Quick Start -- Power Economics and Emissions

This simulation shows a system that is owned by a power utility company. The company provides power to three communities. It owns and operates five types of generators and the transmission lines that serve the communities. On this system, it is usually possible for the utility company to supply all of the load demand using the local generators. However, there could be many reasons why this is not possible or most profitable, and then electricity is purchased from or sold to the external system.

For each of the three consumers of electricity, payment per hour is shown. This payment changes as the consumers' megawatt (MW) demand varies.

The Cost Control Panel has a button and a slider. The button will hide or display the "Payment" boxes and the "Costs and Emissions" boxes. The slider will allow the Power Grid operator to change the amount the utility charges consumers for the electricity produced by the system. When the applet opens it charges $90 per MWh (megawatt hour).

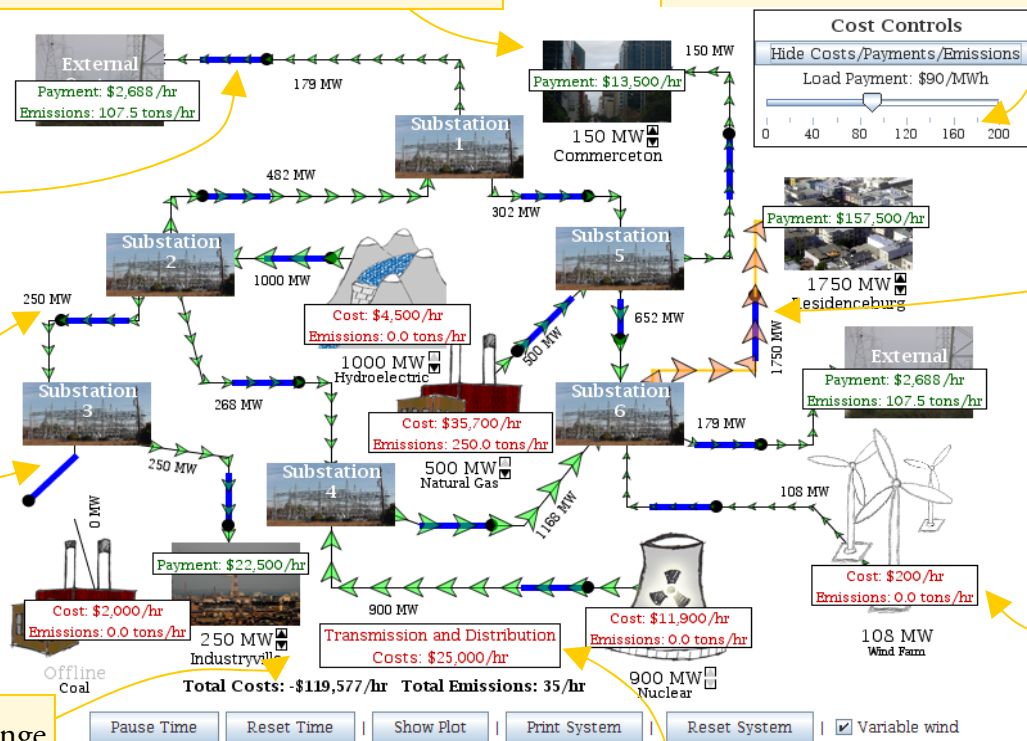Excess power is flowing to the external system.

Orange transmission lines are above 85% of their capacity. When a line capacity is exceeded, the line turns red, and a blackout occurs if the problem is not addressed by the system operator.

Open or close the blue switches by clicking them with the mouse.

Costs include fixed costs and fuel costs. Fixed costs include operation and maintenance but not costs for construction.

When fuel is burned to produce electricity, carbon dioxide (CO_2) emissions are released into the atmosphere. These emissions and cost amounts change when the MW output of the plant changes.

Click on the up or down arrows to change the power demanded by a community. The applet then adjusts the community's payment based on the **Load Payment rate.**
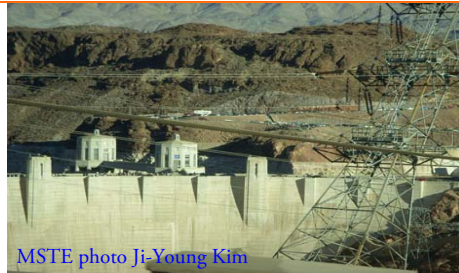
Transmission and Distribution Costs remain constant for the utility and are prorated to the consumer.

Diagram labels

External — Payment: $2,688/hr — Emissions: 107.5 tons/hr
179 MW
150 MW
Substation 1
150 MW — Commerceton
Payment: $13,500/hr

Cost Controls
Hide Costs/Payments/Emissions
Load Payment: $90/MWh
0 40 80 120 160 200

482 MW
302 MW
Substation 2
1000 MW
250 MW
Payment: $157,500/hr
1750 MW — Residenceburg
Substation 5

Cost: $4,500/hr — Emissions: 0.0 tons/hr
1000 MW — Hydroelectric

External — Payment: $2,688/hr — Emissions: 107.5 tons/hr
1750 MW
652 MW
500 MW

Substation 3
268 MW
Cost: $35,700/hr — Emissions: 250.0 tons/hr
500 MW — Natural Gas
Substation 6
179 MW
108 MW

250 MW
0 MW
250 MW
Payment: $22,500/hr
Substation 4
1188 MW

Cost: $200/hr — Emissions: 0.0 tons/hr
108 MW — Wind Farm

Cost: $2,000/hr — Emissions: 0.0 tons/hr
250 MW — Industryville
Offline — Coal
900 MW
Transmission and Distribution Costs: $25,000/hr
Cost: $11,900/hr — Emissions: 0.0 tons/hr
900 MW — Nuclear

Total Costs: -$119,577/hr   Total Emissions: 35/hr

Pause Time | Reset Time | Show Plot | Print System | Reset System | ☑ Variable wind

Can you operate the system? Try to manage these situations.

http://tcipg.mste.illinois.edu/applet/eco

- Press the **Reset System** button. Currently, the system is spending $54,000 per hour to purchase energy from external systems. Can you find a way to set the system so that the power grid does not have to rely on external systems to meet the needs of its customers?

MSTE photo Ji-Young Kim

The hydroelectric power project at Hoover Dam is among the largest in the U.S.

- The producer's total costs include generation costs and transmission & distribution costs. How much per hour is the producer spending altogether (including the external system costs) to provide power to the three locations?

- Without changing the demand from the communities, maximize the provider's profits. How large is the provider's profit? What did you do to maximize the profits?

- The emissions shown in this applet are carbon dioxide (CO_2) emissions. Carbon dioxide is a greenhouse gas. Which generators produce CO_2 emissions?

- How do the emissions for the Coal Generator compare to the emissions for each of the other generators?

- How do the emissions change as the power production changes?

- Press the **Reset Time** button. Keep the power demand from Residenceburg at 1700 MW (megawatts) and from Commerceton and Industryville at 850 MW. Adjust the system so that the utility is making a profit and the CO_2 emissions are lower than 1000 metric tons per hour.

A 2-player game has been developed for this applet. You and a partner use the applet to play a game in which you compete to see who is better at controlling unexpected situations.

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for the applet at http://tcipg.mste.illinois.edu/applet/eco
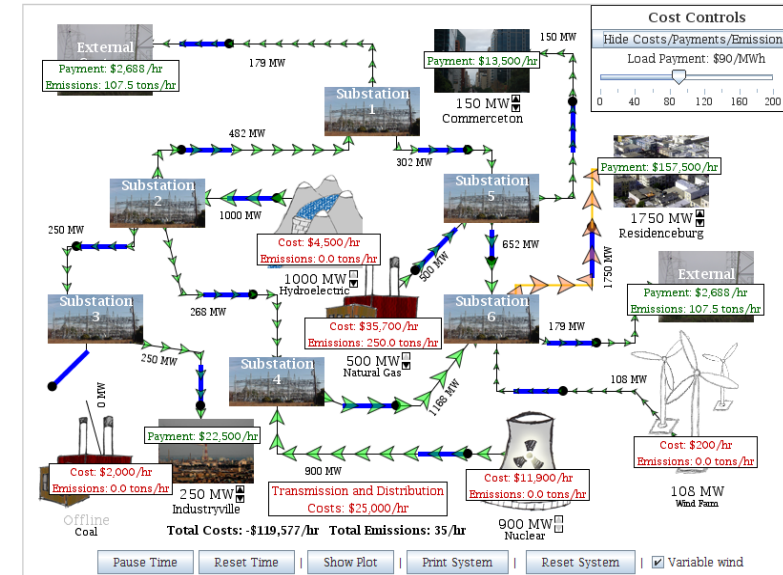
The applet simulates a system that is owned by a power utility company. The company provides power to three communities. It owns and operates five types of generators and the transmission lines that serve the communities. On this system, it is usually possible for the utility company to supply all of the load demand using the local generators. However, there could be many reasons why this is not possible or most profitable, and then electricity is purchased from or sold to the external system.