Designing Beyond Code For Energy Efficiency
Jean Ascoli, Architect, CEM, Program Director for New Construction

Smart Energy Design Assistance Center | University of Illinois, Urbana Champaign
The Law

History


2007 On October 9, 2007 the Law was revised to mandate the latest published edition, excluding supplements, of the International Energy Conservation Code (IECC).

2009 Public Act 096-0778 was signed into law on August 28, 2009 amending the Energy Efficient Commercial Building Act by including residential buildings and amending the name of the act to the Energy Efficient Building Act.
The Law

History (cont.)


2012 Senate Bill 3724, signed by the Governor on August 17, 2012, amends the implementation date of the 2012 IECC to January 1, 2013.

It would also lengthen the time the Board has to review and adopt future published editions of the Code and make them effective.

This would allow stakeholders more time for training and preparation to build, design, and enforce the future updated codes.

The 2012 IECC took effect on January 1, 2013.
The Law

Application

The Law requires all new commercial and residential construction for which a building permit application is received by a municipality or county to follow a comprehensive statewide energy conservation code.

Renovations, alterations, additions, and repairs to most existing commercial and residential buildings must follow the Illinois Energy Conservation Code.

The Law requires design and construction professionals to follow the latest published edition of the International Energy Conservation Code®.

Under the law, the Capital Development Board has the power to modify the Illinois Energy Conservation Code.
Q. If the code isn’t currently regulated or enforced in a municipality or county do designers and contractors still have to follow it?

A. YES! The municipality or county may not regulate or enforce the code – but any project for which “a building permit application is received by a municipality or county” must still comply with it. This is a state-wide code and it is the law.

Illinois Public Act 096-0778:

“If a unit of local government does not regulate energy efficient building standards, any construction, renovation or addition to buildings or structures is subject to the provisions contained in this Act.”
Minimum Compliance in Illinois

As of January 1, 2013
Illinois Energy Conservation Code (IL ECC)

- *International Energy Conservation Code® 2012*
- Chapter 4 [CE] Commercial Energy Efficiency:

**C401.1 Scope.** The requirements contained in this chapter are applicable to commercial buildings, or portions of commercial buildings.

**C401.2 Application.** Commercial buildings comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1
2. The requirements of Sections C402, C403, C404 and C405. In addition, commercial buildings shall comply with either Section C406.2, C406.3, or C406.4.
3. The requirements of Section C407, C402.4, C403.2, C404, C405.2, C405.3, C405.4, C405.6, and C405.7. The building energy cost shall be equal to or less than 85% of the standard reference building.
Minimum Compliance in Illinois

As of January 1, 2013

Illinois Energy Conservation Code (IL ECC)

To comply…You must follow either

- International Energy Conservation Code 2012 (IECC-2012) using one of these paths:
  - ‘Prescriptive’ method
  - ‘Total Building Performance’ method

OR

  - ‘Prescriptive’
  - ‘Energy Cost Budget’ method

You must follow either IECC-2012 or ASHRAE 90.1-2010 in its entirety.
Minimum Compliance in Illinois

As of January 1, 2013

The bar has been raised – way up!

ASHRAE 90.1-2010 estimated to result in 19% savings compared with ASHRAE 90.1-2007¹

¹ Pacific Northwest National Lab
New Commercial Construction Code Stringency
Minimum Compliance in Illinois

As of January 1, 2013

ANSI/ASHRAE/IESNA Standard 90.1 2010

The U.S. Department of Energy (DOE) noted that this newer version of the standard contains 19 positive impacts, including:

- Lower lighting power densities
- Lower illuminance in certain exterior zones
- Control of exterior lighting
- Occupancy sensor control for many specific applications
- Skylights and daylighting in some building types
- Requirements for daylighting controls under skylights
- Daylighting control requirements for side-lighted spaces
- Daylighting controls in more spaces
- Commissioning of daylighting controls
Minimum Compliance in Illinois
As of January 1, 2013
ANSI/ASHRAE/IESNA Standard 90.1 2010
…19 positive impacts, including (cont.):
   ▪ Expansion of new lighting power densities to more retrofits
   ▪ Cool roofs in hot climates
   ▪ Reduced ventilation energy
   ▪ Supply air temperature reset control for non-peak conditions
   ▪ Efficiency requirements for data centers
   ▪ Increased use of heat recovery
   ▪ Extension of VAV fan control requirements.
   ▪ Automatic damper control requirements and use of economizer controls
Minimum Compliance in Illinois

As of January 1, 2013
ANSI/ASHRAE/IESNA Standard 90.1 2010
More additions and improvements

▪ Parking garage occupancy sensor control
▪ Bi-level control for stairwell lighting
▪ Manual-on control sensors in classrooms & offices
▪ Higher envelope insulation levels in most applications
▪ Kitchen Hoods – maximum flow rates
▪ Elevators – controls, ventilation, and lighting
▪ Receptacles – Occupant based controls
Guidance for beyond-code design

Beyond which code???

ASHRAE 90.1-2007 was estimated to have achieved only 5% improvement in energy efficiency compared with ASHRAE 90.1-2004.

ASHRAE 90.1-2010 was envisioned as achieving a goal of 30% improvement in energy savings compared with ASHRAE 90.1-2004.

Current estimates by the Pacific Northwest National Laboratory (PNNL) put ASHRAE 90.1-2010 at roughly 25% better than ASHRAE 90.1-2004 if receptacle loads are included, roughly 30% if receptacle loads are excluded.
Guidance for beyond-code design

Beyond which code???
Guidance for beyond-code design

ASHRAE Advanced Energy Design Guides (AEDG)

To reduce building energy usage, the U.S. Department of Energy (DOE), through its Building Technologies (BT) Program, established a strategic goal to “create technologies and design approaches that enable net-zero energy buildings (NZEB) at low incremental cost by 2025.”

The ASHRAE Advanced Energy Design Guides (AEDG) are a series of publications designed to provide recommendations for achieving energy savings over the minimum code requirements of ANSI/ASHRAE/IESNA Standard 90.1.

This is the first step in the process toward achieving a net zero energy building, which is defined as a building that, on an annual basis, draws from outside resources equal or less energy than it provides using on-site, renewable energy sources.
Guidance for beyond-code design

ASHRAE Advanced Energy Design Guides (AEDG)

These guides have been developed in collaboration with these partnering organizations:

- The American Institute of Architects (AIA)
- Illuminating Engineering Society of North America (IES)
- U.S. Green Building Council (USGBC)
- U.S. Department of Energy (DOE)

The New Building Institute (NBI) participated in the development of the initial guide.
Guidance for beyond-code design

ASHRAE Advanced Energy Design Guides (AEDG)
The 50 Percent AEDG series offer recommendations for achieving a 50% energy savings compared to buildings that meet the minimum requirements of ANSI/ASHRAE/IESNA Standard 90.1-2004.

These include 50% Advanced Energy Design Guides for:
- Small to Medium Office Buildings
- K-12 School Buildings
- Medium to Big Box Retail Buildings
- Large Hospitals
Guidance for beyond-code design

ASHRAE Advanced Energy Design Guides (AEDG)

The 30 Percent AEDG series offer recommendations for achieving a 30% energy savings compared to buildings that meet the minimum requirements of ANSI/ASHRAE/IESNA Standard 90.1-1999.

These include 30% Advanced Energy Design Guides for:

- Small Hospitals and Healthcare Facilities
- Highway Lodging
- Small Warehouses and Self-Storage Buildings
- Small Retail Buildings
Guidance for beyond-code design

**ASHRAE Standard 189.1-2011**
ANSI/ASHRAE/USGBC/IES Standard 189.1-2011

Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings

**TABLE A-5 (Supersedes Table 5.5-5)**
Building Envelope Requirements

| Opaque Elements       | Nonresidential |  |
|-----------------------|----------------|
|                       | Assembly       | Insulation |
| **Roofs**             | Max.           | Min. R-Value |
| Insulation Entirely above Deck | U-0.039      | R-25.0 ci      |
| Metal Building        | U-0.035        | R-19.0 + R-11.0 Ls |
| Attic and Other       | U-0.021        | R-49.0         |
| **Walls, Above Grade**| U-0.080        | R-13.3 ci       |
| Mass                  | U-0.052        | R-13.0 + R-13.0 ci |
| Metal Building        | U-0.055        | R-13.0 + R-10.0 ci |
| Steel Framed          | U-0.051        | R-13.0 + R-7.5 ci |
Guidance for beyond-code design

2030 Challenge

<table>
<thead>
<tr>
<th>Building Use Description</th>
<th>Available in Target Finder</th>
<th>Median Source EUI (kBtu/Sq.Ft./Yr)</th>
<th>Average Percent Electric</th>
<th>Median Site EUI (kBtu/Sq.Ft./Yr)</th>
<th>2030 Challenge Site EUI Targets (kBtu/Sq.Ft./Yr)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>50% Target</td>
<td>60% Target</td>
<td>70% Target</td>
<td>80% Target</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td>144</td>
<td>63%</td>
<td>58</td>
<td>29.0</td>
</tr>
<tr>
<td>K-12 School</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College / University (campus-level)</td>
<td></td>
<td>244</td>
<td>63%</td>
<td>104</td>
<td>52.0</td>
</tr>
<tr>
<td>Food Sales</td>
<td></td>
<td>570</td>
<td>86%</td>
<td>193</td>
<td>96.5</td>
</tr>
<tr>
<td>Grocery Store / Food Market</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convenience Store (with or without gas station)</td>
<td></td>
<td>657</td>
<td>90%</td>
<td>228</td>
<td>114.0</td>
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<tr>
<td>Food Service</td>
<td></td>
<td>575</td>
<td>59%</td>
<td>267</td>
<td>133.5</td>
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<tr>
<td>Restaurant / Cafeteria</td>
<td></td>
<td>434</td>
<td>53%</td>
<td>207</td>
<td>103.5</td>
</tr>
<tr>
<td>Fast Food</td>
<td></td>
<td>1170</td>
<td>64%</td>
<td>418</td>
<td>209.0</td>
</tr>
<tr>
<td>Inpatient Health Care (Hospital)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lodging</td>
<td></td>
<td>163</td>
<td>61%</td>
<td>72</td>
<td>36.0</td>
</tr>
<tr>
<td>Dormitory / Fraternity / Sorority</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hotel, Motel or Inn</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mall (Strip Mall and Enclosed)</td>
<td></td>
<td>247</td>
<td>71%</td>
<td>94</td>
<td>47.0</td>
</tr>
</tbody>
</table>

The Law  Minimum Code  Beyond Code  Help!
## Guidance for beyond-code design

### 2030 Challenge

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<tr>
<td>Education</td>
<td>X</td>
<td>144</td>
<td><strong>X</strong> 29.0 23.2 17.4 11.6 5.8</td>
</tr>
<tr>
<td>K-12 School</td>
<td>X</td>
<td>64</td>
<td><strong>X</strong> 31.2 20.8 10.4</td>
</tr>
<tr>
<td>College / University (campus-level)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food Sales</td>
<td></td>
<td>244</td>
<td><strong>X</strong> 14.6 31.2 20.8 10.4</td>
</tr>
<tr>
<td>Grocery Store / Food Market</td>
<td></td>
<td>820</td>
<td><strong>X</strong> 106.8 80.1 53.4 26.7</td>
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<tr>
<td>Convenience Store (with or without gas station)</td>
<td></td>
<td>209</td>
<td><strong>X</strong> 167.2 125.4 83.6 41.8</td>
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<tr>
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<td>163</td>
<td><strong>X</strong> 36.0 28.8 21.6 14.4 7.2</td>
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<td>Dormitory / Fraternity / Sorority</td>
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ENERGY STAR® Target finder

www.energystar.gov/targetfinder
Guidance for beyond-code design

ENERGY STAR® Portfolio Manager

www.energystar.gov/portfoliomanager
Guidance for beyond-code design

Design to meet the ENERGY STAR

Performance based certification

Based on one year of superior energy performance.
Guidance for beyond-code design

Design to meet the ENERGY STAR

Facilities types that can earn ENERGY STAR

<table>
<thead>
<tr>
<th>Commercial Buildings</th>
<th>Manufacturing Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank branches</td>
<td>Auto assembly plants</td>
</tr>
<tr>
<td>Courthouses</td>
<td>Cement plants</td>
</tr>
<tr>
<td>Data centers</td>
<td>Container glass manufacturing</td>
</tr>
<tr>
<td>Dormitories</td>
<td>Cookie and cracker baking plants</td>
</tr>
<tr>
<td>Financial centers</td>
<td>Flat glass manufacturing</td>
</tr>
<tr>
<td>Hospitals</td>
<td>Frozen fried potato processing plants</td>
</tr>
<tr>
<td>Hotels</td>
<td>Juice processing</td>
</tr>
<tr>
<td>House of worship</td>
<td>Petroleum refineries</td>
</tr>
<tr>
<td>K-12 schools</td>
<td>Pharmaceutical manufacturing plants</td>
</tr>
<tr>
<td>Medical offices</td>
<td>Pulp and paper plants</td>
</tr>
<tr>
<td>Offices</td>
<td>Wet corn mills</td>
</tr>
<tr>
<td>Retailers</td>
<td></td>
</tr>
<tr>
<td>Senior Care</td>
<td></td>
</tr>
</tbody>
</table>
Guidance for beyond-code design

**LEED® v4**

Energy simulation based certification

20% of all points within LEED v4 allocated to optimizing building energy efficiency including credits for beyond code performance, advanced energy metering, demand response, etc.

Prerequisite requirement of 5% improvement for new buildings (3% for major renovations) compared with ANSI/ASHRAE/IESNA Standard 90.1-2010,
Guidance for beyond-code design

Beyond which code???
Guidance for beyond-code design

Design Assistance

- Project energy goal setting for beyond-code savings
- Design charrette participation
- Energy modeling/energy simulation
- Detailed energy cost reduction measure (ECRM) analysis and recommendations
- Life cycle cost analysis
- Design review for energy savings
- General support to architects and engineers
- Help clients overcome technical and knowledge barriers
- Identify available incentives and funding
- Implementation assistance
- Ongoing support
Guidance for beyond-code design

**Design Assistance**

- Identify opportunities to save energy and money
- Feed projects into the incentive programs
- Encourage sustainable design and green building
- Create and save jobs
- Reap environmental benefits
Presentations will be available at: presentations.sedac.org