

Energy units and calculation of net calorific value and energy density as received

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Energy units

	toe	MWh	GJ	Gcal
toe	1	11.63	41.868	10
MWh	0.086	1	3.6	0.86
GJ	0.02388	0.2778	1	0.2388
Gcal	0.1	1.163	4.1868	1

REMEMBER THIS

1 toe = 11.63 MWh

toe = equivalent oil tonne

1 MWh = 3 600 MJ = 3.6 GJ

1 MW = MJ/s

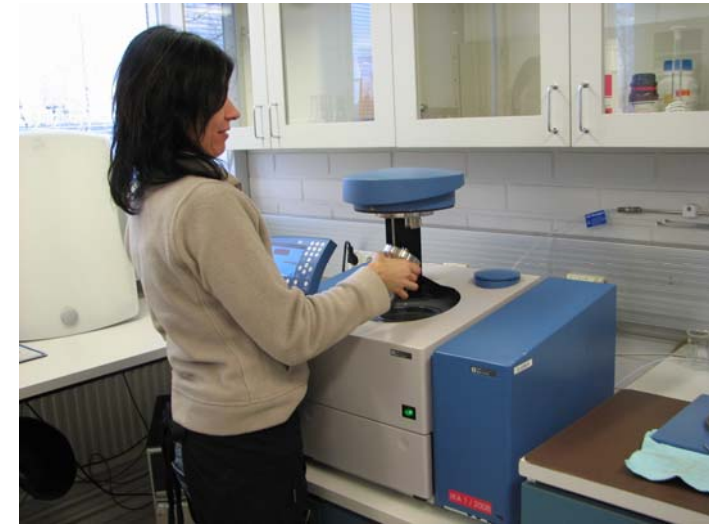
k	kilo	10^3	T	tera	10^{12}
M	mega	10^6	P	peta	10^{15}
G	giga	10^9	E	eksa	10^{18}

Net calorific value as received (Q)

- ◆ Minimum value to be stated (calculation by taking into account the selected moisture category and the typical variation of the net calorific value of dry matter at constant pressure)

$$q_{p,\text{net,ar}} = q_{p,\text{net,d}} \times \left(\frac{100 - M_{\text{ar}}}{100} \right) - 0,02443 \times M_{\text{ar}}$$

- ◆ $q_{p,\text{net,ar}}$ net calorific value as received, (MJ/kg)
- ◆ $q_{p,\text{net,d}}$ net calorific value (constant pressure) dry basis (MJ/kg)
- ◆ M_{ar} total moisture (w-%)
- ◆ 0,02443 is the correction factor of the enthalpy of vaporization (constant pressure) for water (moisture) at 25 °C [MJ/kg per 1 w-% of moisture]



*Calorimetric bomb EN 14918,
Photo: ENAS Oy*

Calculation formula is available in Annex D in EN 14961-1

Net calorific value as received (Q)

- ◆ Minimum value to be stated (calculation by taking into account the selected moisture category and the typical variation of the net calorific value of dry and ash-free matter at constant pressure)

$$q_{p,\text{net,ar}} = \left[\left(\frac{q_{p,\text{net,daf}} \times (100 - A_d)}{100} \right) \times \left(\frac{100 - M_{\text{ar}}}{100} \right) \right] - 0,024\,43 \times M_{\text{ar}}$$

- ◆ $q_{p,\text{net,ar}}$ net calorific value as received, (MJ/kg)
- ◆ $q_{p,\text{net,daf}}$ net calorific value (constant pressure) dry basis and ash-free (MJ/kg)
- ◆ M_{ar} total moisture (w-%)
- ◆ A_d the ash content in dry basis (w-%);
- ◆ 0,02443 is the correction factor of the enthalpy of vaporization (constant pressure) for water (moisture) at 25 °C
[MJ/kg per 1 w-% of moisture]

Calculation formula is available in Annex D in EN 14961-1

Calculation of energy density as received

$$E_{ar} = \frac{1}{3\,600} \times q_{p,net,ar} \times BD_{ar}$$

- E_{ar} the energy density of the biofuel as received, in megawatts hour per cubic metre (MWh/m³) of bulk volume;
- $q_{p,net,ar}$ the net calorific value (at constant pressure) as received, in megajoules per kilogram (MJ/kg);
- BD_{ar} the bulk density, i.e. volume weight of the biofuel as received, in kilograms per cubic metre (kg/m³) of bulk volume;
- 0,02443 the conversion factor for the energy units (megajoules (MJ) to megawatts hour (MWh)).