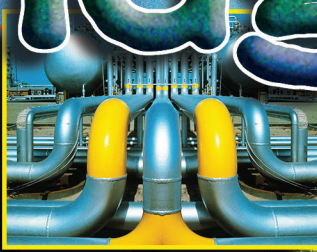
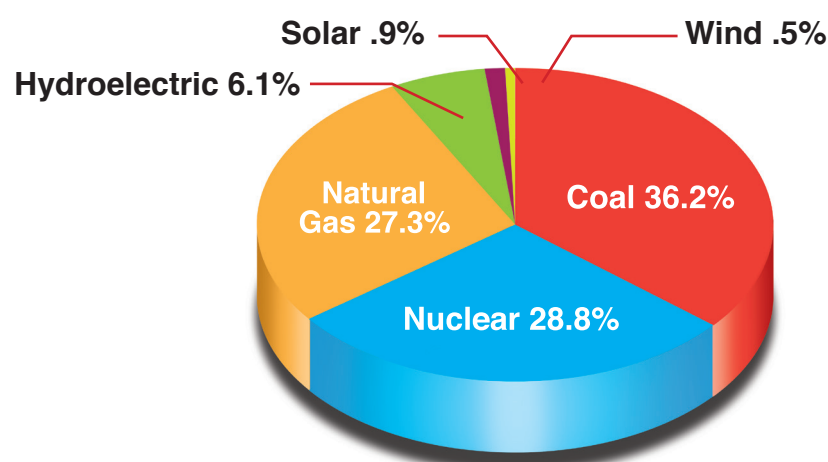


Ag Mag



An AGricultural MAGazine for Arizona Students

Have you ever wondered how the lights always come on when you flip the switch? Well, Arizona's energy industry, although a silent partner to many, assures that no matter when or how much power is needed that it is always there. This reliable and affordable power supply is possible because of Arizona's diverse power generation. This diverse system allows power generators and distributors to balance the risks associated with each energy source.



Who Is Powering Our Lives?

Utility Types

Rural Electric Cooperatives (Co-op) were first established in the 1930s to bring electricity to rural areas that would not otherwise be served. Electric cooperatives are non-profit customer owned electric utilities. Co-op board of directors are customers selected by other consumer-owners within the service area. The board hires managers to direct the day-to-day operations.

Public Owned Utilities (POUs) are non-profits created by a city, state or other government entities. They are managed by locally elected officials and/or public employees. Their goal is to optimize benefits for

local customer owners usually in the form of lower energy rates. SRP, City of Mesa and electrical districts are examples of Arizona POU's.

Investor Owned Utilities (IOUs) are for-profit companies and are owned by stockholders who may or may not be customers and who may or may not live in the service area. Arizona Public Service Co (APS), Tucson Electric Power (TEP), and UNS Electric, Inc. are examples of Arizona IOUs.

Renewable Energy

Arizona's Renewable Environmental standard requires that 15% of the state's electricity is acquired through renewable energy sources by 2050. Because of this, many types of renewable energy are part of Arizona's energy profile.

SOLAR

Arizona ranks 2nd in the country in installed solar capacity since the state sees an average of 299 sunny days per year. There are nearly 400 solar companies in the state that employ over 6,900 people. The 2,453 MW of solar energy installed in the state provide power to 348,000 homes annually. Although energy is only produced when the sun is shining, new technology allows for storage and energy consumption up to 6 hours after sunset.

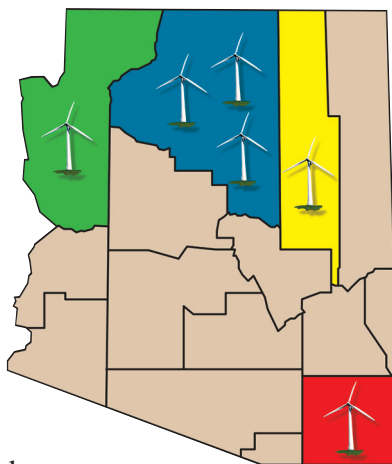
There are many types of solar energy, Photovoltaic and Thermal are common forms of solar generation.

Advantages: solar energy is renewable, it is a clean energy, and requires little maintenance.

Disadvantages: Energy is only produced when the sun is shining, it does not produce power during peak demand periods, and it cannot provide 100% of the electricity demand.

WIND

Although farmers and ranchers have been using windmills for



years, Arizona's first commercial wind turbine was not installed until 1992. There are currently over 100 wind-powered turbines in the state.

Advantages: Wind energy is a clean energy, it is sustainable, and a domestic energy source that is typically built on existing farm and ranch land.

Disadvantages: Good wind sites are usually far from cities where the power is needed which creates a need for more transmission lines, it is not the most profitable use of the land, and energy is only produced when the wind is powering the turbines.

BIOFUEL

Biofuels are liquid fuels taken directly from living matter. Examples might include trees, plants, wood, and yes, even animal waste. Two Arizona dairies, Triple G and Stotz Dairy, are using cow manure and the methane gas that it generates to produce power. With the help of a methane digester, the dairies are able to convert the methane into power and sell it back to the Arizona Public Service Co (APS) to be used on the grid. Maybe poo is what's powering your home!

Advantages: it is a renewable energy that can help reduce the dependence on foreign oils.

Disadvantages: setting aside land for biofuel crops means less land for food production and the start-up costs can be high

COAL

Coal is one of the most affordable ways to produce energy, which is why it plays a large role in Arizona's energy production. Arizona is home to 5 coal-fired generation plants: the **Apache Generating Station**, the **Navajo Generating Station**, the **Springville Generating Station**, the **Coronado Generating Station**, and the **Cholla Station**.

The Coal to Energy Process

- Coal is delivered to the generating facility, most commonly in train cars
- Coal goes into the plant
- Steel balls pulverize coal chunks into a fine powder
- Powder is put into the furnace (surrounded by boiler tubes full of water)
- Burning coal heats the tubes and turns the water to steam
- Pressure of the steam turns the turbine that is connected to the generator
- Rotor spins and a flow of electrons is created
- Steam turns back into water and continues the process

The **Apache Generating Station**, located in Cochise, Arizona, is owned and operated by the Arizona Electric Power Cooperative (AEP-CO) and allows for the burning of coal or natural gas. This flexibility allows for the plant to produce energy using the least expensive fuel. Approximately 100 employees work around the clock to deliver a reliable source of power from this generating station. There are 605 MW produced at this generating station

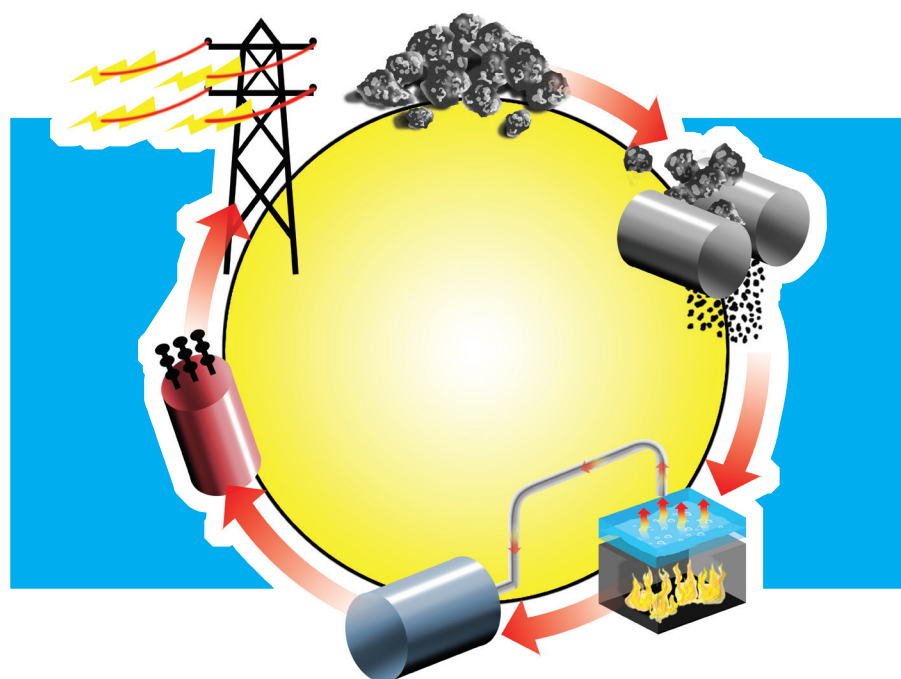
Originally built as part of the 1967 compromise to avoid building hydropower dams up and downstream of the Grand Canyon, the **Navajo Generating Station** continues to produce a lot of power and jobs. Nearly 500 people are employed by the generating station that burns 24,000 tons of coal each day producing nearly 2,250 MW of energy from three 750 MW units. Those 240 train cars of coal each day come from the Kayenta Mine, located about 78 miles from the power generating station on the Navajo Indian Reservation.

Advantages: there is an abundant supply of coal and it is an affordable fuel source

Disadvantages: coal is a non-renewable resource that is expensive to transport and creates potential environmental and health impacts from mining.

Did You Know...

To address the environmental effect of burning coal, generating stations have adapted several clean coal technologies to reduce their release of emissions into the air. Some of these technologies include coal cleaning, using Low-NOx burners, improved plant efficiencies, integrated gasification combine cycle (IGCC) and pressurized fluidized bed combustion. Coal by-products, such as coal ash, are used to make products such as concrete and wallboard to help maintain waste.



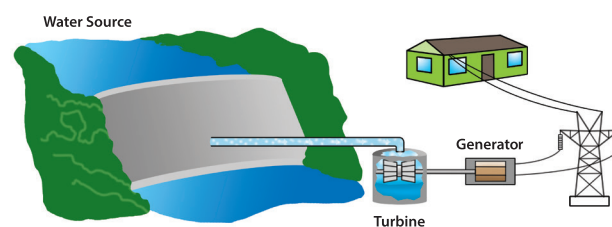
Fast Fact

Fast Fact: Arizona's only coal mine, the Kayenta Mine provides nearly 8 million tons of coal annually.

HYDROPOWER



Arizona is home to 10 different hydroelectric facilities. The oldest and largest facility at the time of construction, the Roosevelt Dam, brought power to rural communities 10 years before the Rural Electrification Act was passed. The Theodore Roosevelt Dam was the Bureau of Reclamations first hydroelectric project. The world's tallest dam at the time, was built to ensure not only a steady and manageable water supply for agriculture, but also to bring power to rural households. Hydroelectric power from the dam was being delivered to homes a full year before the dam was complete. Although in the beginning only a half dozen customers received power from the hydroelectric plant, that number has grown quickly. Today, energy generated from Arizona's hydroelectric facilities power 68,000 households annually.



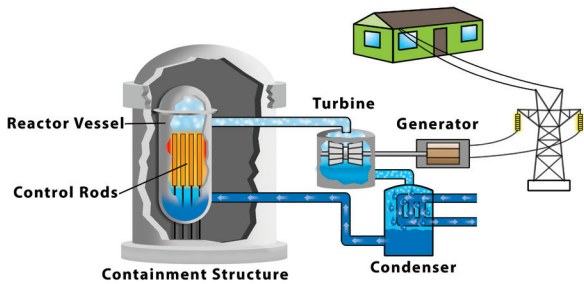
Hydroelectric facilities in Maricopa, Coconino, Mohave, La Paz and Gila Counties

Advantages: Hydroelectric energy is a clean energy, it is renewable, and can flex with the demand.

Disadvantages: The energy production is expensive, droughts can influence output and there is a limited number of reservoirs.

NUCLEAR

The Palo Verde Nuclear Generation Station is not only the largest nuclear plant in the world, but it is also the largest power producer of any kind in the United States and has been since 1992. The plant,



Nuclear power generation provides an extremely efficient source of electricity. It's amazing how little fuel is needed to generate a lot of energy.

located 55 miles west of downtown phoenix, has 3 units capable of generating more than 3,000 MW of electricity. That is enough energy to provide power to 4 million people in Arizona, California, Texas and New Mexico. Although the generating station is operated by APS, it is owned by 7 different utilities that sell power generated from the facility.

The world is full of radioactivity. Radiation is part of our everyday environment, from the earth itself, from space, from naturally occurring radon in the air we breathe, and even from within our own bodies. Radiation is measured in units referred to as millirems. The average dose per person of radiation is 620 mrem per year. International Standards allow exposure to as much as 5,000 mrem a year for those that work around radioactive materials. Have you ever wondered how radioactive you are? Visit the American Nuclear Society and complete their radiation calculator to see your dose.

Advantages: nuclear energy is a clean energy since little fuel is needed to produce a lot of energy and no air pollution is produced.

Disadvantages: the possibility of accidents and the disposal/storage of radioactive waste



A single nuclear pellet (the size of a pencil eraser) can produce as much energy as a ton of coal, 3 barrels of oil, or 17,000 cubic feet of natural gas.

Did You Know...

To prevent radioactive contamination from used fuel, the fuel rods go through a two-step process. First they are kept in wet storage for several years where they cool. Then, they are moved to a dry storage. The dry storage canister is lined with steel and a welded steel lid. The canister is then surrounded by concrete cask rebar, concrete over pack and a concrete lid. Air vents are created to allow for cooling.



Fast FACT

Fast Fact: The Palo Verde Nuclear Generating Station is the only nuclear station not located on a major body of water. Palo Verde uses treated waste water for cooling as to save water in our desert state.

EXPOSURE RATES

- Smoke Detector .008 mrem
- 1,000 ft above sea level 28 mrem
- Internal radiation from food and water 40 mrem
- x-ray inspection at airport .002 mrem
- mammography 40 mrem
- CT Scan Head 1000 mrem
- Average dose of radiation is 620 mrem
- Living within 50 miles of nuclear plant .01 mrem
- Living with 50 miles of coal-fired power plant .03 mrem

Fast FACT

Fast Fact: Did you know? All elements with an atomic number higher than 83 are radioactive. Uranium is the radioactive fuel used by nuclear generating stations. Its atomic number is 92.

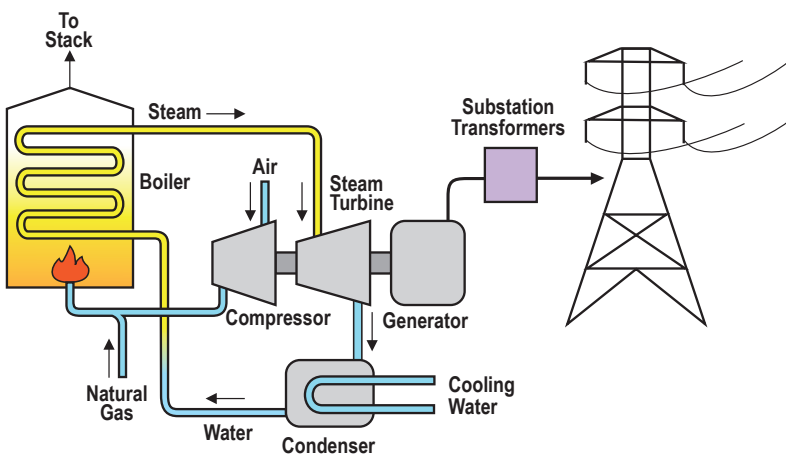
NATURAL GAS

Natural gas occurs deep below the earth's surface and consists mainly of methane. Arizona customers that use natural gas to heat their homes receive gas that has been sent through a pipeline from the San Juan Basin in New Mexico and the Permian Basin in Texas.

Some coal-fired plants are equipped to burn natural gas as an alternate fuel source allowing for some flexibility in energy production. Other plants are designed specifically to run on natural gas as the diagram shows.

Advantages: Natural Gas is an efficient fuel supply with fewer emissions than coal and there is an abundant supply of natural gas in the U.S.

Disadvantages: it is not renewable and the infrastructure needed and storage is expensive.



Natural Gas Power Generation

CAREER CORNER



North Area Construction/Maintenance Manager Michael Cook, Sulphur Springs Valley Electric Cooperative (SSVEC)

As a Construction Manager for SSVEC I travel between two of our main areas on a daily basis. While doing this, I get the chance to do crew audits and visits. I help with questions in our weekly and monthly safety meeting. I help assign workloads and project scheduling, for small day jobs to jobs that last over a year. I help align people to crews and crews to the work that needs to be done. I help in the hiring process and serve as chair for our Apprenticeship Committee. I also manage and coordinate half of SSVEC's outside contractors. I work with at least five different department heads daily to help SSVEC reach its goals. I also help promote our members and communities in which we serve.

The Construction Manager provides continuous and reliable service by leading and supporting training programs and by planning and coordinating the construction and maintenance of electric utility facilities that are cost-effective, high-quality, and consistent with safety regulations and industry practices.

An Associate's degree in a related field or 3 years' equivalent work experience; Must also have a minimum of five years direct work experience as a Foreman or an equivalent combination of education and experience.

Mike Nelson, Plant Manager, Apache Generating Station

I am responsible for the safe and reliable production of electric power from our coal-fired steam units at the Apache Generating Station. To be qualified for this job I had to have multiple years (seven – 10) of experience as a supervisor and operations manager.

A Plant Manager must have a knowledge of fuels (coal/natural gas/other), chemistry, and power transmission (the transmission of electric power from the power plant to the end users). The position requires extensive knowledge of the mechanics associated with all facets of power production, and must be able to manage a diverse staff which also has to have extensive experience in operations and maintenance.

This individual must be able to report to a Chief Executive Officer and a Board of Directors, in a way that is easily understood and covers all aspects of operations. Above all, this individual is responsible for the safety of the people who work in a challenging environment.

This position requires a high school diploma or equivalent and extensive experience leading up to power plant administration.



Jon Martell - Power Trader

As a Power Trader, I have to know how to purchase and sell energy for savings or resale on the open market while maintaining required reserves of energy to maintain grid reliability.

To be a power trader, one must have three years of experience in scheduling, marketing or dispatching generation (energy), as well as extensive knowledge of the requirements of numerous regulatory agencies. This individual must have good mathematical knowledge and the ability to apply that knowledge to energy trading requirements, the ability to make minute-by-minute decisions on buying or selling energy, and the ability and willingness to work evening and overnight shifts. The position requires someone who understands the complex world of energy resources and demand, and the ability to balance loads and demand on an hourly basis.

A power trader must have good communications and marketing skills and a willingness and the ability to learn as the industry evolves.

A bachelor's degree in business, economics or finance or related field is preferred, or an Associate's degree with applicable power trading experience from an institution accredited by an accrediting agency recognized by the US Department of Education.



To learn more about Agriculture in the Classroom and the other FREE classroom resources visit us at www.azfb.org/aitc, or contact Katie Aikins at 480-635-3608.



Grand Canyon State
Electric Cooperative Association, Inc.

Your Touchstone Energy® Cooperatives 

**The Energy and Agriculture AgMag was created
with funding by Grand Canyon State Electric Co-
operative Association**