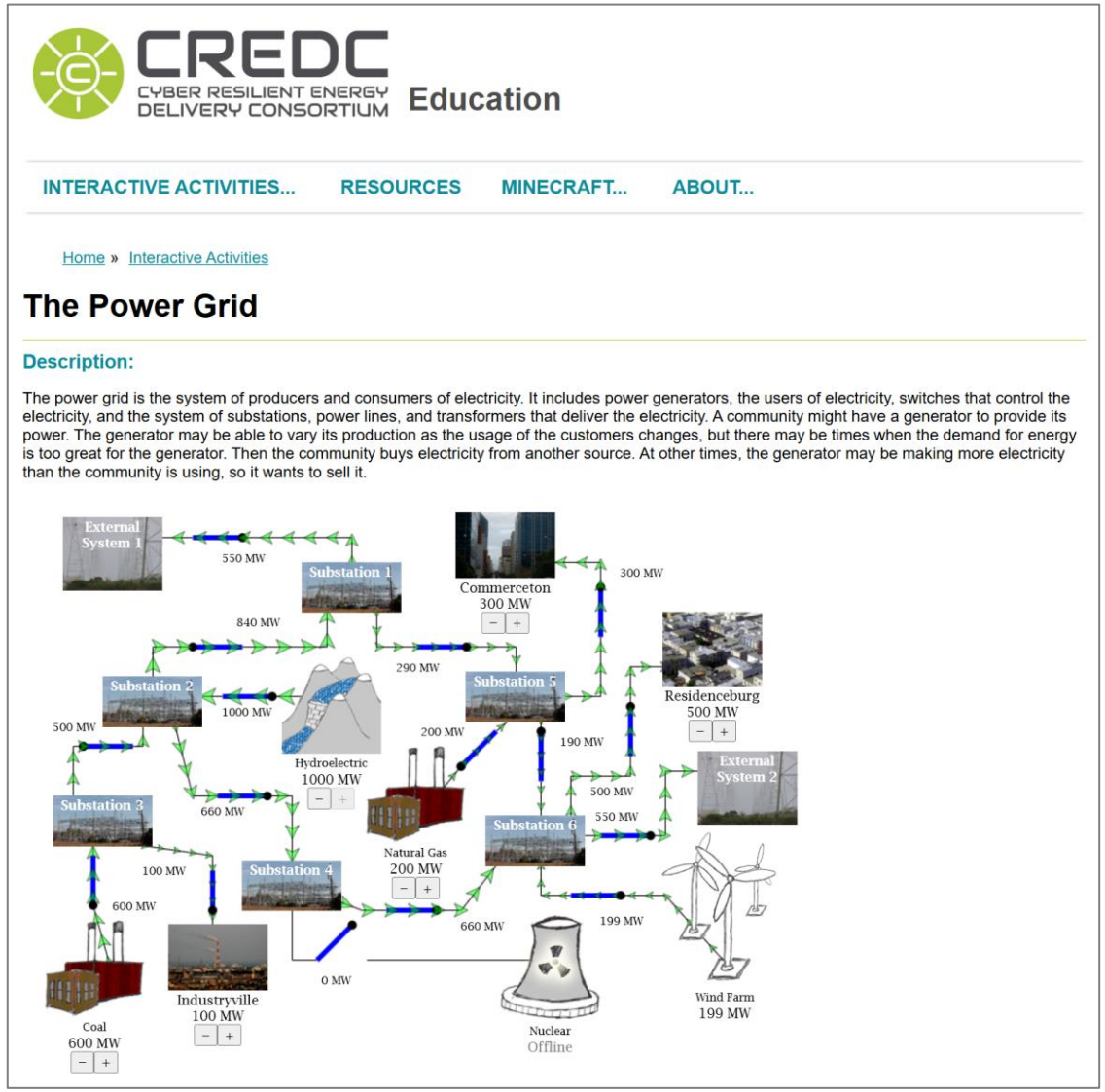
References

The Power Grid (1)



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
  - Commerceton 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

WECC

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