

Thermostats

Thermostats control HVAC operations to ensure occupant comfort, and they can cut energy costs when used correctly. In recent years a new type of thermostat we call “cloud” (also known as “smart” or “Internet-connected”) entered the market. We expect that cloud thermostats will become the new standard in HVAC controls for commercial buildings due to a combination of convenience and learning features, which make them an appealing replacement for nearly all existing thermostats.

WHAT ARE THE OPTIONS?

this section

There are three main types of thermostats: electromechanical, digital (also referred to as electronic), and cloud. Electromechanical thermostats have almost no features beyond temperature regulation; however, both digital and cloud thermostats offer a wide range of sophisticated capabilities.

Electromechanical

These devices are outdated and rarely found in the commercial sector anymore (**Figure 1**). Electromechanical thermostats use bi-metallic thermometers and mechanical switches (usually mercury-filled) to regulate temperatures. Their programming features are limited and they are difficult to maintain and secure.

Figure 1: Honeywell electromechanical thermostat

The most popular electromechanical thermostat used to be the round model shown here, but there were numerous rectangular models. A dial on the front of the round model physically rotated to indicate the setpoint temperature.



Source: Blair Allen

Some electromechanical thermostats are capable of being programmed to a couple of set temperatures for different times of day. Programmable thermostats operate with a physical clock and pins indicating the desired times for temperature changes.

If you replace an electromechanical thermostat, be sure to recycle the device through a recycling program or organization, such as the [Thermostat Recycling Corporation](#), to ensure that the mercury is handled properly.

Digital

The main distinction between digital and electromechanical thermostats is that digital thermostats use electronic temperature sensors and microprocessors. Another important distinction is that these thermostats have digital read-outs for the temperature settings and programming features (if they're programmable; **Figure 2**). Digital thermostats can be effective in saving energy and maintaining occupants' comfort if programmed and maintained correctly, but more often than not, that isn't the case. Building managers often don't know how to properly program and maintain the thermostats, and building occupants change settings without permission.

Figure 2: Honeywell digital thermostat

Digital, or electronic, thermostats have a display screen and buttons instead of the physical dials that electromechanical thermostats have.



Source: Chris Bowyer

Many digital thermostats offer features such as programmability, peak load management, humidity control, and security options.

Programmability. Not all digital thermostats are programmable, but those that are offer more sophisticated programming options than the electromechanical thermostats. Some devices have 5-2 programming, which allows users to set separate programs for the weekdays and weekends. Seven-day programmable thermostats are capable of maintaining a program for each day of the week.

It's important to note that, as the Lawrence Berkeley National Laboratory report [How People Actually Use Thermostats](#) (PDF) describes, programmable thermostats failed in the residential sector because they weren't utilized in the way designers intended, and residents didn't achieve the energy savings they expected. In some cases, residents' energy usage actually went up. Though we are unaware of any similar analyses of commercial programmable thermostats, we expect that building operators' experiences in the commercial sector are similar.

Utility peak load management. Some utilities use programmable, communicating thermostats to reduce power draw during peak load periods, when generating additional electric capacity is most expensive. Under these conditions, the utility sends out a signal that either adjusts thermostat setpoints or cycles the heating or cooling device on and off for a limited time. To encourage customers to participate in these load-management programs, utilities usually offer a bill credit.

Humidity control. Some thermostats offer the ability to sense and maintain humidity levels.

Intelligent recovery. Some digital thermostats sense how long it takes HVAC systems to recover after a setback or setup period and activate early to achieve the temperature setpoint by the desired time.

Security. Most digital thermostats offer security features that protect them from unauthorized tampering. Some offer two levels of security: The first requires the use of a personal identification number (PIN) to access all options and settings; the second enables users to change temperature setpoints without entering a PIN, but locks all other options and settings.

Service reminders. The most common reminder is a notice to change batteries, air filters, or air cleaners?based on either HVAC run time or a set interval. Some thermostats also feature alerts on the thermostat screen for humidifier maintenance.

Cloud

Cloud thermostats enable programming and multistage scheduling via Internet connection, whether wired or wireless. Cloud thermostats have digital temperature sensors, just as the digital thermostats do, with the added benefit of being able to store temperature settings and history in the Internet cloud (**Figure 3**).

Figure 3: Ecobee cloud thermostat

Though Ecobee is primarily a residential cloud thermostat manufacturer, it does market to business customers as well. As pictured here, users have the option to add personalized ?skins? to these devices. Cloud thermostats have large display screens and few, if any, buttons.



Source: Ecobee

Much like the advanced digital thermostats, cloud models are password-protected for security, offer humidity control options, and have utility peak load management capabilities (see the corresponding descriptions above for details), but the list doesn't end there. These devices incorporate a wide variety of features ranging from sophisticated programmability to auxiliary inputs. All the features of cloud thermostat combined provide the potential to save as much as 50 percent overall energy consumption when replacing a standard digital thermostat.

Programmability. Cloud thermostats' programming capabilities are more advanced than those of digital thermostats. Better than the 5-2 programming option, cloud thermostats offer 366-day programming. Users can even schedule special holiday settings for five years out.

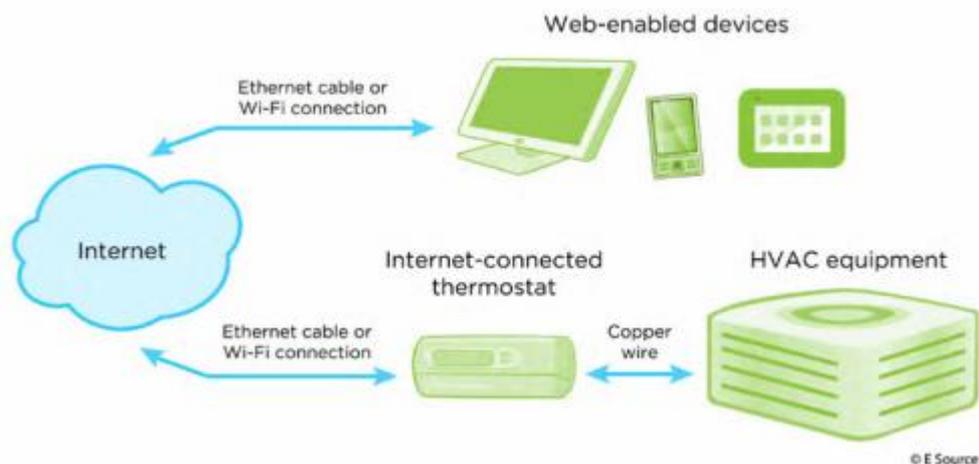
Utility peak load management. Just as digital thermostats do, cloud thermostats have peak load management features. The utilities can connect to thermostats and alter a setpoint temperature in heating or cooling events. With cloud thermostats, the reports that include demand offsets from such events are easily accessible via the Internet.

Internet connectivity. An Internet connection enables online access and data reporting and allows building operators to control and monitor settings remotely with any device that has Internet access—including computers, tablets, and smartphones (**Figure 4**).

Figure 4: How cloud thermostats work

This diagram illustrates how web-enabled devices are virtually connected to cloud

thermostats. With either Wi-Fi or Ethernet cables, smartphone, tablet, and computer users can communicate with those thermostats, manage settings, and analyze history.



History and analysis. Unlike digital thermostats, cloud devices save the history of use in the Internet cloud. Users can access this stored data and analyze it, identifying patterns of use and diagnosing failures. In-depth and consistent data recording can help users troubleshoot problems such as imbalanced heating.

Auxiliary relays. Some cloud thermostats come with two auxiliary relays that can be used to control other devices such as humidifiers.

Intelligent recovery. In addition to activating in time to achieve a set temperature by a certain time, the way digital thermostats do, some cloud thermostats take into account outside temperature when computing their appropriate trigger time.

Notifications. Similar to digital thermostats? service reminders, notifications are set to alert the building operator to extreme temperatures and parts requiring maintenance. Unlike digital models, which display a limited number of reminders based on HVAC run time or set intervals, cloud thermostats send e-mail alerts according to the live and actual performance of the HVAC system.

HOW TO MAKE THE BEST CHOICE

this section

Cloud thermostats offer a wide variety of valuable features at a low incremental cost, making them a clear choice when replacing old devices. Not only are the capabilities of

these devices convenient, but they can also save energy. The Bonneville Power Administration [Measure Summary Report: Web-Enabled Programmable Thermostats](#) illustrates their energy-saving potential, noting one particular instance of 50 percent energy savings when replacing a digital model with an Internet-connected thermostat.

When replacing a thermostat, it's important to ensure that the new thermostat is compatible with the existing HVAC equipment. Some equipment requires specific technology in the thermostat.

WHAT'S ON THE HORIZON?

this section

The next frontier for thermostats is combined HVAC and lighting controls. Users could control both HVAC and lighting settings remotely via Internet connection with one application. Cloud lighting controls already exist and enable individuals in an office to personalize the lighting above their cubicle online. Cloud lighting controls also streamline maintenance with alerts of lamps that will soon burn out. It seems natural that either the cloud lighting or thermostat manufacturers will design a product that will combine the features of both existing products into one convenient package.

WHO ARE THE MANUFACTURERS?

this section

For those interested in upgrading, the following manufacturers produce cloud thermostats:

- [Proliphix](#)
- [Bay Controls](#)
- [Radio Thermostat Company of America](#)
- [75°F](#)
- [Ecobee](#)

A number of companies sell the applications necessary for operation of the device:

- Proliphix
- Bay Controls
- InThrMa
- Makad Energy
- I?m in Control

Neither this list nor any mention of a specific vendor or product constitutes an endorsement or recommendation by E Source, nor does any content the Business Energy Advisor constitute an endorsement or recommendation, explicit or otherwise, of your service provider's various technology-related programs.

All content copyright © 1986-2017 E Source Companies LLC. All rights reserved.

Source URL: https://tva.bizenergyadvisor.com/BEA1/PA/PA_HVACControls/PA-56