# TEACHER'S PACK – SECONDARY

POWER FOR THE WORLD

MAKE THE LINK

*This Pack is a Guide to running a successful workshop, feel free to edit the content to better suit your particular workshop.*


# CONTENTS

# POWER FOR THE WORLD
# INTRODUCTION

Detailing how small-scale wind turbines can help rural communities.

## Aims

| For Pupils | For Teachers |
| --- | --- |
| • To gain an understanding of how renewable energy can provide power in rural communities in developing countries.<br>• To appreciate how simple design technologies can provide this solution.<br>• To develop an understanding of Technology Justice<br>• To begin to feel empathy with people in the to the developing world | • To Integrate global learning into a science activity |

## Description:

By first talking through what everyday objects we use for our morning routines, the group can appreciate that a lot of objects we take for granted require electricity. A simple hands up/down quiz follows on what everyday household items use the most power and energy in the household.

The Starter Activity, looks at how in the UK every household is connected to the national Grid, Whereas in Kenya smaller villages are isolated, and how small scale renewables could be used to solve these issues.

Before the Main Activity, the group is introduced to the ideas of Technology Justice and the Sustainable development goals before being shown a video on some of the things Practical action does to tackle this issue. The workshop then focuses in on Wind Power and how it specifically can help solve the lack of electricity in rural communities around the world.

The focal point is the Main Activity - which is a very creative and think-on-your-feet task. By getting pupils to build their own wind turbine blades out of everyday objects, it builds teamwork and critical thinking as well as an appreciation for the difficulty of a design task. By also adding in an element of unfairness to the groups, depending on which country they have, it allows to develop the ides of unfairness within the world.

## Suited Age Group

Years 7-9 (ages 11-14).

There are separate PowerPoints and Facilitators packs for Primary pupils, years 3-6 (ages 7-11) and Secondary pupils, years 7-9 (ages 11-14). This pack is for Secondary pupils.

## Session Length

Either 60 - 90 minutes

## Session breakdown

1. Introduction and Quiz
2. How is electricity produced and Starter Activity
3. What can be done about this problem?
4. Main Activity
5. Finishing the Session

## For the Starter Activity

There are two key things to prepare for the starter activity, these are having the string cut to the correct length and to have the print outs of cities, towns and villages for this section ready.

## For the Main Activity

The main preparation for the main activity is the building of the stand so that the blades can be tested. The materials are drawings for the stand is shown in the appendices

You will also need the materials the pupils can use for the blades.  You can use practically anything, but suggested materials are card, cardboard and balsa wood. Instruction sheets and countries fact sheets for the groups, if a large class you can use each countries fact sheet more than once.

## The Video

The video is about Renewable Energy and is a very visual way of showing how small-scale renewables can help in rural communities, credit to Practical Action for the video.

http://www.youtube.com/watch?v=usISdE-WSWU

# MATERIALS AND EQUIPMENT

## Necessary materials and equipment checklist

This is a rough guide for what materials will be needed for a group of 30.

| Item | Number Required | Acquired |
|---|---|---|
| White Board Markers | 1 | |
| Pens/Pencils | 1 per person | |
| Laptop connected to a Projector | 1 | |
| Plastic Folder for hand-outs/facilitator pack print out | 1 | |
| String cut up into 0.5m Lengths | 20 | |
| City print outs for the Starter Activity – UK and Kenya | 4 Pages Full | |
| Main Activity briefs | 1 per group | |
| Cardboard | 10 | |
| Card | 30 | |
| Straws | 40 | |
| Cotton Reels | 10 | |
| Sellotape | 6 | |
| Scissors | 6 | |
| Desk Fan | 1 | |
| Wind turbine Stand (See Website for Designs) | 1 | |

# SUGGESTED TIMINGS

The workshop can be run in either 60 or 90 minutes.

## Timings - 90 minutes

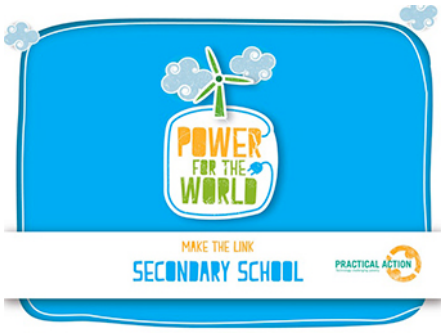
| | |
|---|---|
| 1. Introduction and Quiz (slide 1) | 10 min |
| 2. How is electricity produced and Starter Activity (slide 8) | 20 min |
| 3. What can be done about this problem (slide 13) | 15 min |
| 4. Main Activity (slide 16) | 40 min |
| 5. Finishing the Session (slide 26) | 5 min |

## Timings - 60 minutes

| | |
|---|---|
| 1. Introduction and Quiz (slide 1) | 10 min |
| 2. How is electricity produced (slide 8) | 5mins |
| 3. What can be done about this problem (slide 13) | 10 min |
| 3. Main Activity (slide 16) | 30 min |
| 4. Finishing the Session (slide 26) | 5 min |

# SLIDE ANNOTATIONS

## Slide 1 – Introduction

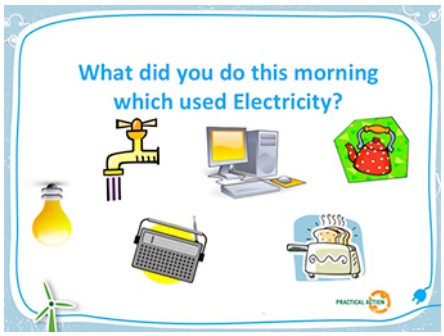



- Talk a little about what Practical action: In short a charity that aims to help developing world countries through the use of technology
- Then introduce what we're looking at today, which is electricity around the world

TEACHER TIP

To engage the younger students ask the students to stand in groups rather than putting hands up or down "those who agree stand to the left, those who don't agree stand to in the middle, whose who do not agree stand to the right."

## Slide 2 – Quiz




- Pose the question: 'what did you do this morning which needed electricity?'
- Get the group to then to put their hands up and give as many things as they can
- Once the list is exhausted or it's been a couple of minutes, go through the examples on the slide

(Note: The icons on the slide are set with animations)

TEACHER TIP

Get students into pairs and discuss the question. There is a massive link between talking, thinking and learning.

## Slide 3


Use of terminology is very key here, make sure to stress that **Power is the amount of energy (electricity) something uses in just one second**.

- Introduce the task, they have to tell us out of the two pictures on the upcoming slides, which one uses more power
- Use a hands up/hands down or stand up/down approach

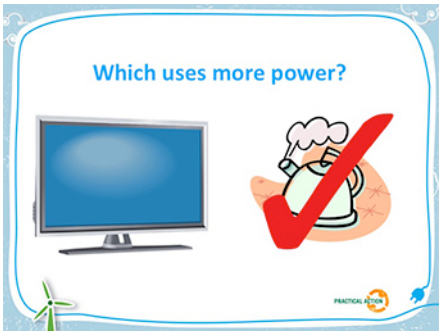
## Slide 4


Between a **standard light bulb** and **TV**
**Answer: TV**

## Slide 5


Between a **standard light bulb** and an **energy saving bulb**
**Answer: Energy saving bulb**

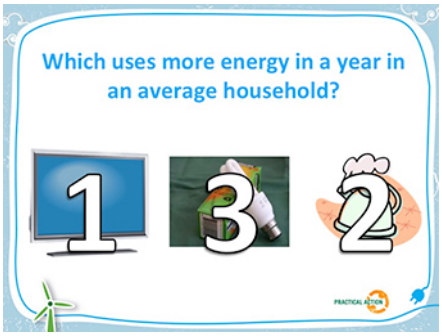
## Slide 6




Between a **kettle** and a **TV**
**Answer: Kettle**

Note: This is the tricky example because the kettle is only on for a few minutes compared to the TV.

## Slide 7



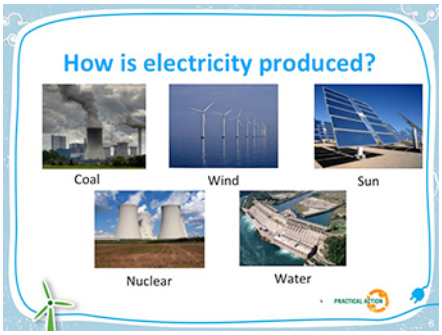

This slide is about **Total Energy consumption NOT Power**

- From the previous examples: which one of these costs the most to run in a year?

1) TV- LCD £51.23
2) Kettle- £16.90
3) Energy saving ,light bulbs- £2.63

http://www.carbonfootprint.com/energyconsumption.html
Note: The numbers will replace the pictures

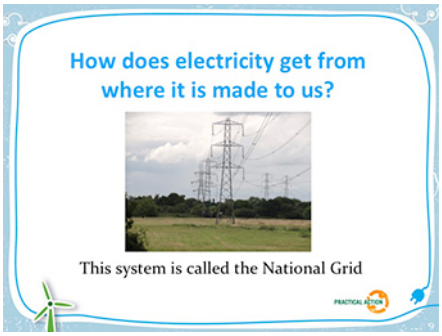
## Slide 8




This slide again is an interactive question and answer slide.

- Your looking to get the students to suggest different kinds of power stations
- After the class has run out of ideas, go through the answers on the slide

## Slide 9




- We know where electricity comes from but 'how does it reach us from the power station?
- This is just a lead up to the starter activity, so don't linger too much talking about the National Grid.

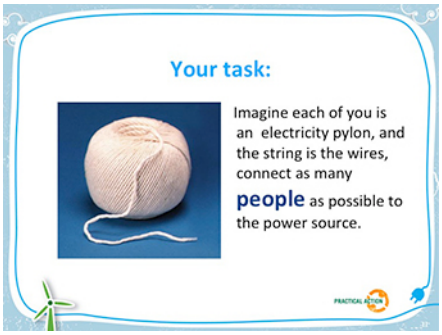
Ask pupils if they have any ideas how else they could get electricity. Show the posters form Practical Action to highlight the 4 main ways energy is available to small communities in rural areas in the developing world.

## Slide 10 - Starter Activity


***Starter Activity***

Keep it very brief on this slide, the point to get across is that we are all connected to the National Grid here in the UK and they will be replicating that.

## Slide 11




This slide is just a brief description of the task, refer to the sections starter activity for more info on how to run this task.

## Slide 12

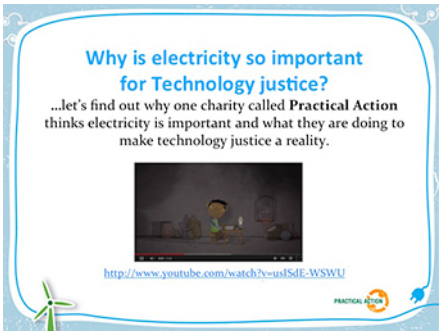

After the starter activity, we move onto Technology justice along with the info on the slide try get this message across:
"If you believe everyone has the right to something as important as electricity then like us you believe in **technology justice. This is everyone's right to have the technologies that they need to live a decent life".**

## Slide 13


***Keep this brief on The SDGs***

- Ask if anyone has heard of the SDGs before and what they are?
- Go on to explain how they were set to make a big difference to reducing poverty in the world.

## Slide 14



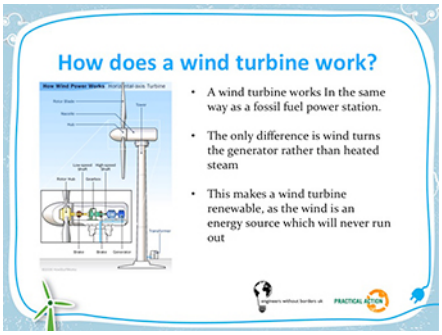

This slide includes a video from practical action:
http://www.youtube.com/watch?v=usISdE-WSWU

Introduce the video, as a showcase of the problems and some solutions to the problems of a lack of electricity

## Slide 15


Try get across the benefits of wind power, this links in nicely with the starter activity as it can be used on a small scale to provide electricity to those not connected to the national grid and that wind energy is Renewable.

## Slide 16




How does a wind turbine work:

- The same as a conventional power station, however the wind turns the generator not steam
- Thus a wind turbine is renewable

For more details on Wind Power see:
https://www1.eere.energy.gov/wind/wind_how.html

## Slide 17


Speed of turning is key for electricity generation. The magnets need to pass the coils quickly and as many times as possible. More blades would increase drag. Research suggests 3 is optimum for catching wind whilst keeping drag low.

## Slide 18 – Main Activity Slide 1


- Use this slide to talk about the task the students have
- Hand out the instruction sheets and allowing reading time before moving to the next slide

For an example of what happens when a wind turbine goes wrong show video
http://www.youtube.com/watch?v=-YJuFvjtM0s&feature=player_embedded

## Slide 19 – Main Activity Slide 2


- Use this slide to talk about the materials and time the students have to complete the task
- Hand out The materials whilst the students are reading the activity briefs
- The budget element links the activity to developing countries and governments budgets showing how poorer countries can struggle.
- Groups can donate materials to other groups.
- Materials cannot be taken back to “the shop”.

***For more details on the task see the Main Activity section of this pack.***

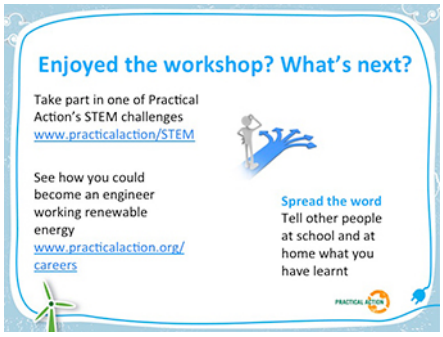
## Slide 20


A Wind turbine built by William Kamkwamba when he was just 14 in Rural Africa.
Using a book he found and very little money, he attempted to rebuild the 'windmill' he had read about.

For More details of the story see:
http://en.wikipedia.org/wiki/William_Kamkwamba

Also his book: "The Boy Who Harnessed the Wind"
Message to get across: If he can do it so can you!

## Slide 21




This slide just details how the students can find out more if they wish to!

## Slide 22


And you're done, time for the Q&A section!

# STARTER ACTIVITY

## Background

- In the UK, all communities, big or small are connected by the national grid, and even in times of black outs they only last for a few hours.
- In a developing country, such as Kenya, in Africa, the smaller communities that live in village and rural locations generally don't have a connection to the main power station, and small scale renewables could solve that issue.

## Summary

Pupils first model the national grid in England, then in Kenya. Some pupils act as villages, towns and cities and others as pylons.

## Timeframe

15 mins

## Resources

- 16 population cards, 8 for England and 8 for Kenya. Please fill in the blank card with your own location and population. If you live outside England you could prepare 8 cards for your own country.
- Approximately 20 pieces of string cut to 0.5 m length, more for a large class or if several classes are taking part.
- A fairly empty room would be good – a school hall or outside is ideal.

## Instructions

Explain that the class is going to act out the differences between how people in England and Kenya get their electricity.

# ACTIVITY 1 - NATIONAL GRID IN UK

- Hand out the 8 card for villages, towns and cities in England (or your country). Highlight the different size populations. Ask the children holding these cards to spread out in the room.
- Select an area of the room e.g. whiteboard, to be the main power station for all the communities.
- Explain that in the activity the rest of the pupils will act as pylons, with string for the power lines and that the aim is for them to connect to as many people as possible.
- Demonstrate that each pupil holds the ends of the string in their hands and all the strings must touch each other for the electricity to flow from one' pylon' to the next.

- Hand out the power lines and remind pupils they have to reach a many people as they can starting from the power station. They can go from one village, town or city directly to another one. Just hand out a few at a time.
- When pupils say there are some villages they can't reach just had out more power lines.
- When all the locations are connected point out that in your country nearly everyone is connected. Model what happens if a power line goes down by cutting one of the strings. Ask pupils who is affected? Ask them

what will happen next. They are likely to say that eventually it will be fixed. Agree and hand out power line to model the system being restored.

## ACTIVITY 2 – NATIONAL GRID IN KENYA

- Repeat the activity above but for Kenya. This time when you had out the power lines make sure you only hand out enough for the main cities and towns to be connected.
- Discuss why there are no more lines. The country is poor and the government doesn't prioritise everyone having electricity. Do pupils think this is fair?
- Ask pupils if they have any ideas how people in the villages can get electricity if they are not connected to the grid.
- After discussion give the 4 pupils holding villages a renewable poster each from the Practical Action set and ask them to show their possible solution to the rest of the class.
- Again cut one of the pieces of string and ask who is affected and what they think will happen next. The system might be fixed but is could take a lot longer and if the government is short of money then even some towns won't have electricity for a long time.

This activity is a great starting point for cross-curricular work, particularly related to geography. You could ask pupils to research the different villages, towns and cities in Kenya that have been part of this activity and produce a display of a large map showing where they all are and information gathered on different locations. You could look at the case study of Kathamba, where Practical Action worked with the village to install a micro-hydro system, and discuss if this would be suitable for other villages in Kenya.

POWER FOR THE WORLD

# York

Population 198,000

# London

Population 8,174,000

# Manchester

Population 503,000

# Rugby

Population 62,000

# Hanmanby

Population 3,300

# Inskip

Population 880

# Rawmarsh

Population 17,400

# Davidstow

Population 470

POWER FOR THE WORLD

# Nairobi

Population 2,750,00

# Mombosa

Population 800,000

# Kitale

Population 75,000

# Nakuru

Population 260,000

POWER FOR THE WORLD

# Village 1

Population 152

# Town 1

Population 4,300

# Village 2

Population 76

# Town 2

Population 3,500

# MAIN ACTIVITY

## Aims

The main activity aims to encourage creativity, team work and enhancing the practical skills of the participants by the hands on building of wind turbine blades.

## Summary

Working in groups of five or six, pupils have to design and build their own set of wind turbine blades out of cardboard, card and straws. Each group receives one country fact sheet, which lists the materials that each country receives as well as a brief set of instructions of their task.

The Blades are to then be tested by connecting them to a stand which will lift an object. A fan is to be used to stimulate air flow onto the blades during the testing process. The group which has blades which can lift the object the quickest will have built the best design, however durability has to be taken into account and flimsy blades can be a point of discussion if a group has them.

## Time frame

30-40 Minutes

## Scenarios

There are 6 scenarios (UK, Kenya, Denmark, Tanzania, Argentina and China), each with their own set amount of resources, see the country fact sheets for each specific country.

## Materials

- A stand to attach the Blades to
- 8 x pieces of Cardboard
- 30 x A4 Card
- 40 x Straws
- 6 x Country Factsheets
- 6 x Scissors
- 6 x Sellotape
- Stop watch

## Stand Design

The Stand design you choose for the workshop will depend on resources available, even something as simple as a clamp stand from the science department would work.

## Instructions

- First hand out the country fact sheets as well as all the materials listed on the country factsheets, allow time for the group to read the sheet.
- Promote planning of the blades by having paper and pens on the tables with the intentions for design to be drawn (The pens/paper can be used for the blades as well!)
- If a group finishes early allow them to test their design, this will help any group lagging behind and also gives the group something to do.
- If a group is running out of resources than give them some more using a phrase such as 'Kenya has received resources as aid from the EC'
- Test the blades
- Wrap up the session with the last few slides.

### Things to discuss before the Activity starts

- Different types of wind turbines- Ensure the group is aware that more blades is generally better for a mechanical worked turbine
- Resources are limited- Planning is essential

### Things to discuss/promote whilst the Activity is on-going

- Are they effectively using their time and resources?
- Are their blades sturdy enough to withstand the force of the fan?
- Have you got excess resources? Could you donate that to other groups?

### Things to discuss/promote after the Activity

- Which design was best and why?
- Why did some designs fail?
- What is different to the real world?

# UNITED KINGDOM


You need to build a set of wind turbine blades which can provide Power for your country

## Quick facts

- Population: 63,230,000
- GDP: $2435 billion
- Literacy Rate: 99%
- Natural Hazards: Winter windstorms and floods
- Average wind speed:  14-20mph

## Instructions

Using the materials listed on this card, your task is to build a set of turbine blades which will be tested by using the wind generated by an electric fan.

Your design can be any shape or size that you want, but be careful that you don't build blades which are too flimsy and will fall apart when being tested. A requirement of the design is that it must have a cotton reel attached on the back without the hole being blocked, other than that your good to go!

Feel free to ask any questions and best of luck with your design.

Budget = £36

## Materials

Your Country has the following materials:

£0

£0

£0

£3 per piece

£1 = 5 straws

£4 per piece

# KENYA


You need to build a set of wind turbine blades which can provide power for a small village in your country

## Quick facts

- Population: 43,180,000
- GDP: $37 billion
- Literacy Rate: 87%
- Natural Hazards: Droughts
- Average Wind Speed: 6-9mph

## Instructions

Using the materials listed on this card, your task is to build a set of turbine blades which will be tested by using the wind generated by an electric fan.

Your design can be any shape or size that you want, but be careful that you don't build blades which are too flimsy and will fall apart when being tested. A requirement of the design is that it must have a cotton reel attached on the back without the hole being blocked, other than that your good to go!

Feel free to ask any questions and best of luck with your design.

Budget = £19

## Materials

Your Country has the following materials:

£0

£0

£0

£3 per piece

£1 = 5 straws

£4 per piece

# DENMARK


You need to build a set of wind turbine blades which can provide power for a small village in your country

## Quick facts

- Population: 5,590,000
- GDP: $314 billion
- Literacy Rate: 99%
- Natural Hazards: Floods
- Average Wind Speed:  9-12mph

## Instructions

Using the materials listed on this card, your task is to build a set of turbine blades which will be tested by using the wind generated by an electric fan.

Your design can be any shape or size that you want, but be careful that you don't build blades which are too flimsy and will fall apart when being tested. A requirement of the design is that it must have a cotton reel attached on the back without the hole being blocked, other than that your good to go!

Feel free to ask any questions and best of luck with your design.

Budget = £28

## Materials

Your Country has the following materials:

£0

£0

£0

£3 per piece

£1 = 5 straws

£4 per piece

# TANZANIA


You need to build a set of wind turbine blades which can provide Power for a small village in your country

## Quick facts

- Population: 47,780,000
- GDP: $28 billion
- Literacy Rate: 70%
- Natural Hazards: Floods and Drought
- Average Wind Speed:  10-14mph

## Instructions

Using the Materials Listed on this card, your task is to build a set of turbine blades which will be tested by using the wind generated by an electric fan.

Your design can be any shape or size that you want, but be careful that you don't build blades which are too flimsy and will fall apart when being tested. A requirement of the design is that it must have a cotton reel attached on the back without the hole being blocked, other than that your good to go!

Feel free to ask any questions and best of luck with your design.

Budget = £19

## Materials

Your Country has the following materials:

£0

£0

£0

£3 per piece

£1 = 5 straws

£4 per piece

# ARGENTINA


You need to build a set of wind turbine blades which can provide power for a small village in your country

## Quick facts

- Population: 41,090,000
- GDP: $475 billion
- Literacy Rate: 98%
- Natural Hazards: Earthquake, Windstorms, Flooding
- Average Wind Speed: 16-20mph

## Instructions

Using the Materials Listed on this card, your task is to build a set of turbine blades which will be tested by using the wind generated by an electric fan.

Your design can be any shape or size that you want, but be careful that you don't build blades which are too flimsy and will fall apart when being tested. A requirement of the design is that it must have a cotton reel attached on the back without the hole being blocked, other than that your good to go!

Feel free to ask any questions and best of luck with your design.

Budget = £8

## Materials

Your Country has the following materials:

£0

£0

£0

£3 per piece

£1 = 5 straws

£4 per piece

# CHINA


You need to build a set of wind turbine blades which can provide power for a small village in your country

## Quick facts

- Population: 1,351,000,000
- GDP: $8227 billion
- Literacy Rate: 95%
- Natural Hazards: Floods and Earthquakes
- Average Wind Speed:  8-10mph

## Instructions

Using the Materials Listed on this card, your task is to build a set of turbine blades, which will be tested by using the wind generated by an electric fan.

Your design can be any shape or size that you want, but be careful that you don't build blades which are too flimsy and will fall apart when being tested. A requirement of the design is that it must have a cotton reel attached on the back without the hole being blocked, other than that your good to go!

Feel free to ask any questions and best of luck with your design.

Budget = £42

## Materials

Your Country has the following materials:

£0

£0

£0

£3 per piece

£1 = 5 straws

£4 per piece