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## Energy Code Primer: Lighting Control and Plug Loads

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## Module 1: Energy Codes: Objectives and Benefits

### Learning Objectives

By the end of this section, you will be able to:

- **Identify** the specific building systems and components governed by national and local energy codes.
- **Evaluate** the primary differences between prescriptive and performance-based compliance methods.
- **Determine** the adoption status and regulatory timeline for major energy standards like ASHRAE 90.1.

*Executive Summary:* Building energy codes establish minimum efficiency boundaries to mitigate uncertain energy supplies and capacity constraints. Through standardized enforcement—including plan reviews and field inspections—these codes mandate cost-effective strategies to reduce building life-cycle costs and environmental impact.

### Energy Codes: Design Fundamentals

Why should we bother to address energy usage in buildings? Our **uncertain energy supply** (the bulk of the country's energy comes from petroleum-based products) and **capacity constraints** (the cost and environmental impact to build new power plants) are just a couple of the reasons why it is important to address energy consumption in buildings. Building energy codes address cost-effective, energy-efficient strategies to **reduce energy usage and demand**, eliminate inefficient construction practices, and improve our environment and the air we breathe.

Additionally, various organizations have cropped up over the past several years to tackle the need for sustainable building practices. Examples include:

- U.S. Green Building Council (USGBC): Administers the **LEED®** program, focusing on practical green building design and operations.
- **International Dark-Sky Association (IDA)**: Works to curb the hazards of light pollution.

### Code Coverage and Building Systems

What specific parts of buildings do energy codes cover? They apply to a building's **envelope** (the materials that make up its outer shell) as well as its **systems and built-in equipment**.

- **Building Envelope**
- **Mechanical Systems**
- **Service Water Heating**
- **Lighting**



- **Electrical Power**

The life cycle of a building is typically decades and can even be centuries long. As minimum energy-use requirements in these vital areas are improved, future generations will benefit from more efficient and less costly living and working environments.

### Primary Energy Standards


Major energy codes exist at national, state, and city levels to set baseline efficiency metrics.

### National Energy Codes

- **ASHRAE Standard 90.1:** Versions include 1999, 2001, 2004, 2007, 2010, and 2013.
- **International Energy Conservation Code® (IECC®):** Developed by the ICC; versions include 2003, 2004s, 2006, 2009, 2012, and 2015.

### State and City Codes

- **State:** California Building Energy Efficiency Standards and Washington State Energy Code (WSEC).
- **City:** Seattle Energy Code and Albuquerque Energy Conservation Code.

 **Design Tip:** Always verify the specific jurisdiction's adopted code version, as some states lack a statewide code and rely on local city-level mandates.

### Energy Code Benefits and Impact

## Implementation and the Building Process

Enforcement strategies vary according to a state or local government's regulatory authority, resources, and manpower. Commonly they include some or all of the following activities:

- **Review of plans** and supporting calculations.
- **Review of products**, materials, and equipment specifications.
- **Review of tests**, certification reports, and product listings.
- **Field Inspection** of the building and its systems during construction and prior to occupancy.
- **Evaluation of materials** substituted in the field.

### Commercial Building Energy Code Adoption Status

Codes are not effective nor enforceable unless adopted by a state or other jurisdiction.

- **High Efficiency:** 2 states have adopted ASHRAE 90.1-2013 or IECC 2015.



- **Standard Adoption:** 20 states utilize 90.1-2010/IECC 2012; 21 states utilize 90.1-2007/IECC 2009.
- **Baseline:** Over 70% of states have adopted 90.1-1999 or better.

### DOE Rulings and Mandatory Compliance

Rulings from the U.S. Department of Energy (DOE) drive state updates to building energy codes. This results in mandatory lighting control requirements for new construction and major renovations.

### DOE Determination Timelines

- **July 2011:** DOE determined 90.1-2007 saves 3.7% more energy than the 2004 version. States had until July 2013 to certify compliance.
- **October 2011:** DOE determined the 2010 version saves 18.2% more energy than the 2007 version. States had until October 2013 to certify compliance.

⚠ **Safety Constraint:** States must file certification that their commercial building energy code meets or exceeds the determined ASHRAE version by the DOE-mandated deadlines.

### Energy Code Compliance Methods

Two primary approaches determine if a design meets energy code requirements.

#### The Prescriptive Method

The most common approach, requiring that a building and its individual components be built exactly to the **prescribed values** (e.g., specific R-values or lighting power densities) listed in the code.

#### The Performance-Based Method

Focuses on the building's **energy performance as a whole** rather than individual components.

- The structure is allocated an **energy budget** (total allowable energy use).
- Engineers can use various combinations of efficiencies to stay within this budget, allowing for design flexibility.



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*Checkpoint Quiz*

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**1. Which building component is typically EXEMPT from building energy code coverage?**

- a) Building Envelope
- b) Interior Furnishings
- c) Service Water Heating
- d) Lighting Systems

**Answer:** (b). Energy codes specifically apply to the building envelope, mechanical systems, service water heating, lighting, and electrical power.

**2. Under the performance-based compliance method, how is a building evaluated?**

- a) Each component must meet a specific prescribed value in the code.
- b) Each room is assessed space by space for individual component efficiency.
- c) The building must meet a total allowable energy budget as a whole.
- d) Compliance is only required for buildings larger than 10,000 sq. ft.

**Answer:** (c). This method prioritizes overall structure performance over individual component values.

**3. What was the significant energy savings increase determined by the DOE when moving from ASHRAE 90.1-2007 to the 2010 version?**

- a) 3.7%
- b) 10.5%
- c) 18.2%
- d) 25.0%

**Answer:** (c). The October 2011 DOE determination found that the 2010 version offered substantially higher savings compared to the 2007 version.



## Module 2: Plug Load Control

### Learning Objectives

By the end of this section, you will be able to:

- **Identify** the mandated spaces and percentage requirements for automatic receptacle control under ASHRAE 90.1-2013.
- **Evaluate** different hardware solutions, including wireless RF and timed receptacles, for code compliance.
- **Select** appropriate permanent marking methods to visually differentiate controlled outlets per NEC and California Title 24 requirements.

*Executive Summary:* Plug load control limits energy consumption for products powered by standard 125V AC plugs through automatic shutoff mechanisms. Modern codes like ASHRAE 90.1-2013 and California Title 24 mandate that at least 50% of receptacles in high-use commercial spaces be automatically controlled and permanently marked for easy identification by end users.

### Defining Plug Load Control

A basic definition of **plug load control** is the ability to limit the energy used by products powered by an ordinary AC plug (15 or 20A, 125V). Engineers should approach these loads with the same logic used for lighting controls. While several methods exist to manage these loads, professional practice requires selecting methods that specifically meet modern energy code requirements.

### Strategies for Implementation

While simply unplugging equipment is the most basic form of control, human behavior often makes this unreliable, necessitating automated solutions.

- **Plug-in Devices:** These can be controlled via smart phones or sensors but **do not comply** with ASHRAE 90.1-2013 mandates for permanent installation.
- **Network-Based Control:** Receptacles are integrated into a lighting management system where entire circuits are controlled by external relays or power packs.
- **Device-Level Control:** The control mechanism is integrated directly into the receptacle itself.

### ASHRAE 90.1-2013: Section 8.4.2 Mandates

The standard requires automatic control for the following:

- **Specified Spaces:** At least **50% of all 125-volt 15- and 20-amp receptacles** in private offices, open offices, conference rooms, print/copy rooms, break rooms, classrooms, and individual workstations.
- **Modular Furniture:** At least **25% of branch circuit feeders** installed for modular furniture not shown on construction documents.



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