Energy makes things happen

Energy is not a substance or an object that you can touch or hold, but substances and objects can possess energy. Energy is needed to make objects move or change their state. Energy is found in different forms such as potential or kinetic energy, which can be transformed from one to another. An energy source is a system, which generates energy by transforming one type to another more useful type, usually electricity.

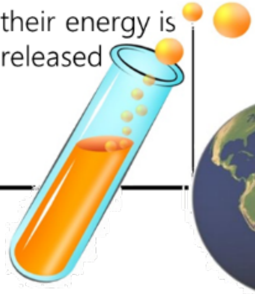
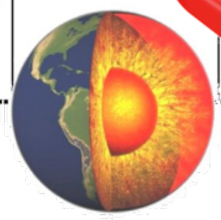
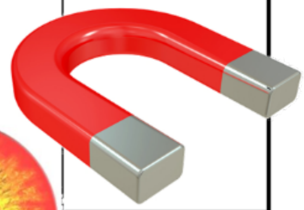
Any change in speed, size, shape or temperature in an object requires energy. **Energy is the ability to do work.** Work is applying force to an object and making it move in distance.
Energy is measured in a unit called a joule (j)

Energy can exist as Potential or Kinetic Energy
Energy can be classified into two types; kinetic energy (E_k) and potential energy (E_p). Kinetic energy is seen when particles, waves or objects move. All forms of stored energy are called potential energy – this cannot be seen until it is transformed (changed) into active energy.

Kinetic energy

Light (radiant) Energy	Sound Energy	Mechanical kinetic Energy	Heat (thermal) Energy	Electrical Energy
Energy traveling in waves, with wavelengths that can be seen by humans.	Sound travels in waves of different pressure. This causes movement of particles. Sound cannot travel in a vacuum.	Movement energy. This can be seen when matter changes its position in space	The kinetic energy that atoms contain. The more they move the more heat they contain. Measured by temperature	Energy contained in electrons. This can either be static like lightning or current electricity that moves in a circuit.

Potential energy

Gravitational Energy	Elastic Energy	Nuclear Energy	Chemical Energy	Geothermal Energy	Magnetic Energy
This is the energy contained by an object which pulls it back to Earth. The further up from the ground the more it contains.	Found in springs, rubber bands etc. The more they are compressed the more energy they contain to make them change back to their original shape	The energy contained by the nucleus of an atom which holds the neutrons and protons together. A lot of energy is released when these are separated in a nuclear reaction	The energy contained in the bonds of chemical molecules – i.e.food or battery acid. When these bonds are broken in a chemical reaction then their energy is released	Energy produced by geological processes of the Earth which causes heat and pressure to rise to the surface.	Energy contained by a magnet to either attract or repel other magnetic objects. It can also cause electrical currents.
					

Energy is always conserved.

Energy cannot be created or destroyed; it can only be changed from one form to another.

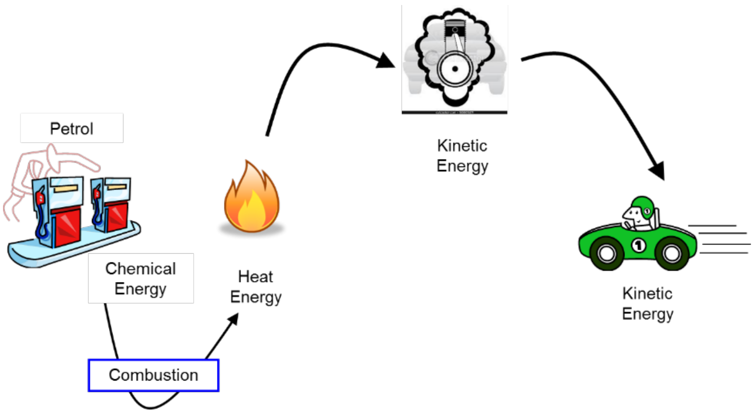
The total amount of energy never changes. Energy can transform from one type to another. All types of potential energy must be transformed into kinetic energy for work to be done.

Energy can be transformed from one type to another

Energy can be transferred from one object to another. E.g. heat energy from the rocks cooking the food in a hangi. The type of energy does not change.

Energy can also be transformed from one type into another. E.g., electrical energy changed into heat and sound energy when boiling a jug. One type of energy can be transformed into many different types.

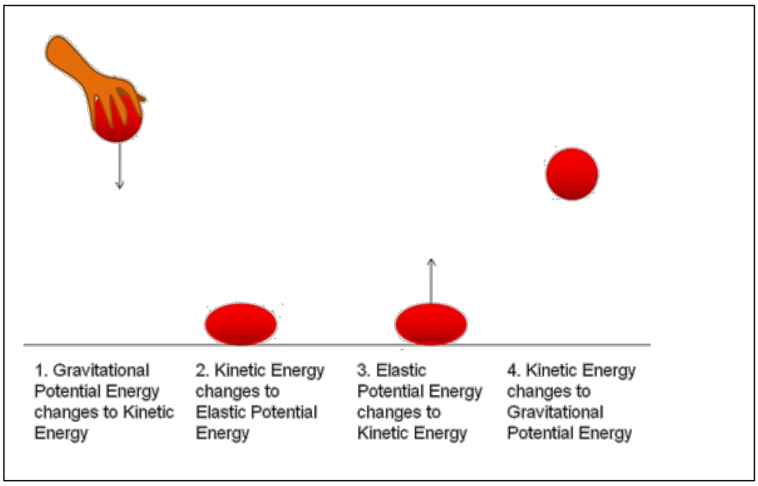
Writing Energy Transformation Stories



Beside is an example of the energy transformations taking place in a car.

The input energy is **chemical potential** energy from the petrol. This transforms into **heat** energy when it is combusted inside the car energy. Heat energy is then transformed into **kinetic** energy, moving the car engine parts, which also makes the car move along the road.

Step **ONE** Identify what type of input energy you start with: This ball can fall, so we start with Gravitational Potential energy



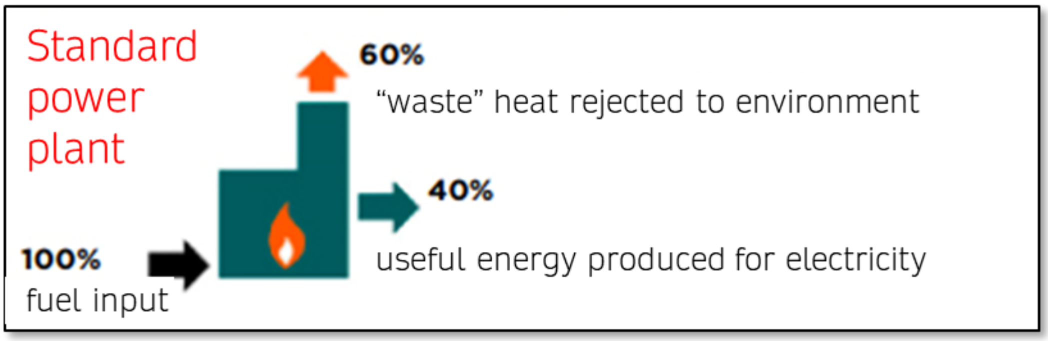
Step **TWO** as stuff happens, identify what your starting energy changes into: The ball is falling. It now has Kinetic Energy.

Step **THREE** IF anything else happens, identify any further energy transformations: The ball changes shape when it hits the ground, which means it has Elastic Potential energy. It also makes a noise, so it produces Sound Energy.

Step **FOUR** Continue if there are further energy transformations: The ball now starts to move upwards so it has Kinetic Energy.

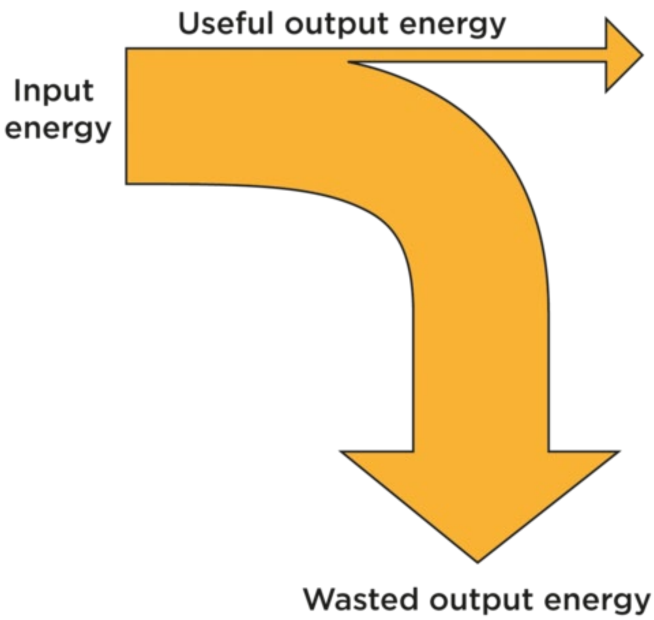
How sources of energy are transformed into useful energy and wasted energy

When energy is transformed, some of the energy turns into forms we don't want. This energy is called wasted energy. Wasted energy takes the form of heat and sometimes sound or light.
During any energy transfer, some energy is changed into heat. The heat becomes spread out into the environment. (dispersed). This dispersed energy becomes increasingly difficult to use in future energy transfers. In the end, all energy is transformed into heat and eventually lost out into space.



For example, from the diagram above of a traditional power plant more energy is waste than useful. Newer designed power plants are developing ways to reuse most of the waste energy to generate further electricity.[

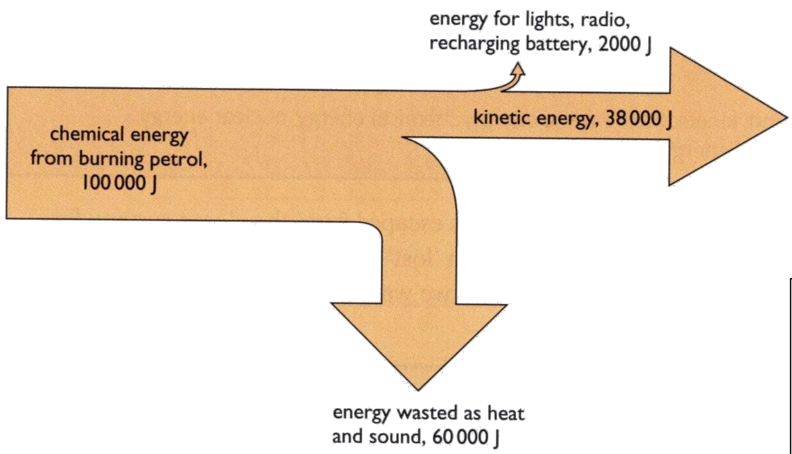
Sankey Diagrams



Many objects that use energy do not convert 100% into useful energy. We can use diagrams to show the relative amounts of useful energy (energy that is put to the purpose that we want) and waste energy. Due to the conservation of energy, the useful energy and the waste energy, which together we call the **output energy**, **must equal the total amount of input energy**.

Sankey diagrams summarise all the energy transfers taking place in a process. The thicker the line or arrow, the greater the amount of energy involved.

Calculating Wasteful energy Example



As an example of calculating wasteful energy we can look at a car engine.

Total energy input is 100 000J and the kinetic energy to run the car is 38 000J plus 2000J for electrics. To calculate the waste energy, you total the useful energy and subtract it from input energy. The remainder is waste energy: 60 000J

Waste energy = Total input – useful energy

Waste energy = 100000 – (38000 + 2000)

Waste energy = 60000J

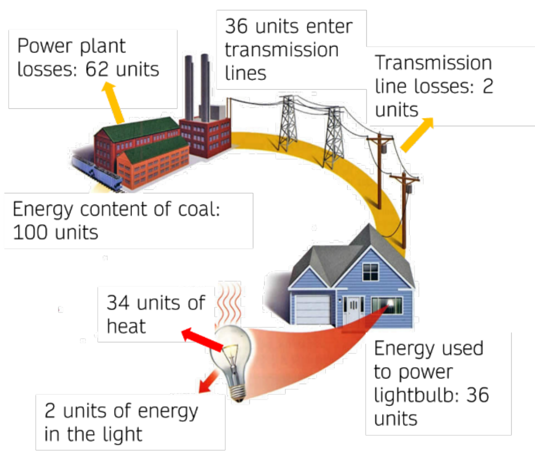
Energy efficiency

Efficiency is a measure of how well an energy user (i.e., bulb or appliance) transfers energy into the form we want. **Efficiency (%) = (useful energy out ÷ total energy in) x 100.**

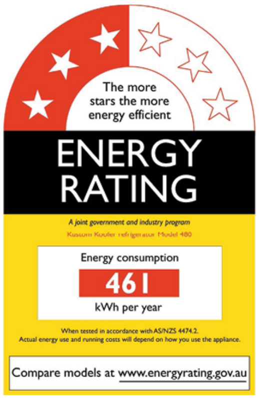
In the example to the right, we use the formula to work out the efficiency of the light bulb from its original 100 units of energy in the form of coal.

$$\text{Energy efficiency} = \frac{\text{Useful output energy}}{\text{Total input energy}} \times 100\%$$

$$\text{Efficiency} = \frac{2}{36} \times 100 = 5.6\%$$



Comparing household appliances for efficiency rating



Appliances are sold with an energy rating sticker. The more stars an appliance has the more energy efficient it is.

As similar appliances need to use approximately the same amount of useful energy, the more efficient appliances will save you money to run.

If less electricity is needed in many houses, then less electricity is required to be generated. This can have a positive impact on the environment if electricity generation uses fossil fuels.

Energy efficiency – comparing types of light bulbs

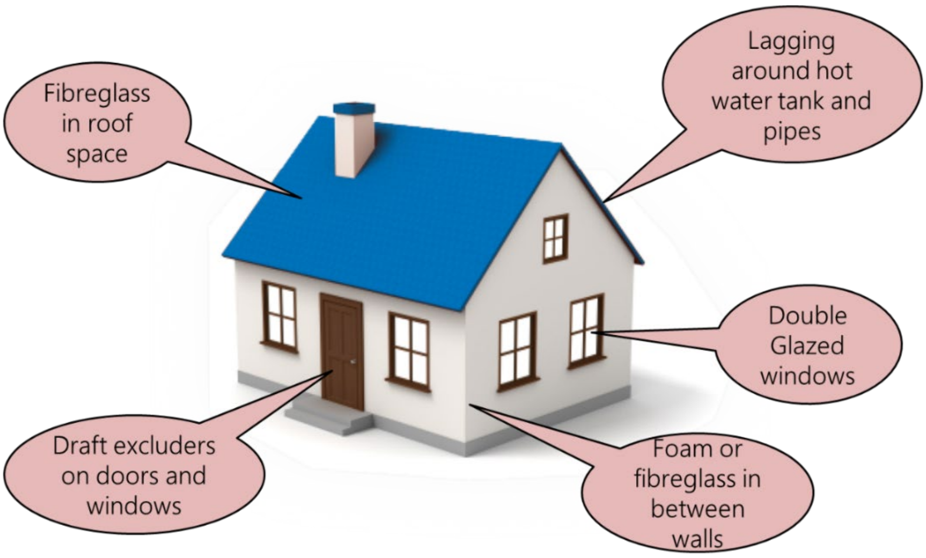
	Incandescent	Compact Florescent	LED
Life Span (average)	1,200 hours	8,000 hours	50,000 hours
Watts of electricity used (equivalent to 60-Watt bulb).	60 watts	13-15 watts	6 - 8 watts

Each of these types of bulbs produces the same amount of useful energy but require different amounts of input energy

Reducing energy loss from our homes

A large amount of energy use in a home is spent on heating. If a home is poorly insulated (with materials that do not conduct heat) then the heat will easily escape, and more energy will be required to maintain the temperature to a suitable level.

Leaving lights on when not being used, using standard incandescent light bulbs instead of the CFL or LED bulbs and leaving appliances switched on at the wall when not in use are all inefficient uses of energy.

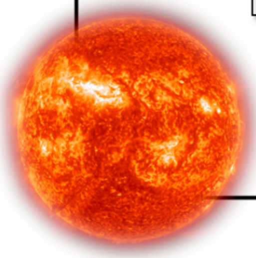


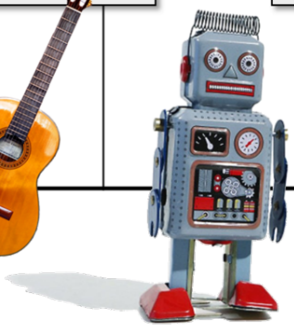
It is important to reduce the loss of heat from our homes. This is done by increasing the insulation of our homes using the methods shown in the diagram above.

1. Match the correct types of energy to their descriptions

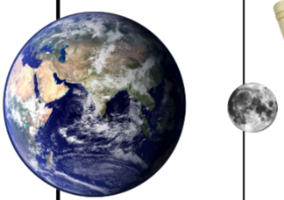
Kinetic	kinetic mechanical light heat sound electrical
Potential	geothermal nuclear elastic magnetic chemical gravitational

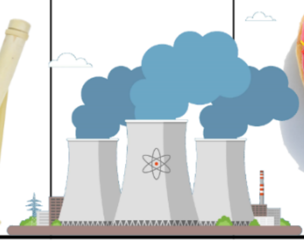
- Energy traveling in waves, with wavelengths that can be seen by humans.
- Waves of different pressure cause movement of particles. These waves cannot travel in a vacuum.
- Movement energy. This can be seen when matter changes its position in space
- The kinetic energy that atoms contain that causes them to move. Measured by temperature
- Energy contained in electrons. This can either be static like lightning or move in a circuit.

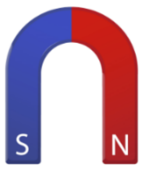




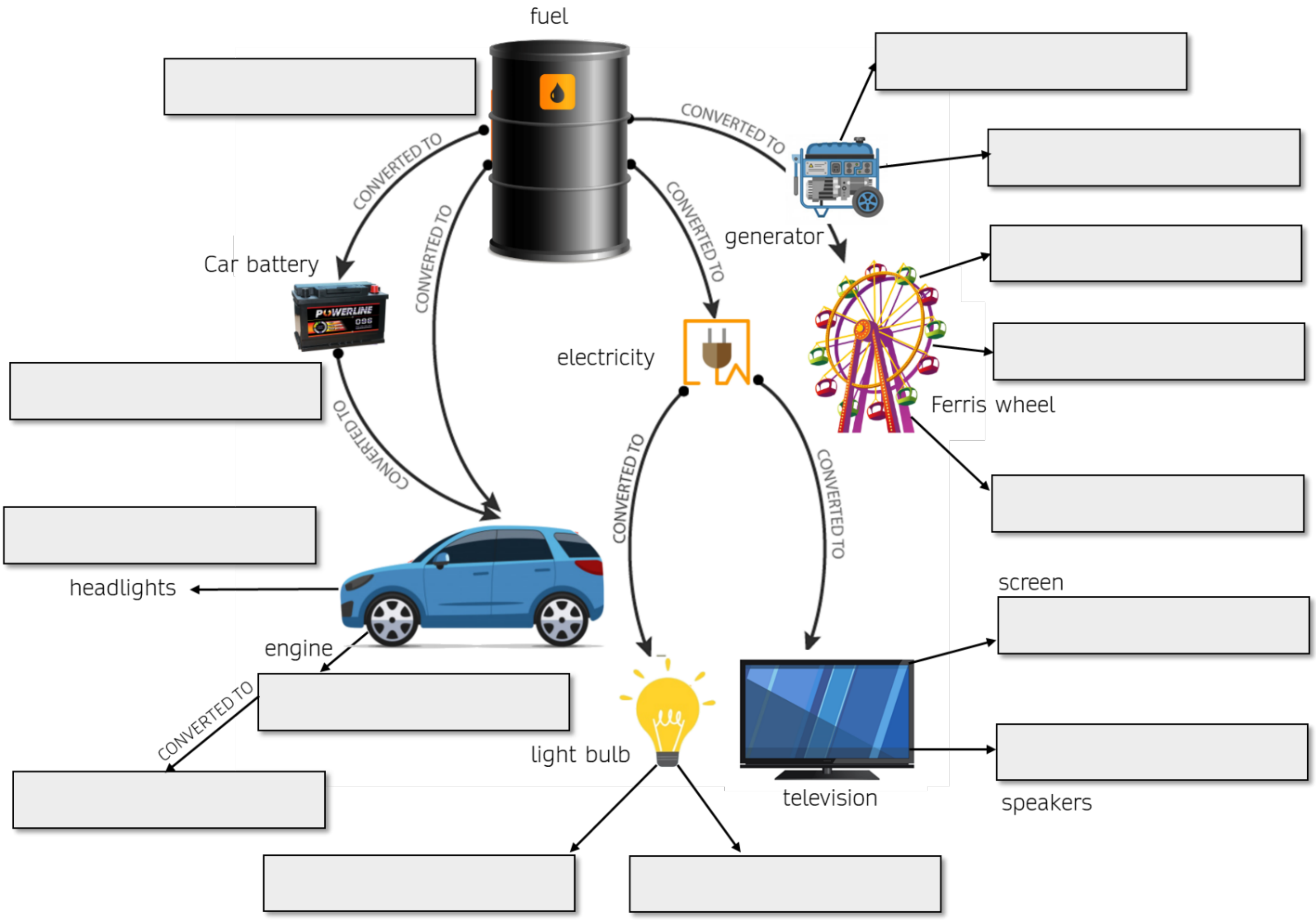
- This is the energy contained by objects that attracts them to each other
- This energy makes objects them change back to their original shape after being stretched
- The energy contained by the nucleus of an atom which holds the neutrons and protons together.
- The energy contained in the bonds of chemical molecules – i.e. food or battery acid.
- Energy produced by geological processes of the Earth which causes heat
- Energy contained by certain substances that either attract or repel other substances





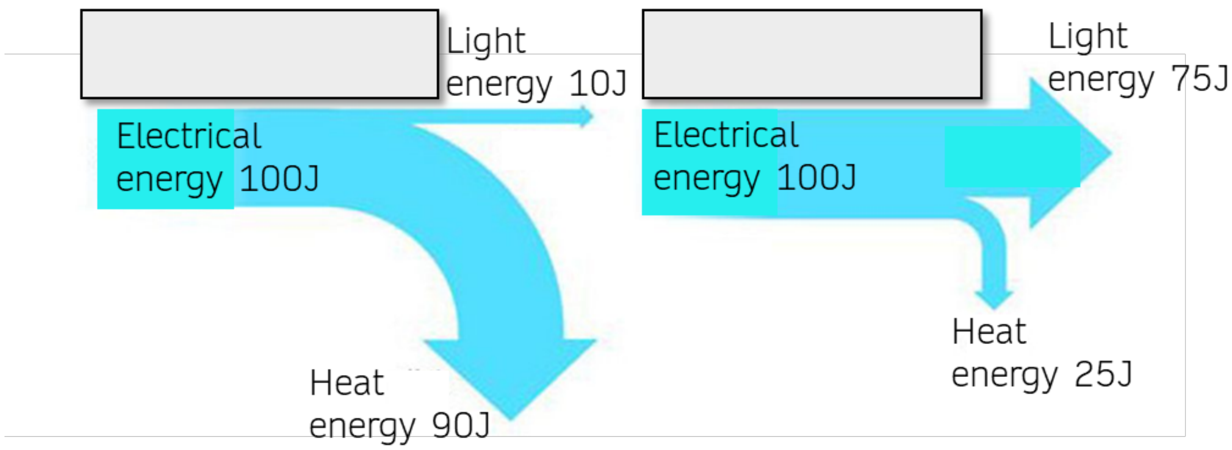



2. Look at each situation below and identify the types of energy at each step. (hint: The energy types can only be from those listed on the previous page)



3. Write out the energy transformation story for the television above

4.a. Two Sankey diagrams below show both an inefficient **filament bulb** and a much more efficient **LED** bulb. Label each bulb correctly



4b. From the Sankey diagrams above:

What type of energy (s) is the INPUT energy?
What type of energy (s) is the OUTPUT energy?

4c. Explain how Sankey diagrams could be used to distinguish between an efficient and inefficient bulb, using the information from the question above to help

4d. Calculate the efficiency of each bulb using the formula:

$$\text{Energy efficiency} = \frac{\text{Useful output energy}}{\text{Total input energy}} \times 100\%$$