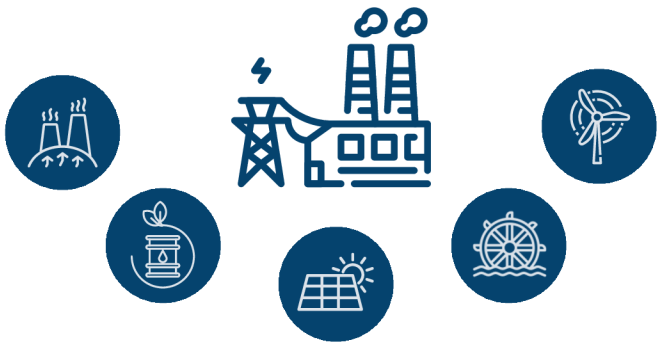
HAWAIʻI STATE ENERGY OFFICE

How Does the Electric Grid Work?

Electricity powers our homes, businesses, and public services, but how does it get there? Understanding how the electric grid works is an important part of understanding Hawaiʻi's energy system.

Step 1: Generation



Electricity is made at a generator by burning fossil fuels or using renewable energy resources such as wind, solar, hydropower, biomass, or geothermal.

Step 2: Transmission

Once electricity is generated, it has to get from the generator to the outlet or light bulb.

Step-up Transformer: Electricity goes to a substation where step-up transformers increase the voltage, allowing the electricity to travel long distances with less energy loss.

Transmission Lines: Electricity is sent to transmission lines to carry electricity over long distances.

Step-down Transformer: Electricity goes to a substation, where a step-down transformer lowers the voltage before sending the electricity to distribution lines.

Voltage is the amount of "pressure" behind electricity, like water pressure.

Step 3: Distribution

Wires and Poles: Electricity travels through distribution lines to a pole-mounted transformer, which lowers the voltage again for safe delivery.

Distribution: Electricity is distributed anywhere it is needed, such as homes and businesses.

In the continental U.S., multiple states use the same electric grid to share energy.

In Hawaiʻi, each island has a separate grid and can only share resources like fuel.

What is Grid Reliability?

A reliable grid provides the electricity we need exactly when we need it, 24/7, 365 days a year. The key features of a reliable grid are:

Quick, real-time responses to changing supply and demand

Can withstand and recover from disruptions, while providing reliable backup sources of electricity

A big enough **supply of energy** to balance supply and demand

Stable voltage and frequency across the entire grid

Frequency is like the rhythm of the electric grid, and flows at 60 Hz, or waves, per second.

Grid Innovations

Microgrids

Microgrids are localized energy systems that can generate, distribute, and regulate the flow of electricity to a specific building, neighborhood, or area. They're connected to the main grid, but can be switched to "island mode." Island mode means a microgrid runs independently during storms, outages, and other disruptions. Microgrids can keep critical infrastructure up and running during disasters.

Microgrids can't stay in island mode all the time because the main grid helps keep the system stable. Long-term islanding requires expensive infrastructure, advanced safety systems, and careful management.

Smart Meters

Smart meters automatically track how much electricity you use at home or work and report the data back to the utility in real time, making it easier to manage supply and demand. Smart meters can help customers understand and better manage their electricity use and can immediately alert the utility when your electricity goes out. In Hawai'i, most homes have smart meters.

Learn more about how the grid works at www.energy.hawaii.gov

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