UBC Pilot Study Summary

Sensible Building Science (SBS) has developed an innovative solution for determining actual building occupancy in real-time. This solution allows for control of building systems based zone occupancy information determined using existing IT infrastructure (Figure 1).

An ongoing pilot study implemented in a mixed-use building of the UBC campus between Nov. 2014 and Aug. 2015 has shown energy savings of 161MWh. The extrapolated results predict a 5.2% reduction in annual heating energy.

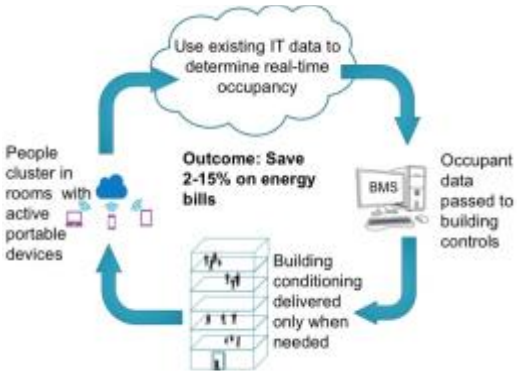

Figure 1: Real-time occupancy-based building controls

Introduction

Building mechanical systems are designed to provide a clean, comfortable indoor environment during occupied hours. The standard control methods utilize fixed on/off schedules based on predictions of building occupancy patterns. Knowledge of the actual occupancy within a space has the potential to reduce energy consumption and improve occupant comfort by controlling around actual occupant needs.

Case Study

Real-time occupancy control methods have been implemented in a pilot study on the University of British Columbia (UBC) campus. Occupancy is determined in real-time by analyzing data from the existing IT infrastructure. The occupancy counts in specified building zones are then transferred to the building automation system to allow for occupant driven control of ventilation. Other occupancy detection methods had been attempted in the in the past but could not provide the required resolution due to high occupant counts and physical obstructions.

The pilot was implemented in a mixed-use library building containing book stacks, lecture rooms, common areas, and staff offices. The 26,000m² building is served by 7 air handling units, 5 of which are included in this pilot.

Occupancy Profiles

Samples of real occupancy counts from two zones in the pilot building are shown in Figure 2. This occupancy data is used to control the start and stop schedule of the air handling units serving the respective areas. The occupancy trends reveal insights into the behavior of building occupants. The lecture theatre shows continuous cyclic loading and unloading of the room throughout the day with consistently reduced occupancy levels starting at approximately 5:00pm. The offices show a slower ramping up of occupancy in the morning and a gradual decline late into the night. Both trends allow for reduced ventilation periods from the standard building schedule that is not possible with other occupancy detection methods.

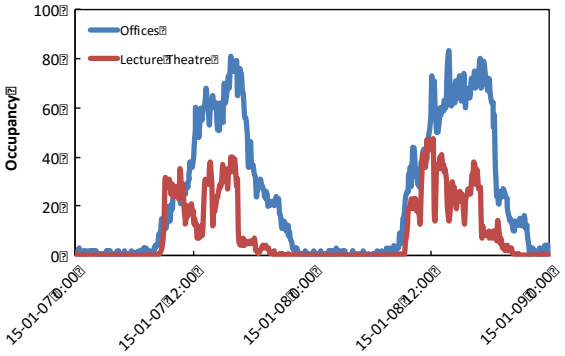

Figure 2: Typical hourly building profiles

Reduction in AHU Operation

The existing pilot study limits the occupancy-based interventions to on/off control using an adjustable occupant threshold. Figure 3 shows a comparison of the number of hours per week each air handling unit was operating before and after the pilot study

implementation. The use of occupancy-based controls to schedule the air handling systems in the pilot building has reduced the operation time substantially.

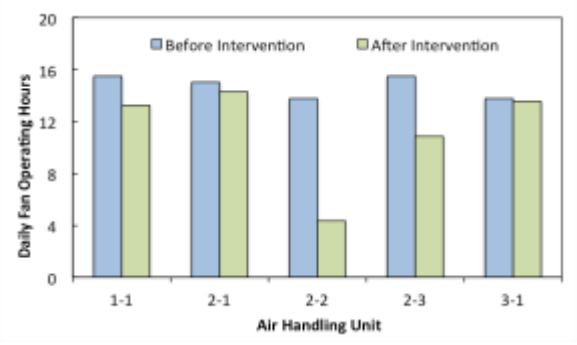

Figure 3: Weekly air handling unit operation

AHU 2-2, which serves the lecture theatre, shows the largest reductions (60%). The average reduction in operating hours through the first eight months of the pilot is 25%. This leads to substantial energy savings by reducing the total volume of conditioned outside air heated to space temperature. Indoor air quality was measured periodically and CO_2 levels remained within the variability associated with regular operation. Additionally, no comfort complaints were reported to building staff.

Total Savings

The savings from reduced operation time has led to reductions in electrical energy use (fan motors), and thermal energy (heating). Figure 4 shows the savings for each air handling unit. Energy saved is calculated from reduced runtime, motor power, airflow rate, and temperature.

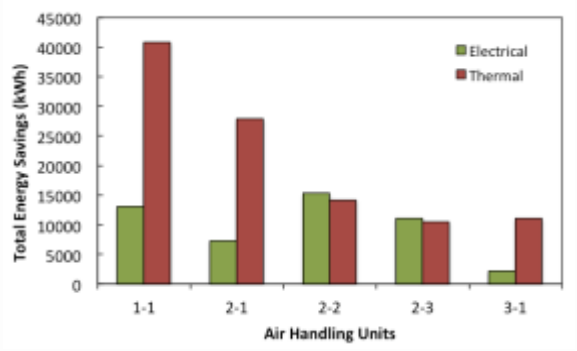

Figure 4: Energy savings through occupancy-based controls

The total energy saved during the first eight months of the pilot was 161MWh. The total annual extrapolated savings (accounting for HDD corrections) is 79MWh (2.8%) Electricity, 224MWh (7.9%) thermal. The total annual cost savings is expected to be approximately $14,500.

Savings Analysis

The cumulative savings for each 15-minute interval of the day over the eight-month period is shown in Figure 5. The trends are similar for both weekday and weekend operation.

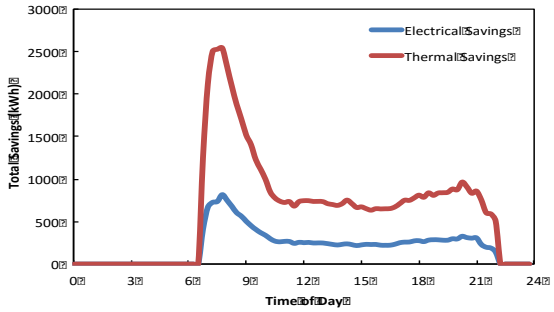

Figure 5: Total savings by time of day

The majority of energy savings from the pilot study occurs during the early morning where the actual occupancy data enables a delayed start of the air handling equipment. A similar, smaller peak in savings is associated with the end of day where occupancy levels decline sufficiency to allow early shutdown. The savings are not limited to shoulder hours. Savings occur throughout the day when building zones are temporarily unoccupied. An example of this occurrence is when the lecture theatre has no classes scheduled.

Conclusion

A real-time occupancy-based controls pilot study on the UBC campus has been successfully implemented. The new technology has allowed occupancy counts to be passed in real time directly to the building controls system. The modified control of air handling unit run times has led to a projected 5.2% annual reduction of energy use for heating. The extrapolated cost savings of $14,500/yr.