

# Conventional Electric Power Generation Systems, Process and Fuel Sources

## Objective:

Students will understand the components of conventional electric power generation systems, processes and fuel sources.

Materials and Curriculum Correlations ▼

## ► Introduction

Conventional electric power generation systems use one or more of the following energy sources: coal, natural gas, oil, uranium or water. Although hydropower uses a renewable resource and the others are nonrenewable, hydropower has been in existence for such a long time that it is considered a conventional generation type.

In 2023, natural gas was used for about 43 percent of the 4 trillion kilowatt-hours of electricity generated in the United States. Natural gas, in addition to being burned to heat water for steam, can also be burned to produce hot combustion gases. These gases pass directly through a gas turbine, spinning the turbine's blades to generate electricity. Natural gas turbines are commonly used when electricity use is in high demand. U.S. natural gas-fired power plants set a record, generating more than 7 million megawatt-hours (MWh) of electricity on August 2, 2024, according to U.S. Energy Information Administration's Hourly Electric Grid Monitor, making up almost half of all electricity generated in the contiguous United States that day. In 2023, 16 percent of U.S. electricity was fueled by coal.

Petroleum can be burned to produce hot combustion gases to turn a turbine or to make steam that turns a turbine. Residual fuel oil and petroleum coke, products from refining crude oil, are the main petroleum fuels used in steam turbines. Distillate (or diesel) fuel oil is used in diesel engine generators. Petroleum was used to generate less than one percent of all electricity in the United States in 2023.

Nuclear power was used to generate approximately 18 percent of all U.S. electricity in 2023. Nuclear power plants produce electricity with nuclear fission to create steam that spins a turbine to generate electricity. Most U.S. nuclear power plants are located in states east of the Mississippi River.

Nearly all hydroelectric capacity was built before the mid-1970s by federal agencies. Hydropower accounts for approximately 27 percent of all electricity generated by renewable resources in the U.S. in 2023.

(Source: [eia.gov](https://www.eia.gov), accessed January 2025)

## Procedure

1. Review with students the parts of the electric generation process. (boiler, turbine, generator, power line, transformer, consumer)
2. Discuss the basic components of conventional power plants (boiler, turbine and generator; except for hydropower which is just the turbine and generator).
3. Discuss the basic process for electrical generation of conventional power plants. (A fuel is burned to make steam to turn a turbine, which generates electricity.)
4. Discuss the basic fuel sources of conventional power plants. (coal, oil, natural gas, uranium and water)

5. Ask students to determine why hydropower is considered conventional. (It is a proven and reliable source of electrical generation for over 100 years. Due to the length of time this resource has been used it is considered conventional.)
6. Have students research the components of each type of conventional power plant and make a diagram labeling each part of the system.  
(Note: Search engines for “power plant diagrams” will result in many images. Students should look thoroughly.)
  - a. Coal power plants should include: boiler, coal, combustion system, compressor, condenser, cooling tower, generator, scrubber and a turbine.
  - b. Natural gas or oil power plants should include: combustion system, compressor, condenser, cooling tower, generator and a turbine.
  - c. Nuclear power plants should include: containment building, reactor, control rods, condenser, cooling tower, generator and a turbine.
  - d. Hydropower power plants should include: reservoir, penstock, intake, outflow, generator and turbine.
7. Have student research and describe how each of the above power plants obtain, prepare and use fuel. With hydropower, have students determine the parameters of choosing a river for a dam site.

## To Know and Do More

Locate and research the nearest conventional electric power generation plant. What is its fuel source? How did that fuel arrive at the power plant? How many customers does it serve? How much electricity can it generate at full capacity?

## Materials Needed:

- Internet

## Curriculum Correlations

4-PS3 - 4

4-ESS3 - 1

5-PS3 - 1

5-ESS3 - 1

MS-LS2 - 1

MS-ESS3 - 3

MS-ESS3 - 4

MS-ESS3.A

MS-ESS3.D

HS-LS2 - 1

HS-LS2 - 7

HS-LS2.A

HS-ESS2 - 4

HS-ESS3 - 1

HS-ESS3 - 2

HS-ESS3 - 3

HS-ESS3 - 4

HS-ESS3 - 5

HS-ESS3.A

HS-ESS3.C

HS-ESS3.D