

Teaching Renewable Energy

Background for *Getting our Hands on Energy*



Lesson Objectives

Students will be able to:

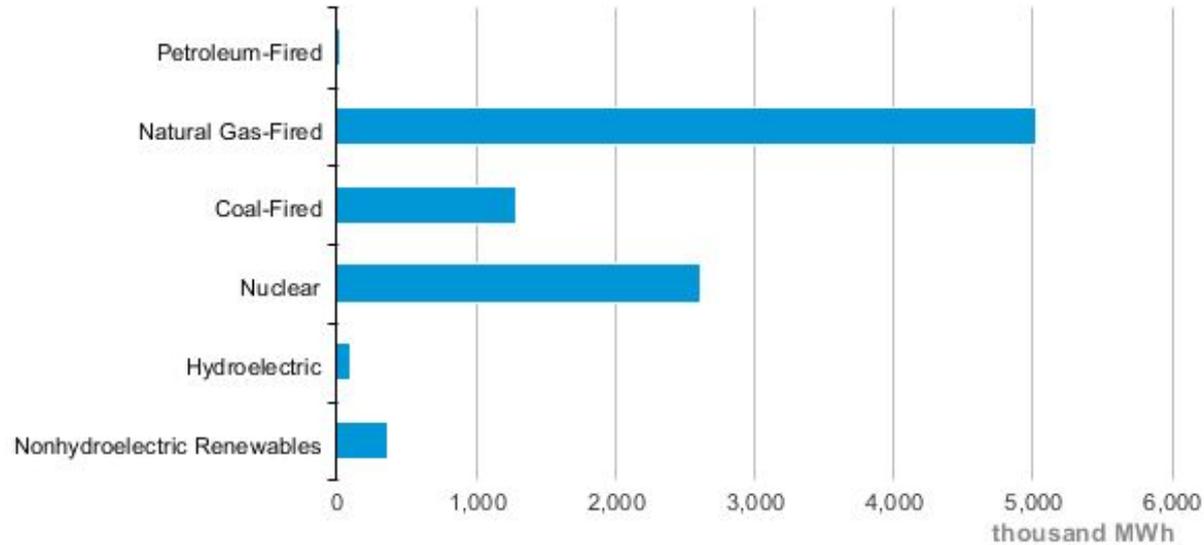
- Identify types of renewable resources
- Understand and explain how the sun, water, wind, and coal generate energy

Students will learn key knowledge and attitudes:

- 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)



Virginia Net Electricity Generation by Source, Aug. 2017

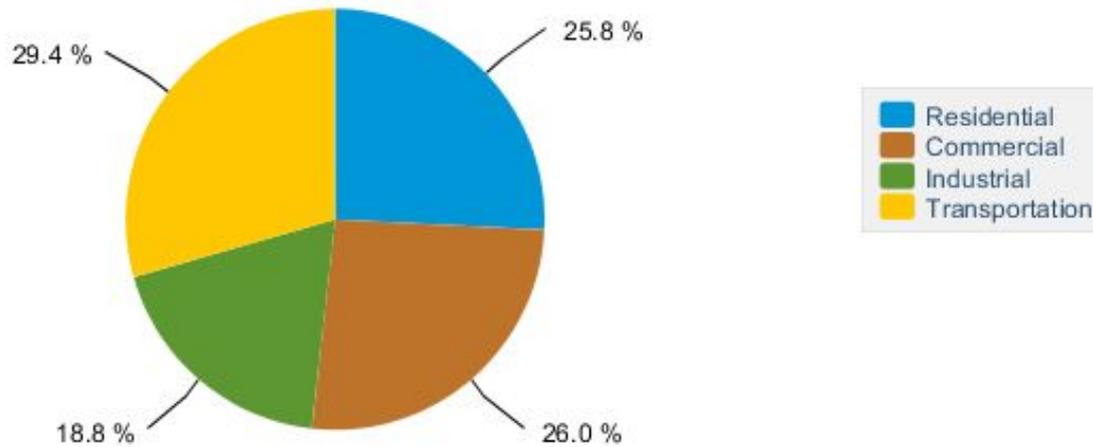


Source: Energy Information Administration, Electric Power Monthly

Major Types of Electricity Sources in Virginia



Virginia Energy Consumption by End-Use Sector, 2015



Source: Energy Information Administration, State Energy Data System

Renewable Energy in Virginia

- Dominion Energy
 - Controls significant amount of energy production in Virginia
- General Assembly passed legislation to include 500 megawatts of solar power amongst other types of energy (2015)
- Homeowners can enter into Power Purchase Agreements (PPA) with solar companies
 - Companies build and maintain solar panels on a homeowner's roof
 - Homeowner agrees to buy low-cost energy from the solar company
- 24 hydropower facilities
- 2 nuclear power plants
 - North Anna Nuclear Generating Station
 - Dominion Surry Power Station



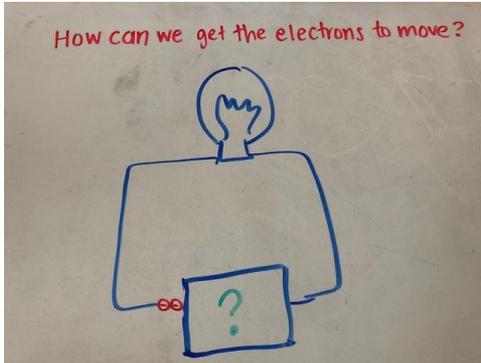
Renewable Energy in Virginia



Getting our Hands on Energy Lesson

Engaging Introduction: Guess the Terms & Electrical Circuit Demo

- Use picture cards to learn new vocab words
- Draw:



- **When electrons move, this makes energy that we call electricity**
- **Pose Question: How do we get the electrons moving to make the light bulb light up?**
 - *Sample Answers: Battery, solar panel; connect the above circuit to electricity made from a wind turbine, hydroelectric plant, nuclear powered plant, or coal powered plant*
- Place a circuit with a battery on each table to demonstrate electricity

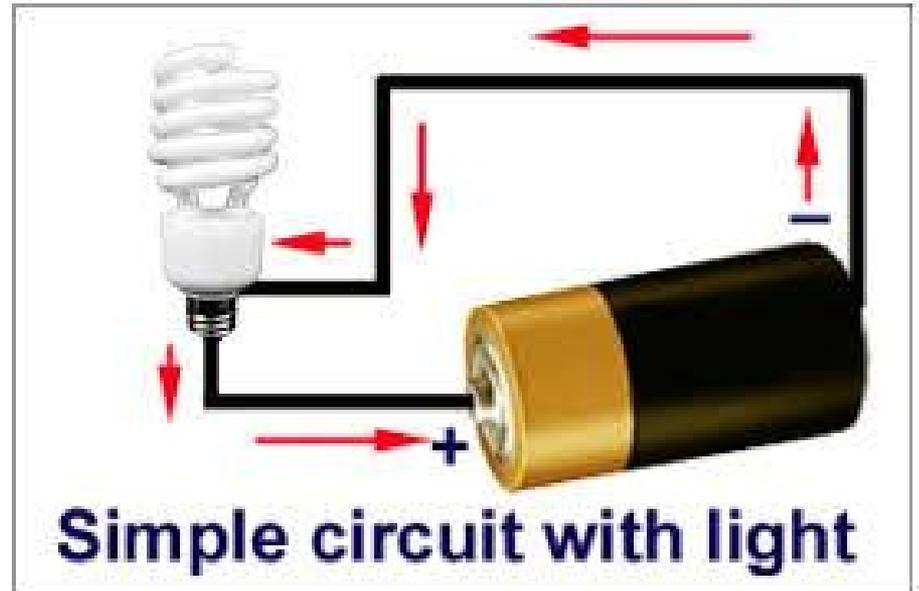
Key Terms

- **Energy**
 - The ability to do work
 - What you use to do anything
 - Many different kinds: ex. mechanical, electrical!
- **Electricity**
 - When electrons move from one point to another
 - Electrons “jump” from one nucleus to another throughout a wire
- **Electron**
 - Negatively charged particle that moves around the nucleus of an atom
- **Renewable Energy**
 - Energy made from something that cannot be used up
 - Ex. Solar, hydro, and wind energy
- **Non-renewable Energy**
 - Energy that can be used up and cannot be replenished in a short period of time
 - Ex. Coal, gasoline, nuclear
- **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)

Key Terms

- **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
- **Electric current**
 - The rate of electron flow, measured in Amps
 - Ex. # of electrons/ sec, 1 Amp = lightbulb
- **Circuit**
 - The path of an electric current
- **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

Make a circuit!



Getting Our Hands on Energy Lesson

Exploratory Activity

- Divide students into 4 groups: Wind, Hydro, Solar, and Coal
- 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
- Have students take turns explaining how each step works to ESLI leaders; encourage students to help each other if they get stuck
- Use the Interactive Energy toys to demonstrate how energy is obtained from each resource
 - Reference the Energy Step Cards to help identify each step of the process
- *IF TIME: Have student act out each step of the energy production pathway for their resource*
- Regroup and have each group share out what they learned about how their resource works to the other resource groups



Coal



**Click on
the
slide to
play
video!**

Impacts of Coal

Mining

- Mountaintop removal destroys habitat and pollutes air and water in Appalachia

Air Pollution

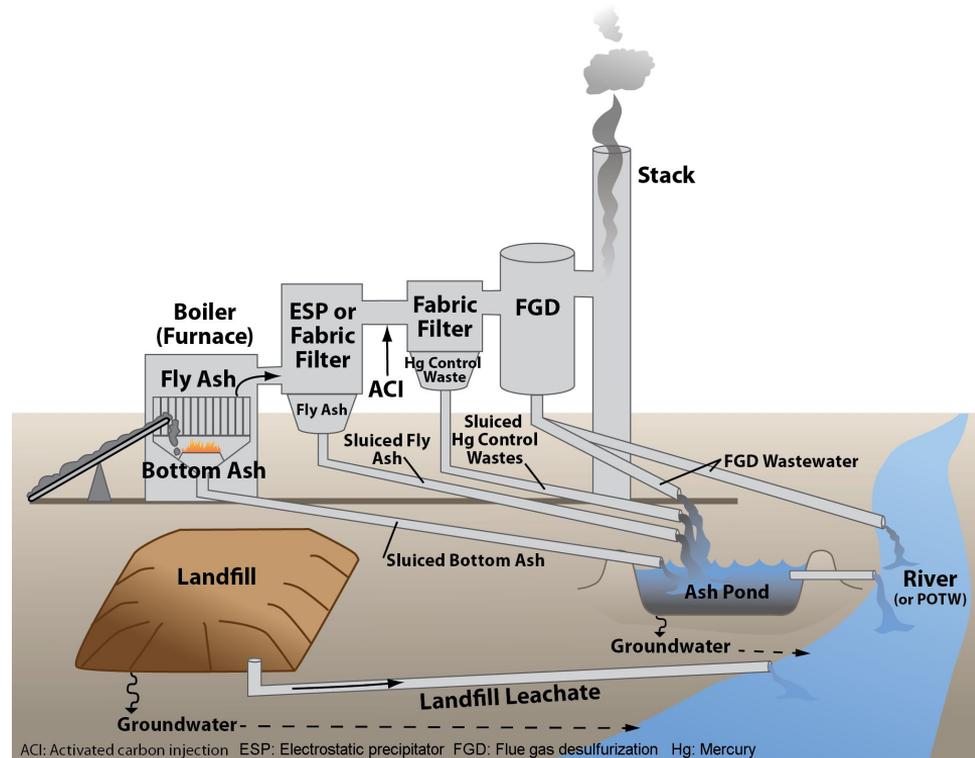
- Burning coal produces methane, CO₂, mercury compounds, SO_x, and NO_x

Water Pollution

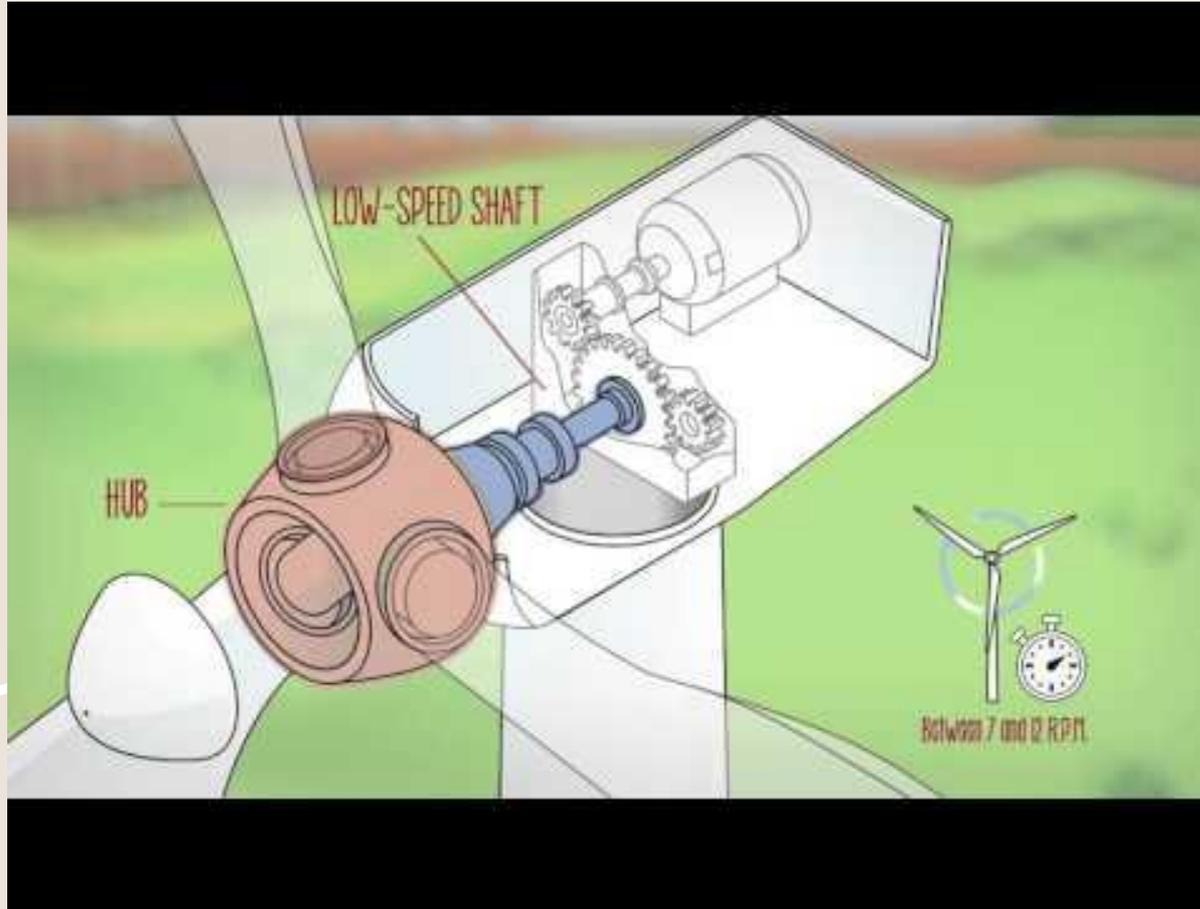
- Water is used during mining, storage, cleaning, and energy production
- Comes in contact with heavy metals (Lead and arsenic) and pollutes groundwater

Coal Ash

- Toxic remains of burned coal that can be recycled but is most often buried in landfills

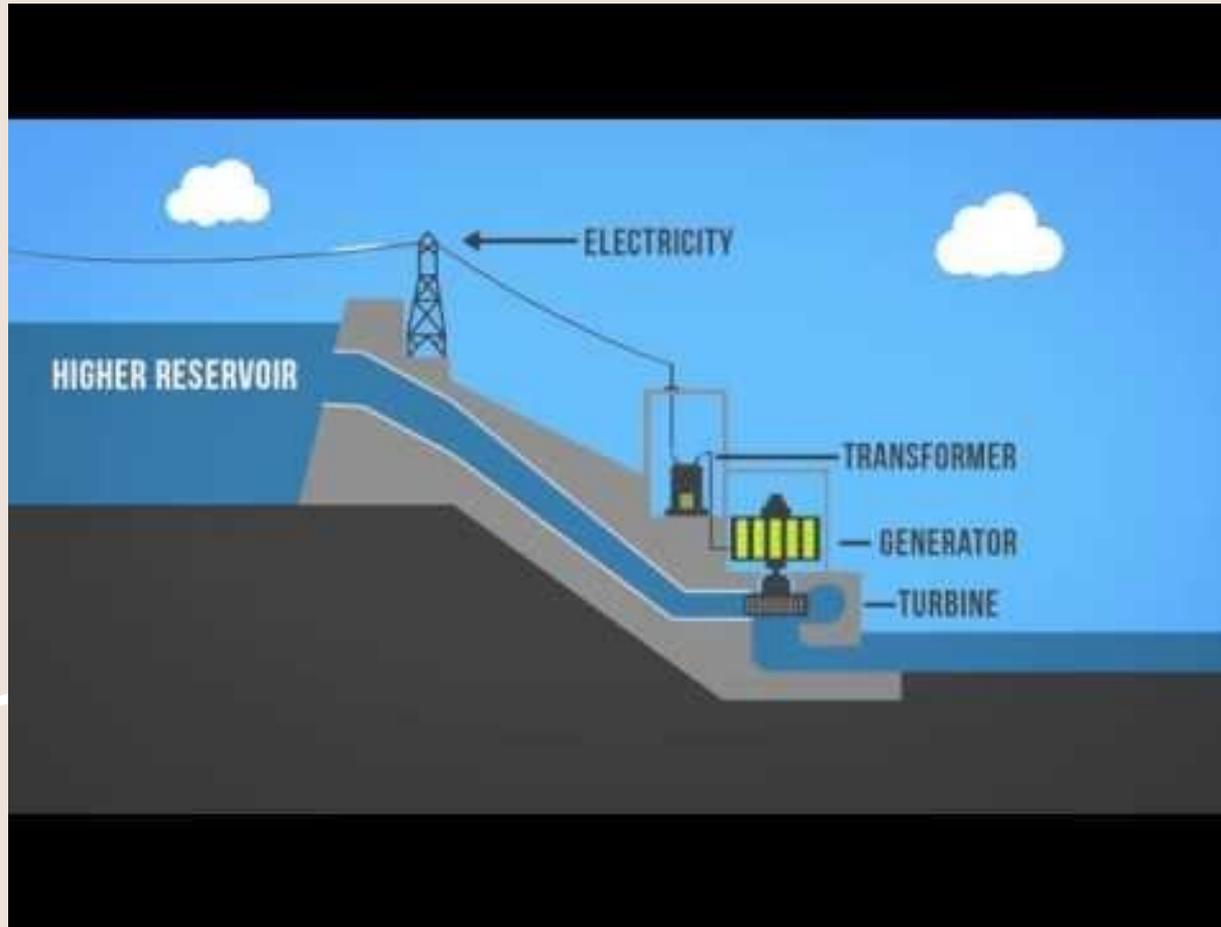


Wind Energy



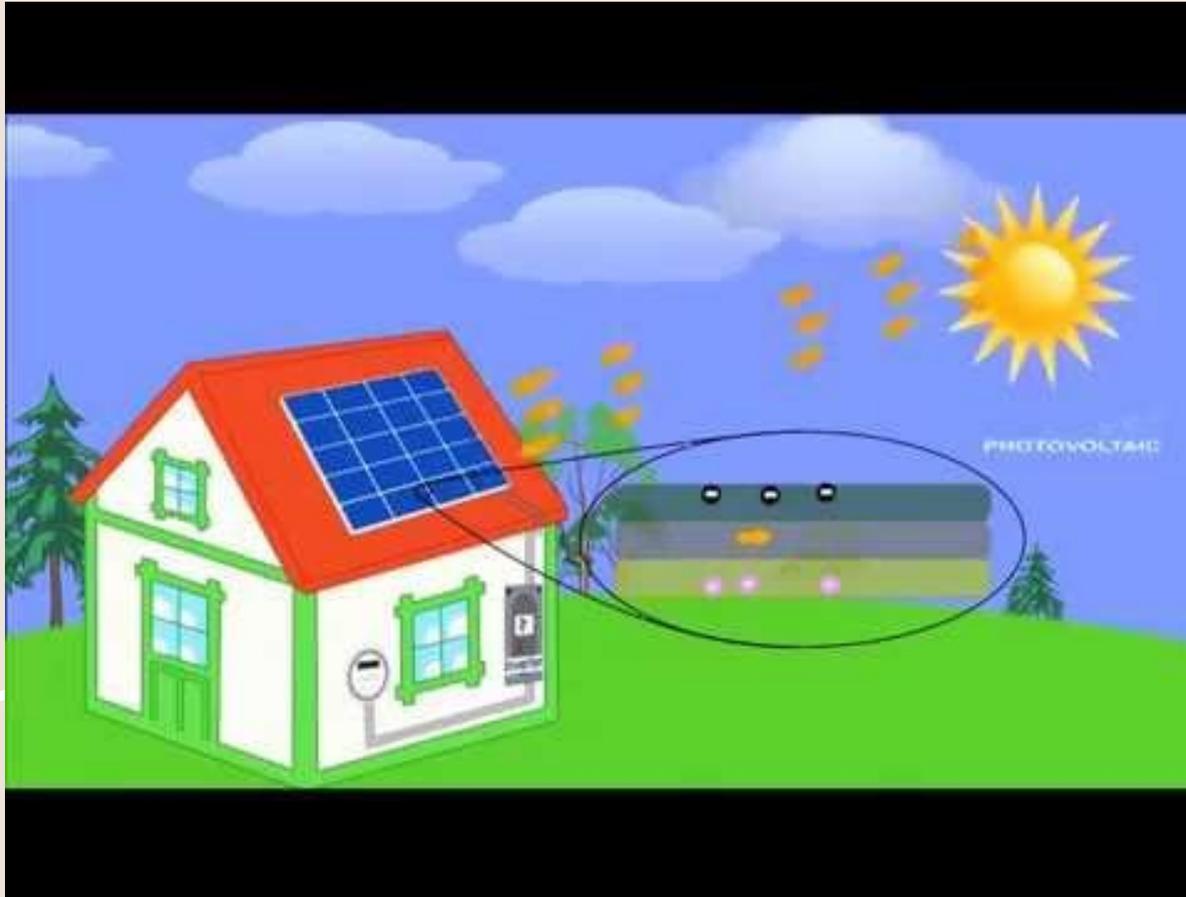
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Hydropower



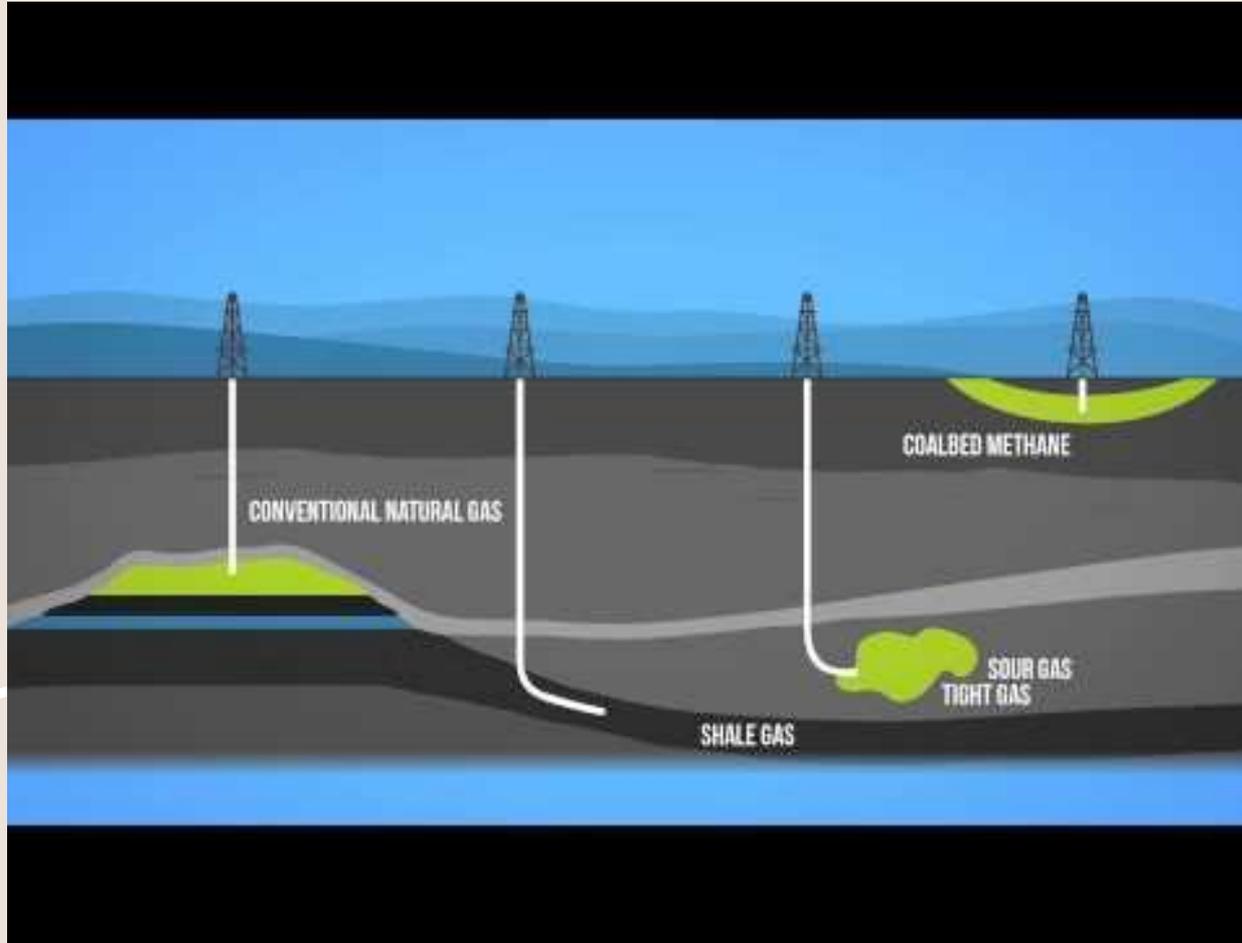
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Solar Energy



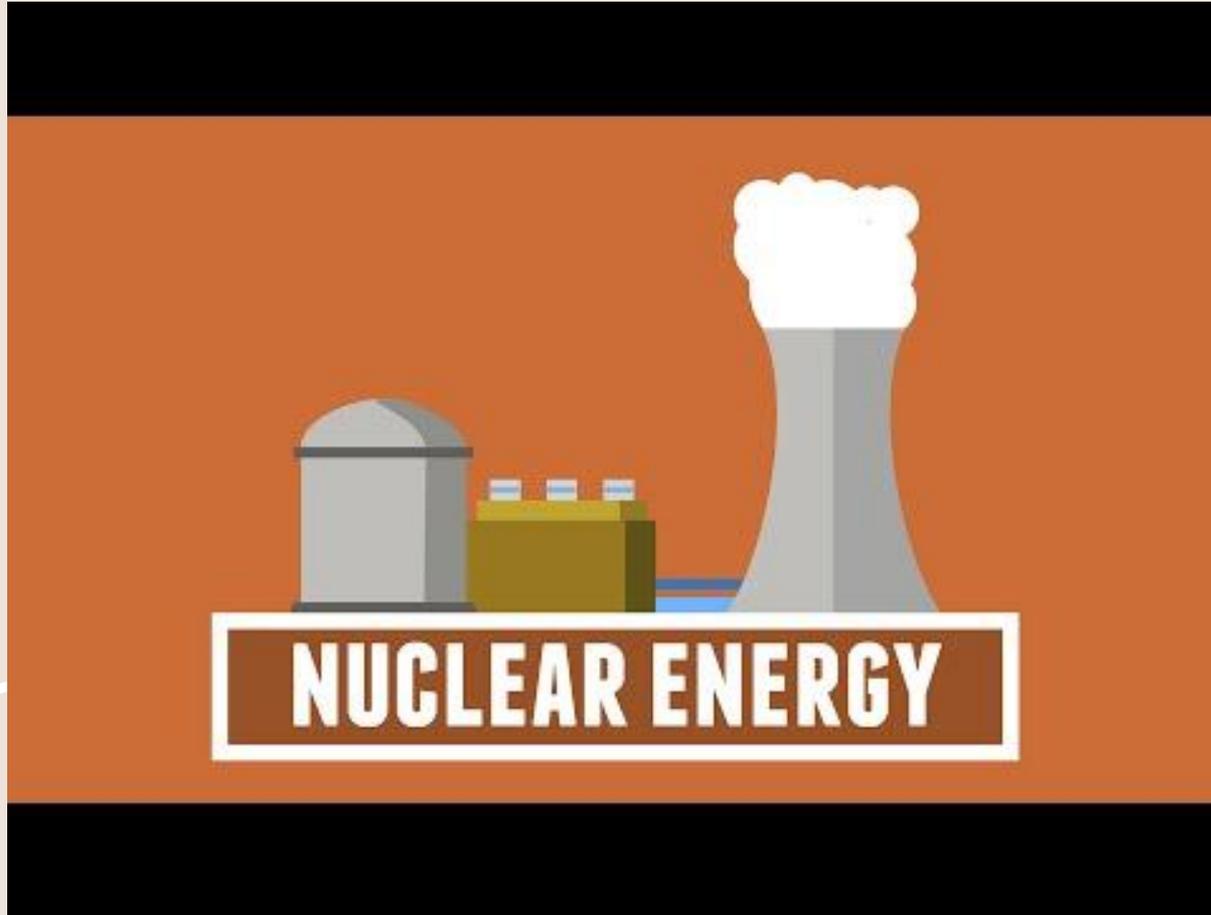
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Natural Gas



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Nuclear Energy



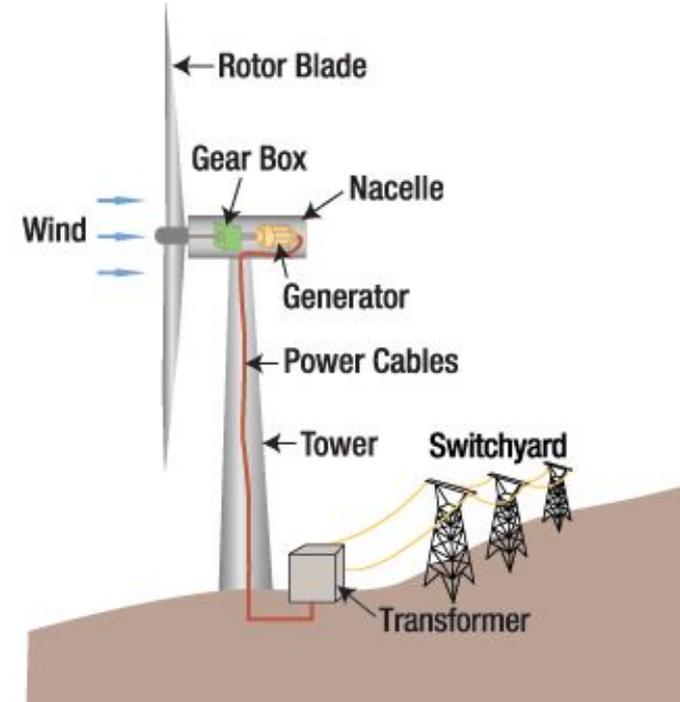
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BREAK INTO GROUPS



Wind Power

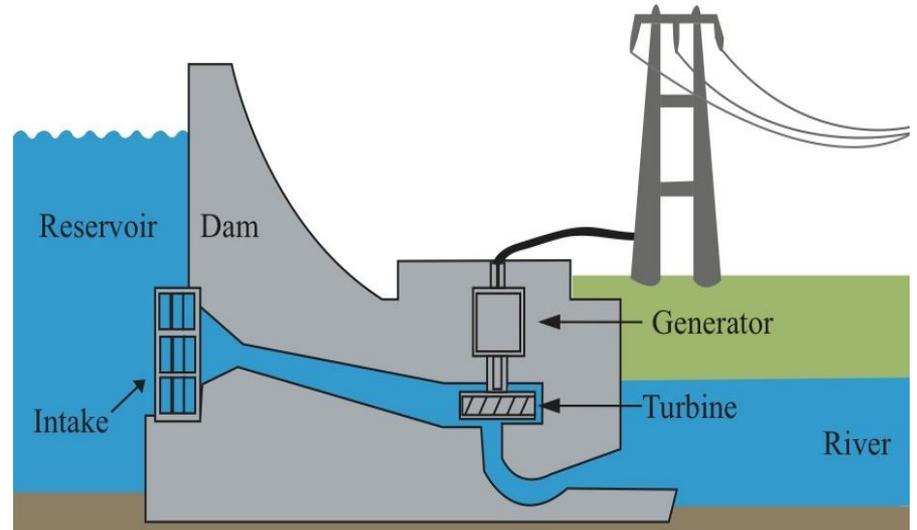
- How do wind turbines work?
 - Wind moves the blades
 - Blades turn the shaft
 - Shaft spins the generator
 - Generator makes electricity
 - Electricity goes to power lines
- Can you think of a historical example of a wind turbine?
 - Old windmills grind grain into flour (like in *Beauty and the Beast*, 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

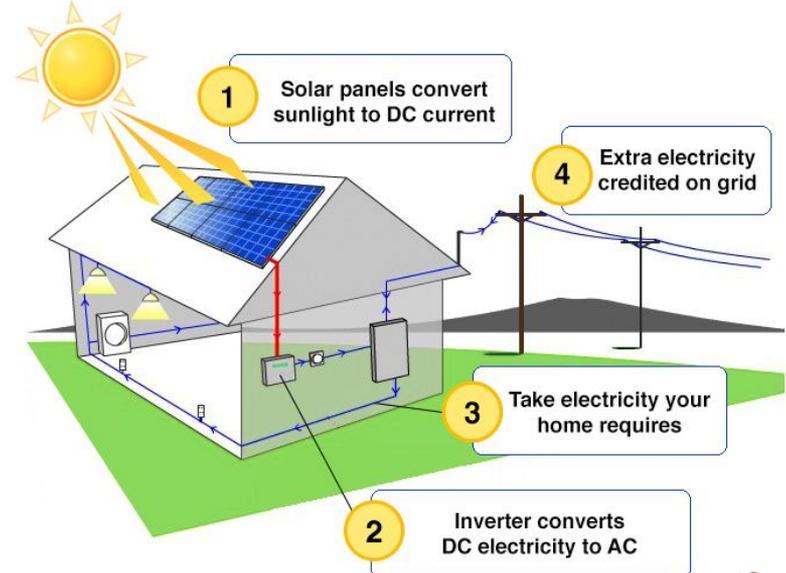
- What does hydropower mean?
 - Water power
- How does hydropower work?
 - Engineers build a hydroelectric dam on a river
 - Water is forced to move over turbines
 - Turbines spin the generator
 - Generator makes electricity
 - Electricity goes to power lines
- Can you think of a historical example of hydropower?
 - Water wheels on old mills 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

Hydroelectric Dam Diagram



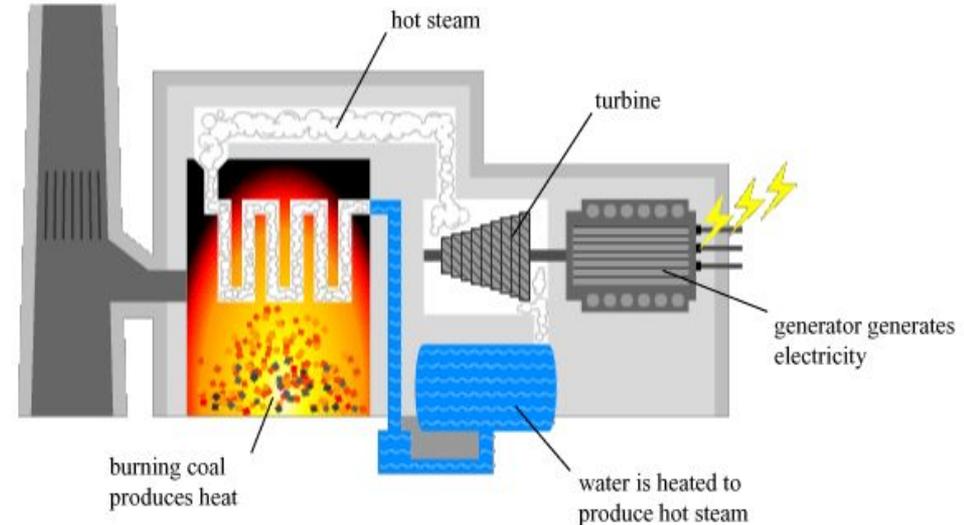
Solar Power

- 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 in areas that get a lot of sun, like the desert
- What are good things about hydropower?
 - 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



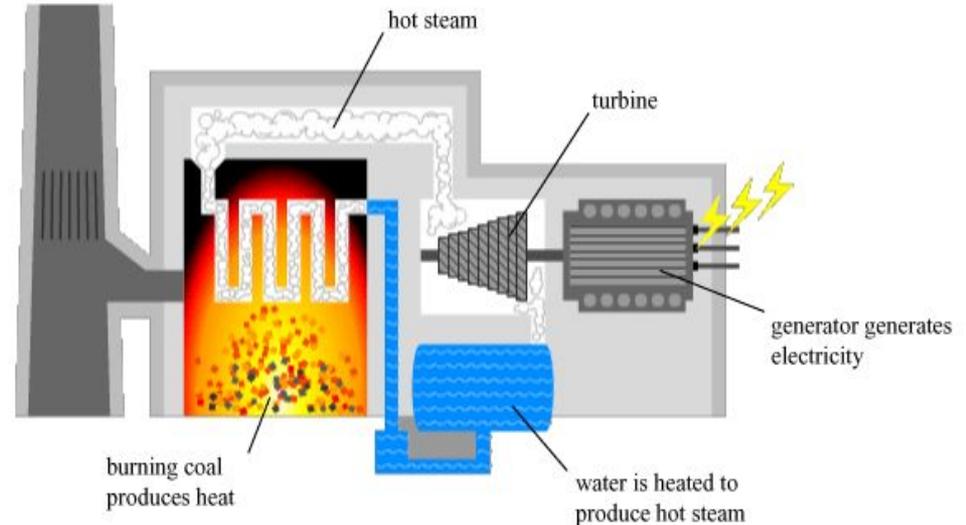
Coal

- 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



Coal

- 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



Getting our Hands on Energy Lesson

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?

