

Appendix 8: Energy: basic data**Table 1: Density of fuels**

Type of fuel	Definition (Sullivan and Heavner, 1981)	Density (Energifakta, 1999)	
		kg/litre	litre/kg
Hard coal	All coal of higher ranks than lignite	0,80	1,25
Lignite	A brownish black coal in which the alteration of vegetal material has proceeded further than in peat but not so far as subitumnious coal	-	-
Coal	a solid brittle combustible carbonaceous rock	-	-
Coke	the residue of coal after destructive distillation and used as fuel	0,45	2,22
Fuel oil	Liquid or liquefied petroleum product for the generation of heat or power. Excl. oils with flash point below 100° F	0,84-0,94	1,19-1,06
Naphtha	an artificial, volatile, colourless liquid obtained from petroleum	-	-
Diesel	-	0,84-0,85	1,20-1,18
Natural gas	naturally occurring mixtures of hydrocarbon gases and vapours	0,00075	1333
Gasoline	a refined petroleum product which, by its composition, is suitable for use as a fuel in internal-combustionengines	0,73	1,37

Table 2: Energy in hard coal

Country	UK	Sweden
Source	Audesley, 1997, p. 29	Energifakta, 1999
Comment	Production energy 55.5 % of inherent energy	-
Inherent energy content, MJ per kg	27,1	27,2
Production and delivery energy, MJ/kg	15	-
Total inherent energy, MJ/kg	42,1	-

Table 3: Energy in lignite

Country	UK
Source	Audesley, 1997, p. 29
Comment	Production energy 22.5 % of inherent energy
Inherent energy content, MJ per kg	8,3
Production and delivery energy, MJ/kg	1,9
Total inherent energy, MJ/kg	10,2

Table 4: Energy in coal

Country	Europe
Source	Audesley, 1997, p. 29
Comment	-
Inherent energy content, MJ per kg	8,3
Production and delivery energy, MJ/kg	1,9
Total inherent energy, MJ/kg	10,2

Table 5: Energy in fuel oil

Country	Europe	Sweden
Source	Audesley, 1997, p. 29	Uppenberg et al, 1999
Comment	production energy 9.7 % of inherent energy	production energy 5-9 % of inherent energy
Inherent energy content, MJ per kg	42,7	41,2-42,7
Production and delivery energy, MJ/kg	4,1	2,1-3,8
Total inherent energy, MJ/kg	46,8	43,2-46,6

Table 6: Energy in naphta

Country	Europé
Source	Audesley, 1997, p. 29
Comment	production energy 13 % of inherent energy
Inherent energy content, MJ per kg	40,7
Production and delivery energy, MJ/kg	5,3
Total inherent energy, MJ/kg	46

Table 7: Energy in diesel

Country	Europe	Sweden
Source	Audesley, 1997, p. 29	Uppenberg et al, 1999
Comment	production energy 9.5 % of inherent energy	production energy 6 % of inherent energy
Inherent energy content, MJ per kg	42,8	42,7
Production and delivery energy, MJ/kg	4,1	2,56
Total inherent energy, MJ/kg	46,9	45,3

Table 8: Energy in natural gas

Country	Europe	Sweden
Source	Audesley, 1997, p. 29	Uppenberg et al, 1999
Comment	production energy 9.1 % of inherent energy	production energy 2 % of inherent energy
Inherent energy content, MJ per kg	46,1	51,9
Production and delivery energy, MJ/kg	4,2	1,04
Total inherent energy, MJ/kg	50,3	52,9

Table 9: Energy in petroleum

Country	Sweden
Source	Uppenberg et al, 1999
Comment	production energy 10 % of inherent energy
Inherent energy content, MJ per kg	43,01
Production and delivery energy, MJ/kg	4,30
Total inherent energy, MJ/kg	47,32

Table 10: Energy in steam, some examples (Lide et al, 1995, p. 6-18).

Pressure Mpa	Temp. K	Density, kg/m ³	Entalpy J/g
0,1	273,15	999,83	0,06
0,1	1000	0,21673	3990,1
0,1	2000	0,10833	6587,9
1	273,15	1000,3	0,98
1	1000	2,1724	3985,2
1	2000	1,0829	6587,2
10	273,15	1004,8	10,1
10	1000	22,243	3934,5
10	2000	10,784	6580,8
100	273,5	1045,3	95,4
100	1000	265,84	3431,3
100	2000	102,94	6532,4

Table 11: Conversion efficiencies

	Source	Efficiency	Comment
Heat production	Uppenberg et al, 1999	0,89-1,04	efficiencies for plants run on fuel oil, gas oil, coal and natural gas
Power production	Uppenberg et al, 1999	0,44-0,58	efficiencies for plants run on fuel oil, gas oil, coal and natural gas
Power production	Frischknecht et al, 1994	0,32	European mix
Steam production	Hendri van der Put, Ångpanneföreningen, pers. com.-00	0,8-0,9	efficiencies for new and old plants