Get Excited about Energy

Eco-Schools Topic:
Renewable Energy
Grade Level:
Grades K-8
Standards:
N/A
Guiding Question:
How does sustainable energy work?
Key Questions, Attitudes and Behaviors to Teach:

- What kind of renewable energy sources do we have in Virginia? Name one. (K)
- I would like to see solar panels on my home and school. (A)

Lesson Objectives:

- Students will be able to identify types of renewable resources
- Students will be able to understand and explain how the sun, water, wind, and coal generate energy

Materials:

- Stuffed animals with paws
- Small magnets
- Coal or charcoal
- Whiteboard/whiteboard markers
- Energy Production diagrams
- Energy Step cards

Prep:

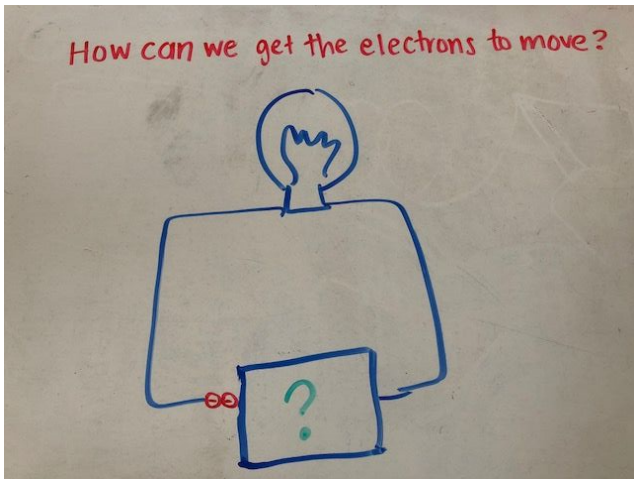
- Have all volunteers review the Teaching Renewable Energy slideshow and demonstrate a solid understanding of how all types of energy system works
- Review Additional Background Terms for Volunteer
- Print out Energy Production diagrams and place in sheet protectors
- Print out Energy Step cards and cut out cards

Engaging Intro

- Introduce new terms (use the whiteboard and props as appropriate)

Term	Definition	Sample Demonstration
Energy	The ability to do work, what you use to do anything. Ex: Electricity	Do jumping jacks, showing that you are using energy to move. Point to the light to show that energy is needed to turn on lights. This energy is called electricity.
Electricity	A stream of electrons moving	Use magnets on a whiteboard drawing of a wire to show electron movement
Electron	Negatively charged particle that moves around an atom's nucleus	Hold a stuffed animal by its paws and spin in a circle quickly. You represent the nucleus and the stuffed animal represents the electron. The bond between your hands and the toy represent the attractive force for an electron to protons in the nucleus. Let go of the toy and watch it fly away, demonstrating how electrons move
Atom	A very small particle that makes up everything, with a center called the nucleus	Hold up a picture of an atom
Renewable Resources	Energy made from something that cannot be used up. Ex. Solar, hydro, and wind energy	Blow air out of your mouth to demonstrate wind, point to the sun to identify it as a resource, hold up a filled water bottle to represent hydropower
Non-renewable Resources	Energy that can be used up and cannot be replenished in a short period of time Ex. Fossil fuels (coal, gasoline), nuclear	Bring coal or a coal-looking rock (like charcoal)

- Draw the following diagram on the whiteboard ---------->



- State: **When electrons move, this is makes energy that we call electricity**
- Explain that when a circuit is closed, the electrons have the energy to move and then can light up the lightbulb. When a circuit is open, the electrons stop moving.
- Pose Question: How do we get the electrons moving to make the light bulb light up?
    - Try to get them to figure out what could be the question mark in the box

    - *Sample Answers to the Question Mark: Battery, solar panel; connect the above circuit to electricity from a wind turbine, hydroelectric plant, nuclear powered plant, or coal powered plant*
- Place a circuit with a battery on each table to demonstrate how a closed circuit with an energy source can make a light bulb work

Exploratory Activity

- Explain that many forms of electricity (Wind, Hydro, and Coal) all use a turbine, generator and wires to produce electricity. The difference is what gets the turbine to turn.
- Divide students into 4 groups: Wind, Hydro, Solar, and Coal
- Give each group the set of energy cards for their specific energy source
- Explain the process for making electricity from your group's resource by walking step by step through the Energy Production diagrams.
    - Make sure to address the key questions listed below for each resource
- Assign a energy card step to each kid (or a pair of kids depending on group number and number of steps). Have the kids think of an action that they could do to demonstrate what part of the process they are.
    - Ex: Wave arms to be steam, spin arms to be a turbine, etc.
- Once every group is done, have each group perform their energy chain for the rest of the group. Have the kids not acting try to guess what the energy process is and the steps that are acted out.

Wind Power

- How do wind turbines work?
    - Wind moves the blades
    - Blades turn the shaft
    - Shaft spins the generator
    - Generator makes electricity
    - Electricity goes to power lines
- Can you think of a historical example of a wind turbine?
    - Old windmills grind grain into flour (like in Beauty and the Beast, 2017)
    - Small metal windmills on farms were used to pump a well
- Where can you have a wind turbine?
    - Places with lots of wide open space so the wind isn't interrupted
        - Midwestern US, off the coast, farms
- What are good things about wind energy?
    - Renewable resource
    - Cost effective
    - Don't have to destroy habitat (you can build them on existing farms)
- What are problems with wind energy?
    - It's not always windy
    - Birds can get hurt running into the blades
    - Turbines are really big and noisy
    - You can't have use it everywhere

Hydropower

- What does hydropower mean?
    - Water power
- How does hydropower work?
    - Engineers build a hydroelectric dam on a river
    - Water is forced to move over turbines
    - Turbines spin the generator
    - Generator makes electricity
    - Electricity goes to power lines
- Can you think of a historical example of hydropower?
    - Water wheels on old mills provided power to grind grain into flour
- Where can you have hydropower?
    - Near a big river
- What are good things about hydropower?
    - Safe
    - Reliable because there is always water in the river
- What are problems with hydropower?
    - Damages the natural river habitat
    - Makes it hard for fish (like salmon) to swim up and down the river
    - Water in the lake behind the dam (called a reservoir) heats up because it isn't moving
    - There can be problems during droughts if the river doesn't have enough water
    - The dams are really big and noisy
    - You can't have them everywhere

Solar Power

What does solar power mean?

- Sunlight power
- How does solar power work?
    - Sunlight hits the photovoltaic cell
    - Electrons in the PV cell get excited
    - Electrons move through wires
    - A DC/AC inverter converts the electric current from the photovoltaic cells (Direct Current or DC) into the type of current you need for your house (Alternating Current or AC)
    - Electricity flows to your house
    - Any extra electricity your house doesn't use goes to power lines
- Where can you have solar power?
    - Everywhere!
    - Most efficient on roofs that aren't shaded or in areas that get a lot of sun, like the desert
- What are good things about solar power?
    - Safe
    - Reliable because there will always be sunlight
        - Solar panels work even if it is a cloudy day
    - You can put solar panels on your house

- What are problems with solar power?
    - Take up a lot of space
    - Need to mine special chemicals to make the photovoltaic cells
    - Can be expensive
    - Can't get any energy at nighttime

Coal

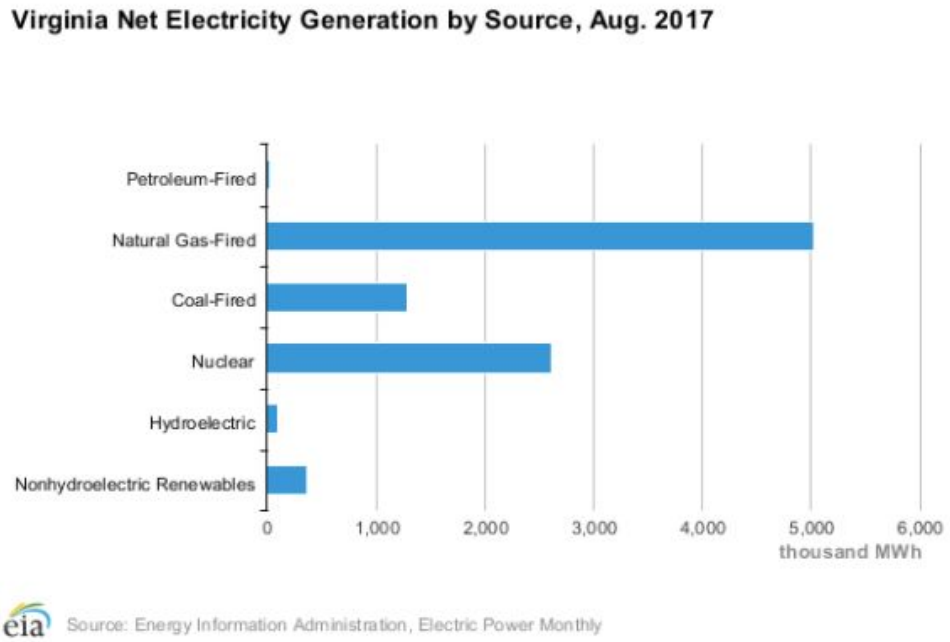
- How do coal power plants work?
    - Coal is mined
    - Coal is transported to power plant by train (think if you've ever seen coal cars on trains)
    - Coal is dumped into a coal pit in the power plant
    - The coal is set on fire and burned
    - Heat from the burning coal turns water in pipes into steam
    - Steam is forced over the turbines, making the turbines spin
    - Turbines spin the generator
    - Generator makes electricity
    - Electricity goes to power lines
    - Gases produced from the burning of coal go up a smoke stack where a scrubber tries to take out all the harmful pollutants
    - Coal ash (the burned coal) must be buried in a landfill
- Can you think of a historical example of coal energy?
    - Coal was used to power steam locomotives (like Thomas the Tank Engine)
- Where can you have coal energy?
    - Anywhere there is space to build a power plant with a water source
- What are good things about coal?
    - Cheap
    - Reliable as long as there is coal
- What are problems with coal energy?
    - It's a fossil fuel and non-renewable resource
    - Produces harmful air pollutants and coal ash
    - Produces greenhouse gases (like carbon dioxide)
    - Contributes to global warming
    - Takes up a lot of space

Meaningful Discussion

- What are similarities and differences between the energy sources and their processes?
    - Similarities: Many of them include turbines and a generator, etc.
    - Differences: They have different sources to turn a turbine (coal, wind, water, the sun)
- Which sources of energy are the most clean (don't hurt the environment) and why?
- What are good ways of using and saving energy at home?
- What are energy sources used in Virginia and what is the process to create energy?

Additional Background Terms for Volunteers' Understanding

- **Electric current**
  - The rate of electron flow, measured in Amps
    - Ex. # of electrons/ sec, 1 Amp = light bulb
- **Circuit**
  - The path of an electric current
- **Voltage (volts, V)**
  - A measure of the force for electrons to flow
  - Ex. A big vs. small push
- **Kilowatt hour (kWh) and Megawatt hour (mWh)**
  - A measure of total energy used over a period of time
  - 1,000 kWh=1 mWh
- **Turbine**
  - A pinwheel-like machine that spins when water, steam, or air is pushed through it
- **Generator**
  - A machine that turns mechanical energy from a turbine into electrical energy
  - A powerful magnet spins inside a shell of wiring, exciting electrons
- **Photovoltaic cell**
  - Solar panel; a sheet made of silicon (Si) that converts the sun's light into electrical energy
- **Fossil Fuel**
  - Energy sources formed in the earth from plant or animals remains
  - Ex. Coal, petroleum (gasoline), natural gas
- **Nuclear Energy**
  - Atoms are very small particles that make up everything
  - Energy produced from splitting a uranium atom (or combining two U atoms together)



Links and Resources

- How Wind Turbines Work: https://www.youtube.com/watch?v=DILJJwsFl3w
- How Hydroelectricity Works: https://www.youtube.com/results?search_query=student+energy+hydropower
- How Solar Power Works: https://www.youtube.com/watch?v=u-5Buq5-U5s
- How Coal Power Plants Work: https://www.youtube.com/watch?v=GI7AhajfhWE
- Jen Explains Coal Interactive Kit: https://youtu.be/bv2dhxcu5Ck
- Energy Basics for Kids: https://www.eia.gov/kids/energy.cfm?page=electricity_home-basics-k.cfm
- State Renewable Portfolio Standards: http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx#va
- Offshore wind energy in Virginia: https://www.youtube.com/watch?v=3j5M-O58B6Y
- Virginia Energy Plan: https://www.dmme.virginia.gov/DE/LinkDocuments/2014_VirginiaEnergyPlan/10Section4Renewables.pdf

ATTACHED BELOW:

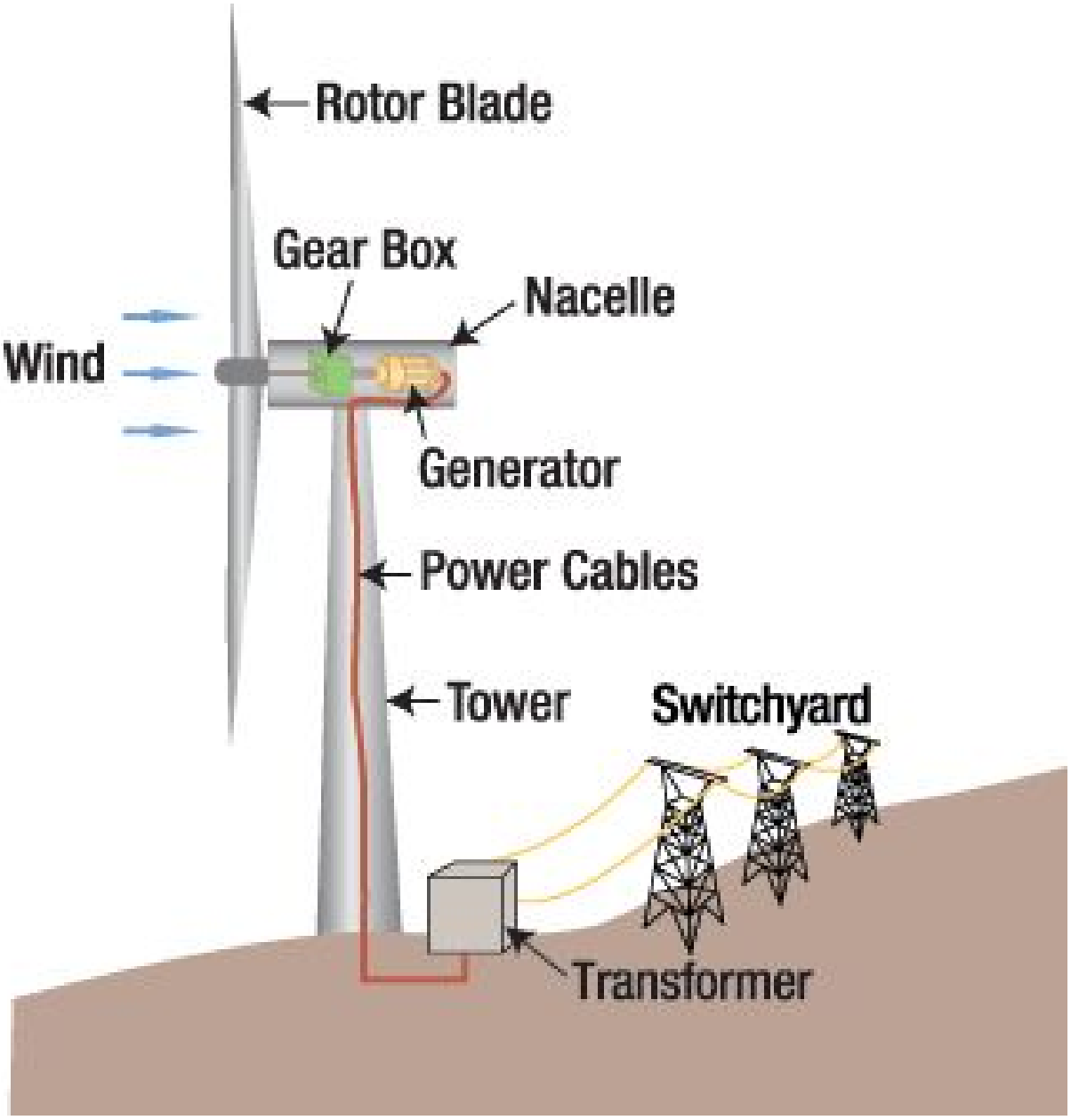
Energy Production Diagrams

- 4 large images: Wind turbine, hydroelectric dam, solar panel system, coal power plant

Energy Step Cards

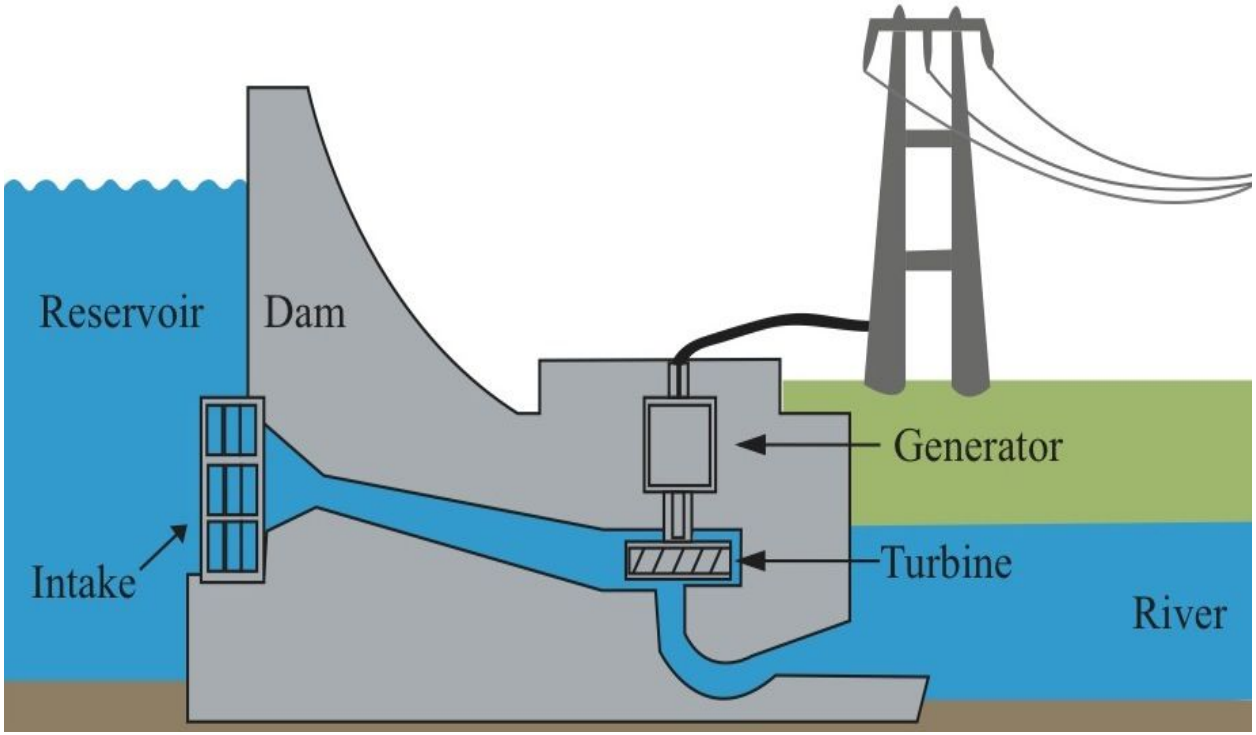
- 4 sheets of picture cards with labels

Coal Power Plant Outline

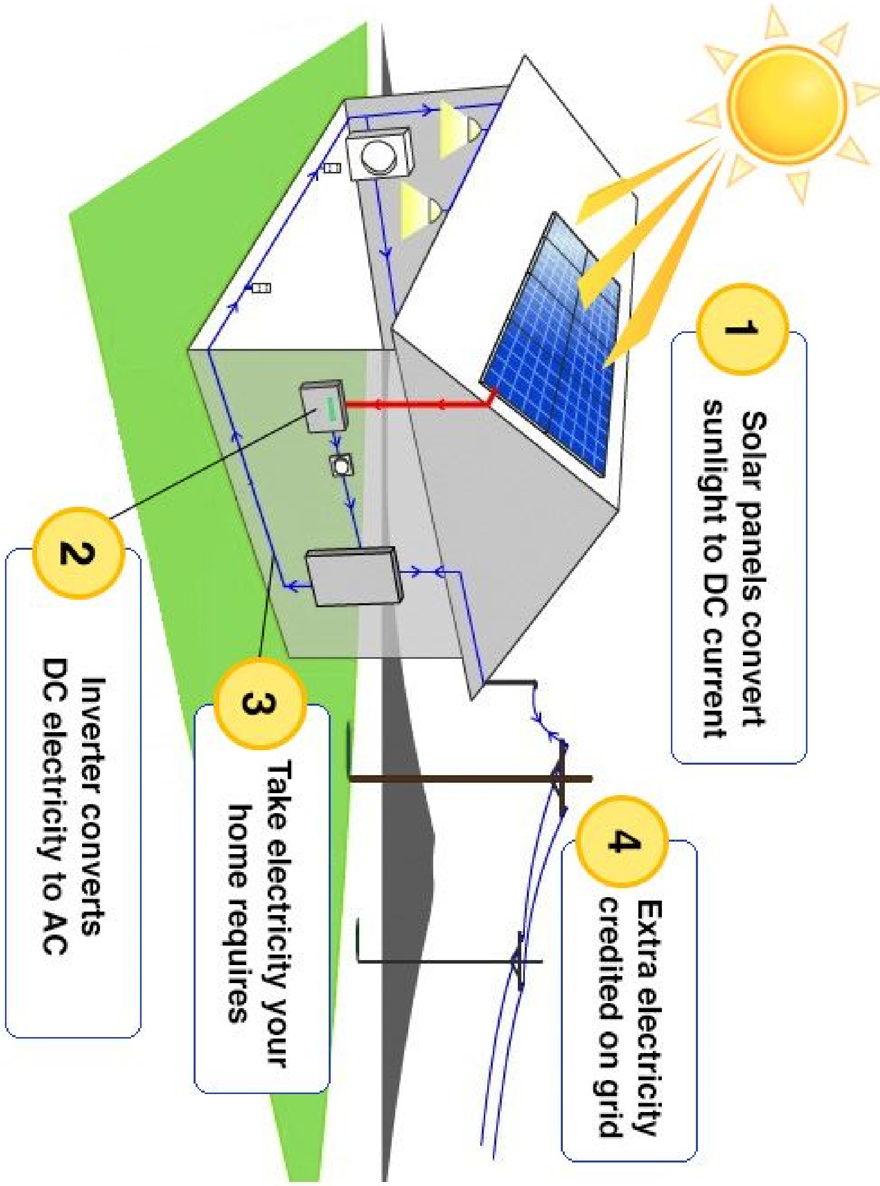


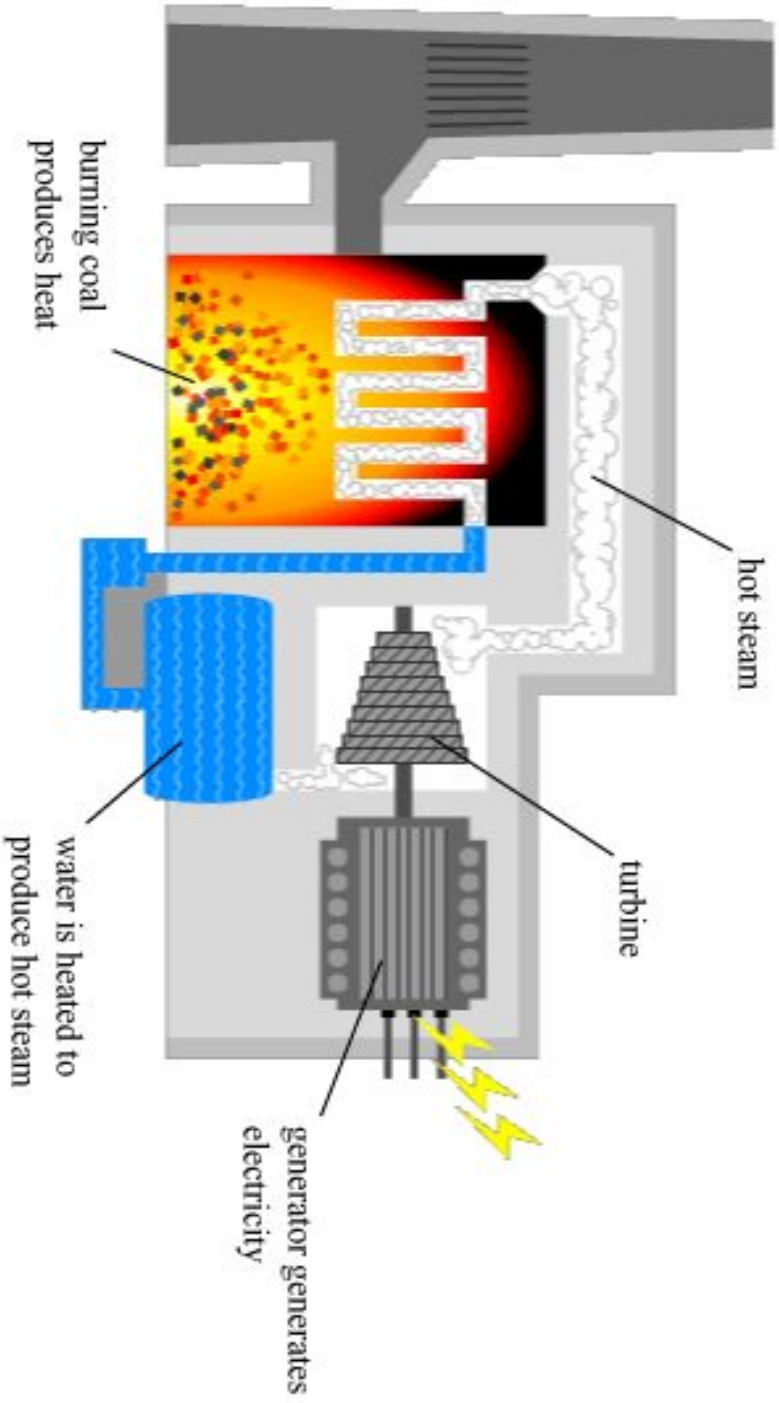
With a little bit of knowledge, we can **ESLI** make a difference

Hydroelectric Dam Diagram



With a little bit of knowledge, we can ESLI make a difference


1
Solar panels convert sunlight to DC current
2
Inverter converts DC electricity to AC
3
Take electricity your home requires
4
Extra electricity credited on grid



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COAL

Coal is mined from ground

COAL

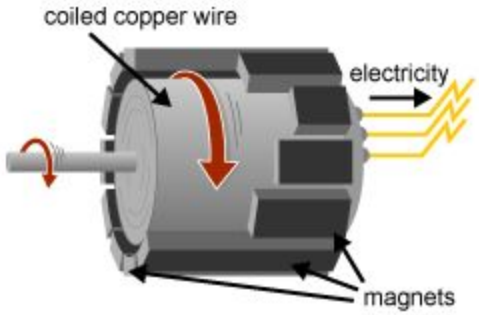
Burn coal

COAL

Steam

COAL

Turns turbine



COAL

Generator makes electricity

COAL

Power Lines

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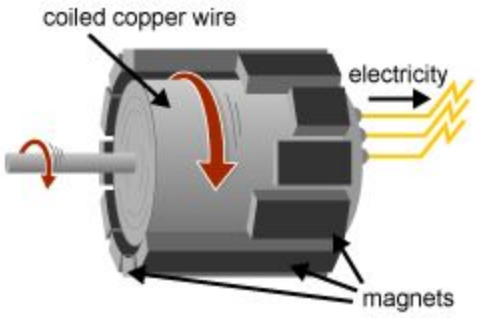
 COAL House	 WIND Wind
 WIND Turbine spins	 WIND Generator makes electricity

WIND

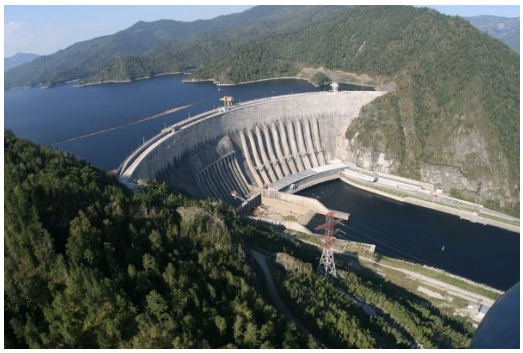
Power lines

WIND

House

HYDRO

Water

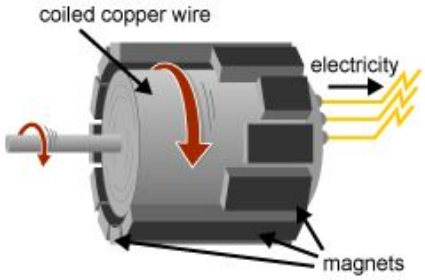


HYDRO

Flows into dam

HYDRO

Turbine spins



HYDRO

Generator makes electricity

Eco-Schools Leadership Initiative

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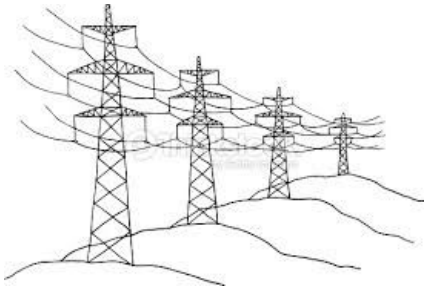 HYDRO Power lines	 HYDRO House
 SOLAR Sun	 SOLAR Solar panels
 SOLAR Inverter converts the electricity	 SOLAR House

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 SOLAR Excess electricity	 SOLAR Power grid

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