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Learning Objectives

1. Understand how existing buildings need to comply with the current Illinois Energy Conservation Code when undergoing alterations or additions.
2. Identify the most important Illinois Energy Conservation Code compliance issues in commercial and residential provisions.
3. Learn about the changes of the updated International Energy Conservation Code (2018 IECC to 2021 IECC).
4. Know the presently recommended amendments for the Illinois Energy Conservation Code.



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Who We Are

The Smart Energy Design Assistance Center (SEDAC) is an applied research program at University of Illinois.

Our mission: Reduce the energy footprint of Illinois and beyond.



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SEDAC is the Illinois Energy Conservation Code Training Provider



This training program is sponsored by
Illinois State Energy Office



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Energy Code Training Program

Technical support
energycode@illinois.edu
 800.214.7954

Online resources at
smartenergy.illinois.edu/energy-code




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www.smartenergy.illinois.edu/energy-code/

TRAINING AND SUPPORT SERVICES


 Workshops


 Webinars


 Online courses


 Technical support

ENERGY CODE RESOURCES


 What is the Illinois
 Energy Conservation Code?


 Frequently asked questions


 Useful websites



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Access to IECC, Illinois Amendments & Chicago Energy Conservation Code

<https://codes.iccsafe.org/content/IECC2018P4>

<https://codes.iccsafe.org/content/IECC2021P1>

<https://www2.illinois.gov/cdb/business/codes/illinoisAccessibilityCode/Documents/2018%20Illinois%20Specific%20Amendment%20with%20Modifications%20Shown.pdf>

<https://codes.iccsafe.org/content/CHIECC20190520S>

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Why Care about Codes?

- Energy codes and standards set minimum efficiency requirements for new and renovated buildings, assuring reductions in energy use and emissions over the life of the building. Energy codes are a subset of building codes, which establish baseline requirements and govern building construction.
- Code buildings are more comfortable and cost-effective to operate, assuring energy, economic and environmental benefits.



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Where do **energy** codes come from?

- In United States – created in response to the energy and economic crises of the 1970s
- 1978 – Congress passed legislation requiring states to initiate energy efficiency standards for new buildings
- 1992 – Energy Policy Act (EPact) – states must review and consider adopting national model energy standard

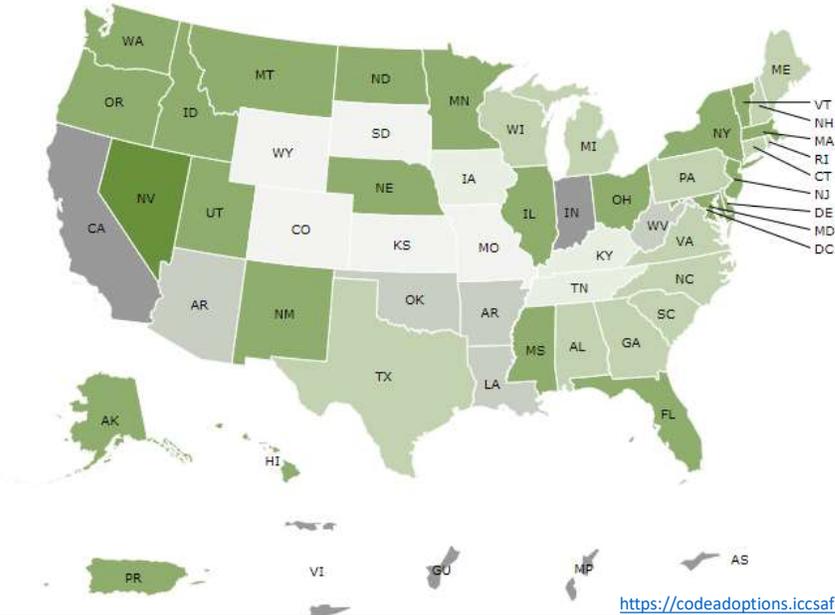


Source: <http://bcap-ocean.org/energycodes101>



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Commercial energy code adoption by state



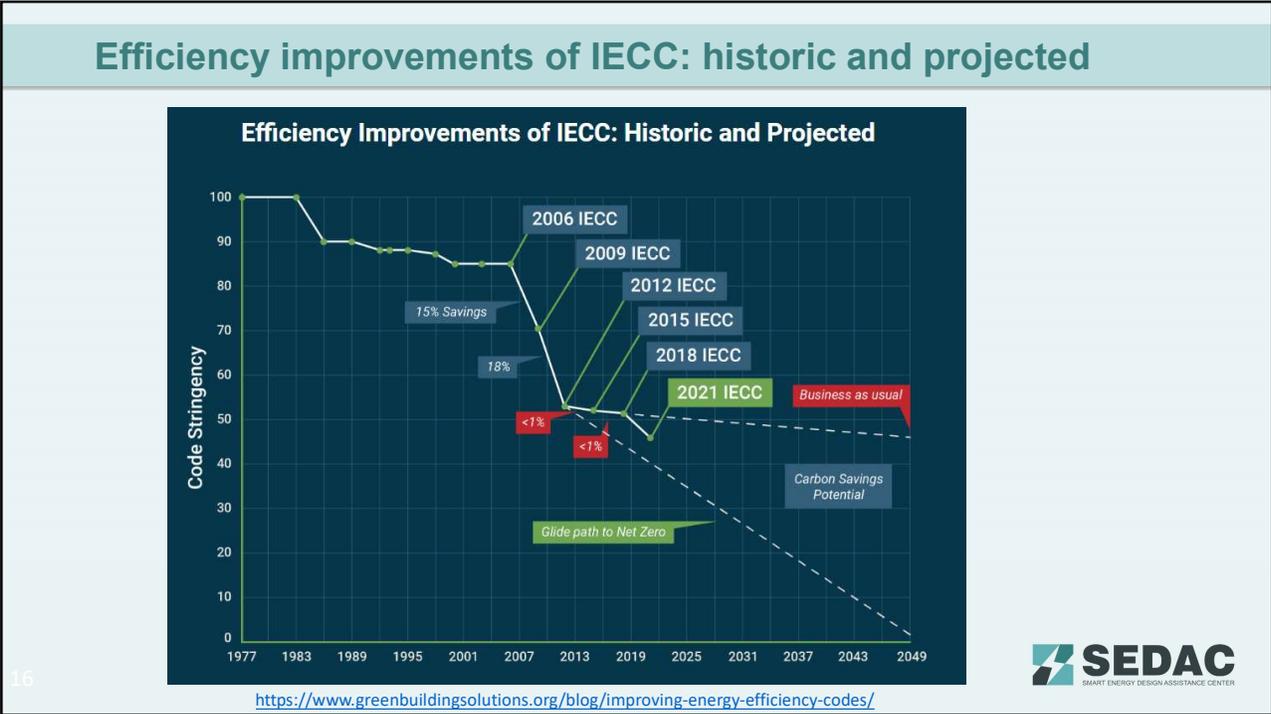
- 2021 IECC®
- 2018 IECC®
- 2015 IECC®
- 2012 IECC®
- 2009 IECC®
- 2006 IECC®
- Local Adoptions
- No state-wide IECC adoption

Adoption information is provided for states where the IECC is adopted statewide, adopted statewide for certain categories of buildings, or adopted by a state body to guide local code adoption.



<https://codeadoptions.iccsafe.org/code-adoption-map/IECC>

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Roof insulation requirements over time

Zone 5, insulation entirely above roof deck, IECC

2003	2006	2009	2012	2015	2018	2021
R-15ci	R-20ci		R-25ci	R-30ci		

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High level overview of Codes

- **Building codes are state laws.** The U.S. does not have a national building code or energy code; instead, states or local governments can choose to adopt one of the national model energy codes, a modified version of the model code, or their own state-specific code.
- **Energy codes are just one of many building codes,** such as fire, electrical, structural, or plumbing.
- **Energy codes are different than appliance and equipment standards.** Energy codes cover the building itself—for example, the walls/floors/ceiling insulation, windows, air leakage, and duct leakage. Appliance and equipment standards cover the things that go into the buildings. However, there is some overlap, particularly in lighting.

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Chicago's adoption of energy codes

ARTICLE XIII.
CHICAGO ENERGY CONSERVATION CODE

SECTION 1. The Municipal Code of Chicago is hereby amended by inserting a new Title 14N, as follows:

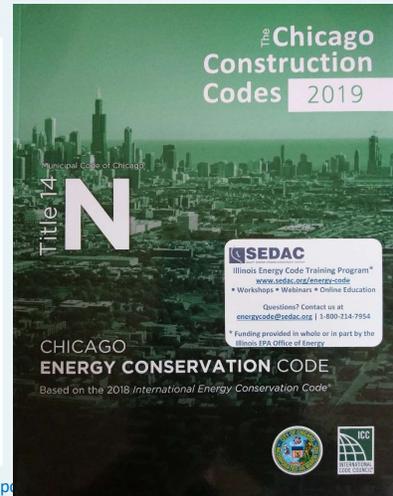
TITLE 14N ENERGY CONSERVATION CODE

PART I – COMMERCIAL PROVISIONS

CHAPTER 14N-C1 SCOPE AND PURPOSE

14N-C1-C001 Adoption of the commercial provisions of the International Energy Conservation Code by reference.

<https://www.chicago.gov/content/dam/city/depts/bldgs/general/Energycode/Title%2014N%20ordinance.pdf>



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<https://codes.iccsafe.org/codes/chicago>



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Listed Historic Buildings are exempt

- Listed on National Register
- Listed on IL Register
- Designated by authorized personnel as historically significant



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Energy Conservation Code Compliance for Work in Existing Buildings IECC Chapter 5



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CITY OF CHICAGO
DEPARTMENT OF BUILDINGS
Code Memorandum

To: Department of Buildings Plan Reviewers, Project Managers, Project Administrators and Inspectors

From: Judith Frydland
Commissioner 

Date: February 7, 2017

RE: **Energy Conservation Code Compliance for Work in Existing Buildings**

The Chicago Energy Conservation Code (Chapter 18-13) is designed to promote the effective use and conservation of energy over the useful life of each building. The Energy Conservation Code applies to **repairs, alterations, and additions** in existing buildings as well as new construction. Because building reuse typically offers greater environmental benefits than demolition and new construction, the provisions of the Energy Conservation Code are to be applied in a flexible manner to promote building reuse.

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Repairs (C504/R504)

The following guidelines should be considered when applying the Chicago Energy Conservation Code to work in existing buildings:

REPAIRS are "the reconstruction, replacement or renewal of any part of an existing building for the purpose of its maintenance or to correct damage."

The Energy Conservation Code does not require anything for repairs other than to not increase building energy consumption. Repairs include:

- a) Glass-only replacements in existing sash and frame;
- b) Roof repairs;
- c) Where only the bulb, ballast or both within existing luminaires provided lighting power is not increased;
- d) Ordinary repairs that are exempt from building permits

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Additions (C502/R502)

ADDITIONS to existing buildings may comply in a number of ways, but in general, **only the newly-built portion must comply with the new construction requirements of the Energy Conservation Code.**

In many cases, the licensed design professional will submit a report generated by compliance software, such as REScheck or COMcheck to demonstrate compliance for additions and new construction or may just use the prescriptive requirements.

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Additions (C502/R502)

In some circumstances, improvements to the energy efficiency of the pre existing building may allow relaxed requirements to apply to the addition.

One may model the whole building to demonstrate compliance and not just the addition.

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Alterations (C503/R503)

ALTERATIONS are "any construction, retrofit, or renovation to an existing structure other than repair or addition that requires a permit [or] a change in a building, electrical, gas, mechanical, or plumbing system that involves an extension, addition, or change to the arrangement, type, or purpose of the original installation that requires a permit."



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Alterations (C503/R503)

ALTERATIONS shall be such that the existing building or structure is not less conforming to the provisions than prior to the alteration.



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Alterations (C503/R503)

ALTERATIONS shall conform to the provisions of this as those provisions relate to new construction without requiring the unaltered portions of the existing building or building system to comply with this code. Alterations shall not create an unsafe or hazardous condition or overload existing building systems.



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Alterations (C503/R503)

The following alterations need not comply with the requirements for new construction, provided that the energy use of the building is not increased:

1. Storm windows installed over existing fenestration
2. Surface-applied window field installed on existing single-pane fenestration assemblies reducing solar heat gain, provided that the code does not require the glazing or fenestration to be replaced
3. Existing ceiling, wall or floor cavities exposed during construction, provided that these cavities are filled with insulation
4. Construction where the existing roof, wall or floor cavity is not exposed
5. Roof recover (see definition)

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Alterations (C503/R503)



The collage consists of five images: top-left shows a green-painted window frame on a brick wall; top-center shows a hand peeling a clear film from a window; top-right shows a vertical crack in a wall with the number '5501' written on it; bottom-left shows a construction worker in a plaid shirt and red cap working on a roof; bottom-right shows vertical wooden paneling on a wall.



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Definition of terms:

ROOF RECOVER: The process of installing an additional roof covering over an existing roof covering without removing the existing roof covering.

ROOF REPAIR: Reconstruction or renewal of any part of an existing roof for the purposes of its maintenance.

ROOF REPLACEMENT: The process of removing the existing roof covering, repairing any damaged substrate including insulation or sheathing and installing a new roof assembly.



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Roof Membrane Peel & Replacement

*This provision is narrow and not likely to apply as flat roofs are rarely replaced before there is a leak which would require work to be carried out on the roof insulation, eliminating the ability to use the provision.

Roof membrane peel and replacement – Where an existing weather resisting roof membrane alone is removed, exposing insulation or sheathing and only a new weather resisting roof membrane is installed.

This is also known in the City of Chicago as roof covering replacement.



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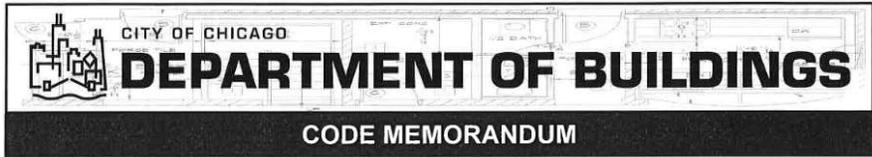
C505/R505 Change of Occupancy or Use

Spaces undergoing a change in occupancy that would increase demand for energy need to be brought into full compliance



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Roofing



CITY OF CHICAGO
DEPARTMENT OF BUILDINGS
CODE MEMORANDUM

To: Department of Buildings Plan Examiners and Inspectors

From: Judith Frydland
Commissioner 

Date: July 20, 2016

Re: **Roof Requirements**

The city of Chicago Building Code is performance based, not prescriptive, regarding roof requirements. The only code requirement is the roof must keep the building dry. The code is silent on how to do that. Therefore the purpose of this memo is to clarify acceptable practices regarding roof installation and replacement.

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Constraints on installation of code required amount of R-value on existing buildings:

C503.1 and R503.1 allows for accommodation of existing constraints. The City of Chicago and the State of Illinois has consistently interpreted this **to allow for a reduction in the required amount of insulation during replacement if the height of the installation would require other elements not part of the scope of work to be changed.**

The Department of Buildings has not required special administrative relief for this situation, just **a statement on the application as to the amount of insulation to be provided and a description of the constraint preventing full insulation value.**

This means that parapet heights, equipment curbs, skylight curbs, window sills, door thresholds, and other such elements with flashing into the roof system, are not required to be increased in height solely to provide adequate depth for code required insulation.

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R503.1 Alterations Exception

The following are not required to comply provided the energy use of the building is not increased:

1. Storm windows over existing fenestration
2. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation
3. Construction where the existing roof, wall or floor cavity is not exposed
4. Roof recover (See definition)
5. Roofs w/o insulation in the cavity and where the sheathing or insulation is exposed during the reroofing shall be insulated either above or below the sheathing
6. Surface applied window film installed on existing single pane fenestration to reduce solar heat gain provided that the code does not require the glazing or fenestration to be replaced



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Examples



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Replacing HVAC unit

New unit needs to meet current requirements ie. heat/cooling load calculation, equipment sizing, economizer w/ fault detection, controls, demand control ventilation, etc.



<https://www.achrnews.com/articles/142042-rooftop-manufacturers-are-ready-for-2023-efficiency-standards>



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Lighting Replacement

Replacing more than 10% of light fixtures in a space requires compliance with the current requirements ie. lighting power density, controls, etc.



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Fenestration Replacement

New fenestration needs to meet the U-factor, SHGC, and air leakage requirements

Increasing area beyond C402.4.1 isn't allowed, area can be maintained if already exceeding, though.



<https://www.energy.gov/energysaver/update-or-replace-windows>



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2021 IECC changes



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C401.3 Thermal envelope certificate

Must include:

1. R-values of insulation installed in or on ceilings, roofs, walls, foundations and slabs, basement walls, crawl space walls and floors and ducts outside conditioned spaces
2. U-factors and solar heat gain coefficients (SHGC) of fenestrations.
3. Results from any building envelope air leakage testing performed on the building

Where there's more than one value for any component of the building envelope, shall be the area-weighted average value or list each value that applies to 10% or more of the component area

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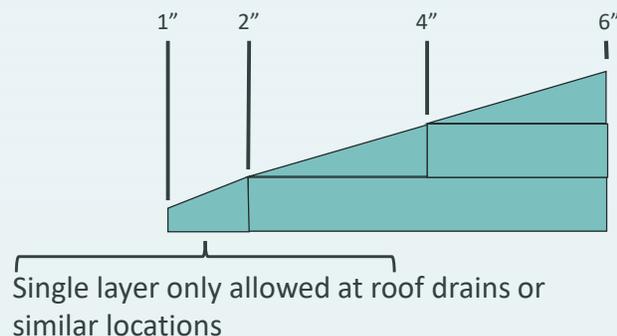


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C402.2.1.2 Tapered insulation, minimum thickness

Allows the minimum thickness of above-roof deck tapered insulation at its lowest point, gutter edge, roof drain or scupper, shall be not less than 1 inch

Be aware, this minimum could lead to condensation or other moisture problems.



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Table C402.4 Fenestration SHGC

Changed SHGC based on Fixed vs Operable, previously was based on direction.

Climate Zone		5	
Vertical fenestration, U-factor			
Fixed fenestration		0.36	
Operable fenestration		0.45	
Entrance Doors		0.63	
SHGC		Fixed	Operable
PF < 0.2		0.38	0.33
0.2 ≤ PF < 0.5		0.46	0.40
PF ≥ 0.5		0.61	0.53

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C402.5.1.2 Air barrier testing

Requires buildings or portions of building including Group R and I occupancies to meet C402.5.2 (≤ 0.30 cfm/ft² at 50Pa) testing each dwelling, sampling allowed for buildings w/ more than 7 dwellings

Or

Requires buildings or portions of buildings other than Group R and I occupancies to meet C402.5.3 (≤ 0.40 cfm/ft² at 75Pa)



<https://energyconservatory.com/applications/commercial-multifamily/>

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C402.5.11 Operable openings interlock

Occupancies with openings to the outdoors larger than 40 square feet in area, such openings shall be interlocked with the heating and cooling system to adjust setpoints or deactivate systems within 10 minutes of opening the operable opening



Photo Courtesy of Garage Doors Unlimited



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C403.2.3 Fault detection and diagnostics (FDD)

New buildings with HVAC systems over 100,000 square feet shall include fault detection and diagnostics system. The FDD system shall:

1. Include permanently installed sensors and devices to monitor the HVAC system's performance
2. Sample performance at least every 15 min.
3. Automatically ID and report HVAC system faults & notify authorized personnel
4. Automatically provide prioritized recommendations for repair
5. Be capable of transmitting recommendations to remotely located authorized personnel



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C403.8.3 Fan efficiency

Changed from Fan Efficiency Grade to Fan Efficiency Index

Needs to have FEI of 1.00 or higher at design point of operation, as determined in accordance with AMCA 208, VAV systems shall have FEI of not less than 0.95

Comparing FEI against FEG

Fan Size in. (mm)	Fan Speed rpm	Fan Power bhp [kW]	Actual Total Efficiency %	Baseline Power	FEG	FEI
18 (460)	3,238	11.8 [8.8]	40.1	7.96	85	0.67
20 (510)	2,561	9.6 [7.2]	49.5	7.96	85	0.83
22 (560)	1,983	8.0 [6.0]	59.0	7.96	85	0.99
24 (610)	1,579	6.8 [5.0]	69.1	7.96	85	1.16
27 (685)	1,289	6.2 [4.6]	75.8	7.96	85	1.28
30 (770)	1,033	5.7 [4.3]	82.5	7.96	85	1.39
36 (920)	778	6.0 [4.5]	78.7	7.96	85	1.32

Includes drive losses; more accurate to system efficiency rather than component efficiency

Data table courtesy <https://staging.amca.org/assets/resources/public/pdf/EEDAL-2017-Paper.pdf>



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C405.2.1.4 Corridor occupant sensor function

Need to reduce lighting power by at least 50% of full power within 20 minutes after all occupants have left the space

Excludes corridors with less than 2 fc of illumination on the floor at the darkest point with all lights on



Image source: pexels.com



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C405.11 Automatic receptacle control

In enclosed offices, conference rooms, copy/print rooms, breakrooms, classrooms, and individual workstations, at least 50% of all 125V, 15- and 20-amp receptacles shall have automatic control function

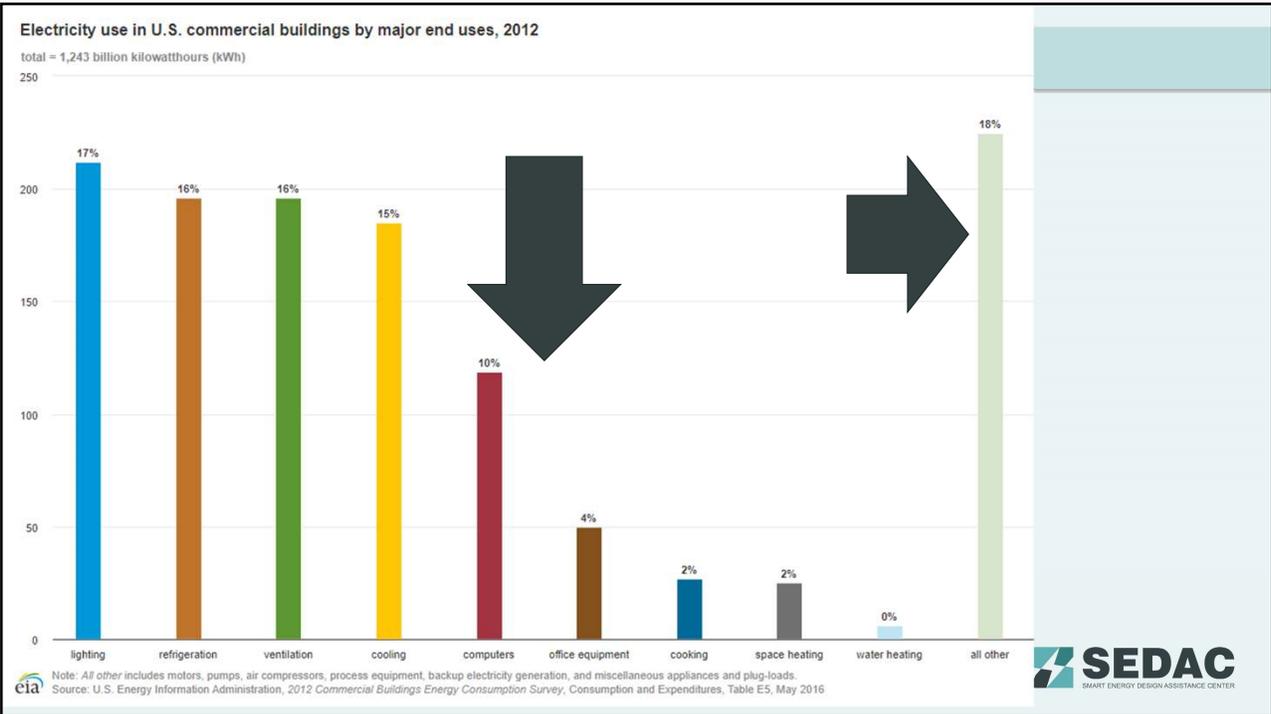


Image courtesy of Leviton



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C405.12 Energy monitoring

New buildings with a gross conditioned floor area of at least 25,000 square feet need to be equipped to measure, monitor, record, and report energy consumption data at least hourly with 36-month capacity

End use categories:

1. Total HVAC system
2. Interior Lighting
3. Exterior Lighting
4. Plug loads
5. Process loads exceeding 5% of peak connected load
6. Building operations and other misc. loads



Image source:

<https://betterbuildingssolutioncenter.energy.gov/alliance/technology-solution/energy-management-information-systems>



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C406 Additional Efficiency

Previously was choose 1 from list of 8, now need 10 credits from applicable table

Each credit worth approximately 1/4%

10 credits equal to about 2.5% savings



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C406 Additional Efficiency					
	Group B	Group R & I	Group E	Group M	Other
C406.2.1 5% heating efficiency improvement	1	1	1	1	1
C406.2.2 5% cooling efficiency improvement	2	1	2	2	2
C406.2.3 10% heating efficiency improvement	2	1	2	2	2
C406.2.4 10% cooling efficiency improvement	4	2	4	4	4
C406.3 (10%) Reduced lighting power	8	2	8	15	8
C406.4 Enhanced digital lighting controls	2	0	2	4	2
C406.5 On-site renewable energy	9	7	6	8	8
C406.6 Dedicated outdoor air system	5	6	0	3	5
C406.7.2 Recovered or renewable water heating	0	14	1	0	14
C406.7.3 Efficient fossil fuel water heater	0	8	2	0	8
C406.7.4 Heat pump water heater	0	5	1	0	5
C406.8 Enhanced envelope performance	7	4	1	6	5
C406.9 Reduced air infiltration	8	7	0	3	6
C406.10 Energy monitoring	3	1	3	4	3
C406.11 Fault detection and diagnostics system	1	1	1	1	1

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IL IECC Subcommittee Recommended Amendments

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C402.4.1.3 Fenestration orientation

Raises SHGC levels if more than $\frac{1}{4}$ of fenestration is on east or west side of building

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C405 Lighting for plant growth

For buildings with more than 40 kW of horticultural lighting load and not subject to IL Cannabis Regulation and Tax Act

Photosynthetic photon efficacy of not less than $1.7\mu\text{mol}/\text{J}$ for greenhouses and not less than 2.2 for all other indoor growing spaces



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Image source:

https://www.energy.gov/sites/prod/files/2017/12/f46/ssl_horticulture_dec2017.pdf



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R401.2 Passive House

Adds Passive House 2021 option for Residential Energy Code Compliance



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Image source: https://passivehouse.com/03_certification/02_certification_buildings/05_wallplaque/05_wallplaque.html



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R402 Insulation and fenestration requirements

Most of the table is proposed to remain at the 2018 IECC levels and not move to the substantially higher levels of 2021 IECC

City of Chicago may proceed and adopt the 2021 levels to support climate goals. Most buildings get 1 chance at the envelope.

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R402.4 Air leakage testing

Removes the amendments relaxing the required air tightness level.

Effectively moves from 4 ACH to 3 ACH

Additions/alterations still exempt from testing, but need to be inspected.



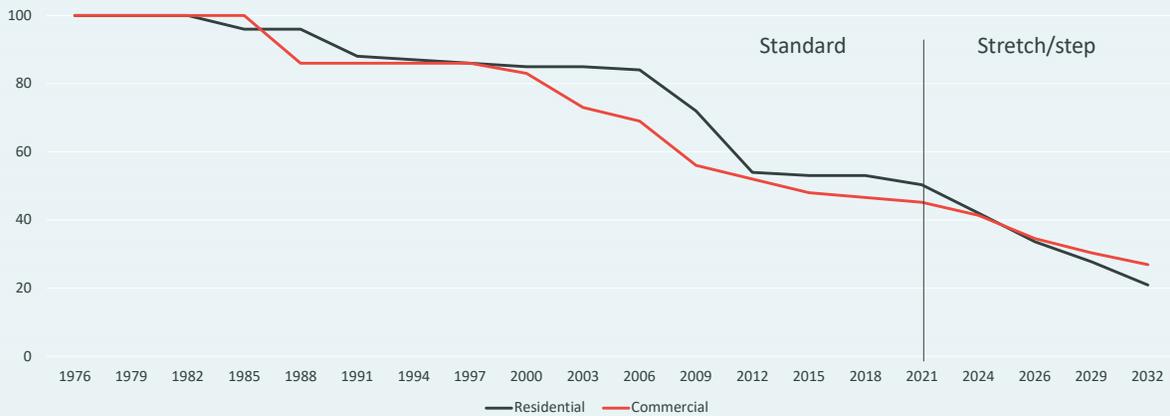
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IL Stretch Code

Coming starting 2024



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Examples Cont.



The slide features a central teal box with the text "Examples Cont." in white. The background is light blue with a dark grey horizontal band behind the teal box. The SEDAC logo is in the bottom right corner.

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Commercial remodel

Each floor of a 2-story commercial remodel project is 26,000 square feet. Each floor will serve a separate entity yet there is only one HVAC system.

Likely will need at least zone isolation controls, may consider two smaller HVAC units



The slide has a light blue background with a teal header bar containing the title "Commercial remodel". The text is centered. The SEDAC logo is in the bottom right corner.

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Commercial remodel

Planned Scope: Roof Replacement, presently 2" of insulation, equipment curbs only allow 1" more of insulation, no other obstructions.

How much insulation do you think is needed?

3"

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Commercial remodel

Planned Scope: Roof and HVAC Replacement, presently 2" of insulation, equipment curbs only allow 1" more of insulation, no other obstructions.

How much insulation do you think is needed?

R-30ci

Don't forget the load calc for the HVAC, the new insulation combined with other building improvements over time may mean smaller (cheaper/lighter) equipment

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