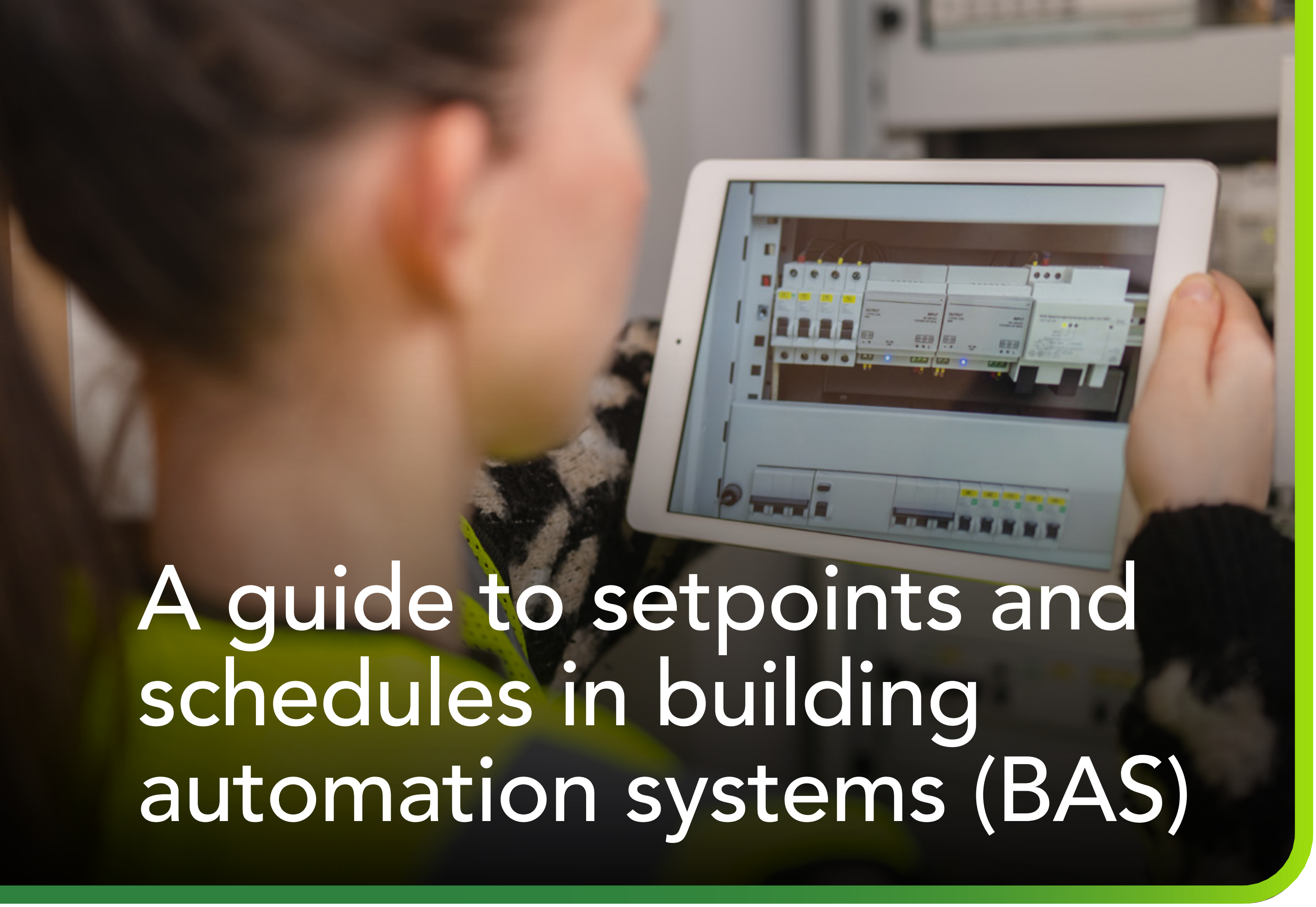

A guide to setpoints and schedules in building automation systems (BAS)

This guide is designed to help you optimize your BAS setpoints and schedules. Understanding the basics of a BAS is essential to help minimize energy use, reduce operational and maintenance costs of heating, ventilation and air-conditioning (HVAC) equipment and reduce greenhouse gas (GHG) emissions.

BAS basics

A BAS may also be referred to as a building management system, building automation and control system or building energy management system. In Ontario, BAS is the most commonly used term.

A BAS is a centralized network that automates, manages and controls all a building's critical systems, such as:

- **HVAC**
- **Lighting**
- **Security, fire and life safety**
- **Energy management**

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Important BAS terms to know

Input devices or sensors
Measure temperature, air speed, damper positions, occupancy and more.

Controllers
Regulate and maintain building conditions based on sensor data.

Output devices or actuators
Adjust system components based on the control signal response of the controller.

Communication protocol
The BAS language that allows building systems and devices to communicate seamlessly with one another. The most commonly used open protocol for BAS is BACnet, the Building Automation and Control Network protocol developed by ASHRAE.[1]

Setpoints
Desired conditions for building system operations that the BAS will focus on maintaining.

Schedules
Provided in the BAS to determine the days and times that systems operate.

Benefits of optimizing BAS controls

- **Minimize building energy use**
- **Lower GHG emissions**
- **Potentially extend equipment life**
- **Reduce operational and maintenance costs**
- **Enhance occupant comfort**

[1] https://www.ashrae.org/technical-resources/bookstore/bacnet

Strategies to optimize your BAS

The following are common tactics to optimize your BAS.

Schedules

1. **HVAC**
   Adjust the BAS's HVAC schedule to reduce equipment runtime hours during unoccupied periods (e.g., overnight, weekends and holidays).
2. **Zones**
   Trim zone sizes to reflect occupancy and operating hours. It's best to avoid using the same schedule for the entire floor if some areas have limited use.
3. **Lighting**
   Tighten lighting schedules to reflect building occupancy. Keep in mind maintenance and cleaning staff schedules.
4. **Holidays**
   Program statutory holidays in the BAS to reflect minimal occupancy. For a typical commercial building, weekend schedules and holiday schedules may be identical.
5. **Start/stop**
   Program optimal start/stop HVAC schedules in the BAS that efficiently sequence the equipment during morning startups and after-hour shutdowns. This helps avoid periods of peak energy demand while better aligning equipment use with occupancy.

Economizers

Set to enable
Air-side economizers modulate the outdoor air. They also return air dampers for free cooling when the enable economizer setpoint is met due to favourable outdoor conditions. Where economizers are present, ensure they are enabled in the BAS.

High-limit shutoff
Program air-side economizers to supply minimum outdoor air when the building relies on mechanical systems to cool the spaces. The economizer's control sequence in the BAS will force the economizer to shut down and revert to mechanical cooling when the high-limit shutoff value has been exceeded. Based on ASHRAE 90.1, the economizer is to be shut down when the outdoor air exceeds a dry-bulb temperature of 24 °C (75 °F) or the sensible and latent energy of the air exceeds 47 kJ/kg (28 btu/lb).

For details, see the International Energy Conservation Code, Chapter 4.

Pressure reset

Duct static pressure reset

Optimize the supply and return fan performance by adjusting the static pressure setpoints to match the building's actual pressure demand. Input minimum and maximum duct static pressure setpoints and integrate a control logic that directs the BAS to:

- Increase the duct static pressure setpoint by a specified margin (if the most open variable air volume [VAV] damper in the building is more than 95%), or
- Reduce the duct static pressure setpoint (if the most open VAV damper is below 85%).

This strategy can save 20 to 40% of fan energy use, based on the building.

Unoccupied setbacks

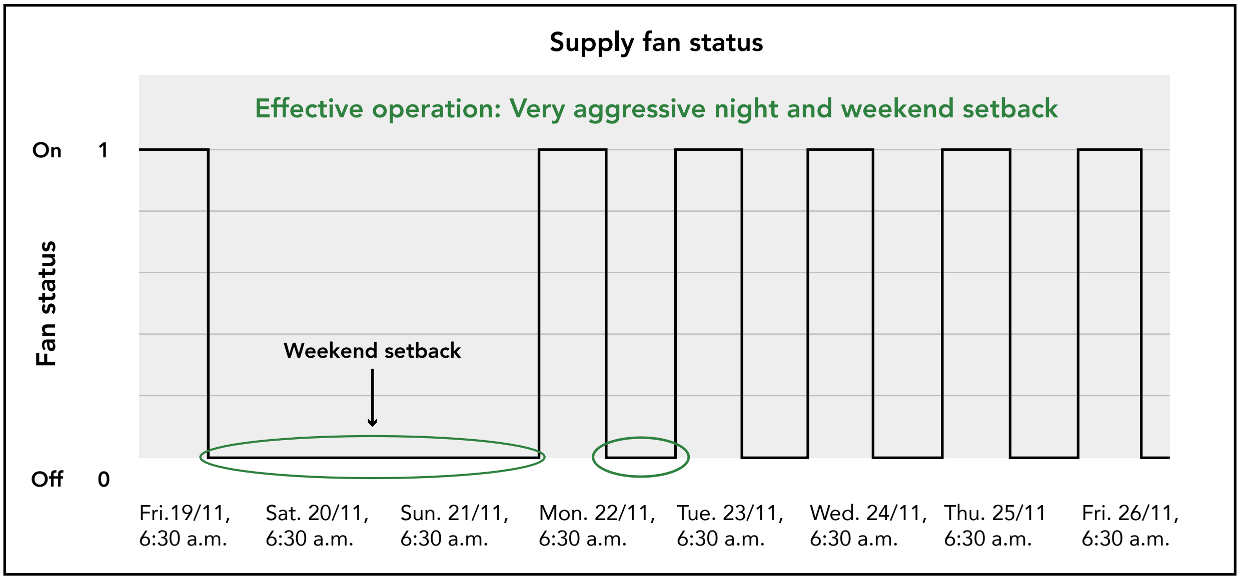
Unoccupied setbacks are a simple strategy to assess, implement and track energy consumption during low occupancy periods. When a building is unoccupied (typically overnight and on weekends), implement an unoccupied mode. This means adjusting the supply temperature and fan settings, from shortly after the building closes until the warm-up period of the next occupied period (typically, a few hours before the building opens).

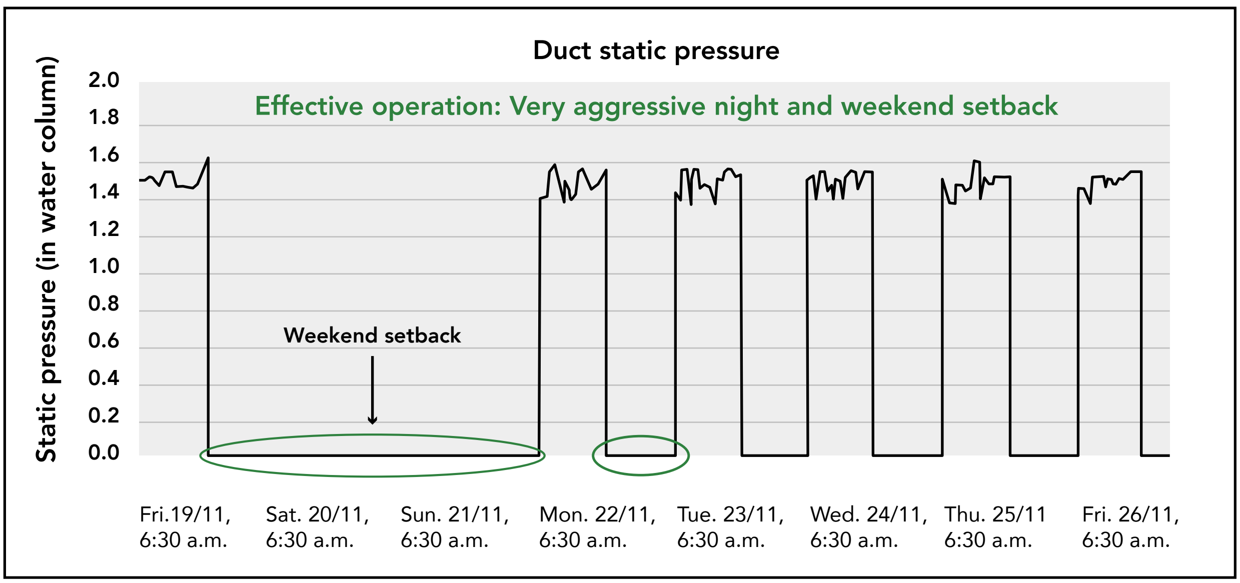
Adjust supply fan schedules

Start with an assessment of the current operation of fans during unoccupied hours. Check the supply fan status hourly. If the supply fan status is not an available point on the BAS, the duct static pressure values can be plotted on a graph to reveal the status. If there are unoccupied hours when the status was off, confirm that the hours match the building's unoccupied hours, or adjust the settings to achieve the desired schedule.

Effective occupancy strategy

The following graphs show examples of an effective occupancy strategy. Fans are shown to be off for the duration of the weekend and each weeknight. The fans restart at 6:30 a.m. Monday through Friday, allowing the building to achieve the desired occupied setpoint by 8:00 a.m.





Seasonal adjustments

Adjust zone temperature setpoints seasonally, by 2 to 4 °C during unoccupied hours as follows:

	Temperature range	
Season	**Occupied hours**	**Unoccupied hours**
Winter	20 – 21 °C (68 – 70 °F)	18 – 19 °C (64 – 66 °F)
Summer	24 – 26 °C (75 – 79 °F)	26 – 28 °C (79 – 82 °F)

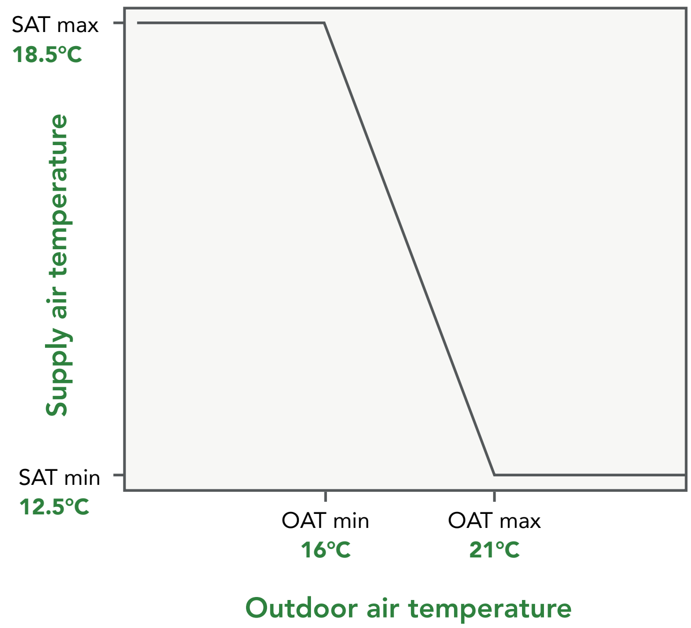
Temperature reset strategies

Supply air temperature (SAT) reset

The minimum SAT for most buildings is typically 12.5 °C (55 °F) to avoid condensation-related issues. The maximum is typically 18.5 °C (65 °F) to avoid high humidity and occupant discomfort.

For outdoor air temperatures (OAT) above the desired space temperature, the supply air temperature in the air handling units should be at minimum 12.5 °C (55 °F). As the outside air temperature decreases, the cooling and heating coils must vary in flow to gradually allow the SAT to increase within the 12.5 to 18.5 °C (55 – 65 °F) temperature range.

The adjacent plot represents what a typical BAS would use for a supply air temperature reset. In most cases, the supply air temperature is calculated based on linear interpolation, using the lower and upper limits of 16 °C (60 °F) and 21 °C (70 °F) for outside air temperatures. Maintaining a consistent temperature range results in energy savings as well as improved occupant comfort.



Temperature reset strategies

Chilled water (CHW) temperature reset

The ideal range for chilled water temperature is 6.7 to 10 °C (44 – 50 °F) for outdoor air temperature limits of 26.5 °C (80 °F) and 15.5 °C (60 °F) respectively. If the building has an economizer and the outside air temperature reaches the switchover setpoint, there will be no need for the chilled water, as the building will switch from mechanical cooling to free cooling. The switchover setpoint may vary based on the building, location, climate and the system type, but it can be expected to be around 12.5 °C (55 °F).

Hot water supply (HWS) temperature reset

Typically, the temperature range for a central heating system is 50 to 60 °C (140 – 180 °F). It's important to consider that older boilers risk corrosion at lower supply water temperatures, particularly below 50 °C (140 °F).

More tips for optimizing BAS settings

- Monitor the building's energy performance to identify any unusual changes in monthly and quarterly energy consumption (electricity, natural gas, water, or other utilities).
- Periodically review "snoozed" BAS alarms and make adjustments as needed. These alarms can indicate issues that are either minor or meant to be ignored for specific periods due to special circumstances within the building, such as renovations or known equipment malfunctions. Operators may choose to configure the alarm settings to only provide alerts for severe alarms. This allows operators to focus on critical issues.

Common building issues a BAS can help identify

Faulty valves

If the heating and cooling coil valves for air handling units are set to off, but the supply air temperature is either heated or cooled, this may indicate that the valves are faulty and require inspection.

Faulty sensors

If the dampers are set to be opened or closed, but airflow through the ducts does not correlate to the damper position, this may indicate the damper sensor is providing false data. Submit a work order to check the damper sensor and actuator to ensure the information being provided to the BAS is accurate.

Faulty readings

If zone temperature sensors are located close to a heating coil, in direct sunlight or away from the supply airflow in the ducts, unusually high temperature readings may result. The BAS may inaccurately call for cooling in that zone. If possible, relocate sensors for more accurate readings.

Conclusion

Optimization measures are often overlooked in the daily operations of buildings. The energy savings, improved occupant comfort and reduced GHG emissions from no-cost and low-cost measures can be significant—around 5 to 15% in energy savings for the average commercial building.

The best results are achieved when communication is maintained throughout the operational chain of a building. All partners involved, including the building operator, BAS technician, property managers, energy managers, consultants and any other contractors, should communicate regularly about the building's energy management strategies, and look for ways to optimize the existing operation, to maximize the potential that a BAS can provide.

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