

EMERGING TECHNOLOGIES AND ACCELERATED COMMERCIALIZATION PROGRAM (ETAC)

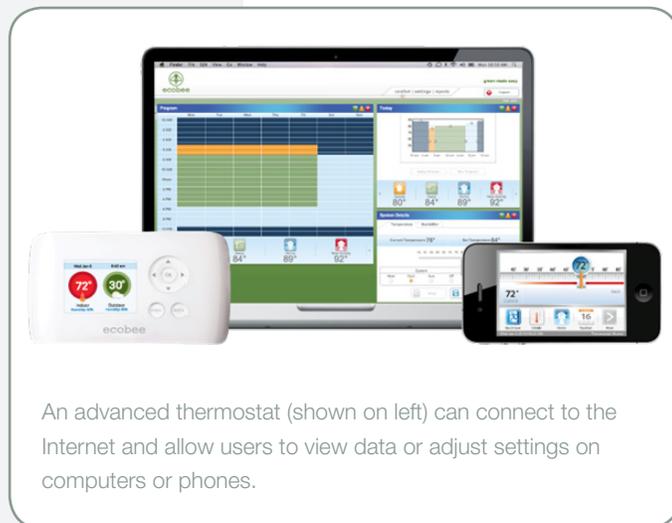
Advanced Thermostats Boost Energy and Cost Savings

Internet-connected technology offers remotely operated climate control solutions and monitoring to small and medium-sized commercial buildings.

Advanced thermostats offer an affordable opportunity to schedule, monitor, and control building systems for small and medium-sized commercial buildings. Building owners and managers can save time and money by making it easier to schedule and operate HVAC units to improve overall unit performance and comfort while also cutting energy costs.

An advanced thermostat is a programmable thermostat that can communicate with building owners, managers, and maintenance staff via a wireless or wired network and Web-based interface. It controls air conditioning or heating units (HVAC units) in the same way that a standard programmable thermostat does, but the Internet connection extends the range of capabilities. The benefits of advanced thermostats include:

- A straightforward, time-saving online interface.
- Reduced operations and maintenance staff time through use of remote control.
- Better comfort outcomes by offering the ability to preempt and more rapidly respond to deteriorating comfort conditions.
- The possibility of improved HVAC unit performance and lifetime with basic fault detection and performance data.
- Energy savings from improved usability and other smart features that optimize control.
- The optional ability to incorporate control, scheduling, and automation of non-HVAC technology like lights or other electric equipment (e.g., office plug loads), all through the same online interface.



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Comparing Advanced and Standard Programmable Thermostats

An advanced thermostat is in many ways similar to a standard programmable thermostat. The hardware for an advanced thermostat replaces a standard thermostat one-for-one – just remove the old one and connect the new one to the same wires. The advanced thermostat controls the HVAC system in the same manner as a standard programmable thermostat.

The major difference is that advanced thermostats communicate to the internet through a wired or wireless network, just like a laptop computer can. This connectivity allows advanced thermostats to be controlled remotely through a web-based interface accessible on a computer or phone. Now, users can control access to multiple thermostats from one central location. Advanced thermostats can also report back on system performance, alerting the user to problems or abnormalities and allowing them to monitor trends via the Web-based interface. The combination of remote control and reporting capability is what makes advanced thermostats more powerful than standard programmable thermostats and a worthy investment for some owners of HVAC equipment.

Internet-connected Thermostats Provide Many Benefits

Advanced thermostat systems provide many benefits including:

Ease of Use

Thermostat set points and schedules can be controlled through an online interface via computer or mobile application. Most owners and maintenance staff find the interface easier to use than the tiny keypad and screen on standard programmable thermostats. In addition, mobile applications mean that a user can adjust the thermostat settings at any time, from anywhere, overriding any “holds” or setpoints entered by a tenant or employee.

Reduced Operations and Maintenance

Remote capabilities are particularly useful to some users. Staff responsible for multiple facilities or a facility with many thermostats can save a lot of travel time by using advanced thermostats. For example, when a tenant, customer, or employee complains about a temperature setting, staff can frequently address the issue without leaving their office, car, or even home. Similarly, they can quickly ensure schedules and temperature settings are appropriate across multiple facilities. In addition, the advanced thermostat software is capable of setting a year-round schedule, as opposed to a weekly schedule that ignores holidays. All of these features ensure that the units can be set to operate efficiently without having to manually set each thermostat.

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Better Comfort Outcomes

Simpler interfaces ensure that the HVAC unit is set properly. As a result, the temperature settings are more likely to be appropriate and comfort will be improved. Moreover, by making it easier for staff to respond to issues, tenant, customer, or employee complaints can be remedied more quickly. Many software systems can even be programmed to send alerts via e-mail or text message to facility maintenance staff to warn them that settings have been changed or that the temperature in a space is reaching an uncomfortable temperature. The alerts allow them to proactively investigate before complaints even occur, improving tenant, customer, or employee satisfaction.

Improved HVAC Unit Performance and Lifetime

Similar reports and alerts can be used to keep expensive HVAC equipment in top condition. For example, if a unit has been running for a while, unchanged temperatures in the space can be a sign that something is wrong. The thermostat triggers an alert, which can be sent to facility maintenance staff or an outside contractor depending on the user's preferences. This individual can then remotely assess the situation by reviewing the last few days' or weeks' worth of performance data – which is available through the on-line interface – and remotely shut down the HVAC unit before damage occurs. Similarly, the software can send a monthly or quarterly report, detailing the performance of the HVAC unit and highlighting any unexpected changes, which may indicate the need for maintenance. These reports may also identify the type of maintenance required. By taking a more proactive maintenance stance with expensive HVAC equipment, users can improve the performance of the unit and extend its lifetime.

Energy Cost Savings

Advanced thermostats can save energy and money. Many users of standard programmable thermostats end up wasting money due to programming challenges that lead to the heat or air conditioning being on when no one is in the space. In many cases, an employee, tenant, or customer has altered the settings, sometimes placing the unit on full blast and overriding the planned schedule. Advanced thermostats can be set to lockout those types of changes altogether, or make it easier to identify them and revert the settings back to the planned schedule. Where thermostats are accessible and occupant modifications are common, this functionality can save more than 20% of heating or cooling energy costs.

Other intelligent features such as “smart recovery” can save energy, too. Smart recovery enables users to set the time they would like the building to reach a temperature as opposed to setting a time that the unit should start operating. This strategy eliminates the guesswork of estimating how long it will take for the unit to warm up (or cool down) the building. The thermostat uses historical performance and weather data to calculate it. Because most regular thermostat users take a conservative approach and give the unit a long time to reach its setpoint, smart recovery reduces overall runtime while delivering identical comfort outcomes.

Controlling Other Equipment

Most of today's advanced thermostats can independently control equipment in addition to HVAC units. Examples include lighting, refrigeration, hot water heaters, and any other equipment that can be turned off and on with an electric switch including office equipment and other plug loads. Auxiliary systems can be remotely controlled and scheduled using the same online interface that controls the HVAC system. Many advanced thermostats have extra input and output channels built into them to accommodate non-HVAC equipment and inputs other than temperature sensors. They lend themselves to significant customization and can form the backbone of more comprehensive equipment management systems. Some customers have used this additional capability for:

- Scheduling large office equipment to coincide with business hours.
- Tying HVAC units to an occupancy sensor in mobile classrooms.
- Connecting a walk-in refrigeration unit to a door contact sensor to alert users when the door is left open.

Which System is Right for My Building?

Advanced thermostats are most suitable to single-zone systems, such as packaged rooftop units or comparable split systems. Consider the following when selecting your system:

Communication Pathways

Wired System:

Pros	Cons
No issues with wireless range limitations	Installing wiring can be disruptive
Ethernet wires can power the unit (no need for batteries)	Wired system installation has a higher first cost
Minimal maintenance requirements (the wired network does not go down)	

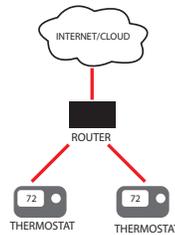
Wi-Fi System

Pros	Cons
Widely-used and familiar technology for the end user	Routers have limited range; overloaded networks slow data transfer
Can make use of existing Wi-Fi routers; no need to purchase extra hardware	Security issues; Wi-Fi can be hacked
Greater bandwidth than mesh networks	Wi-Fi requires maintenance (resets and password changes)

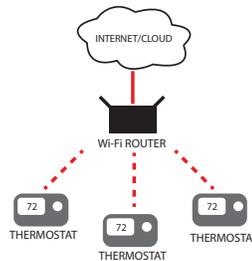
Mesh Network

Pros	Cons
Better range than Wi-Fi	Extra hardware must be purchased (gateway)
Extendable range (can add nodes to the network)	Each gateway requires a minimum number of thermostats to be effective (3)
Nodes provide redundancy, more reliable than Wi-Fi	Mesh networks have limited bandwidth, restricting data transfer

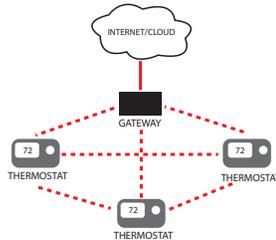
Wired System



Wi-Fi System



Mesh Network



- Communications Pathways:** Advanced thermostats can connect to the Internet in a variety of ways: through a wired network (via an Ethernet cable), a Wi-Fi network, or a mesh network. There are pros and cons to each method of connectivity (see inset), and you will have to select the one that works best in your building. Several advanced thermostat manufacturers offer both wired and wireless options and some can even use a mix of both for communication with peripheral devices and to the cloud.
- Power:** Advanced thermostats need power for their displays and to transfer data. Many advanced thermostats can draw power from the HVAC system itself. Others may require AC adapters, batteries, or Ethernet cables. AC adapters and Ethernet cables offer a more permanent solution, but require wiring, which may raise installation cost.

- Maintenance of Data:** Investigate whether there is an annual fee for continued access to the online interface and historical data from your new thermostats. Furthermore, certain businesses are extremely sensitive to security. In that case, pick a system that can be maintained on internal company servers as opposed to by the thermostat company.
- Training and Support:** Determine what type of training materials, in-person instruction, and documentation is offered by the manufacturer or the installer. Determine who will provide support if you encounter any issues.
- Combination of Features:** Managers and owners can choose advanced thermostat systems based on the package of capabilities they offer. For basic HVAC management, a variety of products offer the following: HVAC control like a normal thermostat; remote access for control of scheduling and set points; and a software platform to access data, generate reports, and provide text or email alerts. Going beyond basic HVAC management, advanced thermostat systems can also offer further enhanced software features including: mobile app access; use of historical data to better run the system; and greater embedded diagnostic capabilities.

- **Additional Controls:** Different systems are better suited to greater integration with non-HVAC equipment and additional controls. If you want the option to expand the system – either at installation or down the road – identifying a unit that includes additional input and output channels or, better yet, offers standalone non-thermostatic control points, would be wise. This option will maximize the integrative capacity necessary to handle other equipment.

Overall, advanced thermostats provide the opportunity for building managers and small business owners to save time and money. The advanced thermostat system leverages its connectivity capabilities to help run HVAC systems more efficiently and to diagnose problems and issues earlier and more effectively. Although not appropriate for all situations, these systems present viable control strategies and promise further integration of systems in the future.

Where do I Learn More?

Advanced programmable thermostat manufacturers and models include:

Autani, BayWeb, Comverge, Control 4, Cypress EnviroSystems, Ecobee Energy Hub, Enphase, Honeywell UtilityPro, Honeywell Prestige, Incenergy, Magnum, Network Thermostat, Proliphix, and Siemens Ecoview.

Visit the manufacturers' websites to learn more about each product and its features.

Note: This list is a representative sample of advanced programmable thermostat manufacturers, but is by no means all-inclusive. The listed manufacturers and their products are not endorsed by NYSERDA, and are provided for your information only.

Contact your HVAC service company to learn more about system options.

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The ETAC program supports multi-site demonstrations, provides in-depth performance validation, and shares results through dedicated outreach.