신재생에너지
(Renewable Energy)

Introduction “Renewable” and “Energy”

“Sustainable” vs “Renewable” (see p.2 from main text book)

-Not substantially depleted by continued use
-Does not cause significant pollution/ health hazards

-Not many for such ideal “sustainable”

-The renewables appear generally more sustainable than fossil or nuclear fuels

Force: mass x acceleration
newton(N)

Energy: en(in) + ergon(work)
force x distance
joule(J) = newton x metres

Power: the rate at which energy is converted
energy /time
watt(W) = joule /second (We, Wt)

Energy for the period: power x time
(e.g.) 1 kWh = 3.6 MJ
(c.f.) kWh_e, kWh_t

* Power plant produce 1000 MW electricity
by burning 3000 MW fuel (the rest 2000 MW?)

Energy for bigger scale: EJ, toe, tce

* 6 litres of oil/day, person in 2002 (*10800 Mtoe in 2002)

Units for energy (or related) & conversion:

(1) kWh: 1000 x 60 x 60 = 3.6 x 10^6 joules

(2) Calorie: energy required to heat 1g of water by 1℃ ≒ 4.2J

(3) Btu(British Thermal Unit): energy required to heat 1lb of water by 1°F ≒ 1.055 kJ ≒ 0.293 kWh

(* 1 lb(pound) = 453.7 gram)

1 therm = 10^5 Btu (used for measurement of natural gas)

1 quad = 10^{15} Btu

Energy for bigger scale: EJ, toe, tce

* 6 litres of oil/day, person in 2002 (*10800 Mtoe in 2002)

Units for energy (or related) & conversion:

(4) 1 tonne oil: 1.5 tonnes had coal

≒ 3.0 tonnes lignite ≒ 12000 kWh

(5) 1 barrel: 42 US gallons ≒ 35 imperial gallons

≒ 0.136 tonnes ≒ 159 litres

(6) 1 horsepower: 550ft per second ≒ 0.746 kW

*US ton: traditional unit of weight used in US, = 2000 pounds

**tonne: a metric ton (1000 kg), ≒ 2205 pounds

***imperial ton = 2240 lb

Units for energy (or related) & conversion (exercise)

(1) Convert 15 MJ into Btu

(2) Convert 500 kg of oil equivalent per year into kW

Forms of Energy:

(1) Kinetic energy

(2) Potential energy (=gravitational energy)

(3) Thermal energy

(4) Electrical energy

(5) Electromagnetic energy

(6) Nuclear energy

Conversion of energy: 90% (water turbine, electric motor)
35-40% (coal-fired power station)
10-20% (internal combustion engine)

Forms of Energy according to the energy use:

(1) Primary energy (from Cleveland & Morris, 2006)
(a) the energy embodied in natural resources prior to undergoing any human-made conversions or transformations
(b) all energy consumed by end users

(2) Delivered energy: arrived energy after transmission losses

(3) Useful energy: final quantity after further losses