

Energy Conversion Fact Sheet

Quick-reference constants for sustainable-fuel and energy analysis — all fuel figures on a lower heating value (LHV) basis.

CARBON ECONOMICS
Dr Ilkka Hannula

ENERGY CONTENT (LHV)

CARRIER	GJ/T	MWH/T
Hydrogen	120	33.3
Ammonia	18.6	5.2
Jet fuel	43	11.9
Ethanol	28.9	8.0
Methanol	19.9	5.5
Methane (~natural gas)	50	13.9
Coal	25.1	7.0
Wood chips	18	5.0
SRF	20	5.6

DENSITY

SUBSTANCE	KG/M³
Hydrogen (NTP)	0.1
Hydrogen (350 bar)	25
Hydrogen (700 bar)	42
Jet fuel	837
Ethanol	789
Methanol	792
Natural gas (200 bar)	185

ENERGY UNIT CONVERSION

1 mmBtu = 1.055 GJ
1 bcm = 0.86 Mtoe = 36 PJ = 10 TWh
1 toe = 42 GJ = 7.5 boe
1 boe = 5.7 GJ
1 EJ = 24 Mtoe = 0.5 mboe/d = 8.3 MtH ₂

FUEL UNIT CONVERSIONS

HYDROGEN		
Amount	1	Mt
equals	120	PJ
equals	33.3	TWh
SAF		
Amount	1	Mt
equals	7.5	Mboe
equals	43	PJ
equals	12	TWh
USING 1 MT OF H ₂ FEEDSTOCK		
produces NH ₃	6.5	Mt
produces SAF	2.8	Mt
produces H ₂ -DRI steel	10	Mt

EMISSION INTENSITIES

COMBUSTION	KGCO ₂ /GJ
Natural gas	56
Coal	115

Source: IPCC AR5 Annex III — Technology-specific cost and performance parameters.

COST UNIT CONVERSIONS

\$60/bbl = \$10/GJ = \$430/tonne
\$100/bbl = \$17/GJ = \$730/tonne

RESOURCES NEEDED FOR 1 MT OF H₂

INPUT	AMOUNT
Electricity	49.8 TWh
Electrolyser cap. (5 000 h/yr)	10.0 GW
VRE capacity	14.9 GW
Purified water	60 Mt

CO₂ REQUIREMENTS

TO CONVERT 1 MT OF H ₂	AMOUNT
to SAF	8 Mt CO ₂
to methanol	7 Mt CO ₂

Reading the H₂ block: 1 Mt of hydrogen carries ~120 PJ (33.3 TWh) of energy and needs ~50 TWh of electricity to produce — the gap is electrolyser and downstream losses. That same megatonne can be converted into ~6.5 Mt ammonia, ~2.8 Mt SAF, or feed ~10 Mt of H₂-DRI steel.