Final Energy Consumption and Greenhouse Gas Emissions in Tokyo

(FY 2014)

March 2017

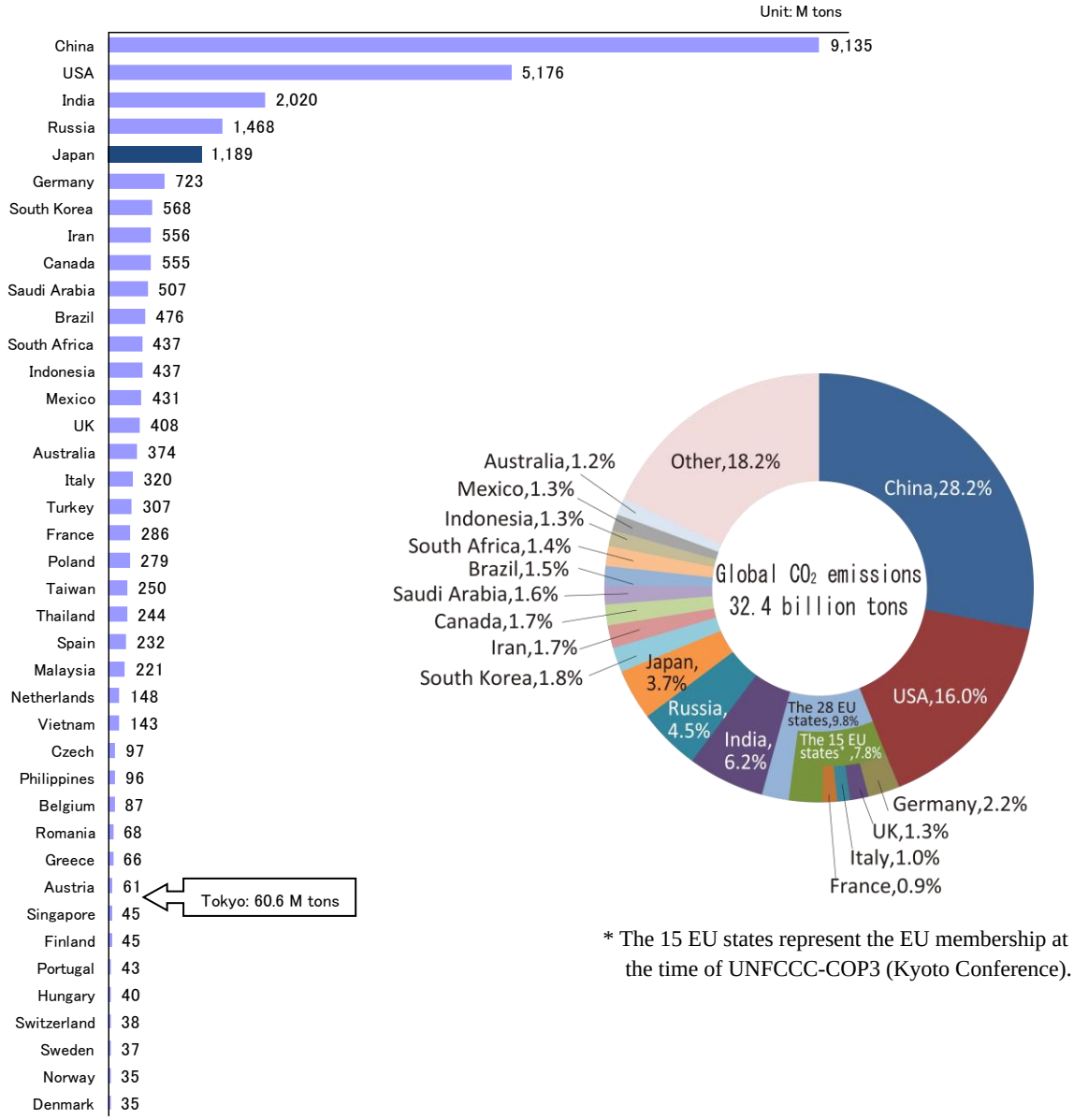
Bureau of Environment
Tokyo Metropolitan Government

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 3.7% of the global emissions.
- Energy-derived CO_2 emissions in Tokyo account for 5.1% of domestic emissions. This is considered to be approximately equivalent to the amount of one country, such as Austria, Greece, etc. (GHG emissions in Tokyo account for 4.9% of domestic emissions.)



* The 15 EU states represent the EU membership at the time of UNFCCC-COP3 (Kyoto Conference).

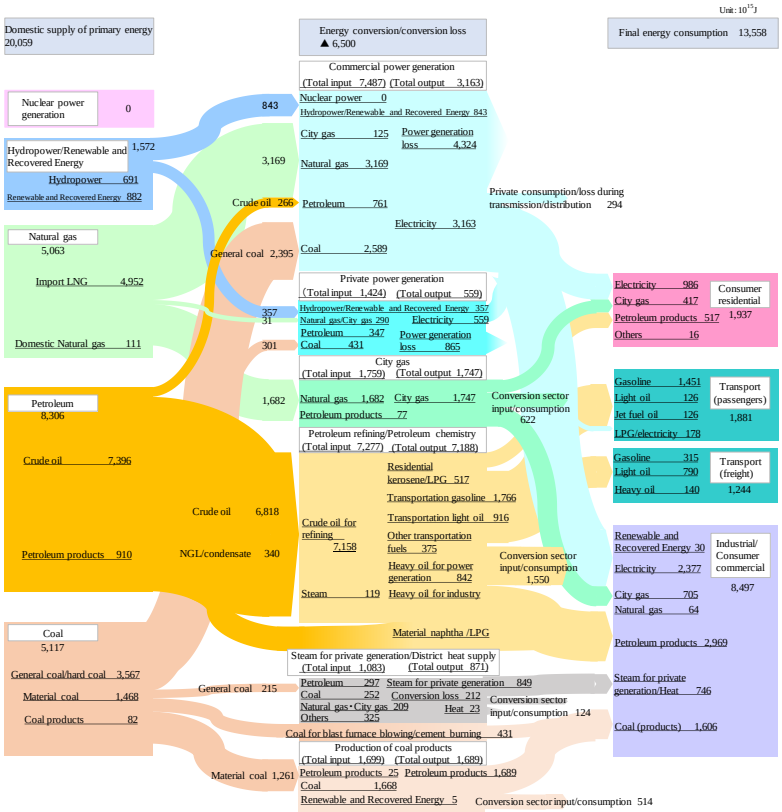
Figure 1-1 Energy-derived CO_2 emissions by country (2014)

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 (2016 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 final demand sectors.
- In this survey, energy consumption excluding the losses in power generation, transmission, distribution, etc. on the final demand sectors (industrial/commercial/residential/transport sectors) (i.e. final energy consumption) in Tokyo is calculated.
- For the calculation methods for final energy consumption, an overview is indicated in Reference Material 1 (pages 37 to 39).



Source: Agency for Natural Resources and Energy, "Energy White Paper 2016"

Figure 2-1 Domestic Energy Balance and Flow (Overview) (FY 2014)

Table 2-1 Heat conversion factors used in this survey (FY 2014)

(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, 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 2014 stood at 646 PJ, which was 19% reduction from 801 PJ in FY 2000, and 1.5% reduction from 656 PJ in FY 2013.

▼ Respective increase rates vs. FY 2000 for the industrial, commercial, and transport sectors stood at -45%, -6.0%, and -40%, while consumption in the residential sector increased by +2.8%.

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

Table 2-2 Final energy consumption by sector in Tokyo, and increases up to FY 2014

	Final energy consumption (PJ)							Increase rate (%)		
	FY 2000	FY 2005	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	Vs. 2000	Vs. 2010	Vs. 2013
Industrial sector	97	79	70	61	60	56	53	- 45%	- 24%	- 4.6%
Commercial sector	245	274	260	233	237	237	231	-6.0%	- 11%	-2.6%
Residential sector	202	217	221	212	212	209	208	2.8%	- 6.1%	-0.6%
Transport sector	257	218	172	168	161	154	154	- 40%	- 10%	0.1%
Final consumption sectors total	801	788	723	674	670	656	646	- 19%	- 11%	-1.5%

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 2014

	Final energy consumption (PJ)							Increase rate (%)		
	FY 2000	FY 2005	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	Vs. 2000	Vs. 2010	Vs. 2013
Electricity	296	316	323	290	293	293	285	- 3.7%	-12%	-2.9%
City gas	187	211	197	188	188	184	181	- 3.0%	- 7.8%	- 1.7%
LPG	32	26	19	21	17	17	21	- 36%	9.0%	24%
Fuel oil	284	235	183	174	171	161	158	- 44%	- 14%	-1.4%
Other	2	0	0	1	0	0	0	- 79%	165%	26%
Total	801	788	723	674	670	656	646	- 19%	- 11%	- 1.5%

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

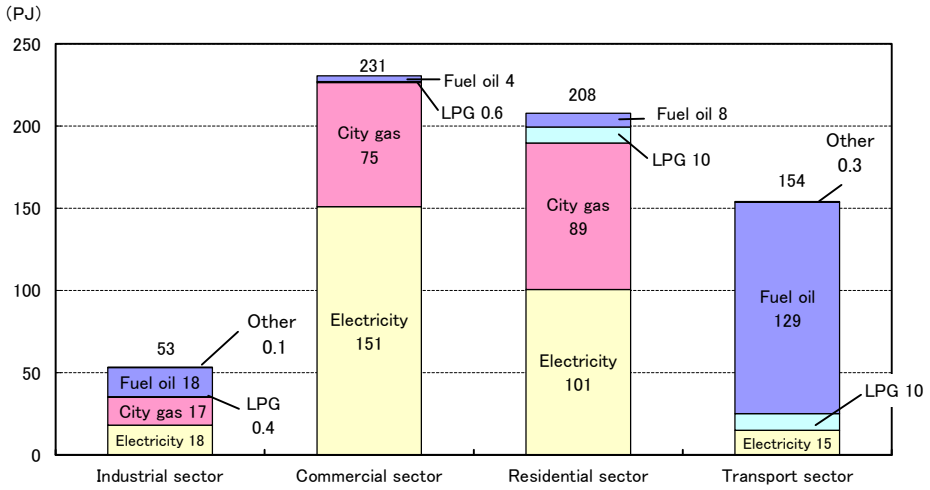


Figure 2-2 Final energy consumption by sector in Tokyo (FY 2014)

2.2.1-1 Final Energy Consumption by Sector in Entire Tokyo

- In the composition in FY 2014, the commercial sector took up the largest share (36%), followed by the residential sector (32%), transport sector (24%), and industrial sector (8%).

- As for sectoral trends in the composition since FY 2000, the commercial sector and the residential sector indicate an increasing trend, while the industrial sector has been showing a decreasing trend. The transport sector has been decreasing until around FY 2010, and thereafter it is almost the same level.

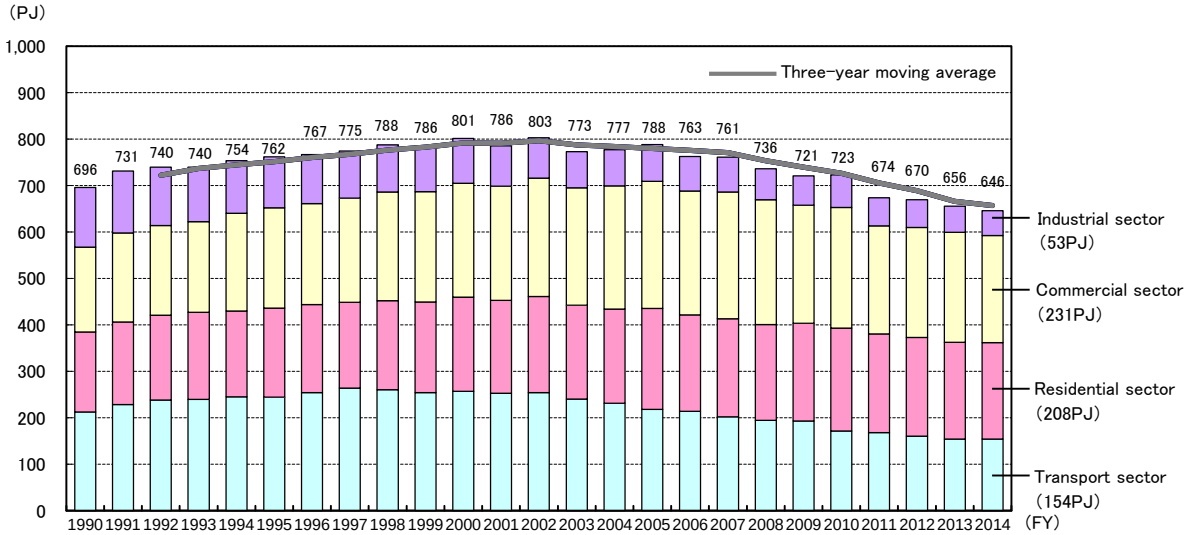


Figure 2-3 Trends in final energy consumption by sector in Tokyo

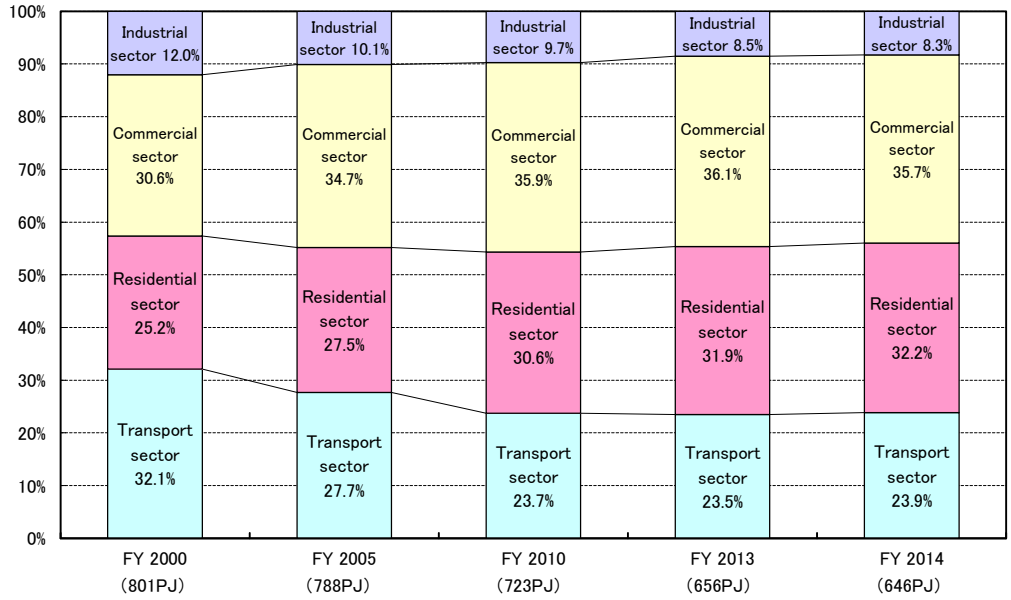


Figure 2-4 Composition ratios in final energy consumption by sector in Tokyo

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

- In the fuel type composition in FY 2014, electricity took up the largest share (44%), followed by city gas (28%) and fuel oil (25%).

- While the share of electricity temporarily decreased after the Great East Japan Earthquake due to the effect of power conservation, its share in FY 2013 recovered to the level of the FY 2010. In the meantime, the share of city gas has been slowly increasing.

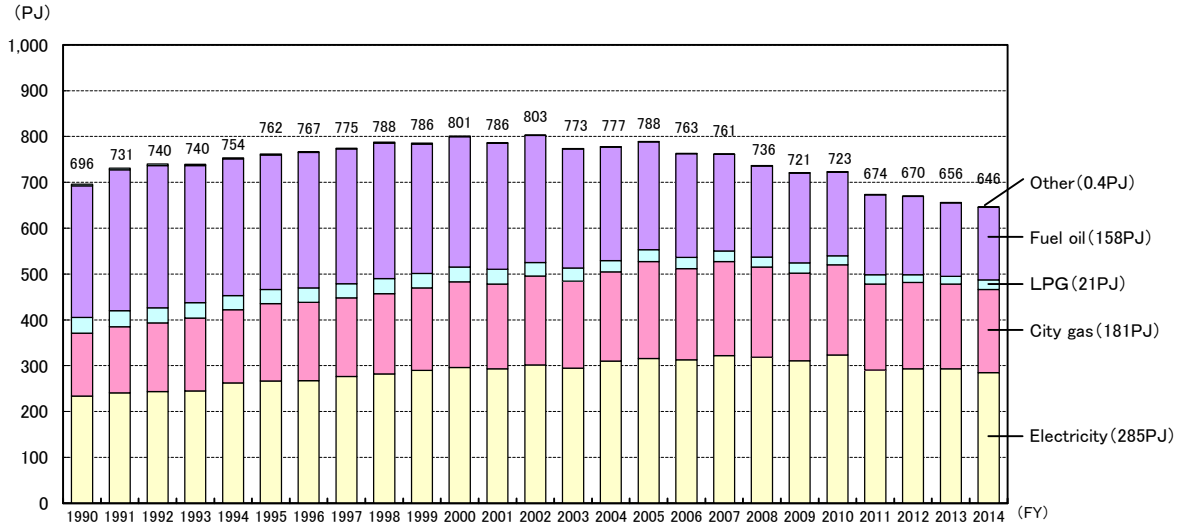


Figure 2-5 Trends in final energy consumption by fuel type in Tokyo

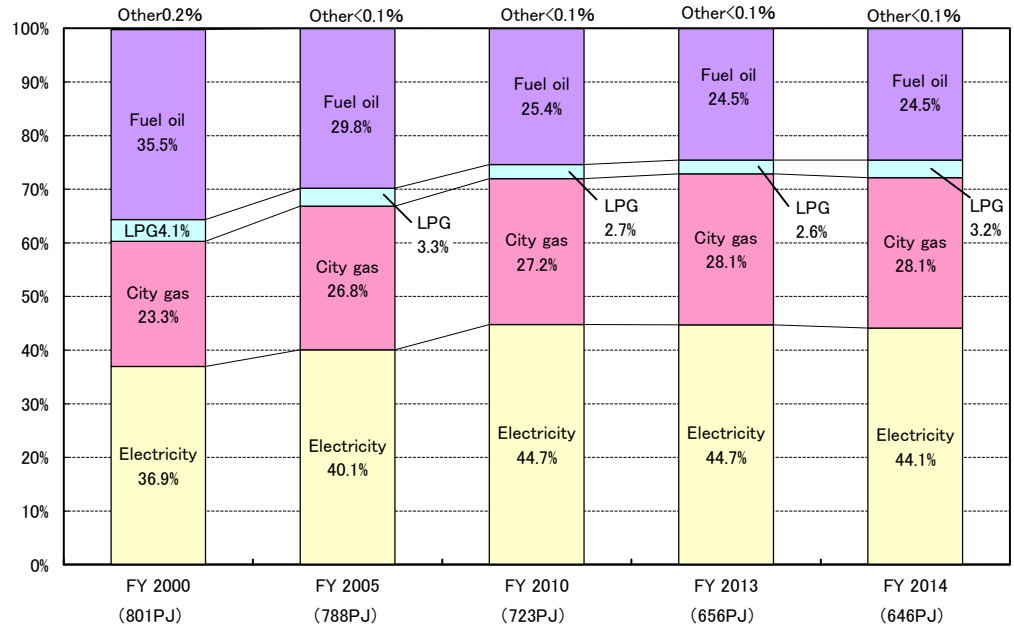


Figure 2-6 Composition ratios in final energy consumption by fuel type in Tokyo

2.2.2 Industrial Sector

▼ The final energy consumption in the industrial sector in FY 2014 stood at 53 PJ, which was 45% reduction from 97 PJ in FY 2000, and 4.6% reduction from 56 PJ in FY 2013.

▼ 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 2014, manufacturing took up the largest share (71%), followed by construction (26%), 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.

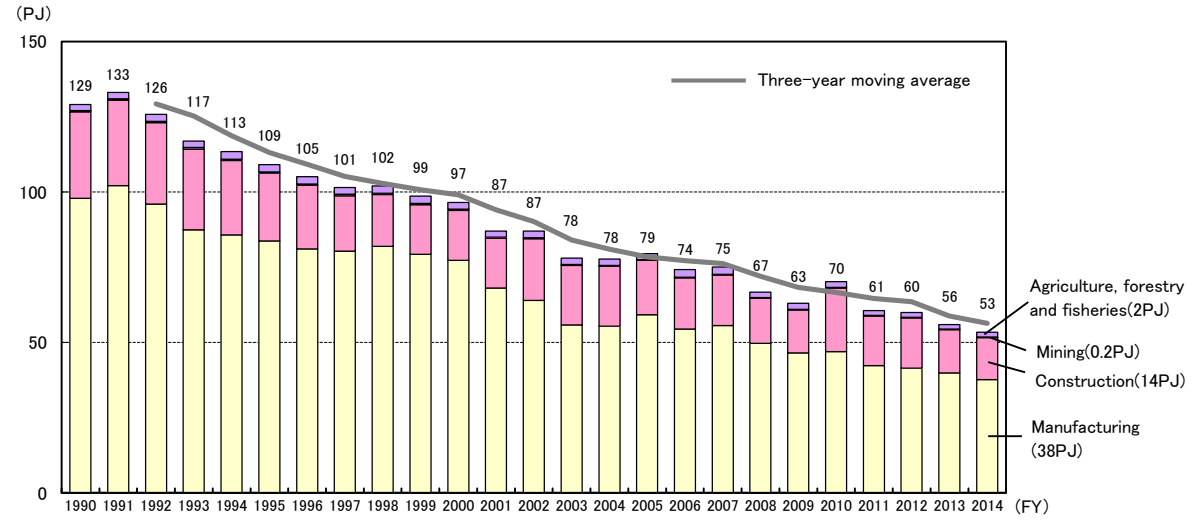


Figure 2-7 Final energy consumption by trade in the industrial sector

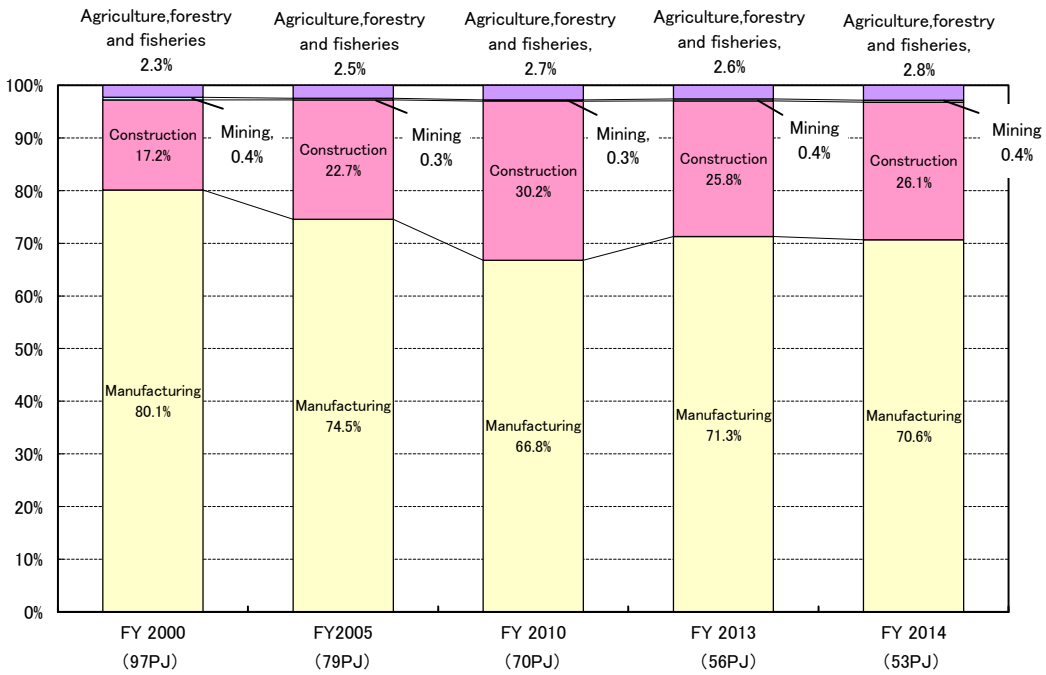


Figure 2-8 Composition ratios in final energy consumption by trade in the industrial sector

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

- In the fuel type composition in FY 2014, electricity took up the largest share (34%), followed by fuel oil (33%) and city gas (32%).
- Compared to FY 2000, the share of fuel oil has been decreasing, indicating progress in the conversion from fuel oils to electricity and city gas.

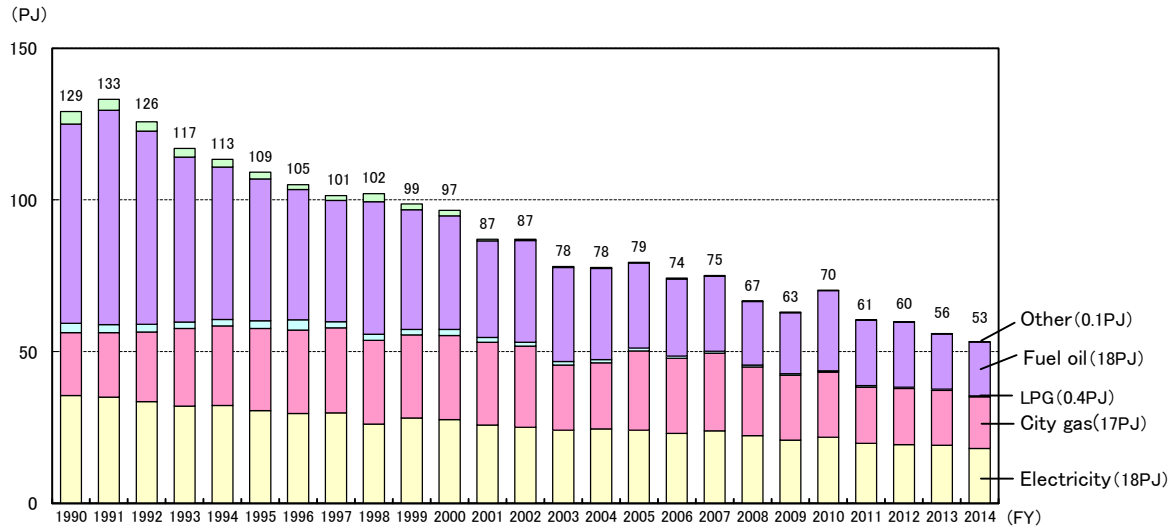


Figure 2-9 Trends in final energy consumption by fuel type in the industrial sector

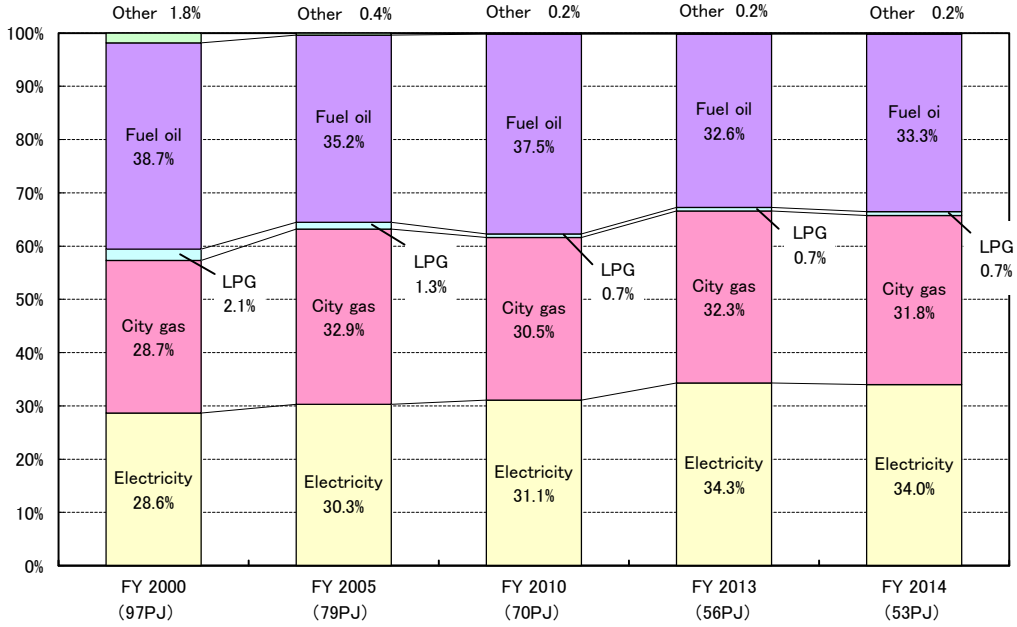


Figure 2-10 Composition ratios in final energy consumption by fuel type in the industrial sector

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 until about FY 2009, but there is a tendency of a slight recovery from FY 2010.
- 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 rate in Tokyo has been similar to that of the nationwide since FY 2008.

* The Indices of Industrial Production (IIP) are a systematic representation of various activities related to production, shipment, and inventory of domestic business sites that produce mining and industrial products. The IIP used here refers to production indices weighted by added value, which is calculated for 176 items (487 items for nationwide indices), based on the dynamic statistics of production, the Census of Manufacturers, etc.

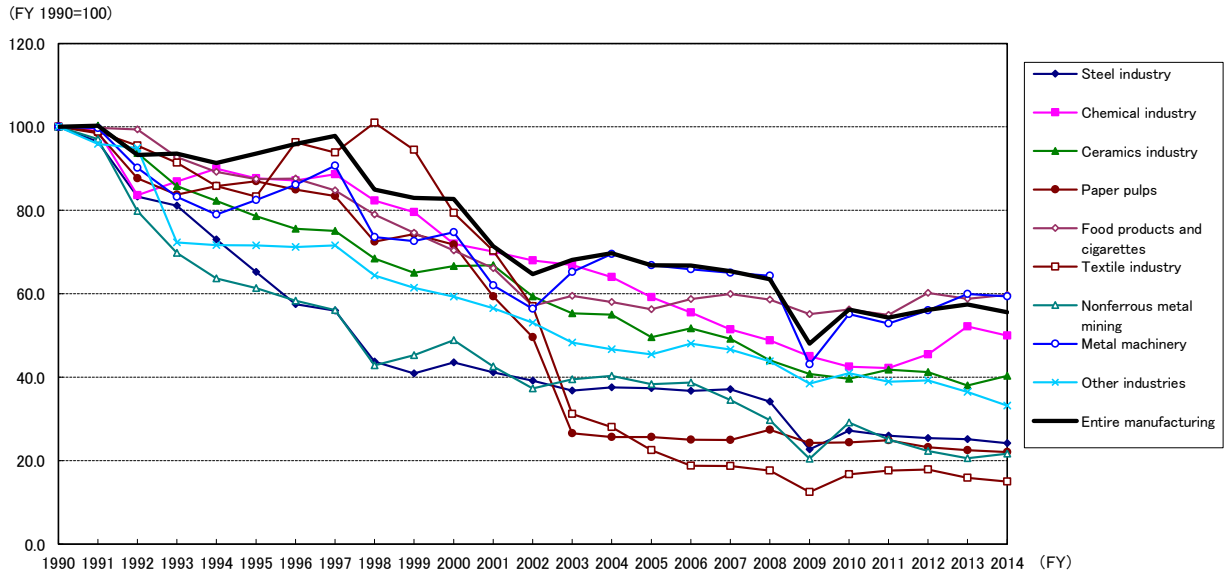


Figure 2-11 IIP increases in manufacturing in Tokyo

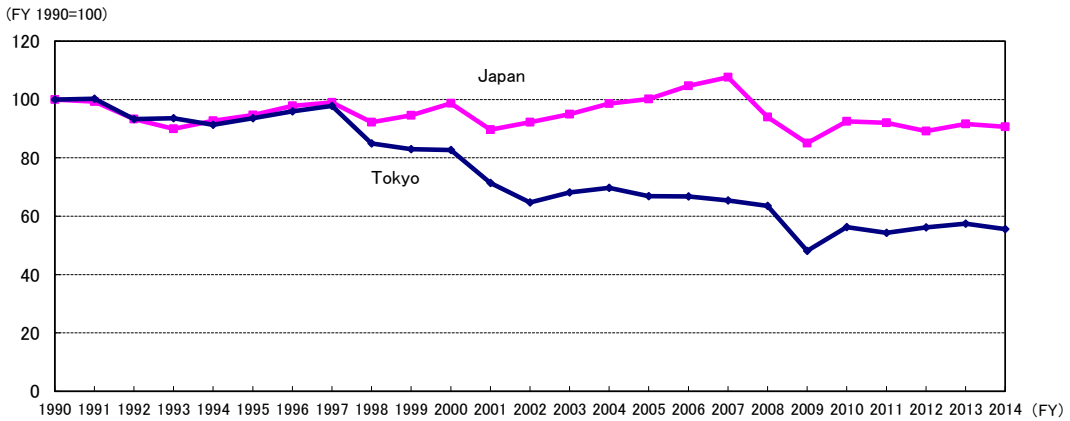


Figure 2-12 Comparison of IIP between Tokyo and Japan

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 2014 stood at 231 PJ, which was 6.0% reduction from 245 PJ in FY 2000, and 2.6% reduction from 237PJ in FY 2013.

▼ 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 2014, office buildings took up the largest share (60%). Other applications included restaurants (9%), schools (8%), 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.

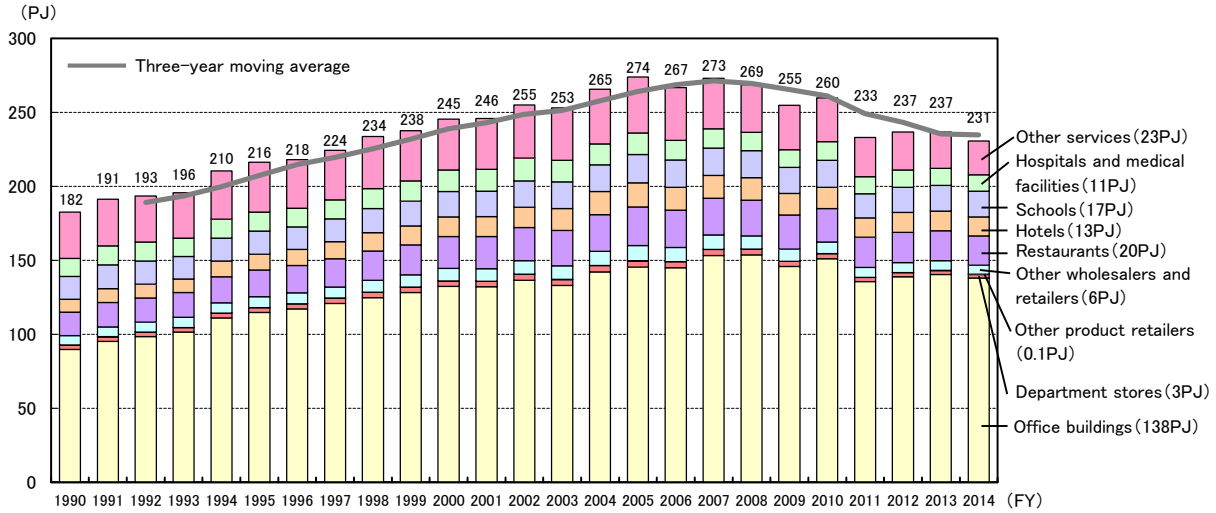


Figure 2-13 Trends in final energy consumption by building application in the commercial sector

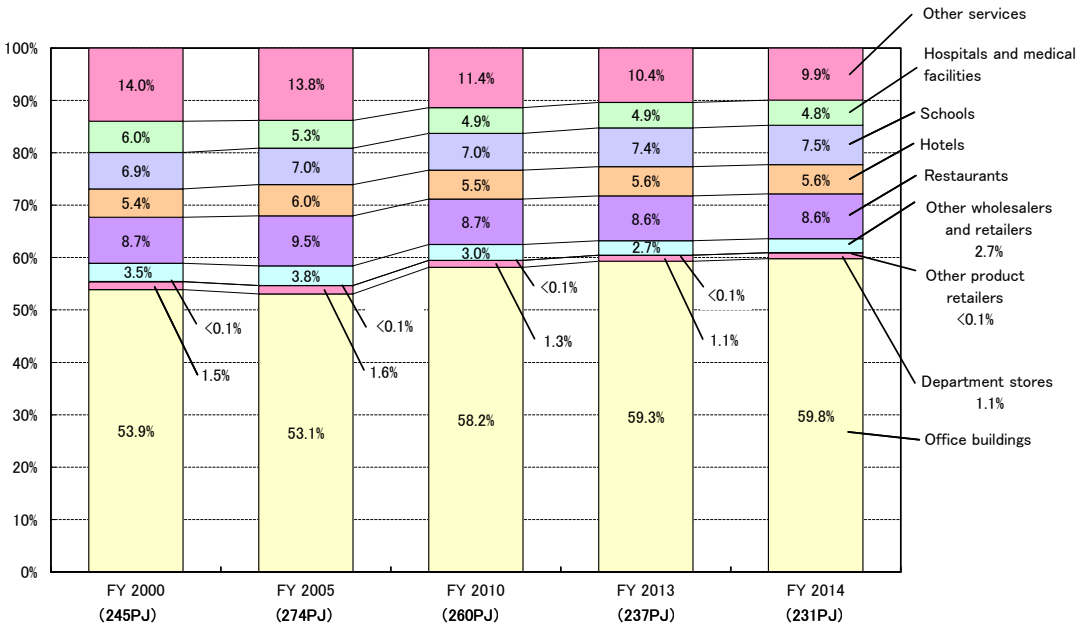


Figure 2-14 Composition ratios in final energy consumption by building application in the commercial sector

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

- In the fuel type composition in FY 2014, electricity (66%) and city gas (33%) combined accounted for 98% of the entire commercial sector.
- Since FY 2000, the share of fuel oil has been decreasing, indicating progress in the conversion from fuel oils to electricity and city gas.

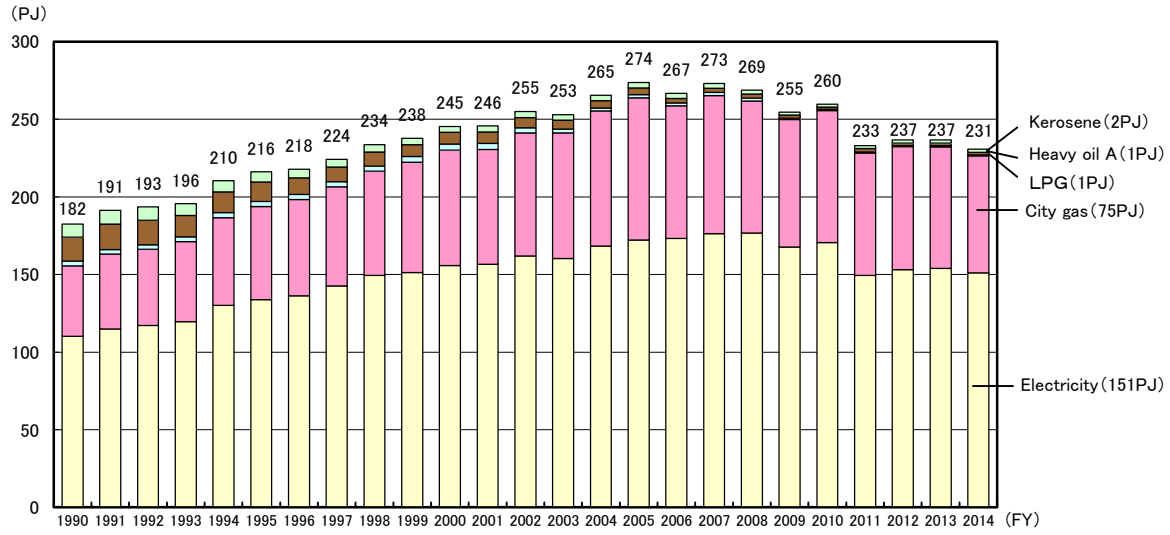


Figure 2-15 Trends in final energy consumption by fuel type in the commercial sector

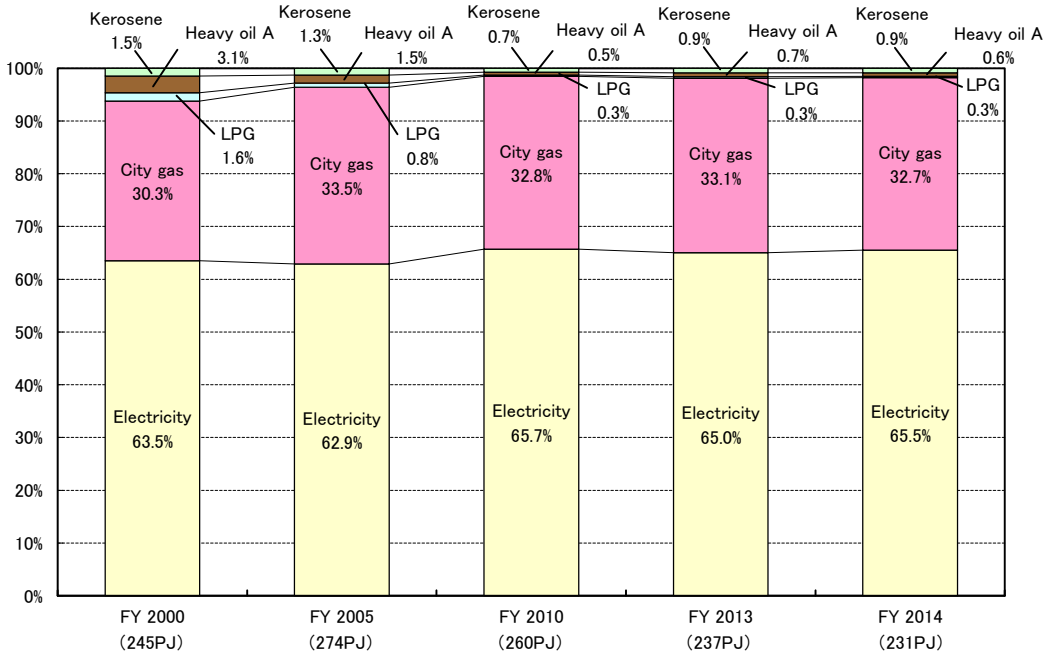


Figure 2-16 Composition ratios in final energy consumption by fuel type in the commercial sector

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.

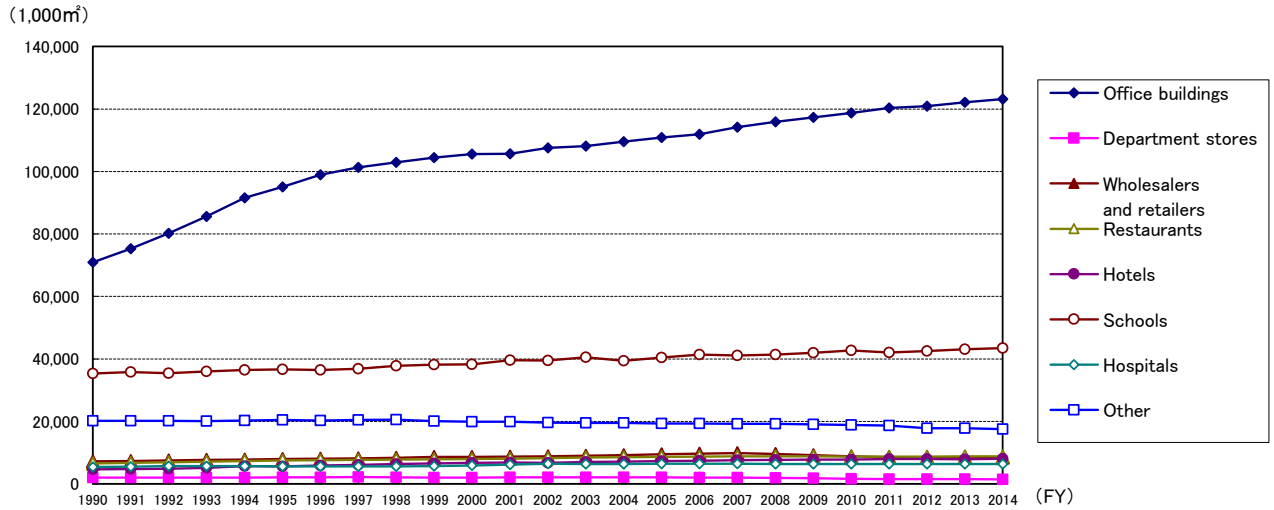


Figure 2-17 Trends in total floor area by trade in Tokyo

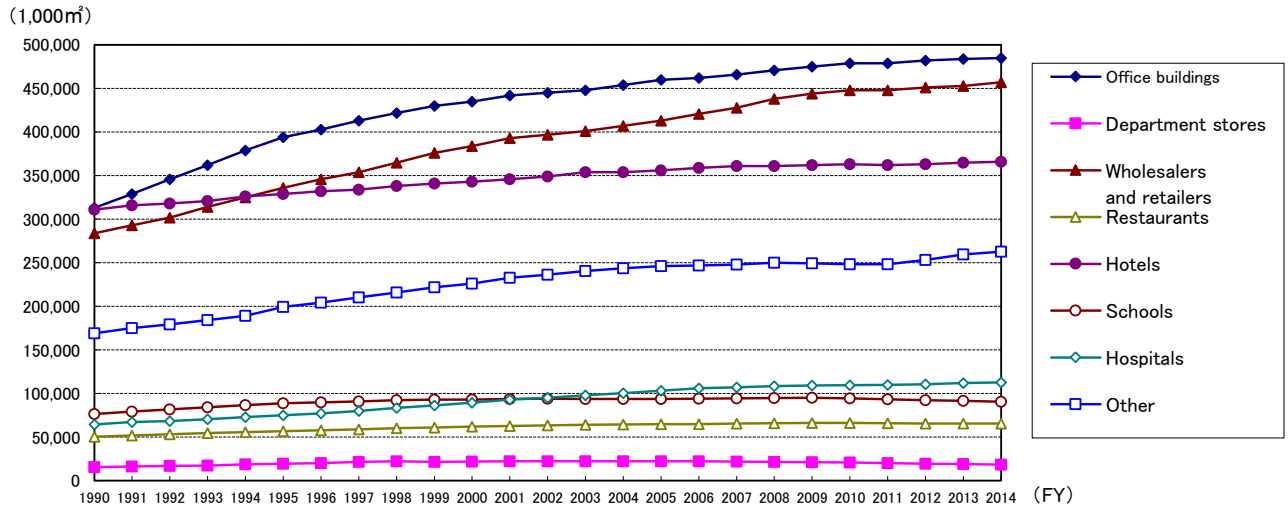


Figure 2-18 Trends in total floor area by trade in Japan

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 2014 stood at 208 PJ, which was 2.8% increase from 202 PJ in FY 2000, and 0.6% decrease from 209 PJ in FY 2013.

▼ Final energy consumption in the residential sector has been increasing since FY 1990, but it tends to decline these years.

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

- In the household type composition in FY 2014, 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.

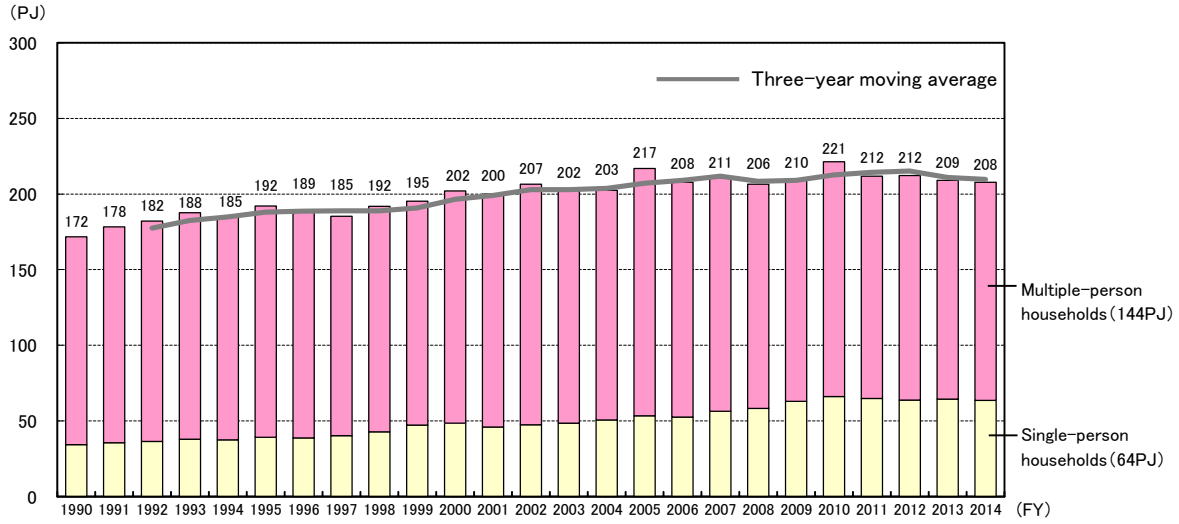


Figure 2-19 Trends in final energy consumption by household type in the residential sector

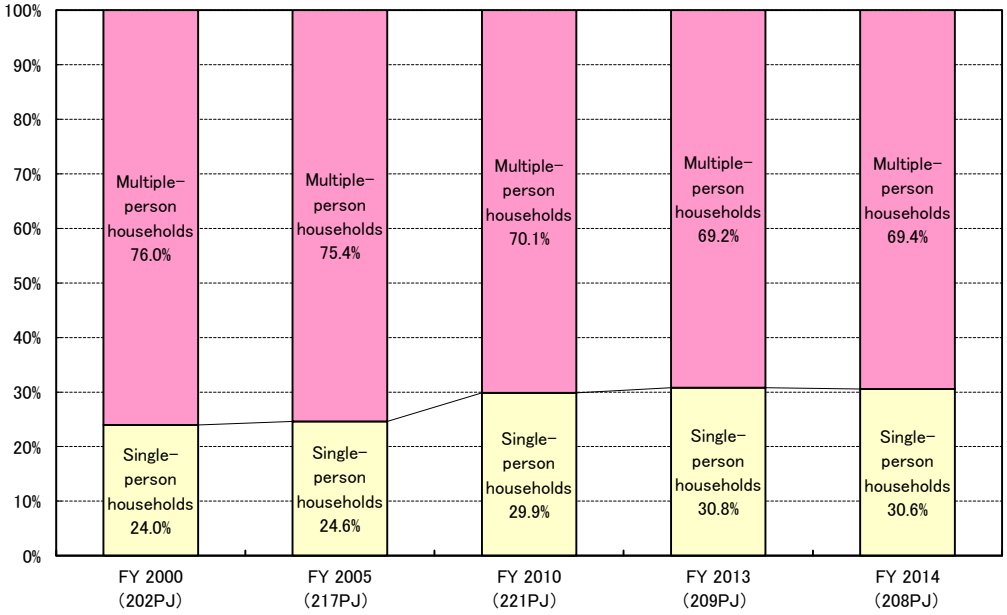


Figure 2-20 Composition ratios in final energy consumption by household type in the residential sector

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

- In the fuel type composition in FY 2014, electricity (48%) and city gas (43%) combined accounted for 91% of the entire residential sector.
- Although the share of electricity had been increasing since FY 2000, it decreased by 3.8 points from FY 2010 level in FY2014 because behavior of power conservation was established after the Great East Japan Earthquake. In the meantime, the share of city gas extended 2.0 points from FY2010 level and the share of LPG extended 1.9 points from FY2010 in FY2014.

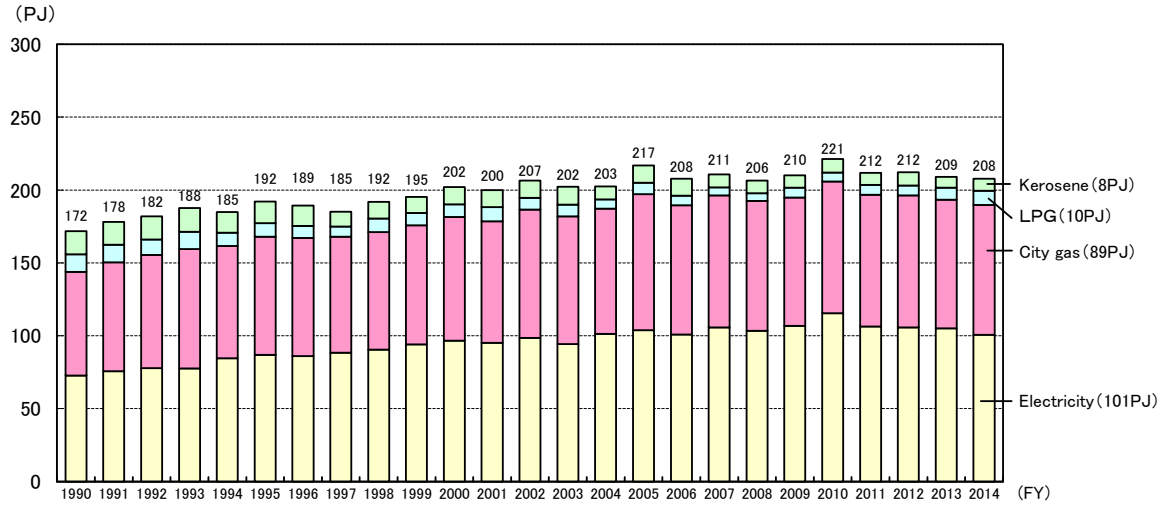


Figure 2-21 Trends in final energy consumption by fuel type in the residential sector

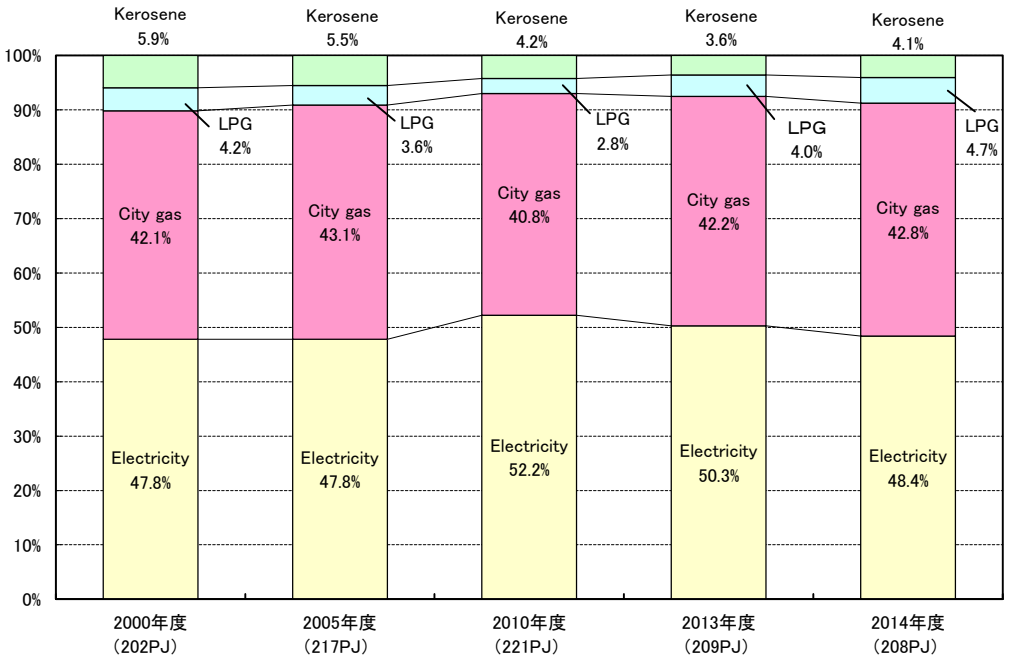


Figure 2-22 Composition ratios in final energy consumption by fuel type in the residential sector

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. In addition, the proportion of the number of single-person households in Tokyo is larger than in Japan.

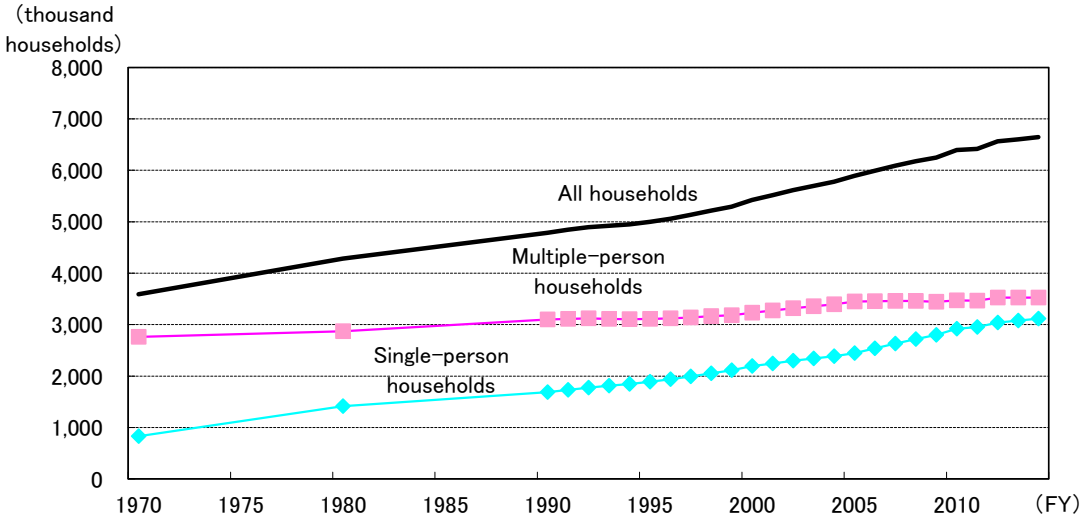


Figure 2-23 Trends in the number of households in Tokyo

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

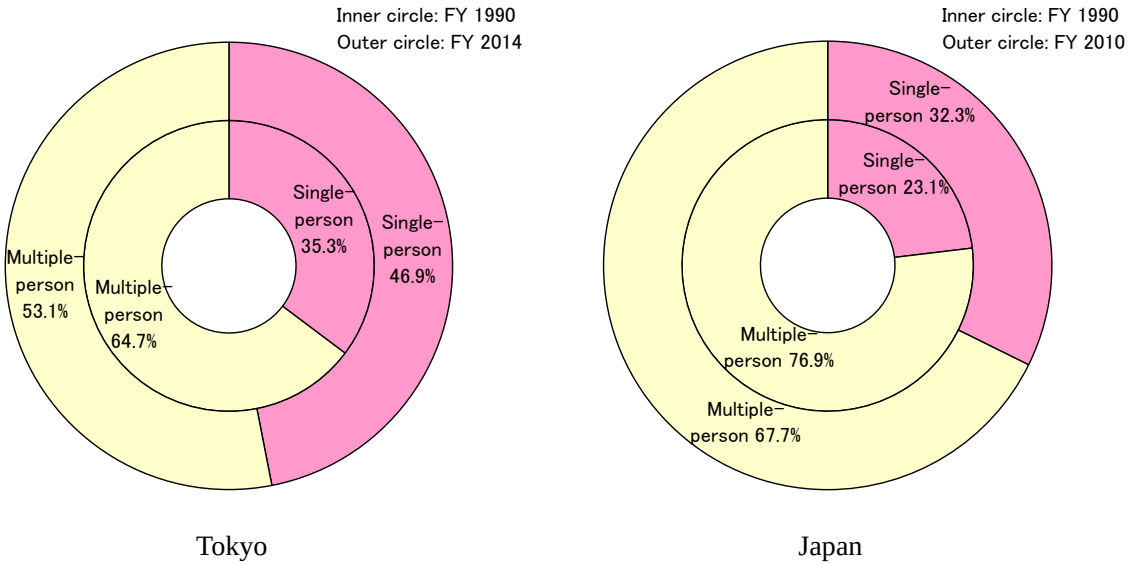


Figure 2-24 Comparison of the number of households between Tokyo and Japan

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. Since FY 2000, the ownership rates of room air conditioners, PCs, toilets with warm water bidet, clothes dryers, etc. have remarkably increased, as it reflects the growing needs for the comfort and convenience of life.

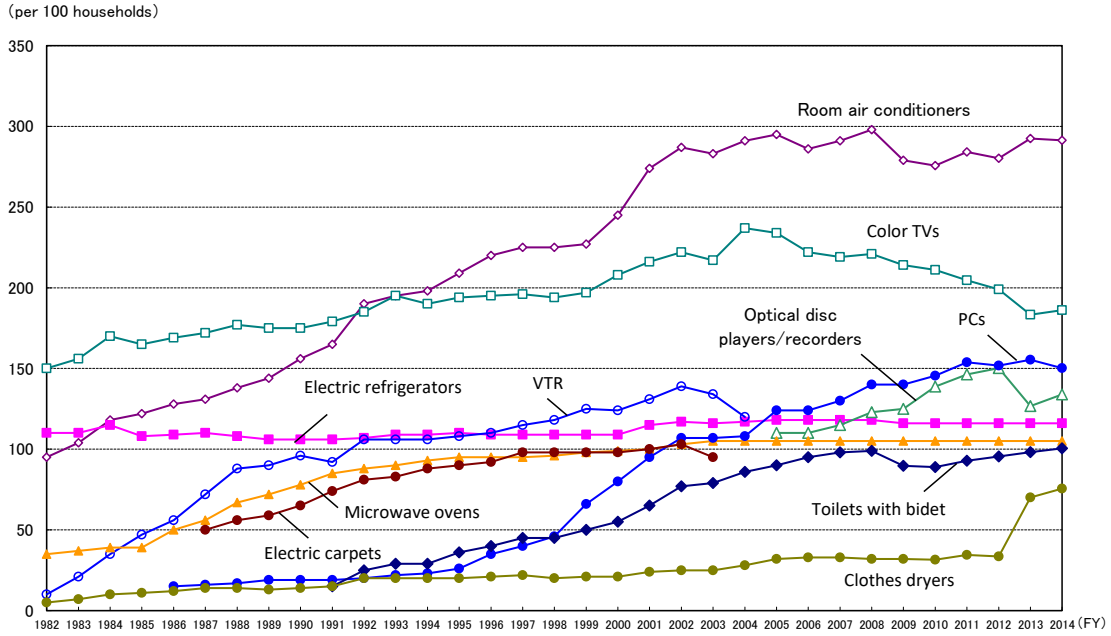


Figure 2-25 Trends in the ownership rates of home appliances in Tokyo

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"

Reference Data 1: Trends in energy consumption per household

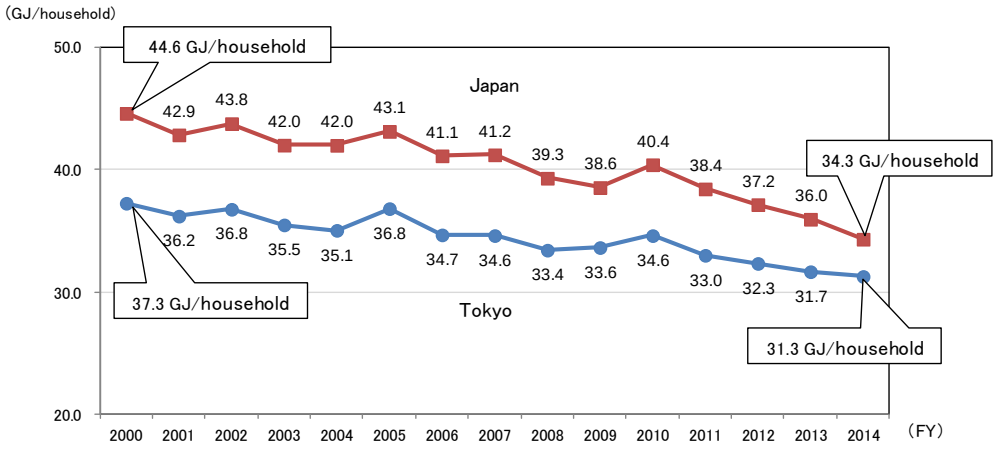


Figure 2-26 Comparison of energy consumption per household in Tokyo with Japan

Source: Prepared from TMG, "Tokyo Statistical Yearbook" and MIC, "Population, demographics and the number of households based on the Basic Resident Register"

Reference Data 2: Progress of energy saving for household electrical appliances

(1) Air Conditioners

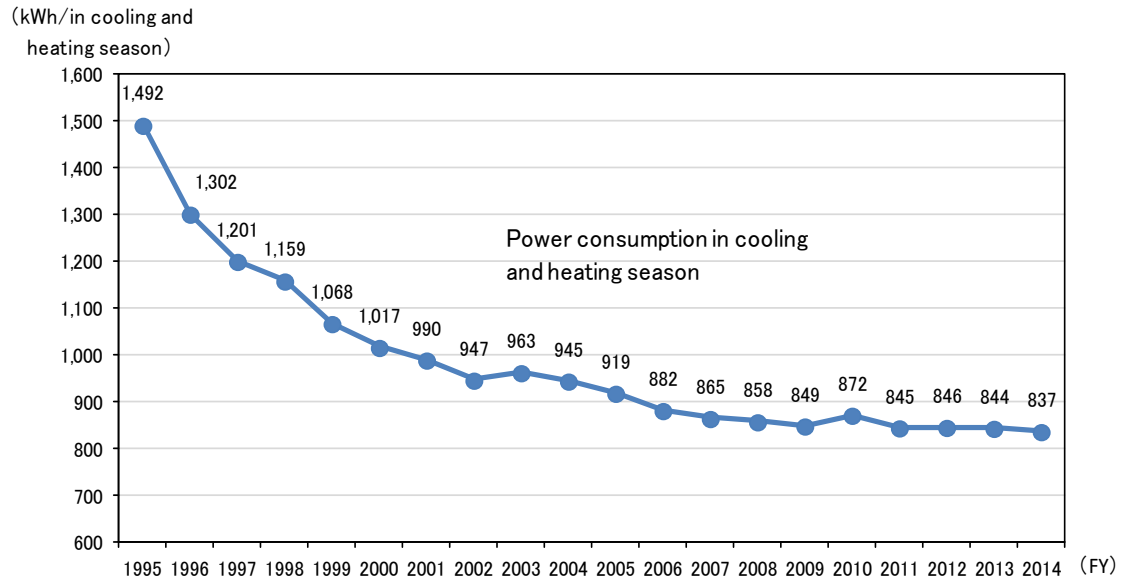


Figure 2-27 Progress of energy saving for air conditioners

Note: Simple average of the wall-mounted representative models with heating and cooling combined, cooling capacity of 2.8kW, and energy-saving function
Source: Prepared from Energy Data and Modeling Center, the Institute of Energy Economics, Japan "EDMC/Energy Economics Statistics Summary"

(2) Electric Refrigerators

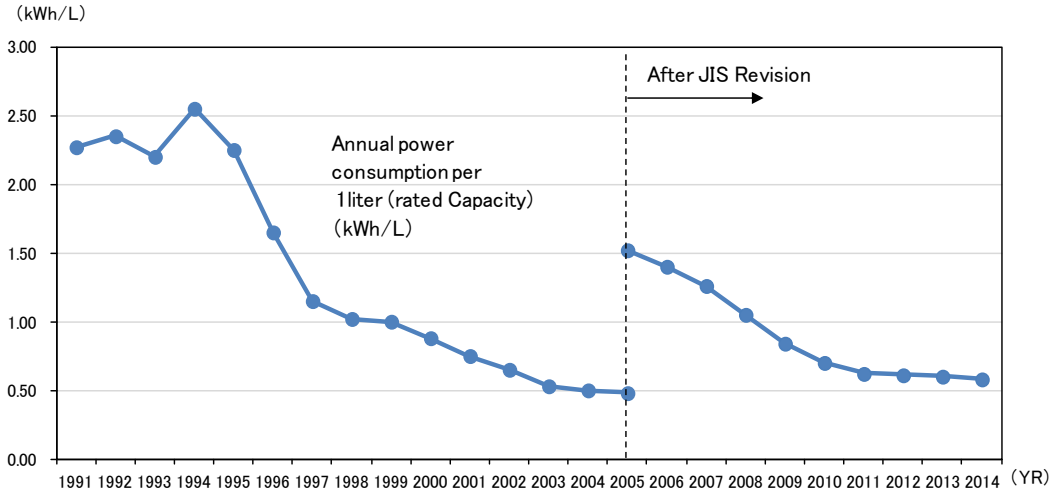


Figure 2-28 Progress of energy saving for electric refrigerators

Note: Average of the products from each company, corresponding to rated capacity of 401-450 liters since 2004
Source: Prepared from Energy Data and Modeling Center, the Institute of Energy Economics, Japan "EDMC/Energy Economics Statistics Summary"

2.2.5 Transport Sector

▼ The final energy consumption in the transport sector in FY 2014 stood at 154 PJ, which was 40% reduction from 257 PJ in FY 2000, but almost no increase or decrease compared with that of the FY 2013.

▼ 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 2014 by means of transportation, road transportation took up the largest share (88%). Other means included railways (10%), 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.

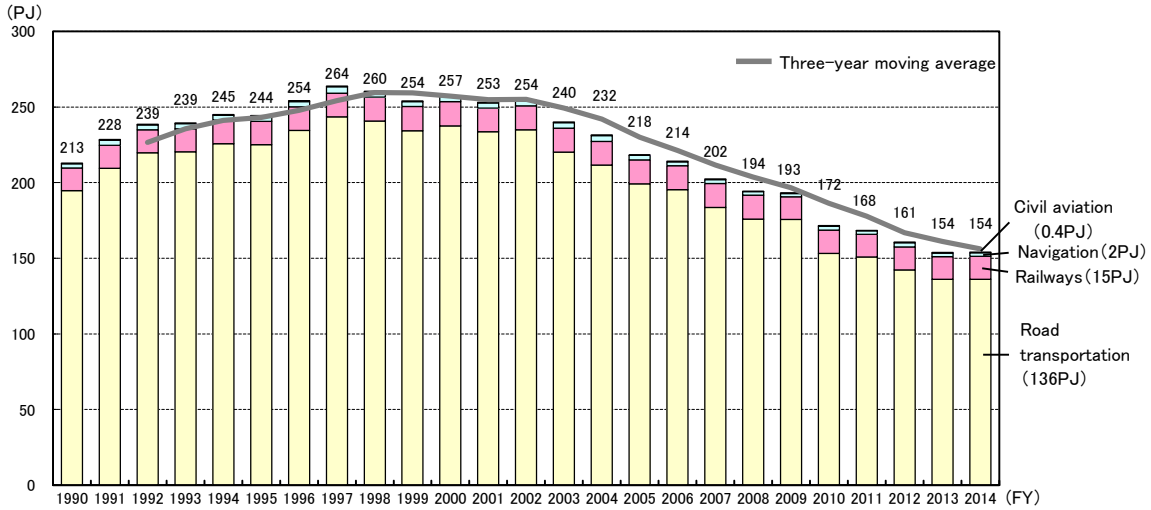


Figure 2-29 Trends in final energy consumption by means of transportation in the transport sector

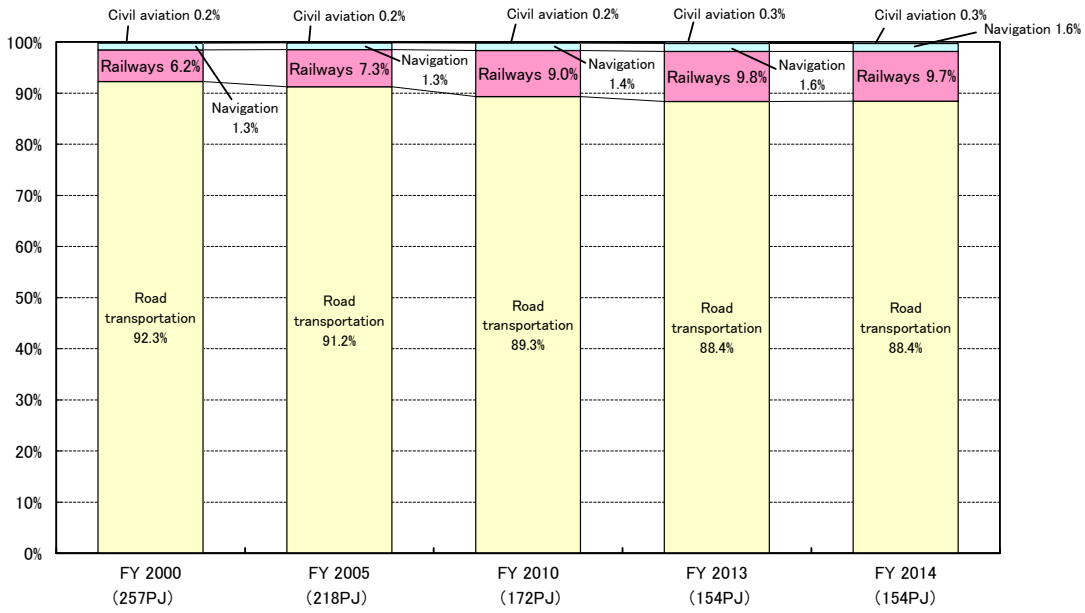


Figure 2-30 Composition ratios in final energy consumption by means of transportation in the transport sector

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

- In the fuel type composition in FY 2014, gasoline contained in fuel oil took up the largest share (57%), followed by light oil (25%) and electricity (10%). Electricity includes the consumption by railroad.
- Since FY 2005, the share of gasoline has been decreasing. The share of light oil consumed by diesel cars tended to expand until FY 2013, but it decreased in FY 2014.

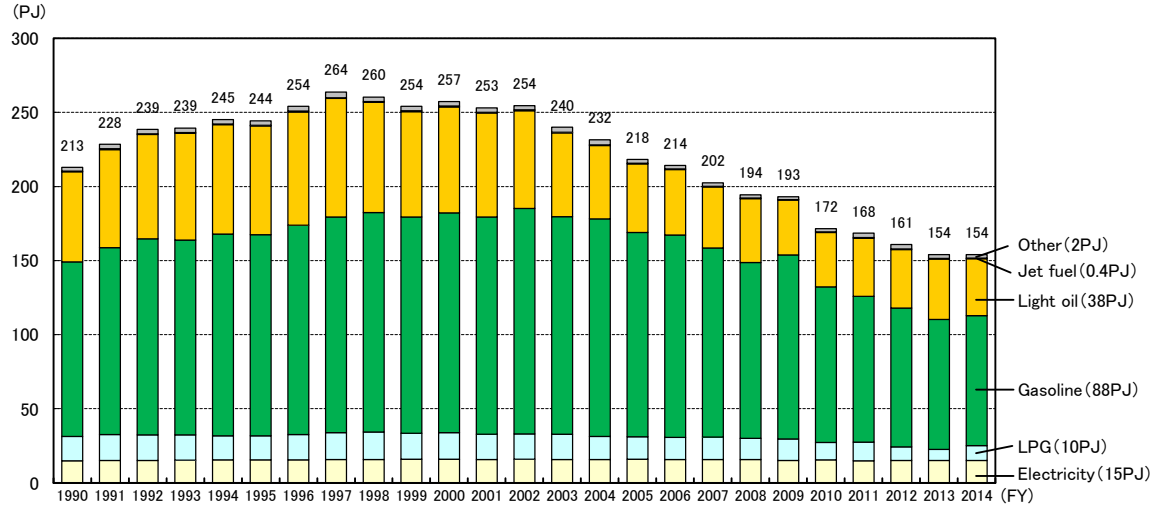


Figure 2-31 Trends in final energy consumption by fuel type in the transport sector

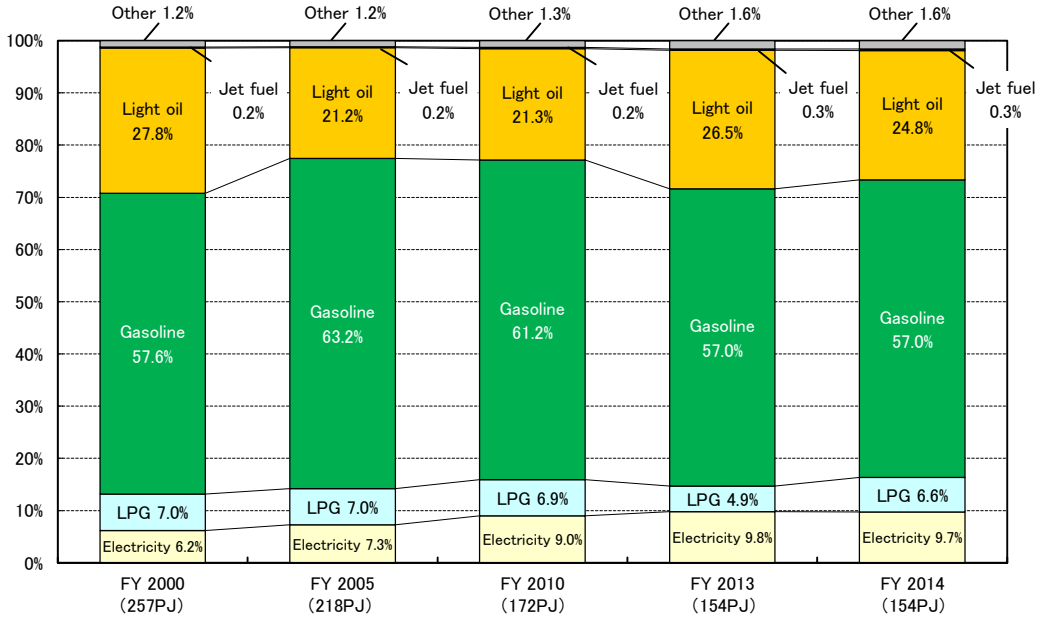


Figure 2-32 Composition ratios in final energy consumption by fuel type in the transport sector

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.
- For the numbers of registered vehicle in Tokyo, those of passenger cars and light cars have been increasing, while those of compact passenger cars and freight vehicles have been decreasing. The overall number remains mostly at the same level, with a slight decrease.
- The traffic of passenger vehicles in Tokyo had been increasing until FY 2000, and then took a downturn. In the meantime, freight vehicles have been slowing decreasing since FY 1990.

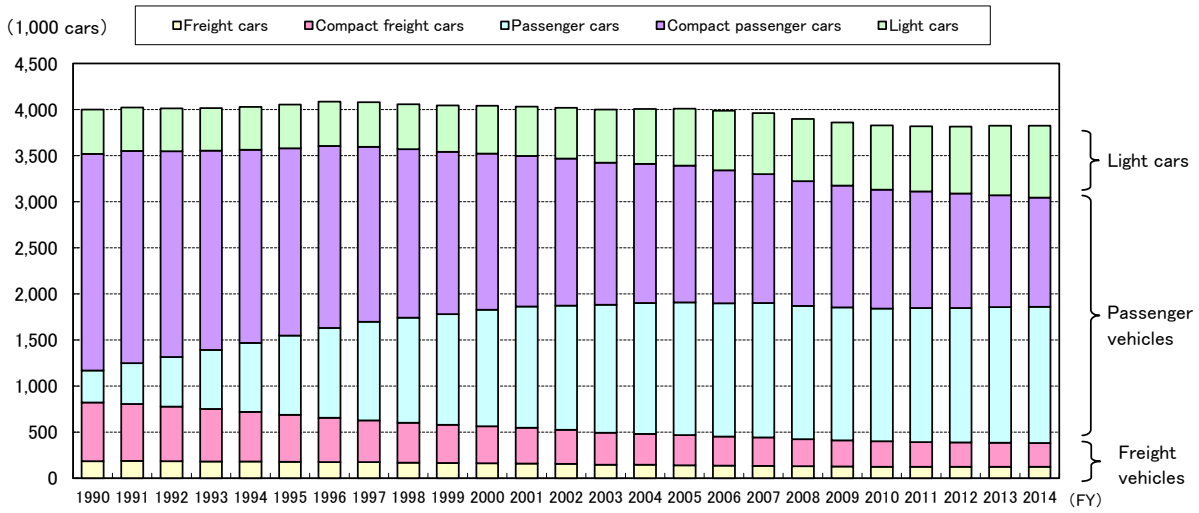


Figure 2-33 Trends in the number of registered vehicles in Tokyo

Note: "Light cars" include light passenger cars and light freight cars.
Sources: TMG "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 2015 (Automobile Inspection & Registration Information Association)

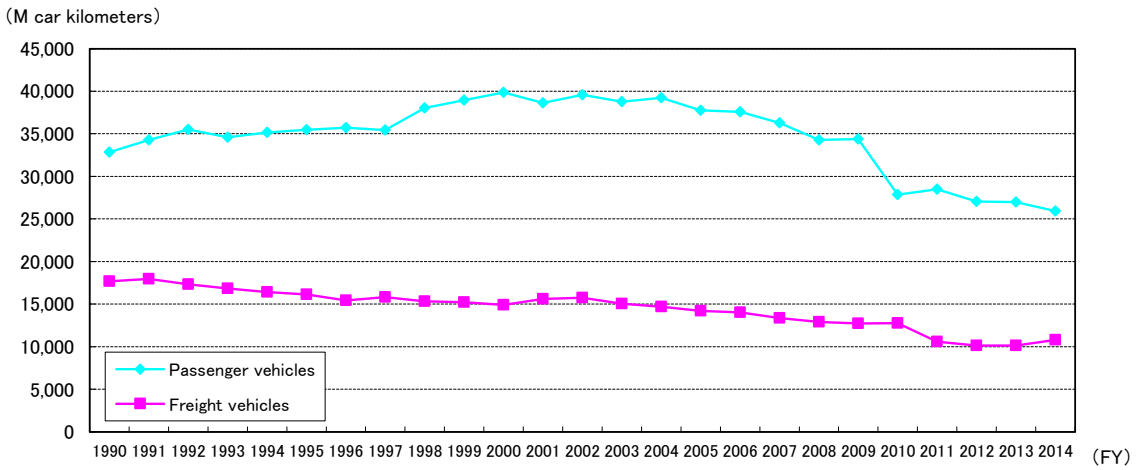


Figure 2-34 Trends in the traveling kilometers of vehicles in Tokyo

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), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). These seven types of gas are defined in the Act on Promotion of Global Warming Countermeasures.
- The GHGs other than CO_2 (CH_4, N_2O, HFCs, PFCs, SF_6, NF_3) 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 37 to 39).

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	25	Agriculture, waste, industrial process, combustion of fuel, leak from fuel, etc.
N_2O	Dinitrogen oxide	298	Agriculture, waste, industrial process, combustion of fuel, leak from fuel, etc.
HFCs	Hydrofluorocarbons	124 to 14,800	Coolant, foaming agent, heat insulation material, aerosol and MDI, etc.
PFCs	Perfluorocarbons	7,390 to 12,200	Solvents, manufacturing of semiconductors and LCDs, etc.
SF_6	Sulfur hexafluoride	22,800	Electrical equipment using insulating gas, manufacturing of semiconductors and LCDs, etc.
NF_3	Nitrogen trifluoride	17,200	Leak from manufacturing of NF_3, manufacturing of semiconductors and LCDs, 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 Fourth Assessment Report (2007) 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 incineration of waste.

Table 3-2 Categorization of carbon dioxides

Categorization	Targeted sector
Energy-derived CO_2 emissions	Final demand sectors * The amount of emission from the final energy consumption of respectively for the industrial, commercial, residential, and transport sectors
Non-energy-derived CO_2 emissions	Waste sector * The amount of emission from the incineration of waste is calculated.

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	2001	2002
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	0.317	0.381
PPS (average)											0.493	0.454	0.442
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	0.318	0.381

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
General Electricity Utility	0.461	0.381	0.368	0.339	0.425	0.418	0.384	0.375	0.464	0.525	0.531	0.505
PPS (average)	0.432	0.448	0.460	0.447	0.480	0.446	0.464	0.420	0.412	0.429	0.425	0.433
All power supplies in Tokyo (average)	0.460	0.383	0.372	0.345	0.428	0.420	0.388	0.378	0.461	0.519	0.523	0.499

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 allocated to the final demand sectors in accordance with the amount of power consumption).

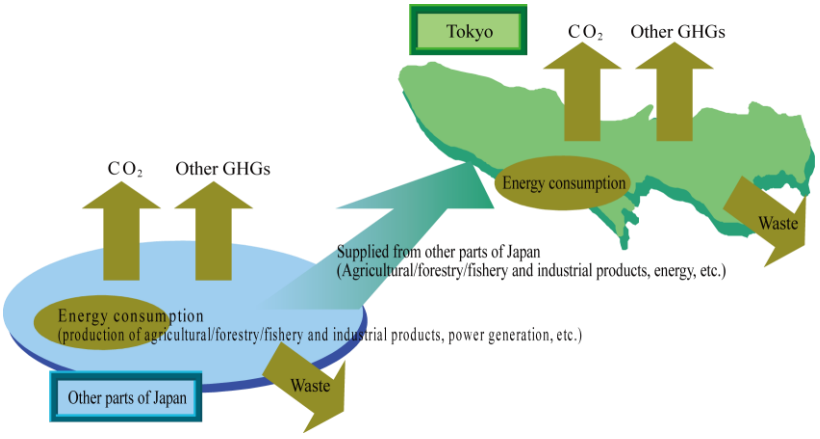


Figure 3-1 Image of GHG emissions in Tokyo

3.2 Total Greenhouse Gas Emissions

3.2.1 Entire Tokyo

▼ The total GHG emissions in FY 2014 stood at 67.2 million tons of CO_2 equivalent. This is 8.2% increase from 62.1 million tons in FY 2000, and 4.1% reduction from 70.1 million tons in FY 2013.

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

(Unit: 10,000 t-CO_2 eq)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
CO_2	5,444	5,734	5,855	5,675	5,913	5,820	5,689	5,751	5,679	5,771	5,889	5,670	6,321	6,768	6,188	6,167	5,755	6,511	6,285	5,894	5,874	6,108	6,577	6,548	6,212
CH_4	221	227	230	231	231	228	218	201	181	159	139	121	105	91	79	72	67	63	62	60	59	58	57	57	57
N_2O	83	89	90	81	86	90	95	96	96	100	98	94	94	92	87	88	80	72	70	65	58	57	56	53	54
HFCs						32	47	60	68	68	75	81	89	100	109	119	137	167	198	224	253	280	316	347	392
PFCs						32	33	40	35	9	5	4	4	4	0	0	0	0	0	0	0	0	0	0	0
SF_6						11	13	14	11	5	4	6	2	2	2	2	3	2	2	2	2	3	3	2	2
NF_3						1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	5,748	6,049	6,174	5,988	6,230	6,214	6,096	6,163	6,070	6,112	6,209	5,975	6,616	7,056	6,465	6,448	6,042	6,816	6,618	6,245	6,246	6,506	7,009	7,007	6,716

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

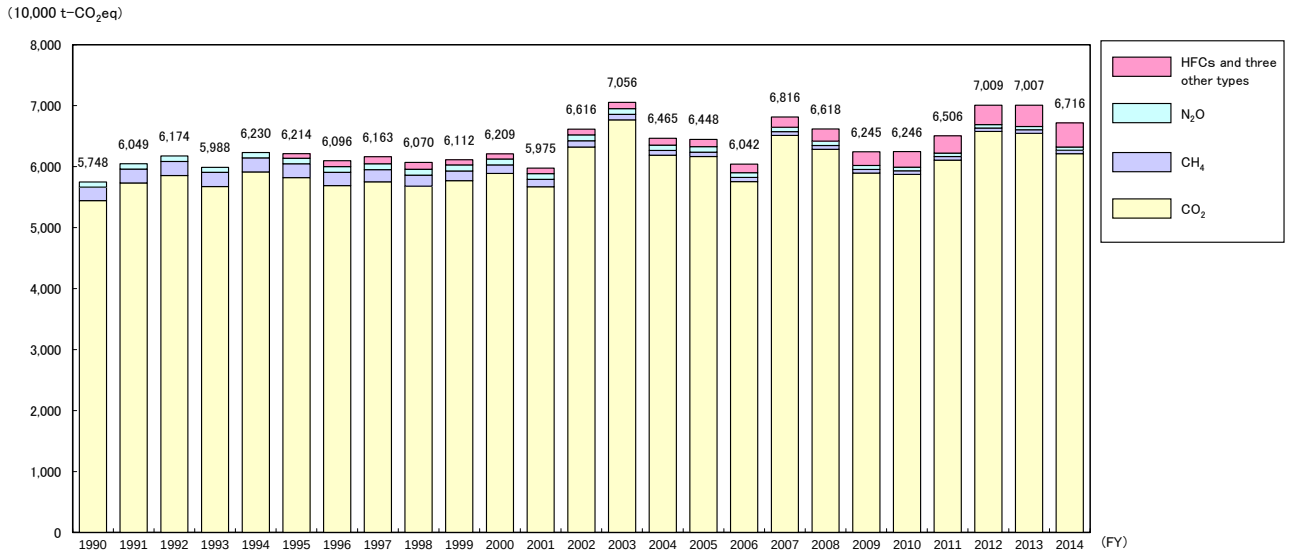


Figure 3-2 Trends in total GHG emissions in Tokyo [Variable cases]

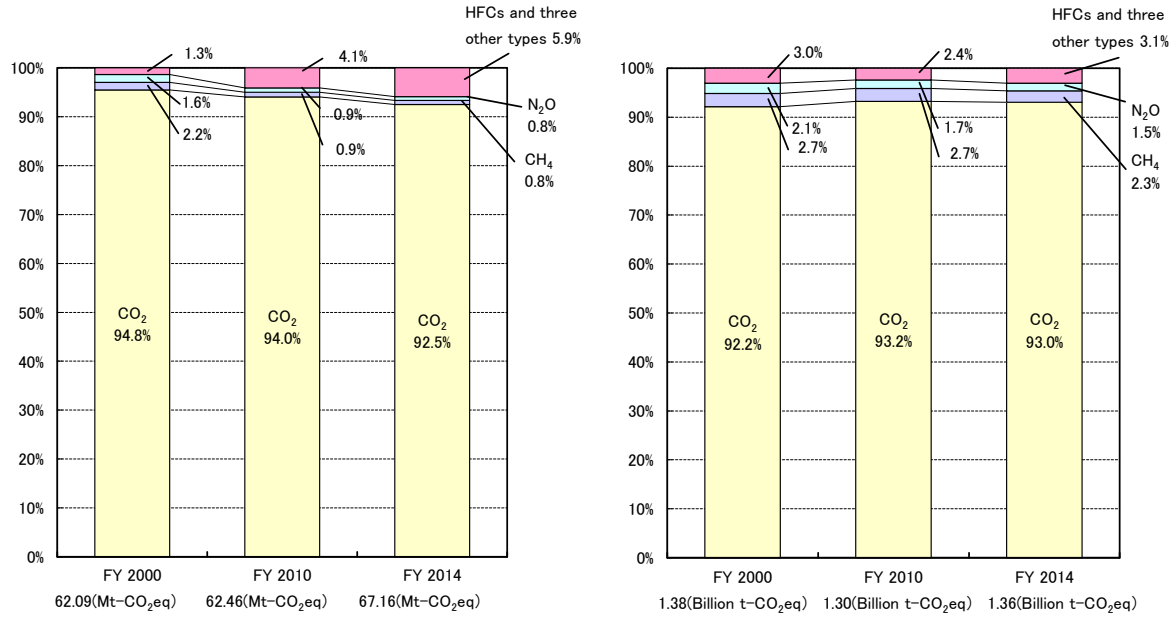
Table 3-6 (Reference) Trends in total GHG emissions in Tokyo [Fixed cases]

(Unit: 10,000 t-CO2 eq)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
CO_2	5,444	5,734	5,855	5,675	5,913	5,820	5,689	5,751	5,679	5,771	5,889	5,760	5,884	5,712	5,760	5,847	5,686	5,693	5,557	5,448	5,513	5,110	5,102	5,060	4,975
CH_4	221	227	230	231	231	228	218	201	181	159	139	121	105	91	79	72	67	63	62	60	59	58	57	57	57
N_2O	83	89	90	81	86	90	95	96	96	100	98	94	94	92	87	88	80	72	70	65	58	57	56	53	54
HFCs						32	47	60	68	68	75	81	89	100	109	119	137	167	198	224	253	280	316	347	392
PFCs						32	33	40	35	9	5	4	4	4	0	0	0	0	0	0	0	0	0	0	0
SF_6						11	13	14	11	5	4	6	2	2	2	2	3	2	2	2	2	3	3	2	2
NF_3						1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	5,748	6,049	6,174	5,988	6,230	6,214	6,096	6,163	6,070	6,112	6,209	6,066	6,178	6,000	6,037	6,128	5,973	5,998	5,889	5,799	5,885	5,508	5,534	5,519	5,479

Note: 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.

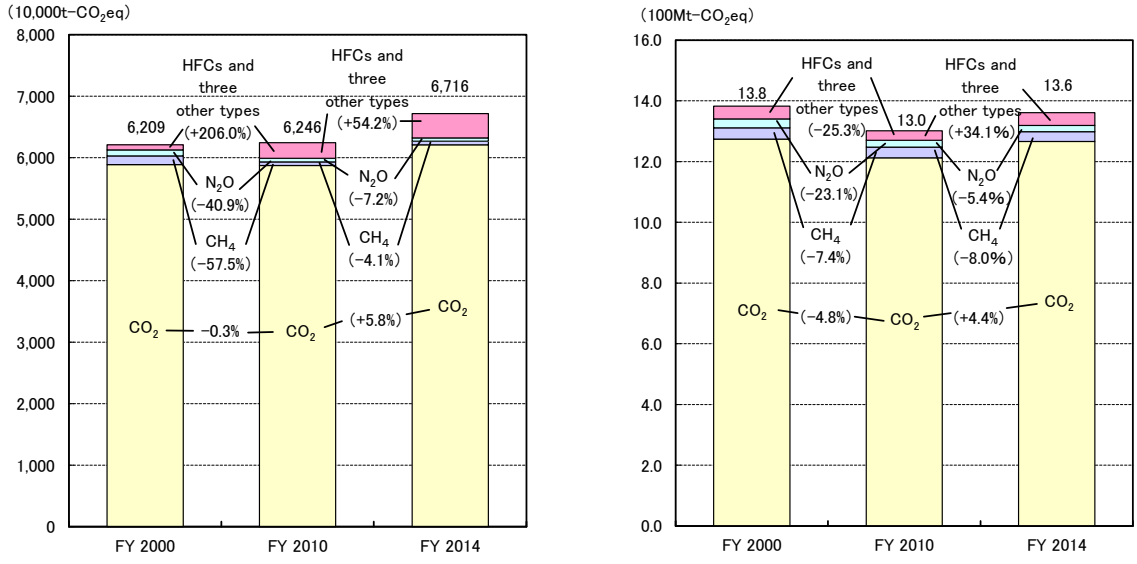
- In the total GHG emissions, CO_2 emissions account for 92.5% in FY 2014, which was 2.3-point reduction from FY 2000, and 1.5-point reduction from FY 2010.
- In comparison with the national shares by GHG in FY 2014, the share of 4 gases in Tokyo is larger than that in Japan (Japan 3.1%, Tokyo 5.9%).



Tokyo Japan

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

Source: Preliminary figures for Japan's GHG Emissions Data (FY 1990 - 2015), Greenhouse Gas Inventory Office of Japan



Tokyo 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 2010 from FY 2000, and increase in FY 2014 from FY 2010.
Source: Preliminary figures for Japan's GHG Emissions Data (FY 1990 - 2015), 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 2014 stood at 62.1 million tons. This is 5.5% increase from 58.9 million tons in FY 2000, and 5.1% reduction from 65.5 million tons in the previous fiscal year.
- ▼ The CO_2 emissions from electricity in FY 2014 increased by 16% from FY 2010, due to the deteriorated emission factor after the Great East Japan Earthquake.

Table 3-7 Total CO_2 emissions by sector and increases up to FY 2014 in Tokyo [Variable cases]

	CO_2 emissions (10,000 t-CO_2)							Increase rate (%)		
	FY 2000	FY 2005	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	Vs. 2000	vs. 2010	vs. 2013
Industrial sector	680	579	520	497	521	496	460	-32%	- 11%	-7.2%
Commercial sector	1,891	2,319	2,243	2,322	2,606	2,626	2,472	31%	10%	-5.9%
Residential sector	1,434	1,652	1,748	1,912	2,091	2,084	1,965	37%	12%	- 5.7%
Transport sector	1,765	1,518	1,206	1,219	1,198	1,170	1,157	- 34%	- 4.1%	-1.1%
Energy-derived CO_2 emissions	5,769	6,067	5,718	5,951	6,417	6,377	6,055	5.0%	5.9%	- 5.0%
Non-energy-derived CO_2 emissions	120	100	156	157	161	171	157	30%	0.3%	-8.5%
Total CO_2 emissions	5,889	6,167	5,874	6,108	6,577	6,548	6,212	5.5%	5.8%	- 5.1%

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 2014 in Tokyo [Variable cases]

	CO_2 emissions (10,000 t-CO_2)							Increase rate (%)		
	FY 2000	FY 2005	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	Vs. 2000	vs. 2010	vs. 2013
Electricity	2,698	3,268	3,392	3,719	4,230	4,261	3,946	46%	16%	-7.4%
City gas	926	1,047	967	923	924	906	891	-3.8%	-7.8%	-1.7%
LPG	196	158	116	124	103	102	125	-36%	8.4%	24%
Fuel oil	1,930	1,592	1,241	1,180	1,156	1,106	1,091	-43%	-12%	-1.4%
Other	19	3	1	6	3	2	3	-87%	70%	20%
Energy-derived CO_2 emissions	5,769	6,067	5,718	5,951	6,417	6,377	6,055	5.0%	5.9%	- 5.0%

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

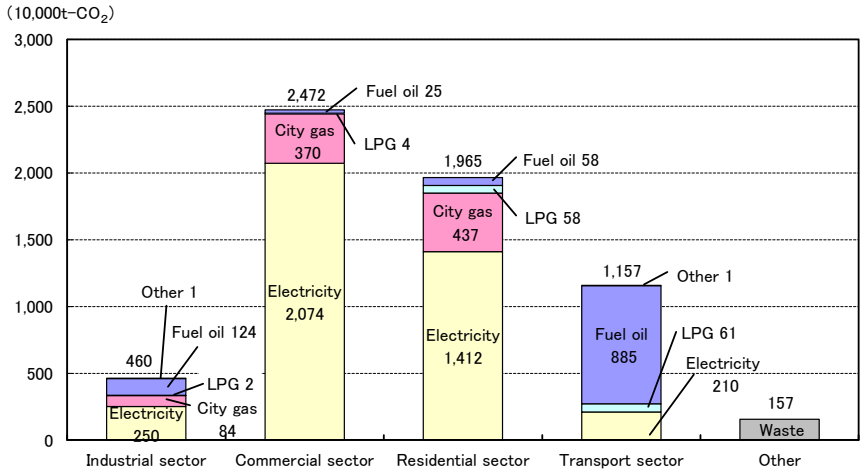


Figure 3-5 CO_2 emissions by sector in Tokyo (FY 2014) [Variable cases]

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:

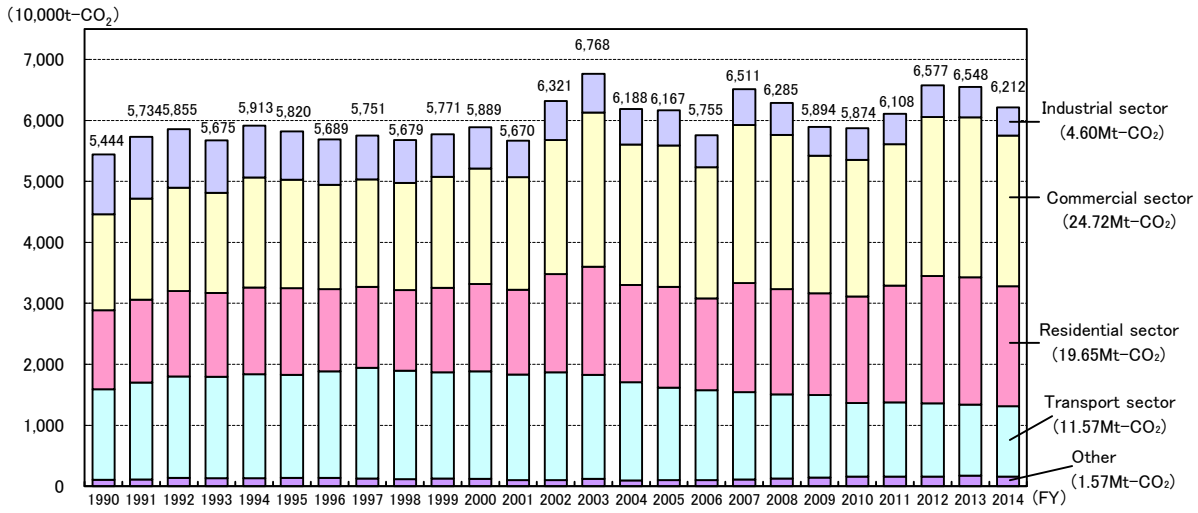


Figure 3-6 Trends in total CO_2 emissions by sector in Tokyo [Variable cases]

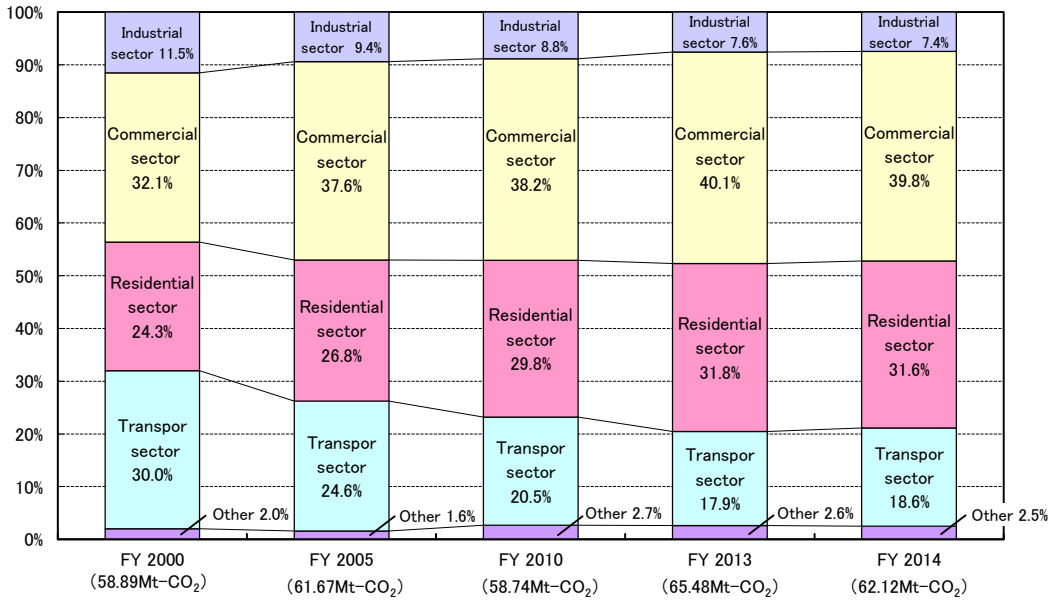


Figure 3-7 Composition ratios in total CO_2 emissions by sector in Tokyo [Variable cases]

Note 1: "Other" indicates CO_2 emissions from the incineration of waste.
Note 2: Tokyo does not count the "energy conversion sector" because Tokyo allocates CO_2 emissions from the energy conversion sector to the final demand sectors in accordance with the amount of power consumption.
Note 3: Tokyo does not count the "industrial process" due to the minimal CO_2 emissions from the industrial process and its difficulty of statistical grasp.

- In comparison with the national CO_2 emission structure by sector in FY 2014, Tokyo has a smaller share of the industrial sector (7.4% vs. 33% nationwide), and larger shares of the commercial sector (40% vs. 21% nationwide) and the residential sector (32% vs. 15% nationwide).

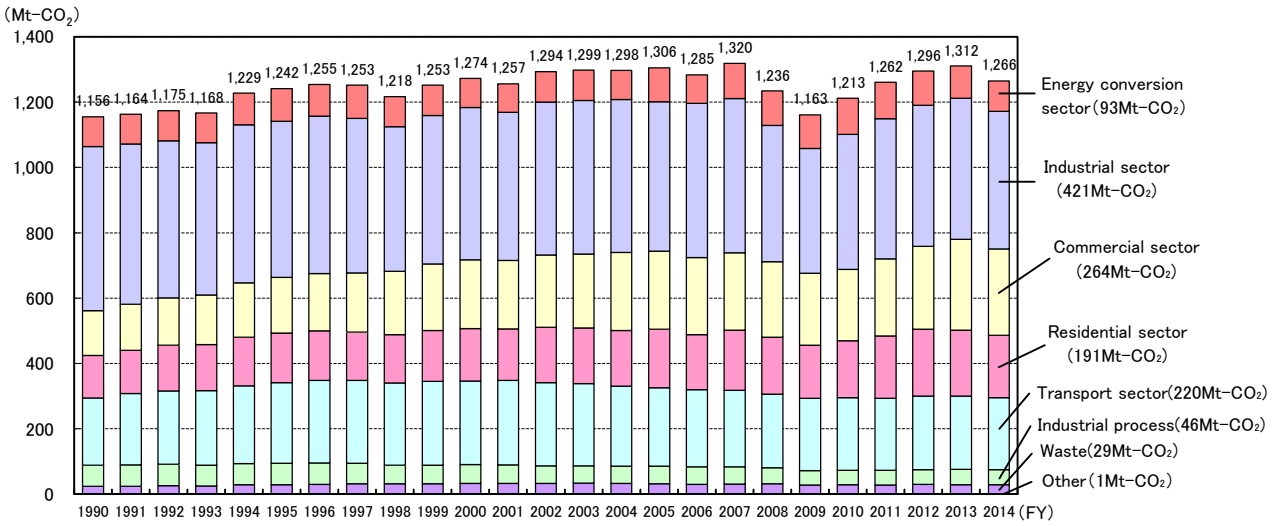


Figure 3-8 Trends in CO_2 emissions in Japan

Source: Preliminary figures for Japan's GHG Emissions Data (FY 1990 - 2015), Greenhouse Gas Inventory Office of Japan

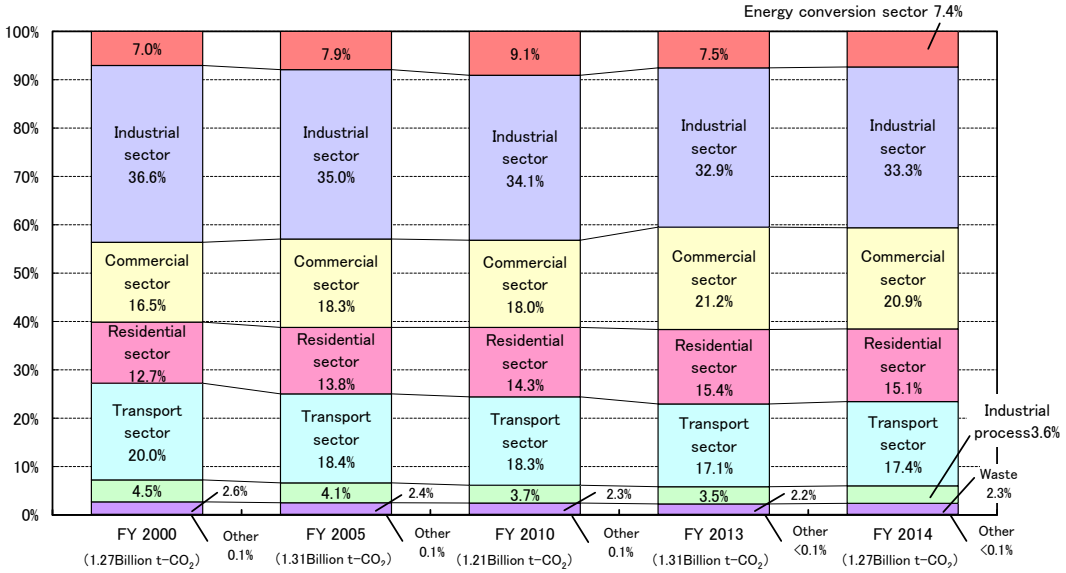


Figure 3-9 Composition ratios in CO_2 emissions in Japan

Source: Preliminary figures for Japan's GHG Emissions Data (FY 1990 - 2015), 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:

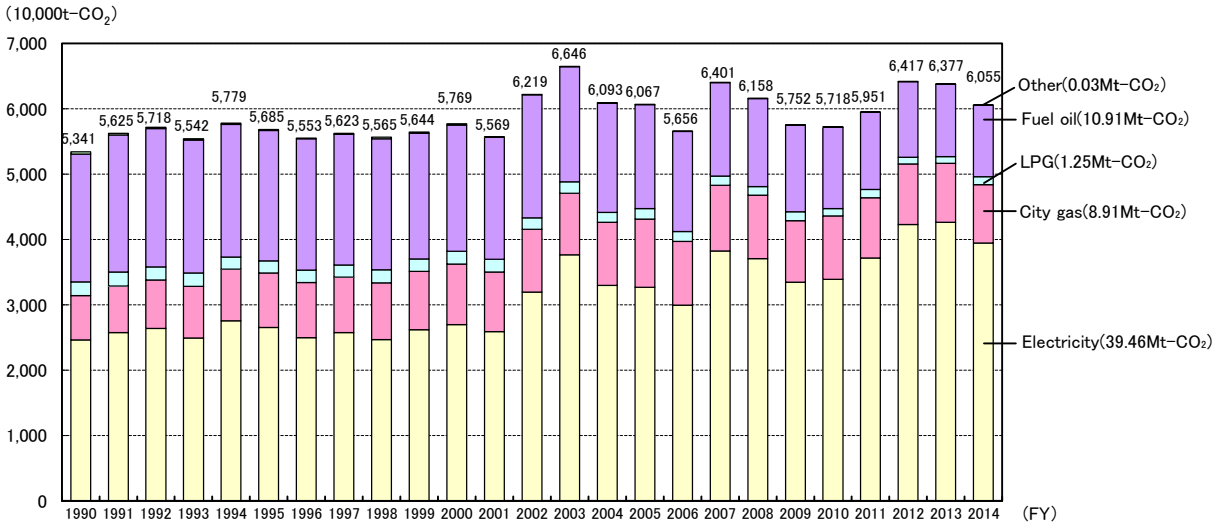


Figure 3-10 Trends in energy-derived CO_2 emissions by fuel type in Tokyo [Variable cases]

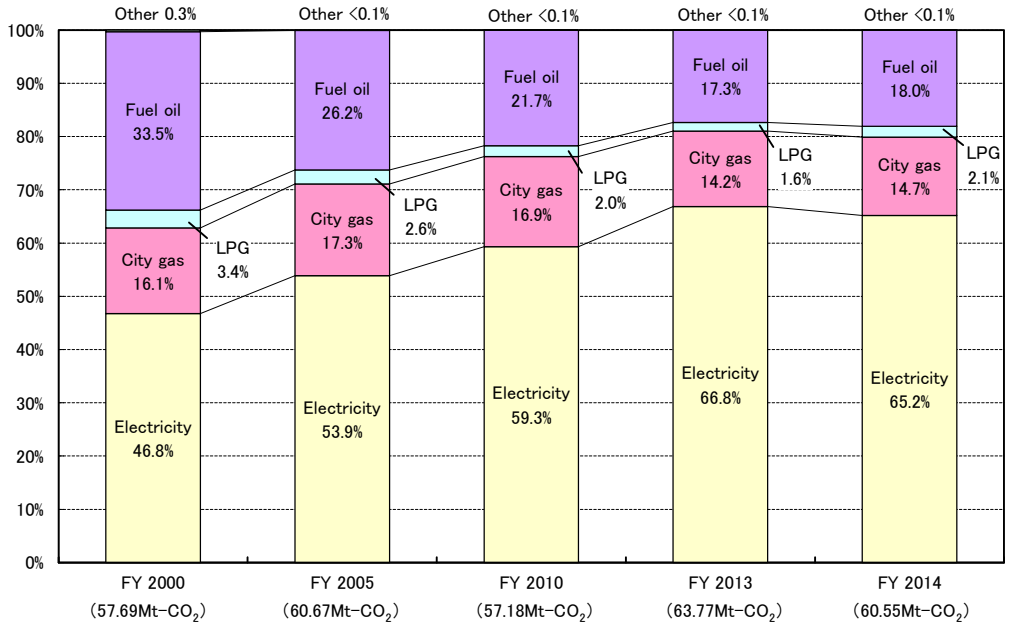


Figure 3-11 Composition ratios in energy-derived CO_2 emissions by fuel type in Tokyo [Variable cases]

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 2014 stood at 49.8 million tons. This is 16% reduction from 58.9 million tons in FY 2000, and 1.7% reduction from 50.6 million tons in the previous fiscal year.
- ▼ The CO_2 emissions from electricity in FY 2014 decreased by 11% from FY 2010, due to the exclusion of influence of the deteriorated emission factor after the Great East Japan Earthquake.

Table 3-9 Total CO_2 emissions by sector and increases up to FY 2014 in Tokyo [Fixed cases]

	CO_2 emissions (10,000 t-CO_2)							Increase rate (%)		
	FY 2000	FY 2005	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	Vs. 2000	vs. 2010	vs. 2013
Industrial sector	680	553	495	430	426	402	385	- 43%	- 22%	- 4.2%
Commercial sector	1,891	2,158	2,078	1,849	1,888	1,910	1,880	-0.6%	- 9.6%	-1.6%
Residential sector	1,434	1,536	1,597	1,510	1,512	1,492	1,471	2.6%	- 7.9%	- 1.4%
Transport sector	1,765	1,501	1,186	1,163	1,115	1,085	1,084	- 39%	- 8.7%	- 0.2%
Energy-derived CO_2 emissions	5,769	5,748	5,357	4,952	4,941	4,889	4,819	- 16%	-10%	- 1.4%
Non-energy-derived CO_2 emissions	120	100	156	157	161	171	157	30%	0.3%	-8.5%
Total CO_2 emissions	5,889	5,847	5,513	5,110	5,102	5,060	4,975	- 16%	- 9.8%	- 1.7%

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 2014 in Tokyo [Fixed cases]

	CO_2 emissions (10,000 t-CO_2)							Increase rate (%)		
	FY 2000	FY 2005	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	Vs. 2000	vs. 2010	vs. 2013
Electricity	2,698	2,948	3,031	2,720	2,755	2,773	2,709	0.4%	- 11%	-2.3%
City gas	926	1,047	967	923	924	906	891	- 3.8%	- 7.8%	- 1.7%
LPG	196	158	116	124	103	102	125	- 36%	8.4%	24%
Fuel oil	1,930	1,592	1,241	1,180	1,156	1,106	1,091	- 43%	- 12%	- 1.4%
Other	19	3	1	6	3	2	3	- 87%	70%	20%
Energy-derived CO_2 emissions	5,769	5,748	5,357	4,952	4,941	4,889	4,819	- 16%	-10%	- 1.4%

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

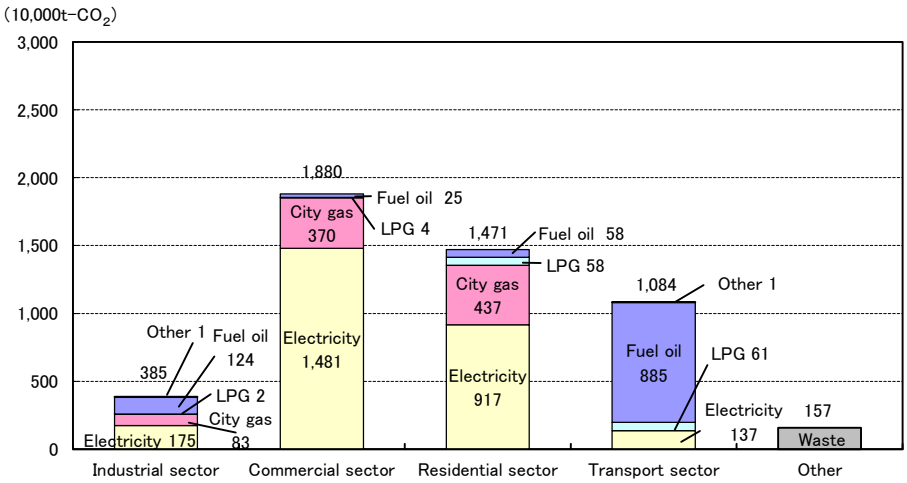


Figure 3-12 CO_2 emissions by sector in Tokyo (FY 2014) [Fixed cases]

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:

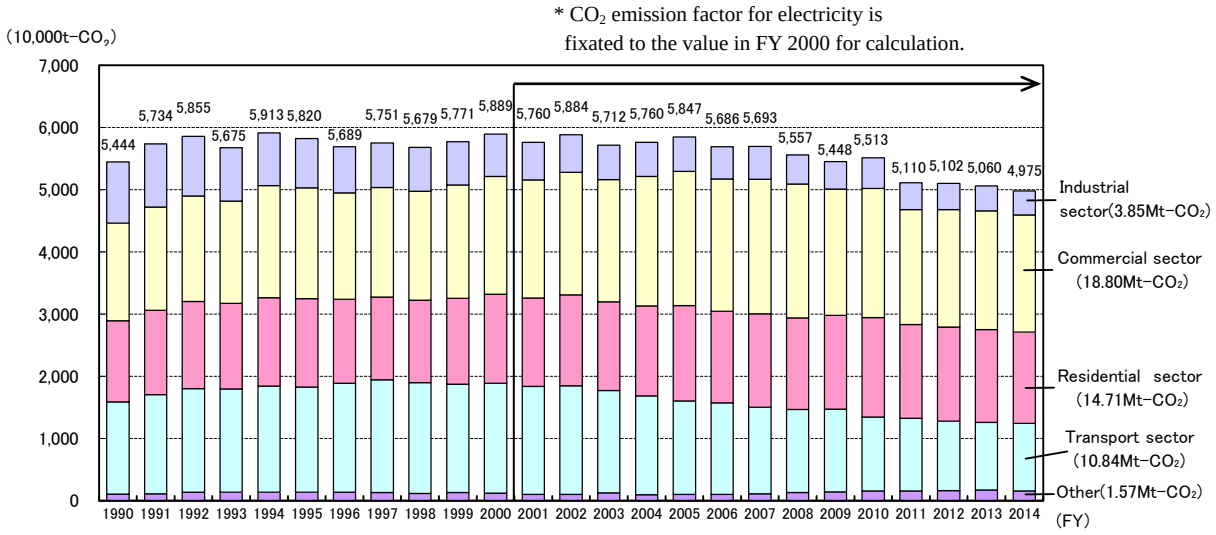


Figure 3-13 Trends in total CO_2 emissions by sector in Tokyo [Fixed cases]

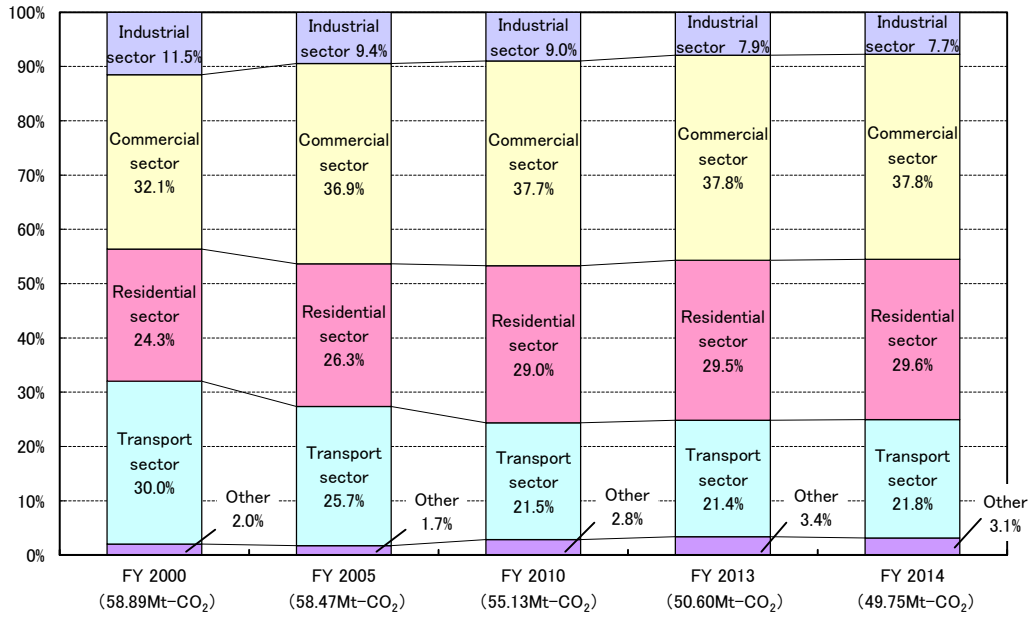


Figure 3-14 Composition ratios in total CO_2 emissions by sector in Tokyo [Fixed cases]

Note 1: "Other" indicates CO_2 emissions from the incineration of waste.
Note 2: Tokyo does not count the "energy conversion sector" because Tokyo allocates CO_2 emissions from the energy conversion sector to the final demand sectors in accordance with the amount of power consumption.
Note 3: Tokyo does not count the "industrial process" due to the minimal CO_2 emissions from the industrial process and its difficulty of statistical grasp.

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:

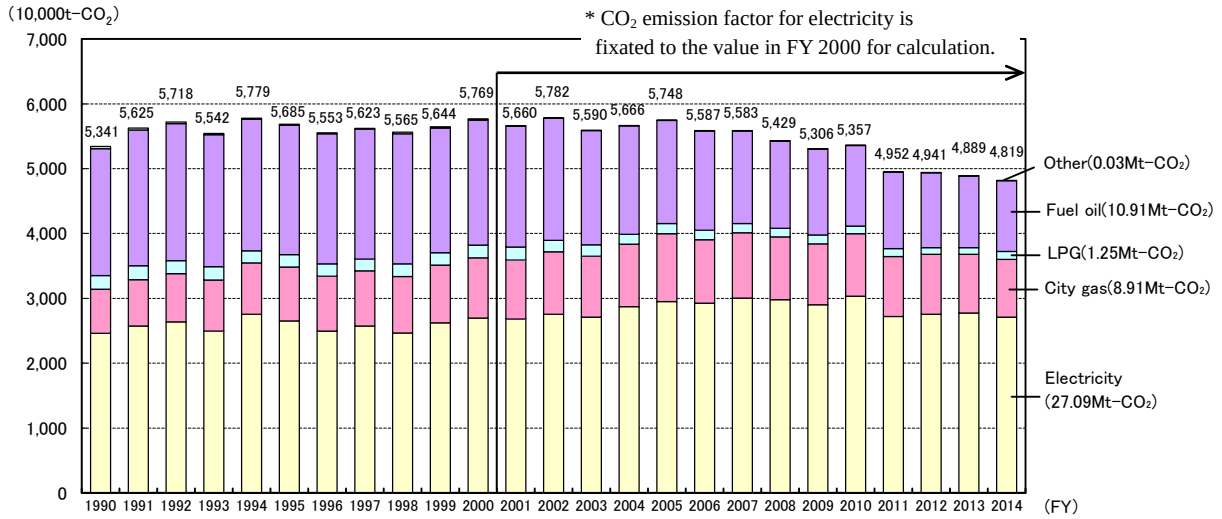


Figure 3-15 Trends in energy-derived CO_2 emissions by fuel type in Tokyo [Fixed cases]

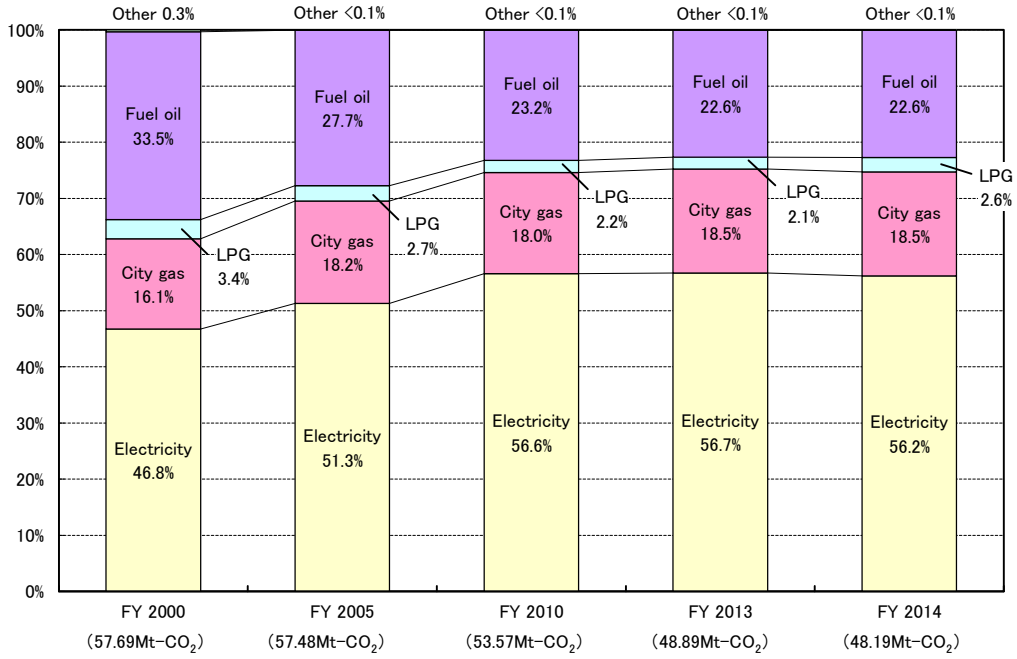


Figure 3-16 Composition ratios in energy-derived CO_2 emissions by fuel type in Tokyo [Fixed cases]

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:

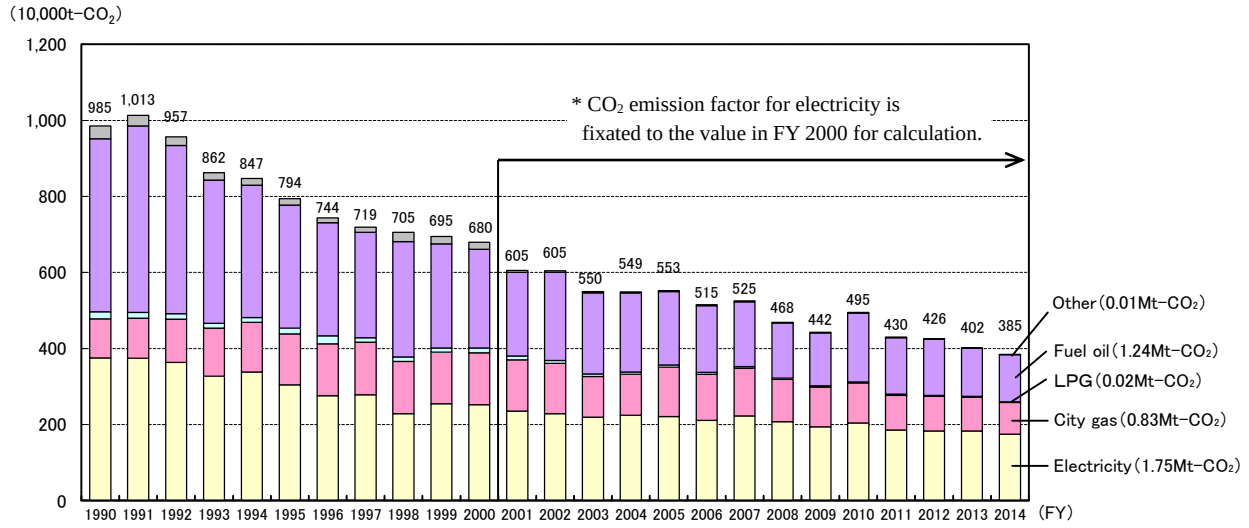


Figure 3-17 Trends in CO_2 emissions in the industrial sector [Fixed cases]

3.4.2-2 Commercial Sector

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

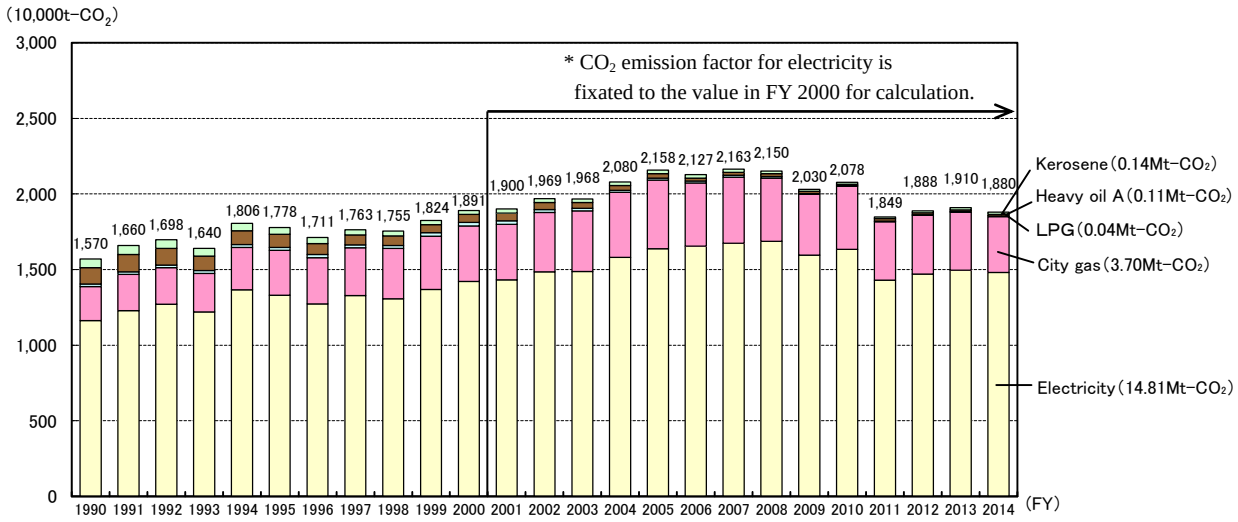


Figure 3-18 Trends in CO_2 emissions in the commercial sector [Fixed cases]

3.4.2-3 Residential Sector

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

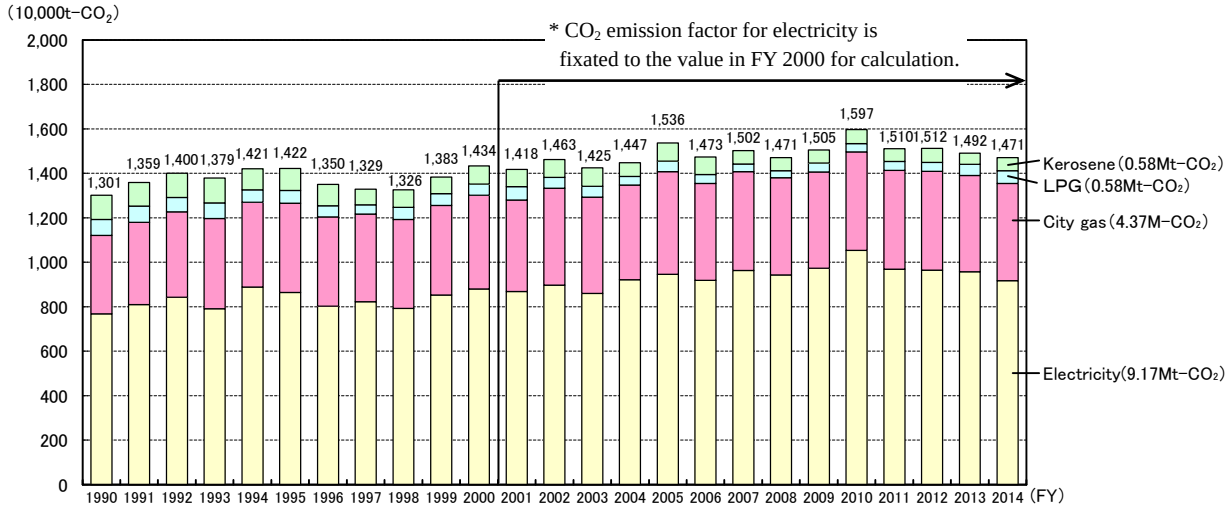


Figure 3-19 Trends in CO_2 emissions in the residential sector [Fixed cases]

3.4.2-4 Transport Sector

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

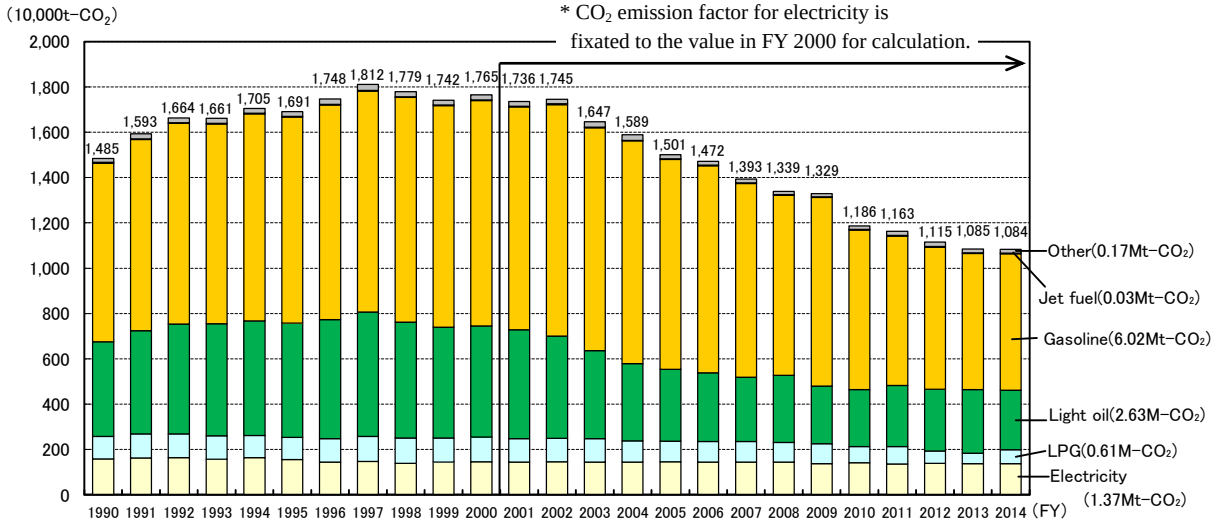


Figure 3-20 Trends in CO_2 emissions in the transport sector [Fixed cases]

3.5 Other GHG Emissions

3.5.1 Overview

3.5.1-1 Trends in Other GHG Emissions

(Tokyo)

- Other GHG emissions in FY 2014 stood at 5.0 million t-CO_2eq, which was 57% increase from 3.2 million t-CO_2eq in FY 2000, and 35% increase from 3.7 million t-CO_2eq in FY 2010.
- HFCs increased by 60% from FY 2000 to FY 2005, 112% from FY 2005 to FY 2010, and 55% from FY 2010 to FY 2014. 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.
- CH_4 and NO_2 have shown a downward trend since FY 2000.

(Japan)

- Other GHG emissions in Japan in FY 2014 stood at 95.1 million t-CO_2eq, which was 12% reduction from 108 million t-CO_2eq in FY 2000, and 7.6% increase from 88.4 million t-CO_2eq in FY 2010.
- HFCs have declined by 44% from FY 2000 to FY 2005 due to a decrease in emissions of HFC-23, which is a by-product in manufacturing specific freon HCFC-22. Since then, due to an increase in the use of CFC substitute HFCs as a refrigerant application, it has increased by 82% from FY 2005 to FY 2010 and by 54% from FY 2010 to FY 2014.
- CH_4, NO_2, PFCs and SF_6 have shown a downward trend since FY 2000. On the other hand, NF_3 has shown a upward trend from FY 2000 to FY 2010, but in recent years there is a sign that starts to decrease.

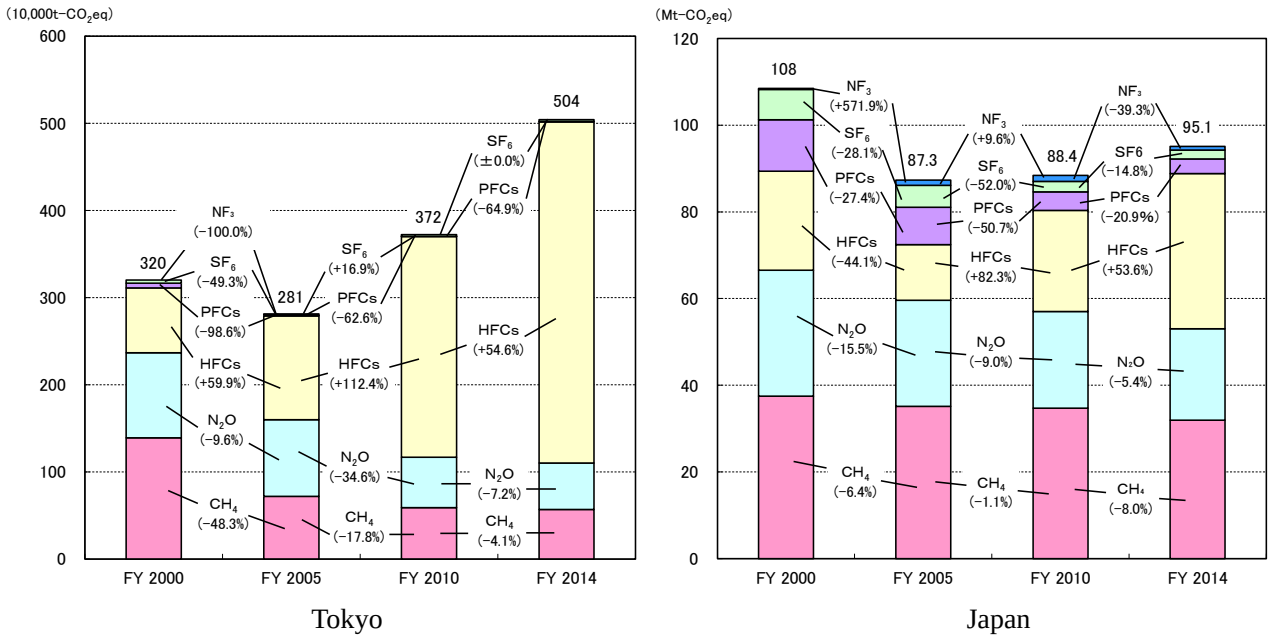


Figure 3-21 Increase rates by GHG (other GHGs) in Tokyo and in Japan

Note: The values in brackets respectively indicate increase in FY 2005 from FY 2000, increase in FY 2010 from FY 2005, and increase in FY 2014 from FY 2010.
Source: Preliminary figures for Japan's GHG Emissions Data (FY 1990 – 2015), Greenhouse Gas Inventory Office of Japan

3.5.1-2 Composition Ratios in Other GHG Emissions

- In Tokyo, HFCs accounted for 78% of other GHG emissions in FY 2014, followed by CH_4 (11%), N_2O (11%), SF_6 (0.4%), and PFCs (< 1%).
- In Japan, HFCs accounted for 38% of other GHG emissions in FY 2014, followed by CH_4 (34%), N_2O (22%), PFCs (3.5%), SF_6 (2.2%), and NF_3 (0.9%).
- Compared to the nationwide composition ratios of other GHG emissions in FY 2014, Tokyo sees a larger share of HFCs, and accordingly smaller shares of the other gases.

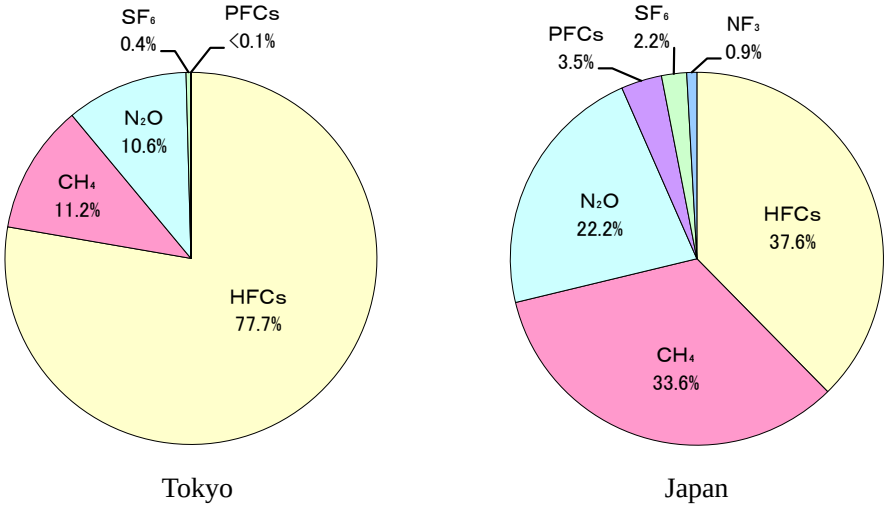


Figure 3-22 Composition ratios of other GHG emissions in Tokyo and in Japan (FY 2014)

Source: Preliminary figures for Japan's GHG Emissions Data (FY 1990 - 2015), Greenhouse Gas Inventory Office of Japan

3.5.1-3 Shares of Other GHG Emissions in Japan

- Other GHG emissions in FY 2014 in Tokyo account for approximately 5.3% in Japan.
- By the type of gas, Tokyo takes up the largest share in Japan with HFCs (11%), followed by N_2O (2.5%) and CH_4 (1.8%). Tokyo's shares are minimal for PFCs, SF_6, and NF_3.

Table 3-11 Comparison of other GHG emissions in Tokyo and in Japan (FY 2014)

(Unit: 10,000 t-CO_2 eq)

	Tokyo	Japan	vs. Japan
CH_4	57	3,194	1.8%
N_2O	54	2,110	2.5%
HFCs	392	3,578	10.9%
PFCs	0	336	0.0%
SF_6	2	207	1.0%
NF_3	0	83	0.0%
Total	504	9,508	5.3%

Source: Preliminary figures for Japan's GHG Emissions Data (FY 1990 - 2015), 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 2014 are indicated below.
- In Tokyo, 95% of CH_4 emissions are derived from waste. "Waste" mainly refers to emissions from landfill sites (inner and outer central breakwater landfill sites) and from sewage treatment.

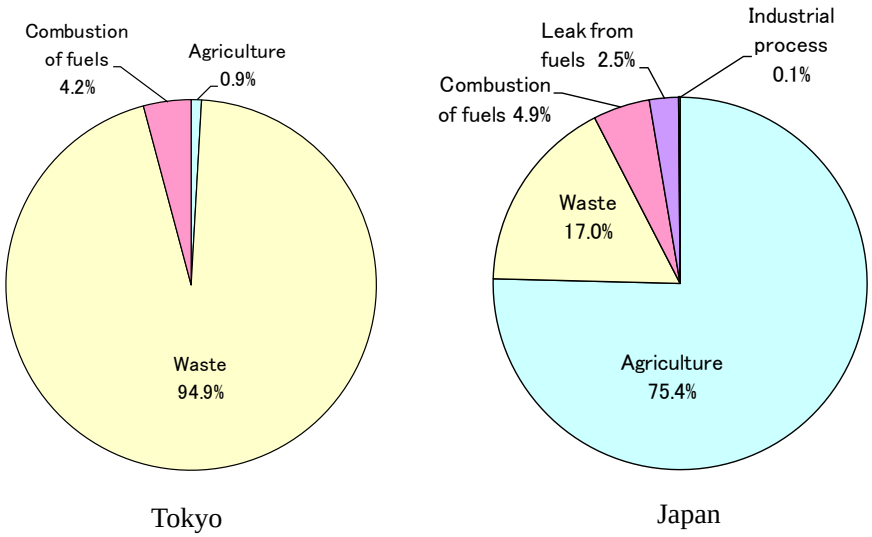


Figure 3-23 Composition ratios of CH_4 emissions in Tokyo and in Japan (FY 2014)

Source: Preliminary figures for Japan's GHG Emissions Data (FY 1990 - 2015), 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 2014 are indicated below.
- In Tokyo, 81% of N_2O emissions are derived from waste. "Waste" mainly refers to emissions from the incineration of waste (general/industrial) and sewage treatment.

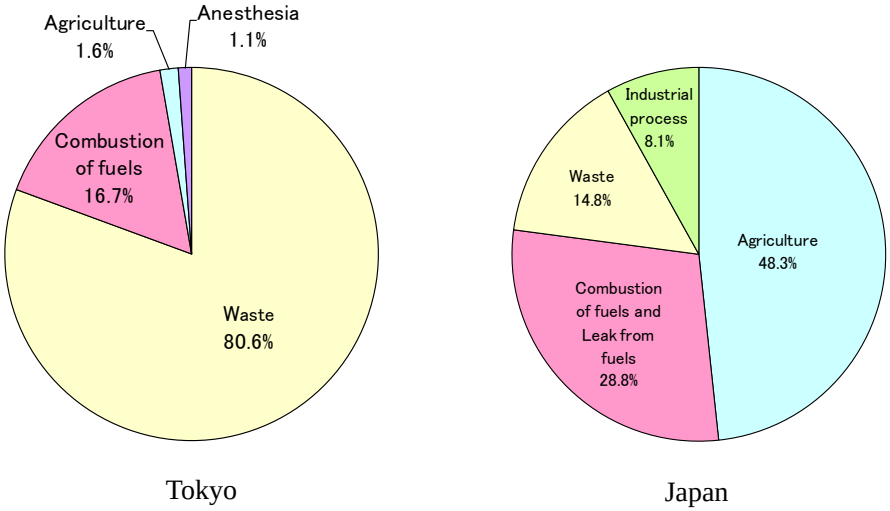


Figure 3-24 Composition ratios of N_2O emissions in Tokyo and in Japan (FY 2014)

Source: Preliminary figures for Japan's GHG Emissions Data (FY 1990 - 2015), Greenhouse Gas Inventory Office of Japan

3.5.4 HFCs and Three Other Types

- The composition ratios of HFCs and three other types of emissions in Tokyo and in Japan in FY 2014 are indicated below.
- In Tokyo, 92% of the emissions of these four gases are HFCs derived from coolants. "Coolants" mainly refers to emissions at the time of production, use, 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 semiconductors and LCDs", "Leak from manufacturing of HFCs and three other types", and "Metal production", etc. are excluded from the emission statistics of Tokyo, because the relevant factories are considered to be very rare in Tokyo.
- 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) which took effect on April 1, 2015, but TMG excluded NF_3 from the emission statistics of Tokyo, because the relevant factories are considered to be very rare in Tokyo.

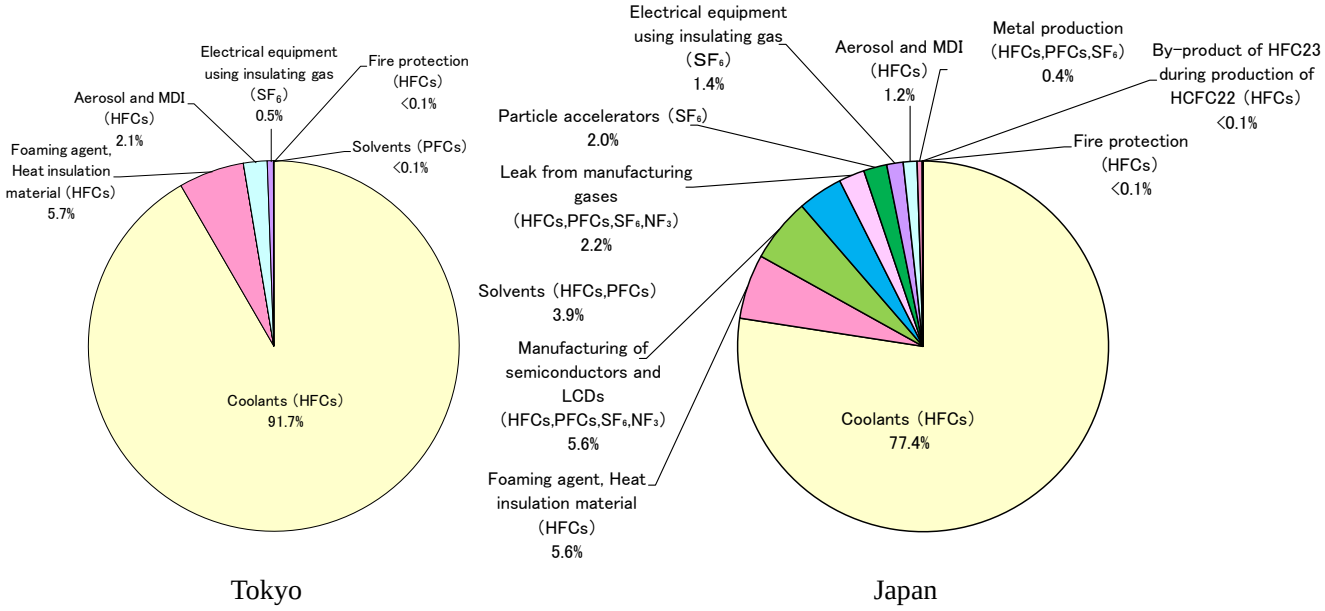


Figure 3-25 Composition ratios of HFCs and three other types of emissions in Tokyo and in Japan (FY 2014)

Source: Preliminary figures for Japan's GHG Emissions Data (FY 1990 - 2015), Greenhouse Gas Inventory Office of Japan

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 sector	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 sector	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 sector	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 family cars 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 sector	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.	• TMG "Traffic and CO_2 emissions by car type and by fuel type"
	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 sector	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 "

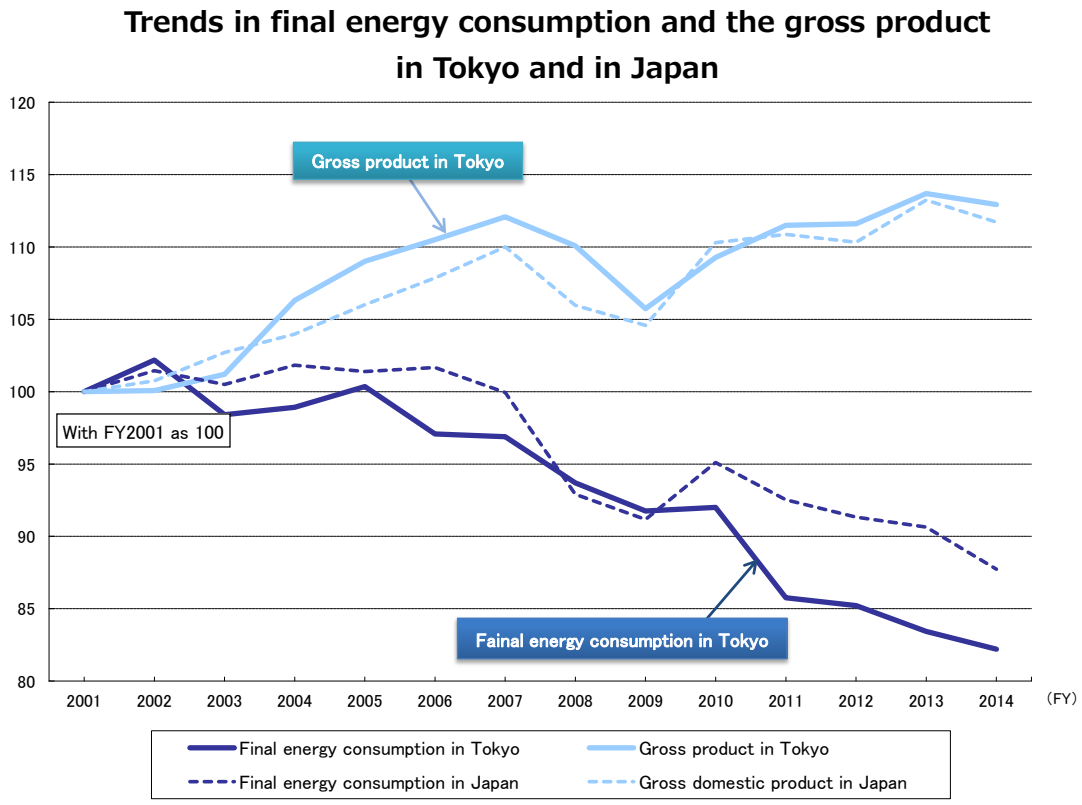
(3) Other GHGs

■ 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 the gas generated from waste landfill sites. The emissions at inner and outer central breakwater landfill sites are estimated using a model that assumes a state of the successive resolution of the waste.	• 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 three other types (HFCs, PFCs, SF_6, and NF_3)	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 vigorous sustainable 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 Environment 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 "Prefectural Accounts of Tokyo"
Cabinet Office "System of National Accounts (GDP Statistics)"
Agency for Natural Resources and Energy "Energy Supply and Demand Performance"

[Material 3] Greenhouse Gas Reduction Target and Energy Reduction Target in Tokyo

- For greenhouse gas emissions, TMG sets the reduction target as a medium-term transit point configuration based on the reduced level of long-term required in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (October 2014), etc.
- For energy consumption, TMG sets the energy saving target at a level necessary to achieve the greenhouse gas reduction target.

Greenhouse gas reduction target

Reducing Tokyo's greenhouse gas emissions by 30% from the year 2000 level by the year 2030

＜Targets by Sectors＞ by the year 2030

- Reduction by about 20% from the year 2000 level in the industrial and commercial sectors (about 20% reduction in the commercial sector)
- Reduction by about 20% from the year 2000 level in the residential sector
- Reduction by about 60% from the year 2000 level in the transport sector

Estimation results of greenhouse gas emissions (Unit: Mt-CO_2 eq)

	2000	2014	vs. 2000	2030 (target)	vs. 2000
Energy-derived CO_2 emissions	57.7	60.6	5.0%	38.8	- 33%
Industrial and commercial sector	25.7	29.3	14%	20.1	- 22%
Industrial sector	6.8	4.6	- 32%	4.2	- 38%
Commercial sector	18.9	24.7	31%	16.0	- 15%
Residential sector	14.3	19.7	37%	11.1	- 23%
Transport sector	17.7	11.6	- 34%	7.6	- 57%
Other gases	4.4	6.6	50%	4.9	11%
Total GHG emissions	62.1	67.2	8.2%	43.7	- 30%

Note 1: The CO_2 emission factor for electricity in 2030 is 0.37kg-CO_2/kWh which is a voluntary target value of electric power industry based on the Long-term Energy Supply and Demand Outlook by the Government (July 2015).
Note 2: Other gases: Non-energy-derived CO_2 emissions, CH_4, N_2O, HFCs and three other types (HFCs, PFCs, SF_6, and NF_3)

Energy reduction target

Reducing Tokyo's energy consumption by 38% from the year 2000 level by the year 2030

＜Targets by Sectors＞ by the year 2030

- Reduction by about 30% from the year 2000 level in the industrial and commercial sectors (about 20% reduction in the commercial sector)
- Reduction by about 30% from the year 2000 level in the residential sector
- Reduction by about 60% from the year 2000 level in the transport sector

Estimation results of energy consumption (Unit: PJ)

	2000	2014	vs. 2000	2030 (target)	vs. 2000
Industrial and commercial sector	342	284	- 17%	246	- 28%
Industrial sector	97	53	- 45%	57	- 41%
Commercial sector	245	231	- 6.0%	189	- 23%
Residential sector	202	208	2.8%	144	- 29%
Transport sector	257	154	- 40%	105	- 59%
Total energy consumptions	801	646	- 19%	495	- 38%

5 Figures and Tables

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Final Energy Consumption and Greenhouse Gas Emissions in Tokyo
(FY 2014)

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(Comprehensive website on countermeasures against climate change, Tokyo)