

The 2009 International Residential Code and the American Recovery and Reinvestment Act of 2009

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Background

Recovery Act. The American Recovery and Reinvestment Act of 2009 requires that the Secretary shall make grants under Section 410 in excess of the base allocation established for a State under regulations issued pursuant to the authorization provided in section 365(f) of such Act. But this is only to be done if the governor of the recipient State notifies the Secretary of Energy in writing that the governor has obtained necessary assurances including that the State, or the applicable units of local government that have authority to adopt building codes, will implement a building energy code (or codes) for residential buildings that meets or exceeds the [2009] International Energy Conservation Code, or achieves equivalent or greater energy savings.

State Applications. The March 21, 2009, Financial Assistance Funding Opportunity Announcement requires a two step process: an initial application and a comprehensive application. The initial application, due March 23, 2009, requires the inclusion of the Governor's assurances required by Section 410 of the Recovery Act. In the second step of the process a State must provide a discussion of the progress it has made in meeting the Governor's assurances.

The 2009 IRC is Not Equivalent to the 2009 IECC. At the International Code Council's Final Action Hearings that produced the 2009 edition of the International Residential Code, a number of significant proposals which won approval for inclusion in the 2009 International Energy Conservation Code, did not win approval for or were not proposed for inclusion in the International Residential Code. Additionally, there are several other differences between the two codes. All differences are listed below.

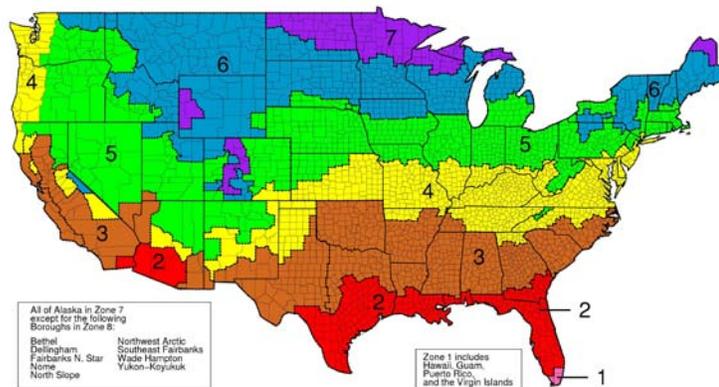


Figure 1. 2009 IECC climate zones

1. The IECC requires an SHGC of 0.30 or lower (Table 402.1.1) whereas the IRC requires an SHGC of 0.35 or lower (Table N1102.1), in climate zones 1, 2, and 3. Impact

resistant fenestration in zones 2 and 3 is allowed to have an SHGC of 0.40 or lower in the IRC only.

2. For basement walls, the IECC requires either R-15 continuous insulation or R-19 cavity insulation in zones 6-8, whereas the IRC requires R-10 continuous or R-15 cavity insulation in these same zones.
3. The IECC requires R-38 floors in zones 7 and 8; the IRC requires only R-30.
4. The IECC limits the allowance for R-30 insulation in ceilings without attics to 500 ft² or 20% of the total insulated ceiling area, whichever is less. The IRC limits the allowance to 500 ft² without regard to the total ceiling area.

The 2009 IECC and IRC also have a number of other differences that may not directly alter energy efficiency requirements but for which the IECC text should be preferred so that there is no doubt that equivalency with the IECC is attained.

1. The IECC has an SHGC trade-off cap of 0.50 in climate zones 1, 2, and 3 (402.5.) and a U-factor cap of U-0.48 in zones 4 and 5 and U-0.40 in zones 6, 7, and 8. These caps are not present in the 2009 IRC. As these caps do not increase stringency of the code (but rather restrict trade-off options), there is no direct impact on annual energy costs. There may, however, be some impacts on occupant comfort and/or resistance to moisture condensation.
2. The air barrier and insulation inspection tables (IECC 402.4.2 and IRC N1102.4.2) differ slightly. The IECC requires checking that “Air-permeable insulation is inside of an air barrier” (right column in the first row). The IRC is missing this.
3. The definitions of “conditioned space” are different between the two codes.
4. The three labels “*mandatory*,” “*prescriptive*,” and “*performance*” are used to label many sections in IECC, but are not used at all in the IRC. The provisions that are “mandatory” are always required while “prescriptive” provisions can be traded off as long as the overall energy efficiency is not decreased.
5. The scope section of the IRC (N1101.1) states that Chapter 11 (Energy Efficiency) does not apply to portions of the building that do not enclose conditioned space. Section 101.5.2 of the IECC is more specific, exempting only building thermal envelope provisions that do not contain conditioned space.

Compliance with the Recovery Act

Amendments to the 2009 IRC. States wishing to adopt the International Residential Code while maintaining compliance with the requirements of the Recovery Act, should adopt the following amendments:

1. Substitute IECC Tables 402.1.1 and 402.1.3 into the following tables for those in the IRC as follows:

Table N1102.1.1 Insulation and Fenestration Requirements by Component^a

Climate Zone	Fenestration U-Factor ^b	Skylight ^b U-Factor	Glazed Fenestration SHGC ^{b,e}	Ceiling R-Value	Wood Frame Wall R-Value	Mass Wall R-Value ⁱ	Floor R-Value	Basement ^c Wall R-Value	Slab ^d R-Value & Depth	Crawl Space ^c Wall R-Value
1	1.20	0.75	0.30	30	13	3/4	13	0	0	0
2	0.65 ^j	0.75	0.30	30	13	4/6	13	0	0	0
3	0.50 ^j	0.65	0.30 ^(e)	30	13	5/8	19	5/13 ^f	0	5/13
4 except Marine	0.35	0.60	NR	38	13	5/10	19	10 / 13	10, 2 ft	10 / 13
5 and Marine 4	0.35	0.60	NR	38	20 or 13+5 ^h	13/17	30 ^g	10 / 13	10, 2 ft	10 / 13
6	0.35	0.60	NR	49	20 or 13+5 ^h	15/19	30 ^g	15 / 19	10, 4 ft	10 / 13
7 and 8	0.35	0.60	NR	49	21	19/21	38 ^g	15 / 19	10, 4 ft	10 / 13

For SI: 1 foot = 304.8 mm.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. R-19 batts compressed into a nominal 2 × 6 framing cavity such that the *R*-value is reduced by R-1 or

more shall be marked with the compressed batt *R*-value in addition to the full thickness *R*-value.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

c. “15/19” means R-15 continuous insulated sheathing on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. “15/19”

shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulated sheathing on the interior or exterior of the

home. “10/13” means R-10 continuous insulated sheathing on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.

d. R-5 shall be added to the required slab edge *R*-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Zones 1

through 3 for heated slabs.

e. There are no SHGC requirements in the Marine Zone.

f. Basement wall insulation is not required in warm-humid locations as defined by Figure 301.1 and Table 301.1.

g. Or insulation sufficient to fill the framing cavity, R-19 minimum.

h. “13+5” means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not

required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated

sheathing of at least R-2.

i. The second *R*-value applies when more than half the insulation is on the interior of the mass wall.

j. For impact rated fenestration complying with Section R301.2.1.2 of the *International Residential Code* or Section 1608.1.2 of the *International Building Code*, the maximum *U*-factor shall be 0.75 in Zone 2 and 0.65 in Zone 3.

TABLE N1102.1.2

EQUIVALENT *U*-FACTORS^a

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR ^b	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
1	1.20	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.65	0.75	0.035	0.082	0.165	0.064	0.360	0.477
3	0.50	0.65	0.035	0.082	0.141	0.047	0.091 ^c	0.136
4 except Marine	0.35	0.60	0.030	0.082	0.141	0.047	0.059	0.065
5 and Marine 4	0.35	0.60	0.030	0.057	0.082	0.033	0.059	0.065
6	0.35	0.60	0.026	0.057	0.060	0.033	0.050	0.065

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR ^b	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
7 and 8	0.35	0.60	0.026	0.057	0.057	0.028	0.050	0.065

- a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.
- b. When more than half the insulation is on the interior, the mass wall *U*-factors shall be a maximum of 0.17 in zone 1, 0.14 in zone 2, 0.12 in zone 3, 0.10 in zone 4 except Marine, and the same as the frame wall *U*-factor in Marine zone 4 and zones 5 through 8.
- c. Basement wall *U*-factor of 0.360 in warm-humid locations as defined by Figure 301.1 and Table 301.2.

2. Modify Section N1102.2.2 by adding the underlined text:

N1102.2.2 Ceilings without attic spaces. Where Section N1102.1 would require insulation levels above R-30 and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-30. This reduction of insulation from the requirements of Section N1102.1 shall be limited to 500 ft² (46 m²) or 20 percent of the total insulated ceiling area, whichever is less.

3. Add the following section:

N1102.5 Maximum fenestration *U*-factor and SHGC.

The area-weighted average maximum fenestration *U*-factor permitted using trade-offs from Section N1102.1.3 shall be 0.48 in Zones 4 and 5 and 0.40 in Zones 6 through 8 for vertical fenestration, and 0.75 in Zones 4 through 8 for skylights. The area-weighted average maximum fenestration SHGC permitted using trade-offs from Section 405 in Zones 1 through 3 shall be 0.50.

4. Add “Air-permeable insulation is inside of an air barrier” in the right column in the first row of Table N1102.4.2.
5. Change the definition of “conditioned space” to “An area or room within a building being heated or cooled, containing uninsulated ducts, or with a fixed opening directly into an adjacent *conditioned space*.”
6. Change the scope of the IRC (section N1101.1) by adding the underlined text:

N1101.1 Scope. This chapter regulates the energy efficiency for the design and construction of buildings regulated by this code.

Exception: Portions of the building envelope that do not enclose *conditioned space* are exempt from building thermal envelope provisions of this chapter.

Impact of Amending the SHGC Provisions of the 2009 IRC

The Department of Energy has had its Pacific Northwest National Laboratory perform a limited analysis of potential impact of these amendments in representative locations using the EnergyGauge (DOE-2) simulation tool on a typical house:

- 2400 ft² floor area, two-story
- natural gas furnace heating at \$1.20/therm, except Table 2, which is heat pump heating
- Central air conditioning electricity at 12 cents/kWh

- Equipment efficiencies at Federal minimum levels
- 360 ft² window area equally oriented in north, east, south, and west. No exterior shading.

The results are shown in Tables 1 through 4.

The Recovery Act requires that a code other than the IECC achieve equivalent or greater energy savings to qualify for state energy grants. The 0.35 SHGC requirement in the IRC compared to the 0.30 SHGC requirement in the IECC results in energy cost increase some but not all climate zone 3 locations according to this simulation analysis. However, it is worth noting there are benefits to lower solar heat gains apart from total energy use impacts, such as reductions in peak loads, which benefits summer peaking utilities and the downsizing of air conditioners. The Department of Energy has and will continue to look at such factors when submitting proposals to upgrade the IECC.

Table 1. Energy Savings of Reducing SHGC from 0.35 to 0.30 in Climate Zones One Through Three – Natural Gas Heating

Climate Zone	Representative City	Cooling Savings	Heating Increase	Energy Savings
1	Miami	\$27	\$1	\$26
2	Houston	\$19	\$11	\$8
3	Atlanta	\$16	\$21	-\$5
3	Jackson MS	\$19	\$16	\$3
3	Memphis	\$14	\$15	-\$1
3	Dallas	\$16	\$17	-\$1
3	El Paso	\$19	\$22	-\$3
3	Las Vegas	\$15	\$18	-\$3

Table 2. Energy Savings of Reducing SHGC from 0.35 to 0.30 in Climate Zones One Through Three – Heat Pump Heating

Climate Zone	Representative City	Cooling Savings	Heating Increase	Energy Savings
1	Miami	\$26	\$0	\$26
2	Houston	\$18	\$8	\$10
3	Atlanta	\$16	\$17	-\$1
3	Jackson MS	\$18	\$14	\$4
3	Memphis	\$12	\$14	-\$2
3	Dallas	\$16	\$13	\$3
3	El Paso	\$18	\$18	0
3	Las Vegas	\$16	\$14	\$2

Table 3. Energy Savings of Increasing Basement Wall Insulation from R-13 to R-19 in Climate Zones Six through Eight

Climate Zone	Representative City	Energy Savings
6	Burlington	\$29
7	Duluth	\$34
8	Fairbanks	\$33

Table 4. Energy Savings of Increasing Floor Insulation from R-30 to R-38 in Climate Zones Seven and Eight (Floor over Unheated Basement)

Climate Zone	Representative City	Energy Savings
7	Duluth	\$13
8	Fairbanks	\$19