

Attachment: Factors (calorific value, emission factor, etc.)

Fuel type						
Fuel type	Fuel form	Unit	FY2013 Unit calorific value [GJ/unit]	FY2014 Unit calorific value [GJ/unit]	FY2015 Unit calorific value [GJ/unit]	FY2016 Unit calorific value [GJ/unit]
Imported coking coal	Solid	t	28.7	28.7	28.7	28.7
Domestic general coal	Solid	t	25.3	25.3	25.3	25.3
Imported general coal	Solid	t	26.0	26.0	26.0	26.0
Imported anthracite	Solid	t	27.8	27.8	27.8	27.8
Coke	Solid	t	29.2	29.2	29.2	29.2
Crude oil	Liquid	kl	38.2	38.2	38.2	38.2
Gasoline	Liquid	kl	33.4	33.4	33.4	33.4
Naphtha	Liquid	kl	33.3	33.3	33.3	33.3
Jet fuel	Liquid	kl	36.3	36.3	36.2	36.3
Kerosene	Liquid	kl	36.5	36.5	36.5	36.5
Diesel fuel	Liquid	kl	38.0	38.0	38.0	38.0
Heavy fuel oil A	Liquid	kl	38.9	38.9	38.9	38.9
Heavy fuel oil B	Liquid	kl	40.4	40.4	40.4	40.4
Heavy fuel oil C	Liquid	kl	41.2	40.9	41.4	41.0
Lubricating oil	Liquid	kl	40.2	40.2	40.2	40.2
Oil coke	Solid	t	33.3	33.3	33.3	33.3
LPG	Gas	t	50.1	50.1	50.1	50.1
Natural gas	Gas	1,000 Nm ³	43.3	43.3	43.3	43.3
LNG	Gas	t	54.5	54.5	54.5	54.5
City gas	Gas	1,000 Nm ³	44.5	44.5	44.4	44.4
NGL condensate	Liquid	kl	34.8	34.7	34.6	34.8
Refinery gas	Gas	1,000 Nm ³	50.3	50.3	50.3	50.3
Coke furnace gas	Gas	1,000 Nm ³	20.6	20.6	20.6	20.6
Blast furnace gas	Gas	1,000 Nm ³	3.5	3.5	3.5	3.5
Linz-Donawitz converter gas	Gas	1,000 Nm ³	8.2	8.2	8.2	8.2

Fuel unit calorific values (continued)

Fuel type	Fuel form	Unit	FY2017 Unit calorific value [GJ/unit]	FY2018 Unit calorific value [GJ/unit]	FY2019 Unit calorific value [GJ/unit]
Imported coking coal	Solid	t	28.7	28.7	28.7
Domestic general coal	Solid	t	25.3	24.2	24.2
Imported general coal	Solid	t	26.0	26.1	26.1
Imported anthracite	Solid	t	27.8	27.8	27.8
Coke	Solid	t	29.2	29.0	29.0
Crude oil	Liquid	kl	38.2	38.2	38.1
Gasoline	Liquid	kl	33.4	33.4	33.4
Naphtha	Liquid	kl	33.3	33.3	33.3
Jet fuel	Liquid	kl	36.4	36.4	36.3
Kerosene	Liquid	kl	36.5	36.5	36.5
Diesel fuel	Liquid	kl	38.0	38.0	38.0
Heavy fuel oil A	Liquid	kl	38.9	38.9	38.9
Heavy fuel oil B	Liquid	kl	40.4	40.4	40.4
Heavy fuel oil C	Liquid	kl	41.0	41.1	41.0
Lubricating oil	Liquid	kl	40.2	40.2	40.2
Oil coke	Solid	t	33.3	33.3	33.3
LPG	Gas	t	50.1	50.1	50.1
Natural gas	Gas	1,000 Nm ³	43.3	41.9	41.9
LNG	Gas	t	54.5	54.7	54.7
City gas	Gas	1,000 Nm ³	44.5	43.6	43.6
NGL condensate	Liquid	kl	34.5	34.5	34.6
Refinery gas	Gas	1,000 Nm ³	50.3	50.3	50.3
Coke furnace gas	Gas	1,000 Nm ³	20.6	20.1	20.1
Blast furnace gas	Gas	1,000 Nm ³	3.5	3.5	3.5
Linz-Donawitz converter gas	Gas	1,000 Nm ³	8.2	8.2	8.2

Fuel unit calorific values (continued)

Fuel type	Fuel form	Unit	FY2020 Unit calorific value [GJ/unit]	Conversion factor (High⇒low calorific value)
Imported coking coal	Solid	t	28.8	0.921
Domestic general coal	Solid	t	24.2	0.943
Imported general coal	Solid	t	26.1	0.951
Imported anthracite	Solid	t	27.8	0.967
Coke	Solid	t	29.0	0.977
Crude oil	Liquid	kl	38.1	0.941
Gasoline	Liquid	kl	33.4	0.939
Naphtha	Liquid	kl	33.3	0.938
Jet fuel	Liquid	kl	36.3	0.938
Kerosene	Liquid	kl	36.5	0.939
Diesel fuel	Liquid	kl	38.0	0.940
Heavy fuel oil A	Liquid	kl	38.9	0.944
Heavy fuel oil B	Liquid	kl	40.4	0.950
Heavy fuel oil C	Liquid	kl	41.1	0.950
Lubricating oil	Liquid	kl	40.2	0.944
Oil coke	Solid	t	33.3	0.985
LPG	Gas	t	50.1	0.927
Natural gas	Gas	1,000 Nm ³	41.9	0.911
LNG	Gas	t	54.7	0.911
City gas	Gas	1,000 Nm ³	43.6	0.912
NGL condensate	Liquid	kl	34.6	0.937
Refinery gas	Gas	1,000 Nm ³	50.3	0.920
Coke furnace gas	Gas	1,000 Nm ³	20.1	0.897
Blast furnace gas	Gas	1,000 Nm ³	3.5	0.978
Linz-Donawitz converter gas	Gas	1,000 Nm ³	8.2	0.998

[Sources]

- Unit calorific values: Some units are converted by the secretariat based on detailed tables in the Agency for Natural Resources and Energy's annual "Comprehensive Energy Statistics (Energy Balance Table)"
- Conversion factors: Calculated by the secretariat based on the Agency for Natural Resources and Energy's "Standard Calorific Values and Carbon Emission Factors by Energy Source" (revised January 2020) and "Explanation of Standard Calorific Values and Carbon Emission Factors by Energy Source (revised FY2018)" (January 2020) (however, the lower calorific value was unknown for heavy oil B, so the conversion factor for heavy oil C was used)

[Notes]

- Unit calorific values are shown as the higher calorific value (gross calorific value).
- The higher calorific value (gross calorific value) can be converted to the lower calorific value (true calorific value) by multiplying the higher calorific value by the conversion factor for each fuel type in the top table. Conversely, the lower calorific value can be converted to the higher calorific value by dividing the lower calorific value by the conversion factor for each fuel type in the top table.
- LPG and LNG: These are generally gases during use, so they are categorized as gases.
- Natural gas: This is natural gas produced domestically, excluding LNG.

Fuel emissions factor

Fuel type	Fuel form	FY2013 Emission factor [t-CO ₂ /GJ]	FY2014 Emission factor [t-CO ₂ /GJ]	FY2015 Emission factor [t-CO ₂ /GJ]	FY2016 Emission factor [t-CO ₂ /GJ]
Imported coking coal	Solid	0.0902	0.0902	0.0902	0.0902
Domestic general coal	Solid	0.0869	0.0869	0.0869	0.0869
Imported general coal	Solid	0.0895	0.0895	0.0895	0.0895
Imported anthracite	Solid	0.0950	0.0950	0.0950	0.0950
Coke	Solid	0.1107	0.1107	0.1107	0.1107
Crude oil	Liquid	0.0697	0.0697	0.0697	0.0697
Gasoline	Liquid	0.0686	0.0686	0.0686	0.0686
Naphtha	Liquid	0.0682	0.0682	0.0682	0.0682
Jet fuel	Liquid	0.0682	0.0682	0.0682	0.0682
Kerosene	Liquid	0.0686	0.0686	0.0686	0.0686
Diesel fuel	Liquid	0.0689	0.0689	0.0689	0.0689
Heavy fuel oil A	Liquid	0.0708	0.0708	0.0708	0.0708
Heavy fuel oil B	Liquid	0.0733	0.0733	0.0733	0.0733
Heavy fuel oil C	Liquid	0.0741	0.0741	0.0741	0.0741
Lubricating oil	Liquid	0.0730	0.0730	0.0730	0.0730
Oil coke	Solid	0.0898	0.0898	0.0898	0.0898
LPG	Gas	0.0601	0.0601	0.0601	0.0601
Natural gas	Gas	0.0513	0.0513	0.0513	0.0513

LNG	Gas	0.0513	0.0513	0.0513	0.0513
City gas	Gas	0.0513	0.0513	0.0513	0.0513
NGL condensate	Liquid	0.0671	0.0671	0.0671	0.0671
Refinery gas	Gas	0.0528	0.0528	0.0528	0.0528
Coke furnace gas	Gas	0.0400	0.0400	0.0400	0.0400
Blast furnace gas	Gas	0.0972	0.0975	0.0972	0.0972
Linz-Donawitz converter gas	Gas	0.1529	0.1529	0.1529	0.1529

Fuel type	Fuel form	FY2017 Emission factor [t-CO ₂ /GJ]	FY2018 Emission factor [t-CO ₂ /GJ]	FY2019 Emission factor [t-CO ₂ /GJ]
Imported coking coal	Solid	0.0902	0.0902	0.0902
Domestic general coal	Solid	0.0869	0.0887	0.0887
Imported general coal	Solid	0.0895	0.0891	0.0891
Imported anthracite	Solid	0.0950	0.0950	0.0950
Coke	Solid	0.1107	0.1096	0.1096
Crude oil	Liquid	0.0697	0.0697	0.0697
Gasoline	Liquid	0.0686	0.0686	0.0686
Naphtha	Liquid	0.0682	0.0682	0.0682
Jet fuel	Liquid	0.0682	0.0682	0.0682
Kerosene	Liquid	0.0686	0.0686	0.0686
Diesel fuel	Liquid	0.0689	0.0689	0.0689
Heavy fuel oil A	Liquid	0.0708	0.0708	0.0708
Heavy fuel oil B	Liquid	0.0733	0.0733	0.0733
Heavy fuel oil C	Liquid	0.0741	0.0741	0.0741
Lubricating oil	Liquid	0.0730	0.0730	0.0730
Oil coke	Solid	0.0898	0.0898	0.0898
LPG	Gas	0.0601	0.0601	0.0601
Natural gas	Gas	0.0513	0.0510	0.0510
LNG	Gas	0.0513	0.0510	0.0510
City gas	Gas	0.0513	0.0513	0.0513
NGL condensate	Liquid	0.0671	0.0667	0.0671
Refinery gas	Gas	0.0528	0.0528	0.0528
Coke furnace gas	Gas	0.0400	0.0400	0.0400
Blast furnace gas	Gas	0.0972	0.0964	0.0964
Linz-Donawitz converter gas	Gas	0.1529	0.1540	0.1540

Fuel type	Fuel form	FY2020 Emission factor [t-CO ₂ /GJ]	Conversion factor (High⇒low calorific value basis)
Imported coking coal	Solid	0.0902	1.086
Domestic general coal	Solid	0.0887	1.060
Imported general coal	Solid	0.0891	1.052
Imported anthracite	Solid	0.0950	1.034
Coke	Solid	0.1096	1.024
Crude oil	Liquid	0.0697	1.062
Gasoline	Liquid	0.0686	1.065
Naphtha	Liquid	0.0682	1.066
Jet fuel	Liquid	0.0682	1.066
Kerosene	Liquid	0.0686	1.065
Diesel fuel	Liquid	0.0689	1.064
Heavy fuel oil A	Liquid	0.0708	1.059
Heavy fuel oil B	Liquid	0.0733	1.053
Heavy fuel oil C	Liquid	0.0741	1.053
Lubricating oil	Liquid	0.0730	1.060
Oil coke	Solid	0.0898	1.015
LPG	Gas	0.0598	1.078
Natural gas	Gas	0.0510	1.097
LNG	Gas	0.0510	1.098
City gas	Gas	0.0513	1.097
NGL condensate	Liquid	0.0671	1.067
Refinery gas	Gas	0.0528	1.087
Coke furnace gas	Gas	0.0400	1.115
Blast furnace gas	Gas	0.0968	1.023
Linz-Donawitz converter gas	Gas	0.1540	1.002

[Sources]

- Units converted by the secretariat based on the “National GHG Inventory Report of JAPAN (NIR)” (April 2020) by the Greenhouse Gas Inventory Office of the National Institute for Environmental Studies, Japan

[Notes]

- Emissions factors are shown based on higher calorific value (gross calorific value).
- If emissions reductions are calculated based on the lower calorific value (true calorific value), multiply by the conversion factor for each fuel type in the top table to convert to emissions factors based on lower calorific value.
- LPG and LNG: These are generally gases during use, so they are categorized as gases.
- Natural gas: This is natural gas produced domestically, excluding LNG.

Average fuel economy of the vehicle

If the fuel economy method is used to calculate CO₂ emissions relating to transport, the following fuel economies are used.

Transportation type		Fuel economy (km/l)	
Fuel type	Maximum load (kg)	Commercial use	Personal use
Gasoline	Light truck	9.33	10.3
	~1,999	6.57	7.15
	2,000~	4.96	5.25
Diesel fuel	~999	9.32	11.9
	1,000~1,999	6.19	7.34
	2,000~3,999	4.58	4.94
	4,000~5,999	3.79	3.96
	6,000~7,999	3.38	3.53
	8,000~9,999	3.09	3.23
	10,000~11,999	2.89	3.02
	12,000~16,999	2.62	2.74

[Sources]

- Joint Guidelines on Methods for Calculating Carbon Dioxide Emissions in the Logistics Sector

Per unit fuel usage in vehicles

If the ton kilometer method is used to calculate CO₂ emissions for transport-related emissions, the following “fuel usage amounts per transport ton kilometer” are applied.

Vehicle type	Fuel type	Maximum load (kg)		Amount of fuel used per unit of transport ton kilometer (l/t•km)					
			Median	Load factor (%)					
				10	20	40	60	80	100
Light/compact/standard truck	Gasoline	Light truck	350	2.74	1.44	0.758	0.521	0.399	0.324
		~1,999	1,000	1.39	0.730	0.384	0.264	0.202	0.164
		2,000~	2,000	0.866	0.466	0.245	0.168	0.129	0.105
Compact/standard truck	Diesel fuel	~999	500	1.67	0.954	0.543	0.391	0.309	0.258
		1,000~1,999	1,500	0.816	0.465	0.265	0.191	0.151	0.126
		2,000~3,999	3,000	0.519	0.295	0.168	0.121	0.0958	0.0800
		4,000~5,999	5,000	0.371	0.212	0.120	0.0867	0.0686	0.0573
		6,000~7,999	7,000	0.298	0.170	0.0967	0.0696	0.0551	0.0459
		8,000~9,999	9,000	0.253	0.144	0.0820	0.0590	0.0467	0.0390
		10,000~11,999	11,000	0.222	0.126	0.0719	0.0518	0.0410	0.0342
		12,000~16,999	14,500	0.185	0.105	0.0601	0.0432	0.0342	0.0285

If the load factor is unknown, the following “per unit amounts” (l/t•km) are applied.

Vehicle type	Fuel type	Maximum load (kg)		If the load factor is unknown			
			Median	Average load factor (%)		Per unit amount (l/t•km)	
				Personal use	Commercial use	Personal use	Commercial use
Light/compact/standard truck	Gasoline	Light truck	350	10	41	2.74	0.741
		~1,999	1,000	10	32	1.39	0.472
		2,000~	2,000	24	52	0.394	0.192
Compact/standard truck	Diesel fuel	~999	500	10	36	1.67	0.592
		1,000~1,999	1,500	17	42	0.530	0.255
		2,000~3,999	3,000	39	58	0.172	0.124
		4,000~5,999	5,000	49	62	0.102	0.0844
		6,000~7,999	7,000			0.0820	0.0677
		8,000~9,999	9,000			0.0696	0.0575
		10,000~11,999	11,000			0.0610	0.0504
		12,000~16,999	14,500			0.0509	0.0421

[Sources]

- Joint Guidelines on Methods for Calculating Carbon Dioxide Emissions in the Logistics Sector

[Notes]

- If the load factor is less than 10%, the value at a load factor of 10% is used.

Grid power emission factor		
Fiscal year	Emission factor (kg-CO ₂ /kWh)	
	All power	Marginal power
FY2013	0.570	0.548
FY2014	0.554	0.512
FY2015	0.531	0.491
FY2016	0.518	0.544
FY2017	0.496	0.544
FY2018	0.462	0.551
FY2019	0.445	0.583
FY2020	0.433	0.623
FY2021	0.435	—

[Sources]

- All electric emissions factors: Adjusted emissions factors, announced in the “Environmental Action Plan of the Electric Power Business” (through FY2014) published annually by the Federation of Electric Power Companies of Japan, on the website of the Electric Power Council for a Low Carbon Society (FY2015), and in the report on emissions factors (national average) reported by business operators calculated under the GHG Emissions Accounting, Reporting, and Disclosure System (FY2016 onward).
- Marginal power emissions factors: Calculated from figures in the Survey of Electric Power Statistics (Agency for Natural Resources and Energy) based on the “Small-Scale Alternative Grid Power Emissions Factors Calculation Results” reported by the Small-Scale Alternative Grid Power Emissions Factors Working Group
 - CO₂ emissions are calculated from the amount of power generated, fuel consumption, caloric values (sourced from the Survey of Electric Power Statistics), and carbon emissions factors (National GHG Inventory Report of Japan) for each combustion type at electric utilities (10 companies through FY2015 values)
 - Of these, coal (actual rate of use 70% (assuming 3 months of inspections out of 24 months)) and LNG (actual rate of use 76.7% (assuming 1 month of inspection out of 24 months)) for which power plant output (Handbook of Electric Power Industry or Survey of Electric Power Statistics) and the 2-year average rate of use during operation calculated from the amount of power generated were less than 80%, as well as all oil-fired power were selected, and marginal power emissions factors (power producing end) were calculated from the amount of power generated and CO₂ emissions
 - Marginal power emissions factors (power receiving end) are calculated using ratios of actual power generated and actual power consumed (Survey of Electric Power Statistics) for the relevant year

[Notes]

- Emissions factors are values on the power receiving end.

Global warming potential (GWP) factors of greenhouse gases	
Greenhouse gases	Global warming potential factors (GWP)
CO ₂	1
CH ₄	25
N ₂ O	298
HFC-23	14,800
HFC-32	675
HFC-41	92
HFC-125	3,500
HFC-134	1,100
HFC-134a	1,430
HFC-143	353
HFC-143a	4,470
HFC-152	53
HFC-152a	124
HFC-161	12
HFC-227ea	3,220
HFC-236fa	9,810
HFC-236ea	1,370
HFC-236cb	1,340
HFC-245ca	693
HFC-245fa	1,030
HFC-365mfc	794
HFC-43-10mee	1,640
PFC-14	7,390
PFC-116	12,200
PFC-218	8,830
Perfluorocyclopropane	17,340
PFC-31-10	8,860
PFC-c318	10,300
PFC-41-12	9,160
PFC-51-14	9,300
PFC-91-18	7,500
SF ₆	22,800
NF ₃	17,200
R-404A (HFC-125/HFC-143a/HFC-134a:44/52/4)	3,920 (Note 1)

R-407C (HFC-32/HFC-125/HFC-134a:23/25/52)	1,770 (Note 1)
R-410A (HFC-32/HFC-125:50/50)	2,090 (Note 1)

[Sources]

- CO2 through NF6: Enforcement Order for the Act on Promotion of Global Warming Countermeasures
- R-404A onward: Enforcement Order for the Act on Promotion of Global Warming Countermeasures, Japan Fluorocarbon Manufacturers Association

[Notes]

- Note 1: GWP of typical mixed refrigerants, calculated based on weighted average using the product of the weight composition ratio and GWP of each ingredient (3 significant digits). GWP of other mixed refrigerants is calculated in the same way.