

Conventional Electric Power Generation Pros and Cons

Objective:

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

Materials and Curriculum Correlations ▼

► Introduction

How much does it cost to generate electricity? What is the efficiency of different types of power plants? How does the generation of electricity affect the environment?

Levelized cost of electricity (LCOE) is a measure of the overall cost of different generating technologies. It represents the per kilowatt-hour cost (in real dollars) of building and operating a generating plant over its projected lifespan. Key factors to calculating LCOE include capital costs (land, building materials for the power plant, etc.), fuel costs, fixed and variable operations and maintenance (O&M) costs, financing costs and a utilization rate for each plant type.

One measure of the efficiency of a generator or power plant that converts a fuel into heat and into electricity is the heat rate. The heat rate is the amount of energy used by an electrical generator or power plant to generate one kilowatt-hour (kWh) of electricity. Heat rates are expressed in British thermal units (Btu) per net kWh generated. Net generation is the amount of electricity a power plant (or generator) supplies to the power transmission line connected to the power plant. Net generation accounts for all the electricity that the plant itself consumes to operate the generator(s) and other equipment, such as fuel feeding systems, boiler water pumps, cooling equipment and pollution control devices.

To express the efficiency of a generator or power plant as a percentage, divide the equivalent Btu content of a kWh of electricity (which is 3,412 Btu) by the heat rate. For example, if the heat rate is 10,500 Btu, the efficiency is 33 percent. If the heat rate is 7,500 Btu, the efficiency is 45 percent.

In 2023, about 4.2 trillion kWh of electricity were generated in the U.S. Therefore, electricity consumption is an important portion of a consumer's environmental footprint. All forms of electricity generation have some level of environmental impact. Most of the electricity in the United States is generated from conventional fossil fuels, such as coal, natural gas and oil. All forms of electrical generation, from both nonrenewable and renewable sources, have their advantages and disadvantages. Air emissions in the United States from renewable energy generation produce much fewer sulfur dioxides and nitrogen oxides than energy produced from fossil fuels.

Using energy more efficiently through more efficient end uses or through more efficient generation, such as combined heat and power, reduces the amount of fuel required to produce a unit of energy output and reduces the corresponding emissions of pollutants and greenhouse gases. Electricity from renewable resources such as solar, geothermal and wind technologies generally does not contribute to climate change or local air pollution since no fuels are combusted in these processes.

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 (EIA) Hourly Electric Grid Monitor, making up almost half of all electricity generated in the contiguous United States that day. In 2023, natural gas was used for about 43 percent of total electricity generation in the U.S., making it the largest source of power generation. In 2023, 16 percent of U.S. electricity was fueled by coal. This was a decrease from 2022, when coal accounted for 20 percent of the country's electricity generation. Nuclear power generated about 18 percent of all U.S.

electricity in 2023. Hydropower accounted for roughly 27 percent of all electricity generated by renewable resources in the U.S. in 2023. While hydropower makes up a significant portion of renewable energy, it only accounts for about 6 percent of total U.S. electricity generation.

(Sources: [epa.gov](https://www.epa.gov) and [eia.gov](https://www.eia.gov), accessed January 2025)

Procedure

1. Either in groups or individually, have students research the cost, efficiency and environmental impacts for each type of conventional electric power generation fuel type: coal, natural gas, oil, nuclear and hydropower.
2. Have students create electronic presentations that deliver the above information.
3. Have the students, or student groups, give their presentations to the class.
4. Make copies of the student sheet grading rubric and have the class grade each presentation as they are given.
5. Discuss with students what direction they think electric power generation will take in 20 years. Will conventional power generation be the same? Will new generation systems be developed?

To Know and Do More

What promising technology is on the horizon? What would be the most futuristic source type? If students could invent a new fuel type, what might it be?

Materials Needed:

- Internet

- Student sheet

Curriculum Correlations

4-ESS3 - 1	HS-ESS3 - 2	HS-ESS3.A
5-ESS3 - 1	HS-ESS3 - 3	HS-ESS3.C
MS-ESS3.A	HS-ESS3 - 4	
HS-ESS3 - 1	HS-ESS3 - 5	

Conventional Power Plant

Presentation Grading Rubric

Names of the Presentation Group:

COAL	Barely covered	Covered fairly well	Covered in depth	Total points
Cost	2	3	5	
Efficiency	2	3	5	
Environmental Impacts	2	3	5	
OIL	Barely covered	Covered fairly well	Covered in depth	Total points
Cost	2	3	5	
Efficiency	2	3	5	
Environmental Impacts	2	3	5	
NATURAL GAS	Barely covered	Covered fairly well	Covered in depth	Total points
Cost	2	3	5	
Efficiency	2	3	5	
Environmental Impacts	2	3	5	
NUCLEAR	Barely covered	Covered fairly well	Covered in depth	Total points
Cost	2	3	5	
Efficiency	2	3	5	
Environmental Impacts	2	3	5	
HYDROPOWER	Barely covered	Covered fairly well	Covered in depth	Total points
Cost	2	3	5	
Efficiency	2	3	5	
Environmental Impacts	2	3	5	

	Total points for each type of fuel presentation
COAL	
OIL	
NATURAL GAS	
NUCLEAR	
HYDROPOWER	
TOTAL PRESENTATION GRADE (out of 75 points)	