

# Commercial Energy Codes Build a Better Bottom Line

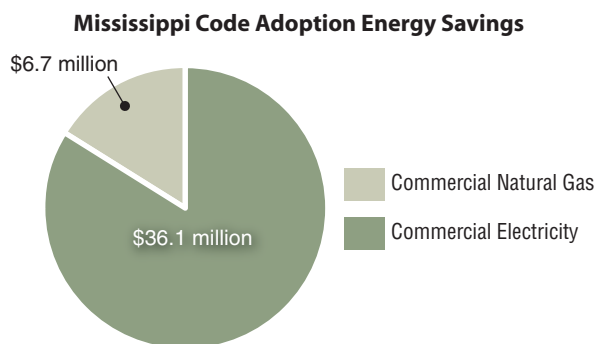
■ Reduce call backs ■ Streamline regulation ■ Market advantages

## Why do building energy codes matter?

Energy codes directly benefit Mississippi commercial contractors and designers by helping ensure increased energy performance. This translates into the following:

- Consistent requirements across the state
- Reduce consumer complaints
- Fewer warranty related call backs
- Higher levels of comfort
- Improved indoor air quality
- Lower energy bills

By adopting the American Society of Heating and Refrigerating and Air-conditioning Engineers (ASHRAE) standard 90.1-2007 as its commercial energy code, the state of Mississippi will be investing in the local construction industry's competitiveness in the global marketplace. Energy codes will also boost the local economy by allowing businesses to spend money that would have otherwise been spent on utilities on other goods and services.



*Projected five-year savings, 2012-2016<sup>1</sup>*

## Long-term financial savings

Savings realized through lower utility bills are the most significant economic benefit achieved by energy code adoption, as these savings directly benefit commercial tenants and property owners month after month throughout the life of the building.

Further, the incremental cost of component upgrades to enhance the energy performance of a building can be included in the overall project financing. Additional monthly financing costs are often paid for by reduced utility costs.

## Mississippi energy savings potential: code-compliant vs. current practice

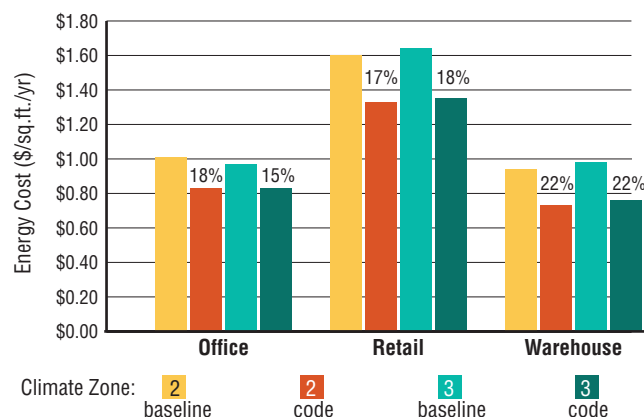
In order to demonstrate the potential energy savings of adopting energy code in Mississippi, building simulations were created for three common building types: office, retail, and warehouse. The analysis includes a baseline energy cost for each type of building, calculated using current building practices, as well as a projected energy cost for the same building, calculated with the addition of the ASHRAE 90.1-2007 standard.

**Office:** A 10,000 sq. ft. steel-framed building with insulation above the flat roof deck.

**Retail:** A 5,000 sq. ft. wood-framed building with a pitched roof and insulated on the attic floor.

**Warehouse (conditioned):** A 45,000 sq. ft. metal building with blanket batt insulation over the roof purlins and walls.

## Mississippi Commercial Building Simulation Comparisons<sup>2,3</sup>



## Potential Annual Energy Cost Savings<sup>2,3</sup>

| Climate Zone 3 | Cooling | Heating | Lighting | Total Savings |     |
|----------------|---------|---------|----------|---------------|-----|
|                |         |         |          | \$            | %   |
| Office         | \$380   | -\$97   | \$1,613  | \$1,896       | 15% |
| Retail         | \$345   | -\$111  | \$1,263  | \$1,497       | 18% |
| Warehouse      | \$2,390 | \$1,539 | \$5,854  | \$9,783       | 22% |

| Climate Zone 2 | Cooling | Heating | Lighting | Total Savings |     |
|----------------|---------|---------|----------|---------------|-----|
|                |         |         |          | \$            | %   |
| Office         | \$368   | -\$87   | \$1,613  | \$1,893       | 18% |
| Retail         | \$269   | -\$99   | \$1,263  | \$1,434       | 17% |
| Warehouse      | \$2,655 | \$970   | \$5,854  | \$9,479       | 22% |

*Note: Heating costs increase primarily due to reductions in heating energy produced by lighting. This provides a net positive impact on cooling costs.*

## The building as a system

The energy code looks at the building as a system that is dependent on the interaction of key components to function properly. Each of these components must be designed with the Mississippi climate in mind and installed correctly, or the entire building system can suffer problems.



### Envelope

The entire building envelope—the roof/ceiling, exterior walls, and floor/foundation—should have complete insulation coverage with no gaps, voids, or compressed areas. The code provides designers flexibility in choosing techniques and products, but requires that materials be installed properly according to the manufacturer's specifications. Installing insulation correctly requires coordination between trade contractors. Improperly installed insulation can reduce performance by as much as 25%. The energy code sets minimum R-value requirements for insulation based on local climate zone. The following are non-residential R-value requirements (for residential and semi-heated buildings, reference ASHRAE 90.1-2007).

#### Roofs

- Insulation entirely above deck: R20 continuous insulation (c.i.)
- Metal building: R13 parallel to purlins + R13 perpendicular to purlins + thermal blocks
- Attic and other: R38

#### Walls, above-grade

- Mass: R7.6 c.i. (Climate Zone (CZ) 2: R5.7 c.i.)
- Metal building: R13
- Steel-framed: R13 + R3.8 c.i. (CZ2: R13)
- Wood-framed and other: R13

#### Floors, over unconditioned space

- Mass: R6.3 c.i.
- Steel-joist: R19
- Wood-framed and other: R19



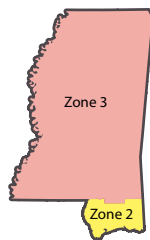
### Air sealing

The code requires a continuous air barrier that prevents air movement, also known as air infiltration, in or out of a building. Air infiltration has a significant effect on building energy consumption and reduces the effectiveness of insulation. Air infiltration also affects the comfort, durability, and indoor air quality of a building. Constructing tight enclosures is key to preventing air infiltration. Examples of areas that should be sealed include: cracks, penetrations, windows, doors, and wall/roof junctures. Drop ceilings do not form effective air barriers, therefore batt insulation should not be installed over them.



## Windows

Efficient windows lower energy consumption, improve comfort, and may contribute to a reduction in HVAC size. The



energy code requires that windows meet specific performance levels. Window performance is rated by an average whole-window U-value, a measure of thermal conductance, and the Solar Heat Gain Coefficient (SHGC), a measure of the amount of solar energy transmitted through the window. The energy code requires that windows meet specific performance requirements.

|                | U-value | SHGC |
|----------------|---------|------|
| Climate Zone 3 | 0.60    | 0.25 |
| Climate Zone 2 | 0.70    | 0.25 |

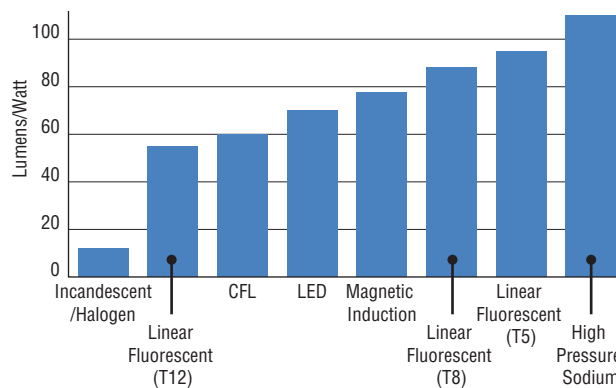


## Lighting

**Design**—The lighting design of a building impacts the initial cost, lighting quality, and energy consumption. The designer must perform a lighting calculation in order to provide adequate lighting levels without exceeding code requirements. Meeting code lighting requirements ensures that each space receives an adequate, but not excessive, amount of light. Excessive lighting increases installation costs for the project and increases cooling energy consumption throughout the life of the building.

**Types**—The type of lighting selected for a building can have a significant impact on its energy use. Lighting efficacy is a measure of how much light (lumens) is produced for a given power input (watts) or lumens per watt. *For example, a T8 lamp produces 730% more light for the same wattage as incandescent.*

Lighting Efficacy



## HVAC

**Equipment**—Cooling efficiency for small air conditioning equipment is measured by Seasonal Energy Efficiency Rating (SEER). Heating efficiency for gas furnaces is measured by Annual Fuel Utilization Efficiency (AFUE) for gas heating. The minimum allowable SEER rating is 13 and the minimum allowable AFUE is 80%.

## CASE STUDY

This case study estimates the energy use of a standard office building constructed using standard Mississippi construction practices compared to an energy code-compliant office building. The building energy simulation was performed with eQUEST.<sup>2</sup> The office building used in this study is a one-story, 10,000-square foot building located in Jackson, MS (Climate Zone 3). This building is constructed with a flat roof and steel-framed walls with 20% of the wall area composed of vertical glazing. Standard construction practices are based on a regional survey. The energy costs are based on an average electricity rate of \$0.093 per kWh and a natural gas rate of \$0.85 per therm.<sup>2,3</sup>

### BUILDING SYSTEMS



**Envelope** – the thermal boundary comprised of an air barrier and insulation surrounding the conditioned space



**Air sealing** – use of a sealant to block critical air leakage points in the building envelope to limit infiltration



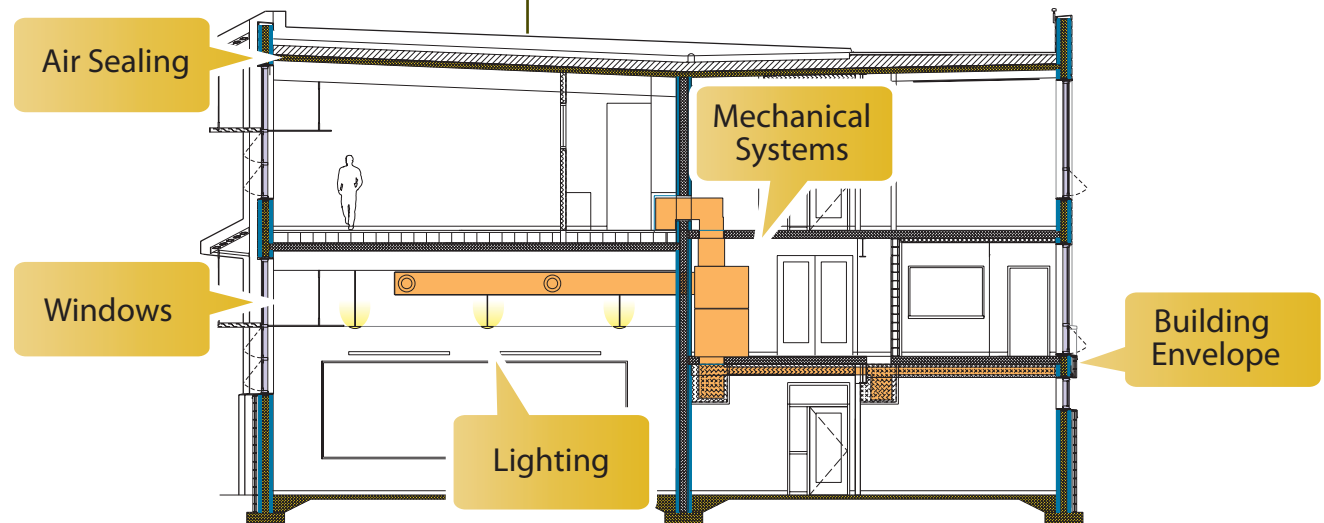
**Window** – windows must meet the minimum performance specifications based on climate zone



**Mechanical systems** – high efficiency systems, ducts inside the thermal envelope, and reduced internal/external loads will help minimize heating and cooling energy consumption

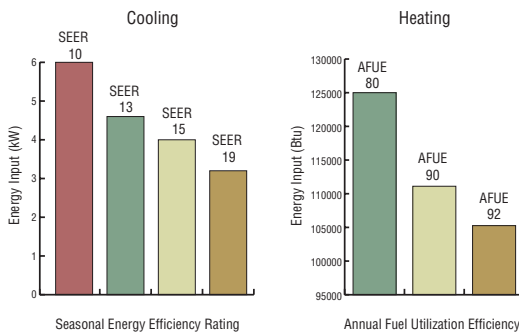


**Lighting** – compliance with lighting requirements achieves significant lighting and cooling energy savings in commercial buildings



| Features                      | Standard Office     | Code-Compliant Office | Energy Savings |
|-------------------------------|---------------------|-----------------------|----------------|
| Steel Stud Wall               | R-13                | R-13 + R-3.8 ci       | 0.5%           |
| Flat Roof                     | R-15 ci             | R-20 ci               | 0.3%           |
| Window U-Value                | 0.4                 | 0.65                  | -0.2%          |
| Window SHGC                   | 0.35                | 0.25                  | 0.7%           |
| Lighting Power Density (W/sf) | 1.55                | 1                     | 14.0%          |
| HVAC (EER)                    | 10.8                | 11                    | 0.5%           |
| Air Infiltration              | 0.261               | 0.163                 | 0.5%           |
| Ext Lights (W/sf)             | 0.2                 | 0.1                   | 3.0%           |
| Usage                         | Annual Energy Costs |                       | Annual Savings |
| Cooling                       | \$2,106             | \$1,772               | \$334          |
| Heating                       | \$249               | \$346                 | -\$97          |
| Lighting                      | \$4,133             | \$2,833               | \$1,300        |
| Total                         | \$10,394            | \$8,499               | \$1,537        |

### Energy usage comparison of HVAC equipment efficiencies<sup>4</sup>



**Duct location and insulation** - Locating HVAC ducts inside the thermal envelope minimizes the impact of duct leaks and reduces the amount of duct insulation that is required, thereby reducing costs.

Duct insulation is required in:

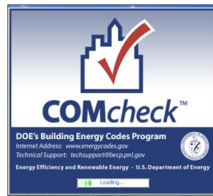
- Unconditioned space: R-3.5
- Exterior ducts or in a vented attic: R-6

*For example: In a vented attic space, ducts must have R-6 insulation. However, using an unvented attic and insulated roofline would require R-3.5 duct insulation. In this case, any duct leakage would still contribute to the building's heating and cooling needs.*

**Setbacks and optimum start** – HVAC controls allow the user to set time periods for each day when the space should be conditioned to pre-programmed temperature settings. Once programmed, the temperatures are automatically controlled by the thermostat. The desired temperatures are programmed for the hours when the building is occupied and then the temperature is set back (called temperature setbacks) when unoccupied. Temperature setbacks should be 55 degrees in the winter and 90 degrees in the summer based on ASHRAE 90.1-2007 energy code. For most buildings, the setback temperatures would not be reached after hours.

Controls with optimum start, or “smart” recovery, features have the ability to reach desired temperatures when the building becomes occupied by measuring how long temperature recovery takes in the specific building. In smaller commercial buildings, a programmable thermostat will provide the ability to do setbacks and optimum start.

*Note: A heat pump thermostat should be used in building with heat pumps, and the setback temperatures programmed to prevent the auxiliary heat from coming on during recovery in the winter.*



### COMcheck

COMcheck is a free software program developed by the DOE to clarify and simplify commercial building energy code compliance.

The software focuses on code requirements that apply to most commercial buildings and offers a streamlined process for demonstrating code-compliant levels of energy efficiency. COMcheck applies to envelope, lighting, and mechanical systems, and it allows the user to:

- Evaluate specific designs quickly
- Perform envelope and lighting tradeoffs
- Assess envelope, lighting, and mechanical system compliance
- Generates certificates that demonstrate compliance to code officials

COMcheck is downloadable for free at [www.energycodes.gov](http://www.energycodes.gov)

### Resources:

[www.southface.org](http://www.southface.org)  
[www.energycodes.gov](http://www.energycodes.gov)  
[www.bcap-ocean.org](http://www.bcap-ocean.org)  
[www.mississippi.org](http://www.mississippi.org)

### Footnotes

1. BCAP - [www.bcap-ocean.org](http://www.bcap-ocean.org)
2. Energy model assumptions
  - a. Modeled using EQuest version 3.64, freely downloadable tool from DOE
  - b. Mississippi building professionals were surveyed and provided information on standard building practices, on which the common building model was based.
  - c. Other models are based on ASHRAE 90.1 2007 and 90.1-1999. Mechanical equipment used in the 90.1-1999 model was changed to reflect systems that are commercially available or more efficient than the older code requirement.
  - d. The model is based on gas heat.
3. Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State. 11 Mar. 2011. U.S. Energy Information Administration. 13 Jun. 2011 [www.eia.gov](http://www.eia.gov)
4. Cooling energy usage comparison is based on 5 ton, 6,000 Btu cooling capacity. AFUE is based on 10,000 Btu heating output.



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