COMPARABLE FUEL PROPERTIES, ALL ENERGY CONTENTS BEING LOWER HEATING VALUES

Fuel	Carbon content	Lower heating value		Relative to petrol		Relative to corresponding fossil fuel		Density	Relative effective added mileage	Effective energy content of fuel, %		Relative to petrol	Relative to corresponding fossil fuel		Composition	Molecular weight	
	%	MJ/kg	MJ/kg C	MJ/kg	MJ/kg C	MJ/kg	MJ/kg C	kg/l	%	MJ/kg	MJ/kg C	in MJ/kg	in MJ/kg	in MJ/kg C			
Petrol	86.4	43.2	50.0	100.0	100.0	100.0	100.0	0.745	0.0	43.2	50.0	100.0	100.0	100.0			Note 1
Diesel	86.1	43.1	50.1	99.8	100.1	100.0	100.0	0.832	0.0	43.1	50.1	99.8	100.0	100.0			Note 1
Bioethanol	52.2	26.8	51.3	62.0	102.7	62.0	102.7	0.794	0.0	26.8	51.3	62.0	62.0	102.7			Note 1
Biodiesel	76.5	37.2	48.6	86.1	97.3	86.3	97.1	0.890	0.0	37.2	48.6	86.1	86.3	97.1			Note 1
Biodiesel ACP	78.7	37.2	47.3	86.1	94.5	86.3	94.4	0.890	0.0	37.2	47.3	86.1	86.3	94.4	C23H46O2	352	Note 2
PPO	77.2	37.2	48.2	86.1	96.4	86.3	96.3	0.920	4.8	39.0	50.5	90.2	90.4	100.9			Note 1
Methane	75.0	50.0	66.7	115.7	133.3	115.7	133.3		0.0	50.0	66.7	115.7	116.0	133.2			Note 1
Hydrogen	0	120.1		278.0		278.0											Note 1
Hard coal	77.2	29.4	38.1	68.1	76.2	100.0	100.0		0.0	29.4	38.1	68.1	100.0				Note 1
Wood	50.0	18.0	36.0	41.7	72.0	61.2	94.5		0.0	18.0	36.0	41.7	94.5				Note 1
Straw		17.20		39.8		58.5											
Petrol	86.5	43.7	50.5	100.0	100.0	100.0	100.0	0.740	0.0	43.7	50.5	100.0	100.0	100.0	C8H15	111	Note 3
Diesel	84.7	42.7	50.4	97.7	99.8	100.0	100.0	0.840	0.0	42.7	50.4	97.7	100.0	100.0	C12H26	185	Note 3
Bioethanol	52.2	26.9	51.5	61.6	102.0	61.6	102.0	0.790	0.0	26.9	51.5	61.6	63.0	102.0	C2H6O	46	Note 3
Biodiesel	77.0	37.3	48.4	85.4	95.9	87.4	96.1	0.880	0.0	37.3	48.4	85.4	87.4	96.1	C19H36O2	296	Note 3
Biodiesel ACP	78.7	37.3	47.4	85.4	93.8	87.4	94.0	0.880	0.0	37.3	47.4	85.4	87.4	94.0	C23H46O2	352	Note 2
PPO	77.4	37.3	48.2	85.4	95.4	87.4	95.6	0.920	4.5	39.0	50.4	89.2	91.3	99.9	C57H104O6	884	Note 3
Petrol	86.5	43.4	50.2	100.0	100.0	100.0	100.0	0.740	0.0	43.4	50.2	100.0	100.0	100.0	C8H15	111	Note 4
Diesel	87.0	42.8	49.2	98.6	98.1	100.0	100.0	0.840	0.0	42.8	49.2	98.6	100.0	100.0	C14H25	193	Note 4
Bioethanol	52.2	26.9	51.5	62.0	102.7	62.0	102.7	0.790	0.0	26.9	51.5	62.0	62.0	102.7	C2H6O	46	Note 4
Biodiesel	77.0	37.5	48.7	86.4	97.1	87.6	99.0	0.880	0.0	37.5	48.7	86.4	87.6	99.0	C18.7H35.4O2	292	Note 4
Biodiesel ACP	78.7	37.5	47.6	86.4	95.0	87.6	96.9	0.880	0.0	37.5	47.6	86.4	87.6	96.9	C23H46O2	352	Note 2
Methane	75.0	47.1	62.8	108.5	125.2	108.5	125.2	0.920	0.0	47.1	62.8	108.5	110.0	127.7	CH4	16	Note 4
Hydrogen	0	121.3										0.0	0.0	0.0	H2	2	Note 4

VALUES OF AVERAGED MONOSATURATED FATTY ACIDS

C atoms in acid	Acid Composition C	H	O	Carbon %	Molecular weight	Ester Composition C	H	O	Carbon %	Molecular weight	Triglyceride Composition C	H	O	Carbon %	Molecular weight	
22	22	42	2	78.11	338	23	44	2	78.41	352	69	128	6	78.71	1052	Note 5
18	18	34	2	76.60	282	19	36	2	77.03	296	57	104	6	77.38	884	Note 5
17.7	17.7	33.4	2	76.46	277.8	18.7	35.4	2	76.90	291.8	56.1	102.2	6	77.25	871.4	Note 5
17.714	17.71	33.43	2	76.46	278	18.71	35.43	2	76.91	292	56.14	102.28	6	77.26	871.99	Note 5

VALUES OF CERTAIN SOLIDS FUELS AND FEEDSTUFFS, ALL ENERGY CONTENTS BEING LOWER HEATING VALUES

	Dry matter content	Energy of dry matter	Energy of total	Share of crop real value	ACP value	Energy share in crop	N content of crop (part) Dry matter	Total	Energy content MJ/kg N in crop	Energy content MJ/kg N in crop /(N2O/N2) /GWP(N2O/CO2 emission ratio)	Meq/M /(N2O-N/N)	Energy content relative to corresponding	Energy content of corresponding amount of corresponding fossil fuel,			
	%	MJ/kg	MJ/kg	%	%	%	g/kg	g/kg	in crop			fossil fuel, %	MJ/kg	MJ/kg C	MJ/kg CO2	
Hard coal	100.0	29.40	29.40													Note 1
Wood	70.0	25.71	18.00									61.22	29.4	38.1	10.39	Note 1
Straw	84.0	20.48	17.20									58.5	29.4	38.1	10.39	Note 1
Rapeseeds	92.5	28.54	26.40	100.0		100.0	33.5	31.0	853	1.83	5.66	89.78	29.4	38.1	10.39	Note 6
PPO	99.0	37.58	37.20	35.5		50.0	0.0	0.0	427	0.92	14.88	86.31	43.1	50.1	13.65	Note 6
Rapeseed cakes	89.0	22.98	20.45	64.5		50.0	53.9	48.0	426	0.92	11.34	69.56	29.4	38.1	10.39	Note 6
Rapeseeds	92.5	28.54	26.40	100.0		100.0	33.5	31.0	853	1.83	5.66	89.78	29.4	38.1	10.39	Note 6
Biodiesel	99.0	37.58	37.20	38.4	45	54.1	0.0	0.0	462	0.99	13.76	86.31	43.1	50.1	13.65	Note 6
Rapeseed meal	88.2	21.27	18.76	58.6		41.7	59.8	52.8	356	0.76	13.59	63.82	29.4	38.1	10.39	Note 6
Wheat whole	85.0	18.10	15.39	100.0		100.0	18.4	15.6	984	2.12	4.91	52.34	29.4	38.1	10.39	Note 6
Wheat bioethanol	100.0	26.80	26.80	28.9	31.3	50.3	0.0	0.0	495	1.06	12.81	62.04	43.2	50.0	13.64	Note 6
Wheat DDG	90.0	21.33	19.20	33.9		42.3	51.2	46.1	417	0.90	11.60	65.29	29.4	38.1	10.39	Note 6
Wheat WDG	11.5	21.33	2.45	265.6		42.3	51.2	5.9								Note 6
Barley whole	85.0	17.88	15.20	100.0		100.0	17.8	15.1	1004	2.16	4.81	51.69	29.4	38.1	10.39	Note 6
Barley bioethanol	100.0	26.80	26.80	27.0	31.3	47.6	0.0	0.0	478	1.03	13.26	62.04	43.2	50.0	13.64	Note 6
Barley DDG	90.0	21.33	19.20	32.8		41.5	51.2	46.1	403	0.87	11.99	65.29	29.4	38.1	10.39	Note 6
Barley WDG	11.5	21.33	2.45	257.0		41.5	51.2	5.9								Note 6
Maize whole	87.5	18.20	15.93	100.0		100.0	15.2	13.3	1197	2.57	4.03	54.17	29.4	38.1	10.39	Note 6
Maize bioethanol	100.0	26.80	26.80	31.3	31.3	52.7	0.0	0.0	631	1.36	10.06	62.04	43.2	50.0	13.64	Note 6
Maize DDG	90.0	21.31	19.18	31.7		38.2	46.6	41.9	389	0.84	12.41	65.24	29.4	38.1	10.39	Note 6

NOTES

1 Values according to [1]

2 Values with carbon content according to [2]

3 Values according to [3]

4 Values according to [4]

5 Values by calculation, being in accordance with various sources including [1], [2], [3], and [4]

6 Feedstuff values and calculated share of PPO in rapeseed crop (35.5% kg/kg) according to [5] and [6]
Biofuel values according to the first table, according to [1]
Share of biodiesel in rapeseed crop (38.4% kg/kg) according to [1]
Values according to some other sources:
37.4% according to [7]
38.8% according to [8]
40.9% according to [9]
45.0% according to [2]
Share of bioethanol in wheat crop (28.9% kg/kg) according to [1]
Values according to some other sources:
26.5% as calculated from the amounts in litres stated in [8]
27.6% according to [9] (IEA 2002 values)
28.1% according to [7]
29.0% according to [10]
29.2% according to [9]
30.5 according to [9] (NDDC 2002 values)
31.3% according to [2]
Share of bioethanol in barley crop (27% kg/kg) as the upper quarter point of the range of values for barley and rye (24 – 28%) according to [9]
Share of bioethanol in maize crop (31.3% kg/kg) according to [9] (average of USDA 2002 values)
Values according to some other sources:
>30% according to [8]
31.0 according to [10] (values for USA)
31.3% according to [2]
32,4 according to [10] (values for EU)

SOURCES:

[1] EU Joint Research Centre: Well to Tank Reports, App 1
Available at http://ies.jrc.ec.europa.eu/wtw.html
[2] N2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels
Available at http://www.atmos-chem-phys-discuss.net/7/11191/2007/acpd-7-11191-2007.html
[3] ETA Renewable Energies: Stationary Applications of Liquid Biofuels, Final Report
Available at: http://ec.europa.eu/energy/res/sectors/doc/bioenergy/pta_biofuels_final_rev2_1.pdf
[4] U.S. Department of Energy: Properties of Fuels
Available at: http://www.eere.energy.gov/afdc/, search for fueltable
[5] Dansk Kvæg: Fodermiddeltabel 2005, Rapport 112, (Danish Cattle: Feedstuff table 2005, Report 112
Available for ordering at http://www.lr.dk
[6] NorFor, Nordic Feedstuff Evaluation System: Various feedtables, currently updated
Available at: http://www.norfor.info/
[7] USDA: EU: Biodiesel Industry Expanding Use of Oilseeds Available at: http://www.fas.usda.gov/pecad2/highlights/2003/09/biodiesel3/
USDA: GAIN Report Number: E36081, EU-25, Sugar, The Economics of Bioethanol Production in the EU Available at: http://www.fas.usda.gov/gainfiles/200605/146187771.pdf
Both available by search at: http://www.fas.usda.gov/
[8] Starthclyde University: Biodiesel Production/Ethanol Production
Available by search at: http://www.strath.ac.uk/search/
[9] Department of Transport: International resource costs of biodiesel and bioethanol
Available at: http://www.dft.gov.uk/pgr/roads/environment/research/cqvcf/internationalresourcecostsof3833?page=4#a100
[10] Commission staff working document 52006SC1167, Annexes to the report from the Commission to the Council on the review of the energy crops scheme
Available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52006SC1167:EN:HTML

RECALCULATION OF Meq/M VALUES ACCORDING TO [2]

FORMULAS AND VALUES:

$M = rC \times \mu CO2/\mu C \times cv$
$Meq = rN \times y \times \mu N2O/\mu N2 \times GWP/e$

y = 0.03 – 0.05	0.03	-	0.05
e = 0.4	0.4		
$\mu CO2/\mu C$ = 44/12	3.67		
$\mu N2O/\mu N2$ = 44/28	1.57		
GWP = 296	296		

Values for biofuels	*rC*	*cv*	*rN*	Meq/M recalculated			Meq/M stated in [2]		
Biodiesel/rapeseed	0.61	0.58	39	1.049	-	1.748	1.0	-	1.7
Bioethanol/wheat	0.44	0.37	22	1.286	-	2.143	1.3	-	2.1
Bioethanol/barley/oat	0.44	0.37	19	1.110	-	1.851	1.1	-	1.9
Bioethanol/maize	0.44	0.37	15	0.877	-	1.461	0.9	-	1.5
Bioethanol/sugar cane	0.43	0.30	7.3	0.538	-	0.897	0.5	-	0.9