the effect of power conservation, its share rose by approximately one point year on year in FY 2012. In the meantime, the share of city gas has been slowly increasing.

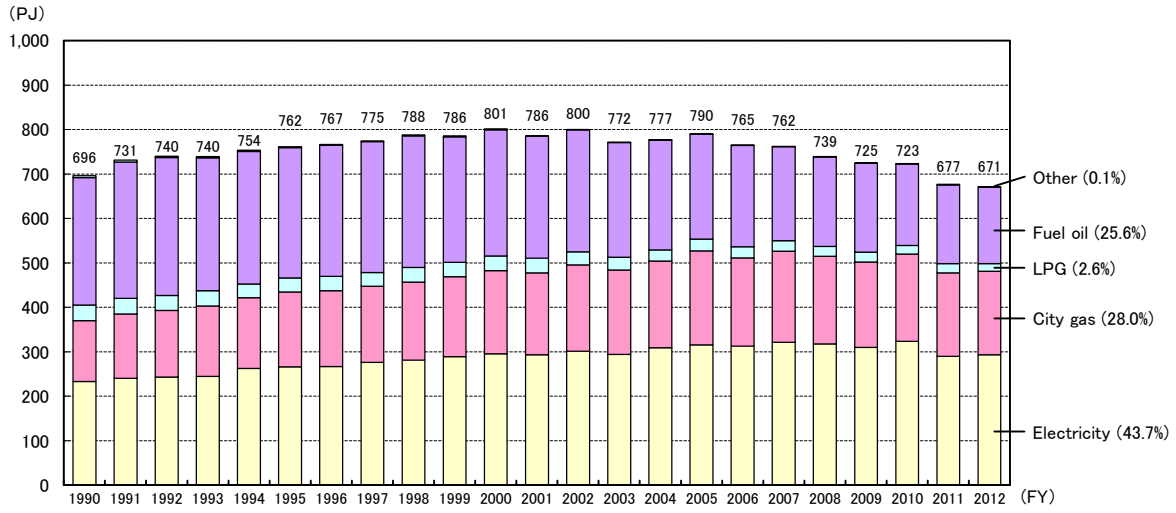


Figure 2-5 Trends in final energy consumption by fuel type in Tokyo

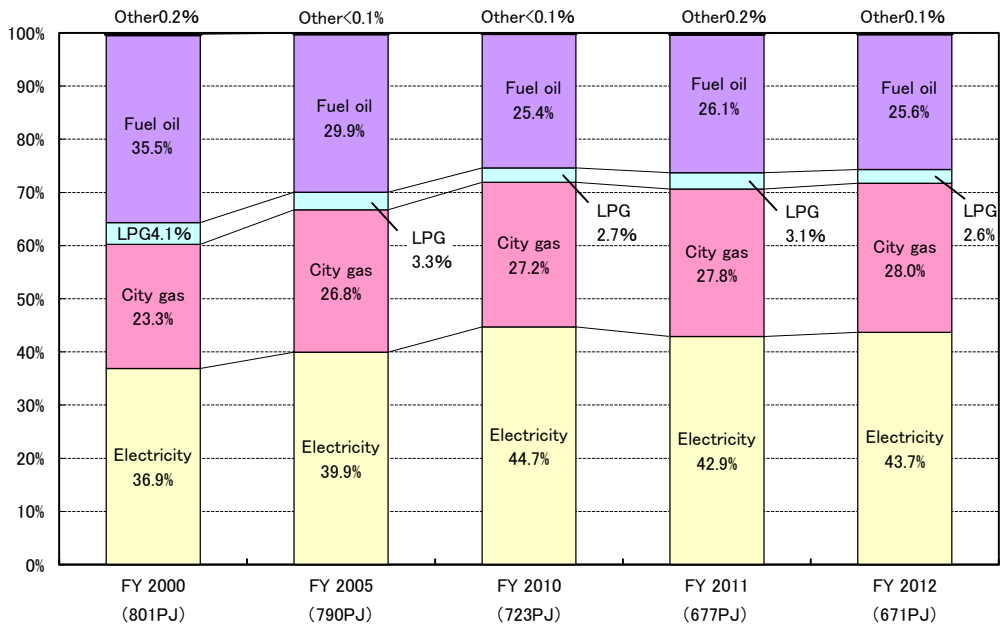


Figure 2-6 Composition ratios in final energy consumption by fuel type in Tokyo

2.2.2 Industrial Sector

▼ The final energy consumption in the industrial sector in FY 2012 stood at 61 PJ, which was 37% reduction from 97 PJ in FY 2000, and 3% reduction from 63 PJ in FY 2011.

▼ Final energy consumption in the industrial sector has been decreasing since FY 1990.

2.2.2-1 Final energy consumption by trade in the industrial sector

- In the trade composition in FY 2012, manufacturing took up the largest share (68%), followed by construction (29%), agriculture, forestry and fishery (3%), and mining (< 1%).

- Final energy consumption has been continuously decreasing in manufacturing, which accounts for approximately 70% of the industrial sector.

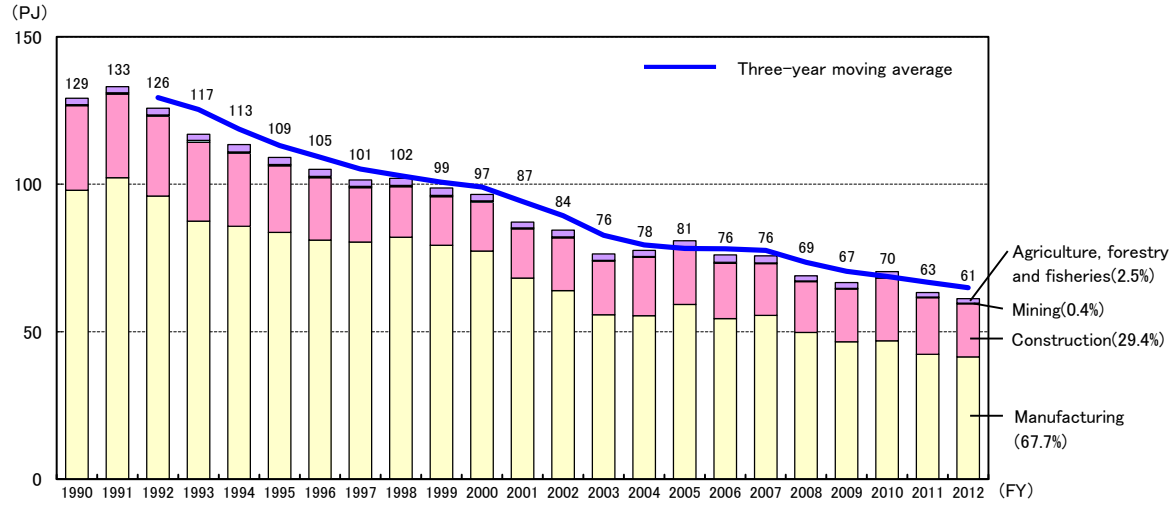


Figure 2-7 Final energy consumption by trade in the industrial sector

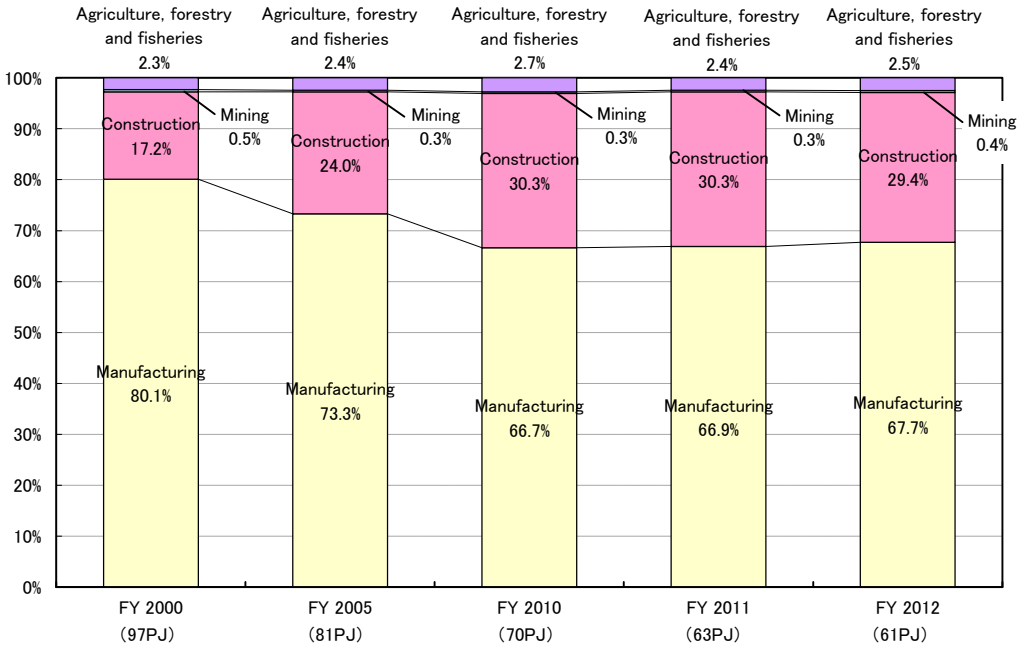


Figure 2-8 Composition ratios in final energy consumption by trade in the industrial sector

2.2.2-2 Final Energy Consumption by fuel type in the Industrial Sector

- In the fuel type composition in FY 2012, fuel oil took up the largest share (37%), followed by electricity (32%) and city gas (30%).
- Since FY 2000, the share of fuel oil has been decreasing, while the shares of city gas and electricity have been increasing, indicating progress in fuel conversion.

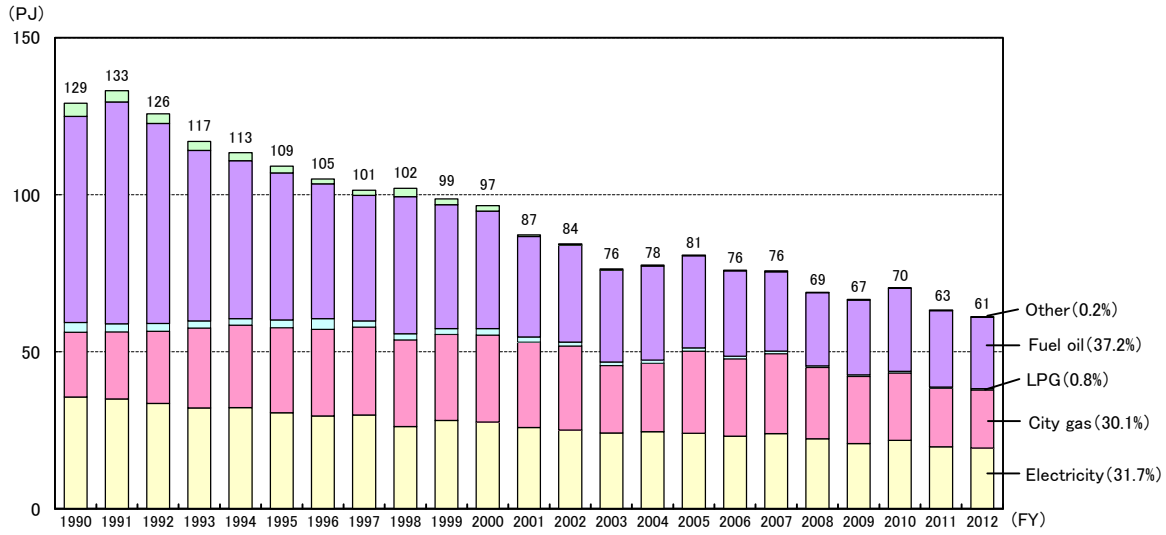


Figure 2-9 Trends in final energy consumption by fuel type in the industrial sector

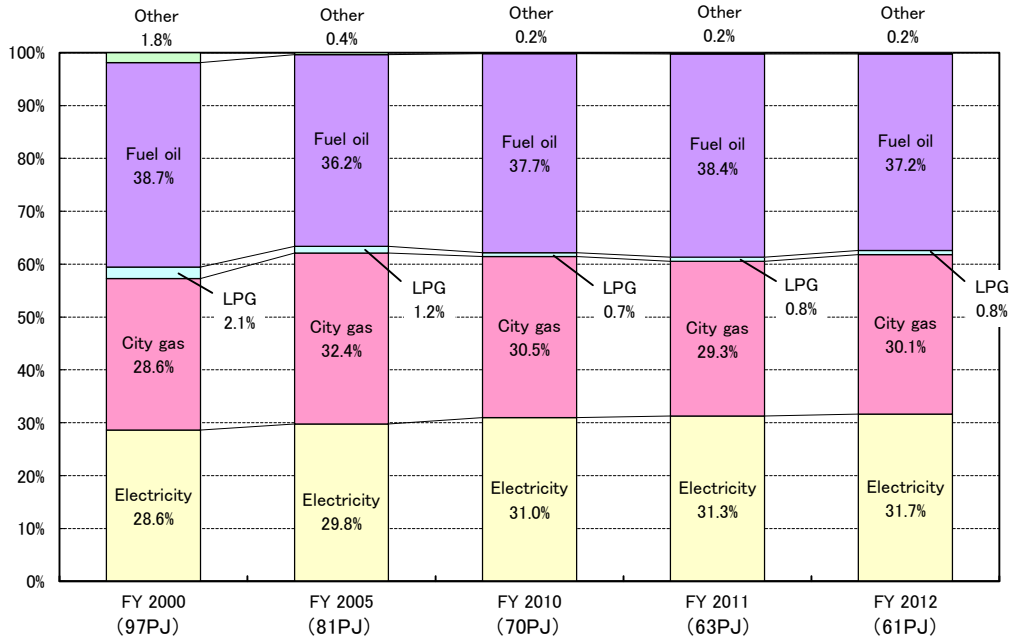


Figure 2-10 Composition ratios in final energy consumption by fuel type in the industrial sector

2.2.2-3 Factor Analysis in the Industrial Sector

- The Indices of Industrial Production (IIP)* for respective trade affect final energy consumption in manufacturing, the main trade in the industrial sector.

- Since FY 1990, IIP increase rates have been generally declining in manufacturing in Tokyo. This is considered to be substantially affecting the decreasing final energy consumption.

- In comparison with the nationwide IIP increase rates, the rates in Tokyo became smaller in FY 1994, and the gap with nationwide rates has become substantial since around FY 1998.

* The Indices of Industrial Production (IIP) are a systematic representation of various activities related to production, shipment, and inventory at domestic business sites that produce mining and industrial products. The IIP used here refers to production indices weighted by added value, which are calculated for 169 items (496 items for nationwide indices), based on the dynamic statistics of production, the Census of Manufacturers, etc.

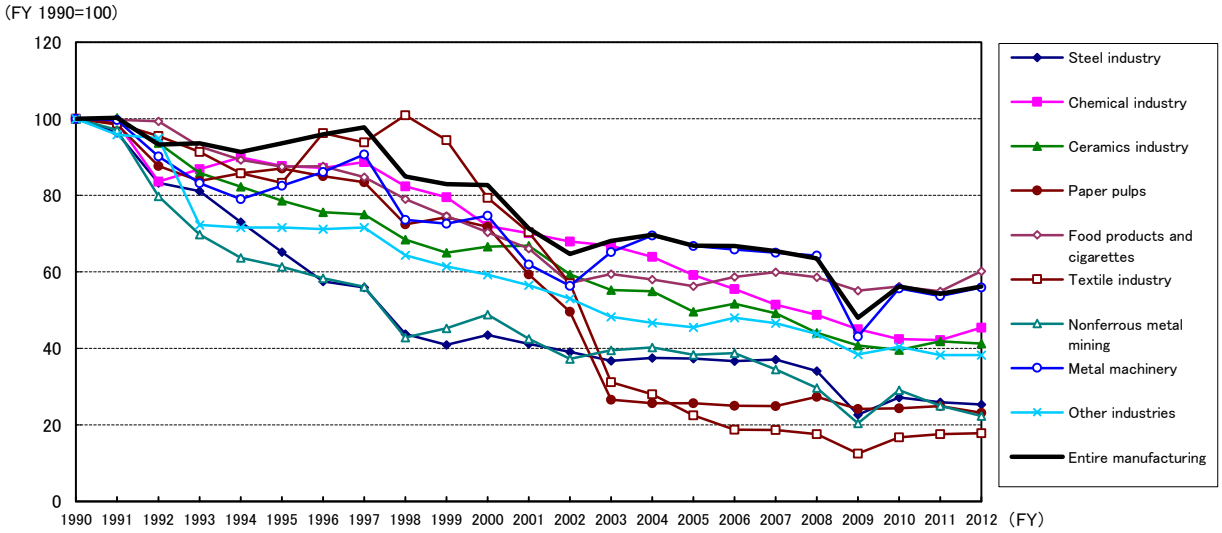


Figure 2-11 IIP increases in manufacturing in Tokyo

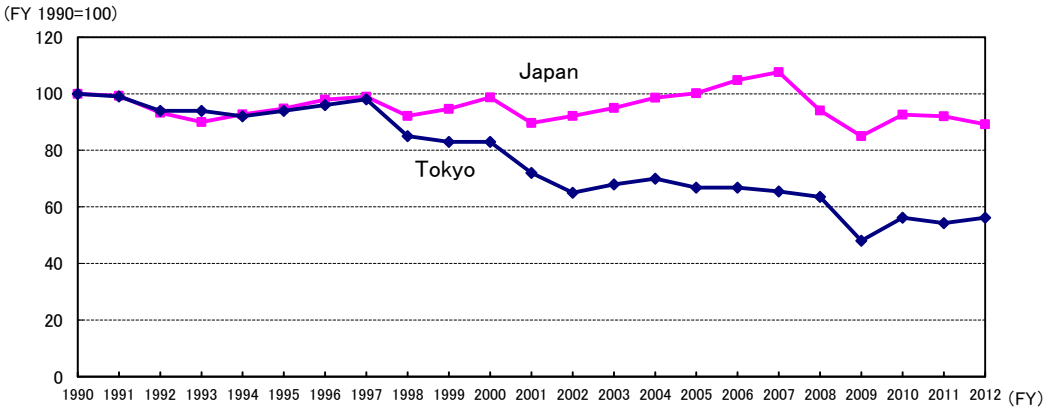


Figure 2-12 Comparison of IIP between Tokyo and Japan

Note: IIP figures are weighted by added value.
Source: Tokyo: Prepared from the Tokyo Metropolitan Government (hereinafter referred to as "TMG"), "Tokyo Industrial Indices"
Japan: Prepared from Energy Data and Modeling Center, the Institute of Energy Economics, Japan "EDMC/Energy Economics Statistics Summary"

2.2.3 Commercial Sector

▼ The final energy consumption in the commercial sector in FY 2012 stood at 237 PJ, which was 4% reduction from 245 PJ in FY 2000, but 2% increase from 233 PJ in FY 2011.

▼ Final energy consumption in the commercial sector has been increasing since FY 1990, but took a downturn with a peak at around FY 2007.

2.2.3-1 Final Energy Consumption by Building Application in the Commercial Sector

- In the building application composition in FY 2012, office buildings took up the largest share (59%). Other applications included restaurants (8%), schools (7%), hotels (6%), etc.
- Since FY 2000, the share of office buildings has been rising. This indicates the structural characteristics of Tokyo, where the corporate head office buildings, tenant buildings, etc., are accumulated.

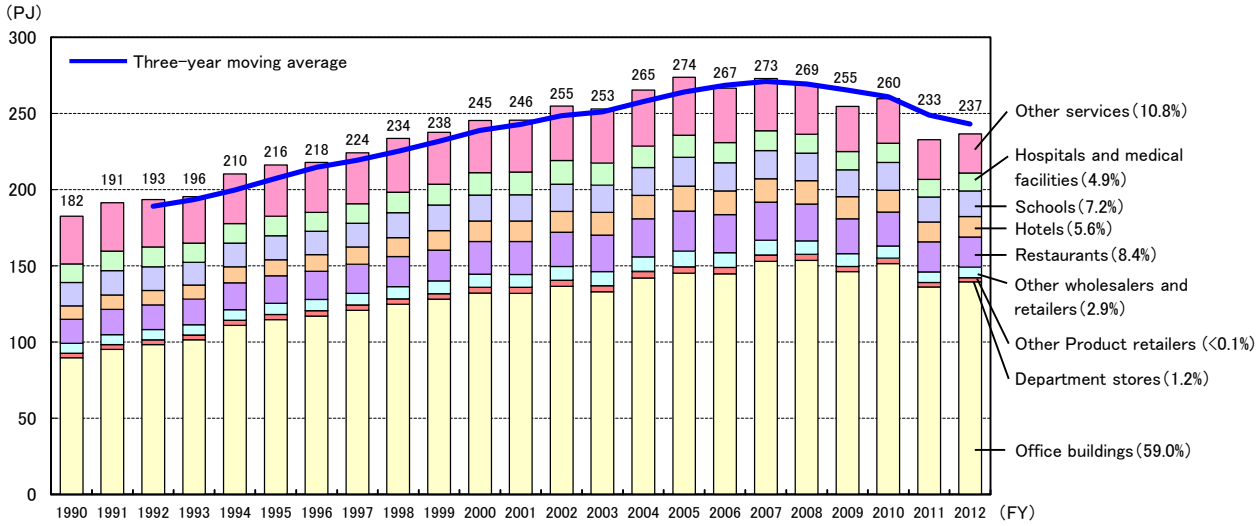


Figure 2-13 Trends in final energy consumption by building application in the commercial sector

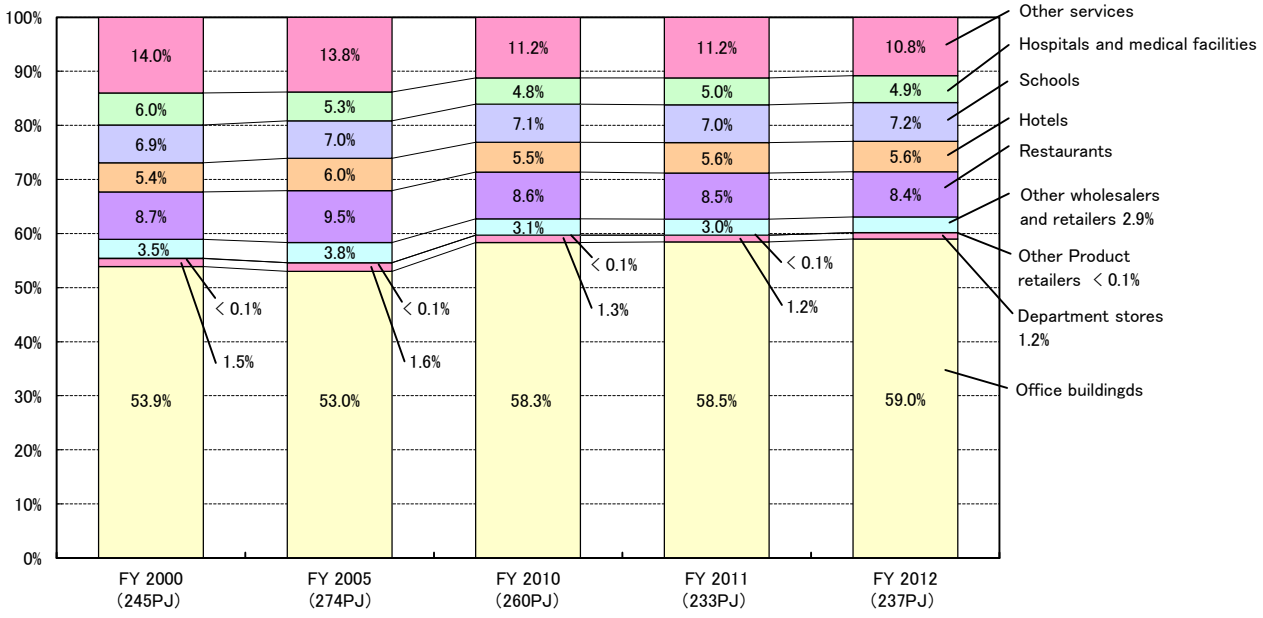


Figure 2-14 Composition ratios in final energy consumption by building application in the commercial sector

2.2.3-2 Final Energy Consumption by Fuel Type in the Commercial Sector

- In the fuel type composition in FY 2012, electricity (65%) and city gas (33%) combined accounted for 98% of the entire commercial sector.
- Since FY 2000, the shares of electricity and city gas have been rising, indicating progress in the conversion from fuel oils to electricity and city gas.

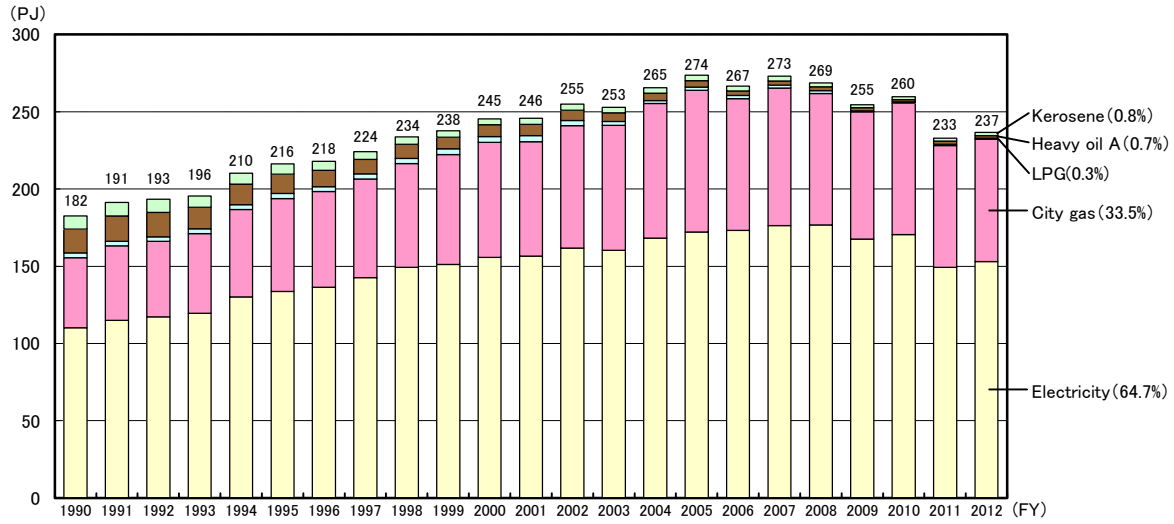


Figure 2-15 Trends in final energy consumption by fuel type in the commercial sector

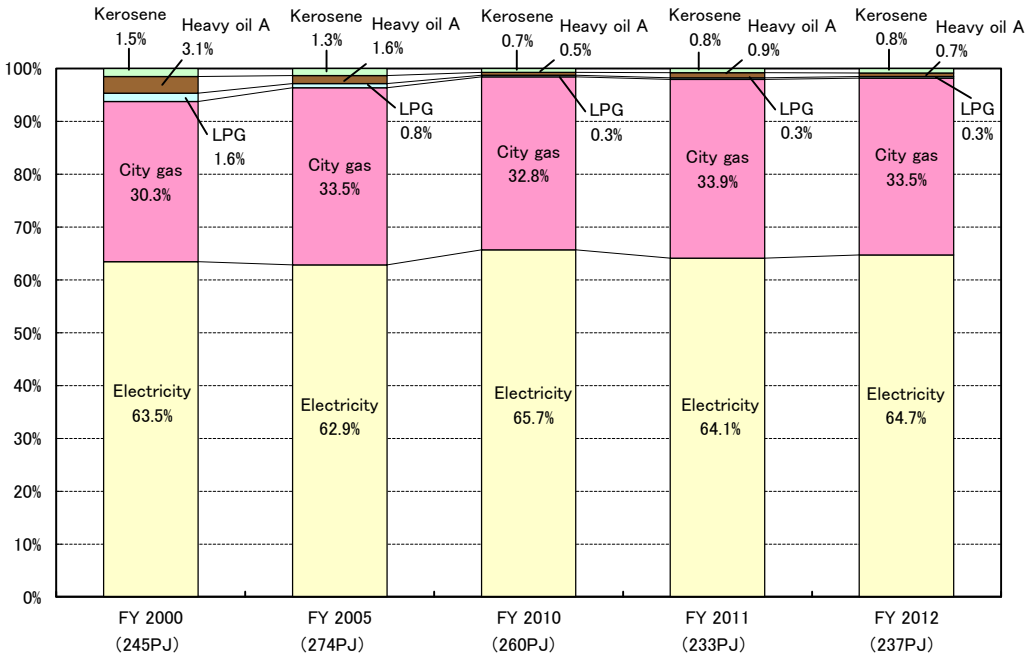


Figure 2-16 Composition ratios in final energy consumption by fuel type in the commercial sector

2.2.3-3 Factor Analysis in the Commercial Sector

- The total floor area by building application is an index that affects final energy consumption in the commercial sector.

- Since FY 1990, the total floor area has been increasing in the commercial sector. While the total floor area in the commercial sector is generally increasing across Japan, the remarkably high rate of office buildings is characteristic in Tokyo.

- The total floor area of office buildings in Tokyo has been steadily increasing since FY 1990.

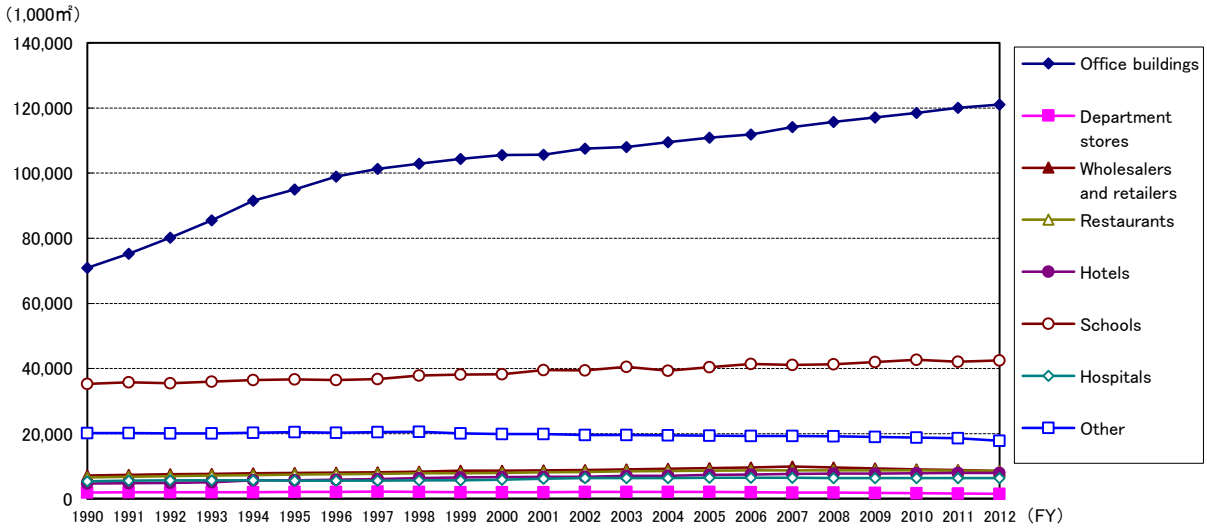


Figure 2-17 Trends in total floor area by trade in Tokyo

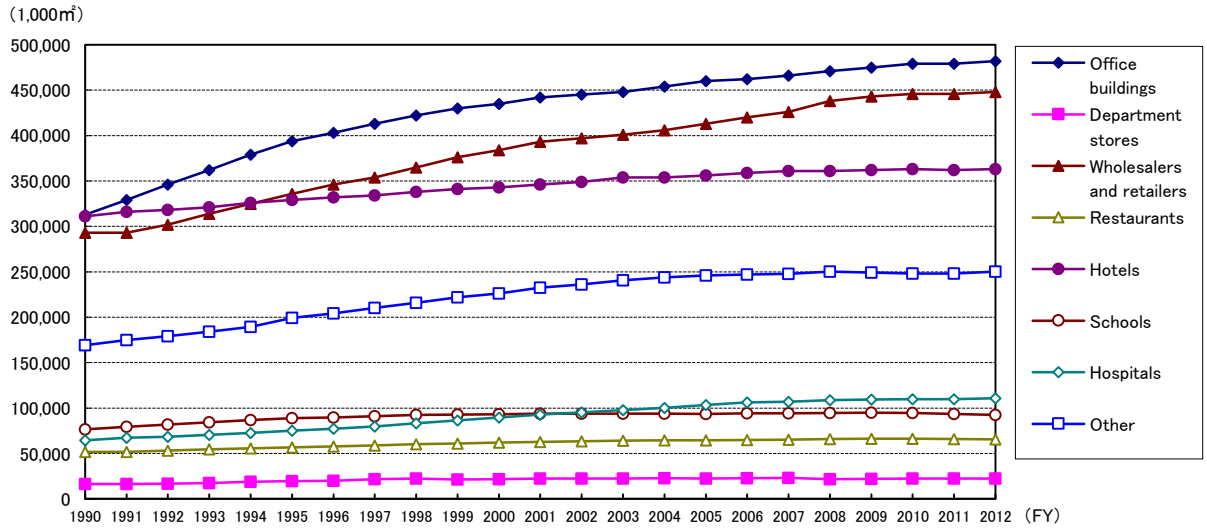


Figure 2-18 Trends in total floor area by trade in Japan

Note: "Department stores" include large-scale retail stores and supermarkets.
Source: Prepared from Energy Data and Modeling Center, the Institute of Energy Economics, Japan "EDMC/Energy Economics Statistics Summary"

2.2.4 Residential Sector

▼ The final energy consumption in the residential sector in FY 2012 stood at 212 PJ, which was 5% increase from 202 PJ in FY 2000, and 0.3% increase from 212 PJ in FY 2011.

▼ Final energy consumption in the residential sector has been increasing since FY 1990, but this upward trend is weakening these years.

2.2.4-1 Final Energy Consumption by Household Type in the Residential Sector

- In the household type composition in FY 2012, multiple-person households accounted for 69%, while single-person households made up 31%.
- Since FY 2000, the share of single-person households has been increasing in final energy consumption, indicating increase in aged single-person households, etc.

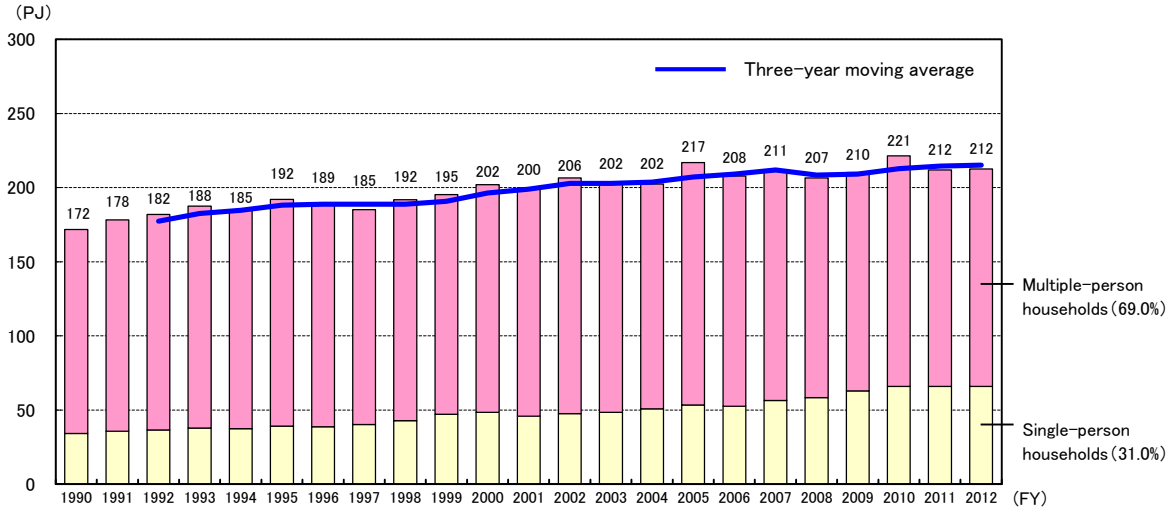


Figure 2-19 Trends in final energy consumption by household type in the residential sector

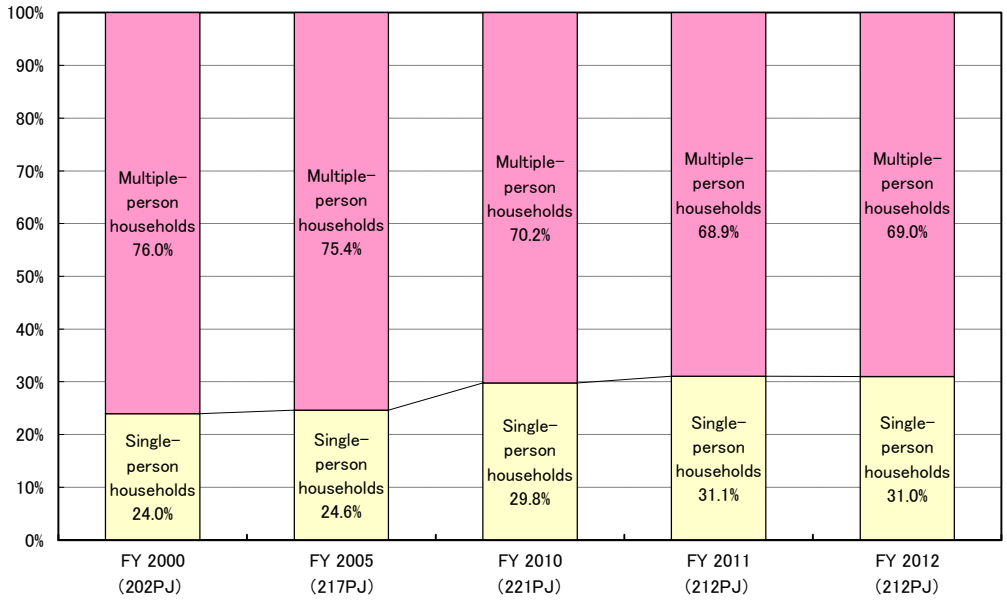


Figure 2-20 Composition ratios in final energy consumption by household type in the residential sector

2.2.4-2 Final Energy Consumption by Fuel Type in the Residential Sector

- In the fuel type composition in FY 2012, electricity (50%) and city gas (43%) combined accounted for 92% of the entire residential sector.
- Although the share of electricity had been increasing since FY 2000, the behavior of power conservation took root in FY 2011 and after, and the share of electricity has remained at a level approximately two points lower than in FY 2010. In the meantime, the share of city gas has remained at a level approximately two points higher than in FY 2010.

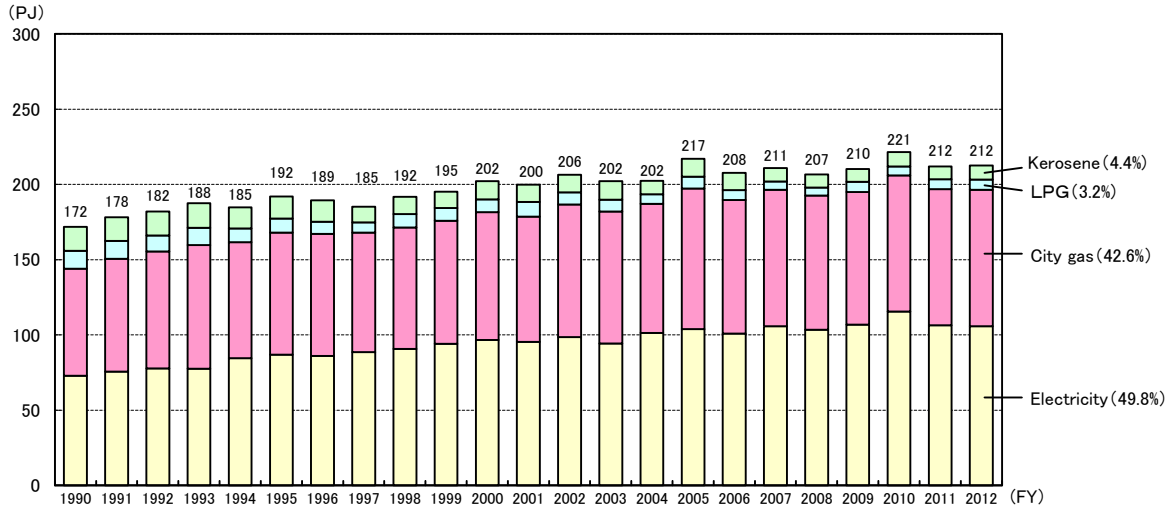


Figure 2-21 Trends in final energy consumption by fuel type in the residential sector

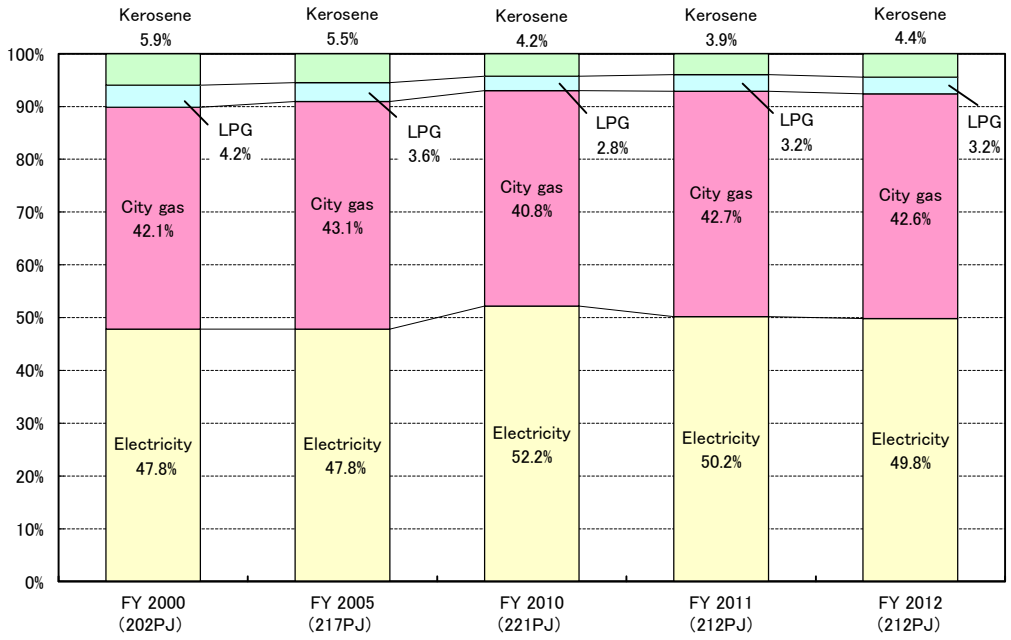


Figure 2-22 Composition ratios in final energy consumption by fuel type in the residential sector

2.2.4-3 Factor Analysis in the Residential Sector

- The number of households is an index that affects final energy consumption in the residential sector.

- Since FY 1990, an increasing trend is more remarkable in single-person households than in multiple-person households. While this is also a nationwide trend, it is more remarkable in Tokyo.

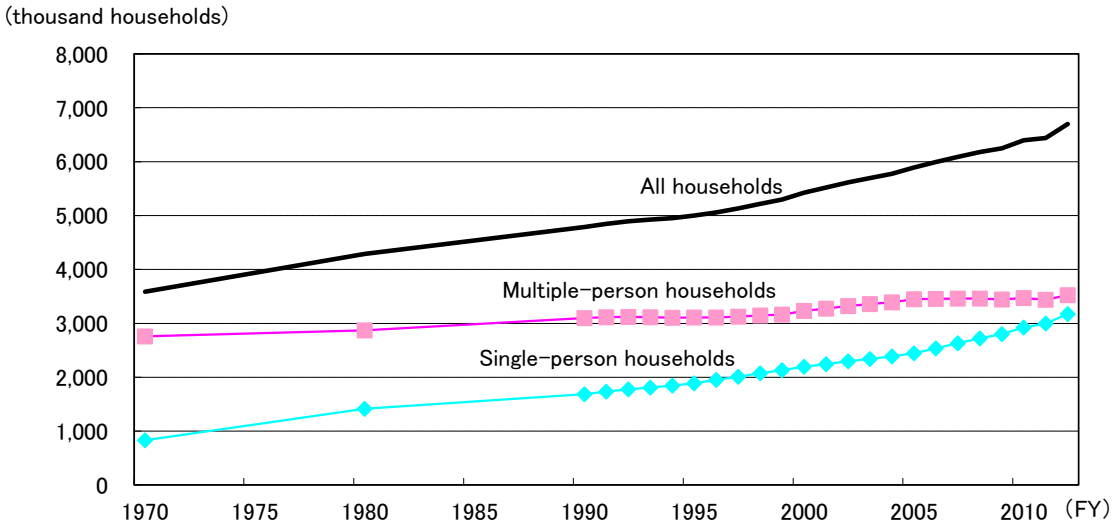


Figure 2-23 Trends in the number of households in Tokyo

Source: Prepared from Ministry of Internal Affairs and Communications (hereinafter referred to as "MIC"), "Census Report" and TMG, "Tokyo Statistical Yearbook"

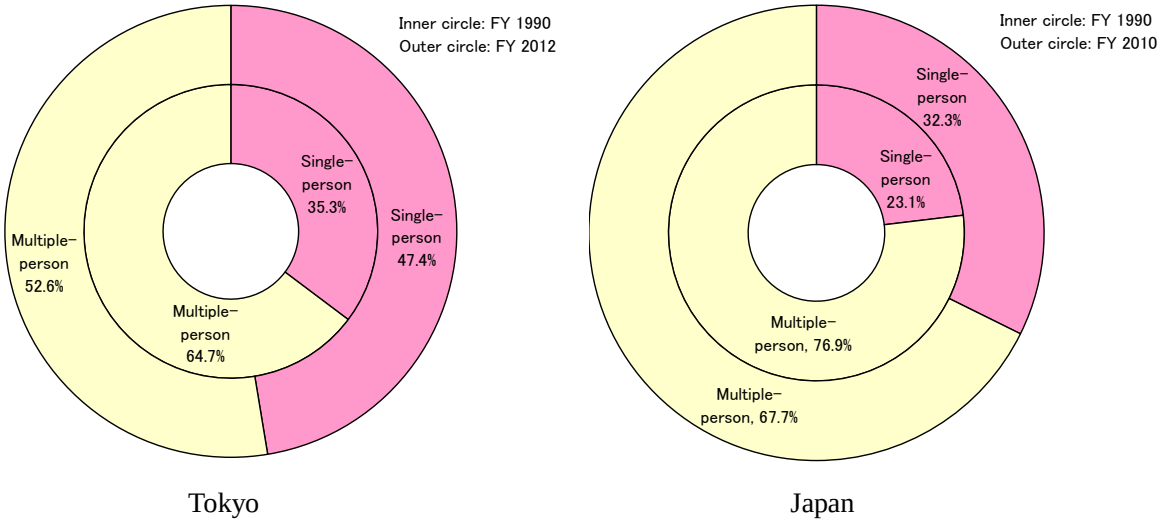


Figure 2-24 Comparison of the number of households between Tokyo and Japan

Source: Prepared from MIC, "Census Report" and TMG, "Tokyo Statistical Yearbook"

- The home appliance ownership rates are indices related to the shares of power consumption in the residential sector.

- In general, ownership rates of major home appliances have been increasing in Tokyo. In these years, increases are remarkable in the ownership rates of PCs, optical disk players/recorders, etc.

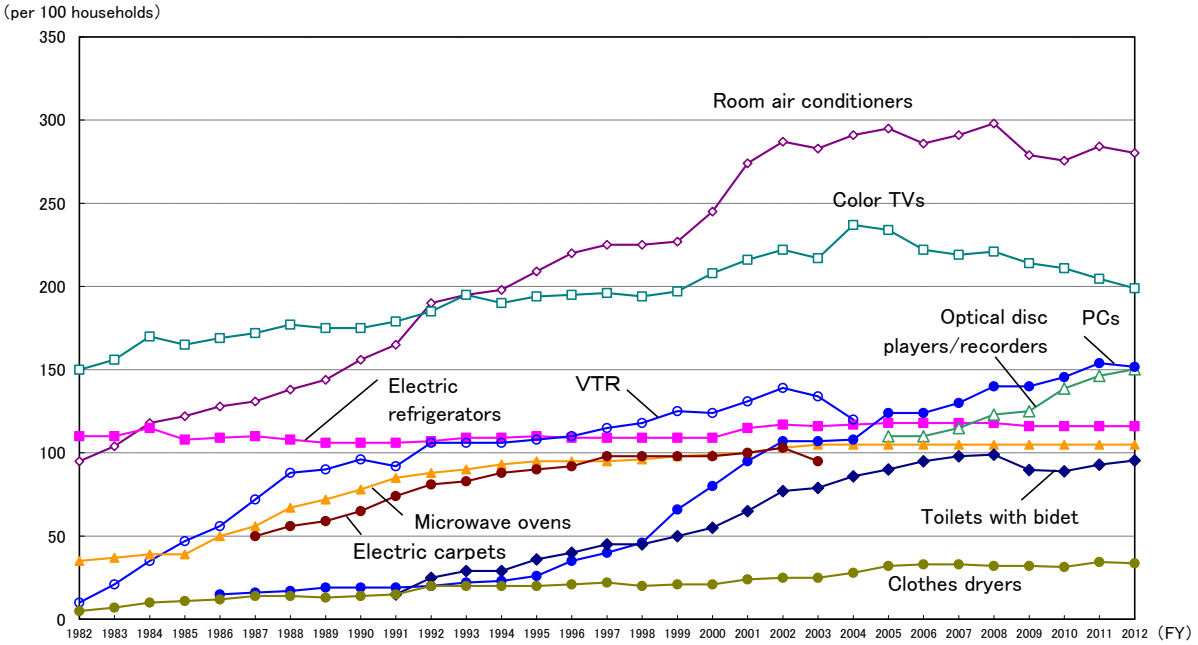


Figure 2-25 Trends in the ownership rates of home appliances in Tokyo

Note: The values for color TVs indicate the total of 29" or larger and below 29" for up to FY 2003, and the total of CRT and flat-screen (LCD, plasma, etc.) for FY 2004 and after.
The values may not be continuous for some appliances between FY 2003 and FY 2009, due to the review of appliances in the source material.
Source: Prepared from MIC "National Consumption Survey" and Cabinet Office "Trends in Household Consumption"

2.2.5 Transport Sector

▼ The final energy consumption in the transport sector in FY 2012 stood at 161 PJ, which was 38% reduction from 257 PJ in FY 2000, and 5% reduction from 169 PJ in FY 2011.

▼ Final energy consumption in the transport sector has been decreasing since FY 2000.

2.2.5-1 Final energy Consumption by Means of Transportation in the Transport Sector

- In the composition in FY 2012 by means of transportation, road transportation took up the largest share (89%). Other means included railways (9%), navigation (2%), and civil aviation (< 1%).
- Road transportation accounts for approximately 90% of the transport sector. In addition to the decreased traffic in Tokyo, road conditions have been improved, and performance of individual automobiles have been enhanced, thereby improving the actual mileage, and leading to the continuous decrease in final energy consumption.

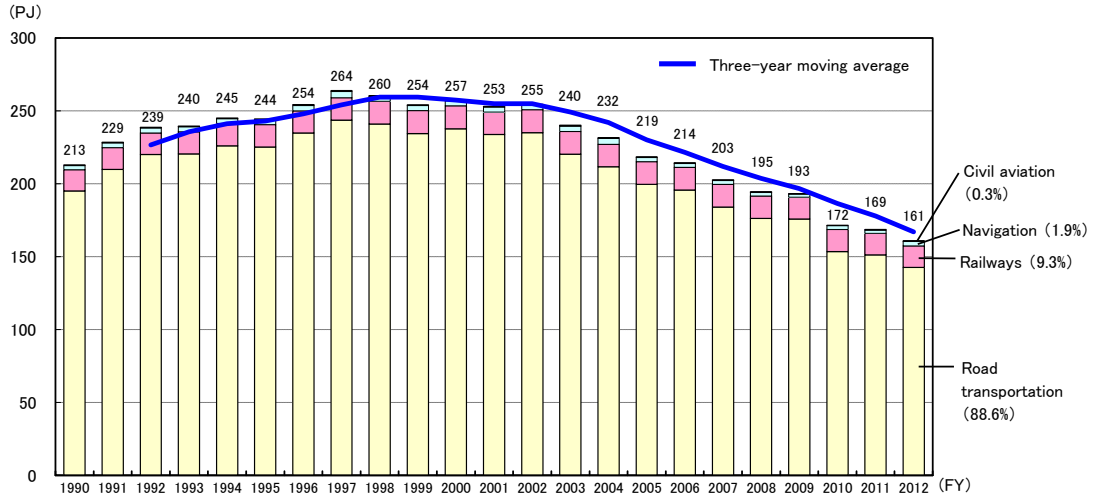


Figure 2-26 Trends in final energy consumption by means of transportation in the transport sector

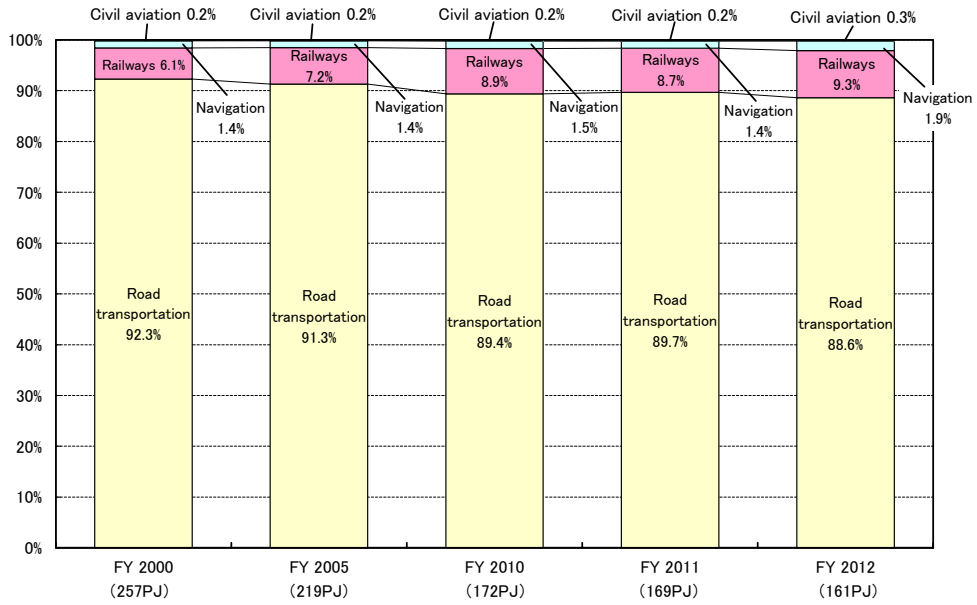


Figure 2-27 Composition ratios in final energy consumption by means of transportation in the transport sector

2.2.5-2 Final energy Consumption by Fuel Type in the Transport Sector

- In the fuel type composition in FY 2012, gasoline contained in fuel oil took up the largest share (58%), followed by light oil (25%) and electricity (9%). Electricity is consumed for the railway operation.
- Since FY 2005, the share of gasoline has been decreasing, while the share of light oil consumed by diesel cars has been slightly increasing.

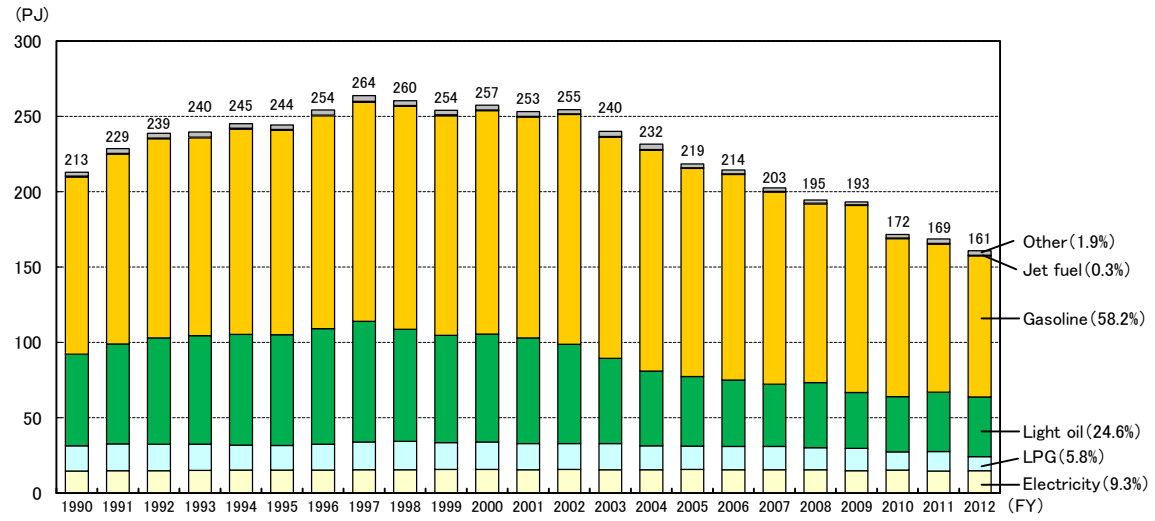


Figure 2-28 Trends in final energy consumption by fuel type in the transport sector

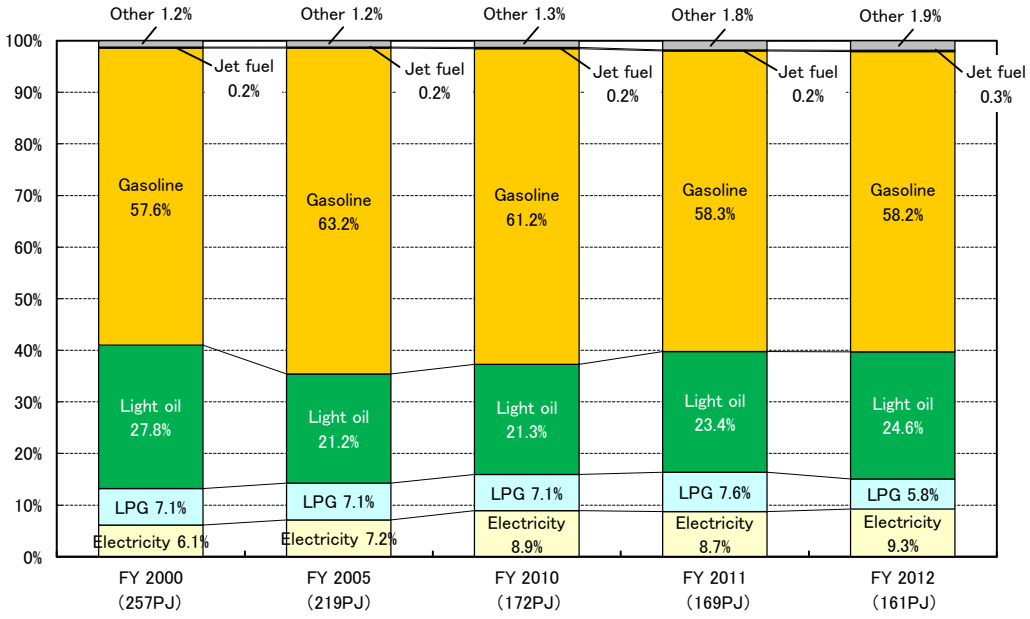


Figure 2-29 Composition ratios in final energy consumption by fuel type in the transport sector

2.2.5-3 Factor Analysis in the Transport Sector

- The number of registered vehicles and the traffic are indices that affect final energy consumption by road transportation, the main means of transportation in the transport sector.

- In Tokyo, passenger cars have been increasing at a rate that sets off the decrease in compact passenger cars. While freight vehicles have been decreasing, light cars have been increasing. The overall number remains mostly at the same level, with a slight decrease.

- The traffic of passenger vehicles had been increasing until FY 2000, and then took a downturn. In the meantime, freight vehicles have been slowing decreasing since FY 1990.

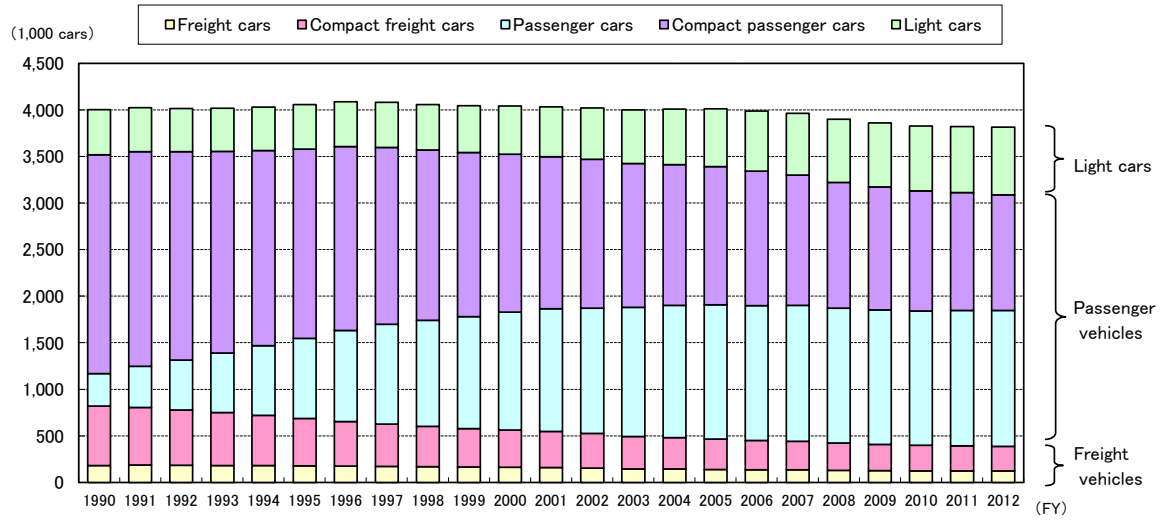


Figure 2-30 Trends in the number of registered vehicles in Tokyo

Note: "Light cars" include light passenger cars and light freight cars.
Sources: Tokyo Statistical Yearbook
Registered Vehicles Based on Materials of the Road Transport Bureau, Ministry of Land, Infrastructure, Transport and Tourism (hereinafter referred to as "MLIT"), March 2014 (Automobile Inspection & Registration Information Association)

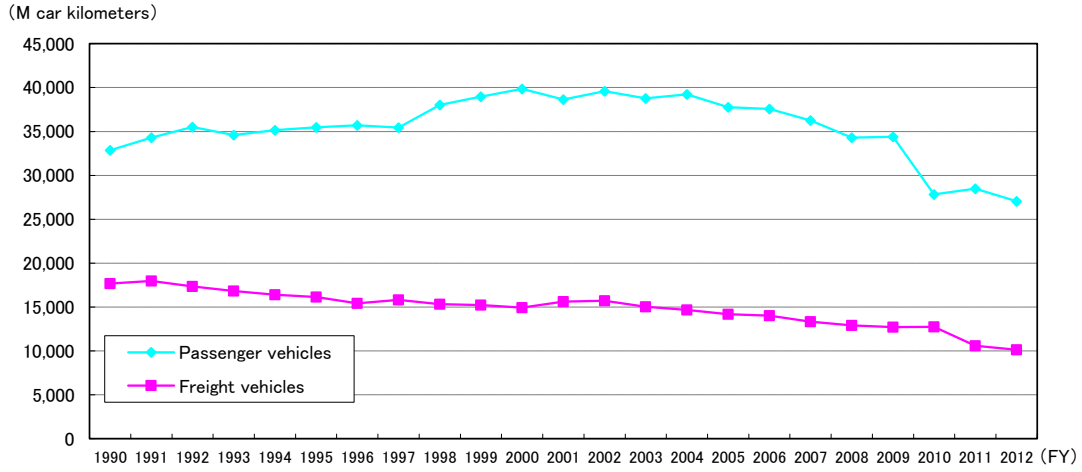


Figure 2-31 Trends in the traveling kilometers of vehicles in Tokyo

Note: Passenger vehicles: light passenger cars, compact passenger cars, passenger cars, and buses
Freight vehicles: light freight cars, compact freight cars, freight/passenger cars, freight cars, and special freight cars

3 Total Greenhouse Gas Emissions

3.1 Concepts for Calculation

3.1.1 Basic Matters

- This chapter clarifies the status of GHG emissions in Tokyo.
- The scope of GHGs includes carbon dioxide (CO_2), methane (CH_4), dinitrogen oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). These six types of gas are subject to the Kyoto Protocol.
- The GHGs other than CO_2 (CH_4, N_2O, HFCs, PFCs, SF_6) are referred to as "Other GHGs."
- In this survey, the values are calculated based on the Ministry of the Environment, "Manual for Formulating Action Plans (Regional Measures) for Municipal Governments against Global Warming". This manual describes calculation methods for GHG emissions in each prefecture. Calculation methods used here reflect the actual status in Tokyo more accurately, incorporating information and findings that have been uniquely collected by TMG.
- For the calculation methods for GHG emissions in this survey, an overview is indicated in Reference Material 1 (pages 36 to 38).

Table 3-1 GHGs and main source(s) of emission

GHG		Global warming potential	Main source(s) of emission
CO_2	Carbon dioxide	1	Combustion of fuel, incineration of waste, industrial process, etc.
CH_4	Methane	21	Agriculture, waste, industrial process, combustion of fuel, leak from fuel, etc.
N_2O	Dinitrogen oxide	310	Agriculture, waste, industrial process, combustion of fuel, leak from fuel, etc.
HFCs	Hydrofluorocarbons	140 to 11,700	Coolant, foaming agent, aerosol, etc.
PFCs	Perfluorocarbons	6,500 to 9,200	Cleaning agents, manufacturing of semiconductors and LCDs, etc.
SF_6	Sulfur hexafluoride	23,900	Electrical equipment using insulating gas, manufacturing of semiconductors and LCDs, metal production, etc.

Note: The "Global Warming Potential (GWP)" is a factor of the extent of greenhouse effect of a GHG, indicated in proportion to the extent of greenhouse effect of CO_2. The values indicated here are based on the Second Assessment Report (1995) by the Intergovernmental Panel on Climate Change (IPCC).

3.1.2 Categorization of GHGs

- GHGs are categorized into CO_2 and other GHGs. CO_2 is further categorized into energy-derived CO_2 emissions and non-energy-derived CO_2 emissions.
- "Energy-derived CO_2 emissions" refers to CO_2 that are generated through final energy consumption of electricity, etc. In this survey, non-energy-derived CO_2 emissions include CO_2 derived from waste.

Table 3-2 Categorization of GHGs

Categorization of GHGs			Targeted sector
GHG Total emissions	Carbon dioxide	Energy-derived CO_2 emissions	Final energy consumption sector * Respectively calculated for the industrial, commercial, residential, and transport sectors.
		Non-energy-derived CO_2 emissions	Waste sector * The amount of generation from the incineration of waste is calculated.
	Other GHGs (CH_4, N_2O, HFCs, PFCs, SF_6)		Combustion of fuel, waste, industrial process, etc.

3.1.3 CO_2 Emission Factor for Electricity

- The CO_2 emission factor for electricity changes every year, based on the power supply mix on the supply side.
- In this survey, **"variable cases"** are calculated applying yearly emission factors for the purpose of incorporating the influence of variation in power supply mix. At the same time, **"fixed cases"** are also calculated, fixating emission factors in FY 2001 and later to the emission factor in FY 2000 for the purpose of excluding the influence of variation in power supply mix.
- For the calculation of variable cases, the yearly emission factor is used for General Electricity Utility, and the yearly average emission factor is used for Power Producer and Suppliers (PPS). For the calculation of fixed cases, the emission factor for General Electricity Utility and the average emission factor for PPS in FY 2001 and later are fixated to the relevant factors in FY 2000 (General Electricity Utility: 0.328 kg-CO_2/kWh, and PPS: 0.493 kg-CO_2/kWh).

Table 3-3 CO_2 emission factors for electricity used in this survey

(Unit: kg-CO_2/kWh)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
General Electricity Utility	0.380	0.385	0.390	0.367	0.378	0.358	0.336	0.335	0.315	0.326	0.328
PPS(average)											0.493
All power supplies in Tokyo(average)	0.380	0.385	0.390	0.367	0.378	0.358	0.336	0.335	0.315	0.326	0.328

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
General Electricity Utility	0.317	0.381	0.461	0.381	0.368	0.339	0.425	0.418	0.384	0.375	0.464	0.525
PPS(average)	0.454	0.442	0.432	0.448	0.460	0.447	0.480	0.446	0.464	0.420	0.412	0.429
All power supplies in Tokyo(average)	0.318	0.381	0.460	0.383	0.372	0.345	0.428	0.420	0.388	0.378	0.461	0.519

Note: "Average" refers to the weighted average calculated in this survey is used, based on emission factors and sold electricity of electricity utilities that supply power in Tokyo.

Table 3-4 Categorized calculation methods based on CO_2 emission factors for electricity

Classification	Energy type	Application of CO_2 emission factors	
Energy-derived CO_2 emissions	Electricity	Variable cases	Yearly emission factors are applied
		Fixed cases	Emission factors in FY 2001 and later are fixated to the emission factor in FY 2000

3.1.4 Scope of Calculation

- Most agricultural, forestry and fishery products, industrial products, etc., that are supplied in Tokyo are produced outside Tokyo, and therefore CO_2 emissions from such activities occur outside Tokyo. Such CO_2 emissions are excluded from this survey.
- CO_2 emissions through power consumption are calculated using emission factors at sale, and include emissions during power generation outside Tokyo (these emissions are not recorded for the energy conversion sectors, but are allocated to the final energy consumption sectors).

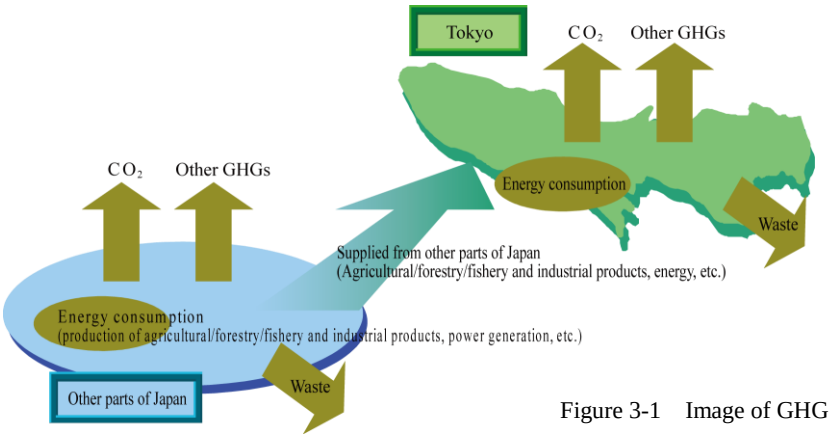


Figure 3-1 Image of GHG emissions in Tokyo

3.2 Total Greenhouse Gas Emissions

3.2.1 Entire Tokyo

- The total GHG emissions in FY 2012 stood at 69.5 million tons of CO_2 equivalent. This is 12% increase from 61.8 million tons in FY 2000, and 8% increase from 64.6 million tons in the previous fiscal year.

Table 3-5 Trends in total GHG emissions in Tokyo [Variable cases]

(Unit: 10,000 t-CO_2 eq)

	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CO_2	5,440	5,440	5,729	5,851	5,670	5,909	5,816	5,686	5,748	5,675	5,768	5,886	5,667	6,299	6,753	6,183	6,173	5,764	6,511	6,297	5,916	5,871	6,123	6,583
CH_4	186	186	190	193	194	194	191	183	169	152	134	117	102	88	76	67	60	56	53	52	50	50	49	48
N_2O	86	86	92	93	85	89	94	99	100	100	104	102	98	98	95	91	92	83	76	74	68	61	61	59
HFCs	29						29	42	54	61	62	68	70	77	86	94	103	116	138	162	181	204	227	257
PFCs	25						25	26	31	27	7	4	3	3	3	0	0	0	0	0	0	0	0	0
SF_6	17						17	18	20	16	7	4	7	3	3	2	2	3	2	3	2	2	3	3
Total	5,781	5,711	6,012	6,137	5,949	6,193	6,171	6,053	6,121	6,031	6,080	6,181	5,946	6,568	7,015	6,437	6,429	6,022	6,781	6,587	6,217	6,187	6,462	6,950

Note 1: The base years are specified by the Kyoto Protocol. The base year for CO_2, CH_4, and N_2O is FY 1990, while the base year for HFCs and two other types (PFCs and SF_6) is FY 1995.

Note 2: CO_2 emissions are calculated in the variable cases, where yearly CO_2 emission factors for electricity are applied.

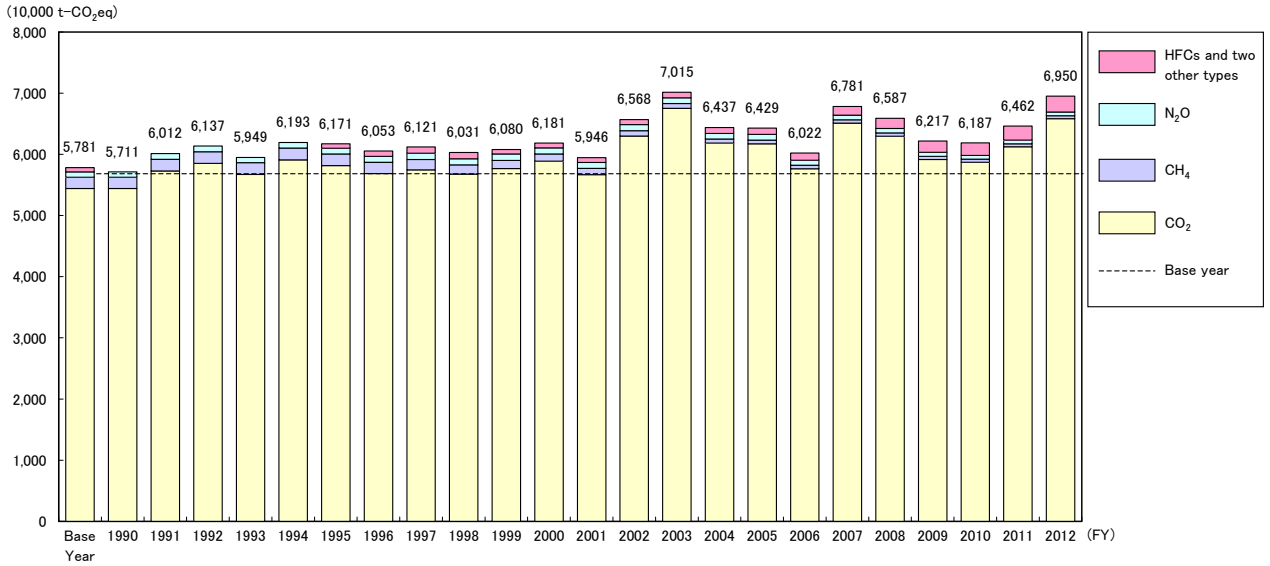


Figure 3-2 Trends in total GHG emissions in Tokyo [Variable cases]

Table 3-6 (Reference)Trends in total GHG emissions in Tokyo [Fixed cases]

(Unit: 10,000 t-CO_2 eq)

	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CO_2	5,440	5,440	5,729	5,851	5,670	5,909	5,816	5,686	5,748	5,675	5,768	5,886	5,758	5,862	5,697	5,756	5,853	5,695	5,694	5,569	5,470	5,510	5,125	5,109
CH_4	186	186	190	193	194	194	191	183	169	152	134	117	102	88	76	67	60	56	53	52	50	50	49	48
N_2O	86	86	92	93	85	89	94	99	100	100	104	102	98	98	95	91	92	83	76	74	68	61	61	59
HFCs	29						29	42	54	61	62	68	70	77	86	94	103	116	138	162	181	204	227	257
PFCs	25						25	26	31	27	7	4	3	3	3	0	0	0	0	0	0	0	0	0
SF_6	17						17	18	20	16	7	4	7	3	3	2	2	3	2	3	2	2	3	3
Total	5,781	5,711	6,012	6,137	5,949	6,193	6,171	6,053	6,121	6,031	6,080	6,181	6,037	6,131	5,960	6,010	6,110	5,953	5,963	5,859	5,771	5,826	5,464	5,475

Note 1: The base years are specified by the Kyoto Protocol. The base year for CO_2, CH_4, and N_2O is FY 1990, while the base year for HFCs and two other types (PFCs and SF_6) is FY 1995.

Note 2: CO_2 emissions are calculated in the fixed cases, where CO_2 emission factors for electricity for FY 2001 and after are fixed to the emission factor in FY 2000.

- In the total GHG emissions, CO_2 emissions account for 94.7% in FY 2012, which was 0.6 point increase from the base year, but 0.5 point reduction from FY 2000.
- In comparison with the national shares by GHG in FY 2012, the share of CO_2 emissions in Tokyo is mostly the same as that in Japan (95.0%).

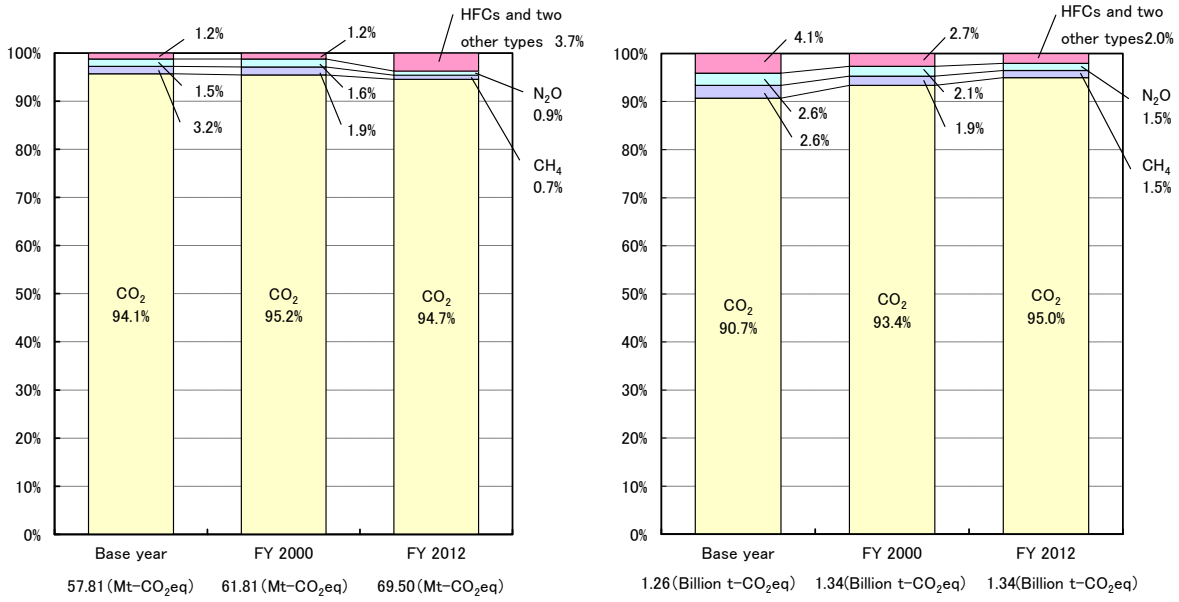


Figure 3-3 Composition ratios by GHG in Tokyo and in Japan [Variable cases]

Source: Finalized Values for Japan's GHG Emissions Data (FY 1990 - 2012), Greenhouse Gas Inventory Office of Japan

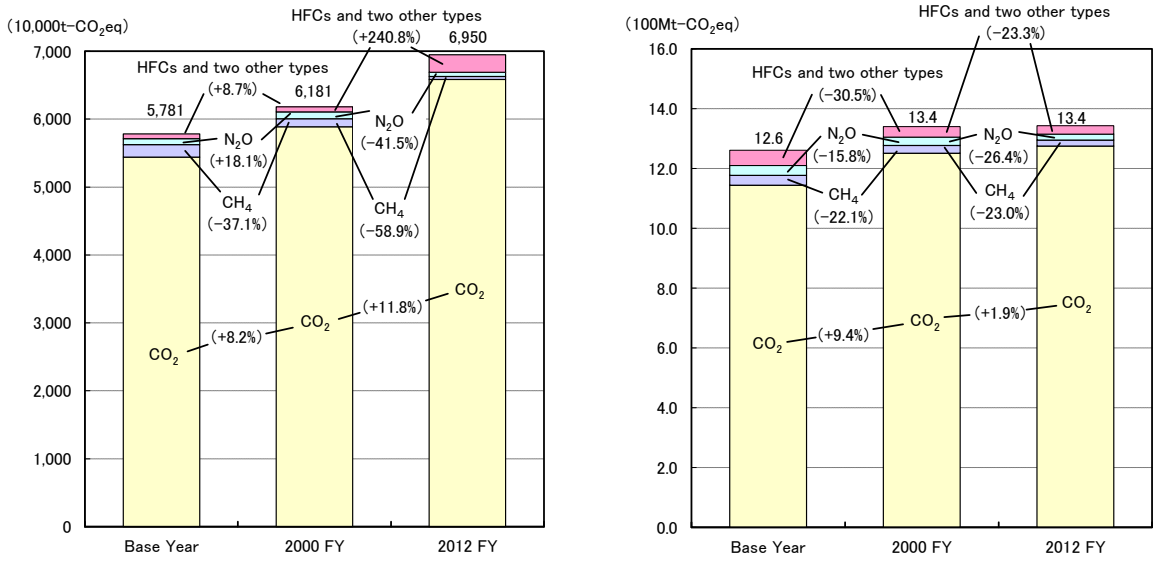


Figure 3-4 Increase rates by GHG in Tokyo and in Japan [Variable cases]

Note: The values in brackets respectively indicate increase in FY 2000 from base year, and increase in FY 2012 from FY 2000.
Source: Finalized Values for Japan's GHG Emissions Data (FY 1990 - 2012), Greenhouse Gas Inventory Office of Japan

3.3 CO_2 Emissions (Variable Cases)

Variable cases: yearly CO_2 emission factors for electricity are applied, for the purpose of incorporating the influence of variation in power supply mix

3.3.1 Entire Tokyo

- The total CO_2 emissions in FY 2012 stood at 65.8 million tons. This is 12% increase from 58.9 million tons in FY 2000, and 8% increase from 61.2 million tons in the previous fiscal year.
- The CO_2 emissions from electricity in FY 2012 increased by 14% from the previous fiscal year, due to the deteriorated emission factor (the final energy consumption of electricity increased by 1% from the previous fiscal year (page 3)).

Table 3-7 Total CO_2 emissions by sector and increases up to FY 2012 in Tokyo [Variable cases]

	CO_2 emissions (10,000 t-CO_2)					Increase rate (%)			
	2000 FY	2005 FY	2010 FY	2011 FY	2012 FY	2000 vs.	2005 vs.	2010 vs.	2011 vs.
Industrial sectors	680	588	521	516	530	- 22.0%	- 9.8%	1.9%	2.8%
Commercial sectors	1,890	2,318	2,243	2,322	2,606	37.9%	12.4%	16.2%	12.3%
Residential sectors	1,433	1,651	1,747	1,911	2,091	45.9%	26.7%	19.7%	9.4%
Transport sectors	1,764	1,517	1,205	1,218	1,196	- 32.2%	- 21.2%	- 0.8%	- 1.8%
Energy-derived CO_2 emissions	5,767	6,074	5,716	5,967	6,424	11.4%	5.8%	12.4%	7.7%
Non-energy-derived CO_2 emissions	119	99	155	156	159	33.4%	60.9%	2.9%	2.0%
Total CO_2 emissions	5,886	6,173	5,871	6,123	6,583	11.8%	6.6%	12.1%	7.5%

Note 1: The residential sector does not include emissions by family cars, which is included in the transport sector.
Note 2: In the transport sector, the scope of calculation for automobiles includes traffic in Tokyo, while that for railway, vessels, and airlines includes service in Tokyo.

Table 3-8 Total energy-derived CO_2 emissions by fuel type and increases up to FY 2012 in Tokyo [Variable cases]

	CO_2 emissions (10,000 t-CO_2)					Increase rate (%)			
	2000 FY	2005 FY	2010 FY	2011 FY	2012 FY	2000 vs.	2005 vs.	2010 vs.	2011 vs.
Electricity	2,696	3,265	3,390	3,716	4,228	56.8%	29.5%	24.7%	13.8%
City gas	926	1,047	967	923	924	- 0.2%	- 11.7%	- 4.4%	0.2%
LPG	195	156	115	123	102	- 47.5%	- 34.6%	- 11.0%	- 16.7%
Fuel oil	1,931	1,602	1,243	1,199	1,167	- 39.6%	- 27.2%	- 6.1%	- 2.7%
Other	19	3	1	6	3	- 84.1%	- 5.7%	100.7%	- 49.8%
Energy-derived CO_2 emissions	5,767	6,074	5,716	5,967	6,424	11.4%	5.8%	12.4%	7.7%

Note: Fuel oils: gasoline, kerosene, light oil, heavy oil A/B/C, and jet fuel; Other: oil coke, coal coke, natural gas, etc.

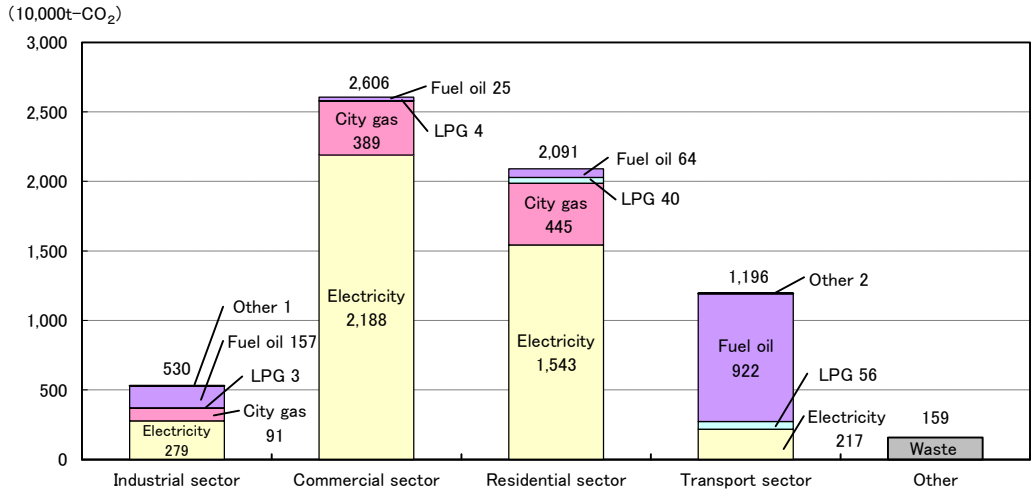


Figure 3-5 CO_2 emissions by sector in Tokyo (FY 2012) [Variable cases]

3.3.1-1 CO_2 Emissions in Entire Tokyo (by Sector, Total CO_2 Emissions)

- Combining energy-derived CO_2 emissions (industrial, commercial, residential, and transport sectors) with non-energy-derived CO_2 emissions (others), trends and composition ratios by sector in total CO_2 emissions are as follows:

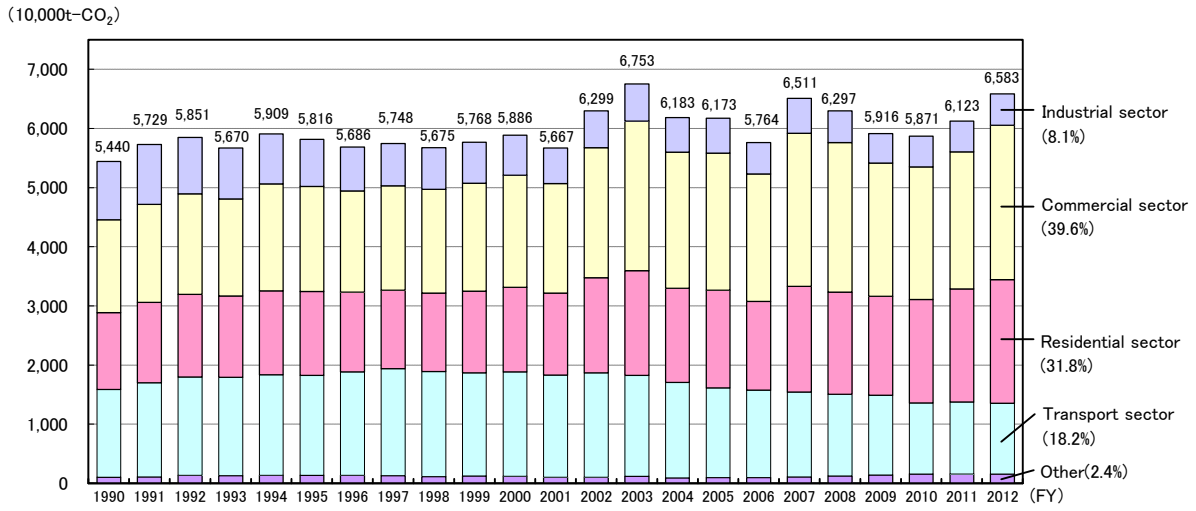


Figure 3-6 Trends in total CO_2 emissions by sector in Tokyo [Variable cases]

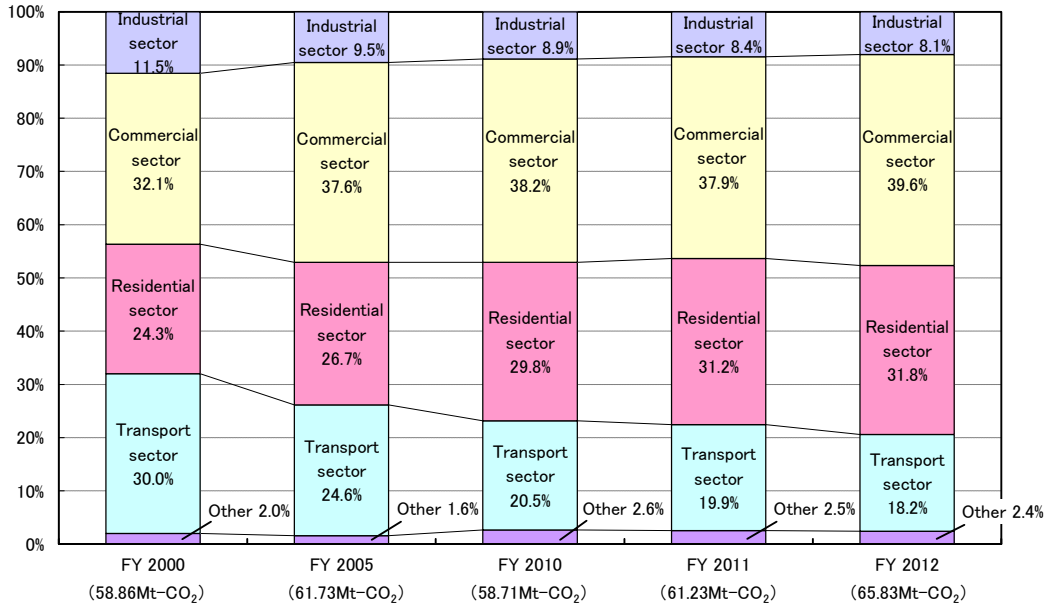


Figure 3-7 Composition ratios in total CO_2 emissions by sector in Tokyo [Variable cases]

Note 1: "Other" indicates CO_2 emissions from the incineration of waste.
Note 2: The "energy conversion sector" as in national statistics is excluded from those for Tokyo because Tokyo allocates CO_2 emissions in the relevant sector in accordance with demands of other respective sectors.
Note 3: The "industrial process" as in national statistics is excluded from those for Tokyo because Tokyo does not count the relevant emissions, due to the minimal CO_2 emissions from the industrial process, and the statistical difficulty.

- In comparison with the national CO_2 emission structure, Tokyo has a smaller share of the industrial sector (8% vs. 33% nationwide), and larger shares of the commercial sector (40% vs. 21% nationwide) and the residential sector (32% vs. 16% nationwide).

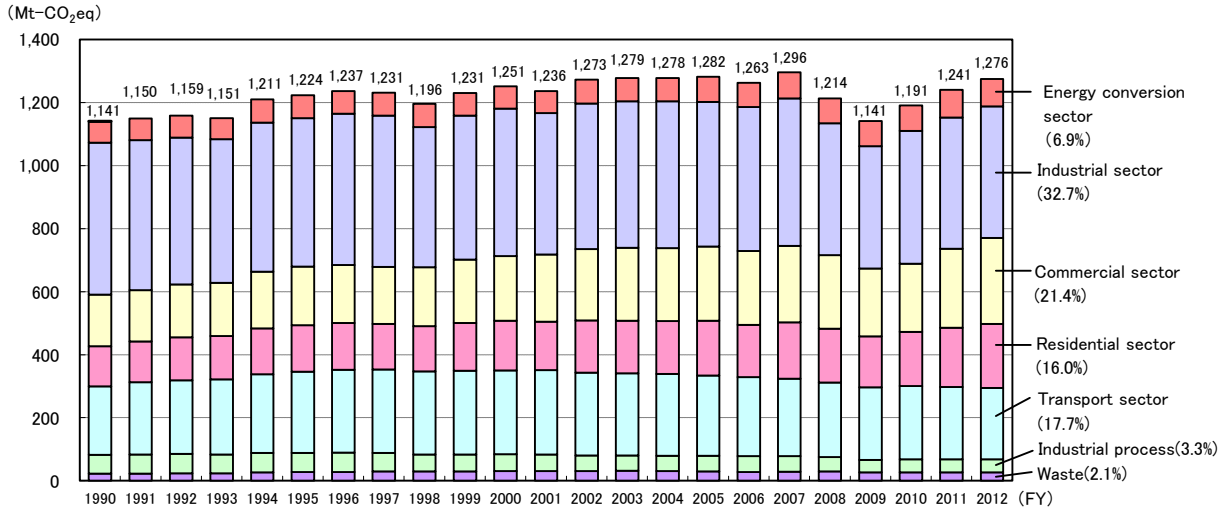


Figure 3-8 Trends in CO_2 emissions in Japan

Source: Finalized Values for Japan's GHG Emissions Data (FY 1990 - 2012), Greenhouse Gas Inventory Office of Japan

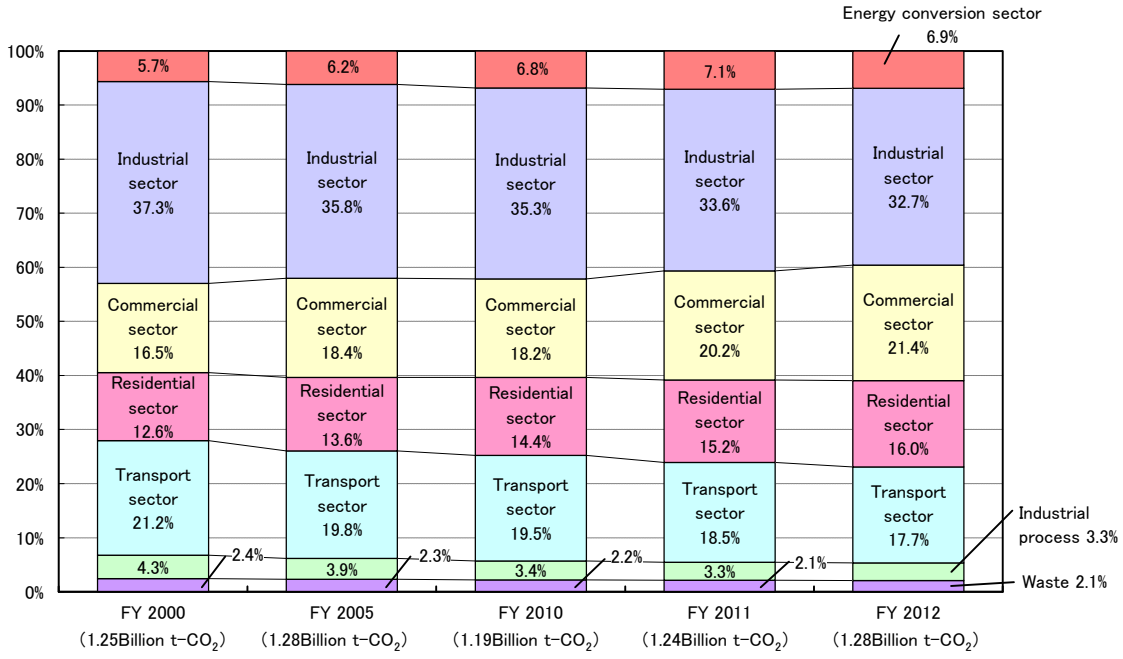


Figure 3-9 Composition ratios in CO_2 emissions in Japan

Source: Finalized Values for Japan's GHG Emissions Data (FY 1990 - 2012), Greenhouse Gas Inventory Office of Japan

3.3.1-2 CO_2 Emissions in Entire Tokyo (by Fuel Type, Energy-derived CO_2 Emissions)

- Trends and composition ratios by fuel type in energy-derived CO_2 emissions are as follows:

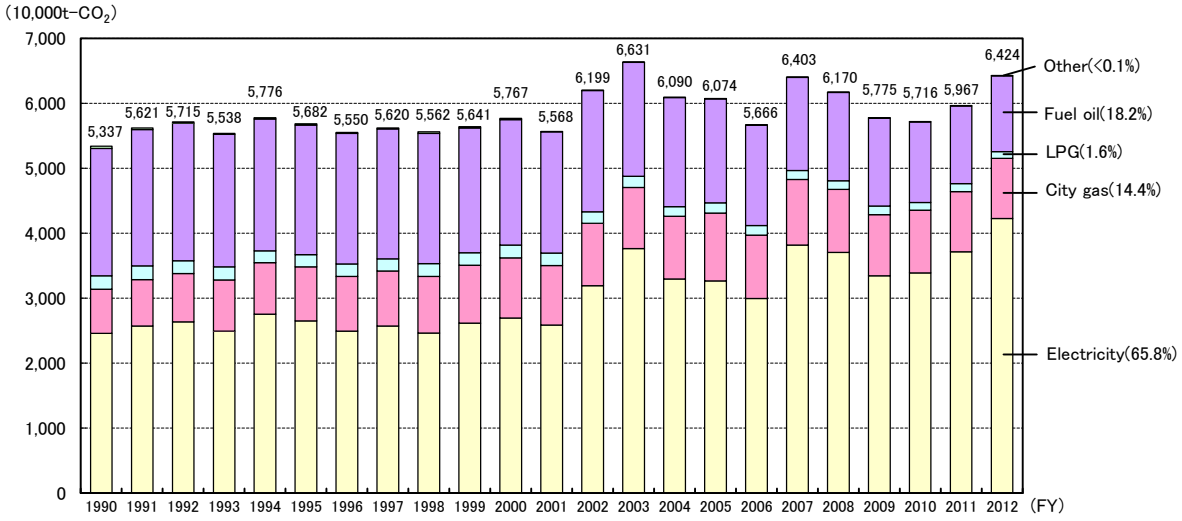


Figure 3-10 Trends in energy-derived CO_2 emissions by fuel type in Tokyo [Variable cases]

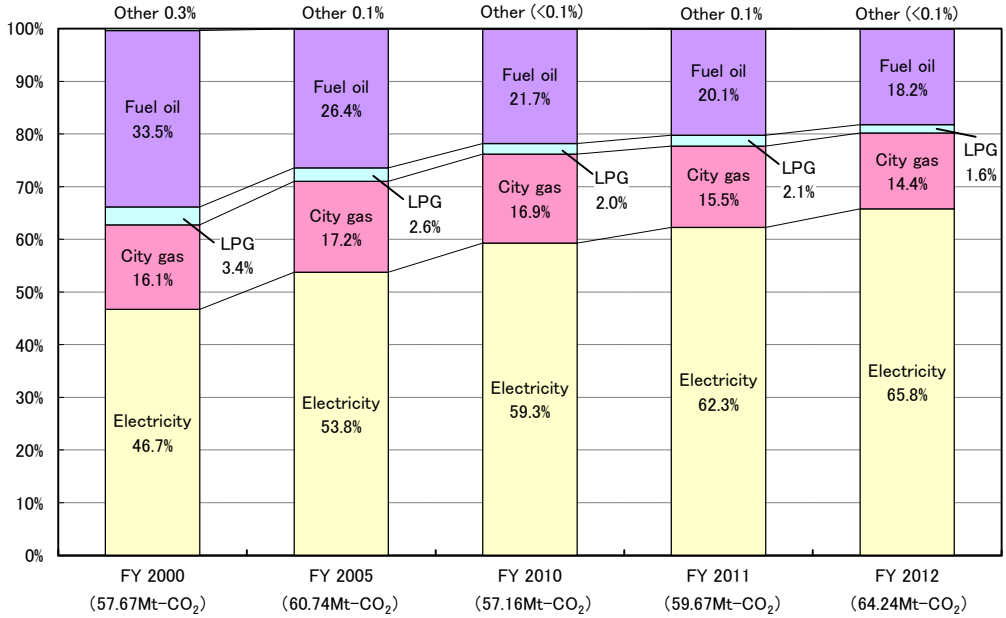


Figure 3-11 Composition ratios in energy-derived CO_2 emissions by fuel type in Tokyo [Variable cases]

Note: Fuel oils: gasoline, kerosene, light oil, heavy oil A/B/C, and jet fuel; Other: oil coke, coal coke, natural gas, etc.

3.4 CO_2 Emissions (Fixed Cases)

Fixed cases: CO_2 emission factors for electricity in FY 2001 and later are fixated to the emission factor in FY 2000, for the purpose of excluding the influence of variation in power supply mix

3.4.1 Entire Tokyo

- The total CO_2 emissions in FY 2012 stood at 51.1 million tons. This is 13% reduction from 58.9 million tons in FY 2000, and 0.3% reduction from 51.2 million tons in the previous fiscal year.
- The CO_2 emissions from electricity in FY 2012 increased by 1% from the previous fiscal year, due to the exclusion of influence of the deteriorated emission factor (the final energy consumption of electricity increased by 1% from the previous fiscal year (page 3)).

Table 3-9 Total CO_2 emissions by sector and increases up to FY 2012 in Tokyo [Fixed cases]

	CO_2 emissions (10,000 t-CO_2)					Increase rate (%)			
	2000 FY	2005 FY	2010 FY	2011 FY	2012 FY	2000 vs.	2005 vs.	2010 vs.	2011 vs.
Industrial sectors	680	562	496	449	435	▲36.0%	▲22.6%	▲12.4%	▲3.1%
Commercial sectors	1,890	2,158	2,078	1,848	1,888	▲0.1%	▲12.5%	▲9.1%	2.1%
Residential sectors	1,433	1,535	1,596	1,510	1,512	5.5%	▲1.5%	▲5.3%	0.2%
Transport sectors	1,764	1,499	1,185	1,162	1,114	▲36.8%	▲25.7%	▲6.0%	▲4.1%
Energy-derived CO_2 emissions	5,767	5,754	5,355	4,969	4,950	▲14.2%	▲14.0%	▲7.6%	▲0.4%
Non-energy-derived CO_2 emissions	119	99	155	156	159	33.4%	60.9%	2.9%	2.0%
Total CO_2 emissions	5,886	5,853	5,510	5,125	5,109	▲13.2%	▲12.7%	▲7.3%	▲0.3%

Note 1: The residential sector does not include emissions by family cars, which is included in the transport sector.
Note 2: In the transport sector, the scope of calculation for automobiles includes traffic in Tokyo, while that for railway, vessels, and airlines includes service in Tokyo.

Table 3-10 Total energy-derived CO_2 emissions by fuel type and increases up to FY 2012 in Tokyo [Fixed cases]

	CO_2 emissions (10,000 t-CO_2)					Increase rate (%)			
	2000 FY	2005 FY	2010 FY	2011 FY	2012 FY	2000 vs.	2005 vs.	2010 vs.	2011 vs.
Electricity	2,696	2,946	3,029	2,718	2,753	2.1%	▲6.5%	▲9.1%	1.3%
City gas	926	1,047	967	923	924	▲0.2%	▲11.7%	▲4.4%	0.2%
LPG	195	156	115	123	102	▲47.5%	▲34.6%	▲11.0%	▲16.7%
Fuel oil	1,931	1,602	1,243	1,199	1,167	▲39.6%	▲27.2%	▲6.1%	▲2.7%
Other	19	3	1	6	3	▲84.1%	▲5.7%	100.7%	▲49.8%
Energy-derived CO_2 emissions	5,767	5,754	5,355	4,969	4,950	▲14.2%	▲14.0%	▲7.6%	▲0.4%

Note: Fuel oils: gasoline, kerosene, light oil, heavy oil A/B/C, and jet fuel; Other: oil coke, coal coke, natural gas, etc.

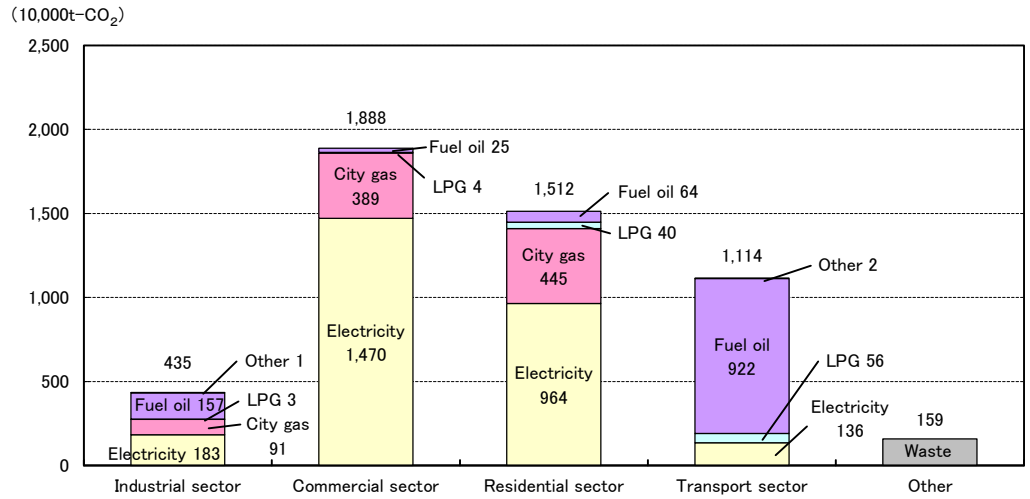


Figure 3-12 CO_2 emissions by sector in Tokyo (FY 2012) [Fixed cases]

3.4.1-1 CO_2 Emissions in Entire Tokyo (by Sector, Total CO_2 Emissions)

- Combining energy-derived CO_2 emissions (industrial, commercial, residential, and transport sectors) with non-energy-derived CO_2 emissions (others), trends and composition ratios by sector in total CO_2 emissions are as follows:

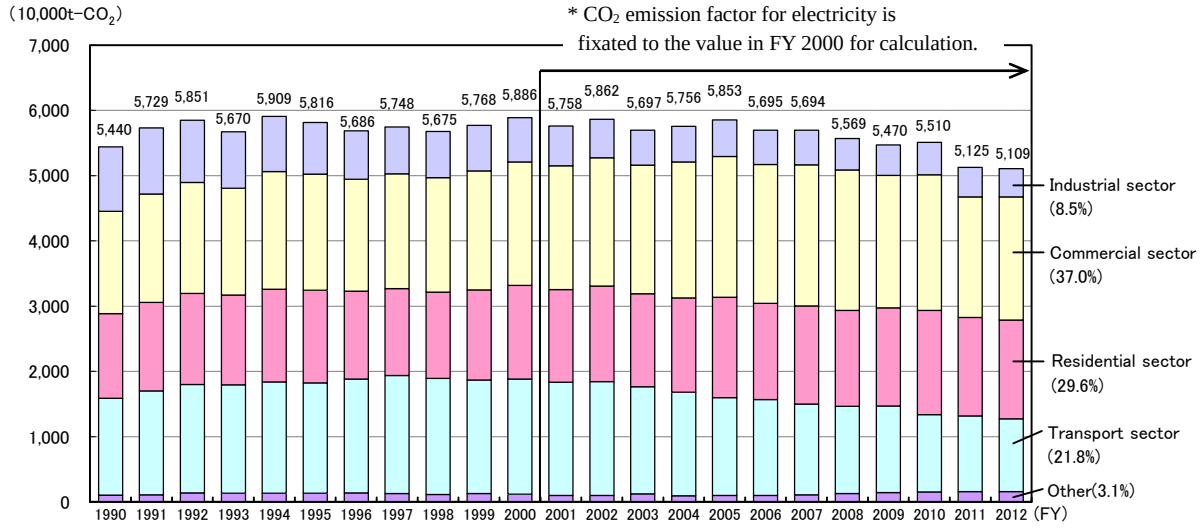


Figure 3-13 Trends in total CO_2 emissions by sector in Tokyo [Fixed cases]

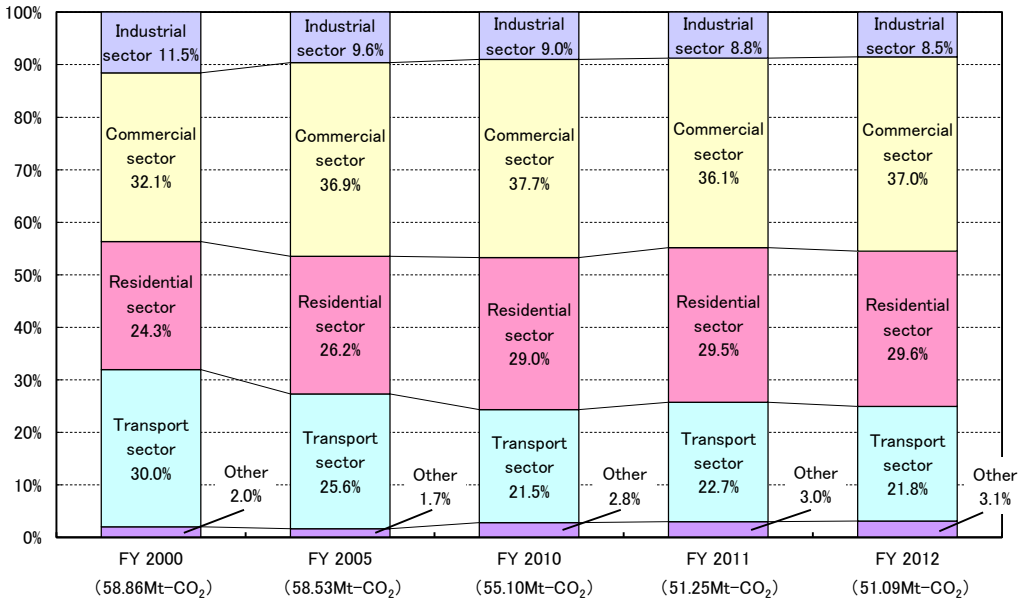


Figure 3-14 Composition ratios in total CO_2 emissions by sector in Tokyo [Fixed cases]

Note 1: "Other" indicates CO_2 emissions from the incineration of waste.
Note 2: The "energy conversion sector" as in national statistics is excluded from those for Tokyo because Tokyo allocates CO_2 emissions in the relevant sector in accordance with demands of other respective sectors.
Note 3: The "industrial process" as in national statistics is excluded from those for Tokyo because Tokyo does not count the relevant emissions, due to the minimal CO_2 emissions from the industrial process, and the statistical difficulty.

3.4.1-2 CO_2 Emissions in Entire Tokyo (by Fuel Type, Energy-derived CO_2 Emissions)

- Trends and composition ratios by fuel type in energy-derived CO_2 emissions are as follows:

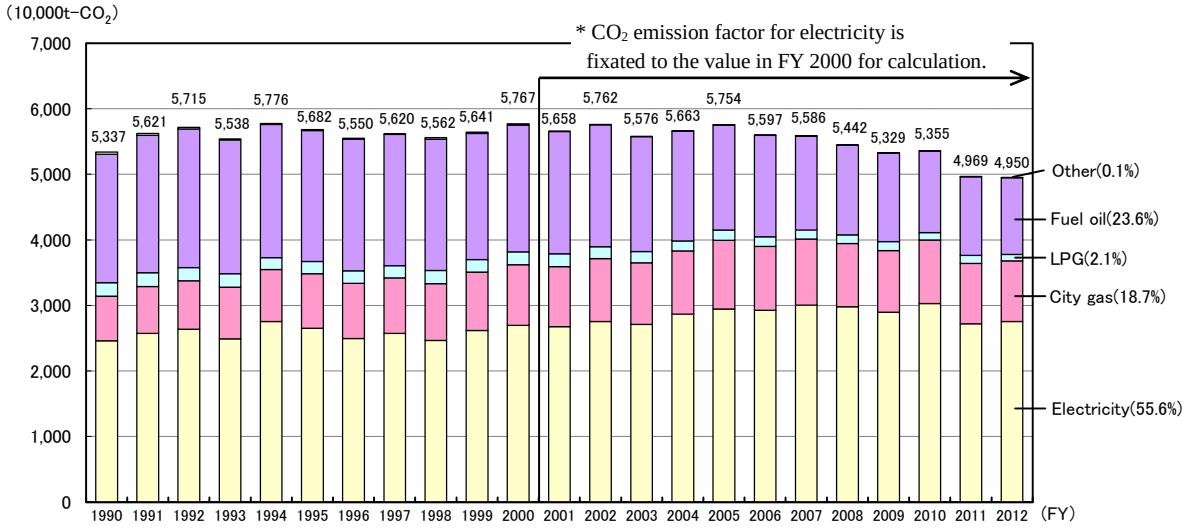


Figure 3-15 Trends in energy-derived CO_2 emissions by fuel type in Tokyo [Fixed cases]

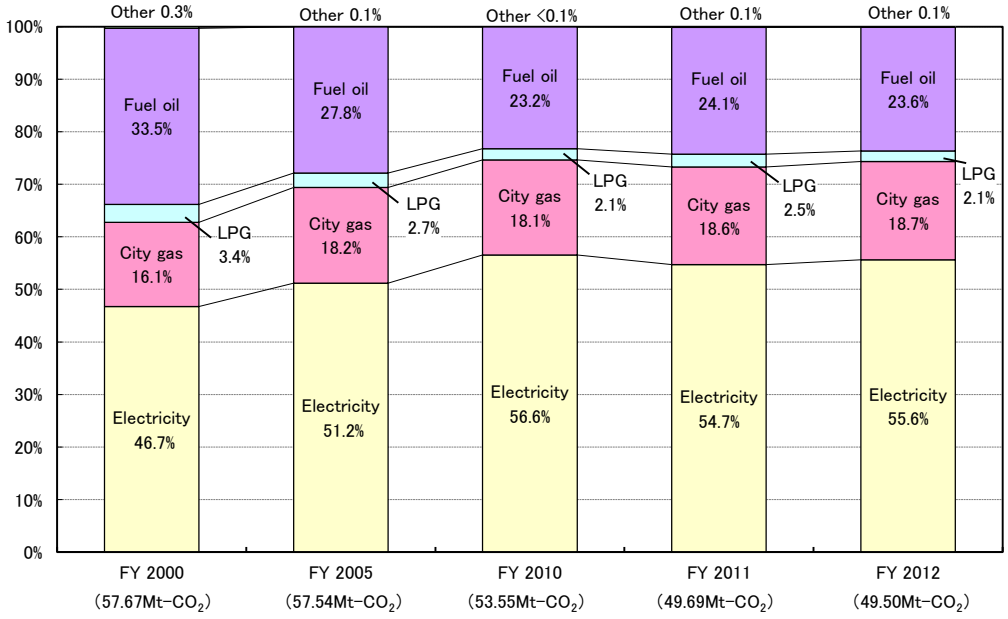


Figure 3-16 Composition ratios in energy-derived CO_2 emissions by fuel type in Tokyo [Fixed cases]

Note: Fuel oils: gasoline, kerosene, light oil, heavy oil A/B/C, and jet fuel; Other: oil coke, coal coke, natural gas, etc.

3.4.2 [Reference] Trends in Each Sector

3.4.2-1 Industrial Sector

- Trends in CO_2 emissions (fixed cases) in the industrial sector are as follows:

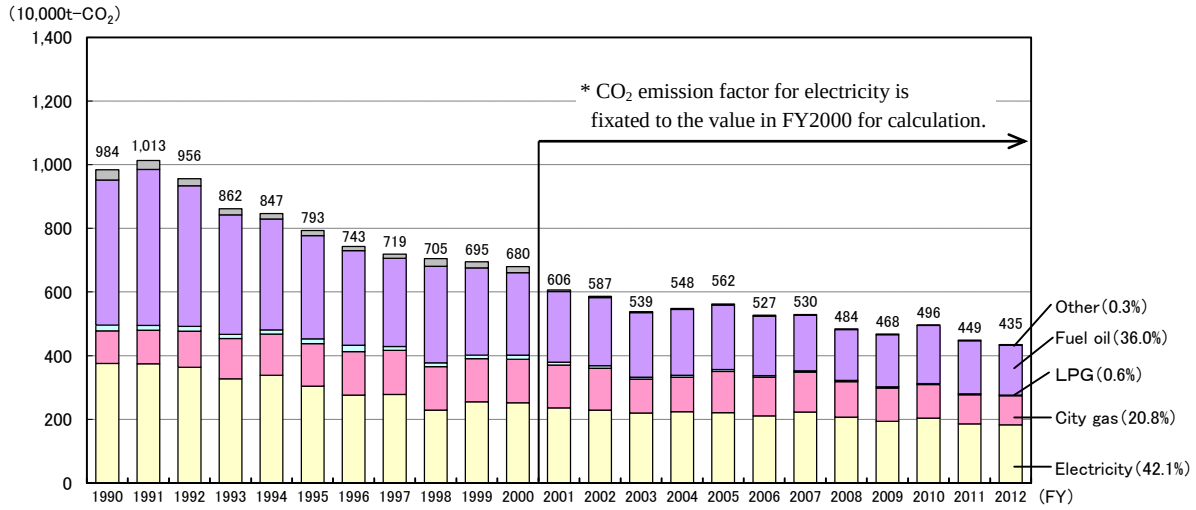


Figure 3-17 Trends in CO_2 emissions in the industrial sector [Fixed cases]

3.4.2-2 Commercial Sector

- Trends in CO_2 emissions (fixed cases) in the commercial sector are as follows:

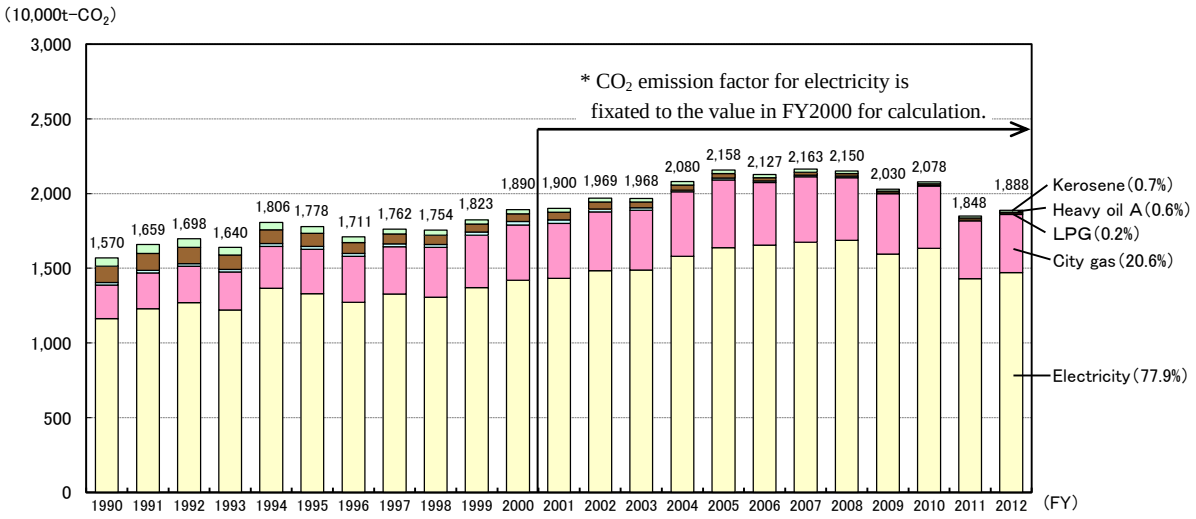


Figure 3-18 Trends in CO_2 emissions in the commercial sector [Fixed cases]

3.4.2-3 Residential Sector

- Trends in CO_2 emissions (fixed cases) in the residential sector are as follows:

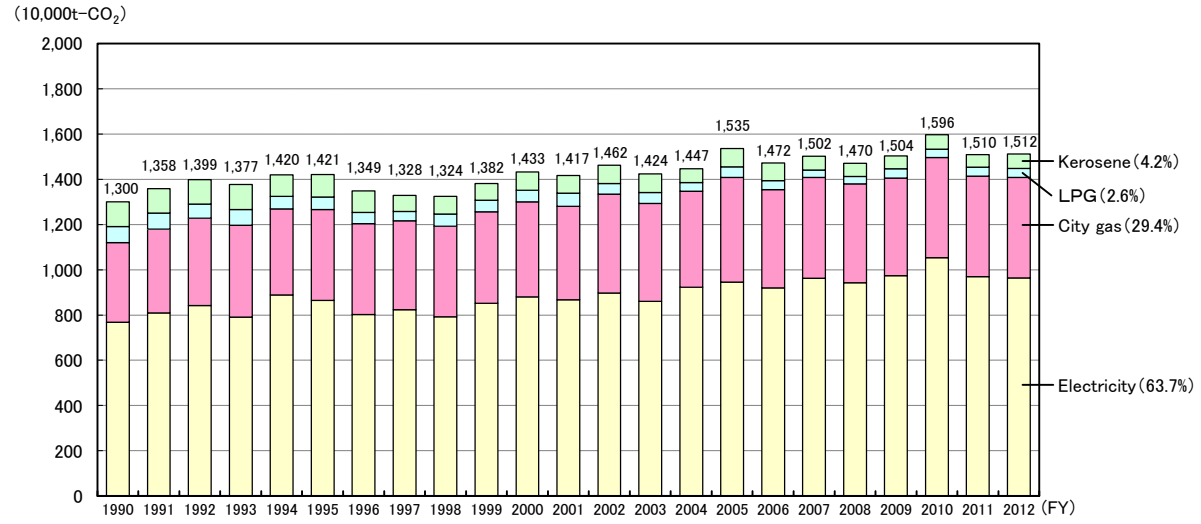


Figure 3-19 Trends in CO_2 emissions in the residential sector [Fixed cases]

3.4.2-4 Transport Sector

- Trends in CO_2 emissions (fixed cases) in the transport sector are as follows:

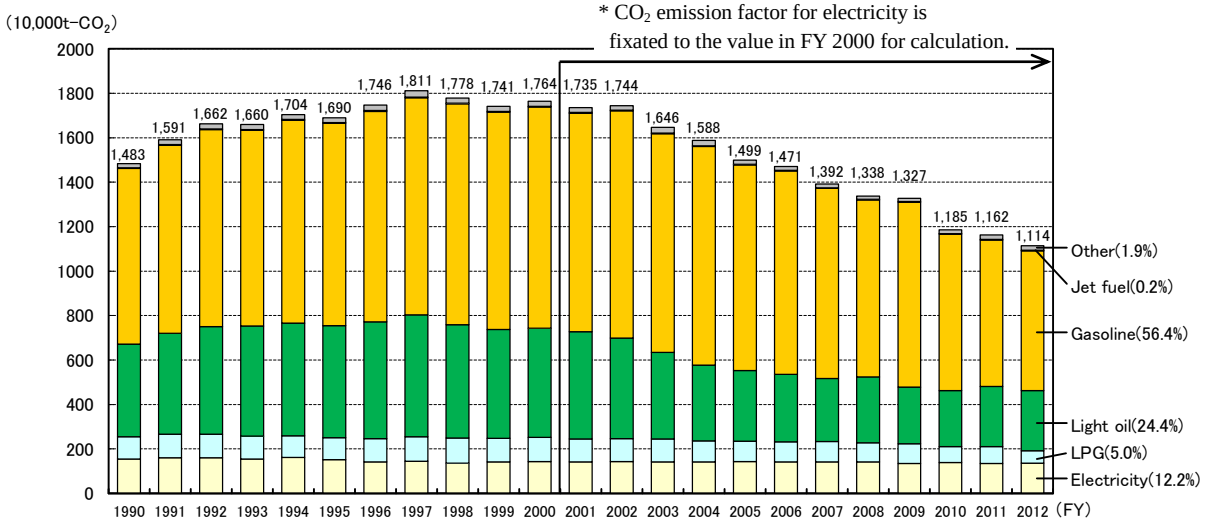


Figure 3-20 Trends in CO_2 emissions in the transport sector [Fixed cases]

3.5 Other GHG Emissions

3.5.1 Overview

3.5.1-1 Trends in Other GHG Emissions

(Tokyo)

- Other GHG emissions in Tokyo in FY 2012 stood at 3.7 million t-CO_2eq, which was 7% increase from 3.4 million t-CO_2eq in the base year, and 25% increase from 3.0 million t-CO_2eq in FY 2000.
- HFCs indicated large increase rates from the base year to FY 2000 and from FY 2000 to FY 2012, respectively, at 135% and at 280%. This is because the substitution of HCFCs, which are regulated under the Montreal Protocol, by HFCs has proceeded, and consequently emissions from the coolant use of HFCs have increased.
- N_2O increased by 18% from the base year to FY 2000, but decreased by 42% from FY 2000 to FY 2012. In the meantime, CH_4, PFCs and SF_6 have shown a downward trend from the base year to FY 2012.

(Japan)

- Other GHG emissions in Japan in FY 2012 stood at 67.5 million t-CO_2eq, which was 42% reduction from 117.2 million t-CO_2eq in the base year, and 24% reduction from 89.1 million t-CO_2eq in FY 2000.
- In Japan, SF_6, PFCs, and CH_4 showed a substantial decrease from the base year to FY 2000, respectively by 58%, 32%, and 22%. SF_6, PFCs, N_2O, and CH_4 decreased substantially from FY 2000 to FY 2012, respectively by 78%, 71%, 26%, and 23%. In the meantime, HFCs increased by 22% from FY 2000 to FY 2012.

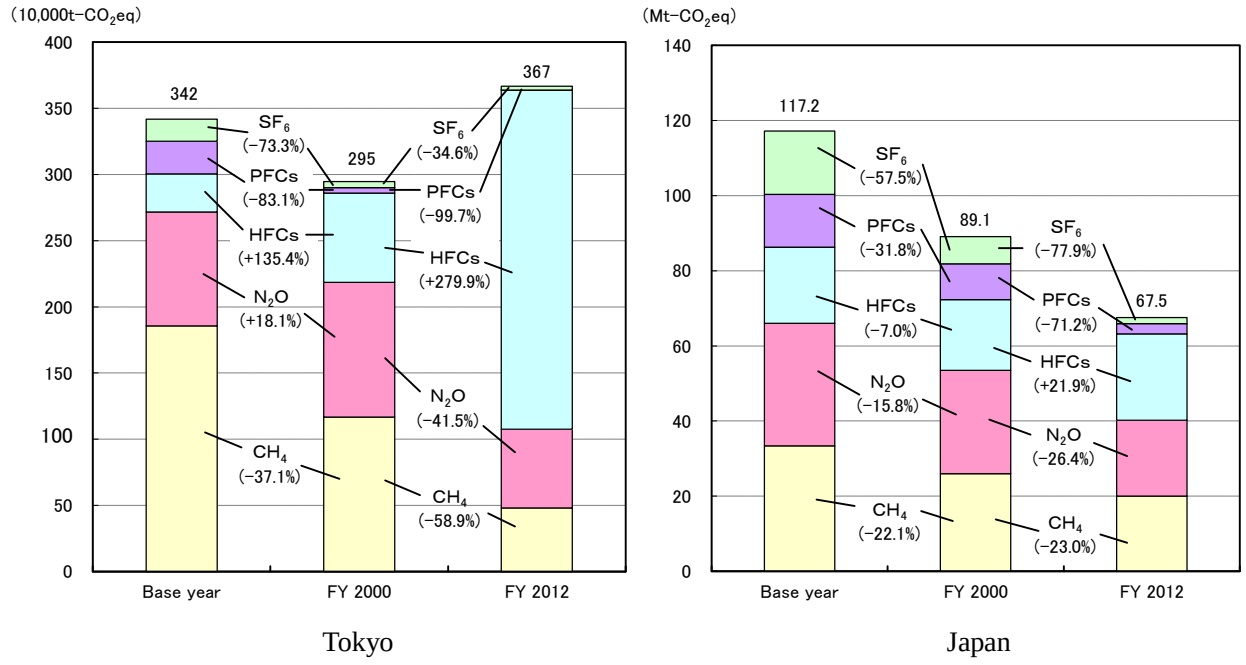


Figure 3-21 Increase rates by GHG (other GHGs) in Tokyo and in Japan

Note: The values in brackets respectively indicate increase in FY 2000 from base year, and increase in FY 2012 from FY 2000.
Source: Finalized Values for Japan's GHG Emissions Data (FY 1990 - 2012), Greenhouse Gas Inventory Office of Japan

3.5.1-2 Composition Ratios in Other GHG Emissions

- In Tokyo, HFCs accounted for 70% of other GHG emissions in FY 2012, followed by N_2O (16%), CH_4 (13%), SF_6 (1%), and PFCs (< 1%).
- In Japan, HFCs accounted for 34% of other GHG emissions in FY 2012, followed by N_2O (30%), CH_4 (30%), PFCs (4%), and SF_6 (2%).
- Compared to the nationwide composition ratios of other GHG emissions in FY 2012, Tokyo sees a larger share of HFCs, and accordingly smaller shares of CH_4, N_2O, PFCs, and SF_6.

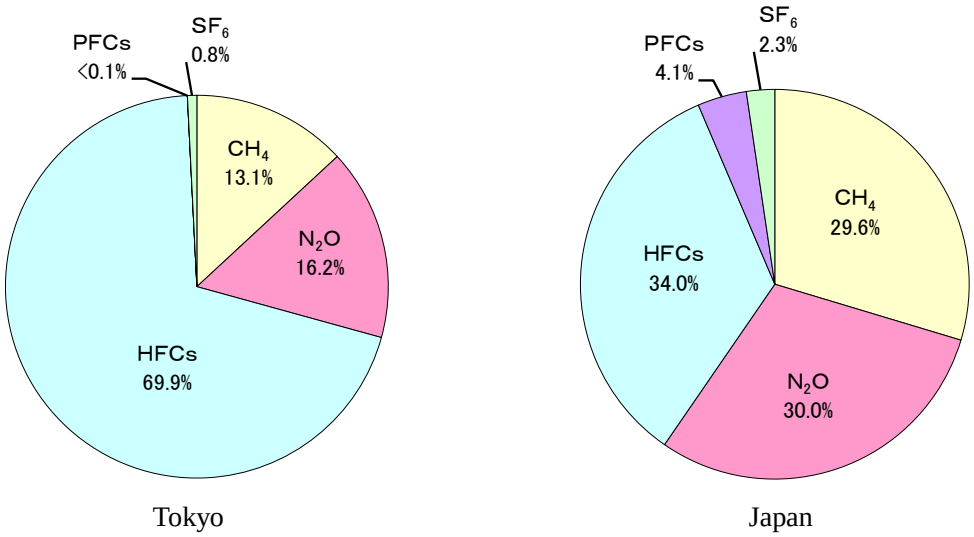


Figure 3-22 Composition ratios of other GHG emissions in Tokyo and in Japan (FY 2012)

Source: Finalized Values for Japan's GHG Emissions Data (FY 1990 - 2012), Greenhouse Gas Inventory Office of Japan

3.5.1-3 Shares of Other GHG Emissions in Japan

- Other GHG emissions in Tokyo account for approximately 5% in Japan.
- By the type of gas, Tokyo takes up the largest share in Japan with HFCs (11%), followed by N_2O (3%) and CH_4 (2%). Tokyo's shares are minimal for PFCs and SF_6 because the manufacturing of semiconductors, etc., as the main source of PFC/SF_6 emissions has been decreasing in Tokyo.

Table 3-11 Comparison of other GHG emissions in Tokyo and in Japan (FY 2012)

(Unit: 10,000 t-CO2 eq)

	Tokyo	Japan	vs. Japan
CH_4	48	2,001	2.4%
N_2O	59	2,023	2.9%
HFCs	257	2,293	11.2%
PFCs	0	276	0.0%
SF_6	3	159	1.8%
Total	367	6,751	5.4%

Source: Finalized Values for Japan's GHG Emissions Data (FY 1990 - 2012), Greenhouse Gas Inventory Office of Japan

3.5.2 CH_4

- The composition ratios of CH_4 emissions in Tokyo and in Japan in FY 2012 are indicated below.
- In Tokyo, 95% of CH_4 emissions are derived from waste. Agriculture, which accounts for 70% of CH_4 emissions across Japan, only takes up the minimal share of 1% in Tokyo. "Waste" mainly refers to emissions from landfill sites (inner and outer central breakwater landfill sites) and from sewage treatment.

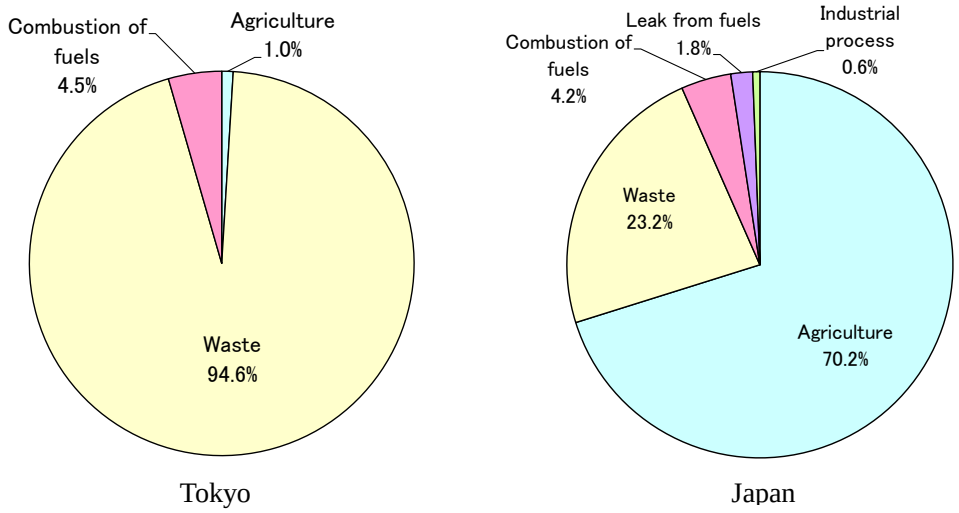


Figure 3-23 Composition ratios of CH_4 emissions in Tokyo and in Japan (FY 2012)

Source: Finalized Values for Japan's GHG Emissions Data (FY 1990 - 2012), Greenhouse Gas Inventory Office of Japan

3.5.3 N_2O

- The composition ratios of N_2O emissions in Tokyo and in Japan in FY 2012 are indicated below.
- In Tokyo, 79% of N_2O emissions are derived from waste. Agriculture, which accounts for 49% of N_2O emissions across Japan, only takes up the minimal share of 2% in Tokyo. "Waste" mainly refers to emissions from the incineration of waste (general/industrial) and sewage treatment.

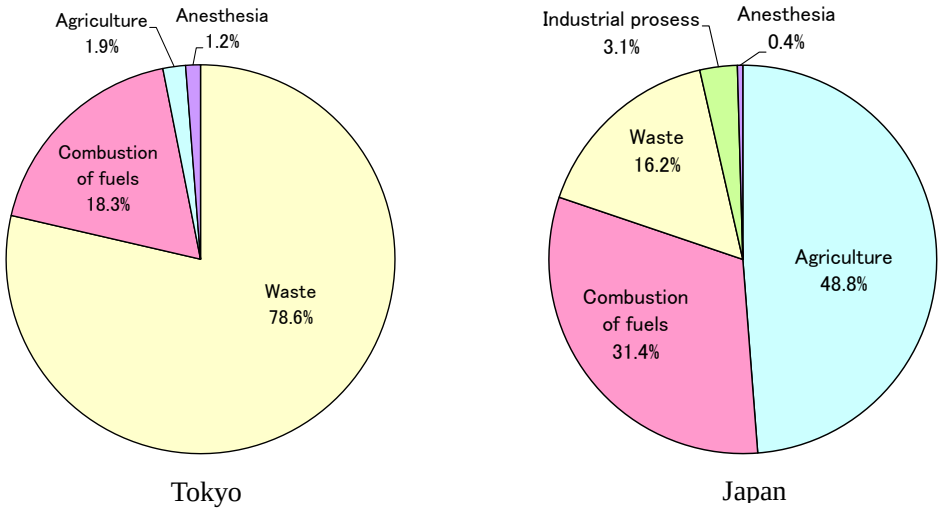


Figure 3-24 Composition ratios of N_2O emissions in Tokyo and in Japan (FY 2012)

Source: Finalized Values for Japan's GHG Emissions Data (FY 1990 - 2012), Greenhouse Gas Inventory Office of Japan

3.5.4 HFCs and Two Other Types

- The composition ratios of HFCs and two other types of emissions in Tokyo and in Japan in FY 2012 are indicated below.
- In Tokyo, 95% of these emissions are HFCs derived from coolants. “Coolants” mainly refers to emissions from the use or disposal of freezers and air conditioners for business use, household air conditioners, car air conditioners, etc.
- Unlike in the emission composition of entire Japan, “Manufacturing of HFCs and two other types”, “By-product in the manufacturing of HCFC22”, and “Metal production” are excluded from the emission statistics of Tokyo, because the relevant factories are considered to be very rare in Tokyo.

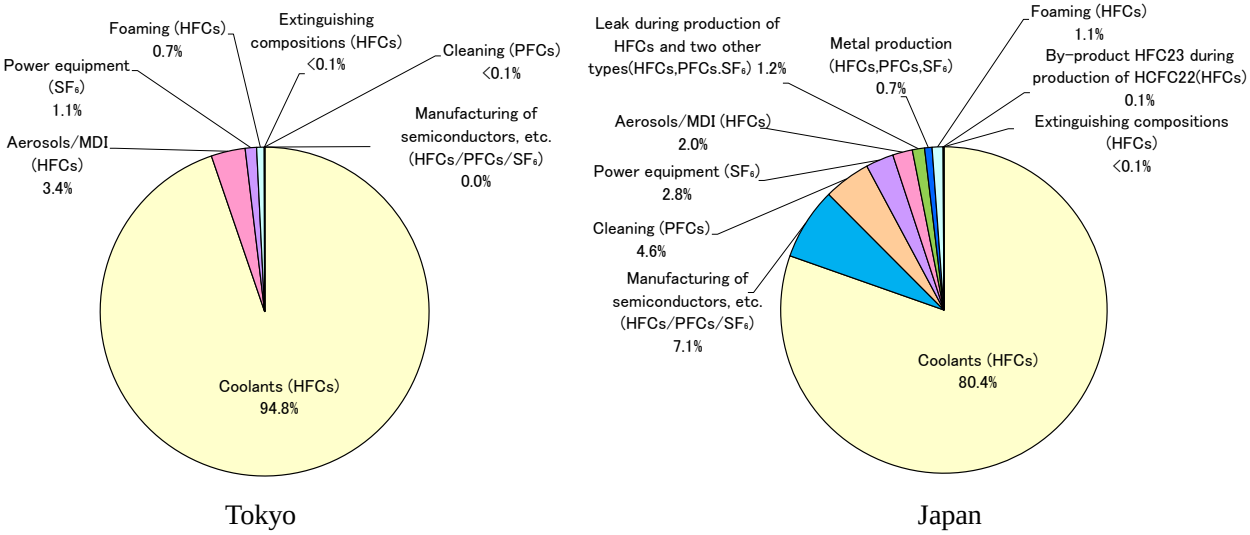


Figure 3-25 Composition ratios of HFCs and two other types of emissions in Tokyo and in Japan (FY 2012)

Source: Finalized Values for Japan's GHG Emissions Data (FY 1990 - 2012), Greenhouse Gas Inventory Office of Japan

3.5.5 [Reference] NF_3

- NF_3 is a gas used in liquid crystal production and other fields. The GWP of NF_3 is set at 17,200 in the Fourth Assessment Report (2007) by the Intergovernmental Panel on Climate Change (IPCC).
- At the COP17 session, which was held from November to December 2011, gases to be added to the international framework for 2013 onward were discussed, and NF_3 was added to the list of the framework.
- In Japan, the addition of NF_3 to the list of GHGs was stipulated in the Partial Amendment to the Act on Promotion of Global Warming Countermeasures (Law No. 18, May 24, 2013), and will take effect on April 1, 2015.
- TMG will include NF_3 into the scope of calculation of GHG emissions starting with FY 2013. It is expected that NF_3 emissions in Tokyo will be minimal because factories that handle liquid crystal production are very few.

4 Reference Materials

[Material 1] Calculation Methods for Final Energy Consumption and GHG Emissions (Overview)

(1) Final energy consumption and energy-derived CO_2 emissions

■ Fuel consumption and energy consumption are estimated by sectors based on statistical data, etc., and CO_2 emissions are calculated by multiplying the consumption by the emission factor.

Sectors		Calculation methods (overview)	Key statistical data, etc.
Industrial sectors	Agriculture, forestry and fishery	Estimated based on utility cost (electricity/kerosene) per farming household, fuel cost (heavy oil A) per fishing management body, etc.	• MAFF "Agricultural Management Statistics Report" • MAFF "MAFF Statistics"
	Mining	Estimated based on national mining energy consumption, fuel and electricity cost rates in Japan and in Tokyo, etc.	• Agency for Natural Resources and Energy "Comprehensive Energy Statistics" • MIC "Economic Census: Activity Survey"
	Construction	National fuel consumption in the construction industry is allocated in accordance with the construction sales rates in Japan and in Tokyo.	• Agency for Natural Resources and Energy "Comprehensive Energy Statistics" • MLIT "Comprehensive Statistical Yearbook for Construction"
	Manufacturing	Energy consumption is estimated based on energy data for business sites in Tokyo, product shipment amount by trade, etc. • Consumption for the entire manufacturing industry is estimated based on energy consumption at soot emitting facilities. • Composition of energy consumption by trade is estimated based on product shipment amount by trade, etc.	• TMG "Soot Emission Survey Report" • TMG "Industry in Tokyo: Industrial Statistics" • METI "Petroleum Consumption Structure Statistics"
		• Consumptions of electricity and city gas by the entire manufacturing industry are identified based on the contract type on the supply side.	• TMG "Tokyo Statistical Yearbook" • Sales data in Tokyo as provided by electricity utilities and gas utilities
Consumer sectors	Commercial	Energy consumption is estimated by multiplying the energy consumption basic unit for each building application of business sites in Tokyo by the total floor area. • Total floor area for each building application is calculated based on national statistical materials. • The national average energy consumption basic unit for each building application has been adjusted in accordance with the actual status in Tokyo. • Energy consumption composition for each building application is estimated based on data reported by large-scale business sites under the Tokyo Metropolitan Ordinance.	• MIC "Summary Record of Prices for Fixed Assets" • Institute of Local Finance "Public Facility Status Survey" (Sources for total floor area data) • The Institute of Energy Economics, Japan "Energy Economics Statistics Summary" • TMG "Global Warming Corrective Measures Plan"
		• Consumptions of electricity and city gas by the entire commercial sector are identified based on the contract type on the supply side.	• TMG "Tokyo Statistical Yearbook" • Sales data in Tokyo as provided by electricity utilities and gas utilities

Sectors		Calculation methods (overview)	Key statistical data, etc.
Consumer sectors	Residential	Energy consumption is estimated based on survey materials concerning household spending, etc. • Consumptions of kerosene and LPG for all households are estimated based on fuel spending per household (single- or multiple-person households), unit prices for fuels, etc. * Gasoline and other fuels used for sedans are included in the transport sector.	• TMG "Living Standards of Tokyo Metropolitan Citizens (Tokyo Livelihood Analysis Report)" • MIC "Household Economy Annual Report"
		• Consumptions of electricity and city gas by the entire residential sector are identified based on the contract type on the supply side.	• TMG "Tokyo Statistical Yearbook" • Sales data in Tokyo as provided by electricity utilities and gas utilities
Transport sectors	Road Transportation	Traffic and CO_2 emissions by car type and by fuel type are estimated based on measurement data provided by TMG. * The scope of calculation only includes traffic in Tokyo.	
	Railways	(Passengers) The basic unit is calculated based on the power consumption and passenger kilometers of each railway company. The emissions are estimated by multiplying the basic unit by the passenger kilometers in Tokyo. (Freight) The national power consumption is allocated in accordance with the transportation tons in Japan and in Tokyo. * The scope of calculation only includes transportation in Tokyo.	• TMG "Tokyo Statistical Yearbook" • MLIT "Railway Statistical Yearbook"
	Navigation	(Passengers) The national fuel consumption is allocated in accordance with the passengers in Japan and in Tokyo. (Freight) The national fuel consumption is allocated in accordance with the transportation tons in Japan and in Tokyo. * The scope of calculation only includes navigation in Tokyo. The values for navigation outside Tokyo (from other parts of Japan to Tokyo, or from Tokyo to other parts of Japan) are calculated for reference.	• MLIT "Coastal Vessel Transportation Statistics" • MLIT "Passenger Regional Fluidity Survey" • MLIT "Freight Regional Fluidity Survey"
	Civil Aviation	Fuel consumptions at airports are counted. * The scope of calculation only includes navigation in Tokyo. The values for navigation outside Tokyo (from other parts of Japan to Tokyo, or from Tokyo to other parts of Japan) are calculated for reference.	• MLIT "Airport Management Status Record" • MLIT "Air Transportation Statistical Yearbook"

(2) Non-energy-derived CO_2 emissions

■ CO_2 emissions are calculated by multiplying the incineration of waste (on a dried basis) by the emission factor.

Sectors		Calculation methods (overview)	Key statistical data, etc.
Waste sectors	General waste	The incinerated amounts (on a dried basis) for waste plastics and synthetic fiber dust are estimated based on the incinerated amount (on a wet basis) in the Tokyo wards area and in the Tama area, the composition ratios of waste, the water content, etc., according to materials provided by cleaning factories and other sources.	• Clean Authority of TOKYO 23 Cities "Cleaning Service Annual Report" and "Survey Report on the Properties of Waste Delivered to Cleaning Factories" • The Institute for Tokyo Municipal Research, "Tama Area Waste Status Survey"
	Industrial waste	The incineration amounts of waste oil and waste plastics are estimated based on materials concerning the treatment of industrial waste.	• TMG "Survey Report on Changes over Time in Industrial Waste" • TMG "Performance Report on Industrial Waste Treatment "

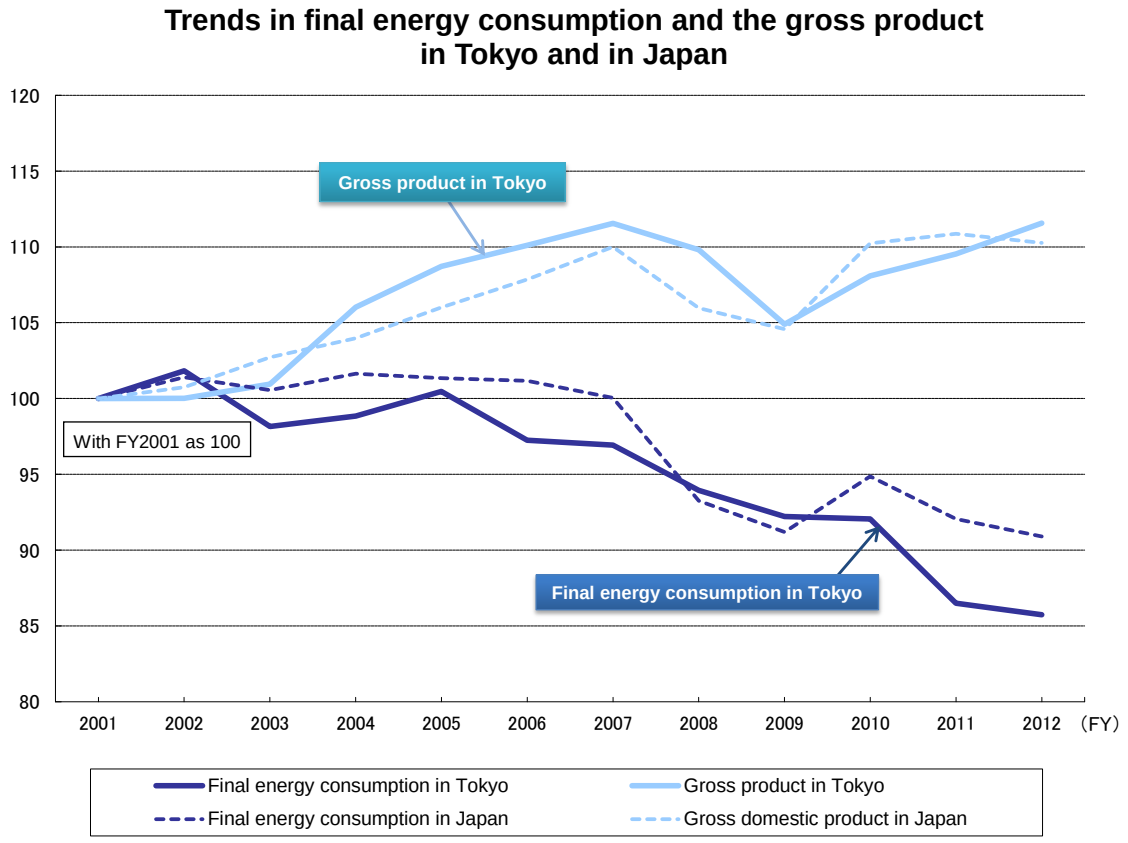
(3) Other GHGs

■ Emissions are estimated based on statistical materials prepared by TMG and the national government.

Sectors	Calculation methods (overview)	Key statistical data, etc.
Methane (CH_4)	The main source of emission is waste landfill sites. The emissions at inner and outer central breakwater landfill sites are estimated using a model that takes account of biodegradation over time (FOD).	• TMG "Survey Results on the Effective Use of Landfill Gas (LFG) (March, 2004)"
Dinitrogen oxide (N_2O)	The main sources of emission are the incineration of waste (general/industrial), sewage treatment at sewage plants, and automobile driving. Emissions are estimated based on statistical materials prepared by TMG and the national government.	• Ministry of the Environment "Survey Results on General Waste Treatment" • TMG "Survey Report on Changes over Time in Industrial Waste" • TMG "Performance Report on Industrial Waste Treatment "
HFCs and two other types (HFCs, PFCs, and SF_6)	The main source of emission is coolants (HFCs) that are emitted during the production, use, and disposal of freezers and air conditioners. National emissions are allocated in accordance with shipment amounts in Japan and in Tokyo. * Also for HFCs that are derived from foaming agents, aerosols, etc., and for SF_6 that are derived from the use of gas insulated transformers, etc., national emissions are allocated in accordance with shipment amounts in Japan and in Tokyo.	• METI materials for the Working Group for Countermeasures against CFCs, Manufacturing Industry Subcommittee, Industrial Structure Council

[Material 2] Trends in Final Energy Consumption in Tokyo and Gross Domestic Product(GDP) in Tokyo

- To realize a sustainable vigorous city, it is necessary to aim at a state where economic growth does not link with increased energy/resource consumption ("decoupling").
- EU includes decoupling in its policy targets under the 6th Environmental Action Plan (2002). International arguments are also had at the sessions of OECD, United Nations Environmental Programme (UNEP), etc.
- Trends in the final energy consumption in Tokyo and the gross product in Tokyo indicate that the decoupling has been in progress since FY 2001. TMG will farther promote smart energy and power conservation which are coexistent with economic growth.



Sources: TMG "Economic Calculations for Tokyo Metropolitan Citizens"
Cabinet Office "Economic Calculations for Japanese People (GDP Statistics)"
Agency for Natural Resources and Energy "Energy Supply and Demand Performance"

[Material 3] New Energy Reduction Targets in Tokyo

Tokyo's New Energy Reduction Target:

Reducing Tokyo's energy consumption by 30% from the 2000 level by the year 2030

- TMG has promoted advanced initiatives under its target of reducing GHG emissions in Tokyo by 25% from the 2000 level by the year 2020. Although energy consumption has been decreasing, CO_2 emissions in Tokyo are on the rise due to the deteriorated CO_2 emission factor for electricity supplied to Tokyo.
  ⇒ In the present status, it is difficult to indicate the effect of energy conservation efforts by businesses and citizens using the CO_2 emission indicator only.

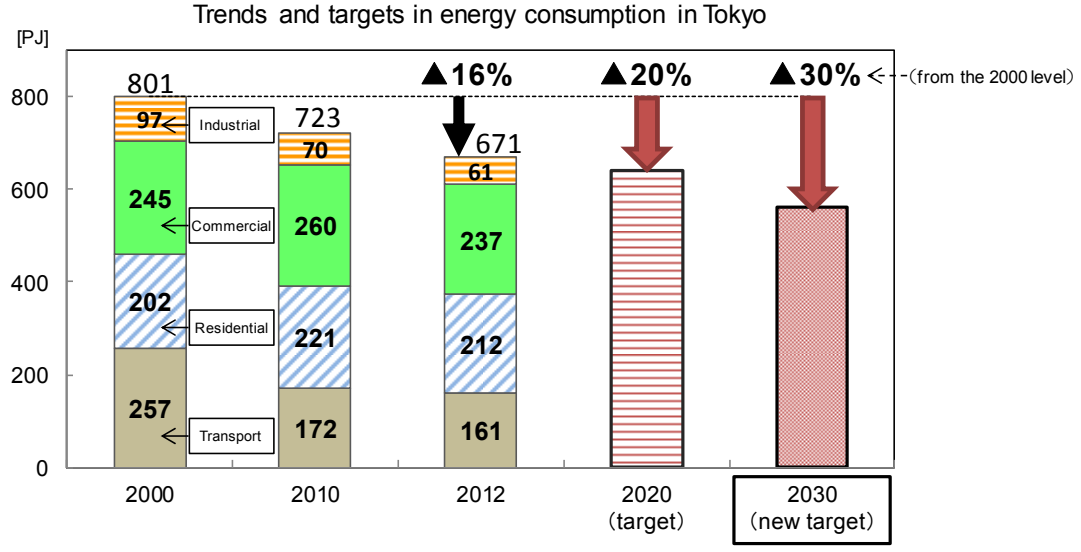
- Therefore, TMG also set a target aimed at energy consumption itself (reducing energy consumption in Tokyo by 20% from the 2000 level by the year 2020), for the purpose of indicating a goal for the demand side, and of clarifying the effect of energy/power conservation efforts by businesses and citizens (March 2014).

- In the Long-Term Vision for Tokyo, which was lately established, a new energy reduction target toward 2030 was specified, in addition to the existing targets above, for the purpose of continuing and enhancing energy conservation efforts in Tokyo after 2020, as a responsibility of the largest consumer of energy in Japan (December 2014).

New energy reduction target:

Reducing Tokyo's energy consumption by 30% from the 2000 level by the year 2030

Trends and targets in energy consumption in Tokyo



➢ **Tokyo should achieve the energy reduction target for 2020 by steadily implementing the existing measures, while taking additional creative initiatives to support efforts in respective sectors, including small and medium-sized facilities and households, thereby promoting effective countermeasures against climate change and energy conservation measures consistent with economic growth, toward the new energy reduction target for 2030.**

Immediate measures toward achieving the targets

Residential	➢ Enhancing heat insulation performance of existing single-family house; promoting the utilization of solar power and solar heat ➢ Promoting the dissemination of home fuel cell systems
Commercial/ industrial	➢ Supporting the renovation of small and medium-sized tenant buildings for improved energy-saving performance; promoting the dissemination of carbon reports ➢ Implementing the Tokyo Cap-and-Trade Program for large facilities ➢ Promoting the dissemination of energy-saving buildings by restructuring the Tokyo Green Building Program
Transport	➢ Promoting the dissemination of next-generation automobiles, such as fuel cell vehicles and electric vehicles ➢ Promoting energy conservation measures in traffic and transportation

5 Figures and Tables

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Final Energy Consumption and Greenhouse Gas Emissions in Tokyo (FY2012)

Issued in March, 2015

Climate Policy Planning Team, Urban and Global Environment Division,
Bureau of Environment, Tokyo Metropolitan Government

For more details,
please visit the website of the Bureau of Environment
Tokyo Metropolitan Government at:
http://www.kankyo.metro.tokyo.jp/en/climate/index.html
(Comprehensive website on countermeasures against climate change, Tokyo)