

# M. Fuel Properties

**Table M.1: Solid Fuel Calorific Values (Gross)**

Region	Mine	Type	Mbtu/tonne	Megajoules/kg
Waikato	Huntly	Sub-bituminous	21.73	22.93
	Rotowaro	Sub-bituminous	21.08	22.24
	Maramarua	Sub-bituminous	19.12	20.17
Buller	Stockton	Bituminous	30.00	31.65
Reefton	Echo*	Bituminous	29.26	30.87
	Terrace	Bituminous	23.67	24.98
Greymouth	Spring Creek	Bituminous	28.27	29.83
	Strongman	Bituminous	28.69	30.27
Canterbury	Canterbury Coal	Sub-bituminous	19.75	20.84
Otago	Kai Point	Sub-bituminous	18.64	19.67
Southland	Ohai	Sub-bituminous	22.85	24.11
	New Vale	Lignite	14.45	15.25
* Largest of several mines				
			<b>Sampled at the Mine Ready for Delivery</b>	
			Mbtu/tonne	Megajoules/kg
<b>Average Coal Figures (weighted for 2005 production)</b>				
Bituminous (Export)			29.86	31.51
Bituminous (Used in New Zealand)			28.13	29.68
Sub-bituminous			21.25	22.42
Lignite			15.10	15.93
Peat			7.11	7.50
Type of Wood	% of Moisture/kg of Wet Wood		Mbtu/tonne	Megajoules/kg
Oven-dried Wood	0–0		19.47	20.55
Fresh Harvested	50–55		8.84	9.33
Bark	60–70		8.59	9.06
Fuel Wood	38–41		11.45	12.08
Wooden Containers	23–29		14.15	14.94
Furniture Residues	12–14		16.86	17.79
Black Liquor	50–50		9.95	10.50

The calorific values of coal are based on the 2005 Analysis Update published by the Coal Association of New Zealand Inc. These analyses were collated by CRL Energy Ltd and were generally of samples collected at the minesite stockpiles ready for delivery to industrial users. The calorific value of a coal varies with moisture content, which depends on storage and transport conditions and the weather.

Table M.2: Solid Fuel Calorific Values (Net)

Region	Mine	Type	Mbtu/tonne	Megajoules/kg
Waikato	Huntly	Sub-bituminous	20.42	21.55
	Rotowaro	Sub-bituminous	19.79	20.88
	Maramarua	Sub-bituminous	17.77	18.75
Buller	Stockton	Bituminous	28.81	30.40
Reefton	Echo*	Bituminous	28.06	29.61
	Terrace	Bituminous	22.47	23.71
Greymouth	Spring Creek	Bituminous	27.04	28.53
	Strongman	Bituminous	27.49	29.01
Canterbury	Canterbury Coal	Sub-bituminous	18.39	19.40
Otago	Kai Point	Sub-bituminous	17.24	18.19
Southland	Ohai	Sub-bituminous	21.58	22.77
	New Vale	Lignite	12.95	13.66
* Largest of several mines				
			<b>Sampled at the Mine Ready for Delivery</b>	
			Mbtu/tonne	Megajoules/kg
<b>Average Coal Figures (weighted for 2005 production)</b>				
Bituminous (Export)			28.67	30.25
Bituminous (Used in New Zealand)			26.92	28.40
Sub-bituminous			19.98	21.08
Lignite			13.61	14.36
Peat			5.21	5.50
Type of Wood	% of Moisture/kg of Wet Wood		Mbtu/tonne	Megajoules/kg
Oven-dried Wood	0–0		18.20	19.20
Fresh Harvested	50–55		7.01	7.40
Bark	60–70		6.63	7.00
Fuel Wood	38–41		9.76	10.30
Wooden Containers	23–29		12.60	13.30
Furniture Residues	12–14		15.45	16.30
Black Liquor	50–50		8.15	8.60

The calorific values of coal are based on the 2005 Analysis Update published by the Coal Association of New Zealand Inc. These analyses were collated by CRL Energy Ltd and were generally of samples collected at the minesite stockpiles ready for delivery to industrial users. The calorific value of a coal varies with moisture content, which depends on storage and transport conditions and the weather.

Table M.3: Petroleum Calorific Values (Gross)

	kg/litre	bb/tonne	Megajoules/bbl	Megajoules/kg	Megajoules/litre
<b>Indigenous Crudes</b>					
Kaimiro Crude	0.794	7.92	5,854.0	46.37	36.82
Kapuni Condensate	0.766	8.21	5,693.9	46.75	35.81
Mangahewa	0.806	7.80	6,386.2	49.83	40.16
Maui Condensate	0.739	8.51	5,536.6	47.12	34.82
McKee Crude	0.832	7.56	6,062.8	45.83	38.13
Ngatoro Crude	0.854	7.36	5,030.2	37.05	31.64
Tariki-Ahuroa	0.794	7.92	5,854.0	46.37	36.82
Waihapa Crude	0.886	7.10	6,311.2	44.80	39.69
<b>Imported Crudes/Residues</b>					
Al Shaheen	0.881	7.14	6,227.5	44.46	39.17
Bonny Light	0.859	7.32	6,204.9	45.43	39.02
Champion	0.859	7.32	6,204.9	45.43	39.02
Cossack	0.790	7.96	5,824.7	46.37	36.63
Iran Residue	0.954	6.59	6,589.8	43.44	41.45
Khafji	0.859	7.32	6,204.9	45.43	39.02
Kidurong	0.844	7.45	6,115.3	45.58	38.46
Legendre	0.814	7.73	5,947.5	45.95	37.41
Masila	0.873	7.20	6,255.8	45.07	39.34
Murban Crude	0.830	7.58	6,052.1	45.86	38.06
Oman Residue	0.850	7.40	6,118.9	45.27	38.48
Varanus	0.835	7.53	6,068.6	45.72	38.17
Woolybutt	0.784	8.02	5,786.3	46.42	36.39
<b>Refinery Feedstocks</b>					
Naphtha	0.750	8.39	5,601.2	46.97	35.23
Middle Distillate	0.820	7.67	5,997.5	46.00	37.72
Lgo/Kero Ex Naphtha	0.810	7.76	5,943.7	46.15	37.38
Intermediate Variation	0.767	8.20	5,700.1	46.74	35.85
Intermediate Residue	0.899	7.00	6,405.2	44.81	40.28
Blendstock	0.840	7.49	6,105.0	45.71	38.40
<b>Petroleum Products*</b>					
Premium Unleaded Gasoline	0.752	8.37	5,612.2	46.95	35.30
Regular Unleaded Gasoline	0.740	8.50	5,543.0	47.10	34.86
Automotive Gas Oil	0.838	7.51	6,091.7	45.73	38.31
Automotive Gas Oil – 50ppm Sulphur	0.828	7.60	6,020.2	45.75	37.86
Marine Diesel Oil	0.859	7.33	6,191.1	45.35	38.94
Light Fuel Oil	0.916	6.87	6,399.6	43.94	40.25
Heavy Fuel Oil	0.944	6.66	6,470.0	43.11	40.69
Bunker Fuel Oil	0.956	6.58	6,503.4	42.78	40.90
Power Station Fuel Oil	0.890	7.07	6,360.9	44.95	40.01
Export Fuel Oil	0.940	6.69	6,598.7	44.15	41.50
Lighting Kerosene	0.788	7.98	5,813.5	46.40	36.56
Jet Fuel	0.800	7.86	5,887.6	46.28	37.03
Aviation Gasoline	0.716	8.78	5,384.8	47.30	33.87
Blended Heating Oil	0.824	7.63	6,079.1	46.40	38.23
Bitumen	1.028	6.12	6,750.1	41.30	42.45
Natural Gasoline	0.668	9.42	5,130.0	48.30	32.26
<b>Liquid Petroleum Gas**</b>					
LPG 60/40	0.534	11.78	4,203.8	49.51	26.44
General Product LPG	0.536	11.73	4,219.6	49.51	26.54
Propane	0.508	12.38	4,027.5	49.86	25.33
Butane	0.572	11.00	4,465.5	49.10	28.09

Sources:

\* The calorific values of petroleum products are based on the New Zealand Refining Company Limited's update for 2005.

\*\* Natural Gas Corporation (now owned by Vector).

Table M.4: Petroleum Calorific Values (Net)

	kg/litre	bb/tonne	Megajoules/bbl	Megajoules/kg	Megajoules/litre
<b>Indigenous Crudes</b>					
Kaimiro Crude	0.794	7.92	5,480.3	43.41	34.47
Kapuni Condensate	0.766	8.21	5,326.1	43.73	33.50
Mangahewa	0.806	7.80	5,770.1	45.02	36.29
Maui Condensate	0.739	8.51	5,170.0	44.00	32.52
McKee Crude	0.832	7.56	5,691.0	43.02	35.79
Ngatoro Crude	0.854	7.36	4,728.1	34.82	29.74
Tariki-Ahuroa	0.794	7.92	5,480.3	43.41	34.47
Waihapa Crude	0.886	7.10	5,987.1	42.50	37.66
<b>Imported Crudes/Residues</b>					
Al Shaheen	0.881	7.14	5,842.8	41.71	36.75
Bonny Light	0.859	7.32	5,763.7	42.20	36.25
Champion	0.859	7.32	5,825.2	42.65	36.64
Cossack	0.790	7.96	5,451.1	43.40	34.28
Iran Residue	0.954	6.59	6,216.2	40.98	39.10
Khafji	0.859	7.32	5,825.2	42.65	36.64
Kidurong	0.844	7.45	5,735.1	42.75	36.07
Legendre	0.814	7.73	5,574.6	43.07	35.06
Masila	0.873	7.20	5,869.5	42.29	36.91
Murban Crude	0.830	7.58	5,674.7	43.00	35.69
Oman Residue	0.850	7.40	5,730.4	42.40	36.04
Varanus	0.835	7.53	5,692.4	42.89	35.80
Woolybutt	0.784	8.02	5,409.7	43.40	34.02
<b>Refinery Feedstocks</b>					
Naphtha	0.750	8.39	5,218.4	43.76	32.82
Middle Distillate	0.820	7.67	5,623.3	43.13	35.37
Lgo/Kero Ex Naphtha	0.810	7.76	5,570.2	43.25	35.03
Intermediate Variation	0.767	8.20	5,328.1	43.69	33.51
Intermediate Residue	0.899	7.00	5,999.2	41.97	37.73
Blendstock	0.840	7.49	5,729.7	42.90	36.04
<b>Petroleum Products*</b>					
Premium Unleaded Gasoline	0.752	8.37	5240.5	43.84	32.96
Regular Unleaded Gasoline	0.740	8.50	5172.6	43.95	32.53
Automotive Gas Oil	0.838	7.51	5713.4	42.89	35.93
Automotive Gas Oil – 50 ppm Sulphur	0.828	7.60	5646.5	42.91	35.51
Marine Diesel Oil	0.859	7.33	5812.9	42.58	36.56
Light Fuel Oil	0.916	6.87	6029.7	41.40	37.92
Heavy Fuel Oil	0.944	6.66	6105.3	40.68	38.40
Bunker Fuel Oil	0.956	6.58	6140.1	40.39	38.62
Power Station Fuel Oil	0.890	7.07	5717.0	40.40	35.96
Export Fuel Oil	0.940	6.69	6174.2	41.31	38.83
Lighting Kerosene	0.788	7.98	5462.7	43.60	34.36
Jet Fuel	0.803	7.84	5528.2	43.32	34.77
Aviation Gasoline	0.716	8.78	5066.1	44.50	31.86
Blended Heating Oil	0.824	7.63	5686.1	43.40	35.76
Bitumen	1.028	6.12	6399.1	39.15	40.25
Natural Gasoline	0.668	9.42	4812.5	45.31	30.27
<b>Liquid Petroleum Gas**</b>					
LPG 60/40	0.534	11.78	3,876.3	45.65	24.38
General Product LPG	0.536	11.73	3,890.9	45.66	24.47
Propane	0.508	12.38	3,713.5	45.98	23.36
Butane	0.572	11.00	4,118.2	45.28	25.90

Sources:

\* The calorific values of petroleum products are based on the New Zealand Refining Company Limited's update for 2005.

\*\* Natural Gas Corporation (now owned by Vector).

**Table M.5: Oil Conversion Factors<sup>1</sup>**

	Thousand Tonnes/PJ	m <sup>3</sup> /PJ
Crude Oil and Condensate	21.801	28,903
Refinery Blendstocks and Other Feedstocks	21.864	28,506
Oil Products Total	21.804	25,773
Petrol Total	21.282	29,154
Premium Unleaded Petrol	21.188	27,990
Regular Unleaded Petrol	21.308	28,298
Diesel	21.749	26,459
Fuel Oil	22.672	24,644
Aviation Fuels	21.566	27,127
Other Petroleum Products	27.676	32,713
LPG/NGL	20.197	37,542

Note:

<sup>1</sup> These conversion factors apply for the 2005 calendar year only. Conversion factors depend upon source (weight average) feedstocks and products.

**Table M.6: Gas Physical Properties**

	Liquid Density	Gas Density	Relative Density		Gross		Net	
	kg/m <sup>3</sup>	kg/m <sup>3</sup>	Water = 1	Air = 1	MJ/kg	MJ/m <sup>3</sup>	MJ/kg	MJ/m <sup>3</sup>
Kapuni Wellhead				1.062		25.7		23.3
Kapuni Processed				0.666*		41.3*		37.4*
Maui Wellhead				0.955		47.2		43.1
Maui Processed				0.666*		39.3*		35.5*
McKee Processed				0.712*		41.3*		37.3*
Methane	300.0	0.678	0.415	0.554	55.6	37.7	50.1	34.0
Ethane	356.6	1.272	0.546	1.038	51.9	66.0	47.5	60.4
Propane	506.7	1.865	0.585	1.523	50.4	94.0	46.4	86.5
n-Butane	583.1	2.458	0.600	2.007	49.5	121.8	45.7	112.5
iso-Butane	562.1	2.458	0.600	2.007	49.4	121.4	45.6	112.1
n-Pentane	629.9	3.052	0.630	2.491	49.0	149.7	45.4	138.5
iso-Pentane	623.3	3.052	0.621	2.491	48.9	149.3	45.3	138.1
n-Hexane	662.7	3.644	0.664	2.975	48.7	177.6	45.1	164.5
n-Heptane	686.9	4.237	0.679	3.460	48.5	205.4	45.0	190.5
n-Octane	705.6	4.831	0.703	3.944	48.3	233.3	44.8	216.5
n-Nonane	720.6	5.426	0.718	4.428	48.1	261.2	44.7	242.5
n-Decane	732.8	6.017	0.730	4.913	48.0	289.1	44.6	268.6
Hydrogen			0.071			11.9		10.1
Acetylene			0.906			55.4		52.6

\* Source: Natural Gas Corporation (now owned by Vector).

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