Fact Sheet

COMMON COMMISSIONING MEASURES **IN EXISTING BUILDINGS**

This fact sheet presents common energy and/or carbon emissions saving measures which are identified during an existing building commissioning (EBCx) investigation. The document provides high-level examples of several measure types and presents background information to help building owners and operators enhance their understanding of typical commissioning measures. The intent is to assist in the identification of opportunities for EBCx and to facilitate the implementation of measures.

Align Equipment Operating Schedules With Building Occupancy

Often, the most valuable opportunities for energy savings in a building exist from reducing equipment runtime and heating/cooling demand. This is achieved by optimizing equipment scheduling and temperature settings in alignment with building or space-specific use.

Options for controlling system operating hours can include implementing or updating weekly schedules, and the addition of holiday calendars, occupancy sensing equipment, and other measures. For example, schedules can be set for spaces which follow consistent use patterns or occupancy sensors can be implemented in areas which are used more sporadically.

Investigation of direct digital control (DDC) system programming and trend logging will provide valuable insight into how building equipment is operating in both occupied and unoccupied modes. Actual room temperature and equipment supply/return temperatures can be checked to ensure that setbacks are being implemented correctly. It is also important to ensure that the building reaches programmed operating temperature on schedule. Implementing an optimal start program which sets an efficient start up program based on building and outdoor conditions may help reduce energy use as the building switches to operating mode.

Optimize Hydronic and Air Supply Temperatures

Boilers, chillers, and HVAC equipment efficiency can be dependent on their programmed supply temperature. If the supply temperature setpoint is not appropriate to the system load or equipment type, it can cause increased energy consumption or equipment operating issues. During periods of more moderate temperatures, an adjusted supply temperature may still be able to meet the building's cooling or heating load while allowing for more efficient, and less wasteful, operation.

Special consideration needs to be given if a building is fitted with high-efficiency gas-fired condensing boilers or burners. Condensing equipment requires certain return temperatures to achieve an efficient, condensing operating state. Therefore, managing the supply temperature, and thus the resulting return temperature, can have a large impact on the system's energy use.

Another example is programming a reset schedule to replace a fixed supply temperature setpoint with a dynamic variable that can change based on outdoor air temperature, valve positions, building occupancy or other applicable variables. An example of a hydronic setpoint scaled linearly with outdoor air temperature is shown in Figure 1 below. This allows the equipment to match the heating/cooling load of the building more accurately when correctly implemented.

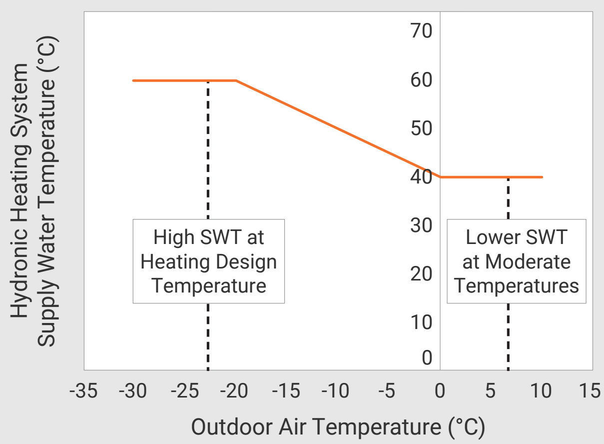

Figure 1. Typical Hydronic Supply Water Temperature Reset

Optimize Ventilation and Exhaust Rates

Managing ventilation and exhaust rates is vital to maintaining indoor air quality. Ventilation heating and cooling are also significant end uses of energy in most buildings. Excess outdoor air ventilation to a space, or excess ventilation to unoccupied spaces, can increase these heating and cooling loads. Other similar issues can arise because of system programming problems, air balancing issues or faulty dampers/actuators which interfere with the management of outdoor air flow.

Space type, frequency/duration of use, heating/cooling demand, and internal heat gain can all affect a building's ventilation/exhaust demands. Building spaces which have been repurposed may be receiving ventilation or exhaust rates unsuitable to the new use. Additional opportunities may also exist to implement exhaust heat recovery and/or free cooling during certain periods of the year to further reduce load on the building's mechanical systems.

An EBCx study will look to optimize ventilation and exhaust operation by examining controls operation and balancing. Upgrades such as added occupancy sensors, carbon dioxide sensors, timers and modified scheduling can all be used to manage ventilation and exhaust systems depending on space type and use.

Diagnose and Eliminate Simultaneous Heating and Cooling

In buildings with both heating and cooling systems, there is the possibility that a single space may be both heated and cooled by different systems simultaneously. This is a very inefficient state of operation which increases energy use and can often compromise occupant comfort. These systems can be found in buildings which have had phased system installations or floor space additions which may not be properly integrated in the main controls system. In some cases, a building can also exhibit higher energy use than expected during spring and fall months when heating and cooling loads may fluctuate.

There are other factors which may contribute to simultaneous heating and cooling including solar gain, internal heat sources, thermostat location, etc. In most cases, the central issue is a lack of control dexterity or control coordination between different systems. One example is when overhead ventilation provides cooling and hydronic systems at the perimeter provide heating. The diversity of potential causes and wide range of severity of simultaneous heating and cooling makes it an excellent point of investigation during the EBCx process.

In many cases, simultaneous heating and cooling will result in occupant comfort issues, despite the fact that building systems appear to be functioning. Further investigation into system control programs and trend logging may find that spaces are being heated and cooled simultaneously by different systems. To mitigate these issues, it is important that building controls systems have the capability to prevent both systems from serving the same space simultaneously. This can be accomplished with zone control valves/dampers, outdoor air temperature lockouts, etc.

Eliminate Passing Valves

Malfunctioning valves which fail to close off water flow for heating/cooling coils or hydronic baseboards can interfere with system operation, leading to increased energy consumption and comfort complaints. Other systems will need compensate to meet target setpoints.

Generally, DDC system investigation can reveal valve issues by allowing real-time comparison of supply/return temperatures or air and/or water streams in equipment, which can then be compared to system performance targets. Discrepancies between observed operation and target setpoints can be indicators of potential control valve issues. In buildings without DDC control, it can be possible to use on site measurements to diagnose faulty valves. Figure 2 shows an example of a situation where a faulty control valve in a heating coil allows hot water to pass through the heating coil despite the indoor space needing cooling. This increases the airstream temperature, resulting in increased cooling load.

Valve wear, insufficient seat load, faulty actuators, improper connections, or other issues can all interfere with a valve's ability to fully stop flow to a coil or baseboard. Incorporating repair or replacement of malfunctioning valves into building maintenance can help prevent these issues and reduce energy consumption.

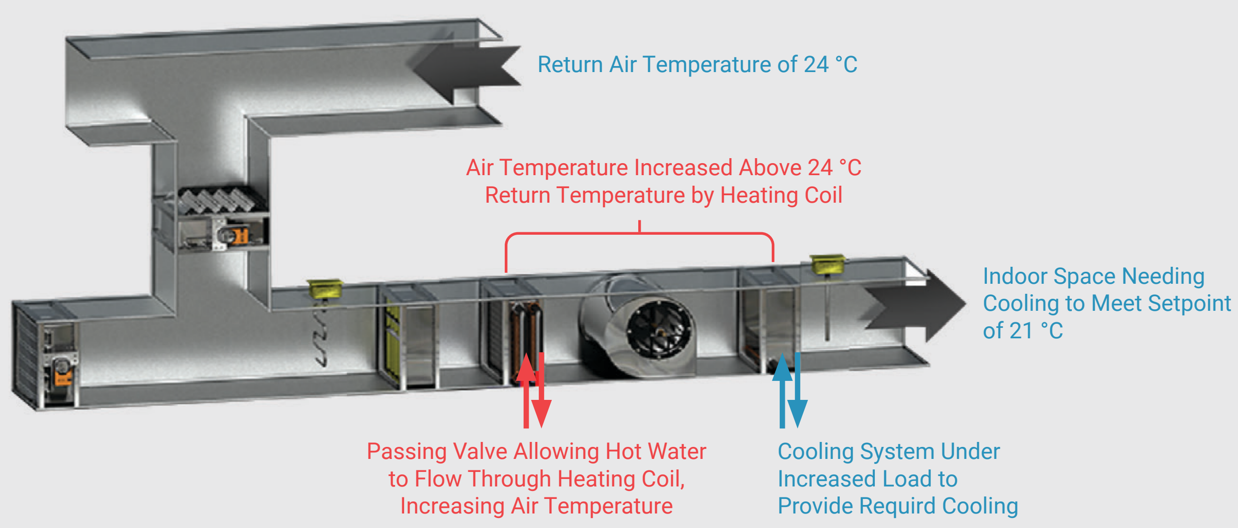

Figure 2. Example Showing the Impact of a Passing Heating Valve in an Air Handling Unit

Eliminate Unnecessary Lighting Use

Unnecessary hours of lighting use can result in increased energy use and utility cost. A given space's light requirements may fluctuate based on available daylight, occupancy, and space use. Lighting operation which can meet these requirements with minimal wasted energy can improve the building's energy performance.

Upgrading to high efficiency LED fixtures is beneficial but savings can also be realized by implementing lighting controls. Scheduling lighting shut down in areas with regular occupancy is a popular option. During scheduled "unoccupied" periods, all lights are swept off at set intervals. In more sporadically occupied areas, occupancy sensors can be implemented. Through energy savings programs, it can also be helpful to inform and educate building occupants about the energy saving systems in place, their operation, and the importance of the savings they provide. Lighting controls upgrades may also be undertaken as part of a larger lighting retrofit to help maximize the return on investment at an incremental cost.

Implement Seasonal Disable for Major Equipment

Effective programming can reduce gas consumption in heating equipment by disabling the main heating plant during summer months. This can be implemented based on a combination of month of the year and an outdoor air temperature threshold. Seasonal shutdowns can allow the building to prioritise use of smaller or more efficient systems to provide heat during warmer months and generally reduce the use of the largest equipment.

Key Takeaways

- Existing building commissioning (EBCx) provides a cost-effective method to ensure that building systems are operating optimally.
- Ensuring optimal operation of building systems will improve the benefits of major equipment upgrades.
- Many EBCx measures result in additional non-energy benefits such as improved occupant comfort and extended equipment life.
- For further information on EBCx resources, support and incentive programs, please visit: **https://natural-resources.canada.ca/existing-building-commissioning**

Summary Table

Opportunity	Range of Potential Energy Savings[1]: (% Savings)	Non-Energy Benefits			
		Improved Occupant Comfort	Improved Building Control[2]	Extended Equipment Life	Reduced Heating and Cooling Load
Align equipment operating schedules with building occupancy	Approximately 2%-4% reduction in space heating load per hour of night setback[3]		X	X	X
Optimize hydronic and air supply temperatures	5%-10% of energy use in a typical air handling unit	X	X	X	X
Optimize ventilation and exhaust rates	Up to a 70% reduction in conditioned outdoor air volume	X			X
Diagnose and eliminate simultaneous heating and cooling	5%-25% of space conditioning energy depending on system type and severity	X	X	X	X
Eliminate passing valves	5%-10% of energy use in a typical air handling unit	X	X	X	X
Eliminate unnecessary lighting use	10%-40% of building lighting energy[4]	X	X	X	X (cooling only)
Implement seasonal disable for major equipment	2%-5% of annual system gas consumption[5]			X	X

1 General Assumptions: Savings may differ from ranges stated based on individual site condition and equipment type. Estimates are based on a unit floor area of 25,000 ft^2, with typical office operating hours, encompassing a range of weather data from major Canadian cities including Vancouver, Calgary, Edmonton, Toronto, and Montreal. Savings are for individual measures in isolation and would not apply if added together due to potential interactive effects.
2 Measures which improve building control increase the dexterity and/or effectiveness of building control systems and equipment. This can improve occupant comfort, help optimize equipment operation, automate processes to reduce building operator workload, help with fault diagnostics, etc.
3 Based on a setback of 3 ºC applied in the evening.
4 Includes savings from lighting automation controls.
5 Assuming two months per year of seasonal shutdown on a boiler with a 5:1 turndown ratio.

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