

Infrastructure Management
Homework #4 - Spring 2004
Due Tuesday April 6th at start of class

Question 1 (25pts): Using the E-GRID spreadsheets please answer the following questions for the year 2000 (available at <http://www.epa.gov/cleanenergy/egrid/download.html>). In the 'Power Flows' spreadsheet, worksheet EGSTIE00, you will find electricity export and import estimates for all of the states in the US.

- a) What are top 5 importing and exporting states in terms of GWh? What about in terms of percent of state generation? What are the reasons why states may import a lot of electricity?
- b) Focus on the Western United States (states with the Grid Region – column D – as 'W'). Does the western grid region come close to providing a 'zero balance' of imported and exported power? If not, what might be the cause of the net import or net export of this entire region?
- c) Do your best to make a small model to consider the power flows in the Western US (i.e. try to match up the importing and exporting states and make the overall power flow balance). If necessary, use import/export data for adjacent regions to help your balance. Make a summary table, spreadsheet, etc. that shows where states get their imported power from (or to where they export it).

Question 2 (15 pts): Assume you have a temperature sensor/data collection system on campus with a single sensor - like the CRITTERS. The sensor has the ability to take a maximum of 20 temperature readings/samples per second. Each temperature reading is 2 bytes. Each of these sensors is connected to a local computer (as in the Critters project). The system configuration is a computer with an extra (empty) 10 GB hard disk. The campus network operates at various speeds from 5 Megabits per second (Mbps) for wireless up to 1000 Mbps wired Ethernet.

- 1) Consider local storage of sensor data at each computer. What are the storage requirements on each machine at the 'maximum mode'? How soon until the hard disk is full?
- 2) Now assume there are 10,000 computers on the campus network, and that each computer is able to get a temperature reading and immediately forward it to a single server on the network. The additional information needed to identify the sensor location is 3 bytes (5 bytes total). If all sensors were on 'maximum mode', what would be the network and data storage requirements for the central server system? What percent of the network bandwidth would be used? What is the primary constraint on this system design and how could it be addressed?
- 3) Hopefully part (2) makes you want to improve the system. Think about temperature, its variability, etc. Consider two new scenarios for measuring and storing the temperature data: First think about how often to store the temperature locally to reduce hard drive demands, and how / when to report your temperature over the network. Make some specific assumptions and then discuss how your 2 new scenarios change your answers to (1) and (2) above.
- 4) What kind of building management questions/problems can be addressed with the maximum mode scenario that could not be addressed with your improved systems?

