

# ENVIROTHON REVIEW: ENERGY



Louisiana State Energy Office



# AGENDA

Topic one: Oil and Gas

Topic two: Renewables

Topic three: Electric Overview

Topic four: Technology

# Energy

Energy is at the heart of development. Energy makes possible the investments, innovations, and new industries that are the engines of jobs, inclusive growth, and shared prosperity for entire economies.

Scientists define energy as the ability to do work. Modern civilization is possible because people have learned how to change energy from one form to another and then use it to do work. People use energy for a variety of things, such as to walk and bicycle, to move cars along roads and boats through water, to cook food on stoves, to make ice in freezers, to light our homes and offices, to manufacture products, and to send astronauts into space.





# TOPIC ONE

## Oil and Gas

# Oil and Gas

Louisiana plays a significant role in the oil and gas industry in the United States. The state is home to extensive oil and natural gas reserves, both onshore and offshore. The Gulf of Mexico, particularly the outer continental shelf, is a major source of offshore oil and gas production.





# Oil and Gas

**Offshore Production:** The Gulf of Mexico, where Louisiana has a substantial coastline, is a crucial area for offshore oil and gas exploration and production. Many oil rigs and platforms are located off the coast of Louisiana.

**Onshore Production:** Louisiana also has onshore oil and gas production, with active drilling operations and extraction activities in various parts of the state.



# Oil and Gas

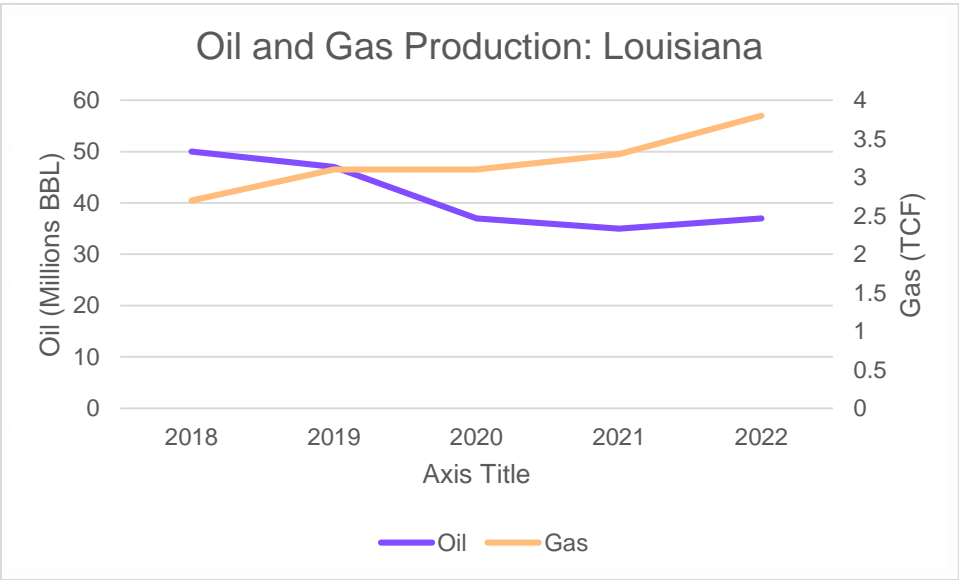
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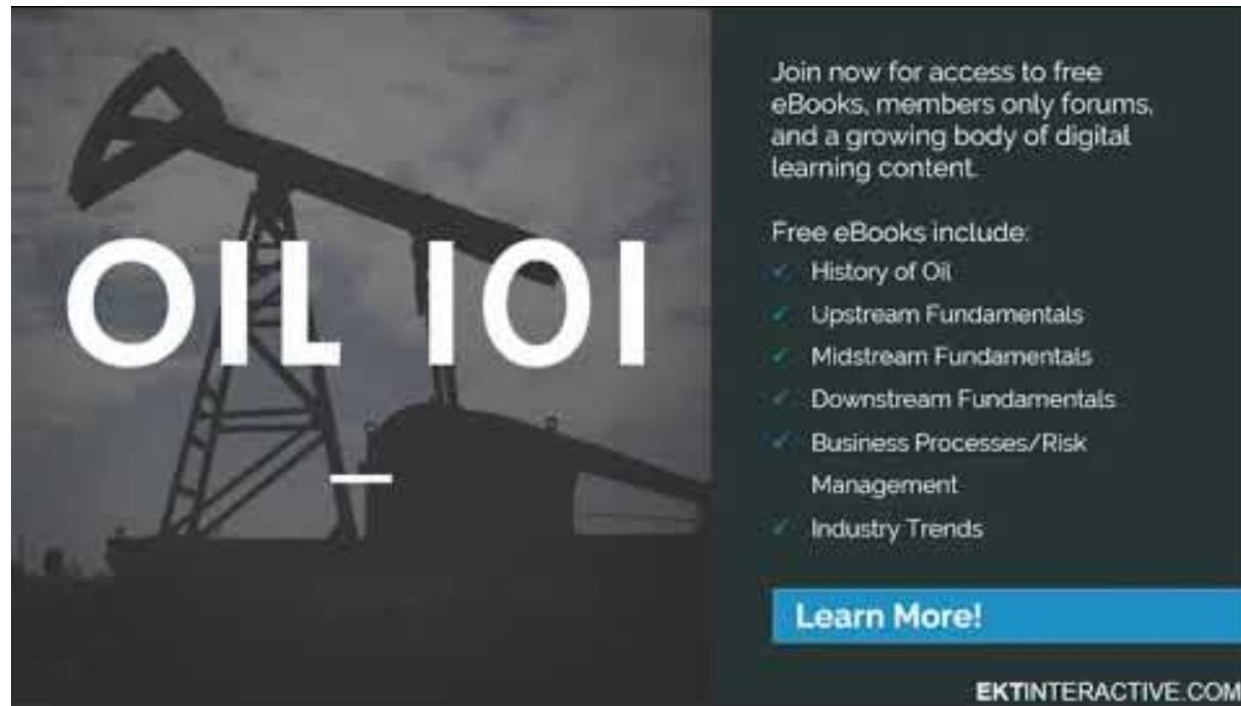
# Oil and Gas

Oil and Gas Production in Louisiana:





# Oil and Gas



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The graphic features a dark background with a silhouette of an oil pumpjack on the left. The text 'OIL 101' is prominently displayed in large, white, sans-serif font. To the right, there is a list of free eBooks available, each preceded by a checkmark. At the bottom right, there is a blue button with the text 'Learn More!' and the website 'EKTINTERACTIVE.COM' below it.



# Oil and Gas

## Energy Content:

### The 6:1 Crude Oil to Natural Gas Ratio

Historically, the Btu (British thermal unit) ratio between crude oil and natural gas has been "accepted" by the industry as 6:1. "As fuel that has a BTU (British Thermal Unit) content of 5.8 million. A cubic foot of gas contains about 1000 BTU, thus, 5.8 thousand cubic feet (MCF) of natural gas has nearly the same number of BTU's as one BOE." And because it makes the mathematics easier, the industry has rounded 5.8 to 6.

In layman's terms, if you burn a barrel of oil, it produces about 6 million BTUs. If you burn an MCF of gas, it produces about one million BTUs. So, the assumption is that 6 MCF of gas is equivalent to one barrel of oil, which is more or less true, on an energy equivalent basis.

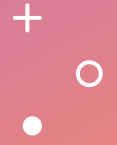
As a result, many decided that they could translate the energy equivalent into a value (or dollar) equivalent, whereby 6 MCF of natural gas should be about the same price as one barrel of oil. Furthermore, many argue that if oil is cheaper than natural gas (on a Btu basis), people will use oil; and if natural gas is cheaper oil (again, on a Btu basis), companies will burn gas.





# TOPIC TWO

## Renewables



# Renewables

Renewable energy is **energy derived from natural sources that are replenished at a higher rate than they are consumed**. Sunlight and wind, for example, are such sources that are constantly being replenished. Renewable energy sources are plentiful and all around us.





# Renewables

## 1. Solar Energy

Solar energy is harnessed from the sun's rays using photovoltaic cells or solar thermal systems. Photovoltaic cells convert sunlight directly into electricity, while solar thermal systems use sunlight to generate steam that drives turbines to produce electricity. Solar energy is abundant and sustainable, making it a popular choice for both residential and commercial applications.

## 2. Wind Energy

Wind energy is generated by harnessing the kinetic energy of moving air. Wind turbines, consisting of large blades connected to a rotor, capture the wind's energy and convert it into electricity. Wind power is a clean and efficient source of energy, with onshore and offshore wind farms being common installations.





# Renewables

## 3. Hydropower

Hydropower, or hydroelectric power, is derived from the energy of moving water. Dams or other structures are used to capture the energy from flowing rivers, creating reservoirs of water. As the water is released, it flows through turbines, generating electricity. Hydropower is a reliable and well-established source of renewable energy.

## 4. Geothermal Energy

Geothermal energy is obtained from the Earth's internal heat. This heat can be harnessed through geothermal power plants, which use steam or hot water from underground reservoirs to generate electricity. Geothermal energy is considered a reliable and continuous source, with low greenhouse gas emissions.



# Renewables

## 5. Biomass Energy

Biomass energy is derived from organic materials, such as plants and animal waste. These materials can be burned directly for heat or converted into biofuels, such as ethanol and biodiesel. Biomass energy is versatile and can be used for heating, electricity generation, and transportation.

## 6. Tidal and Wave Energy

Tidal and wave energy are generated by harnessing the movement of ocean tides and waves. Tidal power involves using the gravitational pull of the moon to generate electricity, while wave energy captures the kinetic energy of ocean waves. Both sources have the potential to provide consistent and predictable power.



# Renewables

Not renewable, but clean, **Nuclear energy is energy in the core of an atom**

Atoms are tiny particles in the molecules that make up gases, liquids, and solids. Atoms are made up of three particles, called protons, neutrons, and electrons. An atom has a nucleus (or core) containing protons and neutrons, which is surrounded by electrons. Protons carry a positive electrical charge, and electrons carry a negative electrical charge. Neutrons do not have an electrical charge. Enormous energy is present in the bonds that hold the nucleus together. This nuclear energy can be released when those bonds are broken. The bonds can be broken through nuclear fission, and this energy can be used to produce (generate) electricity.





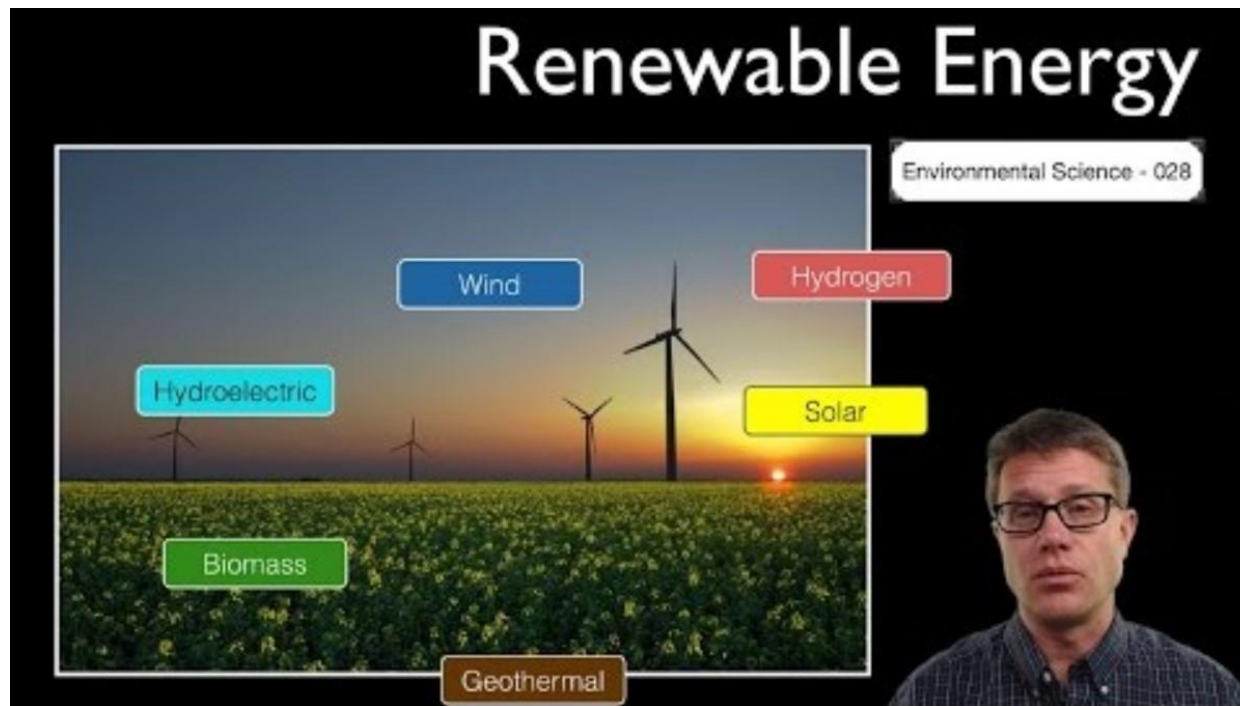
# Renewables

## Nuclear fuel—uranium

Uranium is the fuel most widely used by nuclear plants for nuclear fission. Uranium is considered a nonrenewable energy source, even though it is a common metal found in rocks worldwide. Nuclear power plants use a certain kind of uranium, referred to as U-235, for fuel because its atoms are easily split apart. Although uranium is about 100 times more common than silver, U-235 is relatively rare.



# Renewables







# TOPIC THREE

## Electric Overview

# Electric Overview

Electric generation is the process of converting various forms of energy into electrical power. This crucial aspect of modern society involves diverse technologies and energy sources, each with its own set of advantages and challenges. In this overview, we will explore the fundamentals of electric generation, examining the key methods and sources employed in this dynamic field.



# Electric Overview

## 1. Basics of Electric Generation:

Electric generation begins with the conversion of energy into mechanical energy, which is then transformed into electrical energy. This process adheres to the fundamental principle of electromagnetic induction discovered by Michael Faraday. Generators, the core devices in electric generation, use this principle to produce electricity.



# Electric Overview

- **Generators:** These devices consist of coils of wire rotating within a magnetic field. As the coils spin, they generate an electromotive force (EMF) that induces the flow of electric current. The mechanical energy required to turn the coils can be derived from various sources, such as steam, water, wind, or internal combustion engines.
- **Turbines:** To convert energy into mechanical energy, many electric generation methods employ turbines. Steam turbines, for instance, use high-pressure steam to turn the turbine blades, while hydroelectric turbines harness the kinetic energy of flowing water. Wind turbines convert the kinetic energy of the wind into rotational energy, which drives a generator.





# Electric Overview

## 2. Diverse Sources of Energy:

Electric generation relies on a wide array of energy sources, each contributing to the global energy mix. These sources can be broadly categorized into conventional and renewable.

### •Conventional Sources:

- **Fossil Fuels:** Coal, natural gas, and oil are traditional sources that combust to produce heat, generating steam to drive turbines.
- **Nuclear Power:** Nuclear reactions release vast amounts of heat, used to produce steam for turbine-driven generators.

### •Renewable Sources:

- **Hydropower:** Utilizes the energy of flowing water to turn turbines and generate electricity.
- **Wind Power:** Captures the kinetic energy of the wind to rotate turbine blades.
- **Solar Power:** Converts sunlight into electricity through photovoltaic cells.
- **Geothermal Power:** Taps into the Earth's internal heat to generate steam for electricity production.





# Electric Overview

## Transmission:

Electric transmission refers to the process of transporting electric power from a power plant to various locations, such as homes, businesses, and industries. This process involves the movement of electrical energy over long distances through a network of power lines, transformers, and other electrical infrastructure. The primary goal of electric transmission is to efficiently deliver electricity from the point of generation to the end-users.



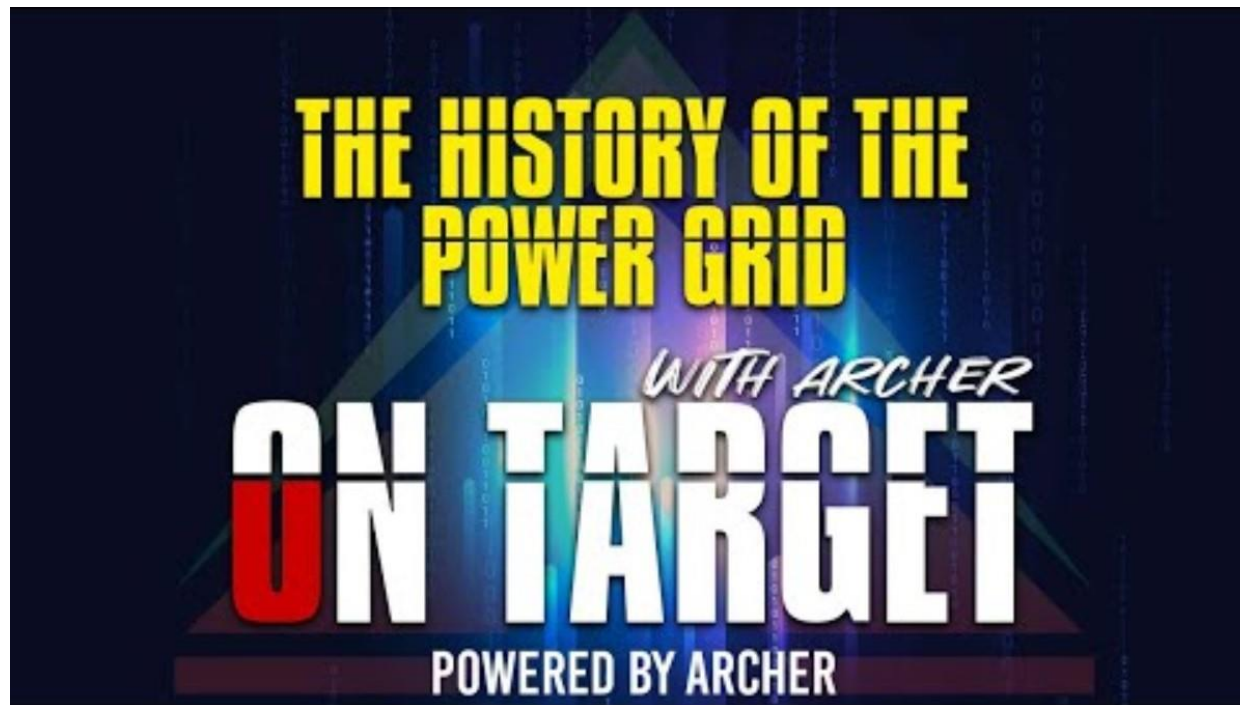
# Electric Overview

## Transmission:

Electric transmission is vital for meeting the demand for electricity across large geographical areas. High-voltage transmission is preferred because it reduces energy losses due to resistance in the transmission lines. The grid system allows for the balance of electricity supply and demand, ensuring a reliable and stable power supply for consumers.



# Electric Overview: History of the Power Grid





# Electric Overview

Key components of electric transmission include:

- 1. Power Plants:** Electricity is generated at power plants, which can use various sources such as coal, natural gas, nuclear energy, hydroelectric dams, wind, or solar power.
- 2. Generators:** These are devices within power plants that convert mechanical energy into electrical energy. Different types of generators are used depending on the energy source.
- 3. Transformers:** Transformers are used to increase or decrease the voltage of electrical energy. High-voltage transmission is more efficient over long distances, and transformers help in adjusting voltage levels at different points in the transmission network.



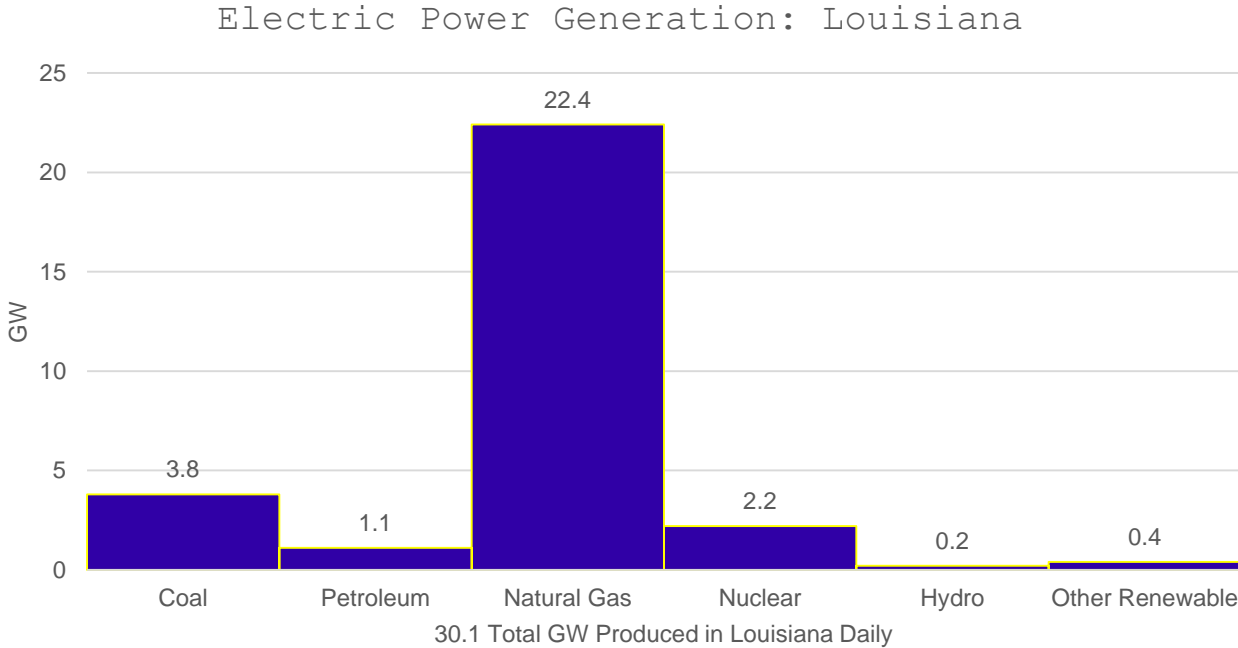
# Electric Overview

- 4. Transmission Lines:** These are conductive cables or wires that carry electricity over long distances. High-voltage transmission lines are preferred for minimizing energy loss during transportation.
- 5. Substations:** Substations are facilities that house transformers and other equipment to control and manage the flow of electricity. They play a crucial role in transforming voltage levels and ensuring the stability of the transmission system.
- 6. Grid System:** The transmission network is organized into a grid system, which is a complex interconnected network of transmission lines, substations, and other infrastructure. The grid allows for the efficient distribution and delivery of electricity.

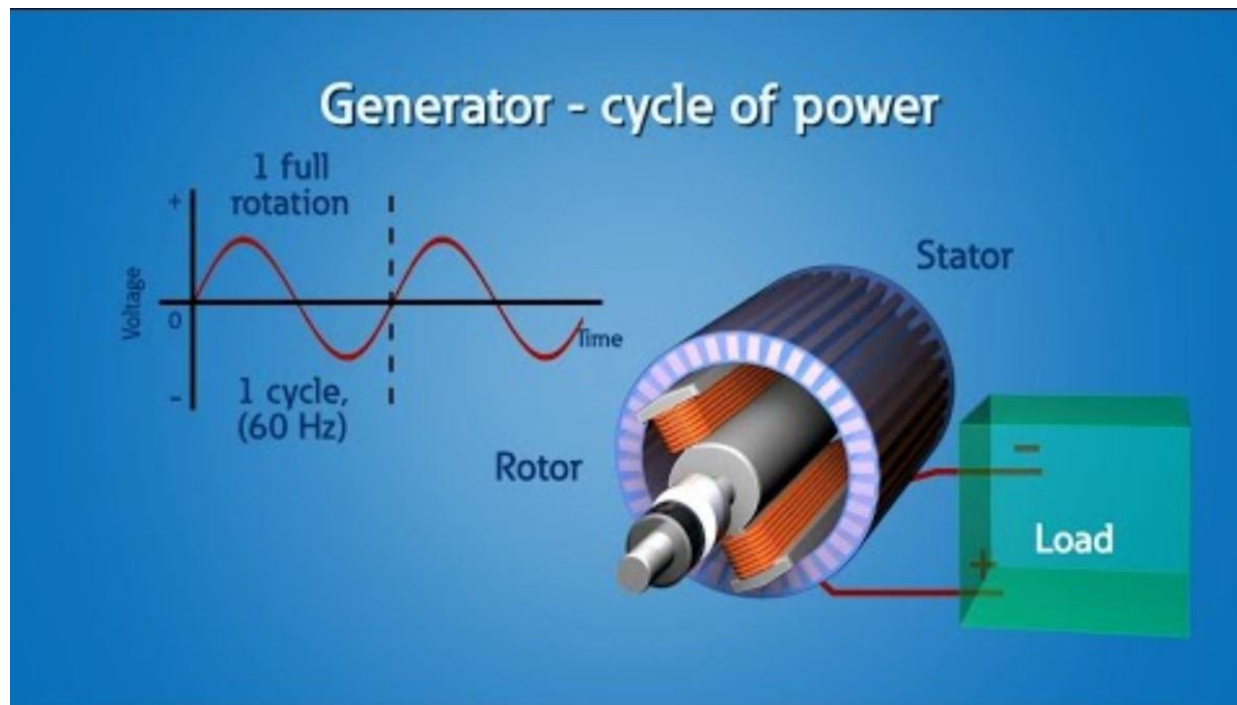




# Electric Overview



# Electric Overview



# U.S. Prices by State per Kilowatt Hour

STATE	Dec-23	STATE2	23-Dec
Alabama	12.41¢ / kWh	Montana	11.85¢ / kWh
Alaska	22.54¢ / kWh	Nebraska	11.31¢ / kWh
Arizona	13.16¢ / kWh	Nevada	11.67¢ / kWh
Arkansas	9.99¢ / kWh	New Hampshire Hampshire	19.63¢ / kWh
California	19.90¢ / kWh	New Jersey	15.64¢ / kWh
Colorado	12.28¢ / kWh	New Mexico	13.37¢ / kWh
Connecticut	21.62¢ / kWh	New York	19.30¢ / kWh
DC	13.21¢ / kWh	North Carolina Carolina	11.24¢ / kWh
Delaware	12.05¢ / kWh	North Dakota Dakota	12.07¢ / kWh
Florida	11.37¢ / kWh	Ohio	12.64¢ / kWh
Georgia	12.26¢ / kWh	Oklahoma	10.72¢ / kWh
Hawaii	32.76¢ / kWh	Oregon	11.02¢ / kWh
Idaho	10.58¢ / kWh	Pennsylvania a	14.38¢ / kWh
Illinois	12.56¢ / kWh	Rhode Island Island	18.64¢ / kWh
Indiana	12.02¢ / kWh	South Carolina Carolina	12.91¢ / kWh
Iowa	13.81¢ / kWh	South Dakota Dakota	12.39¢ / kWh
Kansas	11.56¢ / kWh	Tennessee	10.79¢ / kWh
Kentucky	10.56¢ / kWh	Texas	11.36¢ / kWh
Louisiana	9.37¢ / kWh	Utah	10.63¢ / kWh
Maine	16.16¢ / kWh	Vermont	18.50¢ / kWh
Maryland	13.92¢ / kWh	Virginia	12.40¢ / kWh
Massachusetts	21.11¢ / kWh	Washington	9.79¢ / kWh





# TOPIC FOUR: Technology



# Solar

A photovoltaic solar array, commonly known as a solar panel system, converts sunlight into electricity using the photovoltaic effect. Here's a brief overview of how it works:

**1.Solar Panels:** The basic building block of a solar array is the solar panel. Solar panels are made up of photovoltaic cells, typically composed of semiconductor materials like silicon.

**2.Photovoltaic Effect:** When sunlight (photons) strikes the surface of the solar panels, the energy from the photons is absorbed by the semiconductor material. This absorption of light creates an electric current within the material, known as the photovoltaic effect.



# Solar

**3. Generation of DC Electricity:** The absorbed sunlight excites electrons in the semiconductor material, causing them to move and create an electric current. This electric current is in the form of direct current (DC) electricity.

**4. Inverter Conversion:** Since most household and commercial appliances use alternating current (AC), the generated DC electricity needs to be converted into AC using an inverter. The inverter transforms the DC electricity into the usable AC electricity that can power homes and businesses.



# Solar

**5. Grid Connection or Battery Storage:** The generated AC electricity can be used directly to power appliances, or it can be fed into the electrical grid. In some cases, solar arrays are equipped with energy storage systems (batteries) to store excess electricity for later use, especially during periods of low sunlight.

**6. Net Metering (if connected to the grid):** If the solar array is connected to the grid, excess electricity generated during sunny periods can be fed back into the grid, and the owner may receive credits or compensation for the surplus energy.





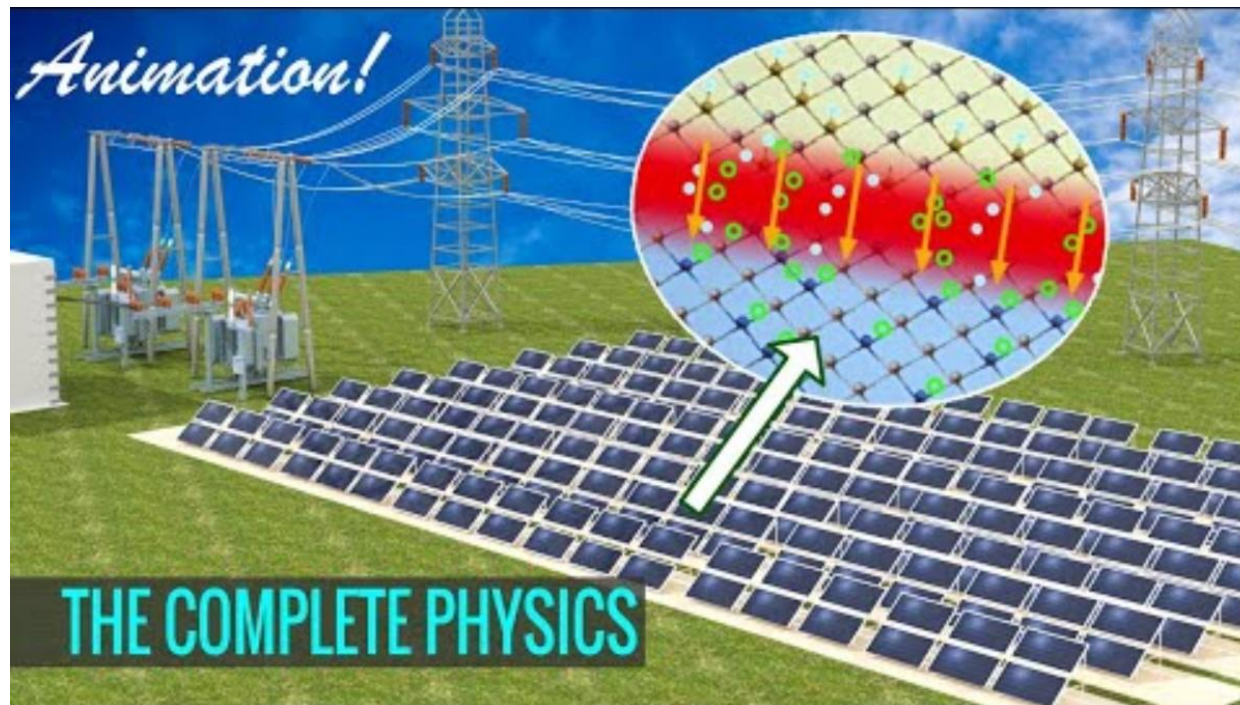
# Solar

**7. Usage and Integration:** The converted electricity is then used to power electrical devices and appliances in the building. Solar arrays can be integrated into both residential and commercial structures, either as rooftop installations or ground-mounted systems.





# Solar



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# Hydroelectric

Hydroelectric power is a form of renewable energy that harnesses the energy of flowing or falling water to generate electricity. The basic principle behind hydroelectric power is to convert the kinetic energy of moving water into mechanical energy, which is then used to generate electricity.





# Hydroelectric

- **Dam or Diversion Structure:** A dam or diversion structure is constructed on a river to create a reservoir. The height of the dam determines the potential energy that can be extracted from the falling water.
- **Reservoir:** The dam creates a reservoir by impounding water. The stored water in the reservoir has potential energy due to its elevated position.
- **Penstock:** The reservoir releases water through a penstock, which is a large pipe. The gravitational force causes the water to flow down the penstock.



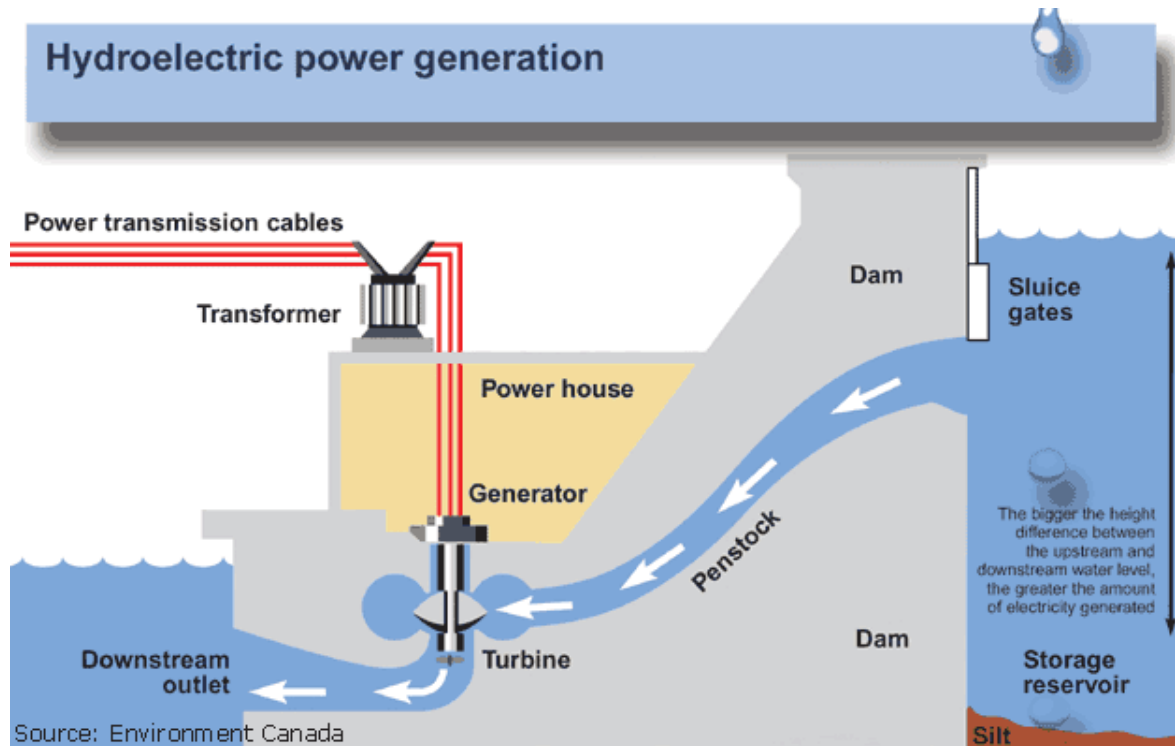
# Hydroelectric

- **Turbine:** As the water flows through the penstock, it strikes and spins the blades of a turbine. The turbine converts the kinetic energy of the moving water into mechanical energy.
- **Generator:** The rotating turbine shaft is connected to a generator. The generator converts the mechanical energy from the turbine into electrical energy.
- **Transmission:** The generated electricity is then transmitted through power lines to homes, businesses, and industries





# Hydroelectric



# Hydroelectric



URL:<https://youtu.be/dNTVItxeyLU>



# Geothermal

Geothermal energy is a renewable and sustainable form of energy derived from the Earth's internal heat. The Earth's interior maintains a substantial amount of heat, primarily generated by the decay of radioactive isotopes and residual heat from the planet's formation. Geothermal energy harnesses this heat to generate electricity or provide direct heating for various applications.

There are three main types of geothermal energy:





# Geothermal

**Geothermal Power Plants:** These plants convert the Earth's heat into electricity. There are three types of geothermal power plants: dry steam, flash steam, and binary cycle. Dry steam plants take steam out of fractures in the ground and use it to directly drive a turbine. Flash steam plants take on high-pressure hot water from the ground, and as the pressure decreases, it flashes into steam to drive a turbine. Binary cycle power plants transfer the heat from geothermal hot water to another liquid that boils at a lower temperature than water, and this vapor is used to drive a turbine.





# Geothermal

**Geothermal Direct Use Applications:** In addition to electricity generation, geothermal energy is used directly for heating purposes. Hot water from the Earth can be used for heating buildings, growing plants in greenhouses, drying crops, heating water at fish farms, and several industrial processes.

**Geothermal Heat Pumps:** These are used for heating and cooling buildings. Unlike other renewable energy sources, geothermal heat pumps use the relatively constant temperature of the Earth a few feet below the surface to provide heating, air conditioning, and hot water.



# Geothermal



# Wind Power

Wind power is a form of renewable energy that harnesses the kinetic energy of the wind to generate electricity. Here is an overview of key aspects of wind power:

**Wind Turbines:** Wind power is generated using wind turbines. These turbines consist of large blades connected to a hub, which is mounted on a tall tower. As the wind blows, it causes the blades to rotate, converting the kinetic energy into mechanical energy.

## Types of Wind Turbines:

- **Horizontal Axis Wind Turbines (HAWT):** These are the most common type, where the blades rotate around a horizontal axis.
- **Vertical Axis Wind Turbines (VAWT):** Blades rotate around a vertical axis. They are less common but have certain advantages in specific applications.





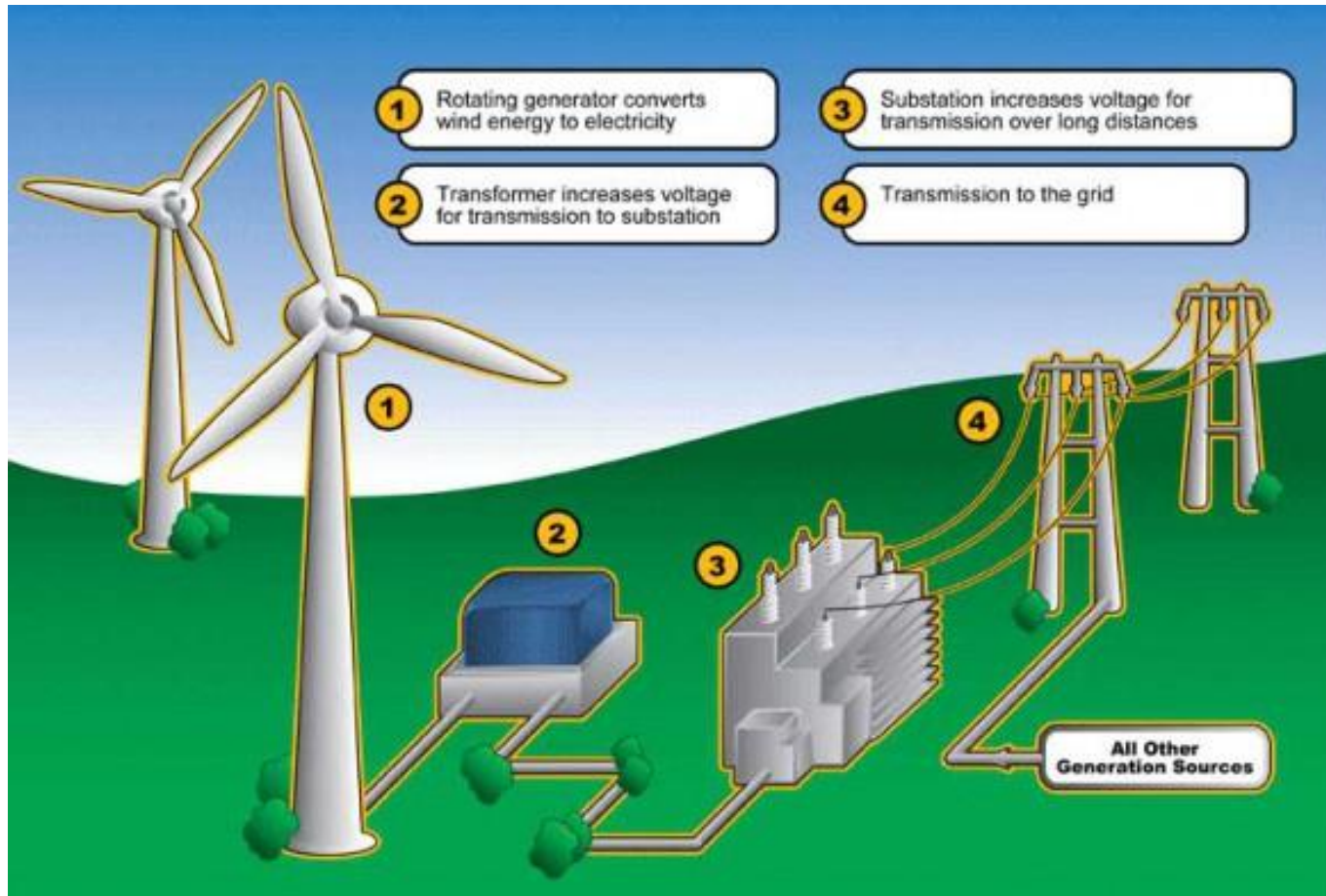
# Wind Power

- **Wind Farms:** Wind turbines are often grouped together in wind farms to maximize energy production. Wind farms can range from a few turbines to hundreds, depending on the capacity and location.
- **Wind Energy Conversion:** The mechanical energy generated by the rotating blades is converted into electricity through a generator. The generator produces alternating current (AC), which can be used directly or converted to direct current (DC) for transmission.
- **Grid Integration:** Wind power is integrated into the electrical grid to supply electricity to homes, businesses, and industries. Advanced technologies and smart grid systems help manage the variability of wind power and ensure a reliable energy supply.





# Wind Power



# Wind Power





# Nuclear

Nuclear energy is a form of energy released from the nucleus, the core of atoms, made up of protons and neutrons. This source of energy can be produced in two ways: fission – when nuclei of atoms split into several parts – or fusion – when nuclei fuse together.

## Fission

Nuclear fission is a reaction where the nucleus of an atom splits into two or more smaller nuclei, while releasing energy.

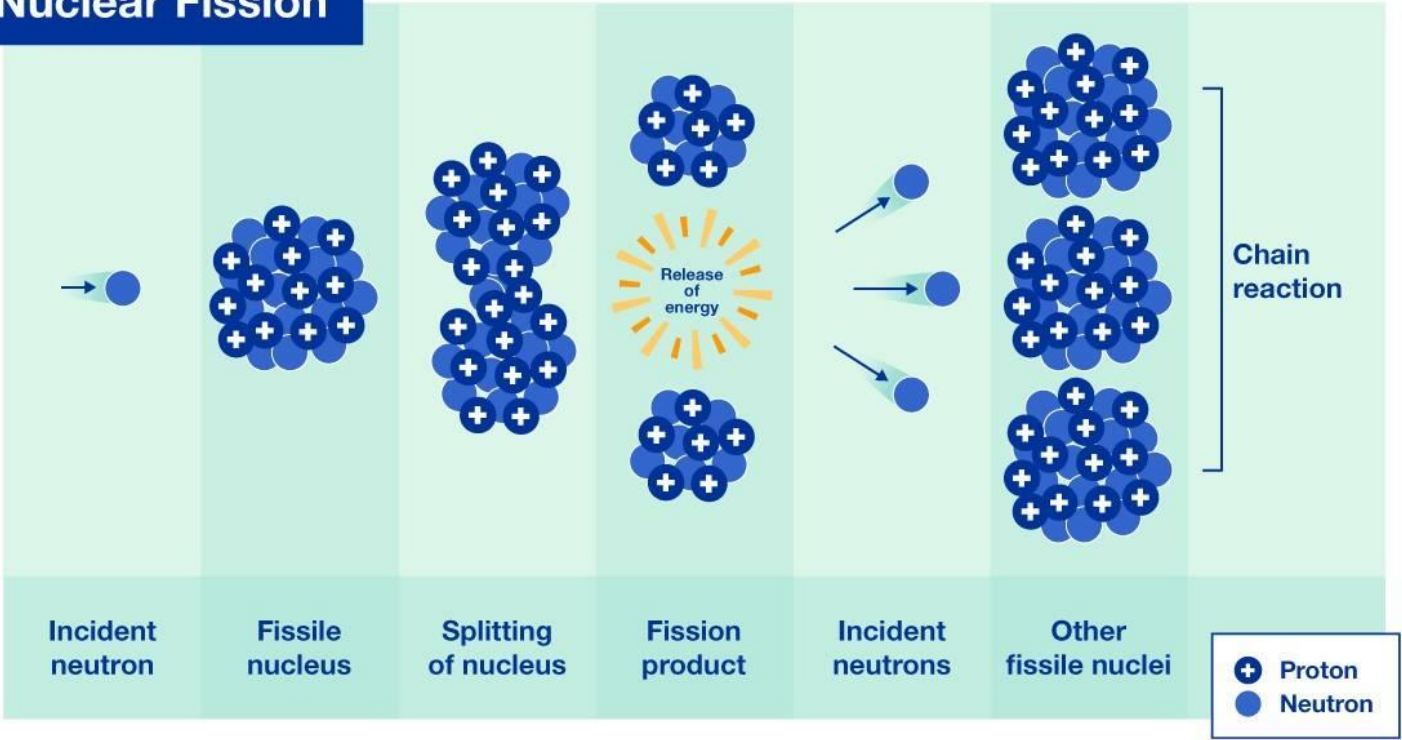
For instance, when hit by a neutron, the nucleus of an atom of uranium-235 splits into two smaller nuclei, for example a barium nucleus and a krypton nucleus and two or three neutrons. These extra neutrons will hit other surrounding uranium-235 atoms, which will also split and generate additional neutrons in a multiplying effect, thus generating a chain reaction in a fraction of a second.

Each time the reaction occurs, there is a release of energy in the form of heat and radiation. The heat can be converted into electricity in a nuclear power plant, similarly to how heat from fossil fuels such as coal, gas and oil is used to generate electricity.



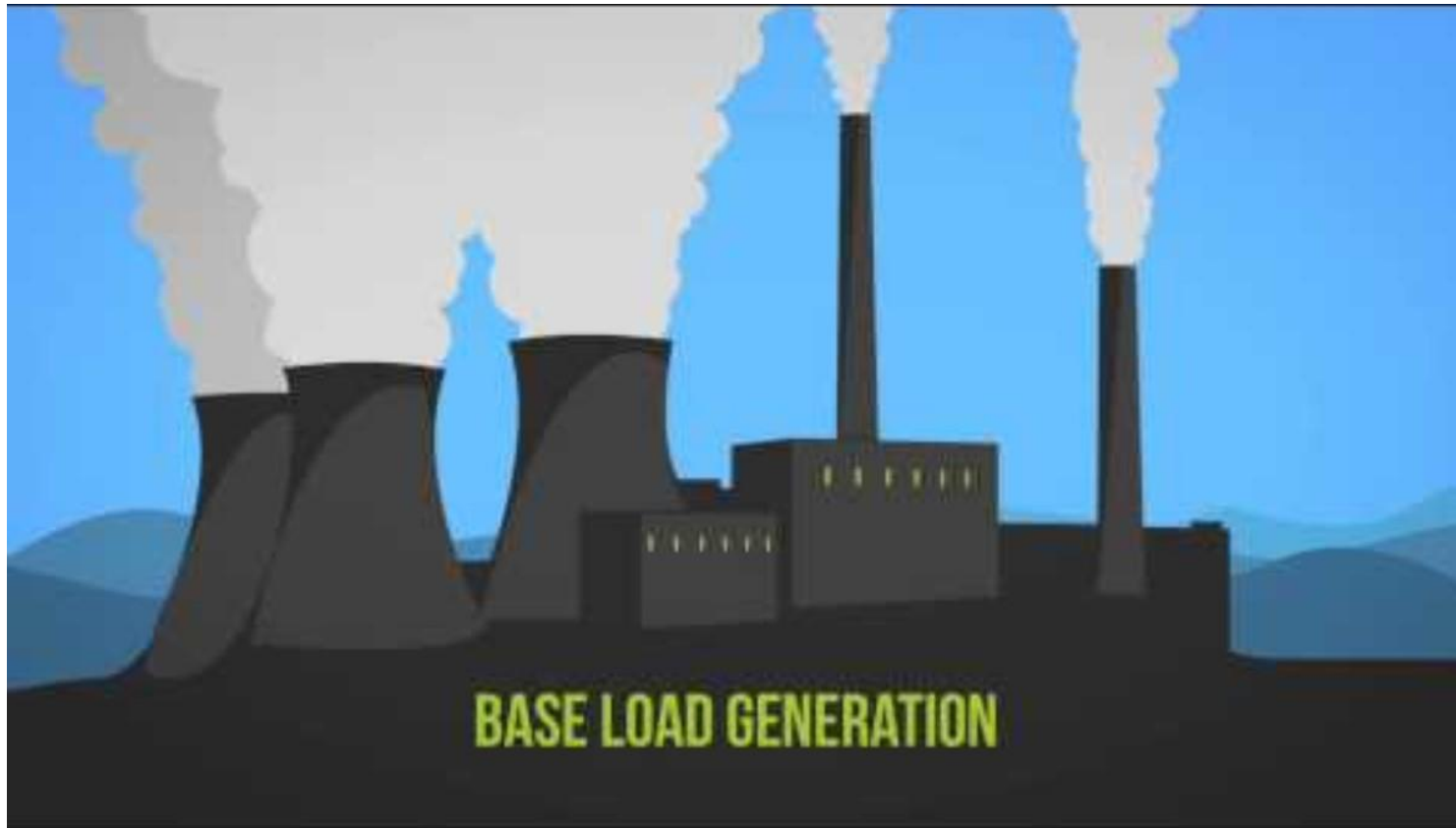
# Nuclear

## Nuclear Fission





# Nuclear



# Hydrogen

Hydrogen is considered a promising alternative energy source with the potential to address environmental concerns and contribute to a more sustainable energy future. There are various ways to produce hydrogen, and its applications include energy storage, transportation fuel, and industrial processes. Here are some key aspects of hydrogen as an energy source:

## Production Methods:

**Electrolysis:** Hydrogen can be produced by electrolyzing water using electricity. If the electricity comes from renewable sources like solar or wind, it can be a clean method.

**Steam Methane Reforming (SMR):** This is a common method where hydrogen is extracted from natural gas. However, it produces carbon dioxide as a byproduct.

**Pyrolysis and Biomass Gasification:** Hydrogen can also be produced from biomass through various thermochemical processes.



# Hydrogen

- **Clean Energy Carrier:**

Hydrogen can be used as a clean energy carrier and a means of storing energy. It can be produced during periods of excess renewable energy and used later when demand is high or renewable sources are not available.

- **Transportation Fuel:**

Hydrogen fuel cells can power vehicles, providing a zero-emission alternative to traditional internal combustion engines. Fuel cell vehicles emit only water vapor as a byproduct.

- **Industrial Applications:**

Hydrogen is used in various industrial processes, such as refining, ammonia production, and steel manufacturing. Transitioning to green hydrogen (produced using renewable energy) in these industries can reduce carbon emissions.





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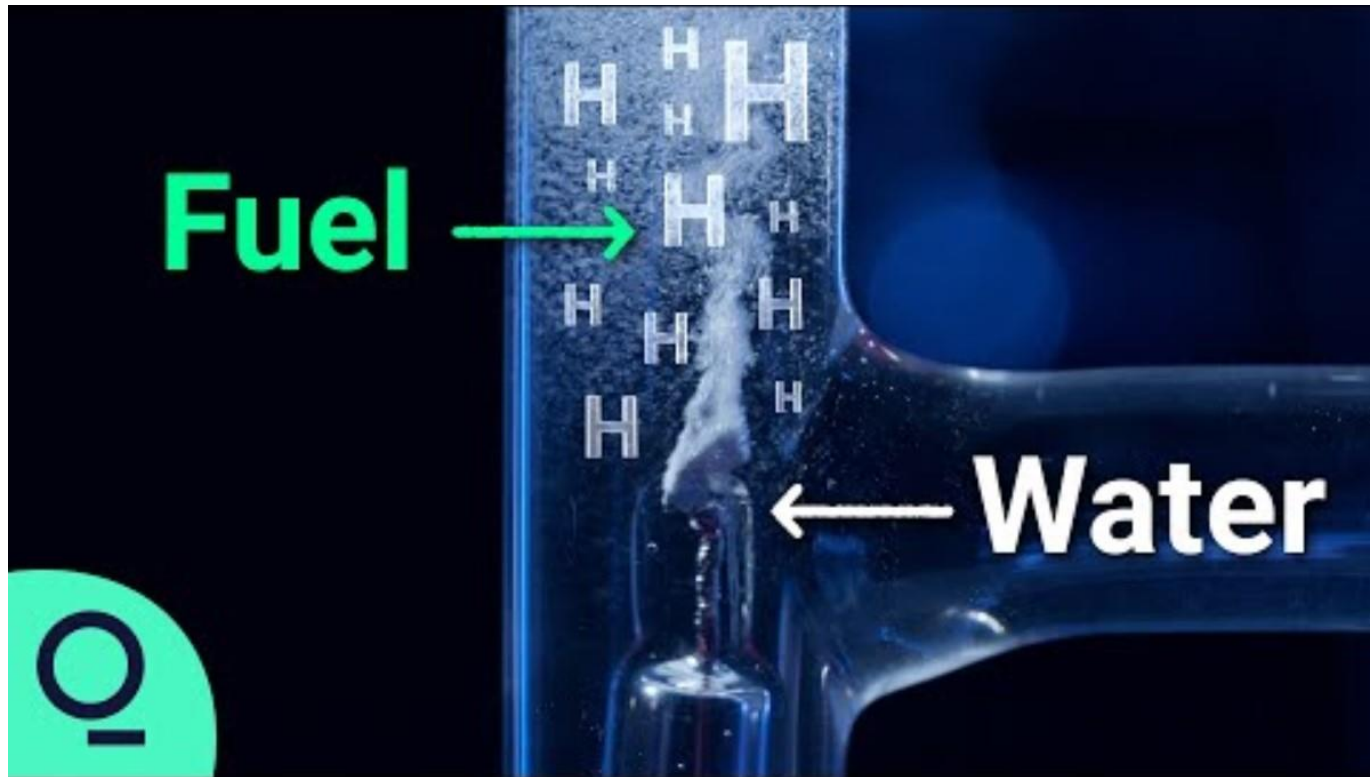
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# Types of Hydrogen



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# THANK YOU

Louisiana State Energy Office