

What to Expect From the 2021 IECC



Acronym City

Let's start with definitions before going any deeper.

IECC

- International Energy Conversation Code
- Companion code (now standard) to the IRC and IBC that focuses specifically on energy conservation in buildings
- Split into commercial and residential provisions



JDS

- ACCA Manual J,D,S
- Air Conditioning Contractors of America Manual J,D, and S are technical guidelines that cover the overall design of HVAC equipment and ductwork in residential buildings.
- Manual J – heat loss calculation
- Manual D – duct design
- Manual S – equipment sizing



RESCheck

- RESCheck
- Department of Energy developed a software pathway to show compliance with the IECC in residential buildings.
- Software performs what is called Total UA Calculations



HERS Index

- Home Energy Rating System Index
- An energy rating index developed and managed by the Residential Energy Services Network (RESNET)
- A 0-100 score that can be used to compare the overall efficiency of a home
 - 100 is comparable with a 2006 Code built home
 - 0 is a net zero home
- HERS can be used for code compliance in some municipalities and for above code program compliance.



Dive Into IECC Compliance

4 Compliance Pathways

- Prescriptive Pathway
- Total UA Alternative
- Total Building Performance or Simulated Performance Alternative
- ERI



Prescriptive vs. Mandatory

R403.5.3 Hot water pipe insulation (Prescriptive).

Insulation for hot water piping with a thermal resistance, *R*-value, of not less than R-3 shall be applied to the following:

1. Piping $\frac{3}{4}$ inch (19.1 mm) and larger in nominal diameter.
2. Piping serving more than one dwelling unit.
3. Piping located outside the *conditioned space*.
4. Piping from the water heater to a distribution manifold.
5. Piping located under a floor slab.
6. Buried piping.
7. Supply and return piping in recirculation systems other than demand recirculation systems.

R402.4 Air leakage (Mandatory).

The *building thermal envelope* shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.5.



Prescriptive Pathway

- Meet or exceed the mandatory and prescriptive requirements written into the code
- Pros
 - Doesn't require an additional consultant to show compliance
- Cons
 - No flexibility in specifications



Total UA Alternative

- An alternative pathway within the prescriptive pathway
- Allows comparison of As Designed Building Total UA with A Reference Home Total UA
- Allows trade-offs between insulation only!

Elements	Building UA	
	IECC Reference	As Designed
Ceilings	15.4	12.0
Above-Grade Walls	39.5	34.4
Windows, Doors and Skylights	69.9	65.7
Slab Floor:	15.5	14.0
Framed Floors	12.7	6.2
Foundation Walls	0.0	0.0
Rim Joists	3.0	2.1
Overall UA (Design must be equal or lower):	156.0	134.4



Total UA Alternative Compliance

- Pros
 - More flexibility in window and insulation values
 - Multiple compliance software
- Cons
 - Possible additional consultant for completing UA Calculations
 - Still must meet all other prescriptive requirements



Simulated Performance Alternative

- Renamed to Total Building Performance In 2021 IECC
- Compares modeled energy cost of designed building with a reference home
- Pros
 - Most flexibility in selecting equipment, insulation, and windows
 - Modeling and inspection process can open up builder to rebates
 - Do not need to follow any prescriptive requirements
- Cons
 - Requires a professional for inspection and modeling



Energy Rating Index (ERI) Pathway

- Meet or exceed code requires ERI
- HERS and IECC ERI are not the same thing
- Similar Pros and Cons to Simulated Performance Alternative

TABLE R406.4 MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX ^a
1	57
2	57
3	57
4	62
5	61
6	61
7	58
8	58

a. Where on-site renewable energy is included for compliance using the ERI analysis of Section R406.4, the building shall meet the mandatory requirements of Section R406.2, and the building thermal envelope shall be greater than equal to the levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.4 of the 2015 *International Energy Conservation Code*.



Major Changes in the 2021 IECC

2021 IECC – Oh What a Code

- Largest changes to the IECC in over a decade
- Considered the most controversial code development process
- Concluded after multiple appeals for NAHB and others



Who Is Adopting? (As Of 3/17/22)

Municipality	Front Range Location	Previous Code	In Review, In Process, or		Implementation Date
			Adopted	Planned or Actual Adoption Date	
Arapahoe County	Denver Metro	2009 IECC	Adopted	November 23 2021	April 1 2022
City of Aurora	Denver Metro	2015 IECC	Adopted	January 8 2021	October 31 2022
Larimer County	Northern Colorado	2018 IECC	Adopted	January 10 2022	March 1 2022
City of Louisville	Denver Metro	2018 IECC	Adopted	November 23 2021	November 23 2021
Town of Parker	Denver Metro	2018 IECC	Adopted	November 1 2021	January 1 2022
City of Longmont	Denver Metro	2015 IECC	Adopted	November 30 2021	January 1 2022
City and County of Denver	Denver Metro	2018 IECC	In Process	In Committee with Planned Adoption Summer 2022	TBD
Town of Erie	Denver Metro	2015 IECC	In Process	Summer 2022	TBD
City of Fort Collins	Northern Colorado	2018 IECC	Adopted	Mid April 2022	TBD
Town of Castle Rock	Denver Metro	2018 IECC	In Process	Spring 2022	
City of Lakewood	Denver Metro	2015 IECC	In Review	2nd or 3rd Quarter 2022	
City of Lone Tree	Denver Metro	2018 IECC	In Review	Present to City Council October 2022	
City of Thornton	Denver Metro	2018 IECC	In Review	May/June 2022	
City of Westminster	Denver Metro	2015 IECC	In Review	Mid to Late 2022	
City of Castle Pines	Denver Metro	2015 IECC	In Review	Late Summer 2022	
City of Broomfield	Denver Metro	2018 IECC	In Review	Mid April 2023	
City of Lafayette	Denver Metro	2015 IECC	In Review	TBD	
Pikes Peak Regional Building Department	Southern Colorado	2015 IECC	In Review	TBD	
Cherry Hills Village	Denver Metro	2018 IECC	In Review	Summer 2022	



Additional Energy Efficiency (R401.2.5)

- **Following Prescriptive:**
Install one of the additional efficiency package options listed in Section R408.2
- **Following Total Building Performance:**
Install one of the additional efficiency package options or have an annual energy cost less than 95% of the reference design
- **Following Energy Rating Index:**
ERI shall be at least 5% less than the target



Additional Efficiency Package Options (R408)

- Enhanced envelope performance option
 - Building UA needs to be less than or equal to 95% of the total UA.
- More efficiency HVAC equipment option
 - 95 AFUE Furnace/16 SEER AC
 - 10 HSPF air source heat pump or 3.5 COP ground source heat pump
- Reduced energy use in service water-heating option
 - 0.82 EF fossil fuel or 2.0 EF electric service water-heating system
- More efficient duct thermal distribution system option
 - 100% of ducts and air handlers within the building envelope
- Improve air sealing and efficient ventilation system option
 - Less than or equal to 3.0 ACH50 with either ERV or HRV



Changes to Prescriptive Insulation Req. (R402.1.3)

Changes from 2018 to 2021 IECC – Climate Zone 5							
Code Year	Fenestration U-Factor	Fenestration SHGC	Ceiling R-Value	Wood Frame Wall R-Value	Floor R-Value	Basement Wall R-Value	Slab R-value & Depth
2018 IECC	0.30	NR	49	20 or 13 + 5ci	30	15ci or 19	10 ci, 2 ft down.
2021 IECC	0.30	.40	60	20 + 5ci or 13 + 10ci or 0 + 15 ci	30	15ci or 19 or 13 + 5ci	10 ci, 4 ft down

- Prescriptive requirement but informs performance modeling
- Cost Impacts
 - Attic R49 to R60: \$0.50 - \$0.75 per SF attic space
 - Walls R20 to R20+5: \$1.00 - \$2.00 per SF wall area



Other Impacts of Continuous Insulation

- Exterior cladding –
 - Siding, stucco, manufactured stone veneer, brick
 - Additional fastener requirements per R703.15 of IRC
- Windows –
 - Must provide more structural support after foam gets thicker than 1"
 - Follow FMA/AAMA/WDMA 500

CLADDING FASTENER THROUGH FOAM SHEATHING	CLADDING FASTENER TYPE AND MINIMUM SIZE ^b	CLADDING FASTENER VERTICAL SPACING (inches)	MAXIMUM THICKNESS OF FOAM SHEATHING ^c (inches)			
			24" o.c. Fastener Horizontal Spacing			
			Cladding Weight:			
			3 psf	11 psf	18 psf	25 psf
Wood framing (minimum 1 1/4-inch penetration)	0.113" diameter nail	6	2.00	0.85	DR	DR
		8	2.00	0.55	DR	DR
		12	1.85	DR	DR	DR
	0.120" diameter nail	6	3.00	1.05	0.50	DR
		8	3.00	0.70	DR	DR
		12	2.15	DR	DR	DR
	0.131" diameter nail	6	4.00	1.35	0.70	DR
		8	4.00	0.90	DR	DR
		12	2.70	0.50	DR	DR
	0.162" diameter nail	6	4.00	2.25	1.25	0.80
		8	4.00	1.60	0.85	0.50
		12	4.00	0.95	DR	DR

Table R703.15.1 from 2018 International Residential Code

Addition of Air-Sealed Electrical or Communication Boxes (R402.4.6)

“Electrical and communication outlet boxes installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces. Electrical and communication outlet boxes shall be tested in accordance with NEMA OS 4”

- Prescriptive only requirement
- Cost impact
 - Single pole box: \$2.00 - \$8.00 per box



Mandatory Duct Testing (R403.3.5)

- Removed the exception previously in the 2018, 2015, 2012, and 2009 for ducts that are 100% within the building envelope of conditioned space
- Mandatory requirement
- Cost impact:
 - Based on other additional services

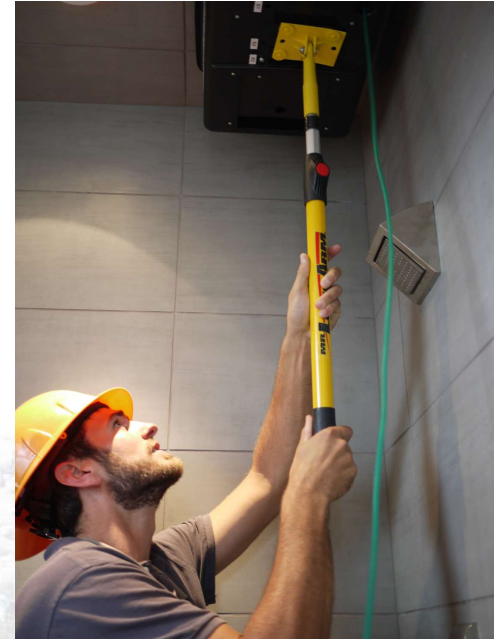


Mechanical Ventilation Testing (R403.6.3)

“R403.6.3 Mechanical ventilation systems shall be tested and verified to provide the minimum ventilation flow rates required by Section R403.6...”

“R403.6 Buildings and dwelling units shall be provided with *mechanical ventilation* that complies with the requirements of the International Residential Code of *International Mechanical Code*...”

- Mandatory requirement
- Cost impact:
 - Talk with your rater

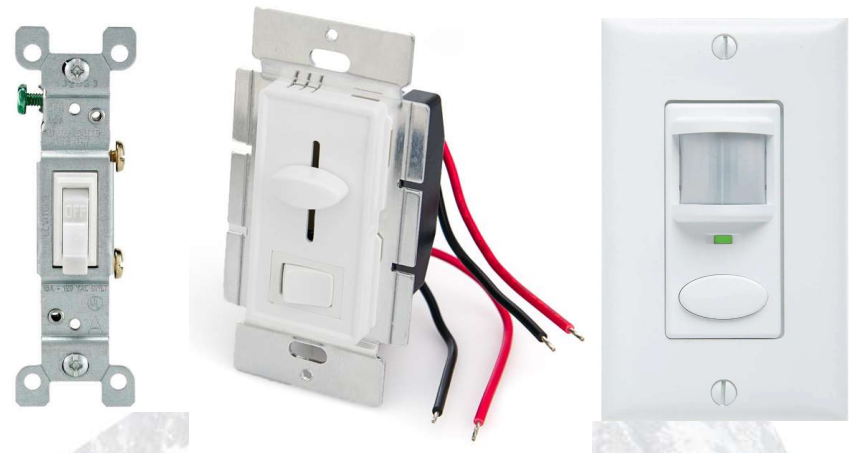


Interior Lighting Control (R404.2)

“Permanently installed lighting fixtures shall be controlled with either a dimmer, an occupant sensor control or other control that is installed or built into the fixture. Exception: Lighting controls shall not be required for the following:

1. Bathroom
2. Hallways
3. Exterior lighting fixtures
4. Lighting designed for safety or security.”

- Mandatory requirement
- Cost impact
 - Single pole switch: \$20 – 30 per fixture



Cost Impact on Colorado Homes

Cost Impact Methodology

- Looking at cost impact in updating from 2018 to 2021
- Based on material take offs from 4 plans built or to be built in Colorado
 - Single family ranch on a basement
 - Single family two story on a crawlspace
 - Interior 3 story townhome on a slab
 - End unit 3 story townhome on a slab



Key Home Metrics

Key Metrics	Single Family Ranch On Basement	Single Family Two Story On a Crawlspace	Interior 3 Story Townhome on a Slab	End Unit 3 Story Townhome on a Slab
SQ FT.	3,611	2,097	1,608	1,793
# of Bedrooms	3	3	2	2
# of Floors Above Grade	1	2	3	3
Volume (CU FT.)	37,630	23,796	15,751	17,818
Exterior Wall Area (SQ FT)	2,027	2,810	1,186	2,165
Attic Area (SQ FT)	1,821	1,272	738	831



100% Prescriptive Compliance Cost

- 100% of insulation table, other major changes, and water heater efficiency option

Added Cost Following Prescriptive Path				
Plan Type	Single Family Ranch On Basement	Single Family Two Story On a Crawlspace	Interior 3 Story Townhome on a Slab	End Unit 3 Story Townhome on a Slab
Added Cost without Efficiency Package	\$5,200.00	\$6,265.00	\$3,015.00	\$4,900.00
Added Cost with Improved WH Option	\$6,050.00	\$7,115.00	\$3865.00	\$5,750.00



Performance Path Models

1. 2018 IECC Prescriptive Values
2. 2021 IECC Prescriptive Values
3. R-23 Wall Cavity Insulation In Place of R20 + 5
4. R-23 Wall Cavity & R-49 Attic Insulation
5. R-23 Wall Cavity, R-49 Attic Insulation, and U 0.28 Windows



Performance Path Results (% Above 2021)

	Pass/Fail 2021 IECC Requirements			
	Single Family Ranch	Single Family Two Story	Interior 3 Story Townhome	End Unit 3 Story Townhome
2018 IECC	Fail	Pass (2.6%)	Pass (8.7%)	Fail
2021 IECC	Pass (4.7%)	Pass (10%)	Pass (15%)	Pass (5.5%)
R-23 Wall	Pass (2%)	Pass (6.1%)	Pass (12.2%)	Pass (0.9%)
R-23 Wall & R-49 Attic	Pass (0.5%)	Pass (5.0%)	Pass (10.5%)	Fail
R-23 Wall, R-49 Attic, & U 0.28 Window UA	Pass (2.4%)	Pass (6.4%)	Pass (12.2%)	Pass (1.8%)

Total Building Performance Cost

- Includes Mandatory Changes
- Include improved Water Heater for R408 Compliance

Added Cost Following Total Building Performance				
Plan Type	Single Family Ranch On Basement	Single Family Two Story On a Crawlspace	Interior 3 Story Townhome on a Slab	End Unit 3 Story Townhome on a Slab
Added Cost to Meet Performance	\$2,193.00	\$1,220.00	\$1,140.00	\$2,618.00
Improvement	R-23 Wall, R-49 Attic	No Insulation Improvement	No Insulation Improvement	R-23 Wall



ERI Pathway

- ERI and HERS Index are not the same.
- Maximum ERI for Climate Zone 5 = 55 ... Or is it?
- Allows the inclusion of mechanicals and solar in code compliance
- 2 Different Pathways Under ERI:
 - With Renewables
 - Without Renewables



ERI Pathways Within the Pathway

- Without Renewables (R406.3.1)
 - Still need to meet 1.15 of the Prescriptive UA
 - Can't completely abandon thermal envelope from improved mechanicals
- With Renewables (R406.3.2)
 - Sets a backstop of 2015 IECC Prescriptive Insulation Requirements
 - R406.4 "...For compliance purposes, any reduction in energy use of the rated design associate with on-site renewable energy shall not exceed 5 percent of the total energy use."



Pathway Cost Comparisons

Added Cost of 2021 IECC Compliance Pathways				
Plan Type	Single Family Ranch On Basement	Single Family Two Story On a Crawlspace	Interior 3 Story Townhome on a Slab	End Unit 3 Story Townhome on a Slab
Prescriptive	\$6,050.00	\$7,115.00	\$3865.00	\$5,750.00
Performance	\$2,193.00	\$1,220.00	\$1,140.00	\$2,618.00



Conclusion.

- There is a pathway to 2021 IECC Code Compliance without Continuous Insulation
- Cost impacts are real but manageable.
- Municipality amendments could have a much larger impact on compliance.



Takeaway

- Excel Spreadsheet to fill out and identify costs for your project.

2021 IECC Prescriptive Pathway Compliance Work Book

provided by 

Instructions: Using plan information, insert the appropriate building information and cost to estimate the cost impacts of 2021 IECC Prescriptive Path Compliance.

Insulation Upgrades					
Exterior Walls - Insulation changed from R-21 Batt to R-21 Batt with R-5 Continuous XPS Insulation. Attachment of wood furring members where required by IRC. Additional window flashing and trim detailing.					
Installation of R-5 Foam Insulation					
2165 SF Exterior Wall Area	X	\$	1.00 \$ / SF	=	\$ 2,165.00
1x Furring Strips @ 24" OC					
2165 SF Exterior Wall Area	X	\$	0.75 \$ / SF	=	\$ 1,623.75
Window Flashing and Detailing					
15 # Exterior Windows	X	\$	10.00 \$ / Window	=	\$ 150.00
Exterior Walls Total				=	\$ 3,938.75
Attic Insulation - Insulation upgraded from R-49 to R-60 in the attic. Truss heel heights can remain consistent.					
R-49 to R-60 Blown Attic Insulation					
831 SF Attic Area	X	\$	0.51 \$ / SF	=	\$ 423.81

About EnergyLogic

EnergyLogic is an applied building science company that partners with building professionals to construct buildings that are efficient, healthy, and resilient. We are based in Colorado and work worldwide.

