Building energy codes driving efficient design

Energy codes are part of a broader collection of building codes, which govern the design and construction of residential and commercial structures. It is well known that energy codes address increasing the efficiency of building systems, but how do you know which energy codes apply and how do you comply? This paper addresses the basics of what energy codes are most important when it comes to building systems efficiency and how to meet them.
**Energy code basics**

The future is electrifying. Electricity growth is on pace to take the same share of growth that oil took over the last 25 years.\(^1\) Electricity is the energy of choice across households and commercial facilities alike; electricity consumption accounted for 47 percent of total U.S. household energy consumption and 61 percent of commercial buildings.\(^2\) Already, residential and commercial buildings account for roughly 40 percent of the total U.S. energy consumption.\(^3\)

Increasing the energy efficiency of buildings systems is one of the most effective ways to reduce energy costs and greenhouse gas emissions. Energy codes address this challenge; as the primary focus of energy codes is to increase energy efficiency of building systems.

By providing guidance to increase energy efficiency, energy codes also help reduce energy costs, drive reductions in greenhouse gas emissions and pollution, and create more comfortable living and working environments by improving air quality.

In the U.S., energy codes were created in the 1970s in response to the energy crisis at that time. By 1978, Congress passed the first legislation requiring states to initiate energy efficiency standards for new buildings. These standards have long-term consequences; the average lifespan of a building is about 50 years and so codes applicable at that time are impacting building energy usage today.\(^4\)

Energy codes address a wide range of construction: HVAC equipment, lighting fixtures, insulation and more. And applicable codes are typically contingent upon the building’s climate zone.

Compliance with energy codes typically falls into either prescriptive or performance-based approaches:

1. Prescriptive codes “stipulate the stringency of the materials and equipment the builder needs to use”
2. Performance or outcome-based codes “allocate a total allowable energy use for proposed building,” allowing the design team to select materials and equipment that meets set targets

The latter, performance codes, provide flexibility and the building energy usage intensity (EUI) determines if the project is compliant.\(^5\)

**Voluntary, model and enforceable energy codes**

There are three basic types of energy codes that drive energy efficient design in construction projects. These include: voluntary, market-based system; model codes; and enforceable codes.

The most common voluntary rating in the world is the Leadership in Energy and Environmental Design (LEED) program. This system rewards building owners with an efficiency rating.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 90.1 and International Energy Conservation Code (IECC) are the national model energy codes. They are designed to help state and local jurisdictions who would like to use these as a framework for enforceable regulations through legislation. Both ASHRAE 90.1-2016 and 2019 IECC are updated on a three-year cycle.

**Enforceable codes** are where the rubber hits the road; these are the building codes adopted by the state for all buildings. Code enforcement is typically carried out at the county or city level. Nonetheless, local jurisdictions are required to assure code compliance.

The state code sets the minimum level of energy efficiency for residential and commercial new construction statewide. Mandatory codes are legislated by state or other jurisdiction and are typically either based on model codes (like ASHRAE 90.1 or IECC) or are independently developed, like California’s Title 24, for example. Further, local codes can be more stringent that the state guidelines.

**Basic requirements of ASHRAE 90.1: Metering is integral**

Since 2013, ASHRAE 90.1 has incorporated a variety of submetering requirements for all buildings or building additions over 25,000 square feet (sf). Typical metering provides utility measurements for the whole building or facility each month. Submetering is defined as the application of metering technology below the level necessary for utility metering.\(^6\)

While submetering does not reduce utility costs directly, it provides building owners and facility managers with real-time information on how energy is being used and the data to help optimize operations, equipment and energy budget forecasting – which can result in overall cost savings. Submetering provides “powerful insight into a building’s resource use by capturing more detailed consumption information, which helps to identify building inefficiencies, meet performance goals, and improve occupant awareness.”\(^7\)

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Panel or circuit submeters measure resource use and provide important insights into consumption habits of specific building systems and equipment.

Image source: Sustainable Facilities Tool, General Services Administration: https://sftool.gov/explore/green-building/section/96/submetering/system-overview#submeter-levels/panel-circuit

For buildings that are more than 25,000 sf with multiple tenants, submetering must be separately monitored for the total building and each tenant with 10,000 sf or more, excluding shared systems.

The data from submetering provides a baseline and allows for benchmarking against performance standards and supports five benefit areas through information or data captured by submeters:

- **Economic:** based on changes in operations and maintenance
- **Reliability:** through proactive maintenance and early indications of problems
- **Environmental:** by reducing energy usage, which reduces environmental impact
- **Security:** reducing the risk of hazards
- **Behavioral:** greater awareness of energy consumption habits provides the information needed to change those habits

**Stretch codes – going beyond the basics**

Stretch energy codes go beyond the basics. A stretch energy code is a “voluntary appendix to a mandatory statewide minimum energy code” that allow local towns or cities to achieve greater levels of efficiency. These codes pull the construction industry into changes beyond the current energy code into efficiency levels that may be a part of the next update for the state and help avoid “the patchwork of dozens of different local energy codes.”

Stretch codes have so far applied to the construction of new residential buildings that are three stories or less, portions of existing residential buildings that are being renovated or added upon, or larger commercial buildings.

Recently, the New Building Institute has developed a 20 percent stretch code that aims at 20 percent better efficiency than current national building codes and offers municipalities a set of energy-saving building strategies. This guidance provides cities with the basis to increase energy savings in both commercial and residential projects.

In 2009, Massachusetts was one of the first states to adopt stretch codes. The applicable codes here were unique in that they were performance based (not prescriptive) and allowed the local construction industry the flexibility to meet performance requirements.

As of June 2018, the Department of Energy data indicates that a total of seven states have adopted 90.1-2013 or more efficient guidelines for commercial buildings:
Green building model raises the bar for efficiency
Similar to stretch codes, green building codes go beyond basic code requirements. These codes can provide a “proving ground” for standards and incorporate elements beyond the “scope of the model energy codes.” These codes provide another tool for local municipalities to guide construction that is more sustainable.

For example, International Green Construction Code (IgCC) is written to be used with International Code Council guidance and improve upon that by generally increasing the efficiency by 10 percent. ASHRAE 189.1, Standard for Design of High-Performance Green Buildings Except Low-Rise Residential Buildings, addresses “site sustainability, water use efficiency, energy use efficiency, indoor environmental quality and the impact on the atmosphere, materials and resources.”

Building performance benchmarking
Many cities require performance benchmarking, which helps tenants understand how buildings compare to similar facilities that look and operate similarly. The Environmental Protection Agency’s Energy Star Score provides guidance on how a facility compares against other similar buildings nationwide. Top performing buildings are eligible for Energy Star certification.

According to the EPA, buildings that were benchmarked consistently reduced energy usage by 2.4 percent per year on average. Further, buildings that started as “poor performers” generated even more savings. Ultimately, benchmarking helps building or facility managers effect change and improve resource utilization based on performance data.

Submetering + IoT connectivity supports model and stretch code compliance
According to the DOE, energy codes will save U.S. homes and business owners an estimated $126 billion and 841 million metric tons of avoided carbon emissions through 2040. A critical component of energy codes is collecting the data needed to make effective and prescient operational decisions that are based on current energy habits and are tailored to actual energy needs.

Now, through Eaton’s cloud-based software for energy visualization, facility managers can aggregate load types and monitor facility-wide energy usage.

As we increasingly rely on electricity as an energy source, finding simple and cost-effective ways to drive efficiency, reduce costs and environmental impact is crucial. Energy codes provide the framework to meet these goals and submetering is right tool in the proverbial shed to provide the data to effect change.
References


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