6.033 Clarifications in response to DPPRs

Flow of electricity: This project deals with two different types of networks: the data network, where commands are getting sent between various components (microgrid controllers, smart meters, etc.), and the electric "network" (grid), where electricity flows. These two networks do **not** work the same way. In particular, there is no notion of "routing" electricity through the grid; electricity is simply available through the grid for any source that is drawing power from the grid. Think of how water flows through pipes: when you turn on a faucet, water isn't routed from a source directly to your faucet. It's simply available (unless there is a failure).

Using electricity: Buildings draw power for normal activities: turning lights on, powering computers, etc. That power can come from a few places:

- The building's battery. Buildings will draw power from their battery as long as it has power stored. The battery is a building's primary source of power, because it costs nothing to draw electricity from the battery.
- Electricity on the grid. Buildings will draw power from the grid if their battery is at 0%. The electricity on the grid comes from two places:
    - Other smart meters on the grid sharing excess power (more on that below).
    - The central utility supplying power to the grid. The central utility itself can get power from two places:
        - Microgrids that are sharing excess power.
        - The New England regional grid.

  Note that when the building is drawing power from the grid, that power is *not also* charging the battery. Batteries are only charged by their solar panels.

Notice that some of these ways of drawing power are more desirable than others: because of monetary cost, or their resilience to certain types of failure. It is **not** your job to decide how buildings draw power; they will do it in the manner described above (batteries first, then grid). It **is** your job to implement a sharing protocol such that more cost-effective sources of energy are available. Some parts of the sharing protocol have been decided for you; other parts are your decisions to make. (See "sharing electricity" below)

Storing electricity: As the sun shines — and even when it doesn't — the solar panels attached to each building are working to store power in the corresponding battery. This means that on a very sunny day, even as a building is consuming power, it could end up with a rising level of storage in its battery (if the solar panel is generating more electricity than the building is using).

Sharing electricity: Centertown wants its microgrids to share power under specific circumstances.

- Within a microgrid:
    - If no batteries are at 0%, then there should be no sharing on the local grid; smart meters will be drawing power from their batteries, not the grid. In this case, any excess power is being shared back to the central utility.
    - If *some* batteries are at 0%, but others are above their threshold, your system should instruct the smart meters with batteries above their thresholds to share, so that batteries that are at 0% can use power from the local grid.
    - If some batteries are at 0%, and *no* others are above their threshold, there should be no sharing on the local grid; batteries that are at 0% will be drawing power from the central utility.

Commands: We have given you a fairly robust set of commands for communicating with the smart meters. You may not need to use all of them. (There are none that are intentional red herrings! It's simply possible to design a good system without using every command given.)

Data Collection: The data that the smart meters get is likely incomplete for your needs. For instance, there is no direct record of how much power a customer is consuming, given that said power can come from multiple sources (batteries, the local grid, the central utility) and only one of which is metered (the central utility). There may be places where your system needs to estimate a value, or do some measurements on its own!

Your job:

- Your design should specify **all** of the details for storing and sending data throughout this system. In addition to the functionality described above, there are requirements for storing data related to billing, the MIT researchers, etc.
- Your design should implement the sharing protocol described above.
- You should describe how your design behaves under various failures (network failures, power outages, etc.). You have **choices** to make about how your system handles these failures.