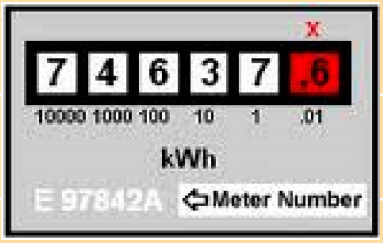
GUZZLER'S VISIT TO SCHOOL: MEASURING AND SAVING ENERGY

Equipment:	Access to electricity meter Access to gas meter
Suggested Class Level:	4th - 6th
Preparation:	



Background information:

ENERGY AND ITS DIFFERENT FORMS:

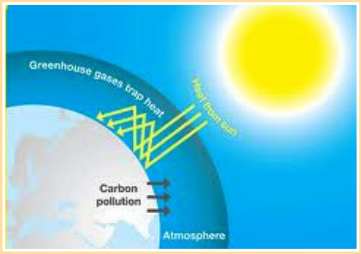
Nothing can happen without energy. Energy is what makes everything work, including you. There are many different types of energy. The main ones are: light energy, heat energy, chemical energy (*in food and fuels among other things*), electrical energy, sound energy, movement energy.

Energy can be changed from one kind to another (*e.g. the chemical energy in food and petrol can turn into movement energy in people and cars ; electrical energy turns into light and/or heat energy in electric lights and cookers*). But energy cannot be made from scratch or destroyed. So to get energy for heating our homes or running our cars **we have to use up some other kind of energy.**

A lot of the energy we use for lighting, heating and appliances at home and in school is in the form of electricity. Up to now much of this electricity has been made by burning fossil fuels (*oil, turf, coal, etc.*) in power stations. **FOSSIL FUELS**

We need to cut down on the use of fossil fuels for 2 reasons:

a) they took millions of years to form and they are running out;
b) burning them produces carbon dioxide and is giving rise to climate change which is having impacts in many parts of the world – floods, droughts, hurricanes, etc.



SUSTAINABLE ENERGY

So what will we use instead to light our homes and schools, run our cars, etc? We will have to use electricity which has been made from other forms of energy which are sustainable (*e.g. sun, wind, waves on the sea.....*).

At present there are many people in Ireland who are using the sun's energy to heat water in their homes and to make electricity. The movement energy of wind is also being used quite widely now to make electricity.

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MEASURING ENERGY – the kilowatt hour (kWh).

The unit of electrical energy is the kilowatt hour (*which is the amount of energy used by a 100 Watt bulb running for 10 hours.*)

This is the unit shown on electricity meters.

Gas meters measure the number of cubic metres of gas used; this is then converted into kilowatt hours by multiplying by 11.4. (*This is called a conversion factor of 11.4*).

To calculate the amount of energy in **heating oil**, you multiply the number of litres of oil by 11.2 (*i.e. a conversion factor of 11.2*)

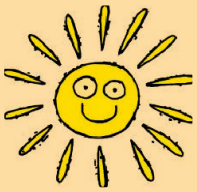
Trigger questions:

Discussion on the different kinds of energy is recommended as an introduction to this activity. Some suggestions follow:

What is energy?

What is the difference between having energy and not having energy? (*Ability to do things*)

What gives you your energy? (*Food. Need for sleep may also be mentioned*)



What gives a car its energy? (*Petro/diesel*)

What gives waves on the sea their energy? (*Wind*)

What gives your kettle or cooker their energy to heat things? (*Children will probably say electricity or gas*)

How is your house/ the school heated? (*Electricity,oil/ gas/turf/ sun/wood pellets, etc.*)

What other kinds of energy do you know? (*Light, sound, heat, magnetic, nuclear...*)

What else in the school uses energy? (*Lights, Computers ,Kettle, ...*)

How does electricity come into the school? (*Through thick wires called cables, you may be able to see this running from a pole to the school*)

How does gas come into the school (*if relevant*)?(*Through pipes*)

Where do oil, gas and turf come from? (*Under the ground or under the seabed*).

How were they formed? (*Millions of years ago, plants absorbed the Sun's energy - through photosynthesis – and they got compressed*)

Why do we need to use less energy?

(*The fossil fuels are running out; and also, burning them produces carbon dioxide and is giving rise to climate change which is having disastrous results in many parts of the world – weather extremes like floods, droughts, hurricanes*).

How do we measure the amount of electricity or gas we use in a building? (*With meters*)

What is the unit of electricity called (*a kilowatthour, kWh for short*)

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Content:	**SCIENCE:** Strand: Energy and Forces; Strand Unit: Heat *"The child should be enabled to ... identify ways in which homes, buildings and materials are heated"* (SESE: Science Curriculum, page 64) Strand: Environmental Awareness and Care; Strand Unit: Environmental awareness *"The child should be enabled to:* • *become aware of the importance of the Earth's renewable and non-renewable resources* • *foster an appreciation of the ways in which people use the Earth's resources* • *come to appreciate the need to conserve resources* • *recognize and investigate aspects of human activities that may have positive or adverse effects on environments..."* (SESE: Science Curriculum, pages 90-91)
	MATHS: Number – place value, operations, % Measures - money Data - Representing and Interpreting Data
Skills:	Investigating (*including 'fair testing'*), measuring, recording, analysing
Cross-curricular Links:	**Geography:** Dinosaurs and fossils **History:** Impact of human activity on the environment; weather, climate and atmosphere
Activities - Science and Maths	Teachers should encourage the children to identify the need to monitor energy consumption in school and to be involved in the design of a survey. In this way children can have a sense of ownership of the project.Measuring the energy used, and calculating the cost, reinforces the idea of looking at our energy use and finding ways to be more efficient. The children can be involved in measuring energy use at present in the school and then measuring energy use after implementing energy saving measures. For a scientific survey, the children need to remember 'fair testing' and monitor over the same length of time for each test, (say one full week, with normal school hours). Strict fair testing can produce some problems on account of the variability of the Irish weather, and the need for different levels of heating or light. This can be discussed, and the children design as fair a test as possible.

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PLANNING WITH THE CHILDREN

"If you want to reduce the amount of energy the school uses, what is the first thing you do? (*Measure the amount the school uses at present*)

"How would we do this?" (*Various suggestions could be made here, e.g. ask to see the bills for ESB, gas , oil etc; or read the meters at intervals of one week, one month...*).

"How will we try to reduce the amount of energy that we use?" (*With our energy saving plan, for example by using less lighting, heating, turning off appliances and equipment when not in use*)

Go to www.energygyineducation.ie and look in finding savings for ideas.

Activity A.
A suggested activity, for a school which is heated by **electricity**, and based on meter readings, could be:

Discuss for 'fair testing' on the following lines:

"What will we keep the same?" the number of hours the school is in use; "What will we change?" (*the amount of energy we use e.g. lights – turning them off as much as possible every day, turn the heating down a degree, turn off some radiators in areas not in use, make sure the photocopier is switched off at night*).

You may decide to:

- implement a different energy saving measure each week and measure it's success (*e.g. turn off lights when not in use or turn down the heating a little.*)
- have a more intensive week long energy saving campaign where the whole school try a range of measures to reduce energy use and see what difference it makes.

A person (perhaps an adult) will need to be appointed to read the meters each week/each month (whatever interval is agreed).

1) Starting with a 'normal' week: Read and record the readings on the electricity meter, at the same time on 2 consecutive Monday mornings. Then calculate how many 'units' were used in the week.

The cost of electricity for the week can be calculated, using the unit cost on your school's bill or a sample rate of €0.15 per unit:

Week 1 'Normal'	Meter reading (kWh) on Monday morning	Meter reading on following Monday morning (kWh)	Number of units used in the week (kWh)	Cost @ €0.15 per unit

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2) Implement your energy saving plan and again take the readings at a similar interval. Calculate the number of units used this week, and the cost.

Week 2 after energy saving plan	Meter reading (kWh) on Monday morning	Meter reading on following Monday morning (kWh)	Number of units used in the week (kWh)	Cost @ €0.15 per unit

Was there any difference in the amount of electricity used?

If so, what was the difference in the number of units? How much money was saved?

What was the % reduction in energy use when the use of energy was reduced for a week?

Activity B. An alternative activity over a shorter time:

The electricity meter could be read every day for the week, the number of units used calculated, and a bar chart drawn. The energy use for the weekend could be shared equally by Saturday and Sunday, i.e. given half each.

Declare a 'low energy day' to try out different energy saving measures like switching off lights and appliances when not in use. Let everyone know about your energy saving plan so that everyone can get involved, and be sure to tell the whole school the results. If you use electricity to heat the school, bear in mind consumption may change depending on the weather, this could affect your results so consider recording temperature on your graph as well. Use a thermometer or go to www.meteireann.ie for weather data.

Can the children draw any conclusion from the bar chart, What do they notice about energy use at the weekends?

GAS

For a school heated by gas, the meter readings would be in cubic metres (m^3). In order to convert this volume of gas into the amount of energy used (i.e. kilowatt hours), the gas company multiplies the volume of gas used by 11.4198. This number (11.4198) is called a *'conversion factor'*.

For the purposes of the calculation check your bill for the unit cost or use a sample charge of €0.03932 per kilowatt hour.

Example:

On a gas bill, the present reading is 1723, the previous reading is 1615. So the amount used is 108m^3. To convert this volume of gas to energy in kilowatt hours, multiply by 11.4198:

Energy used = 108 x 11.4198 = 1,233 kWh

Cost of gas is €0.039 per kilowatt hour.

So the cost of the gas used is 1,233 x €0.039 = €48

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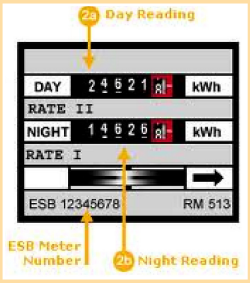
Maths question:
In 2010, one oil company in Ireland was charging the following for heating oil:

€302 for 500 litres and €565 for 1,000 litres.

How much money would you save by buying 1,000 litres in one go, rather than getting two separate deliveries of 500 litres each?

Nightsaver rates for Electricity:
Electricity costs less during the night than during the day, because there are less people using it than in the daytime when offices, shops and factories all need it. Some people heat their houses or schools with 'night storage heaters' which take in and store energy at night, then give it out as heat in the daytime. In order to get the cheaper 'night rate' you need to have a night meter installed. This could be a separate meter from the day meter, or an 'all-in-one' meter for both day and night.



Night rate hours are 11pm to 8am in wintertime and midnight to 9am in summertime.

Maths Question (including night rate electricity):
An electricity bill for a house which has night storage heaters has the following readings:

Meter readings		Quantity (no. of units)	Price per unit	Type	Amount (€)
Present	**Previous**				
25816	25307		€0.14	General	
30215	29466		€0.07	Night heating	
				TOTAL	

Can you fill in the blanks and calculate the total cost of the electricity used.

Safety: **Care with meters – just read, do not touch.**

Assessment: Did the children think that what they did was a fair test? How could they improve on it?

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Follow-up Activities:

If the children were given access to (*copies of*) the school electricity and gas bills, they could design charts for both, and fill in the details for, say, the 6 two-monthly bills for the year. The total number of kilowatt hours for gas and electricity could be added up. This information can be used as part of an application for a Display Energy Certificate for the school, an energy label that public buildings, including schools over 1000m² are required to display. The label assigns the school a rating from A – most efficient to G – least efficient and schools can complete an application and print a certificate at www.energyineducation.ie

ESB bill


Gas bill

(*See 'Useful websites' below for help with understanding the bills*).

Note: For this activity the children should just use the figures for the actual energy use, because other items in the bill can vary from time to time, e.g. Cost of units, standing charge, VAT, etc.

Children Can:

Find out what many countries have agreed to do, under the Kyoto protocol. Where is Kyoto?

Count the number of 'ordinary' light bulbs at home, and the number of energy-saving CFL bulbs .

Find out what are the heaviest users of electricity in school and/or at home, e.g. computer, cooker, fridge, freezer, toaster, washing machine, TV, photocopier, tumble dryer. You may be able to tell this from product information on an appliances giving information on Watts (the amount of electrical power used). (*Remember: the higher the number of Watts, the more electricity is guzzled every second*). Energy labels on appliances will also provide information for example the energy used per cycle for a washing machine.

Did You Know?

- Televisions use energy even when they are in standby. (*So turn your TV off at the power point*).
- You can use a meter to collect information about the use and cost of energy for individual appliances. You plug the meter into an electric socket, and then plug your appliance into the meter. You could use this to measure which gadgets are guzzling electricity – e.g. how much a computer or a kettle in the school costs to run for a year.
- About 2 billion people in the world are currently without electricity.
- It has been calculated that a computer monitor switched off overnight saves enough energy to microwave six dinners!

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Useful Websites:

www.energyineducation.ie
Where schools go to get a Display Energy Certificate for their school building and for lots of information on how to save energy.

http://www.seai.ie/Schools_Display_Energy_Ceretificate_for_Schools
How Roshine N.S. in Co. Donegal got their DEC
For more on alternative energy see DPS Flash Activity: 'Solar Energy'

SEAI have a range of lesson plans for primary schools available at http://www.seai.ie/Schools/Primary_Schools/Lessons_Plan/

www.assets.wf.org.uk
How a primary school in Aberdeenshire, Scotland kept an eye on their energy use using meters.

http://greennav.wordpress.com/2008/08/15/how-to-read-a-natural-gas-bill-%E2%80%93-bord-gais-ireland/
How to read a gas bill from Bord Gais

http://greennav.wordpress.com/2008/02/07/understanding-esb-bills/
How to read an electricity bill from the ESB