Appendix B. Heat Content and Useful Conversions

Table B.1. Heating Values

Material	Energy Content	Source
H_2 (HHV)	0.135 million Btu per kg	P.L. Smith and M.K. Mann, *Life Cycle Assessment of Hydrogen Production via Natural Gas Steam Reforming* (National Renewable Energy Laboratory, February 2001).
H_2 (LHV)	0.114 million Btu per kg	
Motor gasoline (HHV)	0.125 million Btu per gallon	Bureau of Transportation Statistics, *National Household Travel Survey (NHTS) 2001*, Appendix N, Table 9 (January 2004).[a]
Motor gasoline (LHV)	0.1154 million Btu per gallon	
Dry natural gas (HHV)	1,029 million Btu per cubic foot	EIA, *Annual Energy Review 2006*, Table A4.[b,c]

[a]Web site www.bts.gov/publications/National_household_travel_survey_2001_cd/html/appendix_n/table_9.html.

[b]See also, for both LHV and HHV for natural gas, GREET *Transportation Fuel Cycle Analysis Model*, GREET 1.8a, developed by Argonne National Laboratory, Argonne, IL, released August 30, 2007, web site http://www.transportation.anl.gov/software/GREET/index.html.

[c]The HHV for natural gas presented here (1,089 Btu / ft^3) is equal to the *AER* value of 1,029 Btu / ft^3 when the differences in temperature are taken into account.

Notes: The lower heating values and the higher heating values are the amounts of heat released when a substance is combusted at an initial temperature of 25°C. For the lower heating value (LHV), the products are returned only to a temperature of 150°C, and thus the latent heat of vaporization in the water is not released. In contrast, higher heating value (HHV) measurements assume that the products are cooled back down to 25°C, and so the heat from the water is released upon condensation. For stationary combustion (such as in power plants) the HHV measure is more appropriate, because the heat of the product exhaust gases can be harnessed before being discharged. The LHV is more appropriate for combustion processes in transportation, because no useful work is extracted from the exhaust gases. In this analysis, the LHV measure is used in accounting for hydrogen production costs.