



WHAT'S GUZZLING THE POWER? QUICK ACTIVITY

KS3

SAVE INK - don't print this first page!



What's Guzzling the Power? quick activity **KS3**

Lesson overview

In this activity, students learn about which devices and appliances use electricity; how much power each requires to operate; and how they can reduce their own use of electricity.

Learning objectives

- ▶ Learn about the importance of electricity to our lives
- ▶ Learn which of our appliances/activities use the most power
- ▶ Understand that lifestyle choices can save or waste power
- ▶ Consider how these lessons might apply outside the home
- ▶ Discover the range of job opportunities available in the energy industry

Subjects

Science
Physics

Gatsby Benchmarks

This activity supports the following Gatsby Benchmarks:

2: Learning from career and labour market information:

Discover some of the important roles in the energy industry and the routes into them.

4. Linking curriculum learning to careers: Energy and Facilities Managers need to know about appliance and electricity use in their organisation.

Timings

- ▶ Warm up (optional): 5 mins
- ▶ Main activity: 40 mins
- ▶ Careers in energy: 20 mins

Materials and set-up

This Activity Pack contains the following materials:

- ▶ Teacher notes
- ▶ Student worksheet

This activity can be used in the classroom, led by a teacher. Or share these Teacher notes and the Student worksheet with families who are home schooling.

WARM-UP (5 minutes)

Part 1: It's electric!

Do you use electricity at home?

Ask students: How do you know it's in your home, if you can't see it?



HPC Inspire

We're Hinkley Point C's Education Programme in Somerset and the wider South West region. And we're here to help young people take advantage of the huge opportunities that the construction and

operation of HPC has to offer. We do this through a range of fun and innovative activities: including hands-on STEM workshops, careers assemblies and online learning resources.

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Electricity comes into our homes through power cables. We can't see it. But we are able to use it by plugging in things like our PlayStation, TVs and kettles to power sockets in the walls. Electricity also powers our lights.

Some people also use electricity to heat their home and to charge their car.



Did you know?
 From 2035, you won't be able to buy a petrol, diesel or hybrid car. Instead we'll be driving electric or some other type of powered car. Imagine being able to recharge your car at home, in a car park or even on the street.

THE MAIN ACTIVITY

(40 minutes)

Part 1: Powering your day

Electricity provides clean, affordable and safe power, exactly where we need it. In our homes, it powers the appliances, lights and devices that make our day-to-day lives easier and more enjoyable.

1-minute challenge!



Ask students to write down in their worksheet as many things they can think of in the home that need electricity to operate. It might be something they use (e.g. a games console or phone charger). Or it could be something other people in their family use (e.g. oven, heater etc).

Have a brief discussion about what they've included on their list – did everything they include use electricity? Are there any unusual things they've included? Make clear the distinction between battery-operated or gas-powered devices, and those that use electricity.

Watts and kilowatts

Every appliance and gadget has a power rating, which tells you how much electricity it needs to work. This is measured in watts (W) – for example a 10W low-energy light bulb.

Watts are quite a small measure, so for more powerful appliances we use kilowatts (kW):

1,000 watts = one kilowatt

An oven rated at 2kW (2,000W) needs 200 times more electricity than a 10W low-energy light bulb!

Part 2: Does it guzzle power?

Now let's work out how much power different appliances around the home need to operate. Cut out the 12 pictures at the back of this activity. You'll only need one set if you're running this activity at home. But if you're in the classroom, consider dividing the class into smaller groups and give each group a set of 12 pictures.

Ask students to look at each of these appliances and devices. Which do you think uses the most electricity? Which uses the least? Ask them to place the pictures of appliances in order from highest to lowest demand.

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Use the table below to guide a discussion about the students' answers. Prompt students to explain why they've chosen the order they have.

Rearrange the items, if necessary, in the right order and discuss it with the students. Which ones are they surprised by? Can they see a link between the types of devices that use lots of electricity, and the ones which use less? Typically, the most power-hungry devices all heat things, while the middle-ranking ones contain motors. Gadgets tend to use the least power.

ITEM	POWER RATING ¹	DISCUSSION POINT
Kettle	2.2-3.0kW ²	It takes a lot of energy to heat things!
Washing machine	2.2kW ³	
Oven	2.2kW	
Toaster	1.2kW	
Laser printer	800W ⁴	Laser printers 'melt' toner onto the page using special rollers called fusers ⁵ . It takes quite a bit of power to heat them up!
Vacuum cleaner	800W ⁶	
Fridge freezer	300W	The compressor needs quite a powerful motor to drive it
TV	150W	
Games console	120W ⁷	
Laptop	Up to 65W ⁸	
Light bulb	10W	
Mobile phone	10W ⁹	When fast-charging

1 We've used the median values from here unless noted otherwise – and have checked the other values against this list, too

2 3.0kW and 2.2kW

3 The A+++ Samsung is rated at 2.0-2.4kW, so we've taken the median

4 We estimate the average peak consumption is around 800W

5 <https://www.explainthatstuff.com/laserprinters.html>

6 Dyson small ball 700W, Miele PowerLine 890W

7 <https://www.anandtech.com/show/7528/the-xbox-one-mini-review-hardware-analysis/5>

8 This is a reasonable figure for a high-spec Windows laptop, but it can be far lower. A Chromebook only uses 5W when fully charged, but is a very low-power computer

9 The Centre for Sustainable Energy says up to 5W, but most modern smartphones support 2A charging over USB, which is 5V, so you get a maximum of 10W

Understanding kilowatt-hours

Watts and kilowatts tell us how much power a device is using at any instant. However, to really understand energy use you need to know how much power they use over time. Because a power-hungry device might not actually get used very often. Whereas a device that doesn't seem to use much power could actually use a lot of energy if you use it all the time.

Kilowatt-hours (kWh) tell us how much power a device uses at a certain point in time. 1kWh is the amount of energy you would use if you kept a 1,000 watt appliance running for an hour. So if you have a 1kW vacuum cleaner and it takes you one hour to clean the house, you've used 1kWh. If it takes two hours you've used 2kWh – and you should probably ask for more pocket money!

Part 3: Count the hours

Ask students to rearrange their pictures of appliances – this time in order of how much power they might typically use in a year.

Use the table below to guide a discussion about their answers. Prompt students to explain why they've chosen the order they have.

Rearrange the items, if necessary, in the order below and discuss it with the students. Which ones are they surprised by? Can they suggest a reason why some devices (e.g. fridge or games console) use more or less power than they were expecting?

ITEM	APPROX ANNUAL USE (KWH)	BASED ON?
Fridge freezer	270 ¹⁰	EU energy label
Oven	50-150 ¹¹	Used every 2-6 days
Washing Machine	130 ¹²	EU energy label
Kettle	105 ¹³	Used five times a day
TV	100 ¹⁴	EU energy label
Games console	90	Used two hours a day
Laptop	80 ¹⁵	Used eight hours a day during the working year

10 Approximation for A+ based on Samsung range

11 This is going to vary hugely, but we've used the 0.81kWh per cycle figure of this Bosch, and worked it based on a cycle every two to six days

12 This is the energy rating value for our writer's washing machine

13 Our writer's 2.3kW kettle takes 1.5mins to boil two cups' water. We've assumed it does that five times a day, 365 days a year

14 Approx based on this Samsung

15 Approx based on 40W, used eight hours a day for five days a week, 48 weeks a year

ITEM	APPROX ANNUAL USE (KWH)	BASED ON?
Toaster	30 ¹⁶	Two rounds a day
Light bulb	22	Six hours a day
Vacuum cleaner	21	30 minutes a week
Mobile phone	7	Two hours a night
Laser printer	1 ¹⁷	One short print job a day

Part 4: What's the cost?

In the home, we measure and pay for the electricity we use in kilowatt-hours. And the amount of kilowatt-hours we use is measured by a meter.

Ask students if they have any idea how much 1kWh of electricity typically costs.

It's about 18.5p. This [infographic from Ofgem](#) shows how the average price of electricity in the UK compares to other countries. And interestingly, we sit just above halfway in how much we pay. Power is cheapest in Bulgaria, where residents pay just under 9p for 1kWh. But the UK's cheaper than Germany, where people pay nearly 27p – that's three times more! – for the same amount of electricity.

Can students guess how many kWh of electricity the average home uses each year? It's around 3,000¹⁸.

We can work out how much different appliances around the home cost to run if we know how much power a device uses and how much electricity costs per kWh, since:

Cost = Power (kW) x Time (hours) x Price per kWh (pence)

Challenge time!

Estimate how much the following three appliances will cost to run over a year. Use the example to help you work through the different steps to get your answer – and show your working out in your Worksheet. Give your final answer in pounds and pence.

1. Toaster 1.2kW
2. TV 100W
3. Wi-Fi router 3W

¹⁶ Calculated for two rounds of toast, taking two minutes each, each day

¹⁷ Based on using it once a day and the print job taking 20 seconds. The average consumption is lower than the peak – typically around 300W. That gives about 0.6kWh per year

¹⁸ <https://www.ofgem.gov.uk/gas/retail-market/monitoring-data-and-statistics/typical-domestic-consumption-values>

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Use this example to help:

A low-energy light bulb has a power rating of 10W. And we know it costs 18.5p for 1kWh of electricity.

Cost = Power (kW) x Time (hours) x Price per kWh (pence)

So, first we need to convert the power rating to kW. Which we do by dividing the figure by 1,000. This gives it a power rating of 0.01kW.

Next, we need to work out how many hours the light is likely to be on each day. Let's assume six hours. So to work out the time over the year, we have to multiply six by 365. That's 2,190 hours.

So the annual cost works out as:

$$0.01 \text{ (kW)} \times 2,190 \text{ (hours)} \times 18.5 \text{ (p)} = 405.15 \text{ pence} = \text{£}4.05$$

1. Toaster 1.2kW

We know the kW already, so we don't need to work this out.

For time, let's assume the toaster is on for six minutes a day (to make 2-3 rounds of toast). That's 0.1 hours a day, equivalent to 36.5 hours over a year (0.1 hours x 365 days).

And we know the cost of electricity is 18.5p per kWh.

So the annual cost works out as:

$$1.2 \text{ (kW)} \times 36.5 \text{ (hours)} \times 18.5 \text{ (p)} = 810.3 \text{ pence} = \text{£}8.10$$

2. TV 100W

$$100\text{W} = 0.1\text{kW} \text{ (} 100 / 1,000 \text{)}$$

Let's assume the TV is on for 2 hours a day. That's 730 hours a year (2 x 365 days).

And we know the cost of electricity is 18.5p per kWh.

So the annual cost works out as:

$$0.1 \text{ (kW)} \times 730 \text{ (hours)} \times 18.5 \text{ (p)} = 1,350.5 \text{ pence} = \text{£}13.51$$

3. Wi-Fi router 3W

$$3\text{W} = 0.003\text{kW} \text{ (} 3 / 1,000 \text{)}$$

Most Wifi routers are on constantly i.e. 24 hours a day. Over a year this is equivalent to 8,760 (24 hours x 365 days).

And we know the cost of electricity is 18.5p per kWh.

So the annual cost works out as:

$$0.003 \text{ (kW)} \times 8,760 \text{ (hours)} \times 18.5 \text{ (p)} = 486.18\text{p} = \text{£}4.86$$

CAREERS IN ENERGY

(20 minutes)



Part 1: What does a data analyst do?

Read this [National Careers Service job description](#) for a data analyst/statistician. Then use what you've just learnt about the cost of electricity and the job description from the National Careers Service to answer the following questions.

1. **Q. Why might an electricity company need a data analyst? (Clue: think about how you use electricity over the day).**
 - A. Our demand for electricity varies over the course of the day; by season; and with some events. A data analyst helps predict forthcoming demand, ensuring enough electricity is available when it's needed.
2. **Q. Name two appliances you looked at in the activity that might have a variable demand for electricity depending on seasonal or day-to-day reasons, and say why.**
 - A. This could apply to almost any appliance, but good examples include:
 - ▶ Light bulb: variable daylight hours
 - ▶ TV: big events or seasonal TV
 - ▶ Fridge freezer: works harder in summer
3. **Q. How can you get a job as a data analyst?**
 - A. Through a university course or graduate training scheme.

4. Q. Choose four skills or areas of knowledge you need to become a data analyst.
A. Choose from:

- ▶ Maths knowledge
- ▶ Analytical thinking skills
- ▶ To be thorough and pay attention to detail
- ▶ Knowledge of computer operating systems, hardware and software
- ▶ Excellent verbal communication skills
- ▶ Thinking and reasoning skills
- ▶ The ability to read English
- ▶ The ability to think clearly using logic and reasoning
- ▶ To be able to use a computer and the main software packages competently

Part 2: Jobs that involve working with electricity

Want a hands-on job and a skill for life that could take you around the world? A job working with electricity could help you do just that. At Hinkley Point C, we're starting to fit out the buildings across the site and need people who work with electrical, mechanical and heating systems to set-up, install and maintain these.



Electrical apprentice

Watch **this film** with Tom, an electrical apprentice at EDF, and then answer the question below.

Find out more about an electrical engineer and the career opportunities available

Q. What attracted Tom to the apprenticeship?
A. Choose from the following options:

- ▶ You can earn while you learn
- ▶ The job took him down South from Hartlepool, and it was his first time living away from home
- ▶ He'll have a recognised trade
- ▶ He has a career for life

Part 3: Future jobs in energy

There are so many upcoming jobs at HPC. We're recruiting 25,000 people during the project's construction. But we'll need another 900 people when the power station is up and running. Their role is to oversee the safe generation of nuclear power, but also to help maintain and repair the equipment.



C&I apprentice

Watch **this film** with Rachel, a C&I apprentice at EDF, and then answer the questions below.

Find out more about early careers in the energy industry

1. **Q. What qualification has Rachel been working towards?**
A. A BTEC – and she also worked towards an HNC when back on site.
2. **Q. What life skills did Rachel learn on the apprenticeship, which she said she didn't pick up at school?**
A. About finances – understanding things like mortgages and savings.
3. **Q. Give at least two reasons why Rachel's glad she choose an apprenticeship:**
A. Choose from the following options:
 - ▶ She likes working on site
 - ▶ Everyone is very friendly and welcoming
 - ▶ Every day is busy
 - ▶ She likes working at the plant and experiencing what it's like to work on site – she doesn't like working in an office

Part 4: Who checks up on schools and business' energy use?

Big companies often have Energy or Facilities Managers¹⁹: people whose job it is to ensure facilities and energy equipment are available and safe to use at work. How might they be able to reduce the energy used by the company? You could have a look at the **National Careers Service** for more information about what this job involves.

Why not talk to your school Caretaker or Facilities Manager about the school's use of energy too? What does the school do to make sure energy isn't being wasted? How does the school keep track of its energy use? Could you help – for example by designing a 'Switch it off!' notice to place near light switches and other equipment that's been left on?

Curriculum links

Science: Working scientifically

Physics: Energy

Find out more about **Hinkley Point C** and **careers in the nuclear industry**

¹⁹ <https://nationalcareers.service.gov.uk/job-profiles/facilities-manager>



Kettle



Washing machine



Oven



Toaster



Laser printer



Vacuum cleaner



Fridge freezer



TV



Games console



Laptop



Light bulb



Mobile phone

THE MAIN ACTIVITY

Part 1: Powering your day

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1-minute challenge!

Write down in one minute as many things as you can think of in your home that need electricity to operate.

Part 4: What's the cost?

Challenge time!

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A. _____

2. Q. Name two appliances you looked at in the activity that might have a variable demand for electricity depending on seasonal or day-to-day reasons, and say why.

A. _____

3. Q. How can you get a job as a data analyst?

A. _____

4. Q. Choose four skills or areas of knowledge you need to become a data analyst.

A. _____

Part 2: Jobs that involve working with electricity



Watch [this film](#) with Tom, an electrical apprentice at EDF, and then answer the question below.

Q. What attracted Tom to the apprenticeship?

A. _____

Part 3: Future jobs in energy



Watch [this film](#) with Rachel, a C&I apprentice at EDF, and then answer the questions below.

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A. _____

2. Q. What life skills has Rachel learnt, which she says she didn't pick up at school?

A. _____

3. Q. Give at least two reasons why Rachel's glad she choose an apprenticeship:

A. _____

Find out more about **Hinkley Point C** and **careers in the nuclear industry**