

## Read and Work Ahead – TCIPG Reading Group – 14 Sep 12

1. Download and install *PowerWorld Simulator – Version 16* demo/educational version on to your laptop from

<http://www.powerworld.com/download-purchase/demo-software>

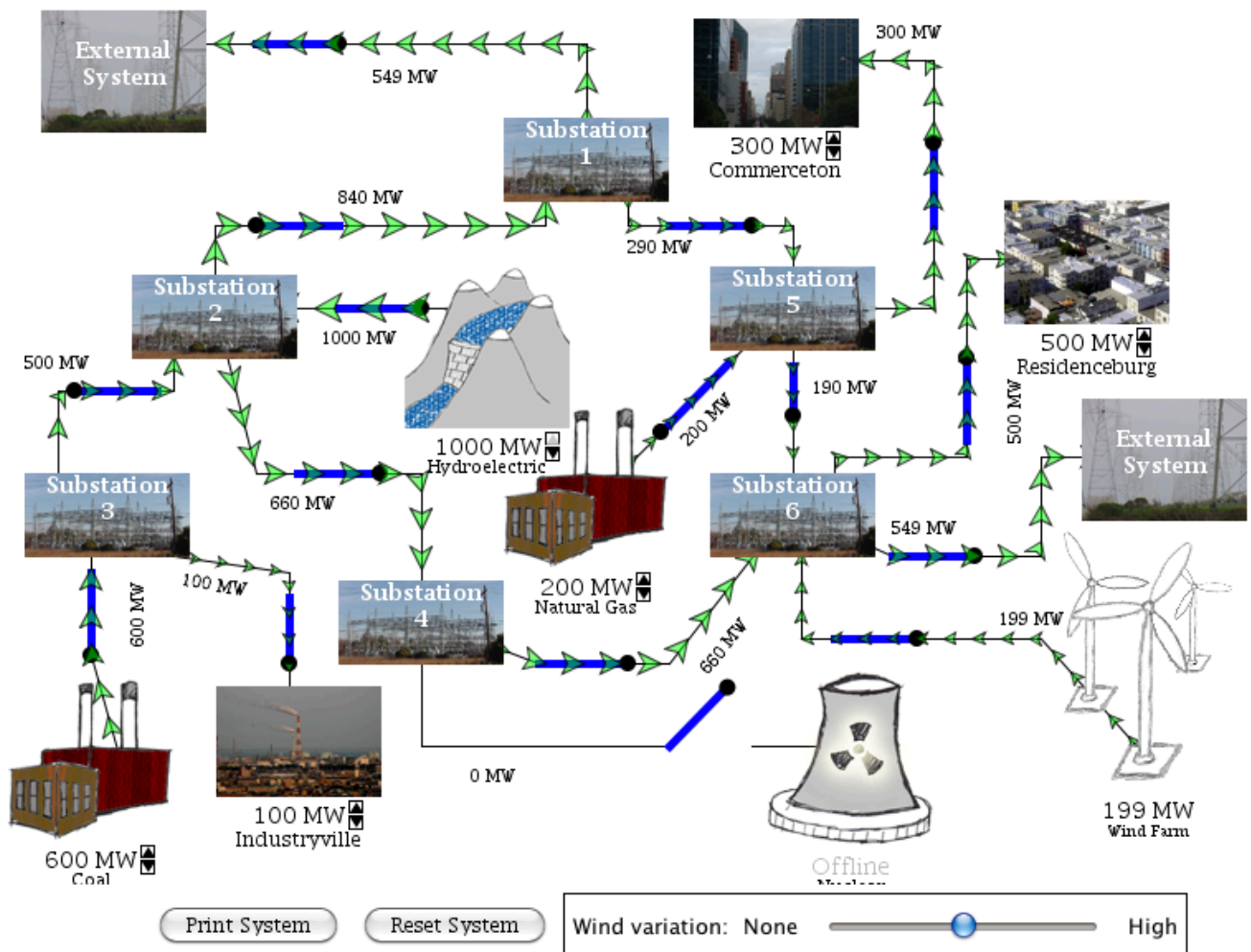
Download the three 5 Bus Case files *B5R.PWB* from the TCIPG Website. Verify that you can open the test case in PowerWorld.

2. Read the Load Flow Notes – TCIPG Reading Group 14 Sep 12.

3. Basic Power Grid – a bit of fun

In this pre-lab, you will access the TCIPG website to see a brief introduction of how a grid works. To begin, please access the URL below.

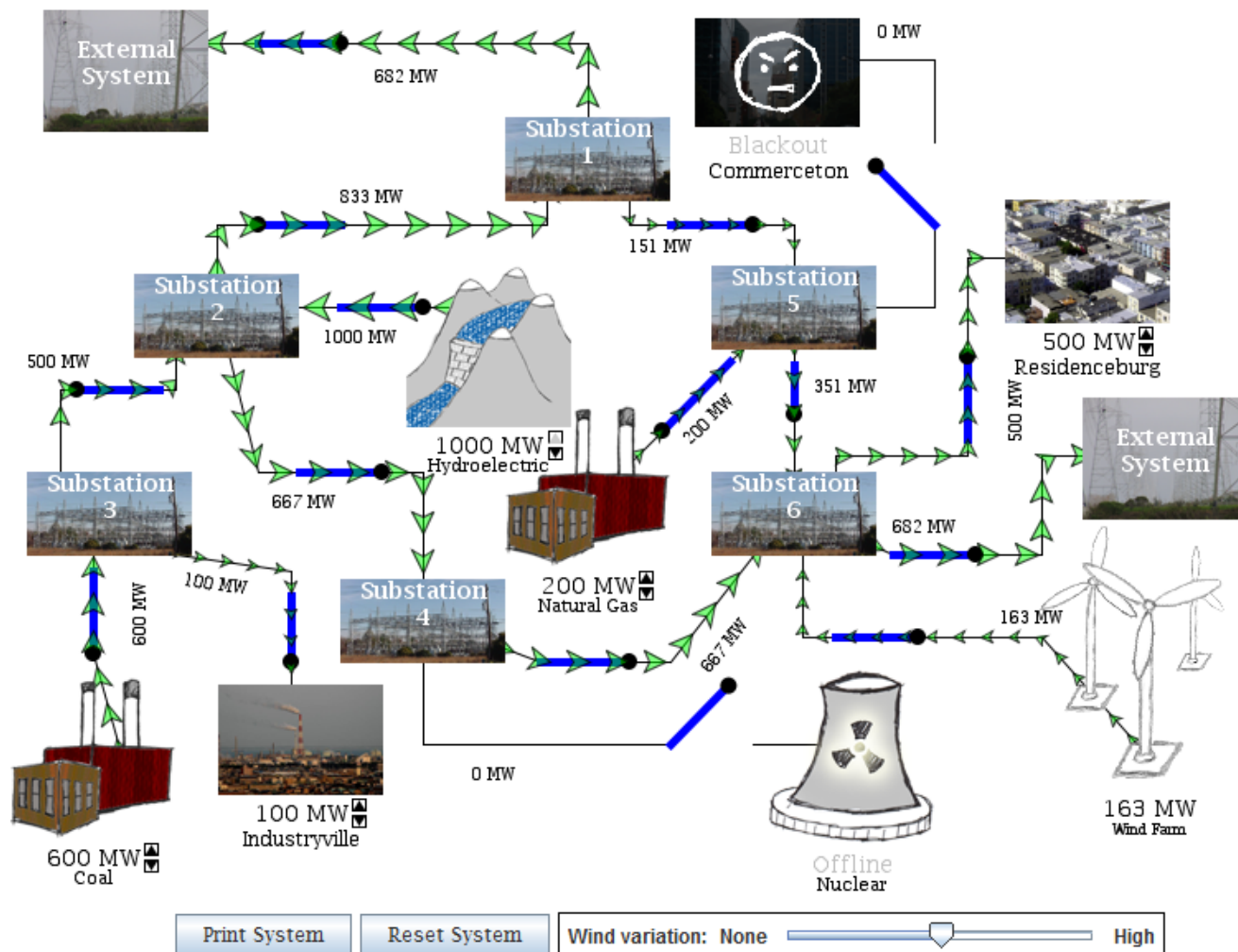
<http://tcipg.org/applet-pg>



The image above shows the applet that is on the site.

This is a very simplified diagram of how our power grid works. We have various types of generators, various types of loads, substations that allocated the power being produced, and connections to external systems. Under each generator and load, you will find an adjustable number which indicates the power production/consumption. Under each power line, it indicates how much power is flowing through it. The arrows indicate which direction the power is flowing through. When you first load the applet, our system is very well balanced and power actually flows out to an external system. However, in order to understand this applet better, we are not going to keep our system happy.

A. First, try increasing the power that is required to power the Commercton to 500 MW. You will notice that bigger arrows are flowing into the system. Now, steadily increase that to 900 MW. Now, you will notice that there is an orange arrow going into the Commercton. This is an indicator that the power line is close to getting shut down. Now increase to 1100 MW. At this point, the arrows turn red, and the line actually shuts off; Commercton is now indicated with an angry face on it.



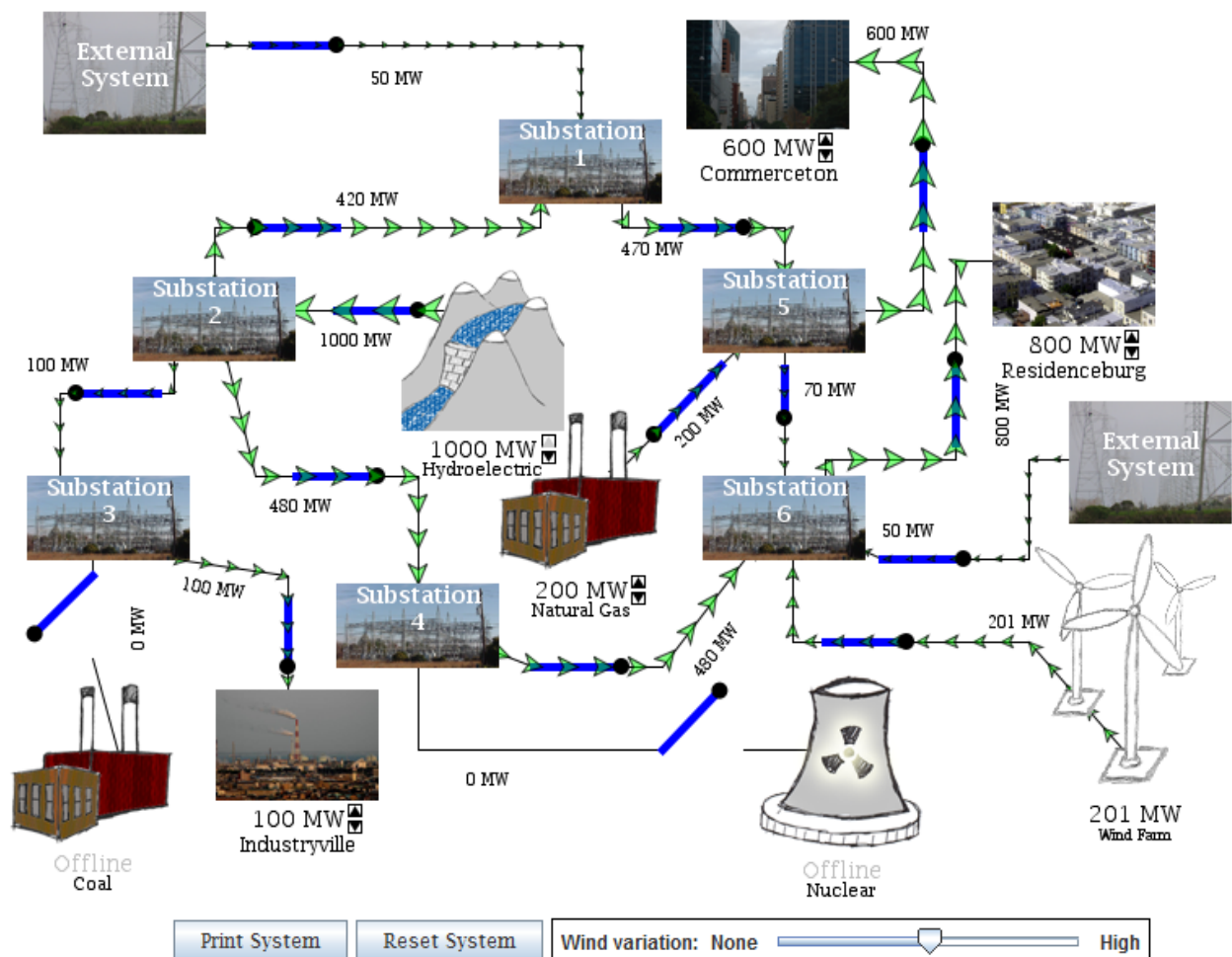
**Why did this happen?** Well, there is only a certain amount of power-flow that the line can handle. When the power flow exceeds that limit, the power line shuts down, and a blackout occurs.

**What can you say about the sum of all powers into/out of each substation?**

**Is this a linear system?** (e.g. that each incremental increase in load drawn changes every other metered value by the same amount with each increment of change?)

## B. Power Grid with Ecological/Economical Consideration

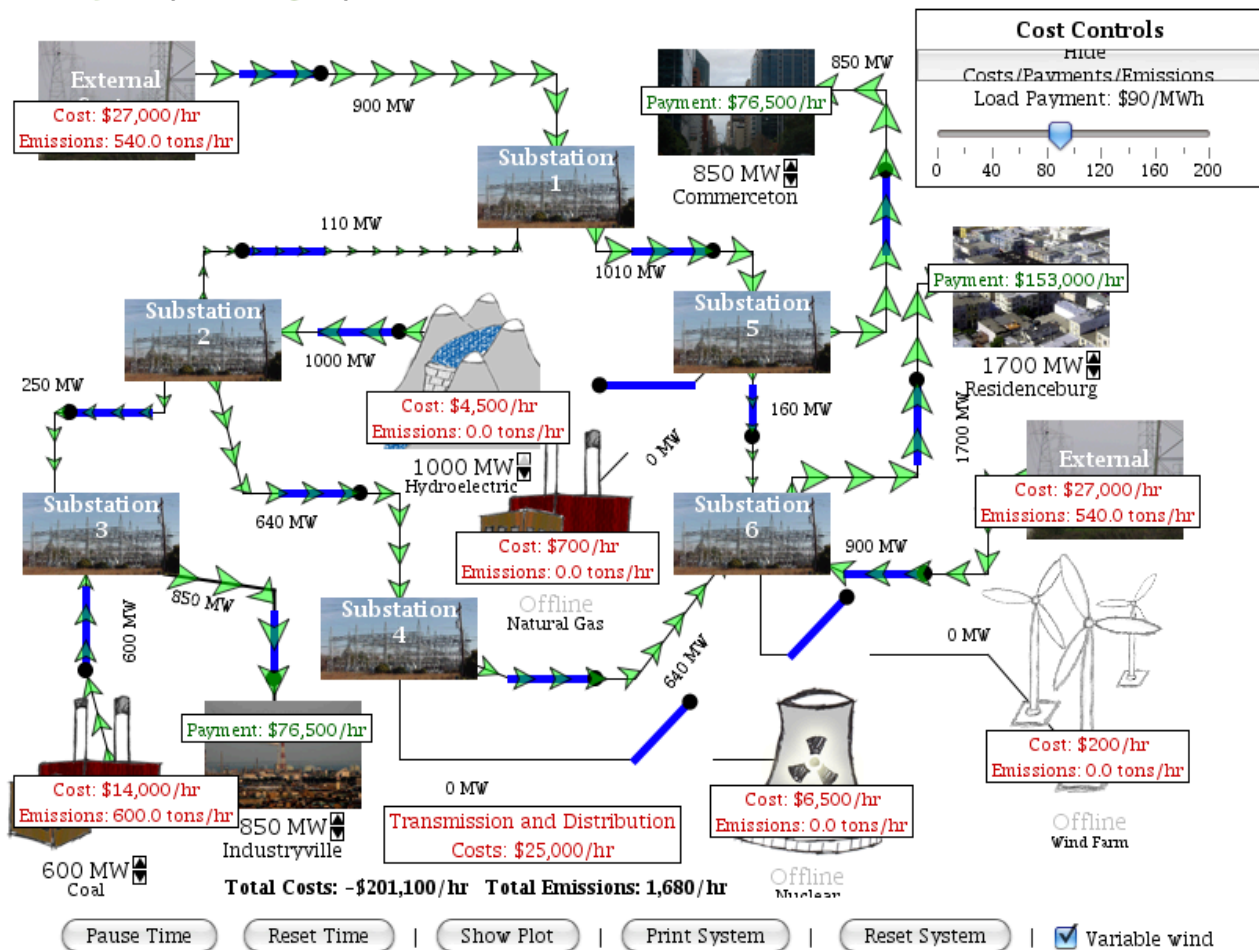
Now, let us reset the system once. This time, increase the Commercetown and Residenceburg usage to 600 MW and 800 MW. Now, shut off the Coal power plant input by clicking the switch on the line right by it. You will now see that the power that was flowing out to the external systems are now flowing into the systems. The external systems can supply energy as well.



Reset the system again. This time, close the switch for Nuclear. Notice, that now the nuclear supplies a lot more power into the system. Cut off one of the lines to the external system and see what happens. The power flow to the other external system increases and the whole system actually shuts down once again.

C. Now that you have seen how power flow works on this particular scale, let us proceed to the next applet in this link.

<http://tcipg.org/applet-eco>



This is essentially the same applet, but with economic and environmental factors included in it. Optimize the cost and the environmental data.

**What are the generation settings for the most cost effective operation you can achieve?**

**What cost savings can you achieve through demand/load reduction?**

**Are the settings different?**

**Is the system linear?**