



Grid Fundamentals

WECC

References

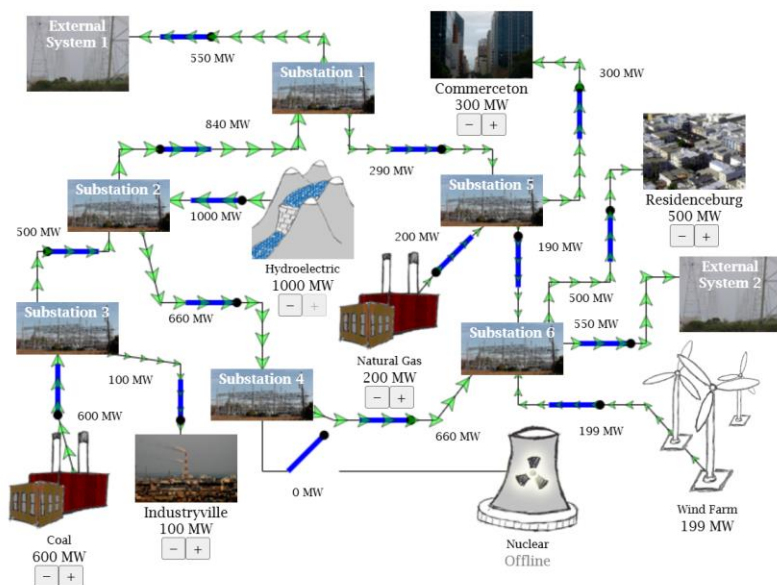
The Power Grid (1)

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The Power Grid

Description:

The power grid is the system of producers and consumers of electricity. It includes power generators, the users of electricity, switches that control the electricity, and the system of substations, power lines, and transformers that deliver the electricity. A community might have a generator to provide its power. The generator may be able to vary its production as the usage of the customers changes, but there may be times when the demand for energy is too great for the generator. Then the community buys electricity from another source. At other times, the generator may be making more electricity than the community is using, so it wants to sell it.



<https://credc.mste.illinois.edu/applet/pg>

The Power Grid (2)

All Power Grid components operate together as one system:

- Generation — Coal, Hydro, Natural Gas, Nuclear, Solar, Wind, Other
- Transmission — Lines, Substations
- Loads — Residential, Industrial, Commerce
- External Neighboring Entities (Balancing Authorities, Transmission Operators)

The Power Grid – Grid Status

Status:

- Generation = 1,000 MW (Hydro), 200 MW (Wind), 0 MW (Nuclear), 600 MW (Coal), 200 MW (Natural Gas) = 2,000 MW Total
- Load = 500 MW (Res), 100 MW (Industry), 300 MW (Comm) = 900 MW Total
- Interchange = 549 MW + 549 MW = 1100 MW
- Generation MW + Interchange MW = Load MW
- Balanced System! (60 Hz)

The Power Grid – Scenario 1 – Adding Generation

- First press the "Reset System"
- Then, close the "blue switch" to the left of the Nuclear Power Plant (900 MW)
- **What happens to the grid?**
 - Additional generation (900 MW) added
 - If the other resource outputs don't change, and the load remains the same, what changes?

The Power Grid – Scenario 2 – Changing Loads

- First press the "Reset System"
- Then, increase each of the three loads by the following:
 - Residenceburg to 1,800 MW
 - Industryville to 400 MW
 - Commercetown to 900 MW
- What happens to the grid?
 - Hints: Change in "arrow colors" and External Systems
 - Close the "blue switch" to the left of the Nuclear Power Plant (900 MW)
 - Did any "arrow colors" change? If not, why not?
 - Did the flows change with the External Systems?

The Power Grid – Scenario 3

- First press the "Reset System"
- Then, open the "blue switch" to the External System 1 and the External System 2
- **What happens to the grid?**
 - Why did this happen?
 - "Reset System" again, and look at the flows to both External Systems
 - What action would possibly mitigate this?

The Power Grid – Homework

- **Challenges:**
 - On your own, work through Challenges 2–5 for discussion tomorrow morning
 - Have fun!

Video Links

Day 1

- [New York Times 2003 Blackout Video](#)
- [Automatic Governor Control Fly Ball Video](#)
- [Natural Gas Fueled Combustion Turbine Combined Cycle Generator](#)
- [Energy 101: Photovoltaic Solar](#)
- [Disconnect Switches in Action](#)
- [Electric Fence Video](#) (Facebook link as original is no longer on YouTube)
- [Tucson Electric Power Repairing Energized Lines](#)
- [Chief Joe Brake](#) (From Bonneville Power Administration's Facebook Page)

Day 2

- [Basics of Essential Reliability Services Videos](#) (3 videos)
- [Video of National Grid \(UK\) Responds to a million kettles with operations](#)

Abbreviations, Definitions, & Information (1)

- [U.S. Energy Information Administration \(EIA\) – Glossary](#)
- [NERC Glossary of Terms](#)
- [NERC BES Definition](#)
- [NERC BPS BES FAQ](#)
- [NERC Reliability Functional Model – Definitions and Functional Entities](#)
- [WECC Study Program Glossary of Terms](#)
- [California ISO Glossary](#)
- [Southwest Power Pool Glossary](#)

Abbreviations, Definitions, & Information (2)

- [WECC's Risk Management Program](#)
- [NERC's Risk Framework](#)
- [NERC Essential Reliability Services](#)
- [Keeping the Lights On: Essential Reliability Services | Department of Energy](#)
- [UTK FNET Server Web Display](#)
- [NERC – The Basics of Essential Reliability Services on Vimeo](#)
- [NERC History book](#)
- [Energy Policy Act of 2025](#)

Abbreviations, Definitions, & Information (3)

- [An Introductory Guide to Electricity Markets regulated by the Federal Energy Regulatory Commission \(FERC\)](#)
- [Western Energy Markets Explainer | Federal Energy Regulatory Commission](#)
- [NERC 2025 State of Reliability – Technical Assessment](#)



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