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Pacific Northwest
NATIONAL LABORATORY

PNNL-35986

National Cost-Effectiveness of the Residential Provisions of the 2024 IECC

January 2025

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U.S. DEPARTMENT OF ENERGY

Prepared for the U.S. Department of Energy
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Executive Summary

The U.S. Department of Energy (DOE) Building Energy Codes Program (BECP) provides technical assistance supporting the development and implementation of building energy codes and standards (42 USC 6833), which set minimum requirements for energy-efficient design and construction of new and renovated buildings, and impact energy use and environmental impacts over the life of buildings. Continuous improvement of building energy efficiency is achieved by periodically updating national model energy codes through consensus-based code development processes, such as those administered by ASHRAE and the International Code Council (ICC). DOE provides technical analysis of potential code revisions and amendments, supporting technologically feasible and economically justified energy efficiency measures during the national model code development process, as well as their implementation across U.S. states and municipalities. Evaluating the expected impacts of the updated model energy codes, including their cost effectiveness, helps ensure that code changes are economically justifiable and encourages their adoption of the latest building codes. Pacific Northwest National Laboratory (PNNL) prepared this analysis to support DOE in evaluating the economic impacts associated with updated codes in residential buildings.

This analysis focuses on single-family and low-rise multifamily residential buildings based on the latest edition of the International Energy Conservation Code (IECC). The IECC is developed by the International Code Council (ICC) on a 3-year cycle through a public development and consensus process. While proponents of code changes often include the energy and cost-effectiveness criteria for their respective code change, the IECC process does not include an energy or cost-effectiveness analysis of the entire edition of the code. DOE conducts such an analysis to evaluate the cost-effectiveness of the updated IECC edition, which helps inform states local governments and industry stakeholders as they adopt and implement updated building energy codes.

PNNL evaluated the cost-effectiveness of the changes in the prescriptive and mandatory residential provisions of the 2024 edition of the IECC, hereafter referred as the 2024 IECC, compared to those in the prior edition, the 2021 IECC. The simulated performance path and the Energy Rating Index (ERI) path are not considered in this analysis due to the wide variation in building construction characteristics that are allowed, and because the prescriptive path is widely considered the predominant path utilized by practitioners.

The process of examining the cost-effectiveness of the code changes has four main components:

- Identification of the building components affected by the updates to the *prescriptive* and *mandatory* residential provisions of the IECC that directly affect building energy use
- Assessment of construction costs associated with these updates
- Analysis of energy and cost impacts associated with these updates
- Cost-effectiveness analysis of the collective updates that combines the incremental costs of these updates with the associated energy impact. The cost-effectiveness analysis does not report the energy and cost impact of individual code changes.

This current analysis builds on the PNNL technical report titled *Energy Savings Analysis: 2024 IECC for Residential Buildings* (Salcido et al. 2024), which identified the prescriptive and

mandatory changes introduced by the 2024 IECC, compared to the 2021 IECC, and determined their energy savings impact.

DOE has an established methodology for determining the energy savings and cost-effectiveness of residential building energy codes (Salcido et al. 2024). [1] This methodology forms the basis of this analysis and defines three cost-effectiveness metrics to be calculated in assessing cost-effectiveness of code changes:

- **Life-Cycle Cost (LCC)** – This is reported as the savings (reduction) in LCC over a 30-year analysis period.
- **Simple Payback** – A simplified metric that estimates the number of years required for energy cost savings to make up for increased construction costs, assuming no escalation in prices or discounting of future cash flows.
- **Cash Flow** – A small suite of metrics summarizing the net cash flows (costs versus savings) for every year of the 30-year analysis period.

Table ES.1 summarizes the weighted LCC savings per dwelling unit for the 2024 IECC compared to the 2021 IECC for each climate zone, aggregated over all residential prototype buildings. Table ES.2 and Table ES.3 summarize the associated simple payback periods and impacts on consumer cash flows. The results show that new construction based on the 2024 IECC is cost-effective when compared to construction based on the 2021 IECC across all climate zones. Simple payback by climate zone ranges from 0 to 9 years, with a national weighted average of 2.5 years. Homeowners see net positive cash flows ranging from 0 to 2 years, with a national weighted average of 1 year.

INSERT

LCC is the primary metric used by DOE to determine the cost-effectiveness of the code or specific code changes. The simple payback is reported for information purposes only and is not used as a basis for determining the cost-effectiveness of the 2024 IECC.

[1] See DOE Residential Energy and Cost Analysis Methodology at: https://www.energycodes.gov/sites/default/files/2024-10/residential_methodology_2024.pdf

Table ES.1. Life-Cycle Cost Savings for the 2024 IECC

Climate Zone	Compared to the 2021 IECC ($/dwelling unit)
1	2,406
2	3,254
3	2,509
4	3,790
5	2,496
6	2,190
7	7,422
8	9,481
National Average	2,954

Table ES.2. Simple Payback Period for the 2024 IECC

Climate Zone	Compared to the 2021 IECC (Years)
1	9.0
2	5.2
3	2.7
4	0.0
5	0.0
6	7.8
7	0.0
8	0.0
National Average	2.5

Table ES.3. Impacts on Consumers' Cash Flow from Compliance with the 2024 IECC

	Compared to the 2021 IECC	
Climate Zone	Net Annual Cash Flow Savings ($ for Year 1)	Years to Cumulative Positive Cash Flow
1	86	2
2	135	1
3	122	1
4	192	0
5	154	0
6	105	2
7	324	0
8	410	0
National Average	144	1

The prescriptive and mandatory provisions of the 2024 IECC are shown to generate an average life-cycle cost savings of $2,954, an average payback of 2.5 years, and the years to cumulative positive cashflow averaging 1 year. These results reflect measures in the 2024 IECC that reduce construction costs as described in this report. The results illustrate that homeowners can benefit financially from the investment in energy efficiency of the 2024 IECC. The analysis shows the higher efficiency levels of the 2024 IECC requires an increased investment in some climate zones with short payback times while remaining cost-effective whereas other climate zones have a decreased investment with an immediate payback.

Acknowledgments

This report was prepared for the DOE Office of Energy Efficiency and Renewable Energy (EERE) Building Technologies Office (BTO). The authors would like to thank Jeremy Williams and Christopher Perry at DOE for providing programmatic direction and oversight.

Acronyms and Abbreviations

ACH50	air changes at 50-pascal pressure differential
AEO	Annual Energy Outlook
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
BC3	Building Component Cost Community
BECP	Building Energy Codes Program
Btu	British thermal unit(s)
CF	cubit feet
CFM	cubic feet per minute
CPI	Consumer Price Index
DOE	U.S. Department of Energy
DX	direct expansion
ECPA	Energy Conservation and Production Act
EIA	U.S. Energy Information Administration
EF	energy factor
ERI	Energy Rating Index
ERV	energy recovery ventilator
EUI	Energy Use Intensity
°F	degree(s) Fahrenheit
ft^2	square foot(feet)
hr	hour(s)
HPWH	heat pump water heater
HRV	heat recovery ventilator
HSPF2	heating seasonal performance factor
HVAC	heating, ventilating, and air conditioning
HWDS	hot water distribution system
ICC	International Code Council
IECC	International Energy Conservation Code
IgCC	International Green Construction Code
IPC	International Plumbing Code
IRC	International Residential Code
kWh	kilowatt-hour(s)
LCC	life-cycle cost
LED	light-emitting diode
LPD	lighting power density
million Btu	million British thermal units
NREL	National Renewable Energy Laboratory

PNNL	Pacific Northwest National Laboratory
SEER2	seasonal energy efficiency ratio
SHGC	solar heat gain coefficient
SRE	sensible recovery efficiency
yr	year(s)

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1.0 Introduction

The U.S. Department of Energy (DOE) supports the development and adoption of energy-efficient building energy codes. Title III of the Energy Conservation and Production Act (ECPA), as amended, requires DOE to participate in the development of model building energy codes and assist states in the adoption and implementation of these codes (42 U.S.C. 6831 et seq.). ECPA also mandates DOE to conduct a determination analysis to evaluate whether the new edition of the code saves energy compared to its immediate predecessor, within 1 year of a new code being published (42 U.S.C. 6833(a)(5)(A)).

Building energy codes set the minimum requirements for energy-efficient building design and construction for new buildings. They impact energy consumed by the building over its life. These codes are developed through consensus-based public processes that DOE participates in by proposing changes that are technologically feasible and economically justified. Pacific Northwest National Laboratory (PNNL) provides technical analysis and support to DOE during the code development processes.

This analysis focuses on single-family and low-rise multifamily residential buildings. These buildings are regulated by the International Energy Conservation Code (IECC). The IECC is updated on a 3-year cycle (i.e., a new edition of the code is published every 3 years, by the International Code Council [ICC]). The 2024 edition of the IECC, hereafter referred as the 2024 IECC, was published in May, 2024 (ICC 2024). Subsequently, DOE published its model energy code *determination* for the 2024 IECC on December 30, 2024. DOE's determination analyses indicate an increase in energy efficiency in single-family and low-rise multifamily residential buildings that are subject to the 2024 IECC compared to the 2021 IECC.

1.1 Purpose

The IECC is developed through a public process administered by the ICC.[1] While proponents of code changes often include the energy and cost-effectiveness criteria associated with their respective code change proposals, the IECC process does not include an energy or cost-effectiveness analysis of the entire edition of the code. Ensuring the cost-effectiveness of IECC changes encourages their adoption and implementation at the state and local levels. In support of this goal, DOE conducts cost-effectiveness analyses of the latest edition of the code compared to its predecessor, following the publication of an updated edition of the IECC. These analyses are conducted at the national and state level by accounting for regional construction and fuel costs.

DOE provides technical assistance, such as the present cost-effectiveness analysis, to states to ensure informed decision-making during their consideration of adopting, implementing, and enforcing the latest model energy codes. DOE has commissioned prior cost-effectiveness analyses of the IECC (DOE 2021). Figure 1 shows the status of the adoption of residential building energy codes as of February 2024 (BECP 2024), with states expected to adopt the 2024 IECC in the coming years, based on historical trends. The state adoption map shows the functional equivalent of the adopted code, including any applicable state amendments.

[1] https://www.iccsafe.org/codes-tech-support/codes/code-development/

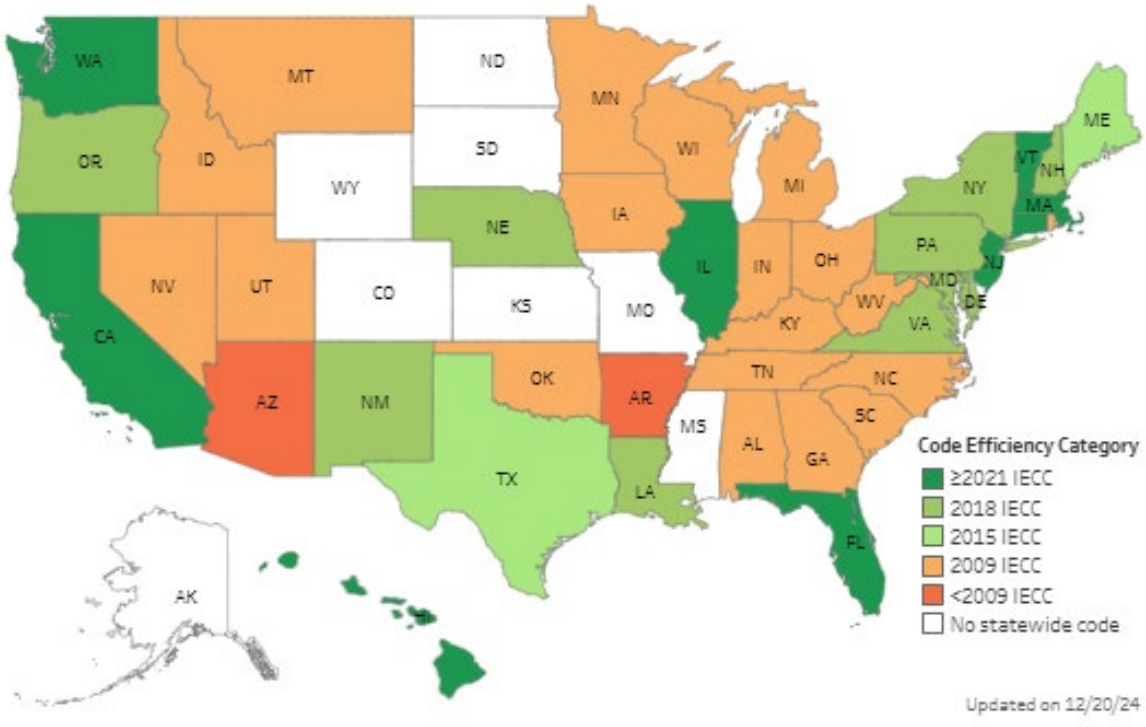

Figure 1. Current Residential Building Energy Code Adoption Status in the United States (BECP 2024)

1.2 Overview

This analysis examines the cost-effectiveness of the prescriptive and mandatory residential provisions of the 2024 IECC. The simulated performance path and the Energy Rating Index (ERI) path are not considered in this analysis due to the wide variation in building construction characteristics that can comply through those paths, and as the prescriptive approach remains the most prominently utilized option. While some states choose to adopt amended versions of the IECC, this analysis focuses on the unamended provisions of the 2024 and 2021 IECC. The methodology established by DOE for determining the energy savings and cost-effectiveness of residential building energy codes (Salcido et al. 2024) forms the basis of this cost-effectiveness analysis.

1.2.1 Building Prototypes

The DOE methodology proposes a suite of 32 residential prototype building models to represent the U.S. new construction residential building stock. This suite, summarized in Table 1, was created based on construction data from the U.S. Census (Census 2020) and the Residential Energy Consumption Survey (RECS 2020). Detailed descriptions of the 32 prototype building models and operational assumptions are documented by Mendon et al. (2014).

Table 1.1. Residential Prototype Buildings

No.	Building Type	Foundation Type	Heating System Type
1	Single-family	Vented Crawlspace	Gas-Fired Furnace

2	Single-family	Vented Crawlspace	Electric Furnace
3	Single-family	Vented Crawlspace	Oil-Fired Furnace
4	Single-family	Vented Crawlspace	Heat Pump
5	Single-family	Slab-On-Grade	Gas-Fired Furnace
6	Single-family	Slab-On-Grade	Electric Furnace
7	Single-family	Slab-On-Grade	Oil-Fired Furnace
8	Single-family	Slab-On-Grade	Heat Pump
9	Single-family	Heated Basement	Gas-Fired Furnace
10	Single-family	Heated Basement	Electric Furnace
11	Single-family	Heated Basement	Oil-Fired Furnace
12	Single-family	Heated Basement	Heat Pump
13	Single-family	Unheated Basement	Gas-Fired Furnace
14	Single-family	Unheated Basement	Electric Furnace
15	Single-family	Unheated Basement	Oil-Fired Furnace
16	Single-family	Unheated Basement	Heat Pump
17	Multifamily	Vented Crawlspace	Gas-Fired Furnace
18	Multifamily	Vented Crawlspace	Electric Furnace
19	Multifamily	Vented Crawlspace	Oil-Fired Furnace
20	Multifamily	Vented Crawlspace	Heat Pump
21	Multifamily	Slab-On-Grade	Gas-Fired Furnace
22	Multifamily	Slab-On-Grade	Electric Furnace
23	Multifamily	Slab-On-Grade	Oil-Fired Furnace
24	Multifamily	Slab-On-Grade	Heat Pump
25	Multifamily	Heated Basement	Gas-Fired Furnace
26	Multifamily	Heated Basement	Electric Furnace
27	Multifamily	Heated Basement	Oil-Fired Furnace
28	Multifamily	Heated Basement	Heat Pump
29	Multifamily	Unheated Basement	Gas-Fired Furnace
30	Multifamily	Unheated Basement	Electric Furnace
31	Multifamily	Unheated Basement	Oil-Fired Furnace
32	Multifamily	Unheated Basement	Heat Pump

1.2.2 Climate Locations

The 2024 IECC climate zone map is based on the 2013 edition of ASHRAE Standard 169, Climatic Data for Building Design Standards (ASHRAE 2013) and aligns with that used by ASHRAE Standard 90.1, ASHRAE Standard 90.2, and the International Green Construction Code (IgCC). ASHRAE Standard 169-2013 includes nine thermal zones and three moisture regimes.

The U.S. climate zones and moisture regimes are shown in Figure 2.

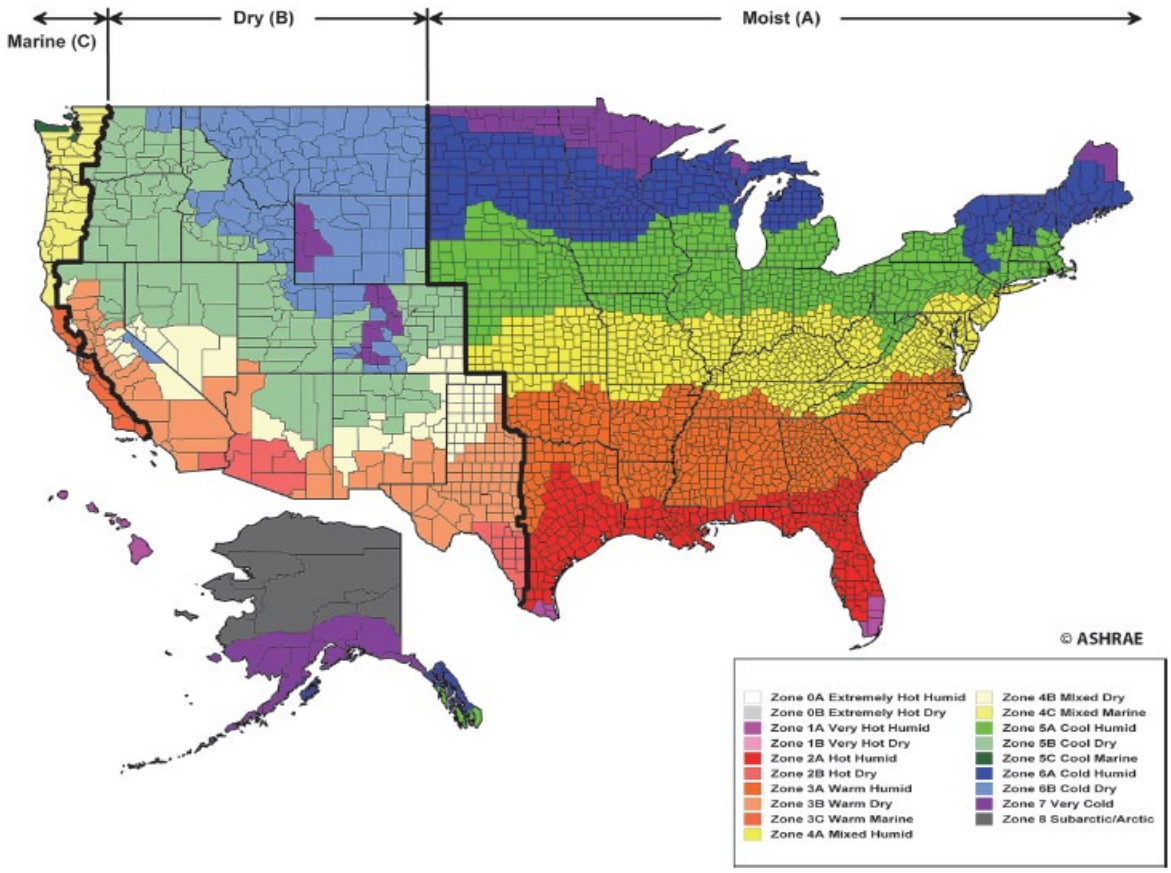

Figure 2. U.S. Climate Zone Map

Climate zones are divided into moist (A), dry (B), and marine (C) regions. However, not all the moisture regimes apply to all climate zones in the United States, and some zones have no moisture designations at all (zones 7 and 8 in the United States); thus, only 19 thermal-moisture zones exist in ASHRAE 169-2013, of which 16 are represented in the United States. In addition, the residential IECC includes a tropical climate designation with an alternative prescriptive compliance path for semi-conditioned buildings meeting certain criteria. Because the national analysis for DOE determinations looks only at the primary prescriptive compliance path, the alternative for tropical semi-conditioned buildings is not considered in this analysis. All homes in the tropical zone are modeled as complying with the prescriptive path. The appropriate state level analyses will include the parameters of the tropical semi-conditioned prescriptive requirements.

The IECC further defines a warm-humid region in the southeastern United States. This region is defined by humidity levels, whereas the moist (A) regime is more closely associated with rainfall. The warm-humid distinction affects only whether basement insulation is required in climate zone 3. This brings the total number of representative cities analyzed to 18.

For the quantitative analysis, a specific climate location (i.e., city) was selected as representative of each of the 18 climate/moisture zones found in the United States:

- 1A: Honolulu, Hawaii (tropical)
- 1A: Miami, Florida
- 2A: Tampa, Florida
- 2B: Tucson, Arizona
- 3A: Atlanta, Georgia
- 3A: Montgomery, Alabama (warm-humid)
- 3B: El Paso, Texas
- 3C: San Diego, California
- 4A: New York, New York
- 4B: Albuquerque, New Mexico
- 4C: Seattle, Washington
- 5A: Buffalo, New York
- 5B: Denver, Colorado
- 5C: Port Angeles, Washington
- 6A: Rochester, Minnesota
- 6B: Great Falls, Montana
- 7: International Falls, Minnesota
- 8: Fairbanks, Alaska

For the determination analysis, one set of prototype models was configured to represent construction practices as dictated by the 2021 IECC, another set was configured to represent the 2024 IECC, and then both sets were simulated in all the climate zones and moisture regimes defined in the IECC. Annual energy simulations were carried out for each of the 592 models using *EnergyPlus* version 23.1.0 (DOE 2024). The resulting energy use data were converted to energy costs using national average fuel prices, and the energy and energy cost results were weighted to the national level using weighting factors based on housing starts.

1.2.3 Weighting Factors

Weighting factors for each of the 32 residential prototype buildings were developed for each of the climate zones using 2020 state new residential construction starts[1] and residential construction details from the U.S. Census (Census 2020). The weights were fine-tuned by the revised county-to-climate zone map based on ASHRAE 169 climate zones. These weighting factors are used to aggregate energy and costs across all building types for each climate zone. Table 2 through Table 5 summarize the weights aggregated to building type, foundation type, heating system, and climate zone levels. Table 6 shows the detailed weighting factors for all 32 residential prototype buildings.

Table 1.2.Weighting Factors by Building Type

Bldg. Type	Weight (%)
Single-Family	82.12
Multifamily	17.88

[1] https://www.census.gov/construction/bps/stateannual.html

Table 1.3. Weighting Factors by Foundation Type

Foundation Type	Weight (%)
Crawlspace	15.53
Slab-On-Grade	59.20
Heated Basement	15.71
Unheated Basement	9.56

Table 1.4. Weighting Factors by Heating System

Heating System Type	Weight (%)
Gas-Fired Furnace	55.60
Electric Furnace	7.88
Oil-Fired Furnace	0.15
Heat Pump	36.37

Table 1.5. Weighting Factors by Climate Zone

Climate Zone	Weight (%)
1	2.12
2	26.02
3	28.84
4	19.07
5	18.33
6	5.05
7	0.55
8	0.01

Table 1.6. Weighting Factors for the Residential Prototype Building Models by Climate Zone (CZ)

Building Type	Foundations	Heating Systems	CZ1 (%)	CZ2 (%)	CZ3 (%)	CZ4 (%)	CZ5 (%)	CZ6 (%)	CZ7 (%)	CZ8 (%)	Weights by Prototype
Single-Family	Crawlspace	Gas-Fired Furnace	0.16	0.28	1.38	2.2	2.01	0.38	0.11	0	6.52
Single-Family	Crawlspace	Electric Furnace	0.01	0.06	0.25	0.26	0.11	0.03	0.01	0	0.73
Single-Family	Crawlspace	Oil-Fired Furnace	0	0	0	0	0	0	0	0	0.01
Single-Family	Crawlspace	Heat Pump	0.05	0.45	2.82	1.73	0.34	0.06	0.02	0	5.48
Single-Family	Slab-On-Grade	Gas-Fired Furnace	0.46	8.97	8.16	2.42	2.99	0.8	0.11	0	23.91
Single-Family	Slab-On-Grade	Electric Furnace	0.13	2.42	1.53	0.35	0.16	0.08	0.01	0	4.68
Single-Family	Slab-On-Grade	Oil-Fired Furnace	0	0.01	0.01	0.01	0.01	0	0	0	0.03
Single-Family	Slab-On-Grade	Heat Pump	0.65	9.26	8.02	1.82	0.44	0.12	0.02	0	20.33
Single-Family	Heated Basement	Gas-Fired Furnace	0.01	0.03	0.48	2.45	4.56	1.26	0.1	0	8.89
Single-Family	Heated Basement	Electric Furnace	0	0.01	0.07	0.24	0.24	0.11	0.01	0	0.69
Single-Family	Heated Basement	Oil-Fired Furnace	0	0	0	0.01	0.02	0	0	0	0.03
Single-Family	Heated Basement	Heat Pump	0	0.08	0.64	1.58	0.51	0.16	0.02	0	2.98
Single-Family	Unheated Basement	Gas-Fired Furnace	0	0.07	0.2	1.22	3.3	0.96	0.07	0	5.81
Single-Family	Unheated Basement	Electric Furnace	0	0.02	0.04	0.1	0.14	0.06	0.01	0	0.36
Single-Family	Unheated Basement	Oil-Fired Furnace	0	0	0	0.01	0.02	0.01	0	0	0.04
Single-Family	Unheated Basement	Heat Pump	0	0.08	0.5	0.55	0.36	0.11	0.01	0	1.6

Building Type	Foundations	Heating Systems	CZ1 (%)	CZ2 (%)	CZ3 (%)	CZ4 (%)	CZ5 (%)	CZ6 (%)	CZ7 (%)	CZ8 (%)	Weights by Prototype
Multifamily	Crawlspace	Gas-Fired Furnace	0.04	0.04	0.31	0.73	0.37	0.08	0.01	0	1.58
Multifamily	Crawlspace	Electric Furnace	0	0.01	0.05	0.07	0.02	0.01	0	0	0.16
Multifamily	Crawlspace	Oil-Fired Furnace	0	0	0	0	0	0	0	0	0
Multifamily	Crawlspace	Heat Pump	0.02	0.06	0.5	0.38	0.06	0.01	0	0	1.04
Multifamily	Slab-On-Grade	Gas-Fired Furnace	0.14	1.87	1.87	0.63	0.57	0.21	0.02	0	5.31
Multifamily	Slab-On-Grade	Electric Furnace	0.03	0.55	0.27	0.07	0.03	0.03	0	0	0.99
Multifamily	Slab-On-Grade	Oil-Fired Furnace	0	0	0	0	0	0	0	0	0.01
Multifamily	Slab-On-Grade	Heat Pump	0.39	1.7	1.35	0.37	0.08	0.03	0	0	3.93
Multifamily	Heated Basement	Gas-Fired Furnace	0	0	0.12	0.78	1.06	0.28	0.02	0	2.26
Multifamily	Heated Basement	Electric Furnace	0	0	0.01	0.06	0.06	0.03	0	0	0.17
Multifamily	Heated Basement	Oil-Fired Furnace	0	0	0	0	0	0	0	0	0.01
Multifamily	Heated Basement	Heat Pump	0	0.01	0.12	0.39	0.12	0.04	0	0	0.68
Multifamily	Unheated Basement	Gas-Fired Furnace	0	0.02	0.03	0.45	0.65	0.15	0.01	0	1.31
Multifamily	Unheated Basement	Electric Furnace	0	0.01	0.01	0.03	0.03	0.02	0	0	0.09
Multifamily	Unheated Basement	Oil-Fired Furnace	0	0	0	0	0	0	0	0	0.01
Multifamily	Unheated Basement	Heat Pump	0	0.01	0.08	0.15	0.07	0.02	0	0	0.33
Totals by Climate Zone			2.12	26.02	28.84	19.07	18.33	5.05	0.55	0.01	100.00

1.3 Report Contents and Organization

This report documents the methodology and results of the cost-effectiveness analysis of the prescriptive and mandatory provisions of the 2024 IECC compared to those of the 2021 IECC. The present analysis builds on work conducted by PNNL during the determination analysis of the 2024 IECC (Salcido et al. 2024).

Building energy models were developed to evaluate the energy performance of the 2024 and 2021 IECC editions as applied to DOE's established residential prototypes. Incremental cost estimates for the provisions of the 2024 IECC compared to the 2021 IECC are combined with the energy performance results to calculate the cost-effectiveness of the 2024 IECC.

This report is divided into three parts. Section 2.0 provides a summary of residential code changes in the 2024 IECC compared to the 2021 IECC and the details of the code changes considered in the present cost-effectiveness analysis. Section 3.0 details the methodology and incremental cost for the code changes considered in this analysis. Section 4.0 provides an overview of the economic analyses and summarizes the aggregated results of the cost-effectiveness analysis at the climate zone level.

The approved code changes incorporated into the 2024 IECC that have a direct effect on energy use are listed in Appendix A. Additional details about the building energy models created for simulating the energy use of buildings built to meet the provisions of the various editions of the IECC are provided in Appendix B.

2.0 Changes Introduced in the 2024 IECC

Following the publication of the 2024 IECC, DOE conducted both a qualitative and a quantitative energy savings analysis of that code compared to its immediate predecessor, the 2021 IECC. All the changes introduced in the 2024 IECC were identified, and their impact on energy efficiency was qualified. A total of 273 formal code change proposals were accepted into the 2024 IECC as shown in Table A.1. Of the 273 changes, 54 were identified as impacting energy use (48 decreasing, six increasing), and eight were identified as requiring further analysis by energy simulation to quantify their impact using whole-building energy simulations of the 32 PNNL residential prototype buildings across the IECC climate zones.

Table 2.1 summarizes the characterization of the eight approved code changes with quantifiable energy impacts considered in the present cost-effectiveness analysis.

Table 2.1. Summary of Analyzed Changes to the 2024 IECC

Proposal Number[a]	Code Section(s)[b]	Description of Change(s)	Impact on Energy Efficiency	Included in Energy Analysis	Discussion
REPI-018-21	R401.2, R401.2.1, R401.2.5, R401.3, R405.2, SECTION R408, R408.1, R408.2, TABLE R408.2 (New), R408.2.1, R408.2.1.1 (New), R408.2.1.2 (New), TABLE R408.2.1.2 (New), R408.2.2, R408.2.3, R408.2.4, R408.2.5, R408.2.7 (New), TABLE R408.2.7 (New), R408.2.8 (New)	Changes the Section R408 additional efficiency packages to an energy credit methodology. Each residential building must select at least two energy credit measures to achieve 10 energy credits.	Reduces energy use	Yes	The energy credit methodology provides a path to increase the energy efficiency of a residential building while providing design flexibility. There are a total of 53 energy credit measures for envelope, heating, ventilating, and air conditioning (HVAC), service water heating (SWH), duct leakage and location, air leakage and ventilation, demand response, lighting, efficient appliances, and on-site renewable energy. Each energy credit represents a 1 percent reduction in total energy savings.

Proposal Number[a]	Code Section(s)[b]	Description of Change(s)	Impact on Energy Efficiency	Included in Energy Analysis	Discussion
REPI-028-21	TABLE R402.1.2, TABLE R402.1.3	Reduced fenestration U-factors in climate zones 4 and 5 from 0.30 to 0.28 and reduced all skylight U-factor requirements to 0.6 in climate zones 0 through 2, 0.53 in climate zones 3, 4A, and 4B, and 0.50 in climate zones 4C through 8 in Table R402.1.2 and R402.1.3.	Reduces energy use	Yes	
REPI-063-21	R402.4.1.2, R402.4.1.3, TABLE R405.4.2(1)	Changes the prescriptive air leakage requirements in climate zones 0, 1, and 2 from 5.0 ACH50 to 4.0 ACH50. The air leakage of the standard reference home in Table R405.4.2(1) is set to 4.0 ACH50 in climate zones 0 through 2.	Reduces energy use	Yes	
REPI-064-21	R402.4.1.2, R402.4.1.3, TABLE R405.4.2(1), R408.2.5	Changes the prescriptive air leakage requirements in climate zones 3 through 8 from 3.0 ACH50 to 2.0 ACH50. The air leakage of the standard reference home in Table R405.4.2(1) is set to 2.0 ACH50 in climate zones 4 through 8.	Reduces energy use	Yes	The air leakage for this proposal was adjusted to keep the prescriptive air leakage requirements at 3.0 ACH50 for climate zones 3 through 5 and 2.5 ACH50 for climate zones 6 through 8.
REPI-089-21	R403.5.2, TABLE C403.12.3, TABLE R405.2, TABLE R406.2	Increases pipe insulation for hot water piping from R-3 to 1 inch of insulation (R-7), which applies to all sizes of piping.	Reduces energy use	Yes	One inch of pipe insulation will achieve an R-7 level of insulation.
REPI-093-21	R403.6.1	Dwelling units shall be provided with a heat recovery or energy recovery ventilation system in climate zones 5 through 8. The ventilation system shall be balanced with a minimum sensible recovery efficiency (SRE) of 65 percent at 32°F (0°C) at a flow greater than or equal to the design airflow.	Reduces energy use	Yes	The proposal was modified to remove the heat recovery ventilator (HRV) requirement for climate zone 5 so the final adjustment is to add HRV requirement for ventilation in climate zone 6 on top of the 2021 IECC requirement of HRVs in climate zones 7 and 8.

Proposal Number[a]	Code Section(s)[b]	Description of Change(s)	Impact on Energy Efficiency	Included in Energy Analysis	Discussion
RED1-110-22	R404.1.2, R404.1.3, R404.1.4, TABLE R404.1	Revises the exterior lighting sections and adds a new lighting power allowance table to match the equivalent requirements in IECC-C. Additional exceptions from IECC-C were added that could apply to the Group R occupancies.	Reduces energy use	Yes	Previously in 2021 IECC, the exterior lighting for low-rise multifamily buildings was required to comply with the commercial exterior lighting provisions.
REPI-033-21	TABLE R402.1.2, TABLE R402.1.3, R408.2, R408.2.1 (New), R408.2.1-R408.2.4	Ceiling insulation in Table R402.1.3 was reduced from R-49 to R-38 in climate zones 2 and 3 and reduced from R-60 to R-49 in climate zones 4 through 8. The associated ceiling U-factors were adjusted for the same climate zones in Table R402.1.2. The new U factor is 0.030 for climate zones 2 and 3 and 0.026 for climate zones 4 through 8.	Increase energy use	Yes	This proposal adjusts the ceiling insulation in climate zones 2 through 8 back to the 2018 IECC levels.

(a) Proposal numbers are as assigned by the ICC (https://energy.cdpaccess.com/live/cah)
(b) Code sections refer to the 2021 IECC. Sections may be renumbered by the ICC in the 2024 IECC.

3.0 Construction Cost Estimates

This section describes the methodology used for calculating the incremental costs of construction of the 2024 IECC compared to the 2021 IECC. Detailed incremental cost estimates for the new provisions of the 2024 IECC considered in this analysis are provided along with a summary of total incremental costs by building type and climate zone.

3.1 Methodology

The present analysis includes only the prescriptive and mandatory provisions of the IECC pertaining to residential buildings. The first step in evaluating the cost-effectiveness of these changes introduced by the 2024 IECC is estimating their incremental construction costs. Data sources consulted for these estimates include, but are not limited to, the following:

- Building Component Cost Community (BC3) data repository (DOE 2012)
- National Renewable Energy Laboratory (NREL) National Residential Efficiency Measures Database (NREL 2013)
- ENERGY STAR Single-Family New Homes, Version 3.2 (Rev.12) Cost & Savings Estimates (EPA 2023)
- ENERGY STAR Multifamily New Construction, Version 1.1 Cost & Savings Estimates (EPA 2018)
- DOE Zero Energy Ready Home Savings & Cost Estimate Summary (DOE 2015)
- RS Means Residential Cost Data (RS Means 2024)
- The Cost of Decarbonization and Energy Upgrade Retrofits for U.S. Homes (Less et al, 2021)
- Residential Ducts in Conditioned Space/High Performance Attics (Wei et al, 2015)
- Price data from nationally recognized home supply stores.

The incremental costs are calculated separately for each code change, and then added together to obtain a total incremental cost by climate zone and building type. The following sections discuss the specific cost estimates identified for the efficiency measures that changed in the 2024 IECC.

3.2 Incremental Cost Estimates for New Provisions of the 2024 IECC

The incremental construction costs associated with the eight code changes in Table 7 are detailed in the following sections. Only costs for the eight code changes with quantifiable energy impacts are considered.

3.2.1 Energy Credits

Recent energy codes have included provisions for additional efficiency measures above and beyond the prescriptive code requirements that must be included in the building design and construction. The 2024 IECC (REPI-18) assigns energy credit values to energy efficiency measures based on the percentage of annual total site energy savings achieved over the baseline prescriptive energy code. Energy credit savings could be expressed in terms of site energy, energy cost, or emissions depending on the emphasized metric. The higher the

savings, the more energy credits assigned. The energy credits are divided into traditional efficiency measures (envelope, HVAC, service water heating, thermal distribution systems, air leakage, and appliances). The amount of energy credits for each measure was determined based on simulation analysis of the energy measure over the prescriptive code for each climate zone. The 2024 IECC stipulates that a typical residential building must achieve 10 energy credits (by selecting not less than two energy credit measures) for prescriptive compliance while dwelling units over 5,000 sq ft require an additional 5 energy credits. The energy credits provide flexibility for meeting the required credit amount, by allowing various combinations of measures to meet the requirement. For the 2024 IECC quantitative analysis, energy credit measures were selected to meet the required 10 energy credits for the prototype building size, based on several factors including standard practice, cost-effectiveness, and the ability to quantify savings using the methodology described in this report. Table 3.2.1 shows the energy credit selections for the all-electric prototypes. Tables 3.2.2 shows the energy credit selections for the fossil fuel prototypes.

Table 3.2.1. Energy Credit Measures for Quantitative Analysis for All-Electric Buildings (Heat Pump and Electric Furnace)

		Credit Value								
Measure	Measure Description	CZ 1	CZ 2	CZ 3	CZ 4	CZ 4C	CZ 5	CZ 6	CZ 7	CZ 8
R408.2.1.2(1)	Window U-factor – 0.25						1			
R408.2.3(3)	Integrated HPWH: UEF = 3.30	10	9	9	7	6	4	3	3	2
R408.2.3(8)	Compact Hot Water Distribution				2	2	2			
R408.2.4(3)	80% of Ducts in Conditioned Space							7	7	9
R408.2.5(1)	HRV @ 75% SRE					1	3			
R408.2.6	Energy Efficient Appliances	1	1	1	1	1				
Total Credits		**11**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**11**

Table 3.2.2. Energy Credit Measures for Quantitative Analysis for Mixed Fuel Buildings (Gas and Oil Furnaces)

		Credit Value								
Measure	Measure Description	CZ 1	CZ 2	CZ 3	CZ 4	CZ 4C	CZ 5	CZ 6	CZ 7	CZ 8
R408.2.1.2(1)	Window U-factor – 0.25						1			
R408.2.2(2)	High Performance Cooling 15.2 SEER2	5	4	3	2					
R408.2.3(2)(b)	Gas-Fired Instant WH, UEF-0.95					3	6	6	7	8
R408.2.3(8)	Compact Hot Water Distribution	2	2	2	2		2	2	2	2
R408.2.4(2)	100% of Ducts in Conditioned Space	2	3	4	6	7				
R408.2.5(1)	HRV installed							2	2	
R408.2.6	Energy Efficient Appliances	1	1	1			1			
Total Credits		**10**	**10**	**10**	**10**	**10**	**10**	**10**	**11**	**10**

3.2.1.1 R408.2.1.2(1): U-factor and SHGC for windows per Table R408.2.1

The energy credit for U-factor and SHGC for windows further reduces (makes more efficient) the U-factor required for residential fenestration (windows and doors) in climate zone 5 from 0.28 to 0.25 Btu/hr-ft2-F for the 2024 IECC. This energy credit is applied across all prototypes in climate zone 5.

The EPA single-family cost and savings estimate report (EPA 2023) shows the cost of moving from a window U-factor of 0.3 to 0.27 is \$0.82/ft^2 of window area converted to 2024 dollars. In order to further reduce the window U-factor to 0.25 required an extrapolation of the window upgrade costs from both the ENERGY STAR single family and multifamily (EPA 2018) to come up with an estimate. The final calculated incremental cost to go from a window U-factor of 0.30 to 0.25 would cost \$2.05/ft^2. The incremental cost to go from a window U-factor of 0.28 to 0.25 would cost an additional \$1.23/ft^2. For the single-family prototypes, the incremental construction cost to move from a window U-factor of 0.28 to 0.25 is estimated to be \$438 while the multifamily dwelling unit estimate shows an incremental cost of \$149.

3.2.1.2 R408.2.2(2): High performance cooling - 15.2 SEER2

For the gas and oil-fired furnace prototypes utilizing the high-performance cooling (15.2 SEER2) energy credit measure, the federal minimum 13.4 SEER2 efficiency air conditioner is replaced with a 15.2 SEER2 centrally ducted air conditioner of the same capacity. The single-family air conditioner energy credit is applied in climate zones 1 through 4A/4B. The multifamily prototypes use the high-performance cooling energy credit in climate zone 4. Above climate zone 4, the air conditioner only awards one energy credit and was not used in favor or higher earning energy credit measures.

The BC3 cost database (DOE 2012) includes average/typical costs for various air conditioner efficiencies. Air conditioner costs were isolated for specific efficiency levels and capacities. For the single-family prototypes, a 3-ton 13.4 SEER2 central air conditioner is estimated to cost \$6,099 to install while a 3-ton 15.2 SEER2 central air conditioner is estimated to cost \$6,577 for an incremental cost of \$498. For the multifamily prototypes, a 1.5-ton 13.4 SEER2 central air conditioner is estimated to cost \$3,911 to install while a 1.5-ton 15.2 SEER2 central air conditioner is estimated to cost \$4,544 for an incremental cost of \$634. These costs were adjusted from 2012 to 2024 dollars using a consumer price index increase of 34 percent as found on the Inflation Calculator provided by the Bureau of Labor Statistics website.

3.2.1.3 R408.2.2(5): High-performance gas furnace - 95 AFUE

For the gas furnace prototypes utilizing the high-performance gas furnace (95 AFUE) energy credit measure, the federal minimum 80 AFUE gas furnace is replaced with a 95 AFUE forced air furnace of the same capacity. The high-performance gas furnace energy credit is applied only to climate zones 4C through 8 for single-family buildings and climate zones 5 through 8 for the multifamily buildings. In climate zones 1 through 4B, the high-performance gas furnace rewards fewer energy credits due to climate and was not used in favor or higher earning energy credit measures. The single-family unit contains an 80 MBH gas furnace while the multifamily dwelling units contain a 60 MBH gas furnace.

To calculate the incremental cost for the high-performance gas furnace measure, the installed cost of the 80 AFUE furnace are subtracted from the installed cost of the 95 AFUE furnace. The installed costs account for material and labor with overhead and profit accounting for 20%.

Table 3.2.4 shows the material, labor, overhead and profit estimated costs for the 80 AFUE gas furnace and the 95 AFUE gas furnace in 60 MBH and 80 MBH capacities. The material costs were obtained from the Grainger online cost database[1] while the labor costs were obtained from the 2024 RS Means online catalog. The incremental cost for the single-family gas furnace energy credit measure is estimated to be $1,068 and the estimated incremental cost for the multifamily gas furnace energy credit is $952.

Table 3.2.3. Costs for the High-Performance Gas Furnace Energy Credit

Gas Furnace	Material Cost	Labor Cost	O&H	Total
80 AFUE – 80 MBH	$1,178	$163	$268	$1,609
96 AFUE – 80 MBH	$1,681	$366	$409	$2,456
		80 MBH Gas Furnace Incremental Cost		**$847**
80 AFUE – 60 MBH	$1,051	$163	$243	$1,457
96 AFUE – 60 MBH	$1,665	$366	$406	$2,437
		60 MBH Gas Furnace Incremental Cost		**$980**

3.2.1.4 R408.2.3(3): Integrated heat pump water heater (HPWH) - 3.30 UEF

The electric prototypes (electric furnace and heat pump) utilize the integrated heat pump water heater (HPWH) energy credit with a uniform energy factor (UEF) of 3.30. The integrated HPWH is one option within the family of reduced energy use in service water heating energy credit options. The HPWH energy credit requires the replacement of the federal minimum efficiency 50-gallon electric storage water heater with a 3.30 UEF integrated HPWH 80-gallon tank for single-family and a 50-gallon tank for multifamily dwelling units. An 80-gallon hot water tank ensures adequate hot water for a family.

According to 2024 RS Means, a 40-gallon, double element electric water heater is estimated to cost $1,078 to install. Based on home supply store costs and 2024 RS Means, the estimated cost to install an 80-gallon 3.30 UEF HPWH is $3,296 and a 50-gallon 3.30 UEF HPWH is estimated to cost $2,157 to install.

The 2021 IECC electric prototypes contain an integrated HPWH with a UEF of 2.0. As a result, the incremental installation cost of the 3.30 UEF HPWH needs to be compared to a 2.0 UEF HPWH. According to the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) directory[2], the lowest rated UEF for a HPWH on the market is 2.8. Based on home supply store costs and 2024 RS Means, the installed cost for a 50-gallon 2.8 UEF HPWH is estimated at $1,751 and $2,674 for the 80-gallon 2.8 UEF HPWH. The delta installation costs for the 3.30 integrated HPWH in the single-family and multifamily prototypes are estimated to be $621 and $406 respectively.

[1] https://www.grainger.com/category/hvac-and-refrigeration/central-equipment/whole-house-gas-furnaces?categoryIndex=1, May, 2024.
[2] https://www.ahridirectory.org/

3.2.1.5 R408.2.3(2)(b): Gas-fired instantaneous water heater (Option 2)

The gas prototypes utilize the gas-fired instantaneous water heater (option 2) energy credit with a uniform energy factor (UEF) of 0.95. The gas-fired instantaneous water heater is one option within the family of reduced energy use in service water heating energy credit options. The gas-fired instantaneous energy credit requires the replacement of the federal minimum efficiency 50-gallon gas storage water heater with a gas-fired instantaneous water heater rated at 0.95 UEF.

According to 2024 RS Means, a 50-gallon, gas-fired storage water heater is estimated to cost $1,438 to install. Based on home supply store costs, an average gas-fired instantaneous water heater with a UEF of 0.95 is estimated to cost $1,575. Adding the installation estimated costs from 2024 RS for a gas-fired instantaneous water heater at $221 plus 20% of profit and overhead estimates the installed cost for the instant water heater at $2,065. The incremental cost to install the gas-fired instantaneous water heater is estimated to be $627.

The 2021 IECC gas prototypes contain an electric instantaneous water heater with a UEF of 0.82 as part of the additional efficiency package requirement. As a result, the incremental installation cost of the gas-fired instantaneous water heater at 0.95 UEF needs to be compared to an electric instantaneous water heater at 0.82 UEF. Based on home supply store costs and 2024 RS Means, the installed cost for an electric instantaneous water heater at 0.82 UEF is estimated at $1,735 ($1,418 for material and $196 for labor plus overhead and profit). This represents an incremental cost of $297 over the 50-gallon gas storage water heater of $1,438. The delta installation cost for the gas-fired instantaneous water heater with a 0.95 UEF over the electric instantaneous water heater for both single-family and multifamily prototypes is $330.

3.2.1.6 R408.2.3(8): Compact hot water design

In previous versions of the residential prototype models, the hot water distribution assumed adiabatic piping for the domestic hot water systems and pipe losses were estimated by applying an assumed pipe loss factor to the hot water usage. For this analysis, the heat losses from the hot water piping are directly simulated in *EnergyPlus* to determine the impacts of those heat losses on hot water energy consumption. By simulating the hot water pipe heat losses, reduction in the domestic hot water energy use resulting from changes in the hot water piping layout can be quantified. The new modeling strategy allows for analysis of the hot water system design and comparison with compact design strategies. The heat losses from the hot water piping not only impact the domestic hot water energy consumption, but also has a small effect on the heating and cooling energy because of the heat dissipated to the indoor air.

The modeled heat transfer from the hot water distribution system is calculated based on pipe material, pipe insulation R-value, pipe diameter, pipe length, indoor air temperature and the rate of water flow. Hot water piping layouts for the single-family and multifamily prototypes were created based on the floor plans which specifically located the water heater and hot water fixtures to determine the necessary pipe lengths required for the hot water distribution. The hot water fixtures are in the bathrooms (each with a sink and shower/tub), the kitchen (sink and dishwasher) and laundry room (clothes washer). The single-family prototypes have three bathrooms while the multifamily prototype dwelling units have two bathrooms. Other than the bathroom fixtures, the two prototypes share the same hot water fixtures (per unit). The water heater is placed in the basement for single-family prototypes with a basement and is otherwise in the garage for the remaining single-family prototypes. The multi-family prototypes have the

water heaters located in a closet unit within conditioned space. Using these layouts, the pipe length from the water heater to each hot water fixture is added to the models.

For the single-family and multifamily prototype floor plans, typical hot water piping layouts were estimated based on foundation type and location of the hot water heater. The baseline hot water piping layout covered approximately 80 percent of the conditioned floor area. For the compact hot water design (R408.2.3(8)), a new floor layout was assumed that created a new hot water piping layout to meet the 16-ounce volumetric requirements in the pipe length between the hot water heater and farthest hot water fixture. The compact hot water layout utilizes shared walls for the hot water fixtures (e.g., a kitchen sink and dishwasher on the opposite side of a shared wall with a bathroom) and places the water heater as close to these fixtures as possible to create the compact design. The compact hot water piping layout covered approximately 3 percent of the conditioned floor area. The compact hot water system design energy credit is modeled by estimating the reduction in pipe lengths from the water heater to the hot water fixtures. The heat loss savings are simulated based on the pipe lengths in the baseline and compact hot water designs. Ultimately, the reduction in hot water usage for the compact design is estimated based on the “time to tap” (estimated time for hot water to arrive at fixtures from the water heater) and the average number of cold start events per day (15 in this analysis).

All piping and fitting costs were estimated from the 2024 RS Means database. The estimated hot water piping costs include cross-linked polyethylene (PEX), acrylonitrile butadiene styrene (ABS) and steel piping and fittings for hot water supply piping, water drain piping and gas supply piping respectively. Pipe insulation is also included in the cost for ¾” piping. The cost for the piping materials for the baseline piping layout in the single-family prototypes is $9,291 and the multifamily dwelling baseline piping layout costs $8,809. The estimated cost for the compact hot water piping layout in the single-family prototypes is $7,701 and the for the multifamily unit is $7,637. The incremental construction cost for the single-family compact hot water design -$1,590 and -$1,173. Tables 3.2.6 and 3.2.7 show the itemized costs for the piping, fittings and pipe insulation for the single-family and multifamily dwelling units respectively. In addition to capturing energy savings in hot water energy use, the construction costs are significantly lower.

Table 3.2.4. Costs for the Single Family Compact Hot Water Design Energy Credit

Baseline Design				Compact HW Design			
Installed Unit Costs (2024 RSMeans)				Installed Unit Costs (2024 RSMeans)			
	Quantity	Unit Cost	Total Cost		Quantity	Unit Cost	Total Cost
Supply Piping - PEX (3/4")	68	$ 1.24	$ 84.32	Supply Piping - PEX (3/4")	4	$ 1.24	$ 4.96
Supply Fittings - PEX (3/4")	6	$ 29.60	$ 177.60	Supply Fittings - PEX (3/4")	2	$ 29.60	$ 59.20
Supply Joints - PEX (3/4")	6	$ 47.00	$ 282.00	Supply Joints - PEX (3/4")	2	$ 47.00	$ 94.00
Supply Hangers - PEX (3/4")	12	$ 28.25	$ 339.00	Supply Hangers - PEX (3/4")	2	$ 28.25	$ 56.50
Supply Piping - PEX (1/2")	91	$ 0.73	$ 66.43	Supply Piping - PEX (1/2")	74	$ 0.73	$ 54.02
Supply Fittings - PEX (1/2")	14	$ 27.95	$ 391.30	Supply Fittings - PEX (1/2")	12	$ 27.95	$ 335.40
Supply Joints - PEX (1/2")	14	$ 30.95	$ 433.30	Supply Joints - PEX (1/2")	12	$ 30.95	$ 371.40
Supply Hangers - PEX (1/2")	42	$ 24.89	$ 1,045.38	Supply Hangers - PEX (1/2")	34	$ 24.89	$ 846.26
Drain Piping - ABS (3")	40	$ 36.25	$ 1,450.00	Drain Piping - ABS (3")	32	$ 36.25	$ 1,160.00
Drain Fittings - ABS	9	$ 56.50	$ 508.50	Drain Fittings - ABS	9	$ 56.50	$ 508.50
Drain Excavation	13	$ -	$ -	Drain Excavation	13	$ -	$ -
Drain Piping - ABS (1")	95	$ 22.15	$ 2,104.25	Drain Piping - ABS (1")	85	$ 22.15	$ 1,882.75
Drain Fittings - ABS	25	$ 58.50	$ 1,462.50	Drain Fittings - ABS	23	$ 58.50	$ 1,345.50
Drain Excavation	38	$ -	$ -	Drain Excavation	34	$ -	$ -
Steel Pipe	24	$ 14.08	$ 337.92	Steel Pipe	29	$ 14.08	$ 408.32
Steel Fittings	2	$ 59.00	$ 118.00	Steel Fittings	3	$ 59.00	$ 177.00
Miscellaneous Joints	19	$ 18.45	$ 350.55	Miscellaneous Joints	19	$ 18.45	$ 350.55
Pipe Insulation	12	$ 11.65	$ 139.80	Pipe Insulation	4	$ 11.65	$ 46.60
Total			**$ 9,291**	**Total**			**$ 7,701**
Incremental Cost for Single Family Compact Hot Water Design							**$ (1,590)**

Table 3.2.5. Costs for the Multifamily Compact Hot Water Design Energy Credit

Baseline Design				Compact HW Design			
Installed Unit Costs (2024 RSMeans)				Installed Unit Costs (2024 RSMeans)			
	Quantity	Cost/item	Cost		Quantity	Cost/item	Cost
Supply Piping - PEX (3/4")	87	$ 1.24	$ 107.88	Supply Piping - PEX (3/4")	4	$ 1.24	$ 4.96
Supply Fittings - PEX (3/4")	4	$ 29.60	$ 118.40	Supply Fittings - PEX (3/4")	2	$ 29.60	$ 59.20
Supply Joints - PEX (3/4")	3	$ 47.00	$ 141.00	Supply Joints - PEX (3/4")	2	$ 47.00	$ 94.00
Supply Hangers - PEX (3/4")	12	$ 28.25	$ 339.00	Supply Hangers - PEX (3/4")	4	$ 28.25	$ 113.00
Supply Piping - PEX (1/2")	78	$ 0.73	$ 56.94	Supply Piping - PEX (1/2")	66	$ 0.73	$ 48.18
Supply Fittings - PEX (1/2")	13	$ 27.95	$ 363.35	Supply Fittings - PEX (1/2")	6	$ 27.95	$ 167.70
Supply Joints - PEX (1/2")	13	$ 30.95	$ 402.35	Supply Joints - PEX (1/2")	8	$ 30.95	$ 247.60
Supply Hangers - PEX (1/2")	12	$ 24.89	$ 298.68	Supply Hangers - PEX (1/2")	12	$ 24.89	$ 298.68
Drain Piping - ABS (3")	61	$ 36.25	$ 2,193.13	Drain Piping - ABS (3")	66	$ 36.25	$ 2,392.50
Drain Fittings - ABS	24	$ 56.50	$ 1,356.00	Drain Fittings - ABS	24	$ 56.50	$ 1,356.00
Drain Excavation	37	$ -	$ -	Drain Excavation	38	$ -	$ -
Drain Piping - ABS (1")	65	$ 22.15	$ 1,439.75	Drain Piping - ABS (1")	39	$ 22.15	$ 852.78
Drain Fittings - ABS	12	$ 58.50	$ 702.00	Drain Fittings - ABS	15	$ 58.50	$ 877.50
Drain Excavation	13	$ -	$ -	Drain Excavation	13	$ -	$ -
Steel Pipe	27	$ 14.08	$ 380.16	Steel Pipe	26	$ 14.08	$ 366.08
Steel Fittings	4	$ 59.00	$ 236.00	Steel Fittings	3	$ 59.00	$ 177.00
Miscellaneous Joints	29	$ 18.45	$ 535.05	Miscellaneous Joints	29	$ 18.45	$ 535.05
Pipe Insulation	12	$ 11.65	$ 139.80	Pipe Insulation	4	$ 11.65	$ 46.60
Total			**$ 8,809**	**Total**			**$ 7,637**
Savings for SF Crawl/Slab							**$ 1,173**

3.2.1.7 R408.2.4(2): 100% of ducts in conditioned space

The energy credit measure for placing 100 percent of ducts in conditioned space is only applied to mixed-fuel, single-family prototypes in climate zones 1 through 4. All multifamily prototypes

already contain 100 percent of the ducts in conditioned space. The duct locations in the baseline single-family prototype buildings aligns with the 2024 IECC R405 standard reference design locations based on the number of stories and the foundation type. This energy credit measure moves all ducts that are in unconditioned space (attic, crawlspace or basement) into the conditioned space. The assumption for the slab, crawlspace and unheated basement prototypes is that a dropped ceiling would be installed to move the ducts from the attic to within the conditioned space. For the heated basement prototype, HVAC was assumed to be in the basement and the ducts were located within the living space and conditioned basement.

According to 2024 RS Means, the cost to construct a dropped ceiling for materials (lumber, air barrier, drywall) and labor is $8.78 per square foot of dropped ceiling. The dropped ceiling of 139.2 sq ft based on the perimeter of the single-family prototype would be adequate to encapsulate the ducts within conditioned space. The cost of the dropped ceiling to move all ducts into conditioned space is estimated to be $1,222. These costs are aligned with the California Case Study *Residential Ducts in Conditioned Space/High Performance Attics* (Wei et al, 2015) costs for dropped ceilings.

3.2.1.8 R408.2.4(3): 80% of ducts in conditioned space

Following on the logic above for moving 100 percent of the ducts into conditioned space, 80% of the needed dropped ceiling were installed to encapsulate the ducts in conditioned space. The incremental construction cost to move 80 percent of the ducts into conditioned space is estimated to be $978.

3.2.1.9 R408.2.5(1): HRV at 75% SRE

The current mechanical ventilation system in the residential prototypes is an exhaust only bathroom fan system running 24 hours per day to meet the IECC ventilation requirements. This energy credit measure installs a heat recovery ventilator (HRV) with a sensible recovery efficiency (SRE) of 75 percent for the all-electric prototypes in climate zone 4C. According to the HVACquick cost website[1], A BROAN™ HRV with 75 percent SRE at the ventilation flow rate needed for the prototype dwelling units (60 cfm for single-family, 45 cfm for multifamily dwelling unit) is estimated to cost $1,169 with an installation cost according to 2024 RS Means estimated at $325 providing a final cost of $1,793 accounting for 20% overhead and profit.

For the mixed-fuel prototypes, the HRV energy credit is used in climate zones 5 through 7. Due to the normative code changes, climate zones 6 & 7 require that an HRV be installed as the mechanical ventilation strategy with an SRE of 65 percent. Mixed-fuel dwelling units in climate zone 5 require the installation of a new HRV at 75 percent SRE while climate zones 6 & 7 need to upgrade the HRV from 65 percent SRE to 75 percent SRE. According to the HVACquick cost website, a BROAN HRV with 65 percent SRE at the flow needed for the prototype buildings is estimated to cost $989 with an estimated installation cost of $325 resulting in a final cost of $1,577 for the installation of an HRV with an SRE of 65 percent (RS Means 2024). As a result, the incremental construction cost for upgrading the SRE is $216.

[1] https://www.hvacquick.com/products/residential/HRVs-and-ERVs/Residential-HRV-ERV/Broan-AI-Series-Heat-Recovery-Ventilators-HRV-With-Side-Ports, May 2024.

3.2.1.10 R408.2.6: ENERGY STAR appliances

The ENERGY STAR appliances energy credit was applied to all prototypes regardless of heating fuel type in climate zones 1 through 4. This energy credit measure replaces the standard efficiency appliances (refrigerator, dishwasher, clothes washer/dryer) with ENERGY STAR rated appliances. According to ENERGY STAR Single-Family New Homes, Version 3.2 (Rev.12) Cost & Savings Estimates (EPA 2023), moving from standard appliances to ENERGY STAR rated appliances (refrigerators, dishwashers, clothes washers/dryers) is estimated to incur an additional cost of $138.

3.2.2 REPI-028 Fenestration U-Factors

REPI-028 lowers (makes more efficient) the U-factor required for residential fenestration (windows and doors) in climate zones 4C, 5 and 6 from 0.30 to 0.28 Btu/hr-ft2-F for the 2024 IECC. Fenestration U-factor requirements for climate zones 7 & 8 were reduced from 0.30 to 0.27. Skylight U-factor requirements in CZ 0-2 are changed from 0.75/0.65 to 0.60, from 0.55 to 0.53 in CZ 3, 4A and 4B, and from 0.55 to 0.50 in CZ 4C - 8 in Table R402.1.2 and R402.1.3. The PNNL residential prototype models do not contain skylights and are not part of the cost-effectiveness analysis.

The EPA single-family cost and savings estimate report (EPA 2023) shows the cost of moving from a window U-factor of 0.3 to 0.27 is $0.82/ft^2 of window area converted to 2024 dollars. For the single-family prototypes, the incremental construction cost to move from a window U-factor of 0.30 to 0.27 is estimated to be $292 while the multifamily dwelling unit incremental cost is estimated to be $99.

3.2.3 REPI-033 Ceiling Insulation R-Values/U-Factors

REPI-033 reduces the stringency of ceiling insulation in climate zones 2 through 8. The ceiling insulation requirement in climate zones 2 and 3 is reduced from R-49 to R-38 for the 2024 IECC. The ceiling insulation requirement in climates zones 4 through 8 is reduced from R-60 to R-49. This reverts the ceiling insulation levels in climate zones 2 through 8 back to the levels specified in the 2018 IECC. To determine first cost of decreased ceiling insulation, it was assumed that cellulose insulation would be used as a lower cost alternative to fiberglass.

RS Means 2024 was used to obtain costs for cellulose insulation. RS Means 2024 shows the estimated cost to install R-38 cellulose insulation is $1.84/ft^2 of ceiling area. The estimated cost to install R-49 cellulose insulation by extrapolation of data from RS Means 2024 is $2.32/ft^2 of ceiling area. Thus, the incremental cost to install R-49 insulation for climate zones 2 and 3 is estimated to be $0.52/ft^2 of ceiling area. The estimated cost to install R-60 cellulose insulation by extrapolation of data from RS Means 2024 is $2.85/ft^2 of ceiling area. Thus, the incremental cost to install R-60 insulation for climate zones 4 through 8 is estimated to be $0.52/ft^2 of ceiling area.

Given that the ceiling insulation is reduced in all climate zones, this will amount to an overall reduction of the construction cost in addition to reducing overall building thermal envelope efficiency. This proposal increases total on-site energy use. For the single-family prototypes, the estimated incremental construction cost is -$618 and the multifamily dwelling units show an estimated incremental construction cost of -$624.

3.2.4 REPI-063 Prescriptive Air Leakage (4.0 ACH50, climate zones 0 – 2)

REPI-063 reduces the prescriptive infiltration levels in climate zones 0 through 2 from 5.0 ACH50 to 4.0 ACH50. According to the NREL National Residential Efficiency Measures Database (NREL 2013), reducing air infiltration from 8.0 ACH50 to 5.0 ACH50 is estimated to cost \$0.73/ft^2 per finished floor area. Reducing air infiltration from 8.0 ACH50 to 4.0 ACH50 is estimated to cost \$0.94/ft^2 per finished floor area. To reduce the air infiltration from 5.0 ACH50 to 4.0 ACH50 results in an estimated cost of \$0.21/ft^2 per finished floor area. Converting the 2013 reduction in infiltration cost to 2024 dollars shows the estimated incremental cost at \$0.28/ft^2 per finished floor area. The total incremental cost for reducing air infiltration for the single-family prototypes is \$665 and the heated basement cost is \$998. The incremental cost for reducing air infiltration for the multifamily prototypes is \$336.

3.2.5 REPI-064 Prescriptive Air Leakage (2.5 ACH50, climate zones 6 – 8)

REPI-064 reduces the prescriptive infiltration levels in climate zones 6 through 8 from 3.0 ACH50 to 2.5 ACH50. According to the NREL National Residential Efficiency Measures Database, reducing air infiltration from 8.0 ACH50 to 3.0 ACH50 is estimated to cost \$1.20/ft^2 per finished floor area. Reducing air infiltration from 8.0 ACH50 to 2.5 ACH50 is estimated to cost \$1.30/ft^2 per finished floor area. To reduce the air infiltration from 3.0 ACH50 to 2.5 ACH50 results in an estimated cost of \$0.10/ft^2 per finished floor area. Converting the 2013 reduction in infiltration cost to 2024 dollars shows the estimated incremental cost at \$0.13/ft^2 per finished floor area. The incremental cost for reducing air infiltration for the single-family prototypes is \$414 and the heated basement cost is \$621. The incremental cost for reducing air infiltration for the multifamily prototypes is \$209.

3.2.6 REPI-089 Pipe Insulation

The 2024 IECC increases the minimum hot water pipe insulation from R-3 to a thickness of 1” of insulation based on insulation conductivity requirements in Table R403.5.2. This requirement applies across all prototypes and climate zones. For the pricing of pipe insulation, rubber tubing pipe insulation costs in 2024 RS Means were used. For the R-3 pipe insulation, 0.5” insulation was assumed for a 3/4” pipe size at an estimated installed cost of \$7.77/linear foot of pipe. The estimated installed cost of the 1.0” rubber tubing pipe insulation for a ¾” pipe size is \$11.65/linear foot. This gives an estimated incremental cost of the 1.0” hot water pipe insulation is \$3.88/linear foot. The single-family prototype baseline piping layout has 77 ft of 3/4” pipe and the multifamily prototype baseline piping layout has 87 feet of 3/4" of hot water pipe. The single-family incremental cost is \$209 and multifamily incremental cost is \$299. The reduced cost of the pipe insulation as part of the compact hot water design were considered as part of the compact hot water design costs.

3.2.7 REPI-093 Heat Recovery Ventilation (HRV)

The 2024 IECC adds a requirement that dwelling units in climate zones 6 must be provided with a heat recovery or energy recovery ventilation system. These balanced ventilation systems must operate with a minimum SRE of 65 percent.

According to the HVACquick cost website[1], a BROAN™ HRV with 65 percent SRE at the flow rate necessary for the prototype dwelling units is estimated to cost $989 with an installation cost according to 2024 RS Means estimated at $325 would give a final cost of $1,577 accounting for 20 percent overhead and profit.

3.2.8 RED1-110 Exterior Lighting Power Allowance

REDI-110 reduces the base site allowance from 400 W to 280 W and reduces most of the exterior lighting power density values. The changes in values stem from: Improvements in LED lighting technology, changes in design practices and a realignment in practice resulting in no-net cost increase for these changes.

It is hard to directly calculate the cost of the base site allowance power change because the value is designed to be flexible and cover any application. The 30 percent reduction in base site allowance is driven by changes in more efficient lighting as well design practices. LED lighting efficacy has increased by approximately 10 percent since the 2021 IECC.

Uncovered parking lighting allowance has a 35 percent reduction from the 2021 IECC. In terms of costs on a site, parking lighting with related trenching and bases for poles represents the largest costs on a given site. The parking area for this site is 19,843 ft^2. A parking space requires 350 ft2 of space for the actual space and related drive paths, therefore, this site has 57 parking spaces. A design rule is roughly 1 light fixture per 20 parking spaces. Since using that linear approach would only require 3 fixtures so this analysis assumes 4 fixtures to account for symmetry and parking lot layout. This analysis assumed a design average illuminance of 0.5 fc across the parking lot.

Table 3.2.8 demonstrates that multiple light fixture options exist that allow the site to meet the desired parking lot illuminance within the allowed power requirements. The values in the table are from Grainger.[2] For the one option in the table that exceeds the parking lot lighting allowance, that lighting power density (LPD) of 0.028 is just slightly larger than the allowed LPD of 0.026. The additional wattage allowance could help offset any potential needed power.

Table 3.1.6. Parking Lot Fixture Prices

Grainger ID	Lumens	Power	Efficacy	Fixture Price	Installed Power	LPD*	Illuminance
	(lm)	(W)	(lm/W)		(W)	(W/ft^2)	(fc)
53XH19	12,818	94	136	$599.71	376	0.019	0.90
53XH20	13,776	94	147	$599.71	376	0.019	0.97
12C683	10,000	82	122	$1,178.36	328	0.017	0.70
45C243	8,400	140	60	$1,422.29	560	0.028	0.59
784K42	11,400	70	163	$399.78	280	0.014	0.80
* Assumes a CU of 0.82 and LLF of 0.85.							

The fact that multiple fixture options exist that can meet the LPD in RED1-110 and a typical lighting design requirement demonstrates that the reduction in LPD from IECC 2024 is cost neutral.

[1] https://www.hvacquick.com/products/residential/HRVs-and-ERVs/Residential-HRV-ERV/Broan-AI-Series-Heat-Recovery-Ventilators-HRV-With-Side-Ports, May 2024.
[2] https://www.grainger.com/category/lighting/outdoor-lighting/roadway-street-lights?categoryIndex=7

3.3 Summary of Incremental Costs

Table 10 summarizes the incremental costs for each new code provision of the 2024 IECC evaluated in the present analysis compared to the 2021 IECC.

Table 3.2. Estimated Construction Cost Increase of the New Provisions of the 2024 IECC

Provision	Specifications	Scope	Associated Cost	Incremental Cost Used in Analysis ($/dwelling unit)
Energy Credit Window U-factors from Table R408.2.1 in climate zone 5	Improve from 0.28 to 0.25 in climate zone 5	All new dwelling units, both single-family and multifamily	$1.23/ft^2 for all prototypes	$149 for multifamily and $438 for single-family buildings
Energy Credit: Gas Instant Water Heater UEF=0.95 in climate zone 5	Add gas-fired instantaneous water heater with a minimum uniform energy factor (UEF) of 0.95 in climate zone 5	All new fossil fuel dwelling units, both single-family and multifamily	$627 for both single-family and multifamily and subtracting $297	$330 for single-family and multifamily prototypes
Energy Credit: Integrated HPWH UEF=3.30	Add an integrated heat pump water heater with a minimum uniform energy factor (UEF) of 3.30	All new electric dwelling units, both single-family and multifamily	$621 for single-family; $406 for multifamily	$406 or $621 based on building type
Energy Credit: Compact HW Distribution	Volume of water in piping from source of hot water to farthest fixture <= 16 oz	All new mixed-fuel dwelling units, both single-family and multifamily	-$1,590 for single-family; -$1,173 for multifamily	-$1,173 or -$1,590 based on building type
Energy Credit: 100% Ducts in Conditioned Space	Moves all ducts in unconditioned space to conditioned space for single-family prototypes in climate zones 1 through 4	All new mixed-fuel dwelling units, single-family	$8.78/ft^2	$1,222 for single-family buildings
Energy Credit: 80% Ducts in Conditioned Space	Moves ducts from unconditioned space to conditioned space to meet 80% for single-family prototypes in climate zones 5 through 8	All new electric dwelling units, single-family	$7.02/ft^2	$0 for multifamily and $978 for single-family slab buildings
Energy Credit: High Performance Cooling	Replaces minimum efficiency central air conditioner with a 15.2 SEER2 system in climate zones 1 through 4	All new mixed-fuel dwelling units, both single-family and multifamily	$498 for single-family; $634 for multifamily	$498 or $634 based on building type
Energy Credit: High Performance Gas Furnace	Replaces minimum efficiency gas furnace with a 95 AFUE furnace in climate zones 4C through 8	All new mixed-fuel dwelling units, both single-family and	$847 for single-family; $952 for multifamily	$847 or $952 based on building type

Provision	Specifications	Scope	Associated Cost	Incremental Cost Used in Analysis ($/dwelling unit)
		multifamily		
Energy Credit: HRV with SRE at 75%	Adds a new HRV ventilation unit with SRE at 75% to replace the exhaust system in climate zone 4C for electric prototypes and climate zones 5 through 7 for fossil fuel prototypes	All new dwelling units, both single-family and multifamily	$1,793 for climate zones 4C and 5, $216 for climate zones 6 & 7	$216 or $1,793 based on climate zone
Energy Credit: ENERGY STAR appliances	Replace standard efficiency appliances in prototypes with ENERGY STAR rated appliances in climate zones 1 through 4	All new dwelling units, both single-family and multifamily	$138 for both single-family and multifamily	$138
Fenestration U-factor	Improve from 0.30 to 0.28 in climate zones 4C through 6 and from 0.30 to 0.27 in climate zones 7 & 8	All new dwelling units, both single-family and multifamily	$0.82/ft^2 for all prototypes	$99 for multifamily and $292 for single-family buildings
Ceiling Insulation R-Value	Reduce ceiling insulation R-value from R-49 to R-38 in climate zones 2 & 3 or from R-60 to R-49 in climate zones 4 through 8	All new dwelling units, both single-family and multifamily	$0.52/ft^2	-$624 for multifamily and -$618 for single-family buildings
Air Leakage	Reducing air infiltration from 5.0 ACH50 to 4.0 ACH50 in climate zones 0 through 2	All new dwelling units, both single-family and multifamily	$0.28/ft^2	$336 for multifamily, $998 for single-family heated basement buildings and $665 for single family buildings
Air Leakage	Reducing air infiltration from 3.0 ACH50 to 2.5 ACH50 in climate zones 6 through 8	All new dwelling units, both single-family and multifamily	$0.13/ft^2	$209 for multifamily, $621 for single-family heated basement buildings and $414 for single family buildings
Heat recovery ventilation	Add heat recovery ventilation to climate zone 6	All new dwelling units, both single-family and multifamily	$1,577	$1,577 for each dwelling unit in climate zones 7 and 8
Pipe Insulation	Increasing pipe insulation for ¾” hot water piping from R-3 to 1”	All new dwelling units, both single-family and multifamily	$3.88/ft^2	$299 for multifamily and $338 for single-family buildings
Exterior lighting	Exterior lighting allowances according to Table R404.1	Multifamily dwelling units	$0.00/ft^2	$0.00

The total incremental costs for the prescriptive and mandatory provisions of the 2024 IECC compared to those of the 2021 IECC, weighted by foundation and heating system type, are summarized in Table 11.

Table 3.3. Total Construction Cost Increase for the 2024 IECC Compared to the 2021 IECC

Climate Zone	Single Family 2,376 ft^2	Apartment/Condo 1,200 ft^2
1	1,541	1,801
2	921	1,354
3	236	1,067
4	-478	1,083
5	-261	-251
6	1,507	1,432
7	-43	-133
8	-257	-316
National Average	282	949

4.0 Economic Analysis

This section provides an overview of the methodology used in evaluating the cost-effectiveness of the prescriptive and mandatory provisions of the 2024 IECC compared to those of the 2021 IECC. Cost-effectiveness results for life-cycle cost (LCC) savings, simple payback, and cash flow are calculated for each building type in each climate zone; the results are weighted using factors detailed in Section 1.2.3 to aggregate results to the climate zone level.

4.1 DOE Residential Cost-Effectiveness Methodology

DOE developed a standardized methodology for determining the cost-effectiveness of residential energy code changes. The established methodology[1] describes the process of assessing energy savings and cost-effectiveness and is used by DOE in the evaluation of published codes as well as code changes proposed by DOE for inclusion in the IECC (Salcido et al. 2024). The methodology forms the basis of this cost-effectiveness analysis by

- defining an energy analysis procedure, including definitions of two building prototypes (single-family and multifamily), identification of preferred calculation tools, and selection of climate locations to be analyzed
- establishing preferred construction cost data sources
- defining cost-effectiveness metrics and associated economic parameters
- defining a procedure for aggregating location-specific results to state, climate zone, and national levels
- defining strategies for the inclusion of societal benefits (e.g., emissions impacts).

Per the methodology, DOE calculates three metrics from the perspective of the homeowner—LCC, simple payback, and cash flow. LCC is the primary metric used by DOE for determining the cost-effectiveness of an overall code or individual code change. The economic parameters used in the current cost-effectiveness analysis are summarized in Table 4.1. DOE updated the economic parameters following the established methodology to account for changing economic conditions.

[1] See DOE Residential Energy and Cost Analysis Methodology at: https://www.energycodes.gov/sites/default/files/2024-10/residential_methodology_2024.pdf

Table 4.1.Summary of Economic Parameters Used in Cost-Effectiveness Analysis

Parameter	Value
Mortgage Interest Rate	5%
Loan Term	30 years
Down-Payment Rate	10% of home price
Points and Loan Fees	0.9% (non-deductible)
Analysis Period	30 years
Property Tax Rate	0.86% of home price/value
Income Tax Rate	22% federal
Inflation Rate	2.2% annual
Home Price Escalation Rate	Equal to inflation rate

4.2 Fuel Prices and Escalation Rates

Data published by the EIA are used to determine the latest national average fuel prices for the three fuel types considered in this analysis—electricity, natural gas, and fuel oil. To avoid seasonal fluctuations and regional variations in the price of electricity, the analysis used the average annual residential electricity price of 15.98 ¢/kWh (EIA 2024a). The EIA reports a national annual average cost of $14.406/1,000 ft3 for natural gas and an average heat content of 1,036 Btu/ft3 for natural gas delivered to consumers in 2016 (EIA 2024b, 2024c). The resulting national average price of $1.391/therm for natural gas was used in this analysis. In addition, the EIA reports a national annual average cost of $4.1392/gallon for No. 2 fuel oil (EIA 2024d). The heat content of No. 2 fuel oil is assumed to be 138,500 Btu/gallon (EIA 2024b), resulting in a national average price of $29.89/million Btu for fuel oil.

4.3 Energy Cost Savings

The calculation of cost-effectiveness metrics primarily requires annual energy cost savings and the associated incremental costs. Energy estimates from the simulations are converted to energy costs using the latest fuel prices described in Section 4.2. Table 13 summarizes the first year annual energy cost savings per dwelling unit for the 2024 IECC compared to the 2021 IECC, aggregated over all 32 residential prototype building models using weighting factors described in Section 1.2.3. Energy cost savings stated in the 2024 IECC Determination report (Salcido et al. 2024) are time zero dollars which are not escalated due to inflation or fuel price escalation.

Table 4.2.Average Annual Energy Cost Savings for the 2024 IECC

Climate Zone	Compared to the 2021 IECC ($/dwelling unit yr)
1	180
2	190
3	140
4	177
5	133
6	191
7	309
8	379
National Average	163

4.4 Life-Cycle Cost

LCC is the primary metric used by DOE to determine the cost-effectiveness of the code or specific code changes. LCC is the total consumer cost of owning a home for a single homeowner calculated over a 30-year period. The economic analysis assumes that initial costs are mortgaged, that homeowners take advantage of the mortgage interest deductions, that short-lived efficiency measures are replaced at end-of-life, and that all efficiency measures with useful life remaining at the end of the 30-year period of analysis retain a residual value at that point.

Table 4.3 shows the LCC savings (discounted present value) per home over the 30-year analysis period for the prescriptive and mandatory provisions of the 2024 IECC compared to those of the 2021 IECC. These savings are aggregated over all 32 residential prototype buildings using weights described in Section 1.2.3.

Table 4.3.Life-Cycle Cost Savings for the 2024 IECC

Climate Zone	Compared to the 2021 IECC ($/dwelling unit)
1	2,406
2	3,254
3	2,509
4	3,790
5	2,496
6	2,190
7	7,422
8	9,481
National Average	2,954

4.5 Simple Payback

Simple payback is a commonly used measure of cost-effectiveness, defined as the number of years required for the sum of the annual returns on an investment to equal the original investment. Simple payback does not take into consideration any financing of the initial costs through a mortgage or favored tax treatment of mortgages. In other words, simple payback is the ratio of the incremental cost of construction and the first-year energy cost savings. The simple payback is reported for information purposes only and is not used as a basis for determining the cost-effectiveness of the 2024 IECC.

Table 4.4 shows the simple payback period of the 2024 IECC when compared to the 2021 IECC aggregated over all 32 residential prototype buildings using weights described in Section 1.2.3. As seen from the table, the simple payback period for the 2024 IECC compared to that of the 2021 IECC ranges from 0 to 9 years, depending on climate zone.

Table 4.4.Simple Payback Period for the 2021 IECC

Climate Zone	Compared to the 2018 IECC (Years)
1	9
2	5.2
3	2.7
4	0
5	0
6	7.8
7	0
8	0
National Average	2.5

4.6 Cash Flow

Most houses are financed[1], and the financial implications of buying a home constructed to meet the provisions of the 2024 IECC compared to the provisions of the 2021 IECC are important to homeowners. Mortgages spread the payment for the cost of a house or an apartment over a long period of time and the cash flow analysis clearly depicts the impact of mortgages. This analysis assumes a 30-year fixed-rate mortgage and that the homebuyers will deduct the interest portion of the payments from their income taxes.

Table 16 shows the impact of the provisions of the 2024 IECC on a typical consumer's cash flow compared to that of the 2021 IECC aggregated over all 32 residential prototype buildings using weights described in Section 1.2.3. In all climate zones, beginning in year 1, there is a net positive cash flow per year to the customer for the 2024 IECC-compliant home when compared

[1] https://www.statista.com/statistics/185206/us-house-sales-with-fha-and-va-insured-mortgages-from-2002/

to the 2021 IECC-compliant home. Positive cumulative savings, including payment of up-front costs, are achieved in 0 to 2 depending on the climate zone.

Table 4.5. Impacts on Consumer Cash Flow from the 2021 IECC

	Compared to the 2018 IECC	
Climate Zone	Net Annual Cash Flow Savings ($ for Year 1)	Years to Cumulative Positive Cash Flow
1	86	2
2	135	1
3	122	1
4	192	0
5	154	0
6	105	2
7	324	0
8	410	0
National Average	144	1

5.0 Conclusions

As seen from the cost-effectiveness results presented in Section 4.0, residential buildings constructed to the prescriptive and mandatory requirements of the 2024 IECC save homeowners money over the life of their homes compared to those built to the prescriptive and mandatory requirements of the 2021 IECC.

The prescriptive and mandatory provisions of the 2024 IECC are shown to generate an average life-cycle cost savings of $2,954, an average payback of 2.5 years, and the years to cumulative positive cashflow averaging 1 year for all climate zones. The results illustrate that homeowners can benefit financially from the investment in energy efficiency of the 2024 IECC. The results also show that the higher efficiency of the 2024 IECC can require decreased or increased investment with moderate payback times while remaining cost-effective.

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Appendix A – Qualitative Analysis of 2021 IECC

Table A.1. Qualitative Analysis of 2021 IECC Code Changes Affecting Energy Use

Proposal Number[a]	Code Section(s)[b]	Description of Change(s)	Impact on Energy Efficiency	Included in Energy Analysis	Discussion
REPI-018-21	R401.2, R401.2.1, R401.2.5, R401.3, R405.2, SECTION R408, R408.1, R408.2, TABLE R408.2 (New), R408.2.1, R408.2.1.1 (New), R408.2.1.2 (New), TABLE R408.2.1.2 (New), R408.2.2, R408.2.3, R408.2.4, R408.2.5, R408.2.7 (New), TABLE R408.2.7 (New), R408.2.8 (New)	Changes the Section R408 additional efficiency packages to an energy credit methodology. Each residential building must select at least two energy credit measures to achieve 10 energy credits.	Reduces energy use	Yes	The energy credit methodology provides a path to increase the energy efficiency of a residential building while providing design flexibility. There are a total of 51 energy credit measures for envelope, HVAC, service water heating, duct leakage and location, air leakage and ventilation, demand response, lighting, efficient appliances and on-site renewable energy. Each energy credit represents 1% reduction in total energy savings.
REPI-028-21	TABLE R402.1.2, TABLE R402.1.3	Reduced fenestration U-factors in climate zones 4 and 5 to from 0.30 to 0.28 and reduced all skylight U-factor requirements to 0.6 in CZ 0-2, 0.53 in CZ 3, 4A and 4B, and 0.50 in CZ 4C - 8 in Table R402.1.2 and R402.1.3.	Reduces energy use	Yes	

REPI-063-21	R402.4.1.2, R402.4.1.3, TABLE R405.4.2(1)	Changes the prescriptive air leakage requirements in climate zones 0, 1 and 2 from 5.0 ACH50 to 4.0 ACH50. The air leakage of the standard reference home in Table R405.4.2(1) is set to 4.0 ACH50 in climate zones 0 through 2	Reduces energy use	Yes	
REPI-064-21	R402.4.1.2, R402.4.1.3, TABLE R405.4.2(1), R408.2.5	Changes the prescriptive air leakage requirements in climate zones 3 through 8 from 3.0 ACH50 to 2.0 ACH50. The air leakage of the standard reference home in Table R405.4.2(1) is set to 2.0 ACH50 in climate zones 4 through 8.	Reduces energy use	Yes	The air leakage for this proposal was adjusted to keep the prescriptive air leakage requirements at 3.0 ACH50 for climate zones 3 through 5 and 2.5 ACH50 for climate zones 6 through 8.
REPI-089-21	R403.5.2, TABLE C403.12.3, TABLE R405.2, TABLE R406.2	Increases pipe insulation for hot water piping from R-3 to 1 inch of insulation which applies to all sizes of piping.	Reduces energy use	Yes	One inch of pipe insulation will achieve an R-7 level of insulation.
REPI-093-21	R403.6.1	Dwelling units shall be provided with a heat recovery or energy recovery ventilation system in Climate Zones 5 through 8. The ventilation system shall be balanced with a minimum SRE of 65 percent at 32°F (0°C) at a flow greater than or equal to the design airflow.	Reduces energy use	Yes	The proposal was modified to remove the HRV requirement for climate zone 5 so the final adjustment is to add HRV requirement for ventilation in climate zone 6 on top of the 2021 IECC requirement of HRVs in climate zone 7 and 8.
RED1-110-22	R404.1.2, R404.1.3, R404.1.4, TABLE R404.1	Revises the exterior lighting sections and adds a new lighting power allowance table to match the equivalent requirements in IECC-C. Additional exceptions from IECC-C were added that could apply to the Group R occupancies.	Reduces energy use	Yes	Previously in 2021 IECC, the exterior lighting for low-rise multifamily buildings was required to comply with the commercial exterior lighting provisions.
REPI-033-21	TABLE R402.1.2, TABLE R402.1.3, R408.2, R408.2.1 (New), R408.2.1-R408.2.4	Ceiling insulation in Table R402.1.3 was reduced from R-49 to R-38 in climate zones 2 and 3 and reduced from R-60 to R-49 in climate zones 4 through 8. The associated ceiling U-factors were adjusted for the same climate zones in Table R402.1.2. The new U-factor for	Increase energy use	Yes	This proposal adjusts the ceiling insulation in climate zones 2 through 8 back to the 2018 IECC levels.

		climate zones 2 and 3 is 0.030 and 0.026 for climate zones 4 through 8.			
CEPI-082-21 Part II	R403.9, R403.10 (New)	Requires controls for roof and gutter de-icing systems to shut off at temperatures above 40°F through moisture sensors or timer control.	Reduces energy use	No	Roof and gutter deicing systems use energy and are often left running at times that are unnecessary for ice dam prevention. Provides automatic controls that limit the system from running when outdoor temperature is above 40°F. Roof and gutter deicing systems are not included in the residential prototypes and not included in the quantitative analysis.
RECD1-7-22	TABLE R406.5	Updates the newly added Energy Rating Index (ERI) with on-site power production (OPP) targets for Table R406.5.	Reduces energy use	No	The original ERI with OPP targets were set at 40 for all climate zones. The updated ERI with OPP targets were based on ERI analysis.
RECPI-10-21	R408.2.3, Table R408.2.3 (New)	Updates the service water heating equipment list based on system type, fuel and capacity as well as the format of Table R408.2.3 for the SWH energy credit measures.	Reduces energy use	No	This proposal was disapproved by subcommittee and the version of table proposed by AHRI was approved.
RED1-027-22	APPENDIX RG (New), RG101 (New), RG405.2 (New), RG406.5 (New), R406.5 (New), RG408.2 (New)	Adds optional Appendix RG for the 2024 IECC Stretch Code with three compliance paths; prescriptive, total building performance and ERI.	Reduces energy use	No	Appendix RG would require an additional 10% efficiency (on average) to be designed into the home over the baseline 2024 IECC prescriptive requirements. Only reduces energy use if Appendix RG is adopted.
RED1-071-22	R408, R408.1, R408.2, TABLE R408.2, R408.2.1, R408.2.1.1,	Adds a new infiltration measure and language to clarify compliance methodology in Section R408 for additional efficiency requirements.	Reduces energy use	No	The added infiltration measure requires the air leakage rate to not be greater than 2.0 ACH50 but not more than 2.5 ACH50 across all

	R408.2.1.2, R408.2.1.3, R408.2.1.4 (New)				climate zones. A cost-effective set of energy credits will be part of the quantitative analysis.
RED1-076-22	SECTION 202, TABLE R408.2, R408.2.7, R408.2.8 (New)	Adds off-site renewable power generation to the list of energy credit measure options in Table R408.2.	Reduces energy use	No	To receive energy credit for off-site renewable energy, a renewable energy power purchase agreement would need a 15-year contract at a minimum and offset 80% of the estimated whole-building electric use on an annual basis. The exact credits were determined based on simulation analysis which provided more than enough energy credits for compliance in all climate zones. A cost-effective set of energy credits will be part of the quantitative analysis.
RED1-079-22	TABLE R408.2, R408.2.1.1	Adds three additional envelope energy credit measures of UA improvement options of 15%, 20% and 30% as compared to the prescriptive baseline.	Reduces energy use	No	These new options allow additional energy credits for improved envelope design. There was an option in this proposal to remove some of the original envelope UA measures (2.5%, 5% and 7.5) since they were not differentiated enough. The final decision by committee was to keep the original UA measures and add the new three UA measures. A cost-effective set of energy credits will be part of the quantitative analysis.

RED1-091-22	Appendix RP (New), RP101 (New), RP102 (New), RP103 (New), RP103.1 (New), RP103.1.1 (New), RP103.1.1.1 (New), RP103.2 (New), RP103.1.3 (New), TABLE RP103.1.3 (New); IRCECC: RP103.1.1.1 (New)	Adds optional Appendix RP for on-site renewable energy with new definitions that describes the requirements for prescriptive solar PV to be installed at the time of construction.	Reduces energy use	No	Terms defined for solar zone area, annual solar access and physical renewable energy power purchase agreement. Requires an on-site renewable energy system not less than 2.0 kW for single family homes or not less than 0.75 Watts/ft2 for R-2 and R-4 occupancies. Exceptions are added based on shading, climate zone or existing renewable energy power purchase agreements. Capacity requirements may differ for compliance demonstrated by R405 or R406 ERI compliance. A new set of ERI with OPP targets are defined for all climate zones. Only reduces energy use if Appendix RP is adopted.
RED1-166-22	R408, R408.1, R408.2, TABLE R408.2, R408.2.10 (New)	Adds an additional energy credit measure in Table R408.2 for whole home lighting control and a new Section R408.2.10 to determine the qualification for achieving the energy credits.	Reduces energy use	No	For whole home lighting control energy credit, a home or dwelling unit must have a switch at the main entrance to turn off all permanently installed interior lighting or the same operation with remote control. Lighting studies supplied with the proposal estimated that whole house lighting savings of 11% could be achieved with whole home lighting control. A cost-effective set of energy credits will be part of the quantitative analysis.
RED1-199-22	TABLE R402.1.2, TABLE R402.1.3; IRCECC: TABLE N1102.1.2, TABLE N1102.1.3	Modifies footnote for window U-factors for high elevation or windborne regions in Tables R402.1.3 and N1102.1.3 to align with previously adopted proposals.	Reduces energy use	No	Requires a fenestration U-factor of 0.30 in climate zones 4C and 5-8 for elevations above 4,000 ft or in windborne regions. Prescriptive fenestration U-factors remain unchanged so will not be part of the quantitative analysis.

RED1-263-22	R202 (New), TABLE R408.2, R408.2.10 (New), R502.2.5, R503.1.5, R506.1	Adds new definition for Substantial Improvement, a new energy credit measure for high efficacy lighting and clarifying language for additional efficiency requirements for additions and substantial improvements.	Reduces energy use	No	Adapts the language for alterations and additions to make it compatible with the new energy credits methodology. Section 506 which references the additional efficiency packages was no longer necessary and removed. The energy credit requirements for additions is 5 credits and alterations need 1 credit. The energy credits allow more flexibility in alterations and additions for additional efficiency.
RED1-310-22	R403.5.1.1; IECC: R403.5.1.1.1	Adjusts language for circulation and demand recirculation hot water systems to minimize circulation pump operation by way of control strategies.	Reduces energy use	No	Adds water temperature in the pipe to prevent activation of demand control recirculation pumps to minimize accidental triggers.
RED1-339-22	TABLE R405.4.2(1)	Adds provisions to Table R405.4.2(1) to require ducts to be placed in conditioned space for the standard reference design.	Reduces energy use	No	This proposal was in response to changes in duct location for the standard reference design in Table R405.4.2(1). The 2021 IECC and all previous editions placed the ducts in the standard reference design in the same location as the proposed design. An adopted proposal changed the location to a combination of locations (conditioned and unconditioned) based on number of stories and foundation type. Through consensus, an agreement was made to adjust the duct locations for conditioned basements.
RED1-351-22	R408.2.2, TABLE R408.2	Adds additional HVAC energy credit measures to encourage homeowners and builders to install efficient HVAC products. More energy efficient product options by climate zones matched with potential credits.	Reduces energy use	No	This proposal provides 14 energy credit measures for high efficiency HVAC equipment and aligns the additional HVAC energy credits with the requirements in the Inflation Reduction Act (IRA) for tax credits for high efficiency HVAC and water heating products.

RED1-358-22	TABLE R408.2.3	Provides more energy credits for higher-efficiency service water heating equipment which will encourage homeowners and builders to install efficient water heater products. ENERGY STAR product specifications and Consortium for Energy Efficiency (CEE) are aligned with the efficiency levels for service water heating options in Table R408.2.	Reduces energy use	No	This proposal provides 11 energy credit measures for high efficiency water heating equipment and aligns the additional water heating energy credits with the requirements in the Inflation Reduction Act (IRA) for tax credits for high efficiency HVAC and water heating products.
RED1-360-22	TABLE R408.2.6, R408.2.6; IECC: SECTION 202 (New)	Aligns the high efficiency appliances energy credit measure with ENERGY STAR product specifications to achieve energy credits. This proposal removed all references to the ENERGY STAR program and utilized annual energy consumption requirements.	Reduces energy use	No	Adds an exemption for Group R-2 dwelling units where a dishwasher is not installed can obtain high efficiency appliance energy credit with two appliance types. Common areas need to fully comply with the energy credit requirements.
REPI-004-21	R102.1.1	Changed the envelope efficiency backstop requirement strategy from an earlier code edition (2009 IECC) to a UA methodology - 1.15 x UA of the prescriptive reference design for compliance using above code programs.	Reduces energy use	No	Through simulation analysis, the 1.15 UA of the standard reference design is equivalent to the 2006 IECC or the 2009 IECC in most climate zones.
REPI-020-21	R405.2, R408.2	Increases the stringency of R405 total building performance compliance by requiring that the proposed home have less than or equal to 90% of the annual energy costs of the standard reference design. For any home over 5,000 sq ft, another 5% reduction in energy costs is required. For prescriptive compliance, a home over 5,000 sq ft is required to obtain 15 energy credits.	Reduces energy use	No	This proposal requires and additional 10% efficiency for the total building performance compliance and 15% more for any building over 5,000 sq ft in both prescriptive and performance compliance. ERI compliance includes an size adjustment factor in the RESNET 301 Standard.
REPI-039-21	R202 (New), R402.2.3 (N1102.2.3) (New), R402.2.3.1	Adds new language to define and describe how to address attic knee walls. It also adds this assembly to the list of required assemblies that	Reduces energy use	No	

	(N1102.2.3.1) (New), TABLE R405.2	must be detailed in the requirements section of the IECC.			
REPI-050-21	TABLE R402.4.1.1	Adjusts the language for HVAC register boots in Table R402.4.1.1 for air barrier, air sealing and insulation installation to require that all supply and return registers be sealed to the surface they are penetrating.	Reduces energy use	No	This proposal aligns the air sealing requirement for HVAC register boots with ENERGY STAR requirements.
REPI-060-21	R402.4.1.2	Increases the maximum tested air leakage rate in Section R402.4.1.2 to 4.0 ACH50 or 0.22 CFM25 / sq ft of dwelling unit enclosure area.	Reduces energy use	No	The proposed air leakage rate change applies to the total building performance compliance and does not change the prescriptive air leakage rates. This change is not part of the quantitative analysis.
REPI-065-21	R402.4.2.1 (N1102.4.2.1) (New), ANSI Chapter 06 (New), CSA Chapter 06 (New)	Adds a new section to specify minimum efficiency levels for gas fireplace heaters at 50%. Also adds two references to Chapter 6 for ANSI and CSA as testing procedures.	Reduces energy use	No	
REPI-068-21	R202 (New), R402.6 (New), TABLE R402.6 (TABLE N1102.6) (New), R402.6.1 (N1102.6.1) (New), TABLE R405.4.2(1), R407.2, R503.1.1, ASTM Chapter 06 (New), CRRC Chapter 06 (New), TABLE R406.2	Adds new definitions for low/steep sloped roofs and a new Section R402.6 to define the requirements for a cool roof in climate zones 0 - 3 and provides methods to determine the aged solar reflectance. Adds these requirements for tropical climate regions and remodeled building envelope assemblies.	Reduces energy use	No	Reflectance and TE values degrade over time, hence 3-year aged values are used for the performance benchmark referred to as aged solar reflectance (ASR) and TE

REPI-073-21	R403.1.2	Reconfigures heat pump supplementary heat requirements to prevent supplemental heating when the capacity of the heat pump compressor can serve the heating load and describes the times when supplementary heat operation is justified.	Reduces energy use	No	This proposal will prevent operation of electric resistance heaters installed in heat pumps that are configured to operate in conditions where sufficient heating capacity is available from the heat pump alone.
REPI-074-21	R202 (New), R403.1.3 (New), ANSI Chapter 06 (New)	Adds new definitions for pilot light operation and adds a new section for continuously burning pilot lights.	Reduces energy use	No	On-demand, intermittent or interrupted ignition pilot lights (as defined in ASNI Z21.20) are not considered to have a continuously burning pilot light.
REPI-086-21	R403.3, R403.3.5, R403.3.6, TABLE R403.3.6 (New), TABLE R405.2, TABLE R405.4.2(1), TABLE R405.4.2(2), TABLE R406.2	Adjusts duct leakage testing language to clarify testing requirements and allowing duct leakage to outside for compliance procedures of R405 or R406 but cannot be used for total duct leakage testing requirements. Also defines a new Table R403.3.6 defining maximum total duct leakage rates based on conditioned floor area and construction.	Editorial - No energy impact	No	Table R403.3.6 shows the maximum duct leakage rates that existed in R403.3.6 for better clarity of the exact requirements based on air handler installation and construction period.
REPI-091-21	R403.5.4 (New), TABLE R403.5.4 (New)	Adds new code language to determine the water volume in ounces in hot water piping based on pipe length, pipe material and nominal size (inches). New Table R403.5.4 provides the internal volume of various water distribution tubing.	Reduces energy use	No	The water volume determination in hot water piping is used in combination with the compact hot water design energy credit which requires not more than 16 ounces of hot water from the source of hot water to the farthest fixture.
REPI-099-21	R202 (New), R403.7.1 (New), TABLE R405.2, TABLE R406.2	Adds a new definition for zonal heating and a new section for operational requirements of single-family homes with electric resistance zonal heating units in climate zones 4 - 8.	Reduces energy use	No	This proposal adds a requirement for homes with zonal electric heating as the primary heating source to install an additional heat pump unit not less than 6.3 HSPF2 in the largest living zone.

REPI-115-21	R202 (New), R103.2.4 (New), R105.2.5 (New), R404.4 (New), R404.4.1 (New), R404.4.2 (New), R404.4.2.1 (New), R404.4.2.2 (New), R404.4.2.3 (New), R404.4.2.4 (New), TABLE R405.2, TABLE R406.2	Adds a new definition for energy storage system (ESS) and defines the electrical and inspection requirements for an energy storage system readiness and adds the requirements to the mandatory requirements tables in Sections R405 and R406.	Reduces energy use	No	Energy storage systems such as Battery Energy Storage Systems charge during the peak PV generation hours and can discharge in late afternoon and evening as the sun sets. Considering these energy storage systems reduce the back feed into the grid, they help with grid management, as well as provide a financial buffer for differing net energy metering policies by states and utilities. In an ideal case, a home with PV and ESS can be nearly "invisible" to the grid.
REPI-118-21	R405.2	Changes the methodology of the building thermal envelope backstop for total building performance compliance from meeting the provisions of an earlier energy code edition to meeting a specific UA level of the current energy code.	Reduces energy use	No	In the 2021 IECC, the building thermal envelope backstop for total building performance compliance was showing equivalency to the 2009 IECC. Now, a UA analysis must be performed where the design home UA must be not greater than 1.15 x UA of the standard reference design.
REPI-122-21	R401.2.5, R405.2, TABLE R405.4.2(1), TABLE R405.4.2(2), DOE Chapter 06 (New)	Removes the R408 additional efficiency requirements from R405 total building performance compliance, aligns the building thermal envelope backstop requirements to the new UA methodology, and changes the performance compliance for the proposed design to have not more than 80% or 85% of the standard reference home design costs for mixed fuel or all-electric homes respectively. Changes to the R405.4.2(1) tables to specify federal minimum efficiency HVAC and service water heating systems and specific duct locations in the standard reference design.	Reduces energy use	No	The 2021 IECC Standard Reference Design specified HVAC and SWH equipment efficiency and duct location to be the same as the proposed design to prevent envelope trade-offs. This proposal returns the HVAC and SWH equipment efficiencies to the federal minimum efficiency standards and sets defined locations for ducts based on number of stories and foundation type. This change will allow trade-offs with other efficiency measures but does include more stringent compliance requirements to counter these changes for equipment efficiency and duct location.

REPI-126-21	R406.2, R406.3, R406.3.1, R406.3.2, R406.4, R406.5, TABLE R406.5	Adds an optional Energy Rating Index (ERI) target that includes on-site power production (OPP) at 40 for all climate zones. The ventilation adjustment for the ERI Reference Home in Section R406.4 was removed. Provisions were set to specify which ERI target could be used for compliance and the envelope backstop was updated to the UA methodology as approved in previous proposals.	Reduces energy use	No	The ERI with OPP targets can be used for compliance for homes with on-site renewable energy systems. The ERI with OPP targets are optional where a home with a renewable energy section can choose to meet the ERI without OPP targets but cannot use the renewable energy generation as part of the proposed design ERI.
REPI-136-21	R408.2, R408.2.2	Adds additional efficiency package measures for Section R408.2.2 (N1108.2.2) More Efficient HVAC Equipment Performance Options based on central ducted and ductless systems. Updates heat pump efficiency metrics to SEER2 and HSPF2.	Reduces energy use	No	This proposal worked off the 2021 IECC Additional Efficiency Package Options and was approved before the energy credits methodology was considered and approved. The existing measures became part of the new energy credits measures.
REPI-142-21	408.2.6 (New)	Adds a new section R408.2.6 for compact hot water design energy credits. The sections requires not more than 16 ounces of water between the nearest source of heated water and the termination of the farthest fixture in order to gain energy credits.	Reduces energy use	No	This energy credit gives credit for reducing the overall footprint of the hot water piping system as a function of conditioned floor area to generate energy and construction cost savings.
REPI-143-21	R501.7 (New), R502.1, R502.2, R502.3.1, R502.3.2, R502.3.3, R502.3.4, R502.3	Adds new language for existing homes to clarify that any change in space conditioning (unconditioned or low-energy spaces become conditioned) requires full compliance with the code. Removes the old change in space conditioning language while renumbering subsequent sections based on these changes.	Reduces energy use	No	The position of the change in space conditioning language makes it apply to any addition or alteration.
REPI-144-21	R202 (New), R502.3, R502.3.5 (N1110.3.5) (New), R503.1, R503.1.5 (N1111.1.5) (New), SECTION	Adds two new definitions for exterior wall envelope and work area and adds new language to require additional efficiency packages for additions and alterations.	Reduces energy use	No	The additional efficiency measures were changed to energy credit requirements as a result of public comments.

	R506 (N1114) (New), R506.1 (N1114.1) (New)				
REPI-145-21	R502.3.2, R503.1.2, R503.1.2.1 (N1111.1.2.1) (New)	Adds new requirements for existing ductwork serving new equipment in additions and alterations to have duct leakage tests. The code language for exceptions to duct leakage tests were modified for clarity.	Reduces energy use	No	This proposal ensures that any existing duct system that is connected to new HVAC equipment as part of an addition or alteration must perform as required for insulation and total duct leakage based on the duct location.
REPI-150-21	R503.1.1, R503.1.1.1, R503.1.1.2 (N1111.1.1.2) (New), 503.1.1.3 (N1111.1.1.3) (New), R503.1.1.4 (N1111.1.1.4) (New), R503.1.1.5 (N1111.1.1.5) (New), R503.1.1.6 (N1111.1.1.6) (New), SECTION 202 (New), SECTION 202, TABLE R402.1.2, TABLE R402.1.3	Adds new definitions for approved source and construction documents, adds new sections for roof, above-grade wall, floor, below grade wall and air barrier alterations. Updates language for building thermal envelope and fenestration alterations for a balance of practicality and cost-effectiveness.	Reduces energy use	No	Provides criteria to trigger or avoid requirements with flexibility.
REPI-151-21	R503.1.2, R503.1.2.2 (N1111.1.2.2) (New), R503.1.2.1 (N1111.1.2.1) (New)	Adds requirement for new heating and cooling equipment as well as new HVAC ducts as part of an alteration must be sized in accordance with the provisions of Section R403.	Reduces energy use	No	This proposal requires right sizing of both HVAC and duct systems as part of any alteration.
REPI-152-21	R503.1.2.1 (N1111.1.2.1) (New)	Requires any new heating and cooling equipment as part of an alteration to be provided with controls as required in Section R403.1.	Reduces energy use	No	The new heating and cooling equipment must have a programmable thermostat and heat pumps must have supplemental heat pump control.

REPI-163-21	TABLE RC102.2	Reduces the Energy Rating Index not including OPP targets to 42 for all climate zones.	Reduces energy use	No	This proposal increases the energy efficiency of the proposed building to a higher level before renewable energy systems can be employed to meet the ERI target of 0.
RED1-309-22	TABLE R403.3.6	Adds a new duct leakage test level for duct systems located in conditioned space with air-handler not installed at Rough-In for both for all homes regardless of size.	Increases energy use	No	At rough-in, a duct system without an air-handler installed was required to have total duct leakage not more than 3 cfm/100 sq ft. This code change will allow a duct system inside conditioned space to have duct leakage not more than 6 cfm/100 sq ft which will increase energy use in these circumstances.
REPI-021-21	R401.2.5, TABLE R406.2	Removes the R408 additional efficiency requirements from the R406 compliance path.	Increases energy use	No	This proposal removes the requirement for a proposed design using the ERI compliance path to have 5% less energy than the ERI targets in Section R406.
REPI-080-21	R403.3.2	Streamlines the code requirements for ducts located in conditioned space by combining the earlier sections for ducts located in floor and wall assemblies.	Increases energy use	No	This proposal combined the language for ducts located in wall or floor assemblies for easier understanding. The proposal reduced insulation requirements from R-19 to R-10 and added an exception for building assembly cavities containing ducts that have been air-sealed would not need to be insulated.
REPI-085-21	R403.3.5, R403.3.6, R403.3.7 (New), R403.3.7	Adds a new section to define a sampling methodology for duct leakage testing of dwelling units within a multifamily building with not less than eight dwelling units. Exceptions were added to the duct leakage requirements for sampled dwelling units.	Increases energy use	No	The concept of sampling for duct leakage testing can help save time and money over testing of every single dwelling unit duct system in a multifamily building. There is risk of missing poorly sealed duct systems that can show performance and comfort issues for the occupants if missed in the sampling process.

REPI-131-21	R406.4	Removes the ventilation rate adjustment for the ERI Reference Home in Section R406.4.	Increases energy use	No	The purpose of this proposal is to fix an error that was introduced in the 2018 IECC during an effort to coordinate the ERI calculation procedure with the residential ventilation rates. The change in 2018 IECC resulted in a significant increase in the ERI scores. That was never the intent of the change as was confirmed by the original proponent, and it was the result of using terms that were not fully coordinated with the specific terms in Standard 301. Proposals and public comments attempted to fix this issue in 2021 IECC, but in the end none of them were approved. This change aligns the IECC ERI with the RESNET ERI.
CE2D-78-23 Part II	NEMA (New)	Adds NEMA to references for air-sealed boxes for electrical and communication applications.	Administrative	No	
CE2D-95-23-23 Part II	R403.9, R405.5.4.1, R405.5.4.2	Replaces thermal envelope to building thermal envelope to align with commercial code.	Administrative	No	
CEC2D-4-23 Part II	R110 (New)	Editorial change to align ordering of Chapter 1 sections with other I-Codes	Administrative	No	
CEPI-008-21 Part II	R104.1, R104.2, R104.3 (New), R104.3, R104.4, R104.5	Adds editorial changes for the payment of fees and adds a new section for permit valuations.	Administrative	No	
CEPI-015-21 Part II	R202 (New)	Adds a new definition for emittance in IECC	Administrative	No	
CEPI-015-21 Part III	N1101.6, R202 (New)	Adds a new definition for emittance in IRC	Administrative	No	

CEPI-019-21 Part II	R303.1.1, R303.1.2	Adds an exception for insulation mark installation for roof insulation installed above the deck.	Administrative	No
CEPI-024-21 Part II	SECTION 202, SECTION 202 (New), R401.2.2, R403.3.3.1, SECTION R405, R405.1, R405.2, TABLE R405.2, R405.3, R405.3.2.2, R405.4, R502.2, R505.1	Editing definitions of proposed and standard reference designs for R405 performance compliance and adds a new definition for simulated building performance. Updates R405 title to Simulated Building Performance and updates language to reflect new definitions.	Administrative	No
IRCED1-10-22	N1103.2	Replaces oil with liquid fuel for hot water boiler outdoor temperature reset.	Administrative	No
IRCED1-7-22	N1102.5.1.2	Removes third exception for testing in accordance with N1102.5.1.2 due to circular logic.	Administrative	No
IRCED1-8-22	N1108.2.1.3 table	Updates language in Table N1108.2.1.3 for minimum roof reflectance to use Solar Reflectance Index (SRI) and updates the ASTM Standards to determine SRI.	Administrative	No
IRCEPI-1-21	N1102.2.6, TABLE N1102.2.6, Chapter 44 (New)	Re-write of Section N1102.2.6 to require steel-frame ceilings, walls and floor U-factors to be determined by AISI S250 and removes TABLE N1102.2.6 for steel and metal framed walls.	Administrative	No
IRCEPI-3-21	N1101.6	Adds a new definition for duct airflow balancing.	Administrative	No

IRCEPI-4-21	N1103.3.6, N1108.2.4	Adds language for an exception to duct leakage testing for ducts in conditioned space if duct airflow balancing in accordance with ANSI/ACCA 5 QI or other methods shows that individual room airflows are be within the greater of ± 20%, or 25 CFM of the design/application requirements for the supply and return ducts.	Administrative	No
IRCEPI-6-21	N1103.3, N1103.3.1 (R403.3.1) (New)	Adds language to require duct systems to be designed according to ACCA Manual D	Administrative	No
IRCEPI-7-21	N1103.3.2	Adds requirements for diffusion ports in unvented attics for ducts in the sealed attic to reduce the risk of condensation on duct work.	Administrative	No
RE2D-02-23	R110.4	Removes "without delay" in the administration section for the action a code official must take in accordance with a decision from the board.	Administrative	No
RE2D-03-23	R202	Updates emittance definition to replace "emission" with "release of thermal radiation".	Administrative	No
RE2D-06-23	R202	Adjusts the definitions of Alteration and Repair to align with approved code changes.	Administrative	No
RE2D-08-23	R202	Adjusts the language in the definition for substantial alteration for clarity.	Administrative	No
RE2D-10-23	R402.1	Corrects section numbers for general building thermal envelope based on earlier approved code proposals.	Administrative	No
RE2D-20-23	R404.7.1, R404.7.2, R404.7.5, R404.7.6	Code language updates for EV charging and removes section R404.7.6 based on it being redundant.	Administrative	No

RE2D-21-23	R404.7.6	Rewrite of section R404.7.6 for EVSE installation for clarity on NFPA 70.	Administrative	No	This code proposal was superseded by RE2D-20-23.
RE2D-24-23	R405.2	Updates R405.2 code language to specify the source energy multipliers based on ASHRAE Standards 1056, 189.1 and 240P.	Administrative	No	
RE2D-25-23	R405.3	Adjusts language in section R405.3 for compliance documentation to account for the proposed design and the as-built design.	Administrative	No	The "As-Built" design is the intent behind the proposed design based on inspection testing.
RE2D-26-23	R405.4.2	Adds Appendix RF for proposed building envelope U-factors and slab F-factors for compliance in R405.4.2	Administrative	No	
RE2D-28-23	R405.5.2	Modification to the language for software vendor testing.	Administrative	No	
RE2D-31-23	TABLE R407.1; IRCECC: TABLE N1107.1	Rewrite of low slope roof reflectance and emittance requirements.	Administrative	No	
RE2D-32-23	R407.2; IRCECC: N1107.2	Adds "low slope" language to roof requirements for the tropical climate region.	Administrative	No	
RE2D-33-23	TABLE R407.1	Replaces reference to the commercial code with internal reference to the residential code for roof reflectance requirements.	Administrative	No	
RE2D-37-23	TABLE R408.2, R408.2.1, R408.2.1.1, R408.2.1.4, R408.2.2, R408.2.3, R408.2.4, R408.2.5	Editorial changes to Table R408.2 and envelope, HVAC, SWH, duct systems and air sealing energy credit measures.	Administrative	No	

RE2D-38-23	TABLE R408.2, R408.2.1.3, TABLE R408.2.1.3, R408.2.1.3.1	Updates language for roof reflectance measures in Table R408.2 and updates the solar reflectance requirements (SRI) for energy credits.	Administrative	No
RE2D-40-23	R408.2.11	Changed "switch" to "manual control" for R408.2.11 whole home lighting measure.	Administrative	No
RE2D-42-23	TABLE R408.2.3	Removed redundant hot water heaters in Table R408.2.3 for service water-heating efficiencies.	Administrative	No
RE2D-43-23	R408.2.3.1	Clarifies requirements for demand recirculation water systems for the compact hot water design energy credit measure.	Administrative	No
RE2D-44-23	R408.2.6, TABLE R408.2.6	Adjusts language for R408.2.6 energy efficient appliances to close loopholes from previous approvals.	Administrative	No
RE2D-46-23	R503.1.1.3	Editorial adjustments for above grade wall alterations.	Administrative	No
RE2D-59-23	TABLE R408.2, TABLE R408.2.3	Added all energy credit values in Table R408.2 from PNNL simulation analysis.	Administrative	No
RE2D-66-23	TABLE R408.2 (New), R408.2.2.1 (New)	Updates the energy credits for the high-performance gas furnace and heat pump credits in Table R408.2 and adds new efficiency requirements for gas furnace and heat pump option and the heat pump in Section R408.2.2.1.	Administrative	No
RE2D-67-23	TABLE R408.2 (New)	Reduced the ground source heat pump energy credits in all climate zones in Table R408.2 based on spreadsheet analysis of original GSHP results.	Administrative	No

REC2D-1-23	TABLE R402.1.2, R402.1.3, R402.2.10.2, R402.2.11.2, RF105, RF105.1 (New), TABLE RF105.1 (New), RF106, RF107, RF106.1 (New), TABLE RF106.1 (New)	Adds necessary language and tables that coordinate the proper calculation of F-factors for slabs and ground coupling for crawl space walls and basement walls.	Administrative	No
REC2D-3-23	ACCA (New)	Adding ACCA Manual D-2023 Standard to the Chapter 6 references.	Administrative	No
REC2D-4-23	TABLE R405.4.2(1)	Corrects an error in the reference design for foundation geometry condition and restores to the 2021 code language in Table R405.4.2(1).	Administrative	No
REC2D-6-23	R402.2.1 (New)	Updates ceilings with attics language to align with changes made in Table R402.1.3 in previous code changes.	Administrative	No
REC2D-7-23	R403.6.2, TABLE R403.6.2	Replaces "balanced" with "balanced ventilation system" for whole-dwelling mechanical ventilation system fan efficacy to align with new definition for balanced ventilation system.	Administrative	No
REC2D-8-23	R202 (New), R402.5.1.2, R402.5.1.2.1, R402.5.1.3, R403.3.1, R403.3.9, R403.6.4, TABLE R405.4.2(1)	Adds a new definition for sleeping unit and revised the definition for testing unit enclosure area while adding these definitions to the section on air leakage testing.	Administrative	No

REC2D-10-23	R402.5.1.3, R408.2.1.4, R403.3.7, R503.1.2.3, R403.6.2	Editorial clean up to correct SI units for the updated air leakage requirements.	Administrative	No	
RECD1-1-22	N1103.6.4, (R403.6.4) (New)	Adds a new section for intermittent exhaust control for bathrooms and toilet rooms to align IECC-R with Section C403.8.6.2 in IECC-C.	Administrative	No	
RECD1-2-22	6 AAMA, AAMA Chapter 06, CSA Chapter 06, 6 WDMA, WDMA Chapter 06	Chapter 6 reference updates	Administrative	No	
RECD1-3-22	TABLE R402.5.1.1	Reconciles language in Table R402.5.1.1 with previously approved code proposals.	Administrative	No	
RECD1-4-22	R404.6.1 (New), R404.6.2 (New), R404.6.2.1 (New), R404.6.2.2 (New), R404.6.2.3 (New), R404.6.2.4 (New), R404.6.2.5 (New), R404.6.2.6 (New), R404.6.2.7 (New), R404.6.2.8 (New)	Moves the solar ready requirements from the referenced Appendix CB and copies them into the R404.6.2 section.	Administrative	No	
RECD1-6-22	R405.2	Adjusts the Exception 2 for using annual energy costs for performance compliance to use source energy and restores a single multiplier to be used rather than multiple sections of ASHRAE 105.	Administrative	No	The original ASHRAE 105 Table references offered 6 different site-to-source multipliers for electricity which could lead to unnecessary complexity for the code official and software implementers.

RECD1-8-22	R405.3, R405.3.1, R405.3.2, R405.3.2.1, R405.3.2.2, R405.4, R405.4.1, R405.4.2; IECC: R405.4.3 (New); IECC: R405.5, R405.5.1, R405.5.2, R405.5.3; IECC: R405.5.2 (New), R405.5.3 (New), R405.5.4 (New), R405.5.4.1 (New), R405.5.4.2 (New)	Adds language to align the software requirements for R405 with the requirements in R406.	Administrative	No
RECD1-10-22	R503.1.2, R503.1.2.1	Removes the language from the exceptions that applies to an addition as these sections apply to alterations.	Administrative	No
RECD1-11-22	R402.2.8	Updates language for floors to specify installation requirements for both cavity and continuous insulation.	Administrative	No
RECPI-2-21	TABLE N1105.4.2(1)	Adjusts footnote (h) for Table N1105.4.2(1) to replace "townhouses" with "townhouse units".	Administrative	No
RECPI-8-21	R401.3, R406.7.2.2, ICC Chapter 06	Adds the RESNET CO2 Index to the compliance certificate (R401.3) and the ERI compliance reports.	Administrative	No

RECPI-11-21	R202 (New), APPENDIX RC, SECTION RC101, SECTION RC202 (New), RC101.1, RC102.1, RC401.2 (New), RC401.3 (New), SECTION RC102, RC406.1 (New), RC406.2 (New), RC406.3 (New), RC102.2, RC406.4.1 (New), RC406.5 (New), TABLE RC102.2, RC406.6 (New), RC406.7 (New), ASHRAE Chapter 06 (New)	Adds a general definition for Energy Rating Index (ERI) and adds new definitions for renewable energy agreements and clarity for Appendix RC ERI analysis to align with definitions.	Administrative	No
RED1-001-22	APPENDIX RC, SECTION RC101, RC101.1, RC101.2, RC101.3, RC101.4, SECTION RC 102 (New), RC102, RC103, RC103.1 (New), RC103.1, RC103.2, RC103.3, RC103.3.1, RC103.4, TABLE RC103.3, RC103.5, RC103.6	Adds clean-up language to ensure Appendix RC is using earlier approved proposal for Appendix RC.	Administrative	No
RED1-003-22	R202	Modifies grade plane definition to remove requirements.	Administrative	No

RED1-006-22	AISI Chapter 06	Adds AISI S250 to Chapter 6 References.	Administrative	No
RED1-007-22	RESNET Chapter 06	Updates RESNET 301 Standard to ANSI/RESNET/ICC 301-2022 version in Chapter 6.	Administrative	No
RED1-008-22	R101, R101.1, R101.2, 101.2.1 (New)	Adds a new section R101.2.1 for Appendices to clarify that appendices do not apply unless specifically adopted.	Administrative	No
RED1-009-22	R101, R101.1, R101.2, R101.3, R101.5, R101.5.1, SECTION R102 (New), R101.4, R101.4.1, R108.3, R108.2, R108.1, R108.1.1, R108.1.2, R107.1, SECTION R107, SECTION R108	Adds provisions in Section 101 Scope and General Requirements and Section 102 Applicability to contain the same basic points for better clarity and ease of use.	Administrative	No
RED1-010-22	R103 (New), 103.1 (New), 103.2 (New), 103.3 (New)	Adds new section R103 for the creation of the code compliance agency.	Administrative	No
RED1-011-22	R103.2.2	Adds a provision to section R103.2.2 for a solar ready zone to require the solar-ready system.	Administrative	No
RED1-012-22	R105.2.2, R105.2.3	Removes redundant code provisions for framing and air-barrier rough-in inspections.	Administrative	No
RED1-013-22	R105.2.3, R105.2.4, R105.2.5, R105.2.6	Reorders the inspections so as to remain consistent with the logical order of inspections currently being done by inspectors.	Administrative	No

RED1-014-22	R105.2.4	Adds language to plumbing rough-in inspection for solar-ready zones.	Administrative	No
RED1-016-22	R105.4, R105.4.1 (New); IECC: R105.4.1.1 (New), R105.4.1.2 (New), R105.4.1.3 (New), R105.4.1.4 (New); IECC: R105.4.2 (New)	Adds new sections and language for approved third party inspection agencies in section R105.	Administrative	No
RED1-017-22	R110, R110.1, R110.2, R110.3, R110.4	Adds provisions to coordinate the means of appeals within the I-codes.	Administrative	No
RED1-028-22	APPENDIX RH (New), RH101 (New), SECTION 202 (New), RH102 (New), RH401.2 (New), RH401.3 (New), RH406.2 (New), RH406.7.2.2 (New)	Adds a new definition for CO2e Index based on the RESNET 301 Standard and adds Appendix RH for operational carbon rating and energy reporting.	Administrative	No
RED1-031-22	R202	Revises the definition for simulated building performance to remove language about using a baseline rather than the standard reference design.	Administrative	No
RED1-032-22	TABLE R402.4.1.1 (New)	Modifies the requirements for HVAC register boots in Table R402.4.1.1 to align with earlier proposals.	Administrative	No
RED1-035-22	R405.1, R405.2	Aligns language in R405.1 and R405.2 to align with new definitions for approved sources.	Administrative	No

RED1-043-22	R405.2	Editorial changes to clarify building performance compliance requirements for mixed fuel and all-electric homes.	Administrative	No	
RED1-054-22	TABLE R405.2, R408.1, RE103.1	Removes additional efficiency requirements from Table R401.2.5 to align with approved code proposals.	Administrative	No	
RED1-056-22	TABLE R405.2, TABLE R406.2	Removed the dedicated row for HW pipe insulation and also removed the text "except Section R403.5.2" due to conflict in approved proposals.	Administrative	No	
RED1-065-22	R202, R406, R406.1, R406.2, TABLE R406.2, R406.3, R406.4, R406.5, TABLE R406.5, R406.6, R406.7, R406.7.1, R406.7.2, R406.7.2.1, R406.7.2.2, R406.7.3, R406.7.4, R406.7.5, R406.7.6, CHAPTER 6 [RE], 6 ANSI, ANSI Chapter 06 (New)	Editorial changes for R405 and R406 for clarity that multifamily ERIs are only performed on a dwelling unit and that common spaces are still subject to the other code requirements in R402 through R404. Some edits maintain consistency, use defined terms, and underscore that the as-built dwelling unit is also required to be compliant, not just the 'rated design' ERI.	Administrative	No	For large MF, the average ERI of all dwelling units in the building should be permitted to be used to demonstrate compliance with the maximum ERI (rather than each individual dwelling unit being required to meet the max ERI).
RED1-067-22	R406.5	Editorial changes to replace "appropriate" with "applicable".	Administrative	No	
RED1-073-22	R408.1; IECC: R408.2; IECC: TABLE R408.2, R408.2.3, R408.2.3 (New)	Provides editorial changes for clarity for compliance with R408 requirements and adds an addition electric hot water heating measure to Table R408.2.	Administrative	No	

RED1-089-22	RC103.3, RC103.3.1	Adjusts the renewable energy contract duration from 10 to 15 years.	Administrative	No
RED1-094-22	R103.2.2	Editorial changes to clarify the provisions and align structural load documentation requirements with other ICC codes.	Administrative	No
RED1-107-22	R403.10	Aligns language for roof and gutter deicing controls with the commercial section C403.14.3 which is to have the system off between sunset and sunrise.	Administrative	No
RED1-111-22	R404.2, R404.2.1, R404.2.2	Editorial changes for interior lighting control for clarity and to correct the defined terms.	Administrative	No
RED1-112-22	R404.3	Editorial change to require residential exterior lighting controls comply with IECC-R rather than IECC-C.	Administrative	No
RED1-116-22	R404.5	Editorial change to electric readiness for clarity.	Administrative	No
RED1-128-22	R404.5.1	Editorial change from cooking products to cooking appliances for electric readiness.	Administrative	No
RED1-131-22	R404.5.2	Editorial changes to simplify electric readiness requirements for clothes dryers.	Administrative	No
RED1-137-22	R404.6.1.3	Editorial change to replace future solar electric with future renewable electric for electrical service reserve space for electric readiness requirements.	Administrative	No
RED1-138-22	R404.6.1.4	Editorial changes for electrical interconnections to allow any renewable connection.	Administrative	No

RED1-145-22	R404.7, R404.7.1, R404.7.2, R404.7.3, R404.7.4.1, R404.7.4, R404.7.5.1	Editorial changes to Electric Vehicle Power Transfer Infrastructure for clarity, usability and enforceability.	Administrative	No
RED1-154-22	R404.7.1, R404.7.4	Moves the exceptions for the electric utility's lack of capacity to the quantity section.	Administrative	No
RED1-157-22	R404.7.4	Adjusts the EVSE circuit capacity exception based on installed cost to account for projected inflation in 2023 and 2024.	Administrative	No
RED1-182-22	R202, TABLE R408.2.1.3; IRCECC: SECTION 202, TABLE N1108.2.1.3	Editorial changes for the new defined terms "low-sloped roof" and "steep-sloped roof" to "low slope" and "steep slope".	Administrative	No
RED1-184-22 PI	N1102.5.1.2	Editorial change to move the details of the air leakage testing conditions before the exceptions for air leakage testing.	Administrative	No
RED1-184-22 PII	R402.5.1.2	Editorial change to move the details of the air leakage testing conditions before the exceptions for air leakage testing.	Administrative	No

RED1-185-22	R102.1.1, SECTION 202, R401.3, R402.1.5, R402.2.7, R402.2.9, TABLE R402.5.1.1, R402.5.1.2, R402.5.4, R402.5.6, R403.3.2, R405.2, R405.3.2.1, R405.3.2.2, TABLE R405.4.2(1), TABLE R406.2, R406.3, R406.7.2.1, R406.7.2.2, R408.2.1, R408.2.1.1, R502.2.1, R503.1.1, R503.1.1.4, R503.1.1.6, R503.1.5, R506.1; IRCECC: N1101.4, SECTION 202, N1101.14, N1102.1.5, N1102.2.7, N1102.2.9, N1102.4.5, TABLE N1102.5.1.1, N1102.5.1.2, N1102.5.4, N1102.5.6, N1105.2, N1105.3.2.1, N1105.3.2.2, TABLE N1105.4.2(1), TABLE N1106.2, N1106.3, N1106.7.2.1, N1106.7.2.2, N1108.2.1, N1108.2.1.1, N1108.2.4, N1110.2.1,	Editorial changes to the residential provisions by replacing instances of "building envelope", "thermal envelope" and "envelope" with the defined term "building thermal envelope".	Administrative	No

	N1111.1.1, N1111.1.1.4, N1111.1.1.6, N1111.1.5, N1114.1			
RED1-186-22	R102, R102.1.1, SECTION R402, R402.1.5, R402.2.1, R402.2.2, R402.2.5, R402.4.3, R402.4.4, SECTION R405, R405.2, SECTION R406, R406.3, SECTION R408, R408.2, TABLE R408.2, R408.2.1.1	Editorial change to replace Total UA with thermal conductance (TC).	Administrative	No
RED1-189-22	R202	Editorial change to remove "black body" with an emissions scale for the definition of emittance.	Administrative	No

RED1-191-22 PI	R202	Editorial change to account for "non-structural" exterior wall elements in the definition for exterior wall envelope.	Administrative	No	
RED1-191-22 PII	R202	Editorial change to account for "non-structural" exterior wall elements in the definition for exterior wall envelope.	Administrative	No	
RED1-194-22	R303.1.5 (New), R303.1.1, R303.2.2	Adds a new section for air spaces to ensure air space R-values are properly specified and applied for both reflective and non-reflective air spaces.	Administrative	No	Air space R-values can vary by as much as a factor of 8 depending on various conditions of use (see ASHRAE 90.1 Appendix A).
RED1-196-22	R402.1	Editorial change to clarify that there are two options that can be used to demonstrate compliance with the residential prescriptive building thermal envelope provisions.	Administrative	No	
RED1-204-22	TABLE R402.1.2; IECC: TABLE R402.1.3	Editorial change to the footnotes for fenestration U-factors to clarify the conditions based on rows instead of columns and remove the exceptions.	Administrative	No	Footnotes should not contain requirements; they should be explanatory. Since there should be no requirements in footnotes there should be no exceptions. There are no columns for fenestration u-factors or SHGC; there are rows.
RED1-208-22	R402.1.5, R405.2, R405.4.2, TABLE R405.4.2(1), R406.3; IECC: R402.2.10	Editorial changes in the performance and ERI compliance sections to account for the changes in the UA calculation to Thermal Conductance (TC) and updated Table R405.4.2(1) to account for slab-on-grade U-factor and perimeter.	Administrative	No	
RED1-210-22	R402.2.10	Editorial change to remove the language "in contact with the ground" from the section for slab-on grade floors as it was redundant.	Administrative	No	

RED1-211-22	R402.2.11.1	Editorial changes to reformat and clarify crawl space wall insulation installation requirements to align better with the basis of the R-value requirements for crawl space walls.	Administrative	No
RED1-212-22	R402.2.3, R402.2.3.1	Editorial changes to differentiate between wood and steel framing. The title of R402.2.3.1 is changed to differentiate between roof/floor trusses and attic knee-walls	Administrative	No
RED1-217-22	R402.2.9.1	Editorial change to the prescriptive basement wall insulation installation to account for the wall insulation depth of the proposed or rated design in the performance compliance paths.	Administrative	No
RED1-218-22	R402.3	Editorial change to remove the commentary as part of the definition for radiant barriers.	Administrative	No
RED1-222-22	R402.5.1.2, R402.5.1.4	Editorial changes to section on air leakage testing for clarity and to improve organization as well as establishes a cfm/ft2 metric as an alternative to ACH50.	Administrative	No
RED1-224-22 PI	R402.5.1, R402.5.1.2, R402.5.1.3 (New), R402.5.1.3, R402.5.1.4; IECC: TABLE R405.2, TABLE R406.2	Editorial updates to separate the mandatory maximum air leakage rate from the test method section by moving the existing language into a separate section identified as mandatory. This is intended to improve the code readability and the ease of understanding the code.	Administrative	No
RED1-224-22 PII	N1102.5.1, N1102.5.1.2, N1102.5.1.3 (New), N1102.5.1.3, N1102.5.1.4 (New),	Editorial updates to separate the mandatory maximum air leakage rate from the test method section by moving the existing language into a separate section identified as mandatory. This is intended to improve the code readability and the ease of understanding the code.	Administrative	No

	TABLE N1105.2, TABLE N1106.2			
RED1-226-22	TABLE R402.5.1.1	Editorial change to remove "sealed" from "sealed air barrier" as part of the air barrier, air sealing and insulation installation requirements.	Administrative	No
RED1-229-22	TABLE R402.5.1.1	Editorial changes to the common walls as part of the air barrier, air sealing and insulation installation requirements.	Administrative	No
RED1-230-22	TABLE R402.5.1.1	Editorial changes to the floors as part of the air barrier, air sealing and insulation installation requirements.	Administrative	No
RED1-231-22	TABLE R402.5.1.1	Editorial changes to the electrical, communication and other equipment boxes as part of the air barrier, air sealing and insulation installation requirements.	Administrative	No
RED1-233-22	TABLE R402.5.1.1	Editorial changes to the showers, tubs and fireplaces as part of the air barrier, air sealing and insulation installation requirements.	Administrative	No
RED1-235-22	TABLE R402.5.1.1	Editorial changes to the knee walls as part of the air barrier, air sealing and insulation installation requirements.	Administrative	No
RED1-237-22	R402.5.1.2	Editorial change relating to water gauge to keep the units consistent with other units in the code section. Also changed the “dwelling unit enclosure area” to italic font is to inform the user	Administrative	No

		that “dwelling unit enclosure area” is a defined term in Chapter 2.		
RED1-243-22 PI	R402.5.4	Relocates section for rooms containing fuel burning appliances.	Administrative	No
RED1-243-22 PII	N1102.5.4	Relocates section for rooms containing fuel burning appliances.	Administrative	No
RED1-249-22	R405, R405.1, R405.2, R405.3, R405.3.1, R405.3.2, R405.3.2.1, R405.3.2.2, R405.4, R405.4.1, R405.4.2, TABLE R405.4.2(1), R405.5.1	Editorial changes to clarify that R-2 buildings show compliance at the dwelling unit level where common spaces shall follow the requirements of R401 through R404 and updates HVAC efficiencies to SEER2, HSPF2 and UEF.	Administrative	No
RED1-250-22	TABLE R405.2, TABLE R406.2; IECC: R402.2.10, R402.2.10.1, R402.2.10.2 (New), R402.2.11, R402.2.11.2 (New)	Editorial changes to the slab-on-grade floors and crawl space walls requirements to work better with performance paths to provide flexibility in design while still meeting the mandatory requirements.	Administrative	No
RED1-251-22	TABLE R405.4.2(1)	Adds a 0.25 cfm50/ft2 metric for the air leakage threshold for attached units and smaller homes when using the prescriptive compliance option and adds those same metrics/thresholds to the Standard Reference Design (SRD).	Administrative	No

RED1-252-22	TABLE R405.4.2(1); IRCECC: TABLE N1105.4.2(1)	Editorial change to replace two instances of "solar absorptance" with "solar reflectance" and the associated values to make all uses consistent throughout the residential provisions.	Administrative	No
RED1-253-22	R407.2; IECC: TABLE C402.4	Replaces the IECC-C requirement for Table C402.3 with options from the new Table R407.1.	Administrative	No
RED1-254-22	R408.2	Editorial changes in section R408 for fenestration in order to make the section more usable, improve the accuracy of credits allocated, and improve clarity and consistency.	Administrative	No
RED1-255-22	R408.2.1.3, TABLE R408.2; IRCECC: N1108.2.1.3, TABLE N1108.2	Editorial changes to the cool roof/solar reflectance energy credits to ensure that, when a cool roof is selected, it can be expected to improve energy efficiency.	Administrative	No
RED1-256-22	R408.2.1.3; IRCECC: N1108.2.1.3	Editorial changes to further clarify the roof reflectance criteria options are only required in specific climate zones based upon the "TBD" credits in Table R408.2 (N1108.2).	Administrative	No
RED1-257-22	TABLE R408.2.1.3, R408.2.1.3.1; IRCECC: TABLE N1108.2.1.3, N1108.2.1.3.1; IECC: ASTM Chapter 06 (New)	Editorial changes to clean up the roof reflectance provisions in Section R408 and Section N1108.	Administrative	No
RED1-260-22	R503.1.1	Editorial change to replace “building envelope” to the defined term in Chapter 2, “building thermal envelope”, and to italicize the defined terms “building” and “roof recover” in the same code section.	Administrative	No

RED1-261-22	APPENDIX RF, RF 101 (New), RF101	Adds new sections to Appendix RF for the scope and purpose of the appendix and related general requirements important to proper application of the appendix in coordination with the IECC standard and also related IRC building code provisions.	Administrative	No
RED1-264-22	R501.2, R501.4, R501.5, R501.6, R501.7, R503.1.1.2, R503.1.1.3, R503.1.1.5, R505.1, R505.1.1	Editorial changes to clarify the existing chapter 5 language and the new chapter 5 language from public comment draft #1.	Administrative	No
RED1-268-22	R503.1.1, R503.1.1.1, R503.1.1.2, R503.1.1.3, R503.1.1.4, R503.1.1.5, R503.1.1.6, TABLE R402.1.2, TABLE R402.1.3	Coordinates with changes made to Section C503.1 of the commercial provisions based on additional input and review by the commercial subcommittee that occurred after the residential existing buildings and main committees had completed action these sections. The two proposals intended to make the two codes consistent. Primarily editorial and formatting coordination between the IECC-C and IECC-R for alterations.	Administrative	No
RED1-271-22	R503.1.1.3	Editorial changes to improve clarity for use of the IRC for R-2, R-3, and R-4 buildings three stories or less that are regulated by the IECC-Residential Provisions and the IBC.	Administrative	No
RED1-273-22	R503.1.1.3	Editorial changes for above grade wall alterations to address conflicts with vapor retarder and wind resistance requirements.	Administrative	No

RED1-277-22	R503.1.5	Removes the exterior wall envelope definition and replaced with building thermal envelope. Exterior wall envelope was used only once in Section R503.1.5 in the entire IECC-R code.	Administrative	No
RED1-280-22 PI	R202	Removes the zonal heating definition.	Administrative	No
RED1-280-22 PII	N1101.6	Removes the zonal heating definition.	Administrative	No
RED1-281-22	Chapter 6	Updates the reference standards related to air leakage assessment in order to keep the references current.	Administrative	No
RED1-283-22	R202	Changes pilot light definitions with industry terms consistent with the source of the definition.	Administrative	No
RED1-284-22 PI	R202	Changes pilot light definitions with industry terms consistent with the source of the definition.	Administrative	No
RED1-284-22 PII	R202	Changes pilot light definitions with industry terms consistent with the source of the definition.	Administrative	No

RED1-285-22	SECTION 202 (New), SECTION 202, R401.3, R402.2.9, TABLE R402.5.1.1, SECTION R403, R403.3, R403.3.1, R403.3.2, R403.3.3, R403.3.3.1, R403.3.4, R403.3.4.1, R403.3.5, R403.3.6, TABLE R403.3.6, R403.3.7, R403.3.8, TABLE R403.6.2, SECTION R405, R405.3.2.1, TABLE R405.4.2(1), TABLE R405.4.2(2), SECTION R408, TABLE R408.2, R408.2.4, SECTION R502, R502.2.2, SECTION R503, R503.1.2, R503.1.2.1, R503.1.2.3; IECC: R403.3.1 (New)	Updates the duct sections for new construction and existing buildings to better define what is meant with ducts, ductwork and duct systems so to better clarify ducts in conditioned space and components in total duct leakage tests. Reduces use of "rough-in" and "post construction" phrases, adds a test exemption for ductless systems or ducted systems with not more than 10 ft of ductwork when in conditioned space and provides a greater duct leakage allowance with a greater amount of return ductwork.	Administrative	No	This proposal was a massive re-write of sections pertaining to duct systems to clarify definitions and requirements to determine duct location and total duct leakage.
RED1-286-22	R402, R402.5.1, R402.5.2, R402.5.2.1, SECTION R403, R403.1, R403.1.1, R403.1.2, R403.1.3, R403.14 (New), R403.14.1 (New), SECTION R405, TABLE R405.2, SECTION R406, TABLE R406.2, CHAPTER 6 [RE],	Moves the gas fireplace efficiency requirement from the R402.5 Building Thermal Envelope section, into the R403 (Systems) section. The gas fireplace efficiency was also combined with the continuously burning pilot light requirements into a new section.	Administrative	No	

	CSA Chapter 06, ANSI Chapter 06, R404.1.5 (New)			
RED1-287-22	R402.5.2.1	Editorial changes for the section to use the full designation of the referenced standards.	Administrative	No
RED1-290-22	R403.1.2	Editorial change for clarity for heat pump supplementary heat.	Administrative	No
RED1-292-22	R403.1.2; IRCECC: N1103.1.2	Expands the fuel types possible for heat pump supplementary heat.	Administrative	No
RED1-296-22	R403.1.3	Makes editorial changes for continuously burning pilot lights and adds an exception for gas-fired appliances using pilots within a listed combustion safety device.	Administrative	No
RED1-298-22	R403.1.3	Editorial changes to the code language to use proper designation of the referenced standard.	Administrative	No
RED1-299-22	R403.11.2	Editorial updates to the exception language to be consistent with other changes in the code for multiple types of renewable energy systems that can be used for pool heating.	Administrative	No
RED1-302-22	R403.3.2	Editorial change to clarify that the exception applies to duct insulation. The building assembly insulation requirements of Item 3.3 must be met.	Administrative	No

RED1-305-22	R403.3.3	Editorial changes to clarify duct location in ceiling.	Administrative	No	
RED1-313-22	R403.5.4, R408.2.3, R408.2.3.1, R408.2.3.1.1 (New); IECC: TABLE R403.5.4	Editorial changes to the language for compact hot water design which clarify the requirements and moves section for water volume determination to the energy credits section.	Administrative	No	
RED1-315-22	R403.5.5; IECC: Table R403.5.5 (New); IECC: 6 AHRI	Adds AHRI Standard 1430 for demand flexible electric resistance storage and electric heat pump water heaters (HPWH)s capable of load management that policymakers can use, state government, electric utilities, authorized third parties, manufacturers, designers, installers, contractors, and users.	Administrative	No	By providing standardized requirements for Demand Flexible Electric Storage Water Heaters (DFWH), utilities and load management program managers can be assured that DFWHs can communicate using standard hardware and software.
RED1-318-22	R403.6; IRCECC: N1103.6	Editorial changes for mechanical ventilation to include dwelling units.	Administrative	No	
RED1-321-22	TABLE R403.6.2	Editorial modifications to the fan efficacy table to improve clarity and improve alignment with the IECC-C fan efficacy table.	Administrative	No	
RED1-322-22	TABLE R403.6.2	Editorial changes to remove the commercial reference with a residential code reference for the mechanical ventilation system fan efficacy table.	Administrative	No	
RED1-324-22	R403.6.3	Editorial change to remove language for programmable airflow settings in airflow measurement tools since testing is in accordance with ANSI/RESNET/ICC 380 which does not have these limitations.	Administrative	No	

RED1-325-22	R403.7, R403.7.1	Editorial changes for clarity with electric resistance space heating and removal of exceptions.	Administrative	No
RED1-329-22	R403.8; IECC: R403.5.2 (New), R403.9 (New), R403.9.1 (New), R403.9, R403.10, R403.9.4 (New)	Revisions to systems serving multiple units, space heating outside building thermal envelope, and snow and deicing controls to remove all IECC-C references.	Administrative	No
RED1-330-22	R404.1	Editorial changes to lighting equipment to clarify that range hoods are exempt based on concerns for durability and viability of high-efficacy lighting exposed to the elevated temperatures associated with residential cooking.	Administrative	No
RED1-335-22	R404.5.3	Editorial changes intended to make all the sections under R404.5 consistent.	Administrative	No
RED1-336-22	R405.4, R405.4.1, R405.4.2, TABLE R405.4.2(1)	Editorial changes to the Standard Reference Design should be modeled with a 40 gallon electric resistance storage water heater when the Proposed Design is a heat pump water heater. This approach is also the same as that used in the ERI Path and similar to the approach used to calculate points for HPWHs in R408.2.3.	Administrative	No
RED1-337-22	TABLE R405.4.2(1)	Editorial clarification and reorganization to improve usability for air leakage rate, mechanical ventilation rate and fan energy.	Administrative	No
RED1-340-22	TABLE R405.4.2(1)	Editorial changes to use proper terminology for the non-electric energy sources for these space heating appliances.	Administrative	No

RED1-343-22	TABLE R408.2, R408.2.5	Editorial changes for improved air sealing and efficient ventilation measures and adds a fifth efficiency measure for HRV/ERV for buildings meeting prescriptive air leakage rates.	Administrative	No	
RED1-365-22	R403.6.3, R403.6.4 (New)	Adds a methodology for sampling testing of mechanical ventilation systems in dwelling units.	Administrative	No	
REPI-009-21	R105.2, R105.2.1, R105.2.2, R105.2.3 (New), R105.2.3, R105.2.4, R105.2.5	Editorial changes for inspections to separate the inspection of the framing and air-barrier from the insulation and fenestration during rough-in.	Administrative	No	
REPI-011-21	R202 (New), R303.1.1	Adds new definitions for reflective insulation and enclosed reflective air space to define conditions in the building thermal envelope insulation.	Administrative	No	The proposal adds specific requirements similar to those for the other insulation materials (as well as appropriate definitions) for a type of material, (reflective insulation) that has been in the market place for over 35 years and has had nationwide distribution and installation. These products are well established and have two associated ASTM Standards, ASTM C727, Standard Practice for Installation and Use of Reflective Insulation in Building Constructions, and ASTM C1224,Standard Specification for Reflective Insulation for Building Applications.
REPI-013-21	R202 (New), R303.2.2 (N1101.11.2) (New), ASTM Chapter 06 (New)	Adds a definition for radiant barrier and adjusts requirements to clarify that radiant barriers are not required but only when installed.	Administrative	No	

REPI-026-21	R202 (New), TABLE R402.1.2, R402.2.9, R402.1.2, R402.1.3, R402.1.5	Adds new definition for slab F-Factor, clarifies slab on-grade requirements and modifies the equation to the overall UA compliance equation to include slab perimeter multiplied by the F-Factor.	Administrative	No	Residential building energy codes that are based on any version of the International Energy Conservation Code (IECC) typically allow compliance to be demonstrated in several ways, one of which is a component tradeoff approach whereby prescriptive requirements for some building components may be relaxed in trade for corresponding improvements in other components. Calculations for this component tradeoff are based on maintaining a maximum overall building UA value, which is the sum across all building envelope components of the product of each component's U-factor (conductance) and area. For slabs on grade, the component UA is based on an F-factor rather than a U-factor and is multiplied by the slab-edge perimeter length rather than slab area.
REPI-030-21	TABLE R402.1.2, TABLE R402.1.3	Transposes the rows and columns of Tables R402.1.2 and R402.1.3 for consistency with IECC-C format.	Administrative	No	
REPI-035-21	TABLE R402.1.3, R402.2.7	Adds prescriptive R-value options to Table R402.1.3 for floors above unconditioned spaces (e.g., crawlspaces, floor overhangs, etc.) to align with the primary insulation options as done for above-grade walls. The options are cavity insulation only, cavity plus continuous insulation, and continuous insulation only.	Administrative	No	
REPI-037-21	R402.2.10, R402.2.10.1	Offers direction for installation of crawlspace wall insulation installation for performance, clarity and ease of compliance. The standing language does not address insulating from the	Administrative	No	

		outside and ambiguously speaks to insulating the rim joist or “the depth of the floor”.		
REPI-040-21	R402.2.6, TABLE R402.2.6, AISI (New)	Requires the U-factors for steel-framed ceilings, walls and floor assemblies determined in accordance with AISI S250 but still meet the requirements of Table R402.1.2.	Administrative	No
REPI-042-21	Definition, R402.3 (N1102.3) (New), ASTM Chapter 06	Adds a definition for radiant barrier and adjusts requirements to clarify that radiant barriers are not required but only when installed.	Administrative	No
REPI-043-21	R402.4, R402.4.1.2, ASTM Chapter 06 (New)	Adds an additional reference test method, ASTM E3158 for air leakage testing requirements. This test method has already been included in the list of acceptable test methods for whole building air leakage testing in the IECC-C but was not added to the parallel section of the IECC-R.	Administrative	No
REPI-047-21	TABLE R402.4.1.1	Updates the language for air barrier and insulation installation criteria for ceilings/attics in Table R402.4.1.1	Administrative	No
REPI-051-21	TABLE R402.4.1.1	Updates the language for air barrier and insulation installation criteria for common walls in Table R402.4.1.1	Administrative	No
REPI-052-21	TABLE R402.4.1.1	Updates the language for air barrier and insulation installation criteria for showers, tubs and fireplaces in Table R402.4.1.1	Administrative	No

REPI-053-21	TABLE R402.4.1.1	Updates the language for air barrier and insulation installation criteria for electrical communication and other equipment boxes, housings and enclosures in Table R402.4.1.1	Administrative	No
REPI-054-21	TABLE R402.4.1.1	Updates the language for air barrier and insulation installation criteria for windows, skylights and doors in Table R402.4.1.1	Administrative	No
REPI-055-21	R402.4.1.1, TABLE R402.4.1.1	Clarifies the language for air barrier and insulation installation criteria for rim joists in Table R402.4.1.1	Administrative	No
REPI-057-21	R402.4.1.2	Updates the language for air leakage testing by adjusting the air leakage units and to clarify the code intent and align terminology with the commercial air barrier testing provisions.	Administrative	No
REPI-058-21	R402.4.1.2	Moves the exceptions for dwelling unit air leakage testing within the main exceptions for overall air leakage testing.	Administrative	No
REPI-061-21	R402.4.1.4	Aligns residential code language for dwelling unit sampling with the commercial provisions of the 2021 IECC and RESNET sampling guidelines so that envelope leakage testing requirements for a multi-family (R2 classification) project that is 3 stories or lower in height (and that falls under the Residential provisions of the IECC) will be tested at the same rate as apartment building that is 4 stories or taller in height (and falls under the Commercial provisions of the IECC).	Administrative	No

REPI-066-21	CHAPTER 4 [RE], R402.4.6	Editorial revision to air-sealed electrical and communication boxes by clarifying the requirements only apply where air-sealed boxes are selected as permitted by the table and applies to those boxes that penetrate the thermal envelope thus necessitating the need for an air barrier or air-sealed box.	Administrative	No
REPI-069-21	R202 (New), R403.1 (N1103.1) (New), R403.1, R403.6.1, R403.8, R404.2 (N1104.2) (New), R404.2, R404.3 (N1104.3) (New), R404.3, R404.4 (N1104.4) (New)	Aligns the requirements of multifamily dwelling units between the IECC-R and the IECC-C in terms of system design, control and stringency between a 3-story MF building and a 4-story MF building.	Administrative	No
REPI-078-21	SECTION 202, R403.3.1, TABLE R405.4.2(1)	Adds a new definition for Distribution System Efficiency (DSE) for consistency with language in Table R405.4.2(1).	Administrative	No
REPI-079-21	R403.3.2	Adds requirement for ducts located in sealed attics to contain vapor diffusion ports to reduce condensation on ductwork. The existing IRC language allows sealed attics with vapor diffusion ports.	Administrative	No
REPI-082-21	R403.3.3	Adds requirement for ducts buried within ceiling insulation to have vapor diffusion ports and be in compliance with vapor retarder requirements for climate zones 0A, 1A, 2A and 3A.	Administrative	No
REPI-083-21	R403.3.3.1	Adjusts language to allow any framing dimensions for effective R-Value of deeply	Administrative	No

		buried ducts given the language in R403.3.3 is sufficient to fully insulate the ducts.		
REPI-087-21	R403.4.1	Clarifies the intent for protection of pipe insulation from weather and to ensure the insulations thermal conductivity energy savings integrity lasts the life of the mechanical system as per the intent of the code.	Administrative	No
REPI-094-21	R403.6.1	Clarifies the requirements for heat or energy recovery ventilation to use the new definition for balanced ventilation system and the term sensible recovery efficiency.	Administrative	No
REPI-095-21	R403.6.2, TABLE R403.6.2, CSA Chapter 06 (New), ASHRAE Chapter 06 (New)	Aligns residential fan efficacy table with the commercial fan efficacy table, the ASHRAE 90.1 fan efficacy table and the ENERGY STAR Ventilation Fans v4.1 specifications.	Administrative	No
REPI-096-21	R403.6.3	Adds new requirement for mechanical ventilation system testing to use the ANSI/RESNET/ICC 380 Standard and updates the exception for kitchen range hoods or for testing where the ventilation system has integrated diagnostic tools used for airflow measurement.	Administrative	No
REPI-101-21	R404.1	Adds an exception for lighting equipment that clarifies the section's intent in regard to lighting that is used for germicidal or antimicrobial purposes and is aligned with the IECC-C Section C405.3.1 exception for antimicrobial lighting.	Administrative	No

REPI-102-21 Part I	R202, R404.1	Editorial change to correct the terminology used to describe lightning equipment and relocates the efficacy criteria from the definition of “high-efficacy light sources” to R404.1 to improve clarity.	Administrative	No
REPI-102-21 Part II	R202, N1104.1	Editorial change to correct the terminology used to describe lightning equipment and relocates the efficacy criteria from the definition of “high-efficacy light sources” to R404.1 to improve clarity.	Administrative	No
REPI-105-21	TABLE R404.1 (TABLE N1104.1) (New), R404.1.1, R404.1.2 (N1104.1.1) (New), R404.1.3 (N1104.1.2) (New), R404.1.4 (N1104.1.3) (New), R404.1.5 (N1104.1.4) (New)	Adds the requirements for exterior lighting power allowance applicable to residential occupancies from the commercial energy provisions and places these requirements directly within the residential code language. Also adds an additional exception intended to cover one- and two-unit R-2 buildings that may fall outside of the scope of the IRC.	Administrative	No
REPI-106-21	R202 (New), R404.2, R404.2.1 (N1104.2.1) (New), R404.2.2 (N1104.2.2) (New)	Adds new definition for Automatic Shut-Off Control and clarifies application of lighting controls in residential occupancies. The revised rule adds a separate lighting control requirement for habitable spaces that includes both automatic and non-automatic control function and adds automatic occupant sensor control only to specific, non-habitable spaces of a residence. The revised language includes provisions to ensure the occupants can manually turn the lighting on and off independently of the occupant sensor control.	Administrative	No

REPI-108-21	R404.2	Clarifies that the control requirements only apply to interior lighting fixtures and removes the language about exterior lighting fixtures to prevent confusion.	Administrative	No	
REPI-117-21	R405.2	Adds exception for the use of energy costs to determine R405 performance-based compliance to use site energy in Btu or Btu/sq ft could be used for all-electric buildings with on-site renewable energy installed.	Administrative	No	
REPI-120-21	TABLE R405.2, TABLE R406.2	Updates the mandatory requirements Tables R405.2 and R406.2 to ensure parity between the performance compliance paths.	Administrative	No	
REPI-121-21	R405.2, CHAPTER 6 [RE], ASHRAE Chapter 06 (New)	Updates the source energy multiplier/conversion factors based on ASHRAE Standard 105 or a data source approved by the code official.	Administrative	No	
REPI-124-21	TABLE R405.4.2(1)	Updates the mechanical ventilation rate for the R405 Standard Reference Design to be adjusted by the design home air leakage rate. Performance Path Ventilation Rate adjustment to B x M in the Standard Reference Design.	Administrative	No	This proposal permits builders and homeowners to increase mechanical ventilation rates to a more reasonable level without imposing an IECC performance path penalty.
REPI-129-21	R406.3.2	Updates the Energy Rating Index (ERI) compliance path in the IECC by updating the mandatory thermal envelope backstop for projects with on-site generation by incorporating a UA trade-off and basing the requirements on the current IECC.	Administrative	No	

REPI-140-21	R408.2.5	Removes a conflict between the HRV/ERV fan efficacy of this section and that of Table R403.6.2 and clarifies that performance values should be the listed values, uses the same SRE reference temperature as is required in Section R403.6.1) and permits recirculation defrost to be used in all climate zones but Climate Zone 8.	Administrative	No
REPI-153-21	APPENDIX RC, SECTION RC101, RC101.1	Simplifies the scope statement of Appendix RC - Zero Energy Appendix.	Administrative	No
REPI-154-21	APPENDIX RC, SECTION RC102, RC102.2	Changes title of Appendix RC from Zero Energy Residential Buildings to Zero Net Energy Residential Buildings.	Administrative	No
REPI-156-21	APPENDIX RC, SECTION RC102, RC102 (New), SECTION RC103 (New), RC102.1, RC102.2, TABLE RC102.2	Reorganizes Appendix RC to improve readability and structure of the language by moving defined words to a definitions portion within the Appendix. Editorial changes to renumber sections based on these changes.	Administrative	No
REPI-157-21	APPENDIX RC, SECTION RC102, R102.2 (New), RC102.2, TABLE RC102.2, ASHRAE Chapter 06 (New)	Adds a reference to ASHRAE Standard 90.2 to allow ERI requirements from ASHRAE 90.2 Table 6-1 for compliance with Appendix RC. Also adjusts the language for on-site power production.	Administrative	No
REPI-158-21	R202, SECTION R404, R404.4 (N1104.4) (New), R406.7.3, RC102.3 (AX102.3) (New)	Adds a definition for Renewable Energy Certificate (REC) and new language to Section R404 to require REC documentation where renewable energy power production is used for compliance.	Administrative	No

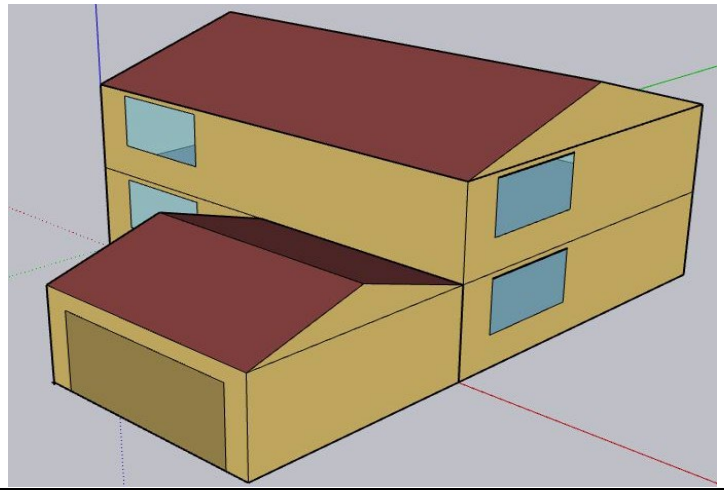
REPI-160-21	RC102.2	Changes the renewable energy purchase contract from 15 to 10 years and utilizes the defined term for renewable energy resources.	Administrative	No
REPI-161-21	RC102.2	Adds new definitions for use in Appendix RC and adds options for financial renewable energy power purchase agreement and using the newly defined terms for the off-site renewable power.	Administrative	No
REPI-165-21	TABLE R402.1.2, R402.1.3, APPENDIX RD (New), RD101 (New), RD101.1 (New), TABLE RD101.1 (New), RD101.2 (New), RD101.3 (New), RD102 (New), RD103 (New), RD104 (New), RD105 (New), RD106 (New)	Establishes Appendix RD to expand R-value options for determining compliance with the U-factor criteria prescribed in Section R402.1.2 of the IECC residential provisions.	Administrative	No

(a) Proposal numbers are as assigned by the ICC (https://energy.cdpaccess.com/live/cah/).
(b) Code sections refer to the 2021 IECC. Sections may be renumbered by the ICC in the 2024 IECC.

Appendix B – Prototype Building Model Description

B.1 Single-Family Prototype Model

	Item	Description	Data Source
General			
	Vintage	New Construction	
	Locations	See under Section 1.2.2	Reference: Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes
	Available fuel types	Natural Gas/Electricity/Fuel Oil	
	Building Type (Principal Building Function)	Residential	
	Building Prototype	Single-family detached	
Form			
	Total Floor Area (ft^2)	2,376 (29.8' x 39.8' x 2 stories)	Reference: Methodology for Evaluating Cost-Effectiveness of

	Item	Description	Data Source
General			
	Building shape		Residential Energy Code Changes
	Aspect Ratio	1.33	
	Number of Floors	2	
	Window Fraction (Window-to-Floor Ratio)	Average Total: 15.0% divided equally among all facades	Reference: Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes
	Window Locations	All facades	
	Shading Geometry	None	
	Orientation	Back of the house faces North (see image)	
	Thermal Zoning	The house is divided into three thermal zones: 'living space', 'attic' and 'crawlspace', 'heated basement', 'unheated basement' when applicable	
	Floor to ceiling height	8.5’	

	Item	Description	Data Source
General			
Architecture			
	Exterior walls		
	Construction	Wood-Frame Walls (2x4 16" O.C. or 2x6 24" O.C.) 1" Stucco + Building Paper Felt + Insulating Sheathing (if applicable) + 7/16" Oriented Strand Board + Wall Insulation + 1/2" Drywall	
	U-factor (Btu / h * ft^2 * °F) and/or R-value (h * ft^2 * °F / Btu)	IECC Requirements Residential; Walls, above grade, Wood Frame	IECC
	Dimensions	Based on floor area and aspect ratio	
	Tilts and orientations	Vertical	
	Roof		
	Construction	Asphalt Shingles	
	U-factor (Btu / h * ft^2 * °F) and/or R-value (h * ft^2 * °F / Btu)	IECC Requirements Residential; Roofs, Insulation entirely above deck	IECC
	Tilts and orientations	Gabled Roof with a Slope of 4/12	
	Window		
	Dimensions	Based on window fraction, location, floor area and aspect ratio	
	Glass-Type and frame	Hypothetical window with the exact U-factor and SHGC shown below	
	U-factor (Btu / h * ft^2 * °F)	IECC Requirements Residential; Glazing	IECC
	SHGC (all)		
	Operable area	100%	
	Skylight		
	Dimensions	Not Modeled	
	Glass-Type and frame	NA	
	U-factor (Btu / h * ft^2 * °F)		
	SHGC (all)		

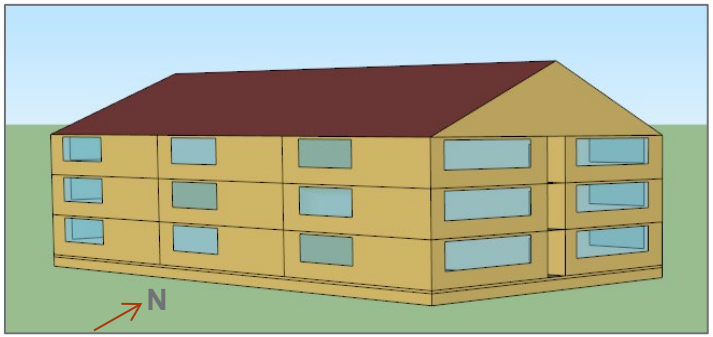
	Item	Description	Data Source
General			
	Visible transmittance		
	Foundation		
	Foundation Type	Four Foundation Types are Modeled- i. Slab-on Grade ii. Vented Crawlspace Depth 2' iii. Heated Basement - Depth 7' iv. Unheated Basement- Depth 7'	Reference: Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes
	Insulation level	IECC requirements for floors and basement walls	IECC
	Dimensions	Based on floor area and aspect ratio	
	Internal Mass	8 lb/ft^2 of floor area	IECC 2024 Table R405.4.2(1)
	Infiltration (ACH)	2006 IECC: 8 Air Changes/Hour at 50 Pa (8 ACH50) 2009 IECC: 7 Air Changes/Hour at 50 Pa (7 ACH50) 2012-2021 IECC: 5 or 3 Air Changes/Hour at 50 Pa (5 or 3 ACH50) depending on climate zone 2024 IECC: 4, 3 or 2.5 Air Changes/Hour at 50 Pa (5, 3 or 2.5 ACH50) depending on climate zone	
HVAC			
	System Type		
	Heating type	Four Heating System Types are Modeled- i. Gas Furnace ii. Oil Furnace iii. Electric Furnace iv. Heat Pump	Reference: Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes

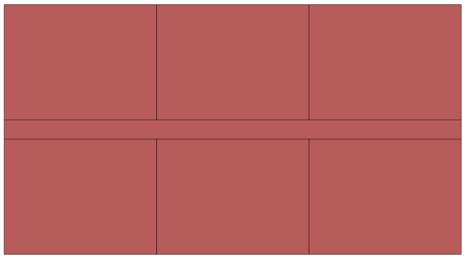
	Item	Description	Data Source
General			
	Cooling type	Central DX Air-Conditioner/Heat Pump	
	HVAC Sizing		
	Cooling	Autosized to design day	
	Heating	Autosized to design day	
	HVAC Efficiency		
	Air Conditioning	13.4/14.3 SEER2 based on state	Federal minimum efficiency
	Heating	AFUE 80% / HSPF2 7.5	Federal minimum efficiency
	HVAC Control		
	Thermostat Setpoint	75°F Cooling/72°F Heating	2024 IECC Table R405.4.2(1)
	Thermostat Setback	No setback	
	Supply air temperature	Maximum 110 F, Minimum 52 F	
	Ventilation	60 CFM Outdoor Air; Continuous Supply	2015 IRC
	Supply Fan		
	Fan schedules	See Appendix B.3	
	Supply Fan Total Efficiency (%)	Depending on the fan motor size	Residential Furnaces and Centralized Air Conditioners and Heat Pumps Direct Final Rule Technical Support Document[1]
	Supply Fan Pressure Drop	Depending on the fan supply air cfm	

[1] Residential Furnaces and Central Air Conditioners and Heat Pumps Direct Final Rule Technical Support Document – Chapter 7 'Energy Use Characterization'
http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/hvac_ch_07_energy-use_2011-04-25.pdf

	Item	Description	Data Source
General			
	Domestic Hot Water		
	DHW type	Individual Residential Water Heater with Storage Tank	
	Fuel type	Natural Gas/Electricity/Oil	
	Thermal efficiency (%)	EF = 0.59 for Gas-fired Water Heaters EF = 0.917 for Electric Water Heaters EF = 0.62 for Oil Water Heaters	Federal minimum efficiency
	Tank Volume (gal)	40 for Gas-fired Water Heaters 52 for Electric or Oil Water Heaters	Reference: Building America Research Benchmark
	Water temperature setpoint	120 F	
	Schedules	See Appendix B.2	
Internal Loads and Schedules			
	Lighting		
	Average interior power density (W/ft^2)	Living space: Lighting Power Density is 0.68 W/ft^2 (For interior lighting) Lighting loads for Garage and Exterior Lighting have also been included	Reference: 2014 Building America House Simulation Protocols
	Interior Lighting Schedule	See Appendix B.3	
	Internal Gains		
	Load (Btu/day)	17,900 + 23.8 x CFA + 4104 x Nbr See Appendix B.4 for the detailed calculations	Reference: IECC 2024 Table R405.4.2(1)
	Internal gains Schedule(s)	See Appendix B.3	
	Occupancy		
	Average people	800 ft2/per person for conditional total and 1601 ft2/per person for total	
	Occupancy Schedule	See Appendix B.3	

B.2 Multifamily Prototype Model

	Item	Description	Data Source
General			
	Vintage	New Construction	
	Location	See Section 1.2.2	Reference: Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes
	Available Fuel Types	Natural Gas/Electricity/Fuel Oil	
	Building Type	Residential	
	Building Prototype	Low-rise Multifamily	
Form			
	Total Floor Area	Whole Building- 23,400 ft^2 Each Dwelling Unit - 1200 ft^2	
	Building Shape		Reference: Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes
	Aspect Ratio	Whole Building- 1.85 Each Dwelling Unit - 1.33	
	Number of Floors	3	
	Number of Units per Floor	6	
	Orientation	Back of the house faces North (see image)	
	Dimensions	Whole Building - 120' x 65' x 25'6" Each Dwelling Unit - 40' x 30' x 8'6"	

	Item	Description	Data Source
	Conditioned Floor Area	Each Dwelling Unit- 1200 ft^2	
	Window Area (Window-to- Exterior Wall Ratio)	23% WWR (Does not include breezeway walls)	
	Exterior Door Area	Each Dwelling Unit - 21 ft^2 Whole Building - 378 ft^2	
	Shading Geometry	None	
	Thermal Zoning	Each floor has six dwelling units with a breezeway in the center. Each dwelling unit is modeled as a separate zone. The other thermal zones are: attic, breezeway and foundation (basements and crawlspace only)	
			
	Floor to ceiling height	8.5’	
Architecture			
	Exterior walls		
	Construction	Wood-Frame Walls (2x4 16" O.C. or 2x6 24" O.C.) 1" Stucco + Building Paper Felt + Insulating Sheathing (if applicable) + 7/16" Oriented Strand Board + Wall Insulation + 1/2" Drywall	
	U-factor (Btu / h * ft^2 * °F) and/or R-value (h * ft^2 * °F / Btu)	IECC Requirements Residential; Wood-Frame Wall R-value	IECC
	Dimensions	Each Dwelling Unit: 40' x 8'6" and 30' x 8'6"	
	Tilts and orientations	Vertical	

	Item	Description	Data Source
	Roof		
	Construction	Built-up Roof: Asphalt Shingles+ 1/2 in. OSB	
	U-factor (Btu / h * ft^2 * °F) and/or R-value (h * ft^2 * °F / Btu)	IECC Requirements Residential; Ceiling R-value	IECC
	Tilts and orientations	Gabled Roof with a Slope of 5/12	
	Window		
	Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
	Glass-Type and frame	Hypothetical window with the exact U-factor and SHGC shown below	
	U-factor (Btu / h * ft^2 * °F)	IECC Requirements Fenestration U-factor and SHGC	
	SHGC (all)		
	Operable area	100%	
	Skylight		
	Dimensions	Not Modeled	
	Glass-Type and frame	NA	
	U-factor (Btu / h * ft^2 * °F)		
	SHGC (all)		
	Visible transmittance		
	Foundation		
	Foundation Type	Four Foundation Types are Modeled- i. Slab-on Grade ii. Vented Crawlspace Depth 2' iii. Heated Basement - Depth 7' iv. Unheated Basement- Depth 7'	Reference: Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes
	Insulation level	IECC Requirements for floors, slabs, and basement walls	
	Dimensions	Based on floor area and aspect ratio	

	Item	Description	Data Source
	Internal Mass	8 lb/ft^2 of floor area	IECC 2024 Table R405.4.2(1)
	Infiltration (ACH)	2006 IECC: 8 Air Changes/Hour at 50 Pa 2009 IECC: 7 Air Changes/Hour at 50 Pa 2012-2021 IECC: 5 or 3 Air Changes/Hour at 50 Pa depending on climate zone 2024 IECC: 4, 3 or 2.5 Air Changes/Hour at 50 Pa (5, 3 or 2.5 ACH50) depending on climate zone	
HVAC			
	System Type		
	Heating type	Four Heating System Types are Modeled- i. Gas Furnace ii. Oil Furnace iii. Electric Furnace iv. Heat Pump	
	Cooling type	Central DX Air-Conditioner/Heat Pump (1 per unit)	
	HVAC Sizing		
	Cooling	Autosized to design day	
	Heating	Autosized to design day	
	HVAC Efficiency		
	Air Conditioning	13.4/14.3 SEER2 based on state	Federal Minimum Equipment Efficiency for Air Conditioners and Condensing Units
	Heating	AFUE 80% / HSPF2 7.5	Federal Minimum Equipment Efficiency
	HVAC Control		
	Thermostat Setpoint	75°F Cooling/72°F Heating	
	Thermostat Setback	No setback	
	Supply air temperature	Maximum 110 F, Minimum 52 F	
	Ventilation	45 CFM Outdoor Air per dwelling unit; Continuous Supply	2021 International Residential Code (IRC)
	Supply Fan		
	Fan schedules	See Appendix B.3	

	Item	Description	Data Source
	Supply Fan Total Efficiency (%)	Fan efficiency 50%; Motor efficiency 86% (PSC motor)	Residential Furnaces and Centralized Air Conditioners and Heat Pumps Direct Final Rule Technical Support Document[1]
	Supply Fan Pressure Drop	1.6" w.g.	
	Service Water Heating (SWH)		
	SWH type	Individual Residential Water Heater with Storage Tank	
	Fuel type	Natural Gas / Electricity/Oil	
	Thermal efficiency (%)	EF = 0.59 for Gas-fired Water Heaters EF = 0.917 for Electric Water Heaters EF = 0.62 for Oil Water Heaters	Federal Minimum Equipment Efficiency
	Tank Volume (gal)	40 for Gas-fired Water Heaters 52 for Electric or Oil Water Heaters	
	Water temperature setpoint	120 F	
	Schedules	See Appendix B.3	
Internal Loads and Schedules			
	Lighting		
	Average power density (W/ft^2)	Apartment units: Lighting Power Density is 0.82 W/ft^2 (For interior lighting) Lighting loads for Garage and Exterior Lighting have also been included	2014 Building America House Simulation Protocols
	Interior Lighting Schedule	See Appendix B.3	
	Internal Gains		
	Internal Gains (Btu/day per Dwelling Unit)	17,900 + 23.8 x CFA + 4104 x N_{br} See Appendix B.4 for the detailed calculations	2024 IECC Table R405.4.2(1)

[1] Residential Furnaces and Centralized Air Conditioners and Heat Pumps Direct Final Rule Technical Support Document: Chapter 7 'Energy Use Characterization.' Residential Furnaces and Centralized Air Conditioners and Heat Pumps Direct Final Rule Technical Support Document

	Item	Description	Data Source
	Internal Gains Schedule(s)	See under Appendix B.3	
	Occupancy		
	Average people	2 people/apartment unit	
	Occupancy Schedule	See Appendix B.3	

B.3 Schedules

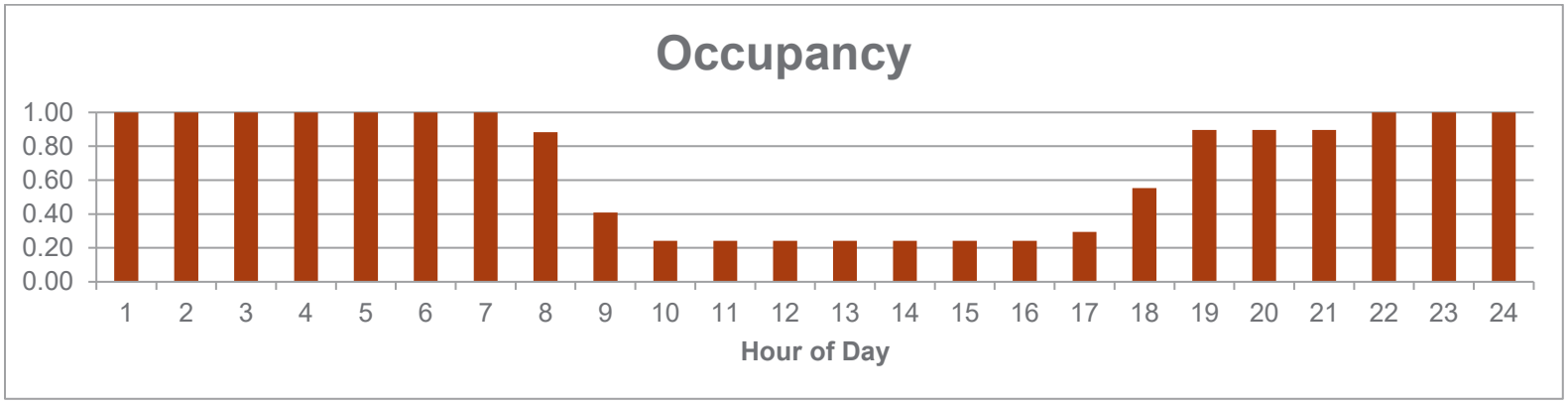


Figure B.1. Occupancy Schedules

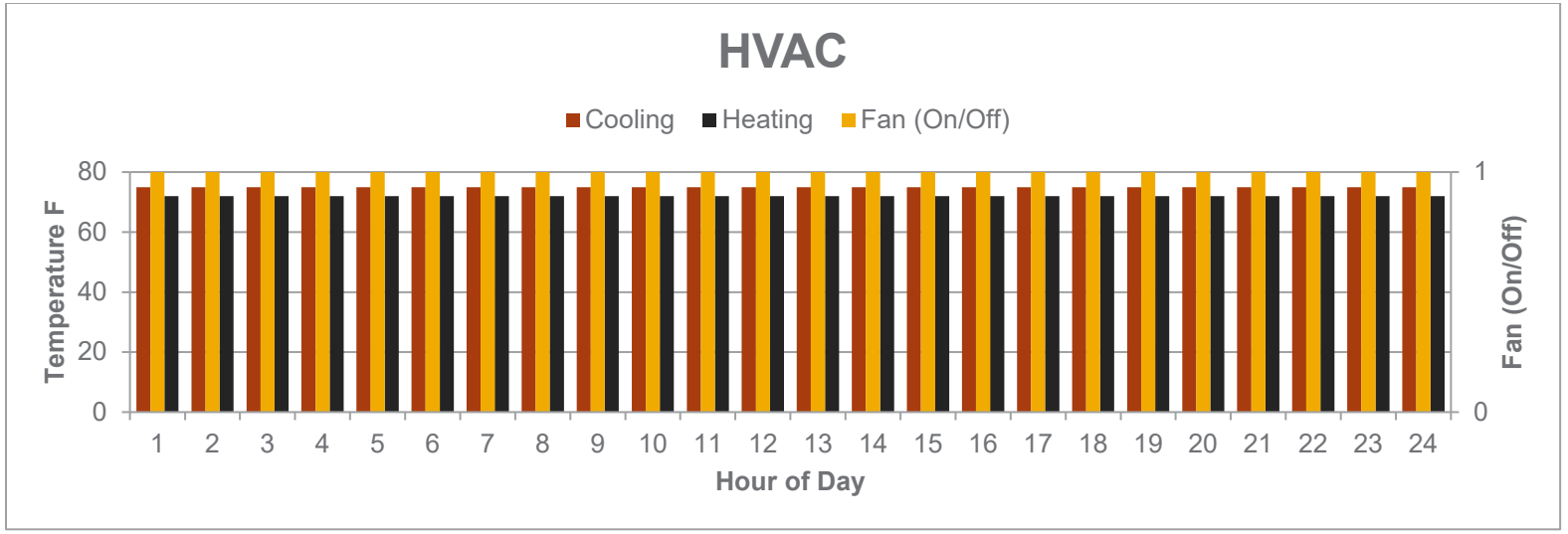


Figure B.2. HVAC Temperature Schedule

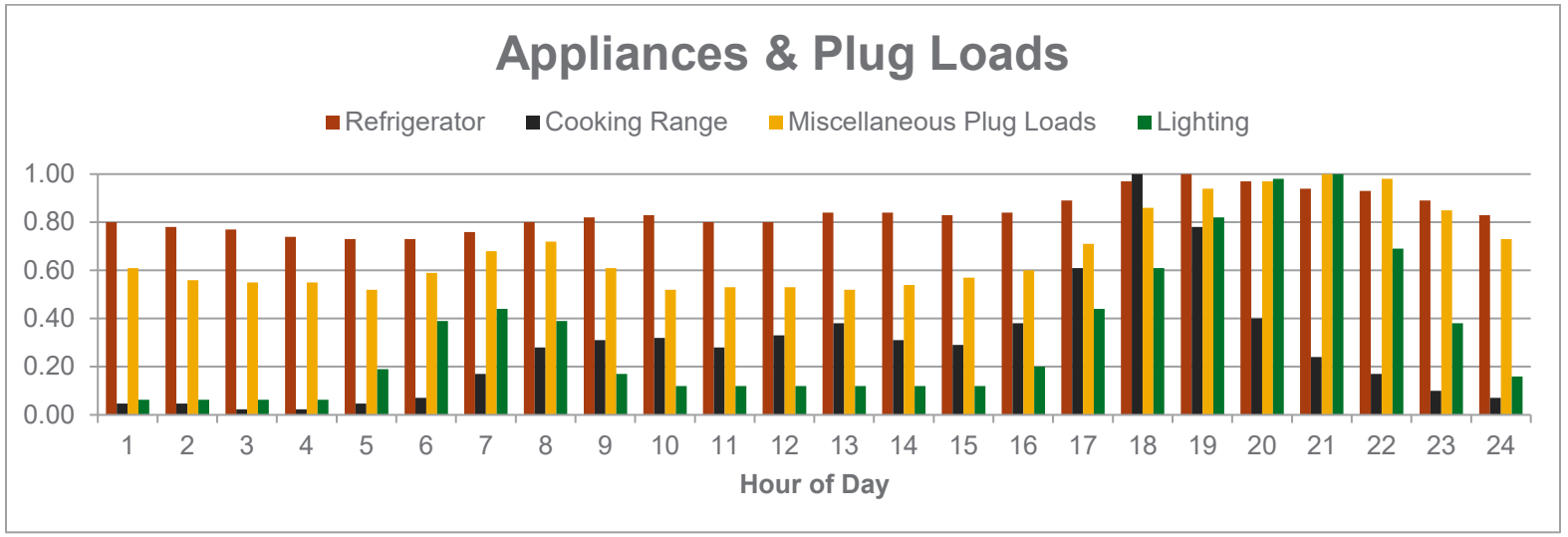


Figure B.3. Lighting and Appliance Schedules

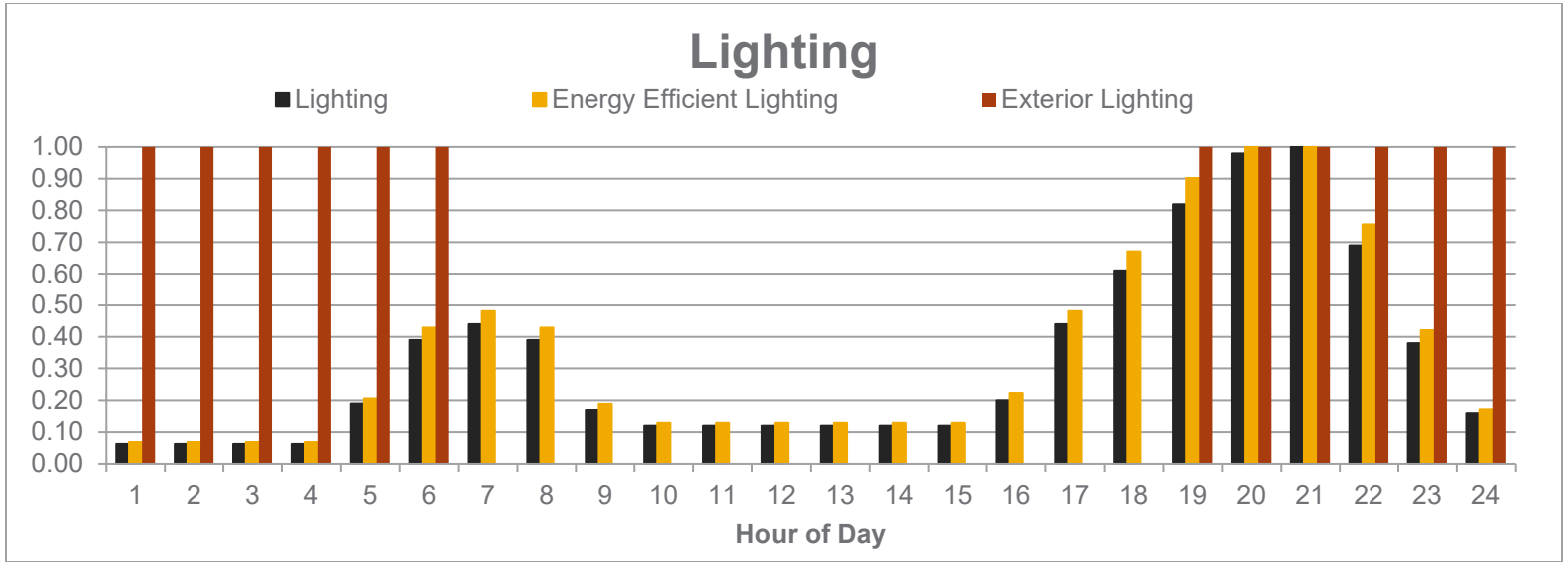


Figure B.4. Interior and Exterior Lighting Schedules

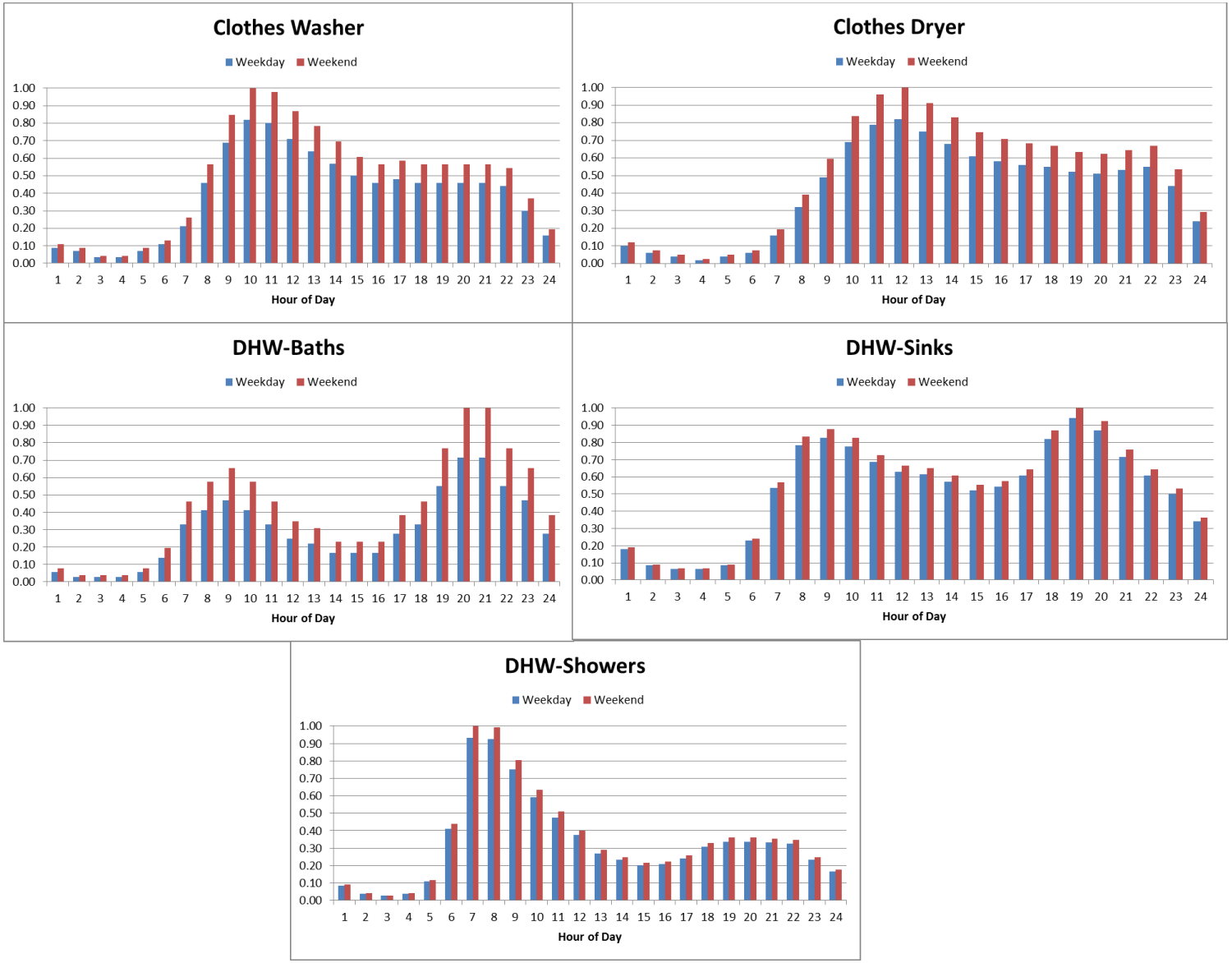


Figure B.5. Service Hot Water Demand Schedules

B.4 Internal Gains Assumptions

Table B.1. Total Internal Gains for the Single-Family Prototype for the 2012 through 2024 IECC

Appliance	Power	Total Electricity (kWh/yr)	Fraction Radiant	Fraction Latent	Fraction of Electricity Use Not Turned into Heat	Internal Heat Gains (kWh/yr)		
						2012 IECC	2015 IECC	2018-2024 IECC
Refrigerator	91.06 W	668.67	1.00	0.00	0.00	669	669	669
Clothes Washer	28.48 W	105.15	0.80	0.00	0.20	84	84	84
Clothes Dryer	213.06W	833.27	0.15	0.05	0.80	125	125	125
Dishwasher	65.70 W	205.90	0.60	0.15	0.25	124	124	124
Range	248.15 W	604.09	0.40	0.30	0.30	242	242	242
Misc. Plug Load	567.46 W	3358.05	0.69	0.06	0.25	2317	2317	2317
IECC Adjustment Factor	340.85 W	2017.01	0.41	0.06	0.25	1392	1392	1392
Lighting			1.00	0.00	0.00	1345	1164	1164
Occupants	3 Occupants					2123	2123	2123
Total					kWh/yr	8420	8239	8239
					kBtu/yr	28729	28112	28112
					Btu/day	78711	77019	77019

Table B.2. Total Internal Gains for the Multifamily Prototype for the 2012 through 2024 IECC (per dwelling unit)

Appliance	Power	Total Electricity (kWh/yr)	Fraction Sensible	Fraction Latent	Fraction of Electricity Use Not Turned into Heat	Internal Heat Gains (kWh/yr)		
						2012 IECC	2015 IECC	2018-2024 IECC
Refrigerator	91.06 W	668.67	1.00	0.00	0.00	669	669	669
Clothes Washer	23.73 W	87.63	0.80	0.00	0.2	70	70	70
Clothes Dryer	177.60 W	694.56	0.15	0.05	0.8	104	104	104
Dishwasher	54.75W	171.60	0.60	0.15	0.25	103	103	103
Range	206.73 W	503.24	0.40	0.30	0.3	201	201	201
Misc. Plug Load	440.55 W	2607.04	0.69	0.06	0.25	1799	1799	1799
IECC Adjustment Factor	29.23 W	172.98	0.41	0.06	0.25	119	119	119
Lighting			1.00	0.00	0	405	351	351
Occupants	2 Occupants					1416	1416	1416
Total					kWh/yr	4886	4832	4832
					kBtu/yr	16673	16489	16489
					Btu/Day	45680	45175	45175

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