

**International Gas Union (IGU)**  
News, views and knowledge on gas – worldwide



# Natural Gas Conversion Pocketbook





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## Conversion Tables

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## Standard Conversion Tables

Conversion factors are rounded up to at most four decimal places for approximation purpose.

### (1) Length

← multiply by →

	centimetre (cm)	metre (m)	kilometre (km)	inch (in)	foot (ft)	yard (yd)	mile
cm		0.01	$1.0 \times 10^{-5}$	0.3937	0.0328	0.0109	$6.214 \times 10^{-6}$
m	100		0.001	39.37	3.281	1.094	$6.214 \times 10^{-4}$
km	100,000	1,000		39,370	3,281	1,094	0.6214
in	2.54	0.0254	$2.540 \times 10^{-5}$		0.0833	0.0278	$1.578 \times 10^{-5}$
ft	30.48	0.3048	$3.048 \times 10^{-4}$	12		0.3333	$1.894 \times 10^{-4}$
yd	91.44	0.9144	$9.144 \times 10^{-4}$	36	3		$5.682 \times 10^{-4}$
mile	160,934	1,609	1.609	63,360	5,280	1,760	

*Example: To convert 100 centimetres (cm) to inches (inch): 100 centimetres =  $100 \times 0.3937 = 39.37$  inches*

## (2) Area

← multiply by →

	square metre (m <sup>2</sup> )	square inch (in <sup>2</sup> )	square foot (ft <sup>2</sup> )	square yard (yd <sup>2</sup> )	acre	hectare
m <sup>2</sup>		1,550	10.76	1.196	$2.471 \times 10^{-4}$	$1.0 \times 10^{-4}$
in <sup>2</sup>	$6.452 \times 10^{-4}$		0.0069	$7.716 \times 10^{-4}$	$1.594 \times 10^{-7}$	$6.452 \times 10^{-8}$
ft <sup>2</sup>	0.0929	144		0.1111	$2.296 \times 10^{-5}$	$9.290 \times 10^{-6}$
yd <sup>2</sup>	0.8361	1,296	9		$2.066 \times 10^{-4}$	$8.361 \times 10^{-5}$
acre	4,047	6,272,640	43,560	4,840		0.4047
hectare	10,000	15,500,031	107,639	11,960	2.471	

### (3) Volume

← multiply by →

	cubic metre (m <sup>3</sup> )	cubic inch (in <sup>3</sup> )	cubic foot (ft <sup>3</sup> )	cubic yard (yd <sup>3</sup> )	litre (ℓ)	Imperial gallon liquid (Imp. gal.)	US gallon liquid (US gal.)	Oil barrel (US bbl)
m <sup>3</sup>		61,024	35.31	1.308	1,000	220.0	264.2	6.290
in <sup>3</sup>	1.639 x 10 <sup>-5</sup>		5.787 x 10 <sup>-4</sup>	2.143 x 10 <sup>-5</sup>	0.0164	0.0036	0.0043	1.031 x 10 <sup>-4</sup>
ft <sup>3</sup>	0.0283	1,728		0.0370	28.32	6.229	7.481	0.1781
yd <sup>3</sup>	0.7646	46,656	27		764.6	168.2	202.0	4.809
ℓ	0.001	61.02	0.0353	0.0013		0.22	0.2642	0.0063
Imp. gal.	0.0045	277.4	0.1605	0.0059	4.546		1.201	0.0286
US gal.	0.0038	231	0.1337	0.005	3.785	0.8327		0.0238
US bbl	0.159	9,702	5.615	0.2079	159	34.97	42	

#### (4) Velocity

← multiply by →

	metre/second (m/s)	metre/minute (m/min)	kilometre/ hour (km/h)	foot/second (ft/s)	foot/minute (ft/min)	mile/hour (mi/h)	yard/hour (yd/h)
m/s		60	3.6	3.281	196.9	2.237	3,937
m/min	0.0167		0.06	0.0547	3.281	0.0373	65.62
km/h	0.2778	16.67		0.9113	54.68	0.6214	1,094
ft/s	0.3048	18.29	1.097		60	0.6818	1,200
ft/min	0.0051	0.3048	0.0183	0.0167		0.0114	20
mi/h	0.4470	26.82	1.609	1.467	88		1,760
yd/h	$2.540 \times 10^{-4}$	0.0152	$9.144 \times 10^{-4}$	$8.333 \times 10^{-4}$	0.05	$5.682 \times 10^{-4}$	

## (5) Mass

← multiply by →

		kilogram (kg)	gram (gr)	ounce (oz)	pound (lb)	ton		
						metric (tonne)	long	short
kg			15,432	35.27	2.205	0.001	$9.842 \times 10^{-4}$	0.0011
gr		$6.480 \times 10^{-5}$		0.0023	$1.429 \times 10^{-4}$	$6.480 \times 10^{-8}$	$6.378 \times 10^{-8}$	$7.143 \times 10^{-8}$
oz		0.0283	437.5		0.0625	$2.835 \times 10^{-5}$	$2.790 \times 10^{-5}$	$3.125 \times 10^{-5}$
lb		0.4536	7,000	16		$4.536 \times 10^{-4}$	$4.464 \times 10^{-4}$	$5.0 \times 10^{-4}$
ton	metric	1,000	15,432,358	35,274	2,205		0.9842	1.102
	long	1,016	15,680,000	35,840	2,240	1.016		1.12
	short	907.2	14,000,000	32,000	2,000	0.9072	0.8929	

*Note: tonne is an alternative designation for the metric ton.*



## (6) Force Or Weight

← multiply by →

		newton (N)	kilogram- force (kgf)	pound-force (lbf)	poundal (pdl)	ton-force		
						metric (tonne)	long	short
N			0.1020	0.2248	7.233	$1.020 \times 10^{-4}$	$1.004 \times 10^{-4}$	$1.124 \times 10^{-4}$
kgf		9.807		2.205	70.93	0.001	$9.842 \times 10^{-4}$	0.0011
lbf		4.448	0.4536		32.17	$4.536 \times 10^{-4}$	$4.464 \times 10^{-4}$	$5.0 \times 10^{-4}$
pdl		0.1383	0.0141	0.0311		$1.410 \times 10^{-5}$	$1.388 \times 10^{-5}$	$1.554 \times 10^{-5}$
ton	metric	9,807	1,000	2,205	70,932		0.9842	1.102
	long	9,964	1,016	2,240	72,070	1.016		1.12
	short	8,996	907.2	2,000	64,348	0.9072	0.8929	

## (7) Pressure

← multiply by →

	bar = 100 kN/m <sup>2</sup>	kilogram- force square centimetre (kgf/cm <sup>2</sup> )	pound-force/ square inch (lbf/in <sup>2</sup> ) [psi]	Standard atmosphere (atm)	millimetre mercury at 0 °C (mmHg)	Inch mercury at 32 °F (inHg)	Inch water at 4 °C (inAq)
bar		1.020	14.50	0.9869	750.1	29.53	401.5
kgf/cm <sup>2</sup>	0.9807		14.22	0.9678	735.6	28.96	393.7
psi	0.0689	0.0703		0.0680	51.71	2.036	27.68
atm	1.013	1.033	14.70		760	29.92	406.8
mmHg	0.0013	0.0014	0.0193	0.0013		0.0394	0.5352
inHg	0.0339	0.0345	0.4912	0.0334	25.40		13.60
inAq	0.0025	0.0025	0.0361	0.0025	1.868	0.0736	

## (8) Mass Per Unit Volume

← multiply by →

	kilogram/ cubic metre (kg/m <sup>3</sup> )	grains/cubic feet (gr/ft <sup>3</sup> )	pound/cubic inch (lb/in <sup>3</sup> )	pound/ cubic feet (lb/ft <sup>3</sup> )	pound/gallon Imperial (lb/gal)	pound/gallon US (lb/gal)	tonnes/ cubic metre (tonnes/m <sup>3</sup> )
kg/m <sup>3</sup>		437	3.613 x 10 <sup>-5</sup>	0.0624	0.01	0.0083	0.001
gr/ft <sup>3</sup>	0.0023		8.267 x 10 <sup>-8</sup>	1.429 x 10 <sup>-4</sup>	2.293 x 10 <sup>-5</sup>	1.910 x 10 <sup>-5</sup>	2.288 x 10 <sup>-6</sup>
lb/in <sup>3</sup>	27,680	12,096,000		1,728	277.4	231	27.68
lb/ft <sup>3</sup>	16.02	7,000	5.787 x 10 <sup>-4</sup>		0.1605	0.1337	0.0160
lb/gal (Imp.)	99.78	43,602	0.0036	6.229		0.8327	0.0998
lb/gal (US)	119.8	52,364	0.0043	7.481	1.201		0.1198
tonnes/m <sup>3</sup>	1,000	436,996	0.0361	62.43	10.02	8.345	

## (9) Energy Or Work

← multiply by →

	Joule (J) = Nm	kilowatt-hour (kWh)	kilocalorie (kcal)	horsepower hours (metric)	British thermal unit (Btu)
J		$2.778 \times 10^{-7}$	$2.388 \times 10^{-4}$	$3.777 \times 10^{-7}$	$9.478 \times 10^{-4}$
kWh	3,600,000		859.8	1.360	3,412
kcal	4,187	0.0012		0.0016	3.968
hp-h (metric)	2,647,796	0.7355	632.4		2,510
Btu	1,055	$2.931 \times 10^{-4}$	0.2520	$3.985 \times 10^{-4}$	

## (10) Power

← multiply by →

	kilowatt (kW) = kJ/s	kilocalories/sec (kcal/s)	toncal/day	horsepower (metric) (hp)	British thermal unit/hour (Btu/h)
kW		0.2388	20.64	1.360	3,412
kcal/s	4.187		86.40	5.692	14,286
toncal/day	0.0485	0.0116		0.0659	165.3
hp (metric)	0.7355	0.1757	15.18		2,510
Btu/h	$2.931 \times 10^{-4}$	$7.0 \times 10^{-5}$	0.006	$3.985 \times 10^{-4}$	

## (11) Rates Of Flow

← multiply by →

	cubic metre/ minute (cm/min)	cubic metre/hour (cm/h) x 10 <sup>3</sup>	cubic metre/day (cm/d) x 10 <sup>3</sup>	cubic foot/min (cf/min)	cubic foot/hour (cf/h) x 10 <sup>3</sup>	cubic foot/day (cf/d) x 10 <sup>3</sup>
cm/min		0.06	1.44	35.31	2.119	50.85
cm/h x 10 <sup>3</sup>	16.67		24	588.6	35.31	847.6
cm/d x 10 <sup>3</sup>	0.6944	0.0417		24.52	1.471	35.31
cf/min	0.0283	0.0017	0.0408		0.06	1.44
cf/h x 10 <sup>3</sup>	0.4719	0.0283	0.6796	16.67		24
cf/d x 10 <sup>3</sup>	0.0197	0.0012	0.0283	0.6944	0.0417	

## (12) Temperature

°C	-50	-40	-30	-20	-10	0.0	+10	20	30	40	50	60	70	80	90	100
°F	-58	-40	-22	-4	14	32	50	68	86	104	122	140	158	176	194	212

From	To	Formula
Degrees Celsius	Degrees Fahrenheit	$[(9/5) \times ^\circ\text{C}] + 32$
Degrees Fahrenheit	Degrees Celsius	$(^\circ\text{F} - 32) \times 5/9$
Degrees Celsius	Kelvins	$^\circ\text{C} + 273.15$
Kelvins	Degrees Celsius	$^\circ\text{C} - 273.15$

## Remarks & Key Assumptions

This section is intended to provide additional information as a reference ONLY on the properties/characteristics of natural gas, liquefied natural gas (LNG) and liquefied petroleum gas (LPG) for background understanding.

The approximations in the tables in Section 2 and Section 3 are based upon the following assumptions:-

- (i) For natural gas:
  - “Gas State” in conversion tables is assumed at Normal, N (0 °C, 1 atm)  
1,100 Btu/scf (60 °F, 1 atm) = 1,163 Btu/cf (0 °C, 1 atm)  
\*Scf = Standard cubic feet. Standard means “(60 °F, 1 atm)”
- (ii) For LNG
  - 1 tonne LNG = 1,300 Nm<sup>3</sup> gas [\*N: Normal. Normal means “(0 °C, 1 atm)”];
  - Density = 450 kg/m<sup>3</sup> LNG
- (iii) For LPG,
  - An assumed 50/50 propane/butane mixture with (*r*) and (*p*) indicating that the LPG is either refrigerated or pressurised.
  - The simulation software known as “Virtual Materials Group (VMG) Process Simulator” is used in the process. Other assumptions are as below:-
  - Pressurised (*p*): temperature = 20 °C, Vapour Fraction (VapFrac) = 0
  - Refrigerated (*r*): temperature = each boiling point, Pressure = 0 kPa (g), g = gauge pressure
 

Corresponding boiling points ->	Ethane	: -88.7 °C
	Propane	: 42.2 °C
	n-Butane	: -0.6 °C
	C <sub>3</sub> .C <sub>4</sub> mix	: -29.2 °C



(iv) Calorific values, mmBtu (gross):

	mmBtu/tonne (gross)	mmBtu/bbl	mmBtu/m <sup>3</sup>
LNG	53.4	3.82	24.0
LPG ( <i>r</i> )	47.3	4.52	28.5
LPG ( <i>p</i> )	47.3	4.13	25.9
Oil	39.68	5.80	
Coal	27.3		

(v) 1 tonne of oil equivalent (toe) = 41.868 GJ = 39.68 mmBtu

(vi) 1 barrel of oil equivalent (boe) = 5,800,000 Btu = 5.8 mmBtu

## Natural Gas Conversion Tables

### (1) Heat & Volume

← multiply by →

	cm = Nm <sup>3</sup>	cf = ft <sup>3</sup>	mmBtu	GJ	Mcal	kWh	boe
cm		35.31	0.0411	0.0433	10.35	12.03	0.0071
cf	0.0283		0.0012	0.0012	0.2930	0.3407	2.005 x 10 <sup>-4</sup>
mmBtu	24.36	860.1		1.055	252.0	293.1	0.1724
GJ	23.08	815.2	0.9478		238.8	277.8	0.1634
Mcal	0.0967	3.413	0.0040	0.0042		1.163	6.842 x 10 <sup>-4</sup>
kWh	0.0831	2.935	0.0034	0.0036	0.8598		5.883 x 10 <sup>-4</sup>
boe	141.3	4,989	5.8	6.119	1,462	1,700	

Note: 1 PetaJoule (PJ) = 1 million GigaJoule (GJ)

## (2) Energy Consumption

← multiply by →

	N bcm/yr	mmcf/d (0 °C, 1 atm)	boe/d x 10 <sup>3</sup>	toe/yr x 10 <sup>3</sup>
N bcm/yr		96.75	19.39	1,035
mmcf/d	0.0103		0.2005	10.69
boe/d x 10 <sup>3</sup>	0.0516	4.989		53.35
toe/yr x 10 <sup>3</sup>	0.0010	0.0935	0.0187	

*boe volumes are normally expressed in gross and toe in net*

## (3) Gross Calorific Value < > Net Calorific Value (Natural Gas)

	Gross	Net
Gross	1	0.9
Net	1.1	1

#### (4) Gas Consumption for Industrial Purposes

PROCESS	INPUT	OUTPUT
Power Generation (Open Cycle)	1.0 bcm gas into plant	3,700 GWh electricity
Power Generation (Combined Cycle)	1.0 bcm gas into plant	5,800 GWh electricity
LNG Project (Plant and Shipping)	1.0 bcm gas into plant	0.85 bcm regasified
Ammonia / Urea Production	1.0 bcm gas into plant	1.8 million tonnes fertiliser
Methanol Production	1.0 bcm gas into plant	1.1 million tonnes methanol
Gas-to-Liquids	1.0 bcm gas into plant	4.0 million barrels oil

*These figures can vary greatly, depending on such factors as the process used, the design and age of the plant, efficiency of operation, ambient conditions, etc. They should be used with caution and only for general exercises. All numbers are rounded.*

## (5) Pipeline Capacities

External diameter (inches)	Capacity (bcm/y)
20	2.0
24	3.2
28	4.7
32	6.6
36	9.0
40	11.7
44	14.9

*These numbers are indicative only and can vary widely*

## LNG Conversion Tables

### (1) Mass, Volume and Heat

← multiply by →

	Tonnes LNG	m <sup>3</sup> LNG	Nm <sup>3</sup> gas	ft <sup>3</sup> gas	mmBtu	boe
Tonnes LNG		2.222	1,300	45,909	53.38	9.203
m <sup>3</sup> LNG	0.450		585	20,659	24.02	4.141
m <sup>3</sup> gas	$7.692 \times 10^{-4}$	0.0017		35.31	0.0411	0.0071
ft <sup>3</sup> gas	$2.178 \times 10^{-5}$	$4.8 \times 10^{-5}$	0.0283		0.0012	$2.005 \times 10^{-4}$
mmBtu	0.0187	0.0416	24.36	860.1		0.1724
boe	0.1087	0.2415	141.3	4,989	5.8	

## (2) LNG Characteristics

The average composition is chosen as being representative among compositions provided by different receiving terminals

Origin	Nitrogen N2 %	Methane C1 %	Ethane C2 %	Propane C3 %	C4+ %	LNG density kg/m <sup>3</sup>	Gas density kg/m <sup>3</sup> (n)	Expansion ratio m <sup>3</sup> (n)/ m <sup>3</sup> liq	Gas GCV MJ/m <sup>3</sup> (n)
Abu Dhabi	0.3	84.8	13.2	1.6	0.1	467	0.826	566	44.9
Algeria-Arzew	0.6	88.0	9.0	2.0	0.5	464	0.813	570	44.1
Algeria-Bethioua 1	0.9	88.1	8.4	2.0	0.7	455	0.806	573	35.7
Algeria-Bethioua 2	0.6	90.7	7.8	0.8	0.0	450	0.780	577	36.0
Algeria-Skikda	0.5	91.8	6.9	0.6	0.1	446	0.769	580	35.5
Australia-NWS	0.1	87.4	8.3	3.4	0.8	467	0.831	562	45.3
Brunei	0.1	90.6	5.0	2.9	1.5	461	0.816	564	44.6
Egypt-Damietta	0.1	97.7	1.8	0.22	0.2	427	0.730	585	40.8
Egypt-Idku	0.0	95.9	2.8	0.9	0.5	436	0.752	579	38.9
Equatorial Guinea	0.0	93.4	6.5	0.0	0.0	439	0.755	585	42.0
Indonesia-Arun	0.2	90.7	6.2	2.0	1.0	457	0.803	569	43.9
Indonesia-Badak	0.0	91.2	5.5	2.4	0.9	456	0.801	568	43.9
Indonesia-Tangguh			2.9	0.5	0.2	432	0.744	580	41.0
Libya	0.7	81.6	13.4	3.7	0.7	485	0.867	559	46.6
Malaysia	0.3	90.3	5.3	3.1	1.1	461	0.813	567	44.3
Nigeria	0.1	92.1	5.3	2.1	0.5	458	0.809	566	44.2
Norway	0.8	91.8	5.7	1.3	0.4	451	0.782	577	40.1
Oman	0.4	87.9	7.3	2.9	1.6	470	0.834	563	45.3
Peru	0.6	89.1	10.3	0.1	0.0	456		579	
Qatar-Qatargas I	0.4	90.1	6.2	2.3	1.0	460	0.808	569	44.0
Russia-Sakhalin	0.1	92.6	4.5	1.9	0.2	449		570	
Trinidad	0.0	97.1	2.5	0.2	0.1	429	0.727	590	39.8
U.S.A-Alaska	0.2	99.7	0.1	0.0	0.0	423	0.719	589	39.9
Yemen	0.0	93.3	5.7	0.9	0.1	434	0.765	567	38.5

## (1) LPG & Ethane: Weight, Volume and Heat

C<sub>3</sub>. C<sub>4</sub> mix is treated separately in which the results are generated from the VMG Simulator.

### Cubic Metres Per Tonne

m <sup>3</sup> /tonne	Ethane	Propane	n-Butane	C <sub>3</sub> . C <sub>4</sub> mix
Pressurised ( <i>p</i> )	3.00	1.98	1.72	1.82
Refrigerated ( <i>r</i> )	1.84	1.71	1.66	1.66

### mmBtu Per Tonne

mmBtu/tonne	Ethane	Propane	n-Butane	C <sub>3</sub> . C <sub>4</sub> mix
Pressurised ( <i>p</i> )	} 49.2	47.7	46.6	47.3
Refrigerated ( <i>r</i> )				

### Barrels Per Tonne

bbl/tonne	Ethane	Propane	n-Butane	C <sub>3</sub> . C <sub>4</sub> mix
Pressurised ( <i>p</i> )	18.9	12.5	10.8	11.5
Refrigerated ( <i>r</i> )	11.5	10.8	10.4	10.5



mmBtu Per Cubic Metre

mmBtu/m <sup>3</sup>	Ethane	Propane	n-Butane	C <sub>3</sub> . C <sub>4</sub> mix
Pressurised ( <i>p</i> )	16.4	24.1	27.3	25.9
Refrigerated ( <i>r</i> )	26.8	27.8	28.2	28.5

mmBtu Per Barrel

mmBtu/bbl	Ethane	Propane	n-Butane	C <sub>3</sub> . C <sub>4</sub> mix
Pressurised ( <i>p</i> )	2.60	3.83	4.34	4.13
Refrigerated ( <i>r</i> )	4.26	4.42	4.49	4.52

1 Barrel Per Day = Tonnes Per Annum

1 bbl/d = tonne/y	Ethane	Propane	n-Butane	C <sub>3</sub> . C <sub>4</sub> mix
Pressurised ( <i>p</i> )	19.3	29.3	33.8	31.8
Refrigerated ( <i>r</i> )	31.6	33.8	34.9	34.9

## Inter-fuel Conversion Tables

The tables contain quick reference equivalents and other factors of general relevance to the natural gas industry. All figures are to be taken as APPROXIMATE VALUES only for use when a high degree of precision is not required. The approximations in these tables are based upon the assumptions that are listed in pages 16 and 17.

### (1) Natural Gas: Cubic Metre Equivalents

	Per Year			Per Day		
	1 bcm natural gas per year =	35.31 x 10 <sup>9</sup> 41.06 x 10 <sup>12</sup>	cf Btu	gas	96.75 x 10 <sup>6</sup> 112.5 x 10 <sup>9</sup>	cf Btu
0.77 x 10 <sup>6</sup> 10.75 x 10 <sup>6</sup>		tonnes barrels	LNG	2,107 29,457	tonnes barrels	LNG
0.87 x 10 <sup>6</sup> 9.08 x 10 <sup>6</sup> 9.95 x 10 <sup>6</sup>		tonnes barrels barrels	LPG LPG ( <i>r</i> ) LPG ( <i>p</i> )	2,378 24,869 27,268	tonnes barrels barrels	LPG LPG ( <i>r</i> ) LPG ( <i>p</i> )
1.03 x 10 <sup>6</sup> 7.08 x 10 <sup>6</sup>		tonnes barrels	oil	2,835 19,395	tonnes barrels	oil
1.50 x 10 <sup>6</sup>		tonnes	coal	4,120	tonnes	coal

	Per Year			Per Day		
	1 mmcm natural gas per day =	12.9 x 10 <sup>9</sup> 15.0 x 10 <sup>12</sup>	cf Btu	gas	35.31 x 10 <sup>6</sup> 41.06 x 10 <sup>9</sup>	cf Btu
0.28 x 10 <sup>6</sup> 3.92 x 10 <sup>6</sup>		tonnes barrels	LNG	769.2 10,752	tonnes barrels	LNG
0.32 x 10 <sup>6</sup> 3.31 x 10 <sup>6</sup> 3.63 x 10 <sup>6</sup>		tonnes barrels barrels	LPG LPG ( <i>r</i> ) LPG ( <i>p</i> )	868 9,077 9,953	tonnes barrels barrels	LPG LPG ( <i>r</i> ) LPG ( <i>p</i> )
0.38 x 10 <sup>6</sup> 2.58 x 10 <sup>6</sup>		tonnes barrels	oil	1,035 7,079	tonnes barrels	oil
0.55 x 10 <sup>6</sup>		tonnes	coal	1,504	tonnes	coal

## (2) Natural Gas: Cubic Foot Equivalent

	Per Year			Per Day		
1 tcf natural gas per year =	1.0 x 10 <sup>12</sup>	cf	gas	2.74 x 10 <sup>9</sup>	cf	gas
	28.32 x 10 <sup>9</sup>	cm		77.58 x 10 <sup>6</sup>	cm	
	29.30 x 10 <sup>6</sup>	tonnes	oil	80,269	tonnes	oil
	200.5 x 10 <sup>6</sup>	barrels		0.55 x 10 <sup>6</sup>	barrels	
	42.59 x 10 <sup>6</sup>	tonnes	coal	0.12 x 10 <sup>6</sup>	tonnes	coal

•  $cm = m^3 = \text{kilolitre}$

	Per Year			Per Day		
	100 mmcf natural gas per day =	36.50 x 10 <sup>9</sup>	cf	gas	1.0 x 10 <sup>8</sup>	cf
1.034 x 10 <sup>9</sup>		cm	2.83 x 10 <sup>6</sup>		cm	
42.44 x 10 <sup>12</sup>		Btu	0.12 x 10 <sup>12</sup>		Btu	
0.795 x 10 <sup>6</sup>		tonnes	LNG	2,178	tonnes	LNG
11.11 x 10 <sup>6</sup>		barrels		30,446	barrels	
0.897 x 10 <sup>6</sup>		tonnes	LPG	2,458	tonnes	LPG
9.38 x 10 <sup>6</sup>	barrels	LPG ( <i>r</i> )	25,703	barrels	LPG ( <i>r</i> )	
10.29 x 10 <sup>6</sup>	barrels	LPG ( <i>p</i> )	28,183	barrels	LPG ( <i>p</i> )	
1.07 x 10 <sup>6</sup>	tonnes	oil	2,930	tonnes	oil	
7.32 x 10 <sup>6</sup>	barrels		20,046	barrels		
1.55 x 10 <sup>6</sup>	tonnes	coal	4,259	tonnes	coal	

### (3) LNG: Volumetric Equivalentents

	Per Year			Per Day		
	1 MTPA LNG =	45.91 x 10 <sup>9</sup>	cf	gas	0.126 x 10 <sup>9</sup>	cf
1.30 x 10 <sup>9</sup>		cm	3.56 x 10 <sup>6</sup>		cm	
53.38 x 10 <sup>12</sup>		Btu	146.2 x 10 <sup>9</sup>		Btu	
78.48 x 10 <sup>6</sup>		cf	LNG	0.22 x 10 <sup>6</sup>	cf	LNG
2.22 x 10 <sup>6</sup>		cm		6,088	cm	
13.98 x 10 <sup>6</sup>	barrels	38,294		barrels		
1.13 x 10 <sup>6</sup>	tonnes	LPG	3,092	tonnes	LPG	
11.80 x 10 <sup>6</sup>	barrels		32,329	barrels		
12.94 x 10 <sup>6</sup>	barrels		35,448	barrels		
1.35 x 10 <sup>6</sup>	tonnes	oil	3,685	tonnes	oil	
9.20 x 10 <sup>6</sup>	barrels		25,213	barrels		
1.96 x 10 <sup>6</sup>	tonnes	coal	5,357	tonnes	coal	

	Per Year			Per Day		
	1 mmcm LNG per year =	20.66 x 10 <sup>9</sup>	cf	gas	56.60 x 10 <sup>6</sup>	cf
0.585 x 10 <sup>9</sup>		cm	1.603 x 10 <sup>6</sup>		cm	
24.02 x 10 <sup>12</sup>		Btu	65.81 x 10 <sup>9</sup>		Btu	
0.45 x 10 <sup>6</sup>		tonnes	LNG	1,233	tonnes	LNG
6.29 x 10 <sup>6</sup>		barrels		17,232	barrels	
0.508 x 10 <sup>6</sup>	tonnes	LPG	1,391	tonnes	LPG	
5.31 x 10 <sup>6</sup>	barrels	LPG ( <i>r</i> )	14,548	barrels	LPG ( <i>r</i> )	
5.82 x 10 <sup>6</sup>	barrels	LPG ( <i>p</i> )	15,952	barrels	LPG ( <i>p</i> )	
0.605 x 10 <sup>6</sup>	tonnes	oil	1,658	tonnes	oil	
4.14 x 10 <sup>6</sup>	barrels		11,346	barrels		
0.88 x 10 <sup>6</sup>	tonnes	coal	2,410	tonnes	coal	

**(4) LPG (Refrigerated)**  
Equivalent based on 50% C<sub>3</sub>, 50% C<sub>4</sub>

	Per Year			Per Day		
	1 MT LPG per year =	40.68 x 10 <sup>9</sup> 1.15 x 10 <sup>9</sup>	cf cm	gas	111.5 x 10 <sup>6</sup> 3.16 x 10 <sup>6</sup>	cf cm
0.886 x 10 <sup>6</sup> 12.39 x 10 <sup>6</sup>		tonnes barrels	LNG	2,428 33,935	tonnes barrels	LNG
1.66 x 10 <sup>6</sup> 10.46 x 10 <sup>6</sup>		cm barrels	LPG ( <i>r</i> )	4,555 28,649	cm barrels	LPG ( <i>r</i> )
1.19 x 10 <sup>6</sup> 8.16 x 10 <sup>6</sup>		tonnes barrels	oil	3,266 22,343	tonnes barrels	oil
1.73 x 10 <sup>6</sup>		tonnes	coal	4,747	tonnes	coal



	Per Year			Per Day		
	10,000 bbl LPG per day =	14.2 x 10 <sup>9</sup> 0.402 x 10 <sup>9</sup>	cf cm	gas	38.91 x 10 <sup>6</sup> 1.102 x 10 <sup>6</sup>	cf cm
0.349 x 10 <sup>6</sup> 0.58 x 10 <sup>6</sup>		tonnes cm	LPG ( <i>r</i> )	956.3 1,590	tonnes cm	LPG ( <i>r</i> )
0.416 x 10 <sup>6</sup> 2.85 x 10 <sup>6</sup>		tonnes barrels	oil	1,140 7,799	tonnes barrels	oil
0.605 x 10 <sup>6</sup>		tonnes	coal	1,657	tonnes	coal

	Per Year			Per Day		
	1 mmcm LPG per year =	24.47 x 10 <sup>9</sup> 0.693 x 10 <sup>9</sup>	cf cm	gas	67.04 x 10 <sup>6</sup> 1.90 x 10 <sup>6</sup>	cf cm
0.601 x 10 <sup>6</sup> 6.29 x 10 <sup>6</sup>		tonnes barrels	LPG ( <i>r</i> )	1,648 17,232	tonnes barrels	LPG ( <i>r</i> )
0.717 x 10 <sup>6</sup> 4.91 x 10 <sup>6</sup>		tonnes barrels	oil	1,964 13,439	tonnes barrels	oil
1.04 x 10 <sup>6</sup>		tonnes	coal	2,855	tonnes	coal

(5) LPG (Pressurised)  
Equivalent based on 50% C<sub>3</sub>, 50% C<sub>4</sub>

	Per Year			Per Day		
	1 MT LPG per year =	40.68 x 10 <sup>9</sup> 1.15 x 10 <sup>9</sup>	cf cm	gas	111.5 x 10 <sup>6</sup> 3.16 x 10 <sup>6</sup>	cf cm
0.886 x 10 <sup>6</sup> 12.39 x 10 <sup>6</sup>		tonnes barrels	LNG	2,428 33,935	tonnes barrels	LNG
1.82 x 10 <sup>6</sup> 11.47 x 10 <sup>6</sup>		cm barrels	LPG (p)	4,994 31,413	cm barrels	LPG (p)
1.19 x 10 <sup>6</sup> 8.16 x 10 <sup>6</sup>		tonnes barrels	oil	3,266 22,343	tonnes barrels	oil
1.73 x 10 <sup>6</sup>		tonnes	coal	4,747	tonnes	coal

	Per Year			Per Day		
	10,000 bbl LPG per day =	12.95 x 10 <sup>9</sup> 0.367 x 10 <sup>9</sup>	cf cm	gas	35.48 x 10 <sup>6</sup> 1.0048 x 10 <sup>6</sup>	cf cm
0.318 x 10 <sup>6</sup> 0.58 x 10 <sup>6</sup>		tonnes cm	LPG ( <i>p</i> )	872.2 1,590	tonnes cm	LPG ( <i>p</i> )
0.379 x 10 <sup>6</sup> 2.60 x 10 <sup>6</sup>		tonnes barrels	oil	1,040 7,113	tonnes barrels	oil
0.552 x 10 <sup>6</sup>		tonnes	coal	1,511	tonnes	coal

	Per Year			Per Day		
	1 mmcm LPG per year =	22.32 x 10 <sup>9</sup> 0.632 x 10 <sup>9</sup>	cf cm	gas	61.14 x 10 <sup>6</sup> 1.73 x 10 <sup>6</sup>	cf cm
0.549 x 10 <sup>6</sup> 6.29 x 10 <sup>6</sup>		tonnes barrels	LPG ( <i>p</i> )	1,503 17,232	tonnes barrels	LPG ( <i>p</i> )
0.654 x 10 <sup>6</sup> 4.47 x 10 <sup>6</sup>		tonnes barrels	oil	1,791 12,257	tonnes barrels	oil
0.95 x 10 <sup>6</sup>		tonnes	coal	2,604	tonnes	coal

## (6) Oil and Coal Equivalents

	Per Year			Per Day		
	1 MT oil per year =	34.13 x 10 <sup>9</sup>	cf	gas	93.51 x 10 <sup>6</sup>	cf
0.967 x 10 <sup>9</sup>		cm	2.65 x 10 <sup>6</sup>		cm	
39.68 x 10 <sup>12</sup>		Btu	108.7 x 10 <sup>9</sup>		Btu	
0.743 x 10 <sup>6</sup>		tonnes	LNG	2,037	tonnes	LNG
10.39 x 10 <sup>6</sup>		barrels		28,470	barrels	
0.839 x 10 <sup>6</sup>	tonnes	LPG	2,299	tonnes	LPG	
8.77 x 10 <sup>6</sup>	barrels	LPG ( <i>r</i> )	24,036	barrels	LPG ( <i>r</i> )	
9.62 x 10 <sup>6</sup>	barrels	LPG ( <i>p</i> )	26,354	barrels	LPG ( <i>p</i> )	
6.84 x 10 <sup>6</sup>	barrels	oil	18,745	barrels	oil	
1.45 x 10 <sup>6</sup>	tonnes	coal	3,982	tonnes	coal	

	Per Year			Per Day		
	1 MT coal per year =	23.48 x 10 <sup>9</sup> 0.665 x 10 <sup>9</sup> 27.30 x 10 <sup>12</sup>	cf cm Btu	gas	64.33 x 10 <sup>6</sup> 1.82 x 10 <sup>6</sup> 74.79 x 10 <sup>9</sup>	cf cm Btu
0.511 x 10 <sup>6</sup> 7.15 x 10 <sup>6</sup>		tonnes barrels	LNG	1,401 19,586	tonnes barrels	LNG
0.577 x 10 <sup>6</sup> 6.035 x 10 <sup>6</sup> 6.618 x 10 <sup>6</sup>		tonnes barrels barrels	LPG LPG ( <i>r</i> ) LPG ( <i>p</i> )	1,581 16,535 18,130	tonnes barrels barrels	LPG LPG ( <i>r</i> ) LPG ( <i>p</i> )
0.688 x 10 <sup>6</sup>		tonnes	oil	1,885	tonnes	oil

	Per Year			Per Day		
	10,000 bbl oil per day =	18.21 x 10 <sup>9</sup> 0.52 x 10 <sup>9</sup> 21.17 x 10 <sup>12</sup>	cf cm Btu	gas	49.89 x 10 <sup>6</sup> 1.41 x 10 <sup>6</sup> 58.0 x 10 <sup>9</sup>	cf cm Btu
0.533 x 10 <sup>6</sup>		tonnes	oil	1,462	tonnes	oil
0.775 x 10 <sup>6</sup>		tonnes	coal	2,125	tonnes	coal

## Selected References

The following references were used by the team in the preparation of this guide.

The IGU wishes to thank and record its appreciation to the respective publishers and organisations:-

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