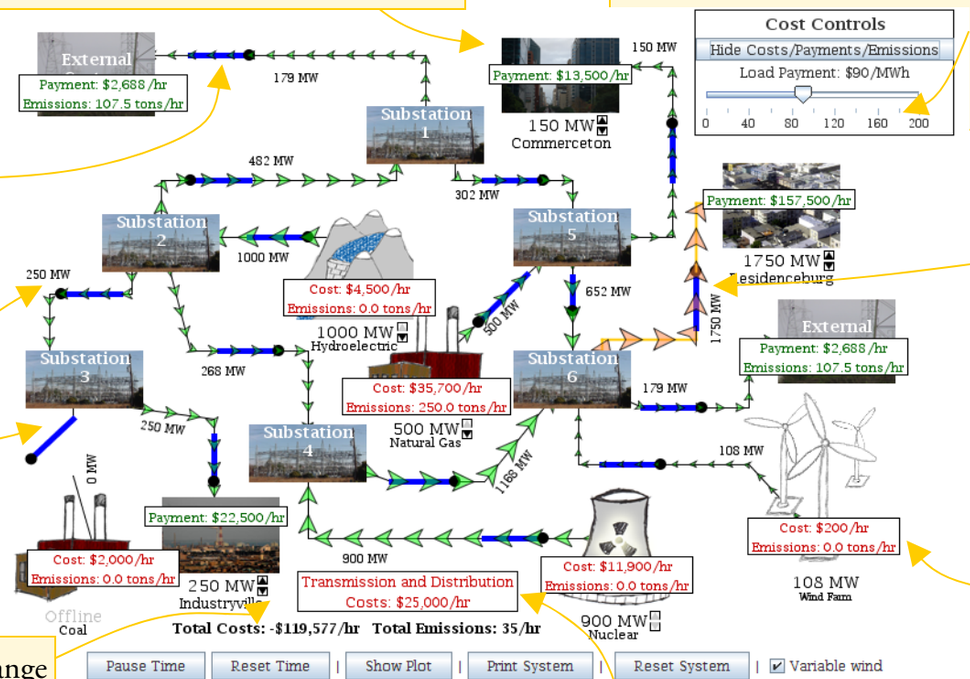
Quick Start -- Power Economics and Emissions

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.**

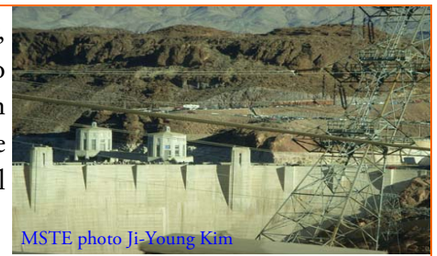
Transmission and Distribution Costs remain constant for the utility and are prorated to the consumer.

The applet used in this exercise is available at
http://tcip.mste.illinois.edu/applet3.php

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

http://tcip.mste.illinois.edu/applet3.php

- 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?
- 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?



MSTE photo Ji-Young Kim

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

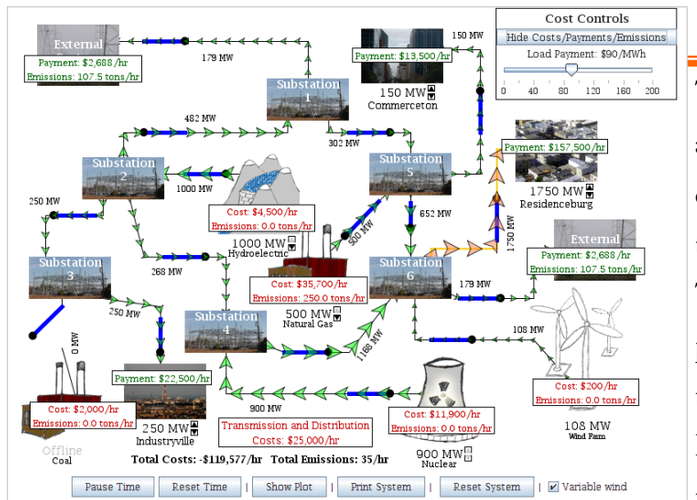
A 2-player game has been developed for this applet. You and a partner use the applet to play a game in which you compete to see who is better at controlling unexpected situations.

- 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.

CONTACT:
Jana Sebestik
Office for Mathematics, Science, and Technology Education
Phone: 217-244-7486
Email: sebestik@illinois.edu

Power Economics and Emissions Quick Start Guide

for the applet at http://tcip.mste.illinois.edu/applet3.php



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.

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

TCIP Education is a joint project of the Office for Mathematics, Science, and Technology Education (MSTE) and Information Trust Institute (ITI).