

How to teach...

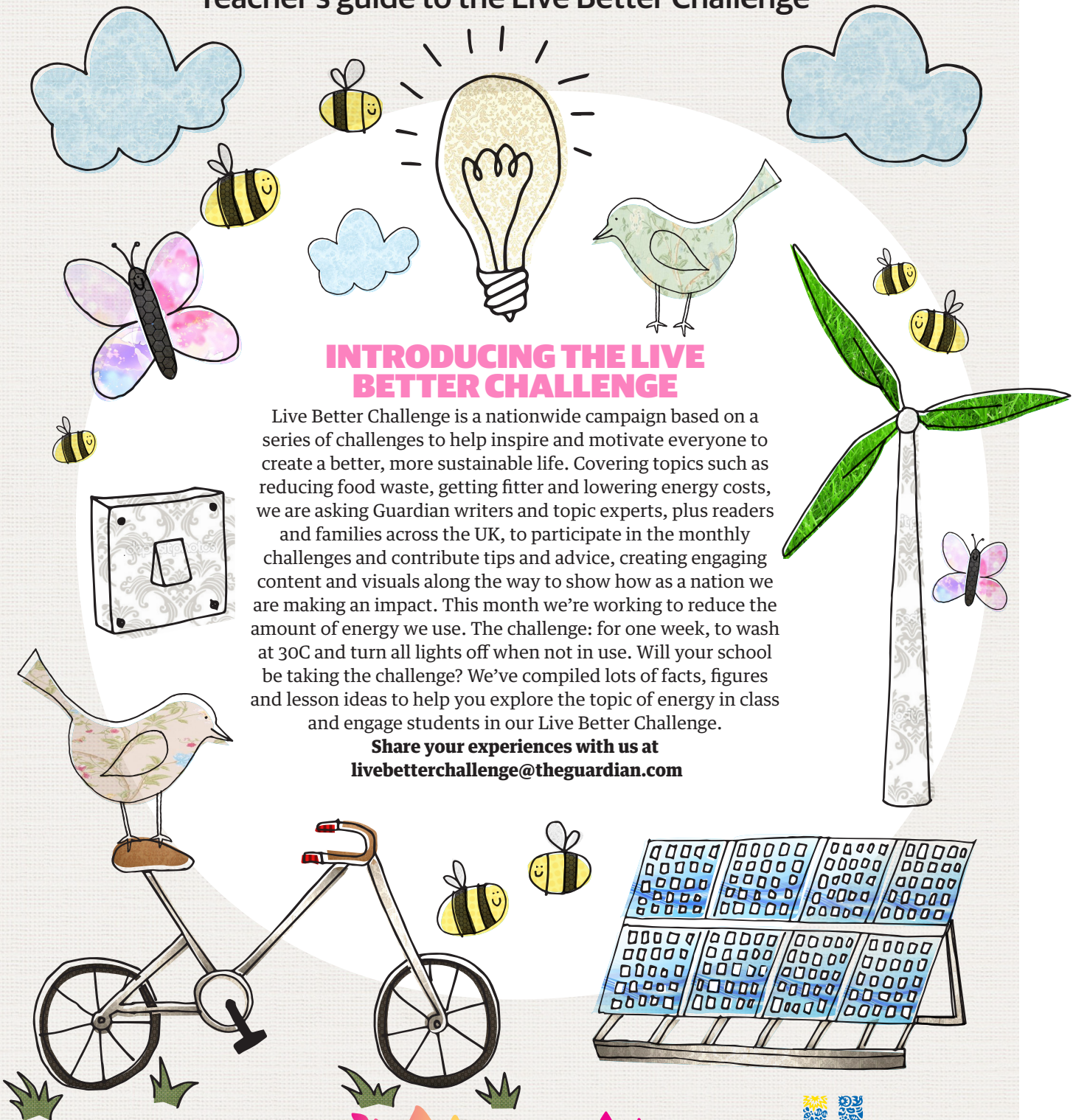
Reducing energy

Teacher's guide to the Live Better Challenge

INTRODUCING THE LIVE BETTER CHALLENGE

Live Better Challenge is a nationwide campaign based on a series of challenges to help inspire and motivate everyone to create a better, more sustainable life. Covering topics such as reducing food waste, getting fitter and lowering energy costs, we are asking Guardian writers and topic experts, plus readers and families across the UK, to participate in the monthly challenges and contribute tips and advice, creating engaging content and visuals along the way to show how as a nation we are making an impact. This month we're working to reduce the amount of energy we use. The challenge: for one week, to wash at 30C and turn all lights off when not in use. Will your school be taking the challenge? We've compiled lots of facts, figures and lesson ideas to help you explore the topic of energy in class and engage students in our Live Better Challenge.

Share your experiences with us at livebetterchallenge@theguardian.com

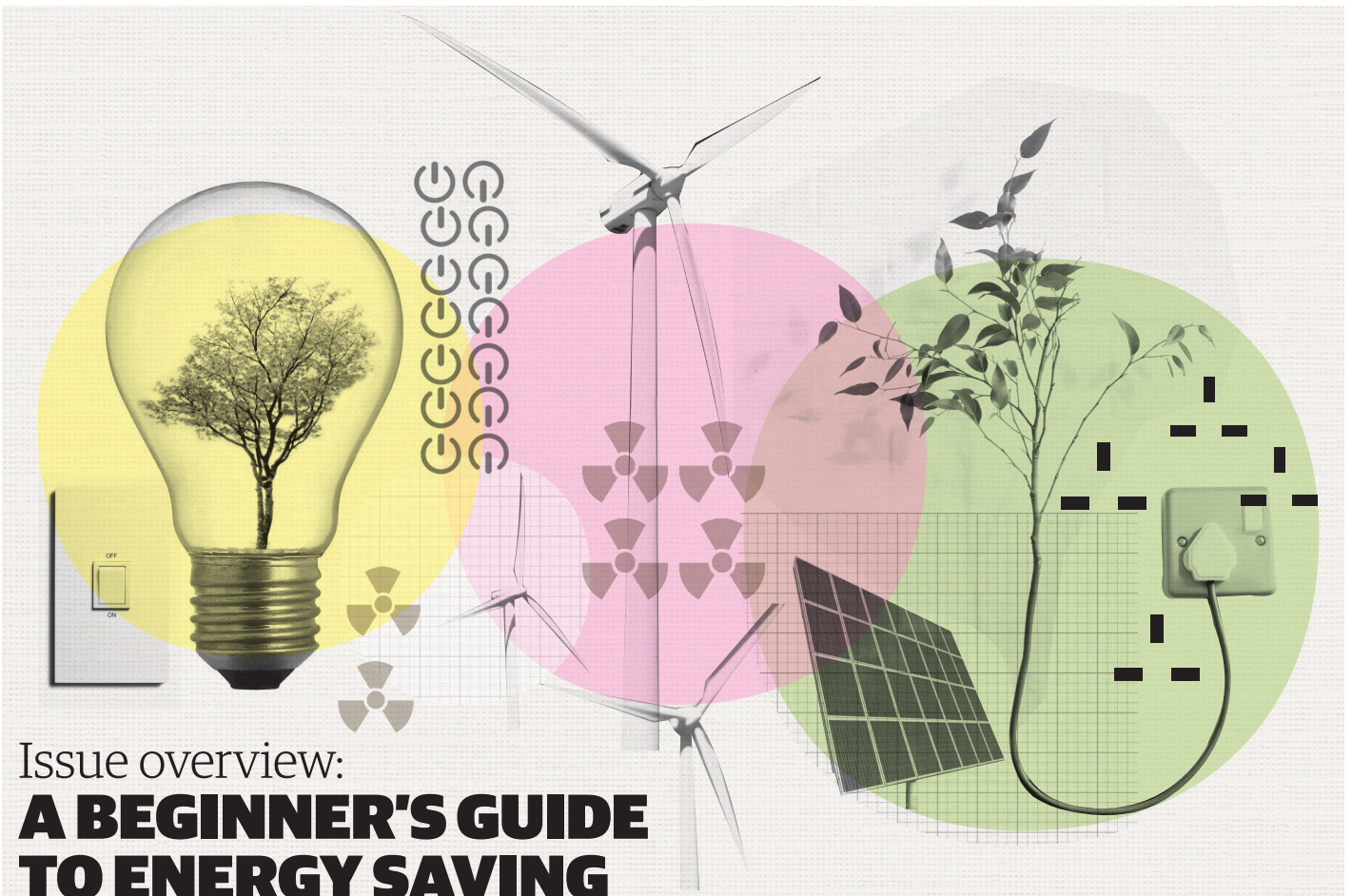


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Live Better Challenge

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Issue overview: **A BEGINNER'S GUIDE TO ENERGY SAVING**

Close your eyes and imagine a world without power. In today's society, life without lights, without television, radio, computers, smartphones, or even Facebook, is almost inconceivable. If someone were to pull the plug tomorrow, we'd be plunged into chaos. It sounds like science fiction, but with fossil fuels dwindling and energy prices rapidly rising, we might have to get used to living in the dark.

Last year, the UK energy watchdog Ofgem (Office of Gas and Electricity Markets) warned that the risk of power blackouts in Britain had doubled since 2012, claiming the margins between electricity supply and demand could tighten to as low as 2% by 2015/16. Renewable energy, such as wind and solar, still only account for a small percentage of the power we need to run our towns and cities, and other alternative sources of fuel such as fracking are vehemently opposed by many environmental campaigners, with the issue dividing politicians.

While scientists struggle to find a solution, the duty falls on us as individuals to take responsibility for reducing the amount of energy we

consume in our everyday lives. So far, however, Britain is lagging behind when it comes to conserving power.

According to the British government, buildings in the UK are among the least efficient in the world and account for 38% of the UK's total greenhouse gas emissions. Millions of homes still do not have full double-glazing, and more than half do not have enough insulation or an efficient boiler. Most do not even have proper heating controls.

Part of the problem is that while people are now more aware of the importance of saving energy, they are still ignorant about how to actually do it. In an Ipsos poll conducted for the Energy Saving Trust and published in January,

half of the participants believed it was more economical to leave their heating on all day than to turn it on and off or up and down as required. In the same survey, more than 60% of people said they'd be more energy efficient if someone told them how.

Teaching the next generation how to save energy and reduce their carbon footprint is therefore vital as we begin to finally wake up to mankind's potentially catastrophic impact on the planet.



WHAT CHANGES CAN WE MAKE?

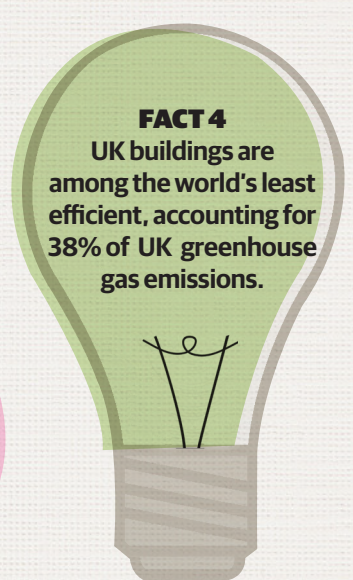
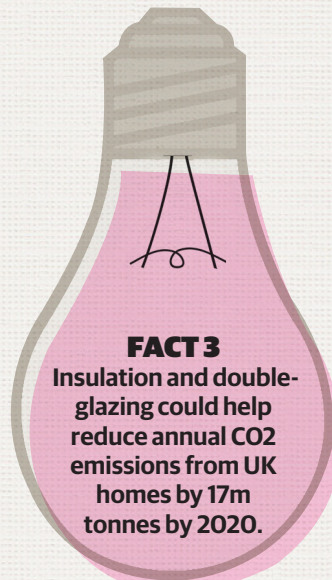
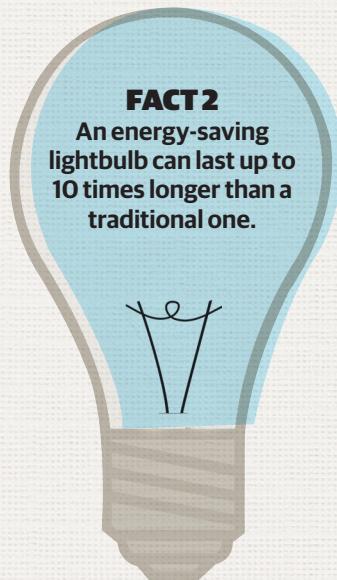
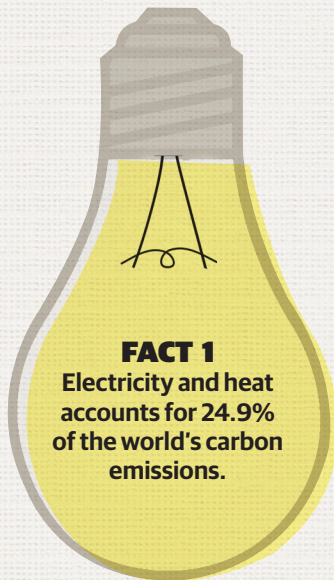
Let's be honest, we're all guilty of taking our energy for granted. We've all left the kitchen light on when not in the room, filled the kettle to the brim to make just one cup or indulged in a 30-minute shower to soak away the day's stresses and strains.

But small changes to the way we live can make a big difference to household bills and to the future of our planet. For example, according to the Energy Saving Trust, one full load in the washing machine, tumble dryer or dishwasher uses less energy than two half loads. An energy-saving lightbulb can last up to 10 times longer than traditional ones, and can save you around £45 in energy costs over its lifetime.

For homes in cooler countries such as the UK, the most effective ways to improve energy efficiency include insulation, draught proofing, installing good quality double-glazed windows and using more efficient appliances. The Committee on Climate Change (CCC) estimates that such changes could reduce annual CO2 emissions from UK homes by around 17 million tonnes by 2020.

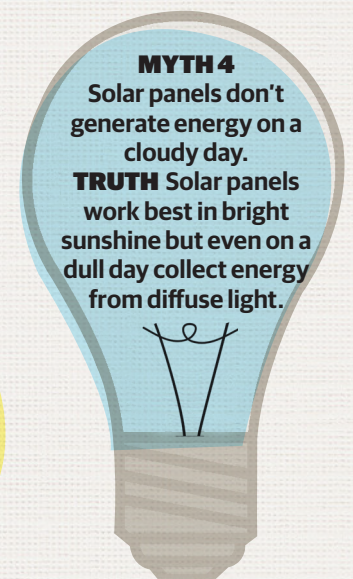
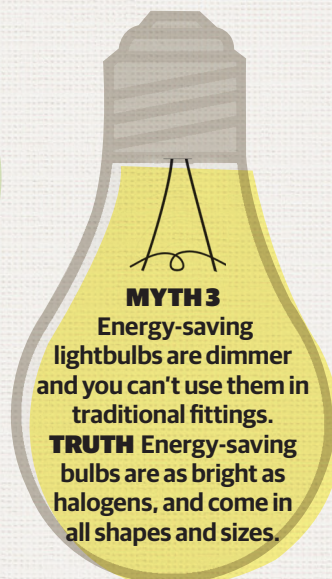
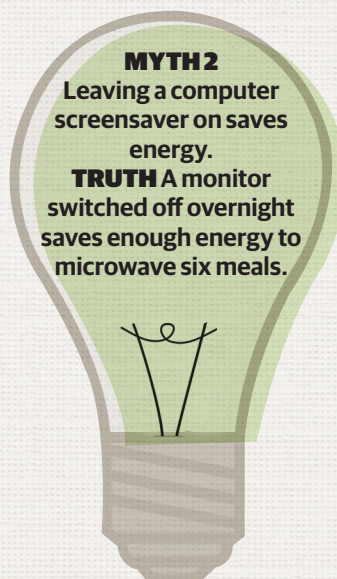
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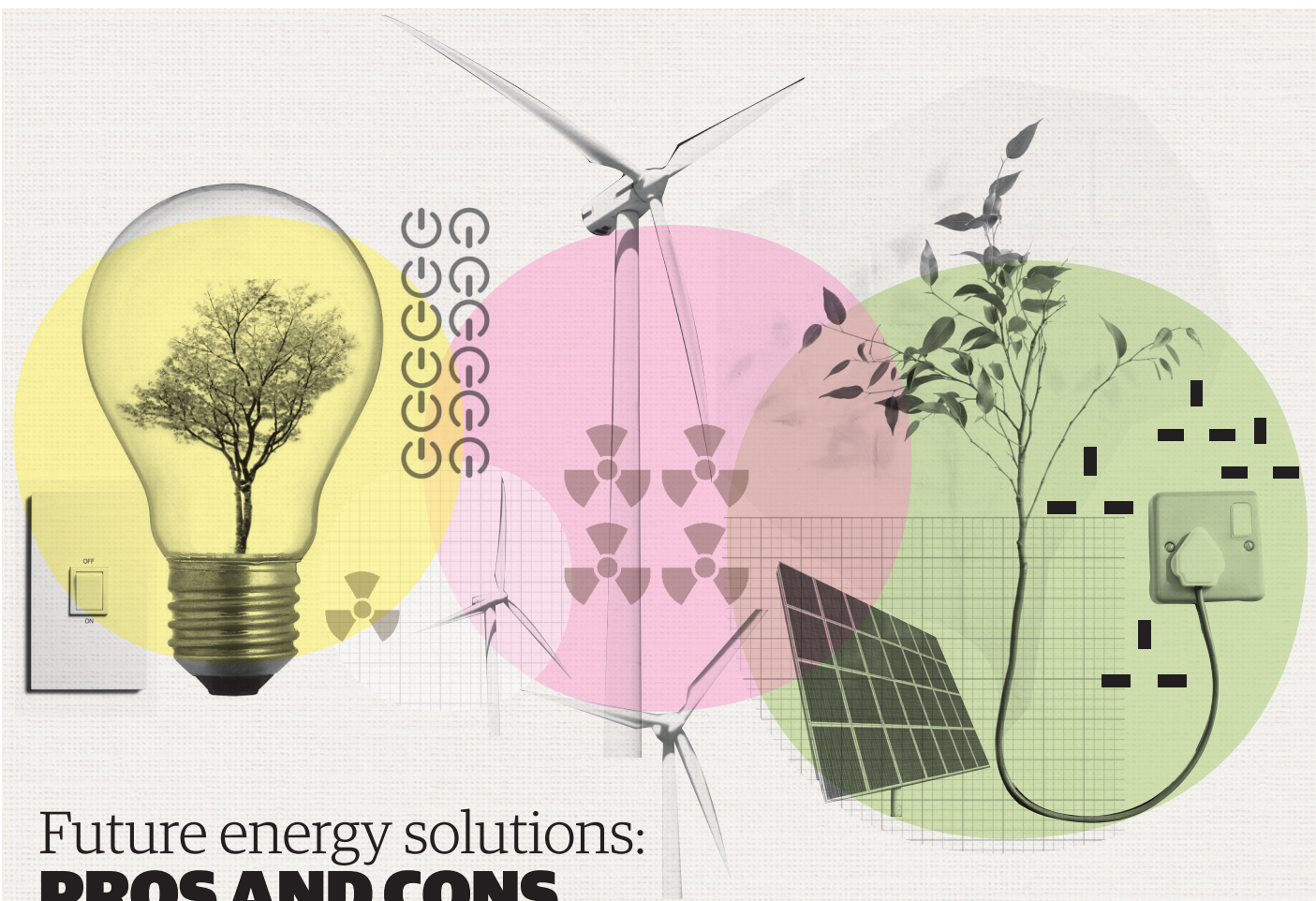
4 Quick facts about our electricity usage



Myth or truth

4 Energy saving myths busted here and now





Future energy solutions: **PROS AND CONS**

Big energy issues continue to dominate the media as Britain searches for a solution to its dwindling energy resources. Wind farms have been popping up like giant daisies across the country's rural landscape, while environmentalists have been protesting against government plans to use fracking to mine the UK's abundant supply of natural shale gas. So what exactly are the options for powering our homes, schools and businesses in the future?

SOLAR

Solar panels convert sunlight into usable energy and can be used to heat water for washing and heating as well as for general electricity needs.

PROS: Solar power is pollution-free, silent, sustainable and can help reduce homeowners' and businesses' bills.

CONS: Unless you have an abundance of sunlight all year round, solar panels can only provide an intermittent energy supply. They are also expensive to install and require a large surface area to be effective.

WIND FARMS

Wind turbines harness the energy of moving air to generate electricity. Onshore wind refers to turbines located on land, while offshore turbines are located out at sea or in freshwater.

PROS: In 2010, onshore wind generated around 7TWh - more than a quarter of the electricity provided by British renewables at that time and enough to save 6 million tonnes of CO2, according to government estimates. By 2020, onshore wind is expected to generate up to 30TWh. It is also one of the most affordable types of renewables.

CONS: One of the biggest criticisms is that turbines are an eyesore and can have a negative impact on wildlife such as birds and bats. Noise is also a concern for nearby residents.

FRACKING

The UK government has given the green light to fracking for shale gas - the practice of hydraulic fracturing. It's a method of harvesting Britain's natural gas resources which is polarising many in the environmental movement.

PROS: The UK may have 6,000 billion cubic metres of shale gas or more, enough for 60 years at current consumption. While gas is a fossil fuel, it is a cleaner option than coal.

CONS: Opponents argue that fracking can cause environmental damage because of the chemicals used. There are also fears that it triggers earthquakes and can damage the landscape. Groups in the US, where fracking is already common, also claim the chemicals used have contaminated water supplies and led to health problems.

NUCLEAR

Nuclear power is one of the most controversial energy sources, but one in which Britain is increasingly interested, in order to reduce the UK's greenhouse gas emissions by 80% by 2050.

PROS: Nuclear fuel does not produce CO2 and plants are relatively accident-free. There is also plenty of radioactive material around and while nuclear fuel itself is non-renewable, so-called breeder reactors produce more fuel than they use..

CONS: Disposing of nuclear waste is tricky as it never loses its radioactivity. It therefore has to be stored safely. And there are accidents. A leak or a meltdown of a plant can have devastating effects on the environment and the health of a population.



Children's quiz

The reduce energy challenge quiz

- 1. What percentage of the UK's greenhouse gas emissions do Britain's buildings produce?** a) 18% b) 28% c) 38%
- 2. By 2020, how much might we cut CO2 emissions by installing improvements such as insulation and double-glazing in UK homes?** a) 16 million tonnes b) 17 million tonnes c) 18 million tonnes
- 3. An energy-saving lightbulb last up to 10 times longer than a traditional one. How much money can it save a typical household in its lifetime?** a) £45 b) £65 c) £85
- 4. Solar panels only work on a sunny day.** True False
- 5. How many microwave dinners can you cook with the power saved by turning your PC off at night?** a) 3 b) 6 c) 9
- 6. How much hot water does a dripping tap waste in a week?** a) A bucket b) A sink c) Half a bath
- 7. What's the recommended energy-efficient temperature to wash your clothes at?** a) 30C b) 40C c) 50C
- 8. In 2010, Britain's onshore wind farms generated around 7TWh. How much are they expected to generate by 2020?** a) 10TWh b) 20TWh c) 30TWh
- 9. Parliament is discussing plans to install solar panels on which of Britain's iconic landmarks?** a) Big Ben b) Angel of the North c) Stonehenge
- 10. What is Britain's target for reducing greenhouse emissions?** a) 60% by 2030 b) 70% by 2040 c) 80% by 2050

The reduce energy challenge answers

How well are your students shaping up to the challenge?

1. What percentage of the UK's greenhouse gas emissions do Britain's buildings account for?

a) 18% b) 28% c) 38%

Answer: 38%

2. By 2020, how much might we cut CO2 emissions by installing improvements such as insulation and double-glazing in UK homes?

a) 16 million tonnes b) 17 million tonnes c) 18 million tonnes

Answer: 17 million tonnes

3. An energy-saving lightbulb last up to 10 times longer ... How much money can it save in its lifetime?

a) £45 b) £65 c) £85

Answer: £45

4. Solar panels only work on a sunny day. True or false?

Answer: False: even on a cloudy day they can harness light to convert to energy.

5. How many microwave dinners can you cook with the power saved from turning your PC off at night?

a) 3 b) 6 c) 9

Answer: 6

6. How much hot water does a dripping tap waste in a week?

a) A bucket b) A sink
c) Half a bath

Answer: Half a bath

7. What's the recommended energy-efficient temperature to wash your clothes at?

a) 30C b) 40C c) 50C

Answer: 30C

8. In 2010, Britain's onshore wind farms generated around 7TWh. How much are they expected to generate by 2020?

a) 10TWh b) 20TWh c) 30TWh

Answer: 30TWh

9. Parliament is discussing plans to install solar panels on which of Britain's iconic landmarks?

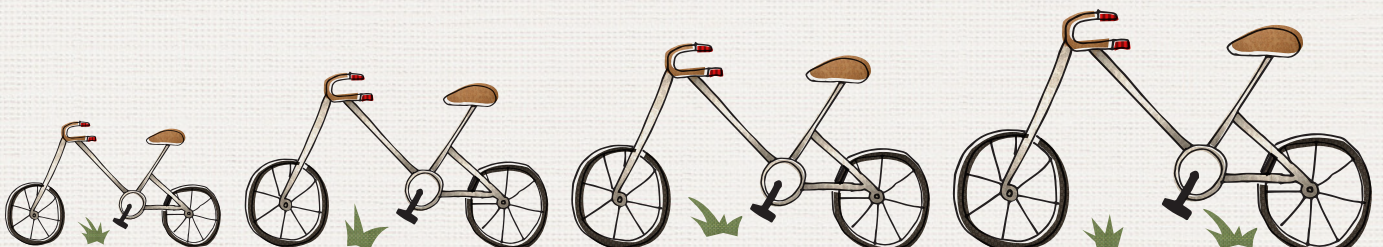
a) Big Ben b) Angel of the North c) Stonehenge

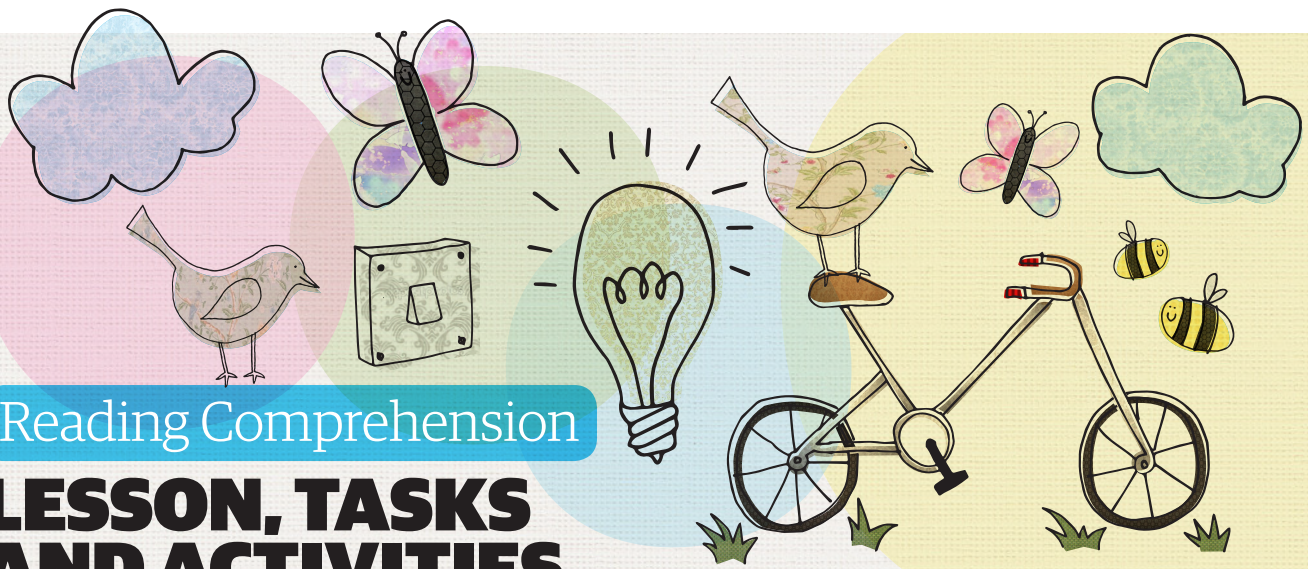
Answer: Big Ben

10. What is Britain's target for reducing greenhouse emissions?

a) 60% by 2030 b) 70% by 2040 c) 80% by 2050

Answer: 80% by 2050





Reading Comprehension

LESSON, TASKS AND ACTIVITIES

What is energy efficiency and how can it help cut emissions?

Explore the facts, figures and context of food waste with your students with this reading task and questionnaire.

Read the Guardian article below as a class, in groups or in pairs and then consider the questions on page 8. The article can also be found online, at bit.ly/1feMot7.

What's energy efficiency and how much can it help cut emissions?

Energy efficiency means using less energy to provide the same service. For example, a compact fluorescent bulb is more efficient than a traditional incandescent bulb as it uses less electrical energy to produce the same amount of light. Similarly, an efficient boiler takes less fuel to heat a home to a given temperature than a less efficient model.

The phrase “energy efficiency” is often used as a shorthand to describe any kind of energy-saving measure, though technically it should be distinguished from energy conservation - a broader term which can also include forgoing a service rather than changing the efficiency with which it is provided. Examples of energy conservation include turning down a thermostat in the winter or walking to the shops rather than driving there.

Increasing energy efficiency often costs money upfront but in many cases this capital outlay will be paid back in the form of reduced energy costs within a short time period. This makes efficiency improvements an attractive starting point for reducing carbon emissions.

The scope of the savings - and the techniques required - depend on the situation and location. For homes in cool countries such as the UK, the most effective measures include increasing insulation, draught-proofing, installing good quality double-glazed windows and

switching to more efficient appliances and lightbulbs. The Committee on Climate Change (CCC) estimates that these improvements could reduce annual CO₂ emissions from British homes by around 17 million tonnes by 2020 - around a tenth of the 2008 residential total.

By contrast, increasing efficiency in nondomestic buildings often means focusing on ventilation and air-conditioning, in addition to lighting, heating and appliances. Many such buildings have achieved savings of around 25% after undergoing a refit to increase efficiency.

Energy-intensive industries, such as iron, steel and cement manufacture, have become more efficient over time thanks to new equipment and better re-use of waste heat. For example, a hot pipe containing a chemical that needs to be cooled can be used to heat up other chemicals (this is known as “heat integration”). Motors are used widely in industry for a variety of tasks, such as pumping, mixing and driving conveyor belts. The installation of efficient, correctly sized motors and drives can result in energy savings of 20-25%.

Vehicles have also become more energy efficient over the decades thanks to factors such as improved engines and lighter, more aerodynamic designs. The potential exists for further improvements and in EU the emissions of the average

new car is set to decrease from 150 to 95 grams of CO₂ per kilometre by 2020. The CCC forecasts that the introduction of efficiency improvements to cars, vans and HGVs could reduce CO₂ emissions in the UK by 12.3 million tonnes by 2020 - around 10% of the total for 2008.

Improving energy efficiency does not necessarily mean reduced CO₂ emissions: the savings depend on the situation. If the energy is supplied from fossil fuels - such as petrol in a car or electricity from a coal-fired plant - then improved efficiency will cut emissions. But if the energy is supplied by a lowcarbon source such as electricity from nuclear or renewables, then improving efficiency may have little impact on emissions.

When comparing electric and non-electric appliances, it's important to consider the efficiency of the power generation: switching from a 90% efficient gas boiler to a “100% efficient” electric heater will increase energy use and emissions if the electricity comes from fossil fuel power plants, which are highly inefficient, losing much of the energy in their fuel as waste heat.

Energy efficiency is always a good idea. Whether it results in energy savings depends on what we do with the money saved. In some cases, efficiency savings can be offset by changes in user behaviour - the so-called “rebound effect”. One example would be that insulating a home may make it more economic for the resident to maintain a higher temperature, increasing the standard of comfort but reducing the energy savings.

Nonetheless, improving energy efficiency is a key tool for reducing CO₂ emissions, alongside energy conservation and low-carbon energy sources such as renewables and carbon capture and storage.



THE INSTALLATION OF EFFICIENT, CORRECTLY SIZED MOTORS AND DRIVES CAN RESULT IN ENERGY SAVINGS OF 20-25%

NOW, CAN YOU ANSWER THESE QUESTIONS?

01. What is the definition of energy efficiency?

02. Give five examples of energy conservation

03. Name three benefits of adopting a more energy-efficient lifestyle

04. What are the most effective ways of saving energy in UK homes?

05. In what ways can energy be saved in non-domestic buildings?

06. How many tonnes of CO₂ could energy efficiency improvements save UK homes a year by 2020?

07. By how many grammes are the emissions of the average new car set to decrease in the EU by 2020?

CONTINUED...

08. How have vehicles become more energy-efficient?

09. How much energy could you save by installing efficient, correctly sized motors and drives in a vehicle?

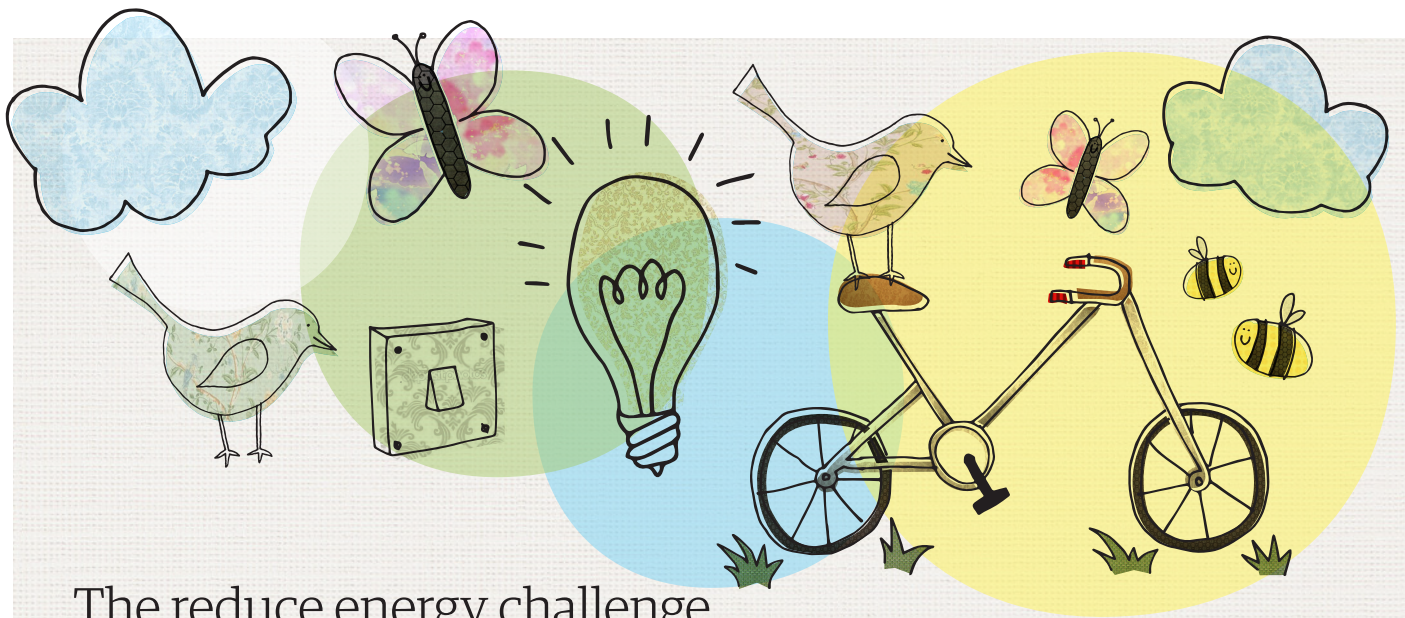
10. What is the difference between energy conservation and energy efficiency?

11. Give an example of a low carbon energy source

12. Why might energy efficiency methods (such as insulating your home) not always save energy?

13. What percentage of their energy use could non-domestic buildings save if they were to undergo an energy retrofit?

14. What have you learned from reading this article?



The reduce energy challenge

LEMON POWER

Did you know that you can save energy by making your own - using lemons? The lemon battery is a type of battery that changes the chemical energy in the fruit into electricity. Some people believe in the future we could even grow potatoes and use them to charge our phones. Why don't you find out if it's true? Here is an experiment you can conduct in class.

Warning Electricity is fun, but can be dangerous. Lemon power should be safe, but be careful and work with an adult.

WHAT YOU WILL NEED

- Copper wire (18 gauge is best)
- Wire clippers
- Steel paper clip
- Sheet of coarse sandpaper
- Lemon
- Help from a teacher or adult

Ask your teacher to strip 5cm of insulation off the copper wire, then clip the bare wire. Straighten out the paper clip and cut about five centimetres off it. Smooth any rough spots on the ends of the wire and clip using the sandpaper, then gently squeeze the lemon, being

careful not to break the skin.

Next push the pieces of wire and paperclip into the lemon, making sure they are as close together as possible, but not touching. Then touch the tip of your wet tongue on to the ends of the two wires. You should feel a slight tingling on your tongue - that's because you have made a circuit, which allows a small electric current to flow. What you can feel is the movement of electrons through the saliva on your tongue. The lemon battery only produces 0.7 volts of electricity and is therefore harmless.



Energy audit

How much greener can you make your school?

Can you spot savings for school, and how green is your teacher?

Can you find five areas that your school could improve on to make itself greener? Get a map of your school from your teacher and add two symbols to your map - a green one for when you find good energy-saving idea, and then a red symbol to find out where the school could make more of an effort to be greener.

Things to look out for

- Are the lights fitted with energy-saving bulbs?
- Are vending machines

turned off during lesson times to save energy?

- Are rooms kept lit when there's nobody in them?
- Does the school use recycled paper towels instead of electric hand-dryers in toilets?
- Are the doors and windows draught-proofed?
- Ask the caretakers - are the buildings insulated in the roof spaces?

Now try this: using your green school map, write to your headteacher advising him or her how to make your school

a more energy-efficient place to study. Use the red symbols as prompts for areas they could improve on.

Now try the same exercise, with a map and symbols, for students in their own home. They could even write letters to their parents!



WRITE TO YOUR HEADTEACHER ADVISING THEM HOW TO MAKE YOUR SCHOOL MORE ENERGY-EFFICIENT

RATE MY TEACHER

How green is your teacher? It's time to shift the attention to the staff in your school. Each child chooses a teacher for a "green interview" - six straightforward questions that give an insight into how green they are at work. Teachers then can make one green promise to improve their lives.

| QUESTION | YES: SCORE A POINT | SOMETIMES: HALF POINT | NO: NO POINTS |
|---|--------------------|-----------------------|---------------|
| 1. DO YOU USE ENERGY-SAVING LIGHT BULBS? | | | |
| 2. DO YOU TURN THE LIGHTS OFF WHEN LEAVING THE ROOM? | | | |
| 3. IS YOUR HOME HEATING AND WATER ON A TIMER? | | | |
| 4. DO YOU ONLY BOIL AS MUCH WATER AS YOU NEED? | | | |
| 5. DO YOU SWITCH YOUR PC MONITOR AND PROJECTOR OFF WHEN NOT IN USE? | | | |
| 6. DO YOU SHARE A CAR, OR WALK/CYCLE TO SCHOOL? | | | |

0-2 - SEE ME! IMPROVEMENT NEEDED

3-4 - GETTING THERE. GOOD EFFORT, BUT THERE'S WORK TO BE DONE

5-6 - GREEN HERO. YOUR TEACHER US AN EXAMPLE TO COLLEAGUES

Thanks to Peter Smith, assistant headteacher at East Bergholt High School, for the Rate My Teacher and school green mapping activities, and to Martin Crabbe, head of geography at Glebe School, London Borough of Bromley for Lemon Power.

Illustrations: Samantha Jones

