

## Energy Conversion Tables and Information

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Pressure	N/m <sup>2</sup>	bar	mbar	mm wg	kPa/cm <sup>2</sup>
1 N/m <sup>2</sup> = 1 Pa =	1	10 <sup>-5</sup>	10 <sup>-2</sup>	0.102*	1.02 x 10 <sup>-5</sup>
1 bar =	10 <sup>5</sup>	1	1000	10200*	1.020
1 mbar =	100	10 <sup>-3</sup>	1	10.2*	1.02
1 mm wg* =	9.81	9.81 x 10 <sup>-5</sup>	0.0987*	1	0.0001
10 mm wg* =	1mbar				

Heat	kW	W = J/s	MJ/h	kcal/h
1 kW =	1	1000	3.6	860
1 W = 1 J/s =	0.001	1	3.6 x 10 <sup>-3</sup>	0.86
1 MJ/h =	0.2778	277.8	1	238.8
1 kcal/h =	1.163 x 10 <sup>-3</sup>	1.163	4.1868 x 10 <sup>-3</sup>	1
Energy	kWh	MJ	J=Ws	kcal
1 kWh =	1	3.6	6.6 x 10 <sup>6</sup>	860
1 MJ =	0.2778	1	10 <sup>6</sup>	238.8
1J = 1 Ws =	2.778 x 10 <sup>-7</sup>	10 <sup>-6</sup>	1	2.388 x 10 <sup>-4</sup>
1 kcal=	1.163 x 10 <sup>-3</sup>	4.1868 x 10 <sup>-6</sup>	4.1868 x 10 <sup>3</sup>	1

Calorific Value	MJ/m <sup>3</sup>	kcal/m <sup>3</sup>	Btu/ft <sup>3</sup>	Thermie/1
1 MJ/m <sup>3</sup> =	1	238.846	26.8392	2.38927 x 10 <sup>-4</sup>
1 kcal/m <sup>3</sup> =	0.0041868	1	0.11237	1.00034 x 10 <sup>-6</sup>
1 Btu/ft <sup>3</sup> =	0.0372589	8.89915	1	8.90216 x 10 <sup>-6</sup>
1 Thermie/1 =	4.18538 x 10 <sup>3</sup>	9.99662 x 10 <sup>5</sup>	1.12332 x 10 <sup>5</sup>	1
Therms/UK Gal =	2.3208 x 10 <sup>4</sup>	5.54314 x 10 <sup>6</sup>	6.22884 x 10 <sup>5</sup>	5.545

Volume	m <sup>3</sup> /h	L/h	UK gal/h	ft <sup>3</sup> /h
1 m <sup>3</sup> /h =	1	1000	220	35.3147
1 l/min =	0.06	60	0.22	2.119
1 ft <sup>3</sup> /s =	101.94	101938	2.24238 x 10 <sup>4</sup>	3600
1 UK Gal/s =	16.37	16366	3600	4.459 x 10 <sup>-5</sup>

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## Calorific Values

Commercial Propane	19,900 Btu/lb net and 21,500 gross. 11,000 kcal/kg net and 11,900 gross.
Commercial Butane	19,700 Btu/lb net and 21,200 gross. 10,900 kcal/kg net and 11,800 gross
UK Natural Gas is typically	47.32 MJ/kg net and 52.41 MJ/kg gross. 34.88 MJ/m <sup>3</sup> net and 38.63 MJ/m <sup>3</sup> gross.

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## Emissions

### For natural gas

100ppm NO<sub>x</sub> at 15%O<sub>2</sub> equates to 171 mg/MJ th [netCV] or 205 mg/m<sup>3</sup> at 15%O<sub>2</sub> [NO<sub>x</sub> as NO<sub>2</sub>]

100ppm CO at 15%O<sub>2</sub> equates to 104 mg/MJ th [netCV] or 125 mg/m<sup>3</sup> at 15%O<sub>2</sub>

100ppm CH<sub>4</sub> at 15%O<sub>2</sub> equates to 59 mg/MJ th [netCV] or 71 mg/m<sup>3</sup> at 15%O<sub>2</sub>

Concentration at reference conditions = Measured concentration x  $\frac{[20.9\% - (\%O_2\text{Ref})]}{[20.9\% - (\%O_2\text{ actual})]}$

Note Boilers and furnaces are measured at 3% oxygen and gas turbines at 15% oxygen.

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## Other Gas Information

Net to gross heat inputs: the conversion factor varies by fuel, for NG it is 1.11 and for Propane is 1.08.

Thus 60 kW gross NG is about 54kW net.

In addition an appliance at 80% gross efficiency will be about 88% net efficiency.

Limits of Flammability	NG = 4.5 to 15%
	Propane = 2 to 10%
	Butane = 1.8 - 9%

Specific heat of NG is about 1.86 kJ/kg per °C whilst that of water is about 4.18 kJ/kg per °C.

Relative Density of NG is about 1.36m<sup>3</sup>/Kg [0.737 kg/m<sup>3</sup>] whilst that of air is about 2.26 m<sup>3</sup>/kg. [SG about 0.6].

100 ft<sup>3</sup> NG = 30 kW [30.4] or 1 m<sup>3</sup> NG = 10 kW [10.7].

Taking NG as 1040 Btu/ft<sup>3</sup> or 38.78 MJ/m<sup>3</sup> gross.

Dewpoint of combustion products is 59°C for NG, 55°C for LPG.

Theoretical combustion air 9.76 for NG and 24 to 25 for LPG

requirements:

Stoichiometric dry flue gas concentration of CO<sub>2</sub> 11.9% for NG and 13.8 to 14% for LPG.

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<b>Fuel Comparison Information</b>			
<b>Fuel Price</b>	<b>Grace C/Gas oil</b>	<b>Grade G oil</b>	<b>Propane</b>
<b>p/litre</b>	<b>p/kWh (p/th)</b>	<b>p/kWh (p/th)</b>	<b>P/kWh (p/th)</b>
8	0.75 (20.94)	0.70 (20.57)	1.14 (33.50)
10	0.94 (27.55)	0.88 (25.71)	1.43 (41.87)
12	1.13 (33.18)	1.05 (30.85)	1.71 (50.25)
14	1.32 (38.71)	1.22 (35.75)	2.00 (58.62)
16	1.50 (43.96)	1.40 (41.03)	2.29 (66.99)
18	1.69 (49.53)	1.57 (46.01)	2.57 (75.37)
20	1.88 (55.10)	1.75 (51.29)	2.86 (83.74)
22	2.07 (60.07)	1.92 (56.27)	3.14 (92.12)

1 therm = 29.31 kWh    1 litre Gas Oil = 10.6 kWh    1 litre Grade G oil = 11.4 kWh  
1 litre propane = 7 kWh    1 tonne propane = 19,900kWh

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