

Exploring Energy

Science Texts for Close Reading



Nuclear Energy

How is electricity generated at a nuclear power plant? Well, it is often a lot like how electricity is generated at a coal power plant, but with one key difference. In both cases, water is heated into steam, which turns a turbine connected to a generator. The generator converts the mechanical energy of the spinning turbine into electrical energy that can be transmitted to homes and buildings through transmission lines.

The key difference between a coal power plant and a nuclear power plant is in the fuel they use to heat the water. In a coal power plant, burning coal supplies the energy to heat the water, which releases carbon dioxide—a powerful greenhouse gas that is contributing to global warming and climate change—and other pollutants into the atmosphere. In a nuclear power plant, this energy comes from nuclear fission, or the splitting of a large atom like uranium into two smaller atoms. Fission happens when a neutron—a neutrally charged particle—collides with a uranium atom. This collision releases more neutrons, which are free to collide with more uranium atoms, causing more fission. When this fission chain reaction is carefully controlled in a nuclear reactor, a constant supply of energy is produced. And it doesn't take much uranium to produce a lot of energy. A single pellet of uranium less than one inch long can produce the same amount of energy as a ton of coal¹!

Nuclear energy is nearly greenhouse gas-free, meaning that it doesn't release carbon dioxide into the atmosphere like coal power plants do. However, nuclear energy isn't without some drawbacks. Nuclear fission is a type of radioactivity, and large amounts of this kind of radioactivity, or radiation, can be harmful to life. The uranium used in a nuclear reactor is carefully trapped and contained so that radiation cannot escape, and nuclear power plants are protected by all sorts of systems that can shut the reactors down quickly if something were to go wrong, but that hasn't prevented a few nuclear accidents from happening in the past². Environments that are contaminated by high levels of radiation are dangerous to live in or visit.

Over time, the fuel in a nuclear reactor becomes less and less effective, and must be replaced with new fuel and disposed of. However, this old, or 'spent' fuel is still radioactive and can be so for hundreds of thousands of years³, so it needs to be disposed of in a way that won't harm the environment or people. This might mean burying it deep underground, but if this isn't done properly, it could contaminate groundwater that might come in contact with it.

To learn more about other energy sources and technologies, go to the [Exploring Energy](#) homepage.

¹ Duke Energy: [How Do Nuclear Power Plants Work?](#)

² Union of Concerned Scientists: [A Brief History of Nuclear Accidents](#)

³ United States Nuclear Regulatory Commission: [High Level Waste](#)





Weighing the Benefits and Drawbacks of Nuclear Energy

For a complex problem, we need to evaluate how a solution fares across multiple dimensions:

Benefits

Drawbacks

**Environmental
Factors**

**Social & Cultural
Factors**

**Economic
Factors**



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Weighing the Benefits and Drawbacks of Nuclear Energy

For a complex problem, we need to evaluate how a solution fares across multiple dimensions:		Benefits	Drawbacks
Environmental Factors		<ul style="list-style-type: none">Nuclear energy produces nearly zero greenhouse gases like carbon dioxide that contribute to global warming and climate change.	<ul style="list-style-type: none">If radioactive material were to escape from a nuclear power plant, it could damage the environment.Improper disposal of nuclear waste could contaminate the environment.Mining the uranium for fuel from the ground can damage the environment.
Social & Cultural Factors		<ul style="list-style-type: none">Since nuclear energy can produce a large amount of energy using minimal materials, it could be a potential solution for the 1.2 billion people worldwide that don't have access to electricity.	<ul style="list-style-type: none">Some people are concerned about the safety risks associated with nuclear power and don't want to live near a nuclear power plant.
Economic Factors		<ul style="list-style-type: none">Nuclear energy is a constant source of energy that isn't limited by rain, clouds, lack of wind, drought, or nighttime.Only a very small amount of fuel is needed to produce a large amount of energy.	<ul style="list-style-type: none">If you take into account the cost of mining uranium for nuclear fuel, ensuring safety, and dealing with waste, nuclear power can be expensive compared to other energy technologies.

Additional resources

U.S. Energy Information Administration: [U.S. Nuclear Statistics](#)

KQED Quest: [How Nuclear Reactors Work](#)

