

# Energy and Power Units and Conversions

## Basic Energy Units

1 Joule (J) = Newton  $\times$  meter

1 calorie (cal) = 4.18 J = energy required to raise the temperature of 1 gram of water by 1°C

1 Btu = 1055 Joules = 778 ft-lb = 252 calories = energy required to raise the temperature 1 lb of water by 1°F

1 ft-lb = 1.356 Joules = 0.33 calories

1 physiological calorie = 1000 cal = 1 kilocal = 1 Cal

1 quad =  $10^{15}$  Btu

1 megaJoule (MJ) =  $10^6$  Joules = 948 Btu, 1 gigaJoule (GJ) =  $10^9$  Joules = 948,000 Btu

1 electron-Volt (eV) =  $1.6 \times 10^{-19}$  J

1 therm = 100,000 Btu

## Basic Power Units

1 Watt (W) = 1 Joule/s = 3.41 Btu/hr

1 kiloWatt (kW) =  $10^3$  Watt =  $3.41 \times 10^3$  Btu/hr

1 megaWatt (MW) =  $10^6$  Watt =  $3.41 \times 10^6$  Btu/hr

1 gigaWatt (GW) =  $10^9$  Watt =  $3.41 \times 10^9$  Btu/hr

1 horse-power (hp) = 2545 Btu/hr = 746 Watts

## Other Energy Units

1 horsepower-hour (hp-hr) =  $2.68 \times 10^6$  Joules = 0.746 kwh

1 watt-hour (Wh) =  $3.6 \times 10^3$  sec  $\times$  1 Joule/sec =  $3.6 \times 10^3$  J = 3.413 Btu

1 kilowatt-hour (kWh) =  $3.6 \times 10^6$  Joules = 3413 Btu

1 megaton of TNT =  $4.2 \times 10^{15}$  J

## Energy and Power Values

solar constant =  $1400 \text{ W/m}^2$

1 barrel (bbl) crude oil (42 gals) =  $5.8 \times 10^6$  Btu =  $9.12 \times 10^9$  J

1 standard cubic foot natural gas = 1000 Btu

1 gal gasoline =  $1.24 \times 10^5$  Btu

1 ton coal  $\approx 3 \times 10^6$  Btu

1 ton  $^{235}\text{U}$  (fissioned) =  $70 \times 10^{12}$  Btu

1 million bbl oil/day =  $5.8 \times 10^{12}$  Btu/day =  $2.1 \times 10^{15}$  Btu/yr = 2.1 quad/yr

1 million bbl oil/day = 80 million tons of coal/year = 1/5 ton of uranium oxide/year

### **One million Btu approximately equals**

90 pounds of coal

125 pounds of dry wood

8 gallons of gasoline

10 therms of natural gas

1.1 day energy consumption per person in the US

100 kwh of electricity generated at a fossil fuel power plant

### **Everyday usage and energy equivalencies**

1 bbl oil = driving 840 miles in average car

State of California energy needs for 8 hours = 1 million barrels of oil

1 gal gasoline = 11 kwh electricity (assuming 30

1 gal gasoline = 48 hours of color TV

1 gal gasoline = 5 hours of air conditioning

1 gal gasoline = average summer solar energy incident on 2 square meters

### **Prefixes**

kilo =  $10^3$ , mega =  $10^6$ , giga =  $10^9$

milli =  $10^{-3}$ , micro =  $10^{-6}$ , nano =  $10^{-9}$