

Fuel uses and costs.



L1 Non-renewable energy resources

Non-renewable energy resources are fuels and materials that we use to generate power and perform various tasks in our daily lives. Unlike renewable energy sources, like solar and wind energy, which can be naturally replenished, non-renewable resources are finite, which means they will eventually run out. The primary types of non-renewable energy resources are fossil fuels (coal, oil, and natural gas) and nuclear energy.

How Is Non-Renewable Energy Used?

Electricity Generation: Non-renewable energy sources are crucial for producing electricity. Power plants burn coal, oil, or natural gas, or use nuclear reactions to generate the electricity we use to light our homes and power our gadgets.

Transportation: Gasoline and diesel fuels, derived from non-renewable resources, are used to power cars, trucks, airplanes, and ships.

Heating: Many homes and buildings use oil or natural gas for heating during cold months.

Advantages of Non-Renewable Energy Resources

Reliability: Non-renewable energy sources are consistent and provide a steady supply of power, which is essential for industries and our daily lives.

Energy Density: Fossil fuels have a high energy density, which means they contain a lot of energy in a small volume.

Affordability: Non-renewable energy sources are often more affordable than renewable alternatives.

Disadvantages of Non-Renewable Energy Resources

Pollution: Burning fossil fuels releases harmful pollutants into the air, contributing to air pollution and climate change.

Finite Supply: Non-renewable resources will eventually run out, and finding new sources becomes more challenging and expensive.

Environmental Impact: Extracting and processing non-renewable resources can harm ecosystems, wildlife, and landscapes.

Health Risks: People living near coal mines or oil refineries may face health risks due to pollution.

Geopolitical Issues: Countries may compete for access to non-renewable resources, leading to conflicts.

Impact on the Environment

Greenhouse Gas Emissions: Burning fossil fuels releases carbon dioxide (CO₂) into the atmosphere, a major driver of global warming.

Habitat Destruction: Extracting resources like coal can destroy habitats and harm wildlife.

Oil Spills: Accidental oil spills in oceans and rivers can devastate ecosystems.

Air and Water Pollution: The extraction and processing of non-renewable resources can contaminate air and water, harming ecosystems, and human health.

Radioactive Waste: Nuclear energy produces radioactive waste, which needs safe storage for thousands of years.

Independent practice

1. What are non-renewable energy resources, and why are they called "non-renewable"?
2. Name three primary types of non-renewable energy sources.
3. How is non-renewable energy used in electricity generation?
4. **Extended writing (paragraph needed):** Evaluate the use of non-renewable energy resources for human energy needs.
5. What is energy density, and why is it an advantage of non-renewable resources?
6. List two environmental advantages of using renewable energy sources.
7. Name two harmful pollutants released when burning fossil fuels.
8. How does burning fossil fuels contribute to climate change?
9. Explain why non-renewable resources can lead to geopolitical issues.
10. What is radioactive waste, and why is it a concern in nuclear energy?
11. Give an example of a non-renewable resource that is used for heating.
12. **Extended writing (paragraph needed):** Why is it important to find alternative, sustainable energy sources?
13. How can individuals and communities reduce their reliance on non-renewable energy?
14. What do you think is the most significant challenge in transitioning to renewable energy sources, and how can it be overcome?

L2 Renewable energy

Imagine a world where we can power our homes, schools, and gadgets without harming the environment. Well, that's exactly what renewable energy is all about. So, grab your thinking cap and let's explore the wonders of renewable energy.

What is Renewable Energy?

- Renewable energy comes from natural sources that never run out. These sources include the sun, wind, water, and even heat from the Earth's core. Unlike fossil fuels like coal and oil, which are finite and harmful to the environment when burned, renewable energy sources are clean and abundant. Let's dive into some of the most common renewable energy sources:
- **Solar Power:** This energy comes from the sun. Solar panels capture sunlight and turn it into electricity. The best part? The sun isn't going anywhere anytime soon!
- **Wind Power:** Wind turbines use the power of the wind to generate electricity. Wind is always blowing somewhere, making it a reliable source of energy.
- **Hydropower:** This energy is produced by the flow of water, like in rivers or dams. Water's always on the move, so this energy source is very reliable.
- **Geothermal Energy:** Heat from the Earth's core is harnessed to produce electricity. It's like tapping into the Earth's internal furnace!

Advantages of Renewable Energy

- Now, let's talk about the awesome benefits of renewable energy:
- **Clean and Green:** Renewable energy doesn't release harmful pollutants like fossil fuels do, which means cleaner air and water.
- **Endless Supply:** Since these sources are natural, we won't run out of them. They're like a never-ending supply of energy.
- **Job Creation:** Building and maintaining renewable energy systems create lots of jobs. It's good for the economy!
- **Cost-Efficient:** Over time, renewable energy can be cheaper because sunlight, wind, and water are free!
- **Reduced Climate Change:** Using renewable energy helps reduce the greenhouse gases that cause climate change. It's like giving the Earth a breath of fresh air.

Disadvantages of Renewable Energy

But, like everything, there are some downsides too:

- **Intermittent Power:** Some renewable sources, like solar and wind, depend on weather conditions. If the sun isn't shining or the wind isn't blowing, we might have less power.
- **Initial Costs:** Building renewable energy systems can be expensive upfront, though they pay off in the long run.
- **Space Requirements:** Wind farms and solar panel arrays need a lot of space, which can be challenging in crowded areas.
- **Environmental Impact:** While renewable energy is much cleaner than fossil fuels, it can still have some environmental impacts. For example, building dams for hydropower can affect local ecosystems.
- **Energy Storage:** We need better ways to store excess renewable energy for when it's not sunny or windy.

Independent practice

1. What is renewable energy, and how is it different from non-renewable energy sources?
2. Name at least three renewable energy sources and explain how they work.
3. Why is renewable energy considered "clean" energy?
4. What is the advantage of having an endless supply of energy sources?
5. **Extended writing (paragraph required):** Evaluate the use of renewable energy resources for generating energy for humans.
6. How does renewable energy help create job opportunities?
7. Why might the initial costs of setting up renewable energy systems be high?
8. Explain why some renewable energy sources, like solar and wind, are intermittent.
9. What are some potential environmental impacts of renewable energy?
10. Why is energy storage important when it comes to renewable energy?
11. Give an example of how geothermal energy is harnessed.
12. How does wind power benefit from the Earth's constant motion?
13. Can you think of some innovative ways to make renewable energy systems more efficient?
14. What are some ways you can contribute to the use of renewable energy in your daily life?
15. Imagine a world powered entirely by renewable energy. What would it look like, and how would it change our lives?

L3 Power

Power ratings are essential because they help us understand how much energy different devices use. Whether it's the toaster you use every morning or the computer you play games on, every electrical appliance has a power rating measured in watts (W) or kilowatts (kW). In this lesson, we'll break down what power ratings mean, why they're important, and how you can use them in your daily life.

What is Power?

First things first, what is power? Well, in physics, power is the rate at which energy is transferred or converted. It tells us how quickly something is using or producing energy. Imagine two light bulbs, one glowing brightly and the other dimly. The brighter one uses more power because it's converting electricity into light faster.

Watts and Kilowatts:

Power is measured in watts (W). A watt is a small unit, so for most household appliances, you'll often see the power rating in kilowatts (kW), which are equal to 1,000 watts. For example, a hairdryer might have a power rating of 1,200 W, which is the same as 1.2 kW.

Why are Power Ratings Important?

- Understanding power ratings is crucial for several reasons:
- Energy Efficiency: It helps us choose energy-efficient appliances. Appliances with lower power ratings use less electricity, which is not only good for your wallet but also for the environment.
- Safety: Knowing the power rating helps you avoid overloading circuits. Plugging in too many high-power appliances can cause circuits to trip or even start a fire.
- Comparing Appliances: It allows us to compare different appliances. For example, when buying a new TV, you can check the power rating to see which one consumes less electricity.
- Estimating Costs: You can estimate how much an appliance will cost to run. Electricity is usually charged per kilowatt-hour (kWh), so if you know the power rating and how long you use an appliance, you can calculate the cost.

Calculating Power:

To calculate the power of an appliance, you can use this formula:

$$\text{Power (W)} = \text{Voltage (V)} \times \text{Current (A)}$$

However, most appliances have their power rating labeled, so you don't need to do the calculations yourself.

Independent practice

1. What is power in physics, and why is it important to understand?
2. How is power measured?
3. Why are power ratings often given in kilowatts (kW) instead of watts (W)?
4. Can you give an example of a small appliance's power rating in watts?
5. **Extended writing (paragraph needed):** Explain why knowing power ratings is important for energy efficiency.
6. How can knowing the power rating of an appliance help prevent electrical problems in your home?
7. When comparing two appliances, one with a power rating of 800 W and the other with 1.2 kW, which one consumes more energy?
8. **Extended writing (paragraph needed):** How can you use power ratings to choose energy-efficient appliances when shopping?
9. If you have an appliance with a power rating of 2 kW and you use it for 5 hours, how many kilowatt-hours (kWh) of electricity do you use?
10. What does the formula for calculating power (Power = Voltage x Current) tell us?
11. Imagine you have a hairdryer that operates at 120V and draws a current of 10A. Calculate its power rating in watts.
12. If you have a device that uses 500 W of power and you use it for 2 hours, how many kilowatt-hours (kWh) of electricity does it consume?
13. Why is it important to check the power rating of electrical outlets and extension cords before plugging in high-power appliances?
14. How can understanding power ratings help you make more informed decisions about using electrical devices in your daily life?

L4 Energy transfers

Energy is all around us, and it plays a crucial role in our everyday lives. Whether you're playing video games, turning on a light bulb, or even just walking to school, energy is involved. In this lesson, we'll explore the different ways we measure energy transfer and understand the units of Joules (J), kilojoules (kJ), and kilowatt-hours (kWh).

What is Energy?

Energy is the ability to do work or make things happen. When you kick a soccer ball, the energy in your leg muscles is transferred to the ball, making it move. Similarly, when you switch on a TV, electrical energy is converted into light and sound energy.

Units of Energy: Joules (J)

Joules are the most basic unit of energy measurement. When you do work or transfer energy, it's measured in joules. For example, lifting a book off the ground requires energy, and we can measure it in joules.

Units of Energy: Kilojoules (kJ)

Sometimes, we deal with larger amounts of energy, and using joules can result in large numbers that are hard to work with. This is where kilojoules come in. One kilojoule is equal to 1,000 joules. So, if you eat a chocolate bar, you're consuming energy, and that energy might be measured in kilojoules because it's a larger amount.

Units of Energy: Kilowatt-Hours (kWh)

Kilowatt-hours are often used to measure the energy consumption in our homes. A kilowatt-hour is a much larger unit than a joule or kilojoule. It's equal to 3.6 million joules or 3,600,000 J. When you pay your electricity bill, it's typically measured in kilowatt-hours because it represents the total energy used by all your electrical devices over time.

Independent practice

1. A light bulb uses 60 watts of power for 5 hours. How much energy does it consume in kilowatt-hours?
2. You lift a 10 kg weight 2 meters high. Calculate the energy required in joules and kilojoules.
3. A car travels 300 kilometres. If it consumes 10 litres of fuel, how much energy is used in kilojoules?
4. A wind turbine generates 500 kilowatt-hours of electricity in a day. How many joules is this?
5. You eat a chocolate bar with 200 kJ of energy. How many joules is this equivalent to?
6. A microwave oven uses 1,000 watts of power for 30 minutes. How much energy is used in kilowatt-hours?
7. A smartphone battery has 2,000 mAh (milliampere-hours) of capacity and operates at 3.7 volts. Calculate its energy capacity in joules and kilojoules.
8. A hydroelectric dam generates 10 megawatts of electricity for an hour. How much energy does it produce in kilowatt-hours?
9. A wind turbine generates 1,000,000 J of energy per second. How many kilojoules is this in one minute?
10. A car battery has a capacity of 50 ampere-hours and operates at 12 volts. Calculate its energy capacity in kilowatt-hours.
11. A refrigerator uses 150 watts of power for 24 hours. How much energy is consumed in kilowatt-hours?
12. A person lifts a 20 kg weight 1 meter high 10 times. Calculate the total energy used in joules and kilojoules.
13. A solar panel generates 2,000 kilowatt-hours of electricity in a month. How many joules is this?
14. A laptop uses 45 watts of power for 4 hours. Calculate the energy consumed in kilojoules.

L5 Domestic fuel use

You may not realize it, but the lights you switch on, the TV you watch, and even the fridge where you keep your snacks all use energy. In this explanation, we'll break down what domestic energy use is all about, why it matters, and how you can be more energy-efficient at home.

What is Domestic Energy Use?

Domestic energy use refers to the energy we use in our homes for things like heating, cooling, cooking, and powering our gadgets and appliances. This energy comes from various sources, such as electricity, natural gas, and even renewable sources like solar panels or wind turbines.

Why is Domestic Energy Use Important?

- **Comfort:** Energy helps keep our homes warm in winter and cool in summer, making our lives more comfortable.
- **Convenience:** Energy powers our devices, making it easier to cook, clean, and enjoy entertainment.
- **Environment:** Some sources of energy can harm the environment, so it's crucial to use energy wisely to reduce our impact on the planet.

How Do We Use Energy at Home?

Let's explore some common ways energy is used in your household:

- **Lighting:** Turning on lights in your room uses electricity.
- **Heating and Cooling:** Adjusting the thermostat controls the temperature in your home.
- **Cooking:** Using the stove or microwave consumes energy.
- **Appliances:** TVs, gaming consoles, and refrigerators all need energy to function.

Types of Energy Sources:

- **Electricity:** Powers most of our devices and appliances.
- **Natural Gas:** Used for heating, hot water, and cooking in some homes.
- **Renewable Energy:** Sources like solar panels and wind turbines harness energy from nature without harming the environment.

How Can We Save Energy?

Being energy-efficient is essential for saving money and reducing our impact on the environment. Here are some tips:

- **Switch Off:** Turn off lights and devices when not in use.
- **Use Energy-Efficient Appliances:** Look for appliances with the Energy Star label.
- **Insulate Your Home:** Proper insulation keeps your home comfortable without wasting energy.
- **Unplug Chargers:** Chargers left plugged in still use energy, even if your device is not connected.

Why is Energy Efficiency Important?

- **Cost Savings:** Energy-efficient homes have lower utility bills, which means more money in your pocket.
- **Environmental Impact:** Saving energy reduces pollution and conserves natural resources.
- **Future Generations:** Being energy-conscious sets a good example and ensures a better world for the future.

Independent practice

1. What is domestic energy use?
2. Why is it important to know about domestic energy use?
3. Name three common ways energy is used in households.
4. What are some sources of energy for homes?
5. **Extended writing (paragraph required):** Describe and explain how we can save energy by making changes at home.
6. How can you save energy when using lights?
7. What does the thermostat control in your home?
8. How does using energy-efficient appliances benefit you?
9. What is the Energy Star label, and why is it important?
10. What does it mean to insulate your home?
11. Why should you unplug chargers when not in use?
12. **Extended writing (paragraph required):** Explain why it is important to be energy efficient.
13. What can you do to help future generations in terms of energy use?
14. Give an example of renewable energy sources.
15. Imagine you left your TV, gaming console, and lights on in your room while you went out for the day. What can you do differently next time to save energy?

L6 Bills

We have already learnt that one unit of energy is the **joule (J)**. Two other units of energy are:

1. The **kilojoule (kJ)**. One kilojoule is equal to one thousand joules.
2. The **kilowatt hour (kWh)**. One kilowatt hour is equivalent to an electrical device with a power of 1 kW (equal to 1000 W) being used for a time of one hour. As there are 3600 seconds in one hour, one kilowatt hour is therefore equal to 3 600 000 J of energy.

We use kilowatt hours when it comes to electricity bills. This is because electrical devices in the average UK household transfer over 10 billion joules of energy a year. It's more convenient to use kilowatt hours as this brings the numbers down to a more manageable amount.

Electrical devices in the average UK household transfer 3000 kWh of energy each year.

To calculate the amount of energy in kWh that a device transfers you need to multiply the power of the device (in kW) by the time that it is used for (in hours):

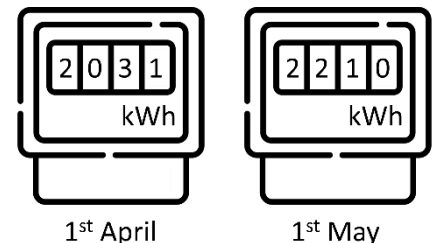
$$\text{Energy (in kWh)} = \text{Power (in kW)} \times \text{time used (in h)}$$

As of April 2022, the price for each kWh in the UK was 28p. To calculate the cost of an electricity bill we use the equation:

$$\text{Total cost (in pence)} = \text{Energy transferred (in kWh)} \times \text{price per kWh (in pence)}$$

Example question:

Using the meter readings to the right, calculate the cost of the monthly electricity bill. The price of each kWh is 28p.



Step 1. Calculate the total number of kWh used.

To do this, we need to look at the difference in meter readings:

$$2210 - 2031 = 179 \text{ kWh}$$

Step 2. Calculate cost by multiplying total number of kWh by cost per kWh.

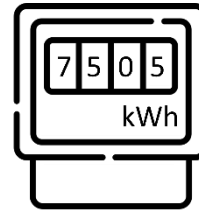
$$179 \times 28 = 5012 \text{ p}$$

There are 100p in a pound. To convert from pence to pounds you need to divide the number of pence by one hundred: **p → £ ÷ 100**.

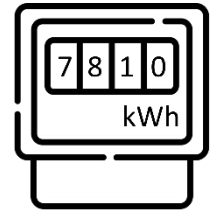
In other words, the 5012 p we calculated is equal to £50.12.

Independent practice

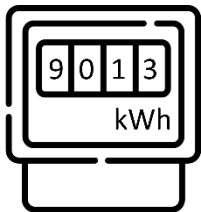
1. State how many joules are in a kilojoule.
2. State how many seconds are in an hour.
3. State how many joules are in a kilowatt hour.
4. An electric oven has a power of 2.2 kW and is used for a time of one hour. Calculate how much energy is used in kWh.
5. A television has a power of 0.2 kW and is used for a time of 8 hours. Calculate how much energy is used in kWh.
6. A hairdryer has a power of 1.8 kW and is used for a time of 30 minutes. Calculate how much energy is used in kWh.
7. State the equation that we can use to calculate cost of an electricity bill.
8. Using the meter readings to the right, calculate the cost (in pence) of the monthly electricity bill. The price of each kWh is 30p.



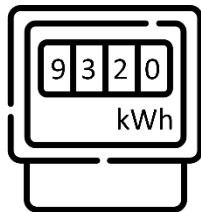
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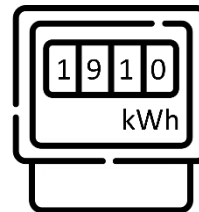
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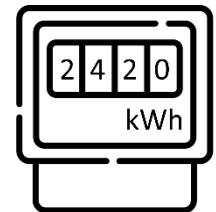
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9. Using the meter readings to the left, calculate the cost (in pence) of the monthly electricity bill. The price of each kWh is 25p.

10. Using the meter readings to the right, calculate the cost (in pounds) of the monthly electricity.



1st March



1st April

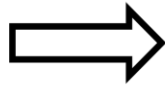
L7 Reducing unwanted thermal energy transfers

To reduce the size of electricity and fuel bills, it is important to reduce thermal energy losses from a home:

In the average home:

- 35% of thermal energy loss is through the walls. This can be reduced with **cavity wall insulation**.
- 25% of thermal energy loss is through the roof/attic. This can be reduced with **loft insulation**.

More thermal energy escaping from home

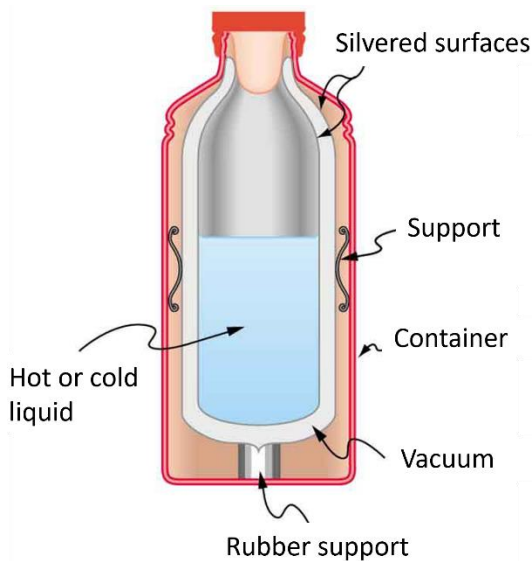
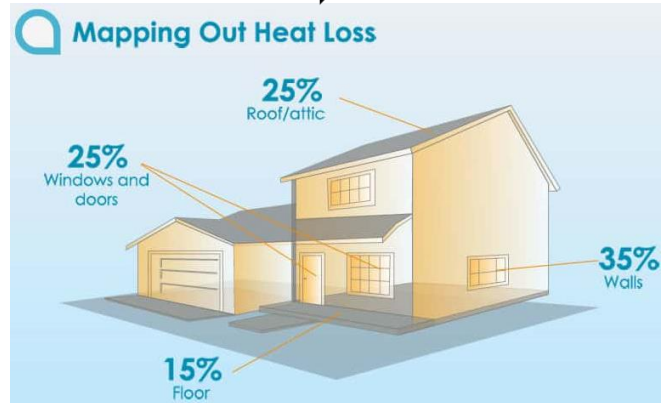


More energy/fuel needed



Higher heating costs

- 25% of thermal energy loss is through windows and doors. This can be reduced with **double glazing**, **closing the curtains** and with a **draught excluder** that stop draughts coming in through the bottom of the door.
- 15% of thermal energy loss is through the floor. This can be reduced by improving the insulation in the floor.



Vacuum flasks are also designed to limit thermal energy transfers. If a hot liquid is inside a vacuum flask, the following features keep the liquid hot for as long as possible:

- **Silvered surfaces** reflect infrared radiation back into the liquid.
- Vacuum does not allow for conduction or convection as there are no particles.
- Plastic lid is an **insulator**, limiting conduction. It also prevents evaporation of liquid.

They also work keep a cold liquid cooler for longer. The silvered surfaces now reflect infrared radiation away from the liquid. The vacuum prevents conduction and convection, and the plastic lid

also limits conduction.

Independent Practice

1. **Extended writing (paragraph required):** Describe all the methods of reducing heat loss in the home.
2. Describe why it is important to reduce thermal energy losses from a home.
3. Double glazing is made from two panes of glass, which are separated by a gas. Describe why double installing double glazing will limit thermal energy loss from the windows.
4. State a way, other than double glazing, of reducing thermal energy loss through windows.
5. Takeaway containers often come in shiny aluminium containers. Describe why this limits thermal energy loss due to radiation.
6. Two metal bottles contain a cold liquid. One of the bottles is coloured black, the other is shiny silver. Explain which one will keep the liquid cooler for longer.
7. The following statements are either true or false. State which are true and which are false.
8. There are no particles in a vacuum.
9. Plastic is a good conductor.
10. Cavity wall insulation can be made of foam, which contains trapped air bubbles. Explain why this is a good insulator.