Energy Grid

What Is It?

The grid is the interconnection of energy infrastructure, including power lines, transformers, capacitors, and more. There are three grid interconnections in North America, which contain regionally controlled transmission system and local utility distribution systems.

Why Is It Important?

People rely on electrical energy to power equipment in their homes, businesses, and the industries around them. There is a transition of additional industries to become consumers of electrical energy, i.e. transportation and building heating. Greater "electrification" requires more grid infrastructure and capacity.

What Does It Cost?

The cost of the electric grid construction and operation is burdened upon the consumers and is dependent upon peak consumption, distance travelled, regional environmental differences, and other conditions. The more complicated the pathway to consumers, the higher the cost.

Space

The grid runs above or below ground across the nation from generator locations to load locations, varies across rural, suburban, or urban areas. While power lines may look thin, utility easements take up lateral space on the ground to reduce risks for the public and allow company access for maintenance of the infrastructure.

How Does It Work?

1. Electricity is generated at power plants using a variety of energy resources and technology.

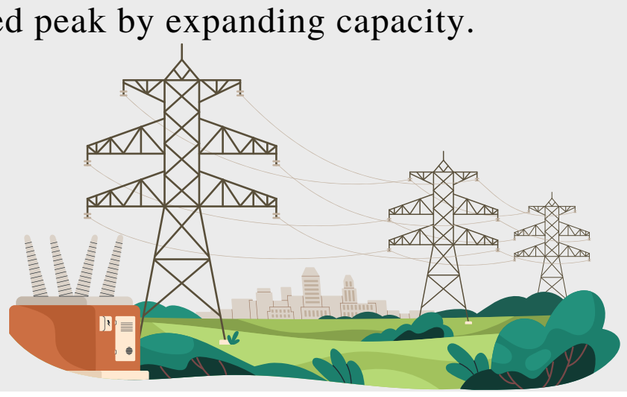
2. Electricity is moved over long distances through high-voltage transmission infrastructure, controlled by regional organizations (ISO/RTOs), which are government-regulated monopolies focusing on performance.

3. Electricity reaches substations that reduce the voltage through transformers for safe distribution by local utility companies. Ultimately, power will reach consumers through local distribution infrastructure.

4. Grid operators continuously monitor the supply to balance it with demand, while sensors and automatic systems help prevent outages.

5. The grid is funded through energy consumer rates, which are calculated based upon funding need to expand capacity to a future peak condition, plus a negotiated baseline utility profit. The higher the rate, the more each individual consumer pays per kWh.

6. Clean energy expansion is moving increased load onto the electric grid over a short period of time requiring quick jumps in the grid's peak capacity. The current energy design model funds utilities to chase that forecasted peak by expanding capacity.



Point ⟷ Counterpoint

Point	Counterpoint
• The electric grid is of national importance, serving the people with a critical service.	○ As demand for energy is coming close to outpacing the speed of development, many upgrades are desperately needed.
• Standardization is promulgated at the Federal level by the Federal Energy Regulatory Commission (FERC).	○ The grid is managed at multiple levels, with each having responsibilities in supporting coordination of this interconnected system with high operational inertia.
• The current grid forecasting-planning process focuses on peak energy flow, evenly dividing the cost between all energy consumers.	○ Power demand is accelerating due to technological and logistical needs, leading to less evenly distributed costs over the forecast horizon.
• Expansion of the electric grid is a necessity for reliability, otherwise risking a voltage collapse of the entire grid interconnection.	○ Peak shaving methodologies are helping relieve the stress of peak demand using Energy Storage Systems (ESS), requiring less peak capacity to maintain reliability.
• A centralized electric grid ensures consistent power delivery to homes, industries, and businesses by balancing supply and demand efficiently across regions.	○ The centralized nature of the grid makes it susceptible to large-scale outages due to cyberattacks, natural disasters, or equipment failures.

Did You Know?

The U.S. power grid is made up of over 11,000 power plants, and has more than 450,000 miles of high-voltage power lines. That's enough to circle the earth more than 18 times!

What's Next?

We are in a transformative phase for electricity. There is significant development of new grid technologies to improve resilience and capacity to match our ever-growing demand for power. Increased adoption of renewable energies will also necessitate an increased expansion of energy storage systems.