## SOURCES OF ENERGY

*Joule or a calorie is a measure of energy for both food and physical activity.*

1 kilocalorie (kcal) = 4.18 Kilojoules (kcal)

| Macronutrients | kJ/g | kcal/g |
|---|---|---|
| **Protein** | 17 | 4 |
| **Carbohydrate** | 17 | 4 |
| **Fat** | 38 | 9 |
| **Alcohol** | 29 | 7 |

**Energy:**
*Energy is the property of matter allowing it to be transformed either by doing or accomplishing work.*

Forms of energy:

Chemical, consumed in food is transformed into
- Mechanical → Movement
- Electrical → Nervous system
- Thermal → Warm-blooded

## LAW OF THERMODYNAMICS AND ENERGY BALANCE

**Law of Thermodynamics:**

1. Energy is not produced, consumed or use up. It is merely transformed from one form into another. (Chemical energy)

Therefore, when energy is not transformed for work in the body, it is stored in adipose tissue.

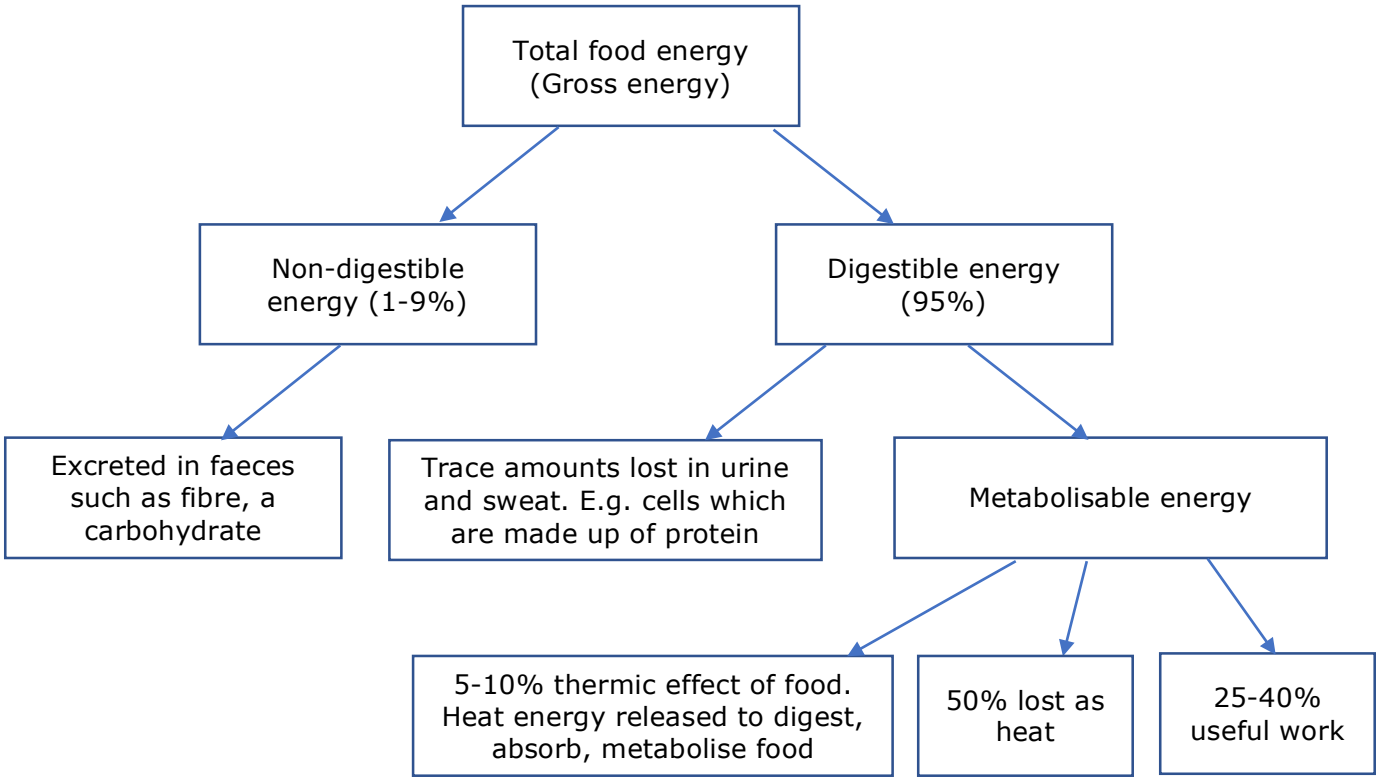
$$E_s = EI - EO$$

Energy Stores = Energy In – Energy Out

2. Transformation of energy is always in direction of a continuous increased universe entropy. (loss of heat)

Whenever energy is transformed in one form to another, there is such inefficiency, that 100% of one energy is not transformed into 100% form of another.

i.e. Some energy lost as heat when converting chemical potential to mechanical energy.




## ENERGY REQUIREMENTS FOR GROWTH AND DEVELOPMENT

Energy required for fuel and homeostasis:

**Basal Metabolic Rate (BMR) x Physical Activity Level (PAL) = Total Energy Expenditure (kJ)**

*Basal Metabolic Rate* → amount of energy expended while at rest

Factors: Eating, gender, body mass, age, muscle and body fat, illness

*Physical Activity Level*

Factors: Household activities, Travel, Exercise, Sports

MET (Metabolic Equivalent Task) Factor
Estimates intensity of a single activity as a multiple of BMR $O_2$ consumption of 3.5 mL/kg/min.

e.g. Cleaning Light/Moderate effort = 2.3 MET (2.3 x BMR)/ 3.8 MET (3.8 x BMR)

Important Factors affecting total energy expenditure:

1. Amount of lean tissue (fat free mass)
2. Weight (Obese individual has more cells to maintain but if fat and lean person weighed the same, fat expends less energy due to lower fat free mass)
3. Level of activity (affects PAL)
4. Age (high BMR during youth for growth and development, then decreases with age → less energy requirements and more exercise)

## ENERGY BALANCE

Sustained positive energy balance → increased weight