

What is Energy and How Much do You Use?

What is energy?

Energy is often defined as the ability to do work. It manifests itself in many forms and common examples are given below.

Heat energy: This brings about a rise in temperature in a material

Kinetic energy: This is the energy contained by a moving object

Electrical energy: This is the energy contained in our electrical supplies or batteries

Chemical energy: This is found in fossil fuels such as diesel, coal, methane

Bio energy: This comes from biomass and can be used directly (burning wood or straw) or indirectly, by converting it to a fuel through processing

Question: which of the above energy forms can exist in your body?

Whatever **form** it is in, it is measured using the same **unit**, the joule (symbol J).

Power is related to energy but represents the rate at which it is used. For example: 10 joule per second is called 10 watt. ($10\text{J s}^{-1} = 10\text{W}$)

A 1000W is often called a kilowatt (kW) and 1000000W is called a megawatt (MW).

In our electricity and gas bills, we are charged by the unit; kilowatt hour.

That is the equivalent of 1000 joule per second over a one hour period. This amounts to 60 second x 60 minutes x 1000 joule = 3600 000 joule (J) or 3.6 MJ. Typically that may cost 25p for electricity and 14p for natural gas – but there are large variations from this, especially if we move towards a world energy famine.

The 3.6MJ is called a unit of energy although it is not an SI unit, simply a convenient “charging bundle”.

A loose approximation of a kW hour is: the amount of electrical energy used by a 40W lamp over a period of 24 hours. That is:

$40\text{W} \times 60\text{s} \times 60\text{m} \times 24\text{ hr} = 3456000\text{J}$ is a close approximation to 1kWh (3.6MJ)

Using our **energy bills** we can calculate our energy consumption quite easily.

Example: If an electricity bill is made up from a £12 standing charge, each unit is charged at 17p and it is £69.79 in total, how much energy has been used?

Energy cost is £57.79 and that is $5779\text{p}/17\text{p} = 410$ units

This is spread over a quarter of one year (approx 91 days). So this household is using 410 units/ over 91days which equates to 4.5 units per day.

This is equivalent to $4.5 \times 3.6 \text{ MJ} = 16\,560\,000\text{J} \approx 16.6 \text{ MJ}$

You might like to consider that to produce that amount of electricity from a fossil fuel generator, would generally require three times that amount of primary energy from coal or gas: Therefore $49\,680\,000\text{J} \approx 50 \text{ MJ}$ of primary energy

As experienced bill payers you may have concluded that this bill is quite light – typically a flat in summer time, so the average kWh per day would be considerably higher for many other households. If there were two people living in that flat, this component of their energy consumption would be 2.25 units per day per capita.

Also, there are approximately 22 million homes in the UK

So if we take into consideration: Air and road transport, heating and cooling, food and farming, electricity for appliances, the average person in the UK uses approximately 125 kWh per day and there are about 60 000000 of us – if you think that is a lot, the average American uses twice as much per capita, be many nations only have a fraction of what we have also.

NB 125 kWh is 450 MJ per person per day and that works out to 5.208 kW per capita or 5208J per second for every second you are alive!

One litre of diesel fuel (auto) has an energy content of approximately 38 MJ – which approximates to 10 kWh (using a ballpark figure) but the efficiency of conversion into kinetic energy is only about 30% - that is better than petrol which is typically 25% depending on the design.

So one litre of diesel will give up about 3.3kWh (30% of the 10 kWh) – the remainder of the energy goes out of the exhaust pipe mainly as hot gas!

Electric cars are about 90% efficient. If the electrical energy is made from renewable sources such as hydro or wind, the value to the environment is immense. However, most of our electricity comes from fossil fuels which have a typical efficiency of 27%, so better to burn diesel directly really. So, the electric car is a good under “some” circumstances but not all.