

**CONCEPT** Solar photovoltaics convert solar energy, which is a form of electromagnetic radiation, into electrical energy. This technology involves using photovoltaic (PV) cells, which are semiconductor devices that convert sunlight directly into electricity.

## BACKGROUND

The history of solar photovoltaics dates back to the early 19th century, but it wasn't until the mid-20th century that practical photovoltaic cells were developed. In 1954, researchers at Bell Labs invented the first practical PV cell made of silicon. PV cell technology continued to improve over the following decades, with new materials and designs leading to higher efficiency and lower costs. The oil crises and growing concern over environmental pollution in the 1970s and 1980s spurred interest in renewable energy, including solar photovoltaics. As the cost of commercial solar PV panels continued to decrease year after year, the industry began to grow rapidly. Today, solar photovoltaics is a rapidly expanding industry, with increasing demand for solar panels and advances in PV cell technology leading to improved efficiency and lower costs.

## REAL WORLD CONNECTIONS

Public and private power entities can benefit from solar photovoltaics by using the technology to diversify their energy portfolios and provide reliable and sustainable power to customers. Private citizens can also use solar PV systems to improve the resilience of their power systems during natural disasters and other emergencies, as well as decrease their overall monthly electric bill.

Nebraska has a wealth of renewable energy resources, including solar, wind and water (hydroelectric). Solar photovoltaics is one option that allows Nebraska public power providers to diversify their generation mix, create jobs in the renewable energy industry and reduce greenhouse gas emissions. Successful community solar projects operate around the state, allowing communities and their citizens to be a part of the growing solar industry while playing a part in being stewards of the environment.



## EXAMPLES

**PHOTOVOLTAIC (PV) CELLS:** Photovoltaic cells are semiconductor devices that convert sunlight directly into electrical energy. When sunlight strikes the cell, it causes electrons in the semiconductor material to become excited and flow through an external circuit, generating an electrical current. The first PV cell was invented in 1954 by Bell Labs and has since become a widely used technology for generating clean, renewable energy.

**SOLAR PANELS:** Solar panels consist of multiple PV cells connected in a series and/or parallel to generate a higher electrical output. They are typically made up of layers of different materials, including semiconductor materials, protective coverings and mounting hardware. Solar panels have become increasingly popular in recent years due to advances in technology that have improved their efficiency and reduced cost.

**CHARGE CONTROLLER:** A charge controller regulates the flow of electrical current from the solar panels to the battery or other load. It prevents overcharging and undercharging of the battery, which can reduce its lifespan. Charge controllers have become a critical component of solar PV systems, helping to ensure the efficient, reliable operation of these systems.

**INVERTER:** This is a device that converts the direct current (DC) electricity produced by the solar panels into alternating current (AC) electricity that can be used to power household or commercial appliances.

**BATTERY STORAGE:** This is a component that stores excess electrical energy generated by the solar panels for later use, such as during periods of low sunlight or at night.

*Make sure it measures up*

## APPLICATION

One application of solar photovoltaics is in the development of off-grid solar systems for remote or rural areas. These systems can provide electricity to homes, businesses and other facilities that are not connected to the traditional power grid, and can help to reduce reliance on fossil fuels and improve energy access in underserved communities.

Off-grid solar systems typically consist of PV panels, batteries for energy storage, and inverters to convert DC power to AC power for use with household appliances. These systems can be customized to meet the specific energy needs of the user and can be designed to be scalable and expandable over time.

Off-grid solar systems are being used in disaster relief efforts, providing emergency power in areas affected by natural disasters such as hurricanes, earthquakes and wildfires. These systems can help provide critical services such as medical care, communications and emergency lighting in the aftermath of a disaster.



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