

enistic energy explorers: lesson plan

How much does it cost to make a cup of tea?



Discuss energy-efficiency and energy wastage with students, and demonstrate how simple behavioural changes can have an impact on an individual's energy consumption.

Lesson objectives

- Understand how to measure the electricity used by an electrical item
- Calculate the cost of the electricity used to boil a kettle
- Work out the difference in cost and energy used when boiling a full, two-thirds full and one-cup full kettle.
- Report these findings in simple graph form
- Think about the implications of this and how individual behaviour affects energy consumption

Time required: 30 minutes

Resources & preparation required

Kettle, water, mug, stopwatch

Enistic Smart Socket or 5-way Smart Strip – (n.b. if you have a large system, or have other enistic equipment in use, ensure that you can easily identify the particular smart socket / strip you are going to use)

Enistic Energy Manager software (available on CD Rom)– set this up so that students can view it on the interactive whiteboard.

Setting up Enistic Energy Manager Pro / Lite (desktop software):

1. Open Energy Manager and click on the Meters tab. Identify the Smart Socket or 5-way Smart Strip you will be using.
2. To rename the socket/strip, right-click on its name, choose edit and then type in a new name.
3. Return to the Graph tab and select only your chosen socket/strip – the graph should show that no energy is currently being used.



Lesson Structure

i. Introduction

Ask students to think about the popularity of tea/coffee in the UK and how many cups they think the nation drinks each day. According to the UK Tea Council, around 165 million cups of tea are drunk daily (and only 70 million cups of coffee). Their website has a counter showing the number of cups of tea consumed in the UK so far each day: www.tea.co.uk.



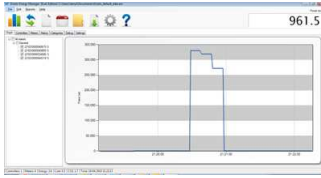
This exercise will show how much energy is used by boiling the kettle to make one of these cups of tea or coffee, and how much that costs.

ii. Classwork using the interactive whiteboard

Ensure that the kettle is full and then plug it in to an Enistic Smart Socket or 5-way Smart Strip, then plug in the socket/strip to a normal electrical socket. Explain to students that the enistic socket or strip contains a smart meter, which will measure the amount of electricity that is passing through it – i.e. the amount used by the kettle.

Draw the students' attention to the whiteboard and show them the graph of energy usage for the kettle. It should show that no power is currently being consumed.





Switch on the kettle, start the stopwatch, and watch the graph change. Record a figure, in Watts, of how much power is used (it will fluctuate a little but you should be able to record a rough average), along with the time taken to boil the kettle. Explain to students that this is not the total energy used but the rate of energy usage. Electrical power is measured in Watt-hours (Wh) or Kilowatt-hours (kWh).

To measure the energy used, you need the formula:

$$\text{Energy} = \text{Power (in W or kW)} \times \text{Time (in hours)}$$

e.g. if the kettle uses 2180W and takes 2 minutes to boil, its energy usage is:

$$2180 \times (2 \div 60) = 72.6\text{Wh or } 0.0726\text{kWh} .$$

Repeat the exercise, but with the kettle only two-thirds full of water, and then with the kettle just holding enough water for one mug of tea.

Calculate the total energy used for each scenario and ask students to draw a simple bar chart to show the comparison. How much energy is wasted if only one mug of water is wanted but a full kettle is boiled?



For each case, work out the costs of the energy used (basing the calculation either on your school's actual electricity tariff, or using the average cost of 10p per kWh) and add them to the bar chart. So for the example above, the cost would be 10p x 0.0726 = 0.007p.



Question: Robin drinks four cups of tea every day and always fills his electric kettle completely before boiling it. Assume that his kettle is exactly the same as the one you have used for the exercise above. How much money could Robin save each week, and then in a whole year, by only boiling enough water for one cup of tea?

iii. Discussion / summing up

Is the amount of energy used by boiling unnecessary water a significant amount?

Ask students to consider how often a kettle is boiled - for cooking as well as for hot drinks. Could each person really save money, and help the environment, by only boiling as much water as they need?

How could students tell others (e.g. teachers, parents) about their findings to encourage them to be more environmentally responsible on a daily basis?

iv. Extension / homework suggestion

1. On average, people in the UK drink 165 million cups of tea every single day. If a kettle like the one you have used for this exercise is used for each of those cups, how much electricity is used every day? Come up with two answers - one for if everyone fills the kettle completely before boiling and one for if they just boil enough water for one cup. What would this cost and how much is saved by only boiling the water needed for one cup?
2. Design a poster explaining the benefits of thinking before you put on the kettle, and only using as much water as you really need.

Risk assessment

The supervising teacher should carry out all risk assessments relating to this activity, and ensure that they comply with the requirements of the institution in which the lesson is conducted.

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How much energy does my PC use?

Discuss energy-efficiency and energy wastage with students, and demonstrate how it relates to them as individuals on a daily basis as they use PCs at school and home.

Lesson objectives

- Understand how to measure the electricity used by an electrical item
- See the difference in electricity consumed by a PC and a laptop, and whether this is affected by the activation of the screensaver
- Calculate the cost of the energy used by a PC, and how much is wasted by leaving a computer or monitor switched on overnight
- Think about the implications of this and how individual behaviour affects energy consumption

Time required: 30 minutes

Resources & preparation required

PC, laptop and other small electrical items – e.g. printer, lamp, heater, mobile phone charger

Enistic 5-way Smart Strip – (n.b. if you have a large system, or have other Enistic equipment in use, ensure that you can easily identify the particular smart strip you are going to use)

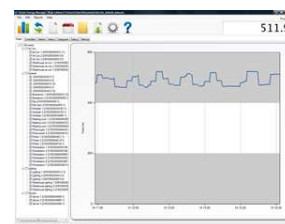
Enistic Energy Manager software (available on CD Rom) – set this up so that students can view it on the interactive whiteboard.

Setting up Enistic Energy Manager Pro / Lite (desktop software):

1. Open Energy Manager and click on the Meters tab. Identify the 5-way smart strip you will be using.

2. To rename the 5-way smart strip, right-click on its name, choose edit and then type in a new name.

3. Return to the Graph tab and select only the 5-way smart strip – the graph should show that no energy is currently being used.



If possible, work out / estimate the total number of PCs used within the school, and find out the school's electricity tariff.

Lesson Structure

i. Introduction

Ask students to guess the number of PCs they think there are in the school. Do they think that they and other students / teachers always remember to switch them off at the end of the day? Are some accidentally left on overnight? How much do students think it costs to run a PC for 24 hours?

The aim of this exercise is to calculate the running costs of a classroom PC, and the amount of electricity it consumes.

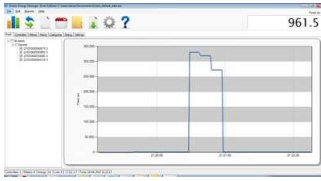


ii. Classwork using the interactive whiteboard

Plug a PC and its monitor in to an Enistic 5-way Smart Strip, then plug in the smart strip to a normal electrical socket. Explain to students that the enistic Smart Strip works in the same way as an ordinary electrical 5-way power strip, but also contains a smart meter, which will measure the amount of electricity that is passing through it.



Draw the students' attention to the whiteboard and show them the graph of energy usage for the 5-way Smart Strip. It should show that no power is currently being consumed.



Turn on the PC and watch the graph as it powers up. Record the figure, in Watts, for energy consumption when the PC is fully active.

Compare this figure with the energy consumed when the PC's screensaver comes on - is there any difference?

Shut down the PC, but leave the monitor switched on. How much energy is still being consumed? Disconnect the PC and plug in and turn on the laptop instead, and record its energy consumption too.



Explain to students that these figures are not an amount of energy used but the rate of energy usage. Electrical power is measured in Watt-hours (Wh) or Kilowatt-hours (kWh).

To measure energy used, you need the formula: Energy = Power (in W or kW) x Time (in hours)
e.g. if the PC uses 120W and is switched on for an hour, its energy usage is $120 \times 1 = 120\text{Wh}$ or 0.12kWh .



Ask students to draw a simple bar chart to compare the energy usage of the PC, the laptop, the PC monitor and the PC with screensaver activated.

Calculate the cost of the energy used by the PC and the laptop, using either your school's actual electricity tariff or a standard approximate cost might be 10p per kWh. How much does it cost to run a PC or laptop for an hour / day / week / year?

How much money is wasted if a PC is left accidentally switched on overnight, or if its monitor is not switched off overnight?

Ask the students to think about other electrical items that might be used in a classroom and predict how much energy they think they would use compared to a PC. You can then test whether they are right by connecting some of these devices, in turn, to the Enistic 5-way Smart Strip and noting the energy used. Students should record the results in a bar chart.



iii. Discussion / summing up

Which devices are the biggest users of energy? Where do students think that most energy is being wasted in their school (e.g. whiteboards / PCs left on standby). Suggest that they also consider other things that will use a lot of power – e.g. lighting, heating.

iv. Extension / homework suggestion

- Whole classroom - calculate the electricity usage and running costs of all the PCs in the classroom.
- If you have some computers that are older than others in the classroom, is there a difference in how much electricity each uses?
- Work out the usage and cost figures for the whole school, and how much money is wasted if:
 - a) the PCs are all left switched on outside of school hours
 - b) the PCs are all left switched on at the weekend?



Risk assessment

The supervising teacher should carry out all risk assessments relating to this activity, and ensure that they comply with the requirements of the institution in which the lesson is conducted.

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Standby v. Switch off: does it really make a difference?



Discuss some aspects of energy-efficiency and energy wastage with students, and demonstrate how simple behavioural changes can have an impact on an individual's energy consumption. The focus is particularly on the usage of devices such as TVs, and the impact of leaving them on standby.

Lesson objectives

- Understand how to measure the electricity used by an electrical item such as a TV
- Work out how to calculate the cost of the electricity used
- Compare the difference in the amount of energy used to power a TV when it is switched on to how much it uses on standby
- Report these findings in simple graph form
- Think about the implications of this and how individual behaviour affects energy consumption

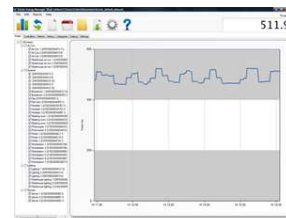
Time required: 30 minutes

Resources & preparation required

- TV and, if possible, other electrical devices with a standby function (e.g. photocopier, printer) and/or a mobile phone charger.
- Enistic Smart Socket or 5-way Smart Strip – (n.b. if you have a large system, or have other enistic equipment in use, ensure that you can easily identify the particular smart socket/strip you are going to use.
- Enistic Energy Manager software (available on CD Rom) – set this up so that students can view it on the interactive whiteboard.

For Enistic Energy Manager Pro / Lite (desktop software):

1. Open Energy Manager and click on the Meters tab. Identify the Smart Socket or 5-way Smart Strip you will be using.
2. To rename the socket/strip, right-click on its name, choose edit and then type in a new name.
3. Return to the Graph tab and select only your chosen socket/strip – the graph should show that no energy is currently being used.



Lesson Structure

i. Introduction

Ask students to name some electrical devices that have a standby function. Why do people use standby and how often? How much energy do they think a TV, for example, uses on standby - what percentage of the power that it uses when it is turned on? How much of the time do they think their TVs at home are left on standby?



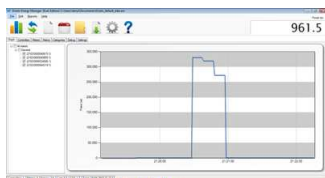
This exercise will show how much energy is used by a TV while on standby, and how much money can be wasted by not switching off completely.

ii. Classwork using the interactive whiteboard

Plug the TV in to an Enistic Smart Socket or 5-way Smart Strip, then plug in the socket/strip to a normal electrical socket. Explain to students that the enistic socket or strip contains a smart meter, which will measure the amount of electricity that is passing through it – i.e. the amount used by the TV.



Draw the students' attention to the whiteboard and show them the graph of energy usage for the TV. It should show that no power is currently being consumed. Switch on the TV and watch the graph change. Record the figure, in Watts, of how much power is used. Now turn the TV on to standby and record how much electricity is being used.



Explain to students that these figures are not an amount of energy used but the rate of energy usage. Electrical power is measured in Watt-hours (Wh) or Kilowatt-hours (kWh).

To measure electrical energy, you need to use the formula: Energy = Power (in W or kW) x Time (in hours)
e.g. if the TV uses 100W and is switched on for an hour, its energy usage is $100 \times 1 = 100\text{Wh}$ or 0.1kWh .



Work out how much it would cost to have the TV switched on for 4 hours, compared to how much it would cost to leave it on standby for 4 hours. Base the calculation either on your school's actual electricity tariff, or using the average cost of 10p per kWh. e.g. if the TV uses 100W, then $100 \times 4 = 400\text{Wh}$, or 0.4kWh . This costs $0.4 \times 10\text{p} = 4\text{p}$.



Ask students to draw a simple bar chart to show how much electricity is used, and its cost, when switched on compared with in standby mode.

If you have other devices available with standby modes, you can repeat the exercise to compare their power usage and running costs when active and on standby. You could also use a mobile phone charger to demonstrate that it still uses power when plugged in but not charging a phone.

iii. Discussion / summing up

How significant is the amount of energy/money wasted by leaving devices on standby? Ask students to think of all the different devices in their homes and at school that could be contributing to this waste. Do they think people are aware of the energy and money they may be wasting by not switching off electrical equipment?

iv. Extension / homework suggestion

1. Ask students to count the number of TVs they have in their home and estimate how many hours they are in use each week. How many more hours are the TVs left on standby? Using these estimates, ask students to calculate how much money it costs to power the TVs for four weeks, and how much money is wasted by leaving them on standby during this same time period.
2. Design a poster to encourage people not to waste energy by leaving electrical equipment on standby.

Risk assessment

The supervising teacher should carry out all risk assessments relating to this activity, and ensure that they comply with the requirements of the institution in which the lesson is conducted.