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Case Study 2: One Montgomery Plaza

The One Montgomery Plaza case study was handled in a stepwise manner. Initial estimates of the simulation inputs were made using the data available for the building – building envelope parameters from site audits [1], occupancy schedules from hourly energy usage data, ventilation rates from known guidelines and rules of thumb, etc. Comparison of the results to actual energy usage led to further iterations that modeled the building's operation more comprehensively and with increasing accuracy. The total time taken for this process, once the proper data sources were located and collected, is as follows: preparation of data for input (both before the initial run and between iterations) – 6 hours; input of variables – 5 minutes; simulation – 1 minute; post-processing – 2 hours.

The baseline run was performed using Design Advisor as available online with no extra calculations performed (aside from conversion from primary energy usage to site energy usage). It was found that while Design Advisor's energy usage predictions matched the shape of the actual usage profile, the actual monthly values were consistently underestimated.

The first model addition was the inclusion of constant electric loads in the energy usage prediction. Design Advisor incorporates given equipment loads in its heating and cooling considerations (based on the power dissipated) but does not report the energy used. Similarly, while it calculates heating and cooling energy requirements, it does not (for the sake of simplicity) model AHU energy usage. Analysis of the data available for One Montgomery Plaza showed consistent AHU energy usage from month to month. As such, it was considered to be a constant load. Simply adding these loads (using an estimate of the building occupancy schedule based on hourly load profiles) to our initial results reduced the maximum monthly error for electricity usage from over 500% to 100%.

The next iteration involved altering our chosen occupancy schedule during the heating season to more accurately reflect the behavior of the building systems. As per the executive summary made available on the Hub Sharepoint site [2], the HVAC systems at One Montgomery Plaza run 24 hours a day from November to March to maintain occupant comfort levels. As such, we performed another simulation run with a hypothetical 24-hour occupancy schedule and extracted the heating data to include in the previous results. This change reduced the maximum monthly error for heating energy usage from 125% to 40%.

The final set of changes made further improvements to the accounting of building subsystems in our prediction. Furnace efficiency was reduced from 100% to a more realistic value of 90%. Fan energy usage was added in a manner similar to that for the air handling units (as seen previously). The heat recovery system in the building was treated as an effective increase in the required air change rate. These modifications, combined with those discussed above, led to the results shown below.

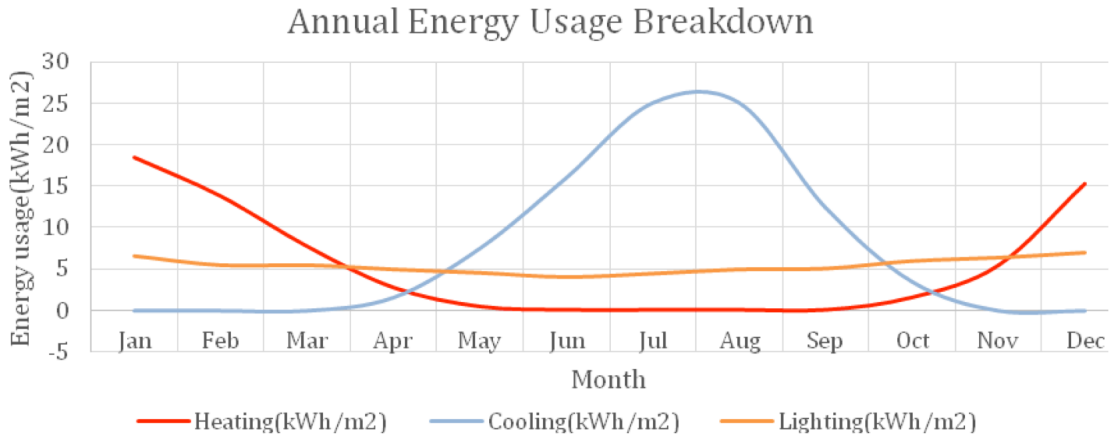

Figure 2 Monthly heating, cooling, and lighting energy usage prediction from Design Advisor for One Montgomery Plaza

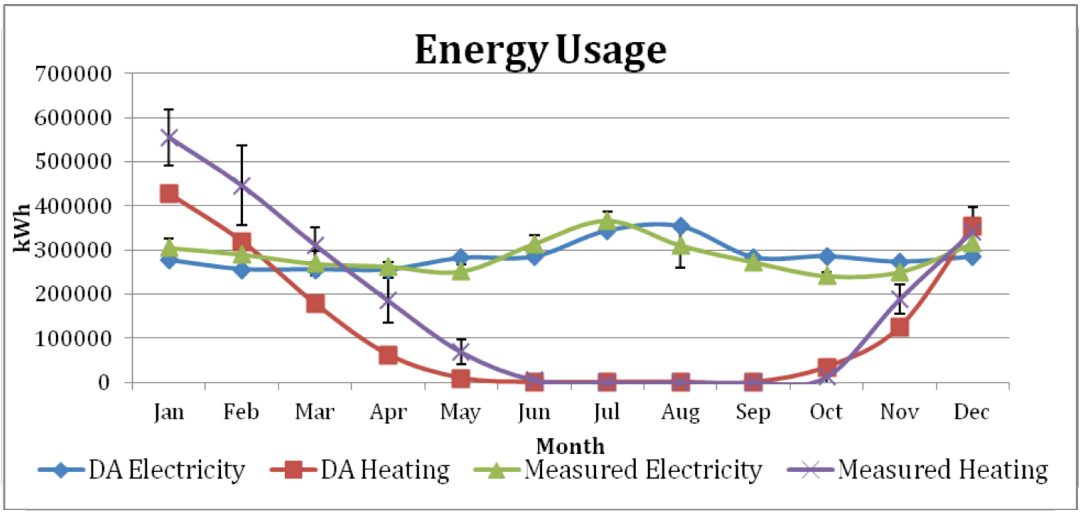

Figure 3 Comparison of monthly heating and electricity (plug loads, lighting, and cooling) energy usage predictions to measured data for One Montgomery Plaza

For the full year, the mean bias error of the combined heating and electricity usage predictions is -11.2%. The root mean squared error is 27.1%. On a monthly basis, the absolute error ranges from 2.9% (December) to 29.1% (April).