Science

Renewable Energy is a growing industry in Northern Ireland, in the rest of the UK and throughout the world. Renewable Energy, now and in the future, will provide a solution to the problems of energy demand, fuel security, fuel sustainability and the ability to reduce CO2 emissions. Renewable Energy is the future of energy, today.

Why use these resources?

These teaching ideas and activities for Key Stage 4 Science are designed to cover topics within GCSE specifications. The topics covered include:

- Renewable Energy – advantages & disadvantages, different technologies, how they work and case studies
- Non-Renewable Energy – advantages & disadvantages
- Management of Energy Resources – energy efficiency and sustainability
- Air pollution: Greenhouse Effect and Global Warming

They are designed to support Science teachers as they up-date schemes of work and look for different teaching ideas. Up-to-date information is provided in a variety of forms to allow for flexibility so that they can be tailored to the needs of students.

Want more?

If you would like a visit to your school from the Education Officer, help to organise a fieldtrip to see renewable technologies or a practical demonstration of wind and solar technologies, please get in touch.

Aims of Action Renewables' Post-Primary Education Programme

Knowledge and understanding

↓

Raising awareness – local and global scale

↓

Engaging and Empowering

↓

Decision-making

↓

Leading to Action

- Increasing **Knowledge and Understanding**, facilitating young people to learn more about renewable energy and its related issues.
- **Raising awareness** at a local and global scale. To allow young people to realize the possibilities, the alternatives and how it can be made a reality in their home, in their school, in their neighbourhood, in their city, country and internationally. To make them look beyond themselves and their lives.
- **Engaging and Empowering** – inspiring young people so that they know they all have apart to play. A small action, makes a difference. Empowering people to realize that we are all citizens in this World, whose actions matter – whether young or old – we can all contribute to a sustainable future.
- **Decision-making** – being apart of a decision, so that young people can consider the options, weigh up arguments and form opinions. It allows students to leave school with the ability to make informed choices, to alter behaviour and to be responsible citizens.
- **Leading to Action**. To take action to encourage energy efficiency and use renewable energy in their school or home. To take action in their futures, as they work to provide for a sustainable future for the following generations.

Outline of Teaching Ideas and Activities

1. What are the different energy resources?
2. Fossil fuels and air pollution
3. What are the advantages and disadvantages of different renewable and non-renewable technologies?
4. Where are the best locations for different renewable technologies?
5. The Wind Turbine Challenge
6. Action Plan for Wiser Energy
7. Puzzles

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the future of energy, today

Key Question	Learning Objectives	Teaching Ideas and Activities	Skills
What are the different energy resources?	o Increasing knowledge and understanding of energy and resources we can use o To become more aware of the difference between renewable and non-renewable energy	Starter: Ask the students to imagine that before school today there was a power-cut (no electricity in your house), which thing that you couldn't use, would annoy you the most? How would you cope? Activity: 'Where does our Energy come from?' Powerpoint (found in KS4 section) While watching powerpoint, students can take notes and then complete Resource 1.1 Resource 1.2 Teacher's Notes: ANSWERS	Managing information
Fossil fuels and air pollution	o To raise awareness of connection between burning fossil fuels, greenhouse effect and global warming	Watch: 'Global Warming Link' powerpoint (found in KS4 section) – looks at causes, evidence, impact and what the future maybe like. Follow-up: internet research: consider the role of the media to inform Discussion: Most of our energy in Northern Ireland comes from fossil fuels - Why do people want us to change and use different energy resources? (Teacher's Notes: Resource 2.1)	Research
What are the advantages and disadvantages of different renewable technologies?	o To increase knowledge of advantages and disadvantages of different technologies	Starter: Recap about different types of energy resources. 'Odd One Out' activity Resource 3.1 – explain that some of them will be hard, but encourage them to have a go – don't give much time for this. Activity: 'Odd One Out' Teacher's Answers: Resource 3.2 State that today they are going to take a closer look at renewable energy and by the end of the lesson you will be: - aware of different types of renewable energy - examples - advantages & disadvantages Activity: Resource 3.3 & 3.4 for groupwork Resource 3.5 for notes during feedback Use the INFO sheets on wind, solar, bio, hydro, geothermal and wave&tidal energy Divide the class into 6 groups Each group is given the information for 1 type of renewable energy and feedback to rest of class.	Thinking skills Working together
Decision-making: Where are the best locations for different renewable technologies?	o To realize what is needed for a wind turbine and solar panel to work effectively	Resource 4.1 Activity involving a survey of school for suitable locations for a wind turbine and solar panels	Decision-making Working with others Managing information Accurate collection of data
Are you ready for the Wind Turbine Challenge?	o To increase knowledge of what is needed for good wind turbine design	Activity: Resource 5.1 & Resource 5.2	Working with others
Action Plan for Wiser Energy: How could renewable technologies be used in your school or home? How can energy be used more efficiently?	o To think about how their actions can make a difference o To raise awareness that the electricity they use in their home = carbon released into the atmosphere o To be aware how to make a building energy efficient	Students can work in small groups or individually. Resource 6.1 & 6.2 This activity is about 'Wiser Energy' – coming up with an Action Plan for a building, which will introduce some renewable technologies to reduce % of non-renewable generated energy. Also, it is about coming up with a few practical ways to make the building more energy efficient. Action should include: - Introducing renewable technologies at home OR school, e.g. Installing a wind turbine OR solar panels to reduce use of fossil fuels for energy. Replacing oil central heating system with a wood pellet burner central heating system - Becoming more energy efficient www.est.org.uk Energy Savings Trust is a good source of information. ALSO, they need to think about how they are going to persuade people to allow their Action Plan to happen.	Creativity & Initiative Decision-making Mathematics
Puzzles	o To consolidate knowledge	Resource 7.1 Word Search Resource 7.2 Word Search ANSWERS Resource 7.3 Double Puzzle Resource 7.4 Crossword	

KS4 Science Resource 1.1

ENERGY Resources

TASK: To answer as many questions as you can by yourself.

1. What is an 'energy resource'?

2. What is the difference between renewable energy resource and a non-renewable energy source ?

3. An example of a renewable energy resource is WIND. What is an advantage of using this resource?

4. An example of a non-renewable energy resource is OIL. What is an advantage of using this resource?

5. What is a disadvantage of using a renewable energy resource?

6. What is a disadvantage of using a non-renewable energy resource?

KS4 Science Resource 1.2

ENERGY Resources

Teacher's Notes

1. What is an 'energy resource'?

   Something that can be used to generate energy. Usually the resource is burnt to produce heat or steam, which then drives a turbine, which drives a generator, which produces electricity.

2. What is the difference between renewable energy resource and a non-renewable energy source?

   Renewable energy resource can be used over and over again, e.g. solar. A non-renewable resource can only be used once, e.g. coal.

3. An example of a renewable energy resource is WIND. What is an advantage of using this resource?

   Freely available and produces no CO2 emissions.

4. An example of a non-renewable energy resource is OIL. What is an advantage of using this resource?

   Efficiently produces electricity. Easily transported.

5. What is a disadvantage of using a renewable energy resource?

   Can be expensive to set up

   Depending on the resource – may need large-scale to provide a significant amount of energy

6. What is a disadvantage of using a non-renewable energy resource?

   Releases CO2 emissions, contributing to Global Warming

KS4 Science Resource 2.1

Teacher's Notes

Reasons for switcing to different sources of energy?

(SOURCE:DTI)

1. **Fossil Fuels will not last forever.** It is predicted that if we keep using fossil fuels at the same rate we are using them today, we might use up all the world's coal reserves in 200 years, all the world's gas reserves in 60 years and all the world's oil reserves in 40 years.

But, will we keep using fossil fuels at the same rate? The rate will probably increase due to population increase and LEDCs becoming more developed.

2. **Burning fossil fuels causes pollution and global warming.** When fossil fuels are burnt to produce energy, they release CO2 emissions. The more CO2 in the air, the less solar rays escape from the atmosphere – resulting in the Earth getting warmer, resulting in Climate Change.

3. **To protect our energy supplies for the future.** We import our fossil fuels from Great Britain and other countries, with Northern Ireland being at the end of the gas pipeline stretching from Russia. If we use more different energy sources we will depend less on other countries.

KS4 Science Resource 3.1

Odd One Out

You need to work out which is the odd one out – which one is different from the others. Be careful! Take your time and get it right.

Circle you answer

1	Gas	Oil	Wind
2	Solar	Geothermal	Nuclear
3	Hairdryer	TV	Mobile phone
4	Turbine	Water	Generator
5	Hydro	Wave	Tidal
6	H_2O	CO2	SO_2
7	Lignite	Oil	Coal
8	Lights	Computer	Car
9	Nuclear	Coal	Oil
10	Gas	Coal	Solar

KS4 Science Resource 3.2

Teacher's Notes

Answers

Odd One Out

1. Wind – only one renewable
2. Nuclear – only one non-renewable
3. Mobile phone – Hairdryer & TV need to be plugged into electric socket, mobile phone runs on battery
4. Water – turbine & generator are machinery needed to produce electricity. Water can also be used but is not man-made machinery
5. Hydro – wave & tidal only at sea, hydro not
6. H_2O – not a greenhouse gas
7. Oil – formed from decayed animal and plant material. Coal and lignite only formed from decayed plant material
8. Car – electricity is not needed (for the majority for cars)
9. Nuclear – coal and oil formed from decayed animal and plant material. Uranium is not
10. Solar - only one renewable

KS4 Science Resource 3.3

Renewable Energy

Select 1 member of the group to READ this to the rest of the group: -

Your TASK

This group is going to become experts at 1 type of renewable energy.

- You will be given an INFO sheet, explaining about 1 type of renewable energy.
- In your group, read the INFO and fill in this sheet.
- Then you will report back to the rest of the class.
- Your teacher will tell you how long you have.
- Good Luck!

Work together as a group to read and note down the information needed. Before you report back to the rest of the class, decide who will say what.

KS4 Science Resource 3.4

Type of Renewable Energy:

How does this renewable produce electricity?

- _____
- _____
- _____
- _____

Advantages?

- _____
- _____
- _____

Disadvantages?

- _____
- _____
- _____

Local Case Study

Where? _____

What? _____

Other information: _____

_____

_____

National Case Study

Where? _____

What? _____

Other information: _____

_____

_____

Global Case Study

Where? _____

What? _____

Other information: _____

_____

_____

KS4 Science Resource 3.5

During feedback - complete this sheet about the other renewables

Type of Renewable Energy	What is this?	Advantages	Disadvantages	Case Study - an example
WIND	Using wind			
SOLAR	Using sunlight			
BIO-ENERGY	Using plant and animal waste			
GEOTHERMAL	Using heat in the ground			
HYDRO	Using moving water			

KS4 Science Resource 4.1

Where are the best locations for different renewable technologies?

TASK:

You are going to work together to carry out a survey of your school to find out where would be suitable for a wind turbine and solar panels

Need:

Compass - to measure direction
Anemometer - to measure wind speed
Map of the school

What makes a suitable site for a wind turbine?

- Wind Strength – use anemometer to discover windy locations round your school.
- ALSO, use www.actionrenewables.org, search for 'wind speed map', enter your school's postcode and find out the average wind speed for your area. For a wind turbine to be effective, average wind speeds = 5 metres/second.

What makes a suitable site for a solar panel?

- South-facing roof
- Space on roof for panels

In groups:

1. Divide up what needs to be done
2. Talk about what information you are going to collect in your survey
3. Talk about how you are going to record your survey
4. After the data is collected – you need to get together in your group and share the information
5. Talk about what you have found out.
6. Share with the rest of the class what you found out. Answer these questions,
   - Where would be best for a wind turbine? (state if there are NO suitable locations)
   - Where would be the best place for a solar panel?

KS4 Science Resource 5.1

Wind Turbine Challenge Teacher's Notes

It maybe helpful for students to do some research on wind turbine design before the lesson

Before the challenge

Get the students into teams
Be ready to give out the team's material: each team needs,

- 1 x straw
- 4 x A4 card
- 4 x A4 paper
- 2 x Brass Tacs
- Sellotape

Introduce the challenge to the class

The Challenge

In teams, students will work together to share ideas and skills

After the 15 minutes, each team can show how good their turbine is by blowing on it and seeing how it works

After each team has tested their turbine, you can decide which the best is

After the Challenge:

Students can either discuss or write the answers to the follow-up questions.

The Wind Turbine Challenge can be repeated, so that teams can improve on their designs.

EXTRA INFO on wind turbines:

- Wind Turbines are constructed on a tower above ground level as wind is stronger above ground level and away from objects that could slow wind down.
- They normally have 3 long narrow blades: Only 3 blades because this is safer in very windy conditions and reduces potential for damage.
- Blades are made from fibreglass because it allow them to be light, durable, stiff and also strong.

KS4 Science Resource 5.2

Wind Turbine Challenge

TASK:
Build a Wind Turbine and test it to find out the best design

Your Challenge:

- Use the materials given to you to build a wind turbine
- You have only 15 minutes, from when you are given the materials
- When you start – take time to THINK…
  - What will make a good wind turbine?
  - How best to use the materials?
  - What will each member of your team do?
- After 15 minutes your team has to stop
- Then each team is to test their turbine – by blowing on it
- Your teacher will decide who has the best design and who has won the Wind Turbine Challenge!

Materials:

1 Straw
4 Sheets of A4 card
4 Sheets of A4 paper
2 Brass Tacs
Sellotape

Follow-up Questions

- Which part of the wind turbine was the most difficult to make?
- Any other problems you had during the challenge?
- What made a good wind turbine?
- If you did the challenge again, what would you do differently?
- If you could request one other material to help with building your wind turbine – what would you ask for?
- Why are wind turbines constructed on towers above ground level?
- What material are the blades of wind turbines made from?
- Why do they normally only have 3 blades?

KS4 Science Resource 6.1

Action Plan:
Wiser Energy

Wiser Energy – is increasing the % of energy produced from renewable sources. It is also energy that is efficiently used – not wasted. It is 'wiser' because it is more sustainable, releases less CO2 emissions and reduces wasting energy.

TASK:

- Choose a building you know, e.g. school, house or a friend's house (choose wisely – you will need to see its electricity bills)
- Work out the amount of carbon that is released into the atmosphere as a result of the energy used in that building
- Design an Action Plan: action that could be taken to make the building use wiser energy. It will be a proposal that whoever owns the building will need to agree with
- Design a strategy that will persuade the people who own the building to adopt your Action Plan.

The Building: _____

Amount of carbon released?

The average UK household uses about 80 to 90Wh or 'units' of electricity each week. Each unit = 120g of carbon released into the atmosphere.

You will need the electricity bill for your chosen building:

- On the bill look for the number of 'units' (1 unit = 1kWh)
- Look for what time period the bill is for (could be 1 month or quarterly = 3 months)
- Calculate the buildings WEEKLY use of electricity = _____ units
- In Northern Ireland, about 3% of our electricity is generated by wind power. To work how many units of electricity have been generated by wind –

  Weekly units _____ divided by 100 and x 3 = _____units generated by renewable energy sources.

  The rest of the units are generated by non-renewable energy sources.

KS4 Science Resource 6.2

- How much carbon is released into the atmosphere from generating this electricity?

  Number of Units (97% of them) x 0.12 = _____kg of carbon (SOURCE:DTI)

The more renewable energy sources used, the less carbon released into the atmosphere. Less carbon released into the atmosphere = reducing the effects of Global Warming and Climate Change.

Every Action, makes a difference.

What renewable technologies would you suggest? (Include a sketch of building to illustrate where the technology would be located)

How could the building be made more energy efficient? If a building is more energy efficient, it uses less energy.(Information on Energy Savings Trust Website www.est.org.uk)

Strategy to persuade adoption of your Action Plan

KS4 Science Resource 7.1

Word-Search

T B E N I R A M S Z L A A M E Y S M W U
Z Y I E B T C B O A Y L G G Q L L F D Q
L N O O M U X I M C Z E A J J Q E F Q N
D S E C G M A R A O V R S V K T U M O F
T A E H C A E I N T R O W G R U F J J I
S Z B P Q H S S W A L P D O H R D Z Y O
Q E C D T S H Z B I R O M Z S B R Y J E
T Q S O F O S S I L N R V U G I V U N L
E K E A R S O L A R P D P O P N V N W D
S G L E G O A L G X G T P I T E P G V L
U D G I Y T I C I R T C E L E O R D Y H
O S S A M O I B C E K B V I T K H K O S
H U P G Z D K O S I T I A Q N N R P F L
N H X R T S P L F T M W W P E N L T A W
E Z Q O O Q W A L F E L W Q R Y F D O E
E L U U F S J S R B S L L E R J I O V U
R L R N Z D W Q I K A H L H U T D E C R
G C G D B Y P E O Y G I O E C S U Z O S
E D Y H N V U H D D N J M R P Z T T A K
G E N E R A T O R G A V O Q E T M J L I

BARRAGE
BIOGAS
BIOMASS
COAL
CURRENT
FOSSIL
FUELS
GASES
GENERATOR
GEOTHERMAL
GREENHOUSE
GROUND
HEAT
HYDROELECTRICITY
MARINE
OFFSHORE
OIL
ONSHORE
PELLETS
PHOTOVOLTAIC
PUMP
SOLAR
SOURCE
TIDAL
TURBINE
WAVE
WIND
WOOD

KS4 Science Resource 7.2

Word-Search Answers

```
+ B E N I R A M + + L + + + E + S + + +
+ + I + + + C + + A + + + G + + L + + +
+ + + O + + + I M + + + A + + + E + + +
+ + + + G + + R A O + R + + + T U + + +
T A E H + A E + N T R + + + + U F + + +
S + + + + H S S W A L P + + + R + + + +
+ E + + T + H + B I + O M + + B + + + +
+ + S O F O S S I L N + V U + I + + + +
E + E A R S O L A R + D + O P N + + + +
S G + E G + + L + + + + + + T E + + + +
U + + + Y T I C I R T C E L E O R D Y H
O S S A M O I B + + + + V + T + H + + +
H + + G + + + O S + + + A + N + + P + L
N + + R + S + + F T + + W + E + + + A W
E + + O O + + + + F E + + + R + + D O +
E + + U + + + + + + S L + + R + I O + +
R + R N + + + + + + + H L + U T D + C +
G C + D + + + + + + + + O E C + + + O +
E + + + + + + + + + + + + R P + + + A +
G E N E R A T O R + + + + + E + + + L +
```

(Over,Down,Direction)

BARRAGE(9,7,NE)
BIOGAS(2,1,SE)
BIOMASS(8,12,W)
COAL(19,17,S)
CURRENT(15,18,N)
FOSSIL(5,8,E)
FUELS(17,5,N)
GASES(5,10,NW)
GENERATOR(1,20,E)
GEOTHERMAL(2,10,NE)
GREENHOUSE(1,18,N)
GROUND(4,13,S)
HEAT(4,5,W)
HYDROELECTRICITY(20,11,W)
MARINE(8,1,W)
OFFSHORE(8,13,SE)
OIL(6,12,NE)
ONSHORE(10,4,SW)
PELLETS(15,19,NW)
PHOTOVOLTAIC(18,13,NW)
PUMP(15,9,NW)
SOLAR(6,9,E)
SOURCE(6,14,SW)
TIDAL(16,17,NE)
TURBINE(16,4,S)
WAVE(13,14,N)
WIND(9,6,SE)
WOOD(20,14,SW)

KS4 Science Resource 7.3

Double Puzzle

1. Unscramble the words
2. Copy the letters in the numbered cells to other cells with the same number

Answers

Wind
Photovoltaic
Solar Panels
Ground Source Heat Pumps
Sun
Turbine
Wind Farm
Biomass
Willow
Biogas
Hydroelectricity
Tidal
Marine Current Turbine
Generator
Blades
Offshore
Onshore
Sustainable
Carbon Neutral
Technologies
Geothermal

The Future of Energy Today

WIDN 

PILCHOTVOOAT 

SRLAO PAESNL 

NURDOG RUOSEC TAEH PSPUM 

UNS 

NEUTIRB 

NIWD RAFM 

SMBAIOS 

LOWLIW 

BAGSOI 

RIHLEIDTCOERYTCY 

ALDIT 

AREMNICUTNERR TEBUIN 

REGNERTAO 

DELSAB 

ROSFOHFE 

SOHRONE 

SILSABNETAU 

CANROB TAURENL 

HOOEGNICLEST 

MARTEGOHEL 

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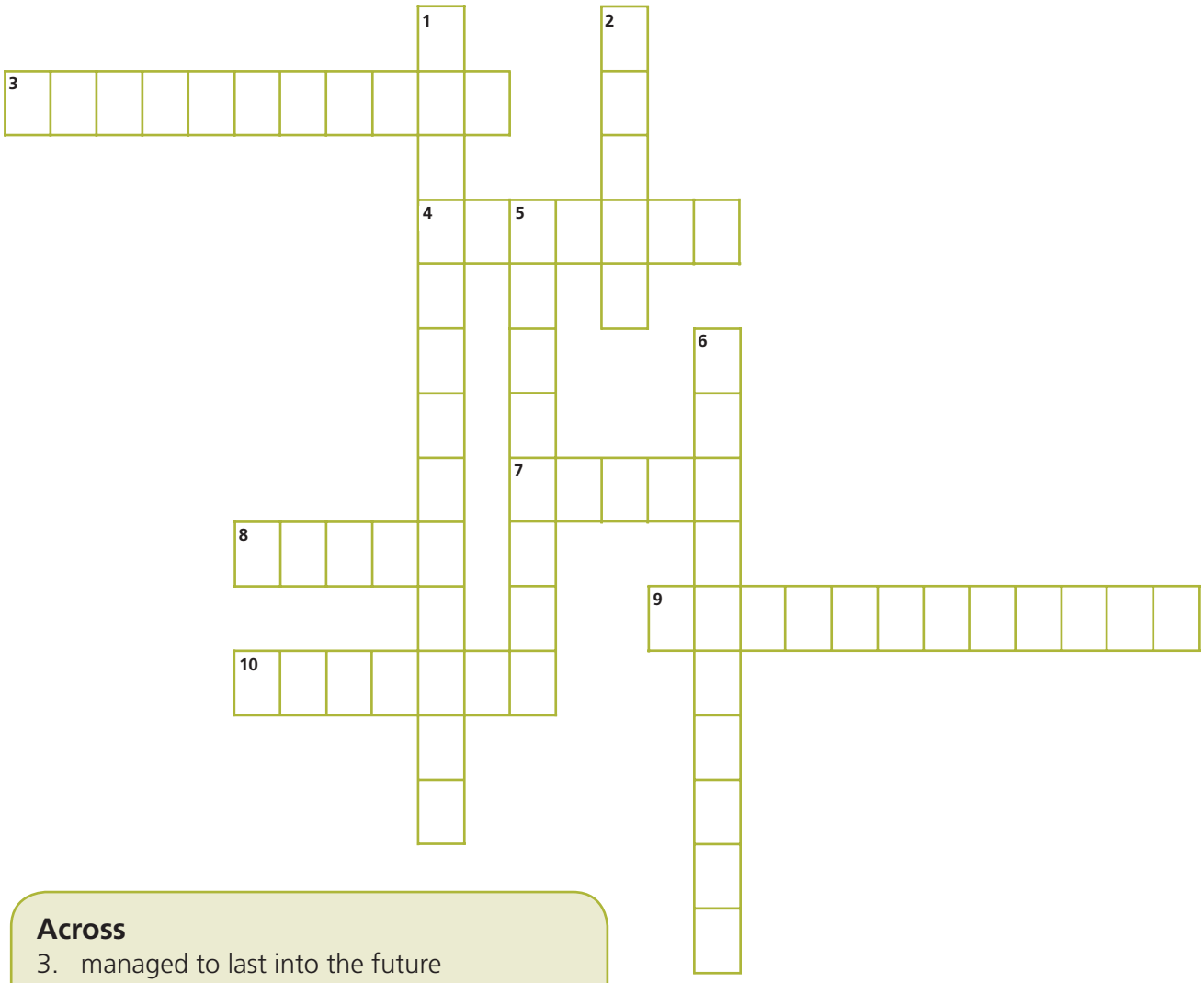
KS4 Science Resource 7.4

Crossword



Across

3. managed to last into the future
4. animal and plant matter
7. uses energy from moving water
8. uses energy from the sun
9. converts sunlight to electricity
10. drives a generator

Down

1. rise in global temperatures
2. uses movement of the sea
5. wind farm located in the sea
6. heat from the ground

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KS4 Science 7.5

Crossword

Answers

Across

3. managed to last into the future sustainable
4. animal and plant matter biomass
7. uses energy from moving water hydro
8. uses energy from the sun solar
9. converts sunlight to electricity photvoltaic
10. drives a generator turbine

Down

1. rise in global temperatures global warming
2. uses movement of the sea tidal
5. wind farm located in the sea offshore
5. heat from the ground geothermal