

-Volumetric Energy Density

Definition: amount of energy (KJ, cal, BTU) in a certain volume (m³, L, gal) for a given material.

$$\text{Gasoline} \quad 48,200 \frac{\text{kJ}}{\text{kg}} * 740 \frac{\text{kg}}{\text{m}^3} = 35,700,000 \frac{\text{kJ}}{\text{m}^3} = 35.7 \frac{\text{GJ}}{\text{m}^3}$$

$$\text{Coal} \quad 33,800 \frac{\text{kJ}}{\text{kg}} * 650 \frac{\text{kg}}{\text{m}^3} = 22,000,000 \frac{\text{kJ}}{\text{m}^3} = 22.0 \frac{\text{GJ}}{\text{m}^3}$$

$$\text{Biodiesel} \quad 39,600 \frac{\text{kJ}}{\text{kg}} * 900 \frac{\text{kg}}{\text{m}^3} = 35,600,000 \frac{\text{kJ}}{\text{m}^3} = 35.6 \frac{\text{GJ}}{\text{m}^3}$$

$$\text{Ethanol} \quad 29,700 \frac{\text{kJ}}{\text{kg}} * 790 \frac{\text{kg}}{\text{m}^3} = 23,500,000 \frac{\text{kJ}}{\text{m}^3} = 23.5 \frac{\text{GJ}}{\text{m}^3}$$

$$\text{Biomass \#1} \quad \frac{\text{kJ}}{\text{kg}} * \frac{\text{kg}}{\text{m}^3} = \frac{\text{kJ}}{\text{m}^3} = \frac{\text{GJ}}{\text{m}^3}$$

$$\text{Biomass \#2} \quad \frac{\text{kJ}}{\text{kg}} * \frac{\text{kg}}{\text{m}^3} = \frac{\text{kJ}}{\text{m}^3} = \frac{\text{GJ}}{\text{m}^3}$$

How many gallons of alternative energy products are required to equal 1 gal of gasoline?

$$\text{Coal} \quad 1 \text{ gal gasoline} * \frac{35.7 \text{ GJ}/\text{m}^3 \text{ gasoline}}{22.0 \text{ GJ}/\text{m}^3 \text{ coal}} = 1.62 \text{ gal coal}$$

$$\text{Biodiesel} \quad 1 \text{ gal gasoline} * \frac{35.7 \text{ GJ}/\text{m}^3 \text{ gasoline}}{35.6 \text{ GJ}/\text{m}^3 \text{ biodiesel}} = 1.003 \text{ gal biodiesel}$$

$$\text{Ethanol} \quad 1 \text{ gal gasoline} * \frac{35.7 \text{ GJ}/\text{m}^3 \text{ gasoline}}{23.5 \text{ GJ}/\text{m}^3 \text{ ethanol}} = 1.52 \text{ gal ethanol}$$

$$\text{Biomass \#1} \quad 1 \text{ gal gasoline} * \frac{35.7 \text{ GJ}/\text{m}^3 \text{ gasoline}}{\text{GJ}/\text{m}^3 \text{ biomass}} = \text{gal biomass}$$

$$\text{Biomass \#2} \quad 1 \text{ gal gasoline} * \frac{35.7 \text{ GJ}/\text{m}^3 \text{ gasoline}}{\text{GJ}/\text{m}^3 \text{ biomass}} = \text{gal biomass}$$

Calculating Bulk Density

Biomass #1

$$\frac{\text{g}}{500 \text{ mL}} * \frac{1 \text{ kg}}{1000 \text{ g}} * \frac{1 \text{ mL}}{1 \text{ cm}^3} * \frac{1,000,000 \text{ cm}^3}{1 \text{ m}^3} = \frac{\text{kg}}{\text{m}^3}$$

Biomass #2

$$\frac{\text{g}}{500 \text{ mL}} * \frac{1 \text{ kg}}{1000 \text{ g}} * \frac{1 \text{ mL}}{1 \text{ cm}^3} * \frac{1,000,000 \text{ cm}^3}{1 \text{ m}^3} = \frac{\text{kg}}{\text{m}^3}$$