Energy

Printable revision sheet — Galaxscia

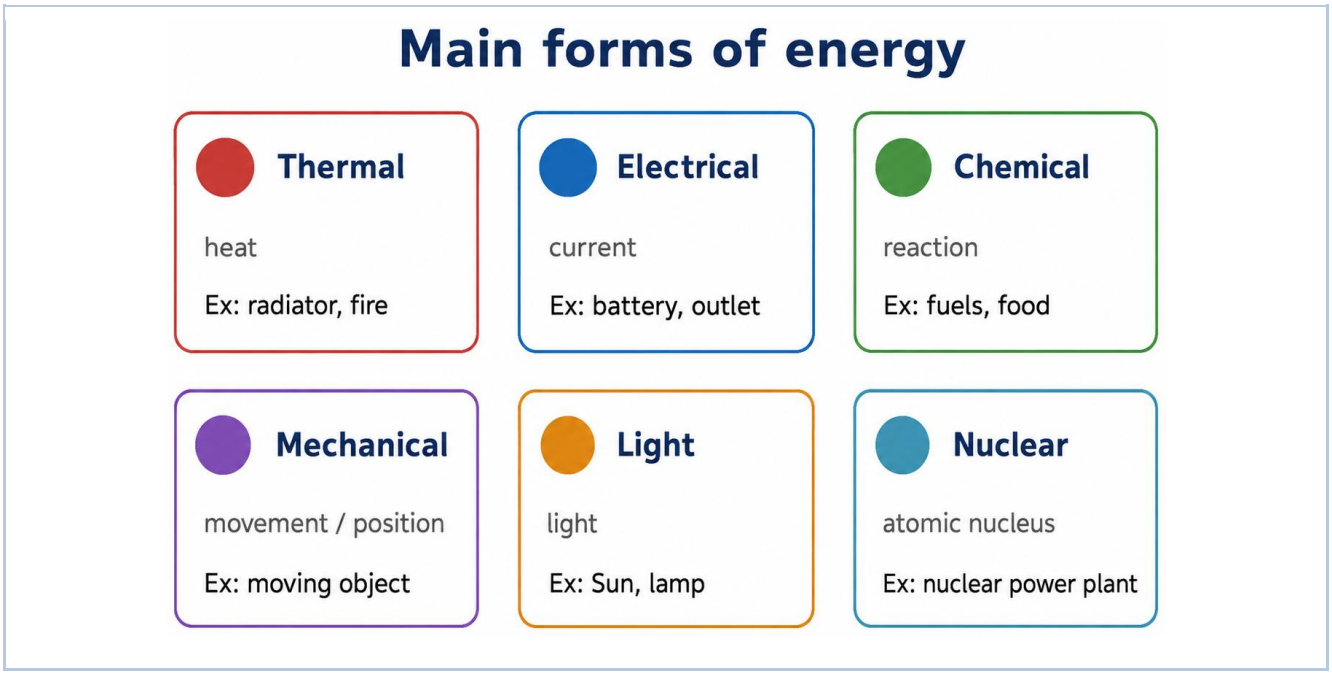
LEVEL 1

The basics of energy

Energy lets objects and living things act, move, heat, light up, and so on. It can be neither created nor destroyed; it is transformed (changes form) or transferred (passes from one object to another). This is the law of conservation of energy.

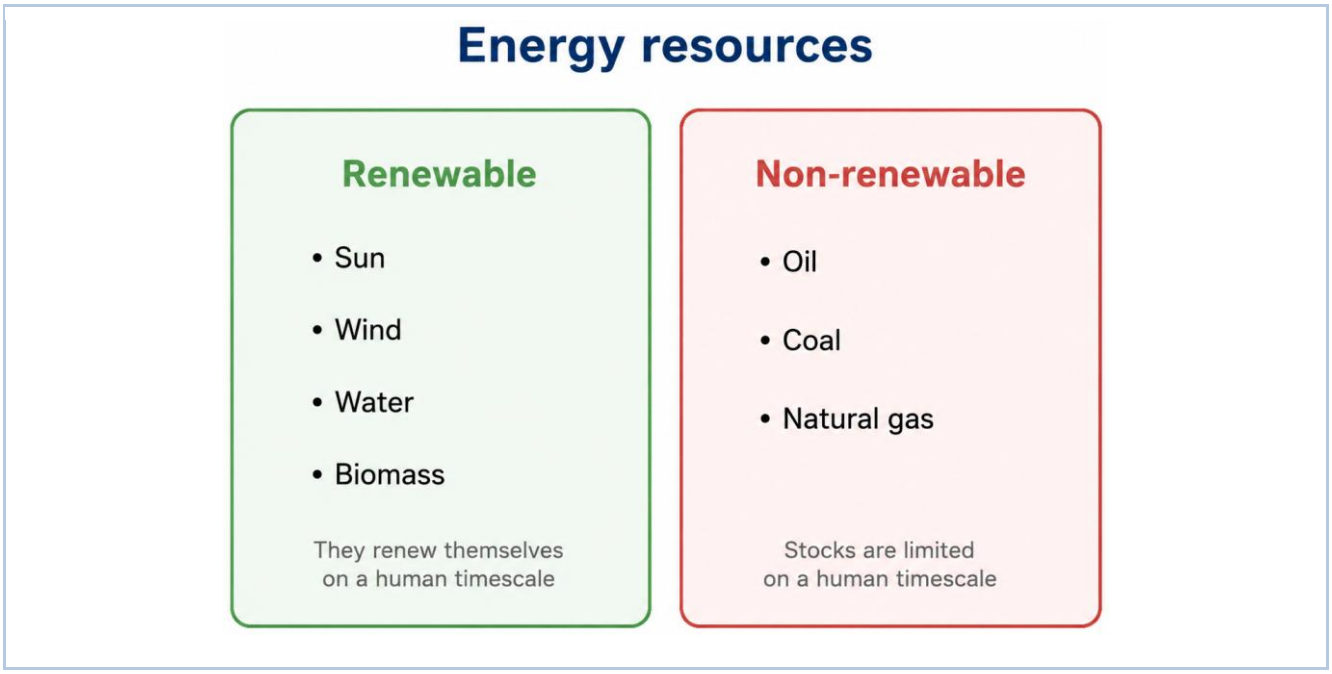
Example: sunlight heats the Earth (thermal transfer) or can be converted into electricity by a solar panel (conversion).

The forms of energy



Energy resources

A resource is *a material that supplies the energy we use* : *oil, gas, air (wind), sun, water, biomass, and so on.*



Key points — revision questions

- What is energy?
- Give three forms of energy with one example of each.
- What is the difference between a renewable and a non-renewable resource?
- Give an example of a resource being used (and say which form of energy results).

LEVEL 2

Energy exchanges

Energy moves between objects by transfer or by conversion.

Transfer: the same form of energy passes from one object to another (e.g. heat from a radiator → the air in the room).

Conversion: the energy changes form (e.g. a solar panel turns light → electricity).

To describe these exchanges we often use an energy chain (source → conversion(s) → useful form).

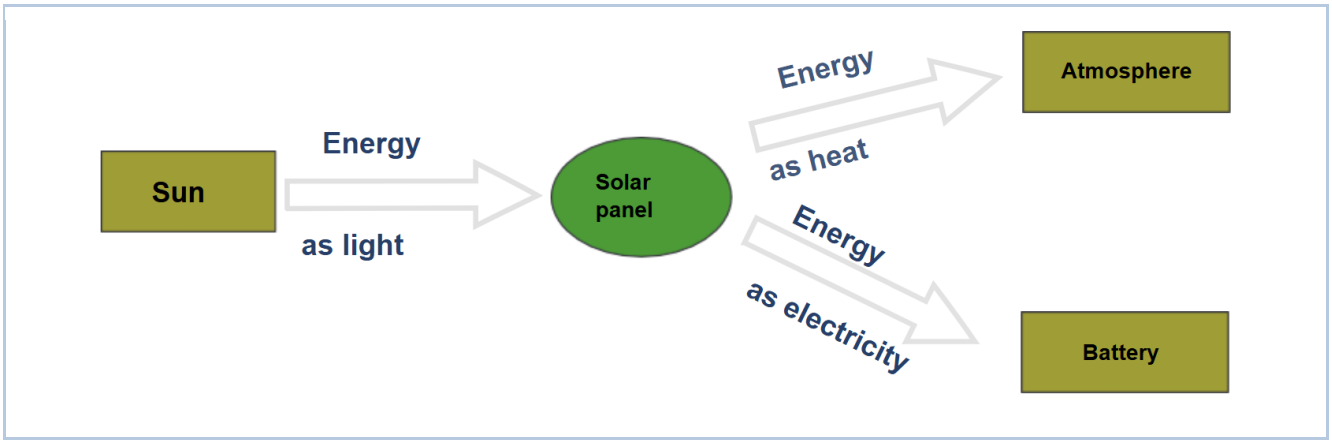
Measuring energy

All forms of energy are measured with the same unit: the joule (J). The kilowatt-hour (kWh) is also used for electricity consumption.

Useful benchmarks: lifting 1 kg by 1 m ≈ 10 J; 1 h of LED lighting ≈ 36,000 J.

Conservation of energy

In an isolated system: energy received = energy given out. Example: a lamp receives 100 J of electricity → 20 J of light + 80 J of heat = 100 J.



Key points — revision questions

- What is the difference between an energy transfer and an energy conversion?
- In which unit is energy measured?
- A motor receives 1000 J and produces 300 J of movement: what happens to the rest?
- Briefly explain what an energy chain is.

LEVEL 3

Mechanical energy

Mechanical energy (Em) is the sum of the energy linked to movement (kinetic) and the energy linked to position (potential).

Formulas:

Mechanical energy: $Em = Ec + Ep$

With all the energies in joules (J)

Kinetic energy: $Ec = 1/2 \times m \times v^2$

m in kg

v in m/s

Gravitational potential energy: $E_p = m \times g \times h$

m in kg

g ≈ 9.81 N/kg ≈ 10 N/kg

h in m

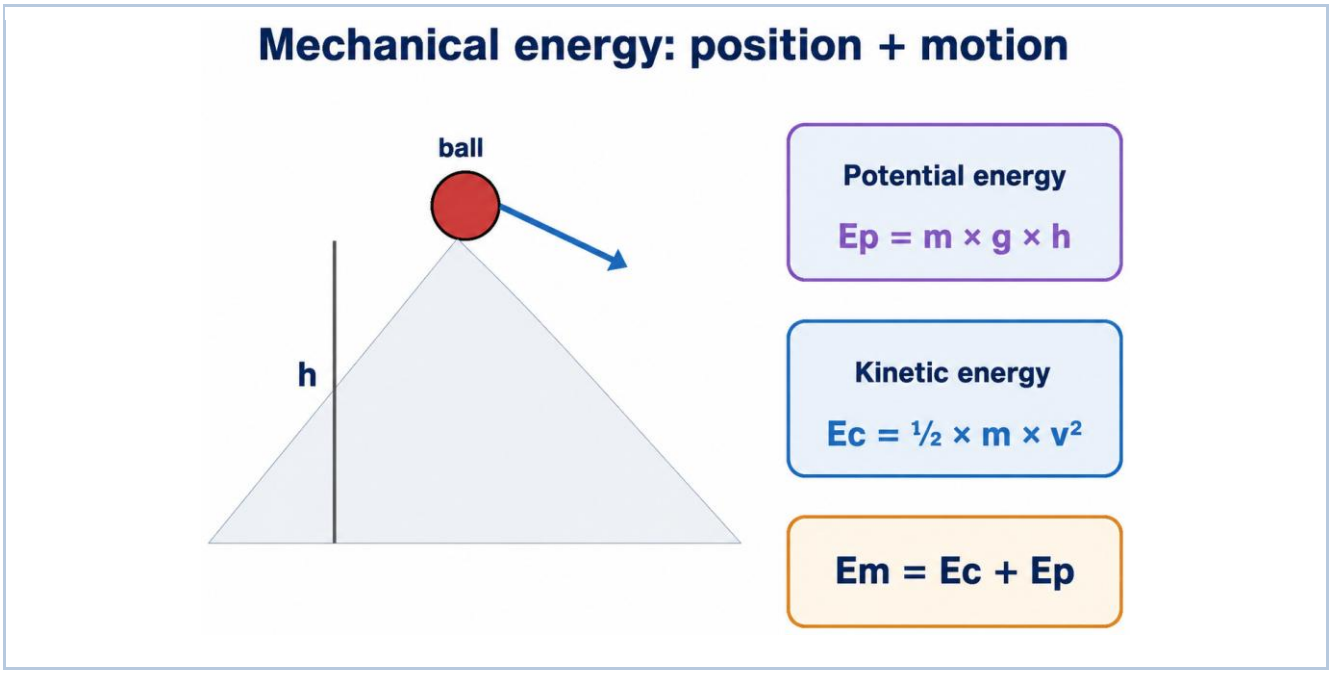
Example: a ball of mass 0.5 kg at a height of 2 m and thrown at 4 m/s:

$E_p = 0.5 \times 10 \times 2 = 10$ J

$E_c = ½ \times 0.5 \times 4^2 = 4$ J

$E_m = 10 + 4 = 14$ J

Mechanical energy simulation



Key points — revision questions

- What is mechanical energy made up of?
- What is the formula for kinetic energy? Give the units of each term.
- What is the formula for gravitational potential energy? Give the units of each term.
- What happens to the potential energy of a falling apple?

LEVEL 4

Energy and power

Power tells you how fast energy is being used or produced.

Analogy: energy = the volume of water in a tank; power = the flow rate of the tap.

The key formula

$$E = P \times \Delta t$$

E: energy (J) or (more practical for billing) kWh

P: power (W or kW)

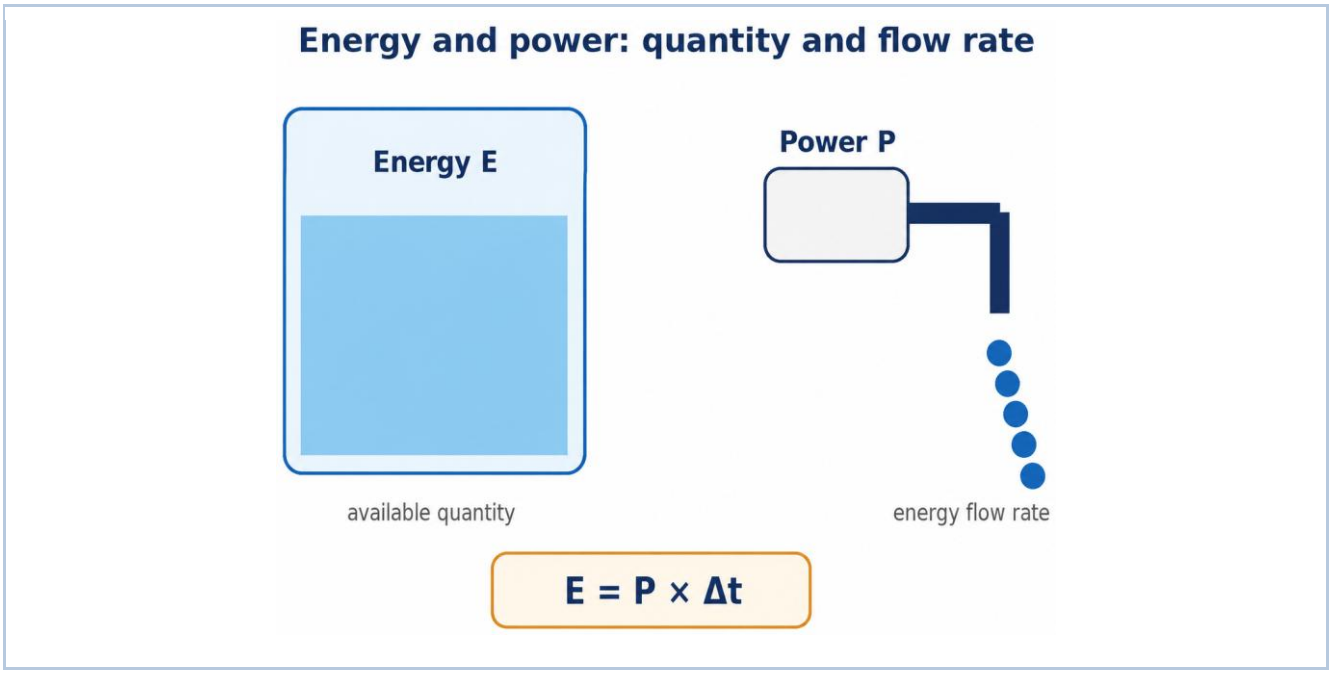
Δt: duration (s or h)

Examples

A 60 W bulb switched on for 2 h → E = 60 W × 2 h = 120 Wh = 0.12 kWh

A 2 kW heater switched on for 3 h → E = 2 kW × 3 h = 6 kWh

An oven at 1500 W for 45 min → 1.5 kW × 0.75 h = 1.125 kWh



Key points — revision questions

- What is the relation between energy and power? Give the units of each term.
- Which unit is normally used to bill electricity?