RESE412

Renewable Energy Control Systems

Control report: 20% of final grade
Complete by 9th of September

Learning objectives:

- Understand the motivation behind the use of demand side management
- Design a demand side management algorithm and implement it in simulated environment
- Evaluate the "success" of the demand side management algorithm

In this assignment, you will be building on assignment 1's model in order to improve your microgrid system with control. You will be implementing demand side management (DSM) using a single thermostatically controlled load (water heater) in each house. You will revisit your stand-alone PV/battery system and see if you can reduce the capital cost of the solution.

The goal is to shift the water heater load to a time that better suits PV power production. With this shift in load, you should be able to reduce your battery storage and in theory reduce the capital cost of the microgrid solution (ignoring the cost of control infrastructure).
The only other requirement is that the water reaches "T_High_WH" at least once a day (T_High_WH can be found in the house parameters, ideally its 60 degrees, but set a little lower in a couple of the houses). This is to ensure bacteria doesn't build up in the water heater.

Further information:

- We will be using a slightly different cost for storage, but this shouldn't change assignment 1 (you may have to reprice your PV/storage solution for this assignment).
- The water heater in the house is controlled by a thermostat which you can utilise or disconnect.
- You can add a switch in to the house in order to control the on/off time of the water. To do so you must disconnect the house from the library (option in yellow at the top of the screen when you try to change the household model).
- You can alter the voltage to the water heater using a buck converter component if you wish (you don't have to). The buck converter is in the standard Simulink/simscape library. It is best to use it in "average model" where you give a value to the buck converter between 0 and 1, and the output is a ratio of the input voltage ($V_o = DV_{in}$ where D is the ratio or "duty cycle") .

To successfully complete this assignment, you will need to:

- Write an algorithm to shift the water heater load to a more ideal time for PV
- Discuss your control topology and why you selected it
- Ensure the water heater reaches T_High_WH at least once a day
- Run a week simulation of your microgrid showing the operation of your algorithm
- Compare the cost of your controlled solution with that of the uncontrolled solution
- Write a report describing your control algorithm and demonstrating its functionality with a discussion on the controlled/uncontrolled solution costs.