Understanding “the Grid” That Powers Delaware

An educational explainer on how electricity is generated, moved and delivered

This explainer accompanies the policy analysis “The Grid and Delaware.”

The electric grid, or simply “the grid,” is the infrastructure that generates, transmits and distributes electricity across vast networks. It connects electricity producers with consumers and ensures that supply meets demand in real time.

Many people think of the grid as a large storehouse of energy. Electricity is put into it when it is produced and taken out when needed. If supply exceeds demand, the lights stay on. In that sense, the grid is often compared to a reservoir that holds water.

In reality, the grid is a just-in-time, use-it-or-lose-it operation. Electricity cannot be stored efficiently on a large scale and must be produced and consumed almost instantaneously. The grid is not a battery.

The grid consists of four main components: *generation, transmission, distribution and customer usage.*

How Electricity Moves Through the Grid

1. Electricity Generation: The process begins with electricity generation. Power plants across the network produce electricity using coal, natural gas and other petroleum based products, nuclear fission, water flow through hydroelectric dams, wind blown turbines, photovoltaic and thermal solar sources, biomass combustion, and biogenic landfill and solid waste recapture.

   In the United States, natural gas accounts for a little more than 40% of utility scale electricity generation, with nuclear just under 20% and renewables just over 20%. Coal provides a bit more than 15%, with the rest coming from petroleum, other gases and miscellaneous sources, according to the U.S. Energy Information Administration.

2. Transmission System: Once generated, electricity is transmitted over long distances to where it is needed. To minimize energy losses caused by resistance in wires, the voltage is increased to extremely high levels using transformers. That energy is then transported by transmission lines supported by tall transmission towers that span hundreds of miles.

3. Distribution Phase: When energy nears its destination, substations step down the voltage for short distance transport and local distribution to consumers. Pole mounted or pad transformers further reduce the electricity to the voltage required for use. Homes typically operate on 120 and 240 volts.

   Distribution lines, whether overhead or buried underground, branch out to deliver power directly to end users. Circuit breakers protect against overloads and shut down distribution when something goes wrong. Utility companies manage this last mile delivery to supply energy to homes and businesses.

4. Energy Consumption: At the final stage, electricity reaches the consumer. Meters track how much electricity is used, and the utility company bills for that usage so the grid can be maintained. Local circuit breakers protect against electrical hazards inside homes and businesses.

Moving Power, Not Storing It: Distribution of responsibility within the grid is not unlike moving goods by truck or rail across the country. Generation is where the product is made. Transmission is the long distance transportation system, similar to interstate highways or main line railroads. Distribution is the local delivery service that brings the product to the consumer.

The critical difference is that the grid has no significant storage capacity. Energy that is produced must be used immediately or it is lost.

Balancing Supply and Demand: One of the most remarkable features of the grid is its ability to balance supply and demand dynamically. As electricity demand fluctuates throughout the day, the grid must respond instantly. Excess supply wastes energy and can damage equipment. Too little supply leads to brownouts and blackouts.

When demand spikes, quick start natural gas units known as peaker plants can come online to prevent shortages. These plants are crucial to maintaining balance on a rapidly changing energy demand landscape.

The system is not without challenges. Storms, cyberattacks, equipment failures and electromagnetic pulses created by high altitude nuclear explosions or geomagnetic disturbances from solar activity can all cause outages. Aging infrastructure in many regions also increases the likelihood that disruptions will occur.

Delaware's Place in the Regional Grid

Delaware and the Grid: The grid that supplies energy to Delaware began in 1927, when electric companies in Pennsylvania and New Jersey formed a power pool to dispatch electric generating plants more efficiently and reduce costs. When two Maryland utilities joined in 1956, the system became known as the Pennsylvania New Jersey Maryland Interconnection, or PJM.

Delmarva Power, then known as Delmarva Power and Light, joined the system in 1981. Today, the PJM grid covers Delaware, Maryland, New Jersey, Ohio, Pennsylvania and West Virginia, as well as most of Virginia and parts of Illinois, Indiana, Kentucky and Michigan.ware.

The role of PJM Interconnection is not to create electricity. It manages regional distribution by maintaining the transmission system and ensuring energy moves efficiently across the grid. Electricity itself is generated by utilities or by merchant generators that connect to the grid to sell the power they produce in capacity markets.

With deregulation, Delmarva Power sold off its generation capacity and is no longer an electricity generator. It now operates solely as an electric utility that manages and maintains the distribution phase. Delmarva Power determines local demand and, when energy is supplied through PJM, it is responsible for moving that electricity to consumers where it is needed.

Conclusion

The electric grid is a real time energy production and distribution system that combines engineering, economics and public policy. It is orchestrated by several entities working together to deliver reliable power. The grid exemplifies human ingenuity in harnessing energy and meeting the increasing needs of modern society.

Author

Dr. David R. Legates is a retired professor at the University of Delaware and serves as director of research and education at the Cornwall Alliance for the Stewardship of Creation. He also is a contributor to the Caesar Rodney Institute and an advisory board member of A Better Delaware.