Please e-mail your group’s first document summarizing the energy markets to everyone in the class. All of these documents, taken together, comprise the resources that you will use for this assignment. Your group should go organize yourselves to go through all of the documents to provide the basis for designing your own market.

In the last assignment, you were asked for each of the markets you investigated, “If you were a FERC commissioner, then what would you change?” This question motivated you to think as the market architect. In this assignment, you are the market architect, and you are developing a proposal in response to a request for proposals (RFP) for an electricity market from the government of the U.S. territory of Puerto Rico. Although market design is complex, the RFP has given only less than 3 weeks to provide a response. Your team must respond in the best way possible given the time constraint that you have.

Working with your same group, your assignment is to design an electricity market system that addresses the following issues:
1. What types of energy markets exist and how do they operate? One of your energy markets must be a real-time (balancing) market.
2. Are the energy markets wholesale or retail?
3. Who can participate in the energy markets?
4. How do the different energy markets interface one with another?
5. What information is required of market players interacting with the different energy markets?
6. What algorithms will you deploy to clear the energy markets?
7. What are the gate closings for each energy market?
8. How and when are the markets settled?
9. What information will you ensure is available in your website to provide information necessary to enable market players to function in the market?
10. How do bilateral markets interact with different energy markets you have designed?
11. What types of ancillary service markets exist and how do they operate?

Your responses to the above should be summarized in a well-organized document.

In addition, it is also important to provide a simple but working prototype of your intended real-time market (RTM) because you suspect that all of the other responses to the RFP will have a working prototype, and if you do not, it will be considered a weakness in your proposal. It is not possible that the prototype use the Puerto Rican network, because the RFP did not make the network information available, so I suggest that you just use the 4 bus example given in class. You should develop code (Matlab, Excel visual basic, or whatever you like, but whatever you choose, you will need to have an LP solver available) which simulates the RTM by prompting each of the 5 market players (agents) for bids. The five agents are comprised of the members of your group, where one person bids as the generator at bus 1, one as the generator at bus 2, one as the generator at bus 4, one as the load at bus 2, and one as the load at bus 3. If you only have 3 or 4 group members, one or two members may have to bid twice.
You should develop your code so that bids are “sealed,” i.e., any one agent is able to only know his or her own bid, but not that of others. One simple way to do this is to have the code loop 5 times, so that in each loop, the data for one agent is requested. Then your group can sit around a single terminal and trade seats as the program loops. Clearly there are more advanced ways to do this, where, for example, the program enables multiple agents to access the interface simultaneously from different terminals. Such a program would need to be internet-based, probably using an SQL database. You are welcome to design it that way (and the real markets do so), but in our class, the first approach will suffice.

Your RTM will ultimately need to be able to accept bids that have different (increasing) prices for different increments of generation; this would require the use of a piecewise linear representation that allows multiple “pieces.” A simpler approach is to require that each bid have only a single price and a single increment of generation; this would require a piecewise linear representation that allows only a single “piece.” The data used in class characterizes the real cost-curves and utility curves of the supply and demand, respectively. But this information, for each agent, is considered “private.” Although each agent should understand how his or her bids relate to their real cost- and utility-curves, they are not constrained to always offer bids that are consistent with these curves; in fact, they may offer bids at whatever price and increment they like, as long as they are prepared to deliver on that bid, absorbing either the loss or the profit as determined by the difference between their bid and their actual cost- or utility-curves.

In addition to your response to the enumerated questions above, you will need to provide illustrations of your working market prototype. These illustrations should include at least 5 sequential rounds of bids, where for each round, you report

- Bids made by each agent
- Amount of power bought or sold by each agent
- Amount of dollars paid or received by each agent
- The resulting line flows in the network
- The nodal prices at each bus

You can organize yourselves in any way that you like. But one suggested approach is to have an initial meeting where you do the following.

1. Discuss and agree on basic issues (what software development environment to use, how to implement the “sealed bid” structure, whether to allow multiple increment bids) related to the implementation of your real-time-market.
2. Identify who will code your real-time market.
3. Allocate responsibilities in relation to answering the architectural questions posed in the enumerated list above. Each person should read all of the reports searching for information and insight in relation to their question(s), in order to gain the best perspective on how to respond to their question(s).

Your report should contain responses to the enumerated questions, the above data for 5 rounds of bids, and the code that you used to implement your prototype RTM.

Your grade on this assignment will be determined based on a ranking of the different proposals, where the highest-ranked proposal will receive A+ and other proposals will receive lower grades depending on their rank. So you are, in fact, directly competing with the other groups (a competitive market!).