SUSTAINABILITY LAB
ROCKIN' RENEWABLES

INTRODUCTION/DISCUSSION/ACTIVITY

1. Energy Island

Concept: Renewable vs Non-Renewable Energy Sources

- Today, we aren't just Mad Scientists in training… we are Environmental Engineers in training!
- We can use technology to change energy into electricity. Machines that make electricity are called generators. We also call them super power sources. We sort these into 2 types – **Renewable and Non-Renewable.**
- Ask the group to name sources of renewable and non-renewable energy that they may already know.
- **I have a challenge for you!** *Show the group the* ***Energy Island Laminate****. This can either be individual or a group activity.*
- **Humans have built all sorts of power generators. The challenge is to find all the power generators. Circle the renewable and cross on the non-renewable.**
- **Renewable energy means it can be replenished.** Example sources are sunlight, wind and water. Geothermal power comes from inside the Earth. Geo=Planet, Thermal=Heat, we use heat from inside the Earth to create power. Ocean's waves, a floating generator makes the energy as the waves float up and down.
- **Sources of Non-Renewable energy get used up e.g. coal, gas and oil?**
- Can you think of some good and bad things about each power source?
- Some power generators work with only a bit of fuel to make them work - like coal, oil or gas. These also make a lot of air pollution or create radioactive waste.
- **Some generators do not make a lot of pollution like solar, wind and water but they do change the environment, make a lot of noise and require a long time to build up the power.**
- What about Nuclear Power? A lot of people think it's Non-Renewable - but unlike fossil fuels it will last fo millions of years! That means it's SUSTAINABLE! This means we can harness energy from it time and time again, but it's bad for the environment so it's not necessarily a good solution.

Activity - Demonstrate that we can harness energy from heat by using ***Stirling Engines***. As *a group activity place pieces of dry ice on top of each Stirling engine. After 20 seconds or so the Stirling engines should begin to spin from the temperature difference between the top and bottom plates.*

Explain that as air gets warmer it expands, this means that as the bottom plate heats the cold air it begins to expand. This causes the expanding air to push the foam pad up, which turns the wheel and pushes it back down, repeating the cycle.

However this isn't a very *efficient* way of getting (harnessing) energy - but they can be used to power fans in very hot or cold places

DEMONSTRATION – ONLY INSTRUCTOR TO USE EQUIPMENT. ALL OTHER PARTICIPANTS MUST BE 2M AWAY.
ZONE READY FOR THIS EXPERIMENT, OR PREPARATION PURPOSES, BOIL A KETTLE AT THE BEGINNING OF EACH

2. Super Steam

Concept: We can harness energy from any element that turns a turbine. This is how all fossil fuel and nuclear power plants work, by burning the fuel to boil water and push steam through a turbine!

- **An excellent example of a renewable energy source is Geothermal Energy!**

energy it's called geothermal energy. **The name geothermal is a combination of the word "geo", which means earth, and "thermal", which means heat.**

Commented [1]: Sterling Engine Geothermal.

- We can also use geothermal energy to make electricity. **A geothermal power plant works by tapping into steam or hot water reservoirs deep underground;** by pumping water down into these resevoirs we can use the Earth's own heat to boil it. This quickly pushes steam back up through the Earth, where it is used to drive an electrical generator (turbine).
- Most geothermal plants are located in the western United States, where hot water reservoirs are common.
- **Show 'Geothermal Energy' LAMINATE.**
- Let's see if we can create our own Geothermal Power Station today!

DEMO - We're going to use our dry ice instead of water for this powerplant, as it would be difficult to boil water as quickly as the Earth in this classroom! That also means that instead of the superhot rocks inside the Earth, we can using boiling water (which gives us a temperature difference of 180*C, about the same as a real geothermal plant!)

Attach a small conical flask to a clamp. Add boiling water to the flask, quickly followed by some dry ice. Insert the bung to form a jet and hold the LED turbine above.

- This small jet is more than enough to light up our LED. A turbine in a power plant would be as big as this classroom, and spinning much faster (with higher pressure).

DEMONSTRATION / GROUP ACTIVITY – PARTICIPANTS TO WEAR SAFETY GOGGLES WHEN TESTING TURBINES. ONLY INSTRUCTORS TO PLUG IN OFFICE FANS.

Commented [2]: Fans with light up LEDs?

Concept: A wind farm can be onshore or offshore

- Explain how a turbine works and show **LAMINATE**:
- Component parts: **nacelle (generator, gearbox, shaft), blades, rotor, tower, foundation.**
- The blades catch wind, they turn a rotor, rotor turns shaft, connected to set of cogs (gearbox), gearbox connected to a generator. This is very similar to our steam turbine, but the gearbox allows or generator to get a fast rotation from the wind slowly turning massive blades (Note: energy comes from lots of wind hitting large blades, it would be hard to get the wind to spin a turbine)
- Each turn of a rotor = revolution.

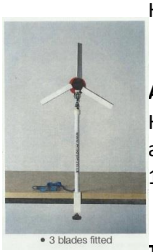
- Rotor turns at approx. 22 revolutions per minute (rpm).
- To generate electricity the generator has to turn 1,500rpm (gearbox converts 22rpm to 1,500rpm).
- The resulting electricity is sent down thick cables to the National Grid.
- Perfect example of a transfer of potential to kinetic to electrical energy!

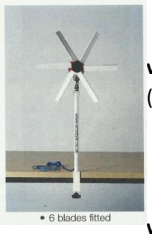
- Show the group all kit/equipment to be used, including voltmeters, fans and turbines.
- Talk through the **2** stages of investigation – a) no. of blades, b) angle of blades, **c) ratio of gears, d) type of module.**
- Discuss creating a hypothesis at each stage.
- Suggest they have the following in the forefront of their minds:
- Importance of experimental design – only changing one variable at a time, keeping others the same.
- Independent variables (number of blades / size of blades / pitch of blades / wind speed) vs dependent (output voltage / reading on voltmeter).

- Split the class into groups. Each group will investigate a turbine with a different number of blades (2,3,4,6), explain that blades must be equally seperated or the weight will be lobsided and it won't spin. Encourage each group to hypothesise as a team – writing each groups predictions on the classroom white board or asking a volunteer for each group to log on the prediction worksheet. How accurate are our predictions?

b) Number of Blades – what is optimum?

Hypothesise, then test! (with blades angled 45° to face of the hub)





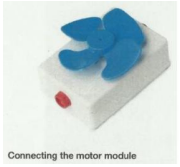
b) Angle of Blades – what is optimum?

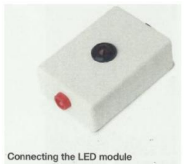
Hypothesise, as decided from task 1.) (using optimum number of blades,

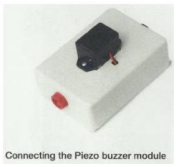
15° 30° 45° 60°

d) Type of Module – which requires least/most power?

Hypothesise, then test! (using best set up, as decided from tasks 1., 2. and 3.)







WHAT CAN WE DO?

- **Let's try to use less fossil fuels! Walking to school might be a good idea if you don't live too far away.**

Commented [3]: Can have preset 4 types with different blade configuration - each group runs the tests and final wrap up can compare results

Commented [4]: Run as a whole class investigation One set up - quicker time.

- Always turn off the lights when you leave a room.
- Only charge devices when needed – take off charge when full!