Pacific Northwest
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PNNL-32381

Cost-Effectiveness of the 2018 IECC for Residential Buildings in Colorado — 2015 IECC Baseline

December 2021

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U.S. DEPARTMENT OF ENERGY

Prepared for the U.S. Department of Energy
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Richland, Washington 99354

Highlights

Please note, this report has been updated to reflect a new baseline. The previous report (PNNL-31252) utilized the 2009 IECC as the baseline, but the Colorado State Energy Office requested this be modified to the 2015 IECC to better align with minimum code requirements in the state.

The 2018 IECC provides cost-effective levels of energy efficiency and performance for residential buildings in Colorado

Moving to the 2018 International Energy Conservation Code (IECC) is cost-effective for both single-family and low-rise multifamily residential buildings in Colorado. The 2018 IECC will provide statewide energy savings of 1.0% across all climate zones compared to the 2015 IECC. This equates to $17 of annual utility bill savings for the average Colorado household. It will reduce statewide CO_2 emissions over 30 years by 2,227,500 metric tons, equivalent to the annual CO_2 emissions of 484,400 cars on the road (1 MMT CO_2 = 217,480 cars driven/year). Updating the state energy code based on the 2018 IECC will also stimulate the creation of high-quality jobs across the state. Adopting the 2018 IECC in Colorado is expected to result in homes that are energy efficient, more affordable to own and operate, and based on current industry standards for health, comfort and resilience.

The average expected statewide economic impact (per dwelling unit) of upgrading to the 2018 IECC is shown in the tables below based on cost-effectiveness and carbon metrics established by the U.S. Department of Energy.[1]

Consumer Impact

Metric	Compared to the 2015 IECC
Life-cycle cost savings of the 2018 IECC	$462
Net annual consumer cash flow in year 1 of the 2018 IECC[2]	$16
Annual (first year) energy cost savings of the 2018 IECC ($)[3]	$17
Annual (first year) energy cost savings of the 2018 IECC (%)[4]	1.0%

[1] A weighted average is calculated across building configurations and climate zones.
[2] The annual cash flow is defined as the net difference between annual energy savings and annual cash outlays (mortgage payments, etc.), including all tax effects but excluding up-front costs (mortgage down payment, loan fees, etc.). First-year net cash flow is reported; subsequent years' cash flow will differ due to the effects of inflation and fuel price escalation, changing income tax effects as the mortgage interest payments decline, etc.
[3] Annual energy savings is reported at time zero, before any inflation or price escalations are considered.
[4] Annual energy savings is reported as a percentage of end uses regulated by the IECC (HVAC, water heating, and interior lighting).

Statewide Impact - Emissions

Statewide Impact	First Year	30 Years Cumulative
Energy cost savings, $	528,100	184,070,000
CO_2 emission reduction, Metric tons	4,570	2,227,500
CH_4 emissions reductions, Metric tons	0.25	122
N_2O emissions reductions, Metric tons	0.035	17
NOx emissions reductions, Metric tons	2.8	1,368
SOx emissions reductions, Metric tons	1.0	509

Statewide Impact – Jobs Created

Statewide Impact	First Year	30 Years Cumulative
Jobs Created -- Reduction in Utility Bills	2	820
Jobs Created -- Construction Related Activities	9	251

Acronyms and Abbreviations

AVERT	U.S. EPA Avoided Emissions and GeneRation Tool
BC3	Building Component Cost Community
BECP	Building Energy Codes Program
CH_4	Methane
CO_2	Carbon Dioxide
CPI	consumer price index
DOE	U.S. Department of Energy
E.O.	Executive Order
eGRID	EPA Emissions & Generation Resource Integrated Database dataset
EIA	Energy Information Administration
EPA	Environmental Protection Agency
ERI	Energy Rating Index
GHG	greenhouse gas
IAM	Integrated assessment models
ICC	International Code Council
IECC	International Energy Conservation Code
LCC	Life-Cycle Cost
NAHB	National Association of Home Builders
N_2O	Nitrous Oxide
NO_X	Nitrogen Oxides
PNNL	Pacific Northwest National Laboratory
SO_X	Sulfur Oxides

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1.0 Cost-Effectiveness Results for the 2018 IECC for Colorado

This section summarizes the cost-effectiveness analysis in terms of three primary economic metrics applicable to the homeowner:

- Life-Cycle Cost (LCC): Full accounting over a 30-year period of the cost savings, considering energy savings, the initial investment financed through increased mortgage costs, tax impacts, and residual values of energy efficiency measures
- Consumer Cash Flow: Net annual cost outlay (i.e., difference between annual energy cost savings and increased annual costs for mortgage payments, etc.)
- Simple Payback Period: Number of years required for energy cost savings to exceed the incremental first costs of a new code, ignoring inflation and fuel price escalation rates

LCC savings is the primary metric established by the U.S. Department of Energy (DOE) to assess the economic impact of residential building energy codes. Simple payback period and the Consumer Cash Flow analysis are reported to provide additional information to stakeholders, including states which have established a range of alternative economic metrics. Both the LCC savings and the year-by-year cash flow values from which it is calculated assume that initial costs are mortgaged, that homeowners take advantage of mortgage interest tax deductions, that individual efficiency measures are replaced with like measures at the end of their useful lifetimes, and that efficiency measures may retain a prorated residual value at the end of the 30-year analysis period.

Societal benefits such as benefits from energy codes as well as reduction of carbon emissions and jobs generated from moving to the 2018 IECC are discussed in Section 5.0.

A complete description of the DOE methodology for assessing the cost-effectiveness of building energy codes is available on energycodes.gov[1].

1.1 Life-Cycle Cost

The Life-Cycle Cost (LCC) analysis computes overall cost savings per dwelling unit resulting from implementing the efficiency improvements of a new energy code. LCC savings is based on the net change in overall cash flows (energy savings minus additional costs) resulting from implementing a new energy code, and balances incremental costs of construction against longer-term energy savings, including consideration for costs of operations and replacements, as needed. LCC savings is a sum over an analysis period of 30 years. Future cash flows, which vary from year to year, are discounted to present values using a discount rate that accounts for the changing value of money over time. LCC savings is the primary economic metric established by DOE for assessing the cost-effectiveness of building energy codes.

Table 1 shows the LCC savings (discounted present value) over the 30-year analysis period for the 2018 IECC compared to the 2015 IECC.

[1] https://www.energycodes.gov/sites/default/files/documents/residential_methodology_2015.pdf

Table 1. Life-Cycle Cost Savings of the 2018 IECC compared to the 2015 IECC

Climate Zone	Life-Cycle Cost Savings ($)
4B	480
5B	458
6B	504
7	526
State Average	**462**

1.2 Consumer Cash Flow

The Consumer Cash Flow results are derived from the year-by-year calculations that underlie the Life-Cycle Cost savings values shown above. The specific cash flow values shown here allow an assessment of how annual cost outlays are compensated by annual energy savings and the time required for cumulative energy savings to exceed cumulative costs, including both increased mortgage payments and the down payment and other up-front costs.

Table 2 shows the per-dwelling-unit impact of the improvements in the 2018 IECC on Consumer Cash Flow compared to the 2015 IECC.

Table 2. Consumer Cash Flow from Compliance with the 2018 IECC Compared to the 2015 IECC

	Cost/Benefit	4B	5B	6B	7	State Average
A	Incremental down payment and other first costs	$7	$5	$5	$5	$5
B	Annual energy savings (year one)	$19	$18	$19	$20	$18
C	Annual mortgage increase	$2	$2	$2	$2	$2
D	Net annual cost of mortgage interest deductions, mortgage insurance, and property taxes (year one)	$0.4	$0.3	$0.3	$0.3	$0.3
E = [B-(C+D)]	Net annual cash flow savings (year one)	$17	$16	$17	$18	$16
F = [A/E]	Years to positive savings, including up-front cost impacts	1	1	1	1	1

Note: Item D includes mortgage interest deductions, mortgage insurance, and property taxes for the first year. Deductions can partially or completely offset insurance and tax costs. As such, the "net" result appears relatively small or is sometimes even negative.

1.3 Simple Payback Period

The simple payback period is a straightforward metric including only the costs and benefits directly related to the implementation of energy-saving measures associated with a code change. It represents the number of years required for the energy savings to pay for the cost of the measures, without regard for inflation, changes in fuel prices, tax effects, measure replacements, resale values, etc. The simple payback period is useful for its ease of calculation and understandability. Because it focuses on the two primary characterizations of a code change—cost and energy performance—it allows an assessment of cost effectiveness that is easy to compare with other investment options and requires a minimum of input data. DOE reports the simple payback period because it is a familiar metric used in many contexts, and because some states have expressed the desire for this metric. However, because it ignores many of the longer-term factors in the economic performance of an energy-efficiency investment, DOE does not use the payback period as a primary indicator of cost effectiveness for its own decision-making purposes.

Table 3 shows the simple payback period for the 2018 IECC. The simple payback period is calculated by dividing the incremental construction cost by the annual energy cost savings assuming time-zero fuel prices. It estimates the number of years required for the energy cost savings to pay back the incremental cost investment without consideration of financing of the initial costs through a mortgage, the favored tax treatment of mortgages, the useful lifetimes of individual efficiency measures, or future escalation of fuel prices.

Table 3. Simple Payback Period for the 2018 IECC Compared to the 2015 IECC

Climate Zone	Payback Period (Years)
4B	2.8
5B	2.0
6B	1.9
7	1.8
State Average	**2.0**

2.0 Overview of the Cost-Effectiveness Analysis Methodology

This analysis was conducted by Pacific Northwest National Laboratory (PNNL) in support of the DOE Building Energy Codes Program. DOE is directed by federal law to provide technical assistance supporting the development and implementation of residential and commercial building energy codes. The national model energy codes—the International Energy Conservation Code (IECC) and ANSI/ASHRAE/IES Standard 90.1—help adopting states and localities establish minimum requirements for energy-efficient building design and construction, as well as mitigate environmental impacts and ensure residential and commercial buildings are constructed to modern industry standards.

The current analysis evaluates the cost-effectiveness of the 2018 edition of the IECC, relative to the 2015 IECC. The analysis covers one- and two-family dwelling units, townhouses, and low-rise multifamily residential buildings covered by the residential provisions of the IECC. The analysis is based on the prescriptive requirements of the IECC. The IECC's simulated performance path (Section 405) and Energy Rating Index (ERI) path (Section 406) are not in the scope of this analysis, as they are generally based on the core prescriptive requirements of the IECC, and due to the unlimited range of building configurations that are allowed. Buildings complying via these paths are generally considered to provide equal or better energy performance compared to the prescriptive requirements, as the intent of these paths is to provide additional design flexibility and cost optimization, as dictated by the builder, designer or homeowner.

The current analysis is based on the methodology by DOE for assessing energy savings and cost-effectiveness of residential building energy codes (Taylor et al. 2015). The LCC analysis perspective described in the methodology appropriately balances upfront costs with longer term consumer costs and savings and is therefore the primary economic metric by which DOE evaluates the cost-effectiveness of building energy codes.

2.1 Estimation of Energy Usage and Savings

In order to estimate the energy impact of residential code changes, PNNL developed a single-family prototype building and a low-rise multifamily prototype building to represent typical new residential building construction (BECP 2012, Mendon et al. 2014, and Mendon et al. 2015). The key characteristics of these prototypes are:

- **Single-Family Prototype:** A two-story home with a roughly 30-ft by 40-ft rectangular shape, 2,376 ft^2 of conditioned floor area excluding the conditioned basement (if any), and window area equal to 15% of the conditioned floor area equally distributed toward the four cardinal directions.
- **Multifamily Prototype:** A three-story building with 18 dwelling units (6 units per floor), each unit having conditioned floor area of 1,200 ft^2 and window area equal to approximately 23% of the exterior wall area (not including breezeway walls) equally distributed toward the four cardinal directions.

These two building prototypes are further expanded to cover four common heating systems (natural gas furnace, heat pump, electric resistance, oil-fired furnace) and four common foundation types (slab-on-grade, heated basement, unheated basement, crawlspace), leading to an expanded set of 32 residential prototype building models. This set is used to simulate the energy usage for typical homes built to comply with the requirements of the 2018 IECC and those built to comply with the requirements of the for one location in each climate zone[1] in the state using DOE's *EnergyPlus*™ software, version 9.5 (DOE 2018). Energy savings of the 2018 IECC relative to the 2015 IECC, including space heating, space cooling, water heating, lighting and plug loads are extracted from the simulation results.

2.2 Climate Zones

Climate zones are defined in ASHRAE Standard 169, as specified in ASHRAE Standard 90.1, and include eight primary climate zones in the United States, the hottest being climate zone 1 and the coldest being climate zone 8. Letters A, B, and C are applied in some cases to denote the level of moisture, with A indicating humid, B indicating dry, and C indicating marine. Figure 3 shows the national climate zones. For this state analysis, savings are analyzed for each climate zone in the state using weather data from a selected city within the climate zone and state, or where necessary, a city in an adjoining state with more robust weather data.

[1] One location is simulated for each combination of climate zone, moisture regime (Moist, Dry, Marine) and humidity designation (Warm-Humid, Not Warm-Humid) that exists in the state.

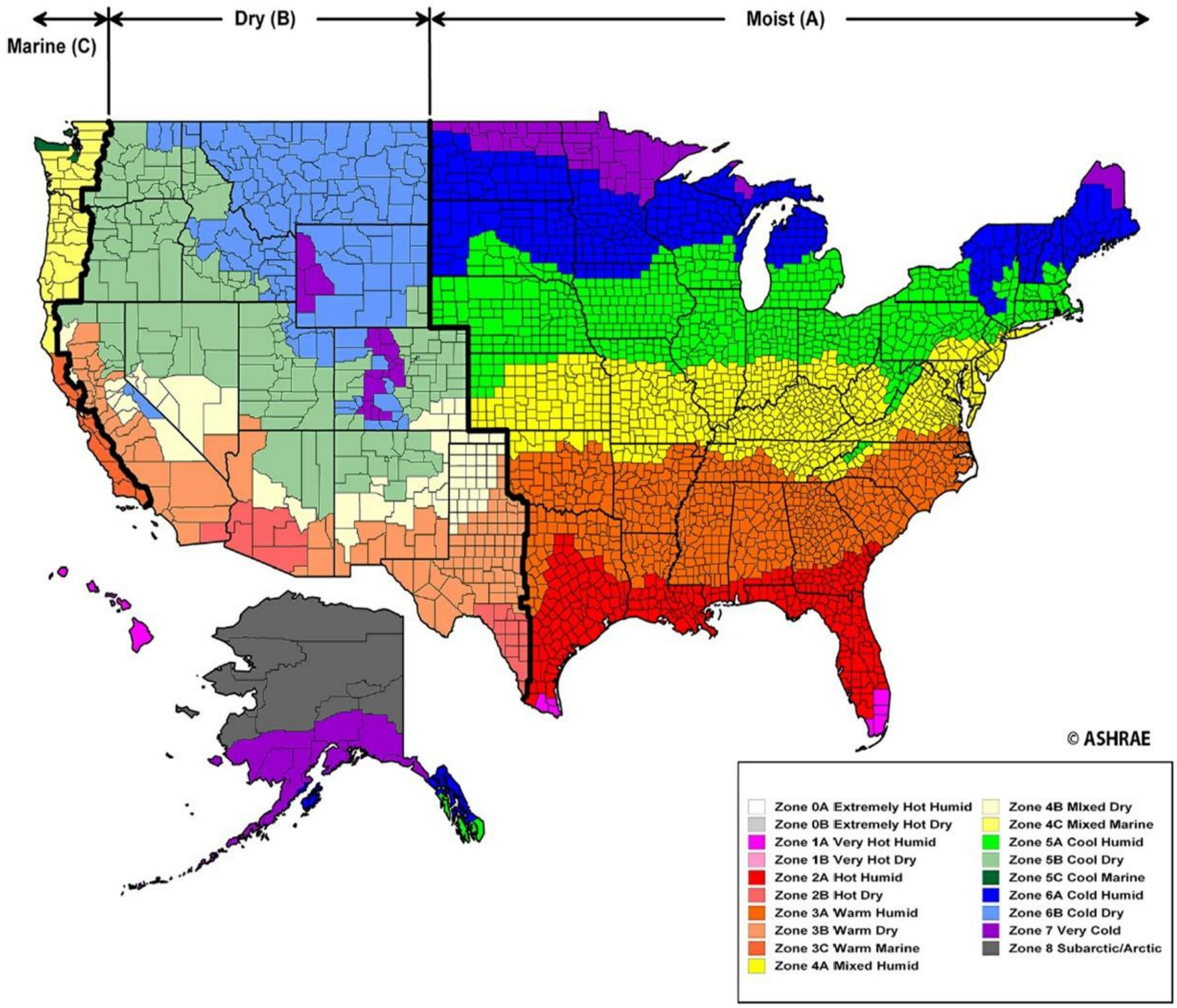

Figure 1. National Climate Zones

2.3 Fuel Prices

The energy savings from the simulation analysis are converted to energy cost savings using the most recent state-specific residential fuel prices from DOE's Energy Information Administration (EIA 2020a, EIA 2020b, EIA 2020c). The fuel prices used in the analysis are shown in Table 4.

Table 4. Fuel Prices used in the Analysis

Electricity ($/kWh)	Gas ($/Therm)	Oil ($/MBtu)
0.125	0.584	2.519

2.4 Financial and Economic Parameters

The financial and economic parameters used in calculating the LCC and annual consumer cash flow are based on the latest DOE cost-effectiveness methodology (Taylor et al. 2015) to represent the current economic scenario. The parameters are summarized in Table 5 for reference.

Table 5. Economic Parameters Used in the Analysis

Parameter	Value
Mortgage interest rate (fixed rate)	3%
Loan fees	1% of mortgage amount
Loan term	30 years
Down payment	12% of home value
Nominal discount rate (equal to mortgage rate)	3%
Inflation rate	1.4%
Marginal federal income tax	12%
Marginal state income tax	4.55%
Property tax	0.6%

2.5 Aggregation Scheme

Energy results, weighted by foundation and heating system type, are provided at the state level and separately for each climate zone within the state. The distribution of heating systems for Colorado is derived from data collected by the National Association of Home Builders data (NAHB 2009) and is summarized in Table 6. The distribution of foundation types is derived from the Residential Energy Consumption Survey data (RECS 2013) and is summarized in Table 7. The single-family and multifamily results are combined for each climate zone in the state and the climate zone results are combined to calculate a weighted average for the state using 2019 new residential construction starts from the 2010 U.S. Census data (Census 2010). The distribution of single- and multifamily building starts is summarized in Table 8.

Table 6. Heating Equipment Shares

Heating System	Share of New Homes (percent)	
	Single-Family	Multifamily
Natural Gas	80.7	80.7
Heat Pump	16.9	16.9
Electric Resistance	2.2	2.2
Oil	0.2	0.2

Table 7. Foundation Type Shares

Foundation Type	Slab-on-grade	Heated Basement	Unheated Basement	Crawlspace
Share of New Homes (percent)	30.4	26.1	8.7	34.8

Table 8. Construction Shares by Climate Zone

Climate Zone	Share of New Homes (percent)	
	Single-Family	Multifamily
4B	62.2	37.8
5B	62.2	37.8
6B	62.2	37.8
7	62.2	37.8

3.0 Incremental Construction Costs

In order to evaluate the cost-effectiveness of the changes introduced by the 2018 IECC over the 2015 IECC, PNNL estimated the incremental construction costs associated with these changes. For this analysis, cost data sources consulted by PNNL include:

- Building Component Cost Community (BC3) data repository (DOE 2012)
- Construction cost data collected by Faithful+Gould under contract with PNNL (Faithful + Gould 2012)
- RS Means Residential Cost Data (RSMeans 2020)
- National Residential Efficiency Measures Database (NREL 2014)
- Price data from nationally recognized home supply stores

The consumer price index (CPI) is used to adjust cost data from earlier years to the study year (U.S. Inflation Calculator 2018).

The estimated costs of implementing the prescriptive provisions of the 2018 IECC over the 2015 IECC are taken from earlier PNNL studies that evaluated the cost-effectiveness (Lucas et al. 2012), (Mendon et.al. 2015) and (Taylor et al. 2019). The national scope costs from those studies are adjusted to reflect local construction costs in using location factors provided by RSMeans (2020). The incremental costs of implementing the provisions of the 2021 IECC over the 2018 IECC are described in National Cost Effectiveness of the Residential Provisions of the 2021 IECC (Salcido et al. 2021).

Table 9 and Table 10 show the incremental construction costs associated with the 2018 IECC compared to the 2015 IECC for an individual dwelling unit. Table 9 shows results for a house and Table 10 shows results for an apartment or condominium. These have been adjusted using a construction cost multiplier, 0.9715, to reflect local construction costs based on location factors provided by RSMeans (2020).

Table 9. Total Single-Family Construction Cost Increase for the 2018 IECC Compared to the 2015 IECC ($)

Single-family Prototype House				
Climate Zone	**Crawlspace**	**Heated Basement**	**Slab**	**Unheated Basement**
4B	$71	$71	$71	$71
5B	$48	$48	$48	$48
6B	$48	$48	$48	$48
7	$48	$48	$48	$48

Table 10. Total Multifamily Construction Cost Increase for the 2018 IECC Compared to the 2015 IECC ($)[1]

Multifamily Prototype Apartment/Condo				
Climate Zone	**Crawlspace**	**Heated Basement**	**Slab**	**Unheated Basement**
4B	$24	$24	$24	$24
5B	$16	$16	$16	$16
6B	$16	$16	$16	$16
7	$16	$16	$16	$16

[1] In the multifamily prototype model, the heated basement is added to the building, and not to the individual apartments. The incremental cost associated with heated basements is divided among all apartments equally.

4.0 Energy Cost Savings

Table 11 and Table 12 show the estimated the annual per-dwelling unit energy costs of end uses regulated by the IECC as well as miscellaneous end use loads, which comprise heating, cooling, water heating, lighting, fans, mechanical ventilation and plug loads that result from meeting the requirements of the 2018 IECC and the 2015 IECC

Table 11. Annual (First Year) Energy Costs for the 2015 IECC

Climate Zone	2015 IECC						
	Heating	Cooling	Water Heating	Lighting	Fans	Vents	Total
4B	$284	$200	$149	$172	$96	$43	$1,783
5B	$315	$169	$156	$172	$117	$43	$1,809
6B	$388	$126	$170	$172	$106	$43	$1,843
7	$448	$102	$179	$172	$100	$43	$1,883
State Average	**$320**	**$166**	**$157**	**$172**	**$116**	**$43**	**$1,812**

Table 12. Annual (First Year) Energy Costs for the 2018 IECC

Climate Zone	2018 IECC						
	Heating	Cooling	Water Heating	Lighting	Fans	Vents	Total
4B	$276	$201	$149	$161	$96	$43	$1,764
5B	$309	$169	$156	$161	$116	$43	$1,792
6B	$380	$127	$170	$161	$106	$43	$1,825
7	$440	$103	$179	$161	$100	$43	$1,864
State Average	**$314**	**$167**	**$157**	**$161**	**$115**	**$43**	**$1,795**

Table 13 shows the first-year energy cost savings as both a net dollar savings and as a percentage of the total regulated end use energy costs. Results are weighted by single- and multifamily housing starts, foundation type, and heating system type.

Table 13. Total Energy Cost Savings (First Year) for the 2018 IECC Compared to the 2015 IECC

Climate Zone	First Year Energy Cost Savings	First Year Energy Cost Savings (percent)
4B	$19	1.1%
5B	$17	1.0%
6B	$19	1.0%
7	$19	1.0%
State Average	**$17**	**1.0%**

5.0 Societal Benefits

5.1 Benefits of Energy Codes

It is estimated that by 2060, the world will add 2.5 trillion square feet of buildings, an area equal to the current building stock. As a building's operation and environmental impact is largely determined by upfront decisions, energy codes present a unique opportunity to assure savings through efficient building design, technologies, and construction practices. Once a building is constructed, it is significantly more expensive to achieve higher efficiency levels through later modifications and retrofits. Energy codes ensure that a building's energy use is included as a fundamental part of the design and construction process; making this early investment in energy efficiency will pay dividends to residents of Colorado for years into the future.

5.2 Greenhouse Gas Emissions

The urban built environment is responsible for 75% of annual global greenhouse gas (GHG) emissions while buildings alone account for 39%.[1] On January 20, 2018, President Biden issued Executive Order (E.O.) 13990,[2] which noted that it is essential that agencies capture the full costs of greenhouse gas emissions as accurately as possible, including by taking global damages into account and that doing so facilitates sound decision-making, recognizes the breadth of climate impacts, and supports the international leadership of the United States on climate issues.

While carbon dioxide emissions represent the largest share of greenhouse gas emissions, building electricity use and fossil fuel consumption on site also contribute to the release of other emissions, two of which, methane (CH_4) and nitrous oxide (N_2O) are significant greenhouse gases in their own right.

For natural gas and for fuel oil combusted on site, emission metrics are developed using nationwide emission factors from U.S. Environmental Protection Agency publications for CO_2, NOx, SO_2, CH_4 and N_2O (EPA 2014). For electricity, marginal carbon emission factors are provided by the U.S. Environmental Protection Agency (EPA) AVoided Emissions and GeneRation Tool (AVERT) version 3.0 (EPA 2020). The AVERT tool forms the basis of the national marginal emission factors for electricity also published by EPA on its Greenhouse Gas Equivalencies Calculator website and are based on a portfolio of energy efficiency measures examined by EPA. AVERT is used here to provide marginal CO_2 emission factors at the State level.[3] AVERT also provides marginal emission factor estimates for gaseous pollutants

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[1] Architecture 2030

[2] Exec. Order No. 13990, 86 Fed. Reg. 7037 (January 20, 2018) <https://www.federalregister.gov/documents/2018/01/25/2018-01765/protecting-public-health-and-the-environment-and-restoring-science-to-tackle-the-climate-crisis>

[3] AVERT models avoided emissions in 14 geographic regions of the 48 contiguous United States and includes transmission and distribution losses. Where multiple AVERT regions overlap a state's boundaries, the emission factors are calculated based on apportionment of state electricity savings by generation across generation regions. The most recent AVERT 3.0 model uses EPA emissions data for generators from 2019. Note that AVERT estimates are based on marginal changes to demand and reflect current grid generation mix. Emission factors for electricity shown in Table 14 do not take into account long term policy or technological changes in the regional generation mix that can impact the marginal emission benefits from new building codes.

associated with electricity production, including NOx and SO_2 emissions. While not considered significant greenhouse gases, these are EPA tracked pollutants. The current analysis uses AVERT to provide estimates of corresponding emission changes for NOx and SO_2 in physical units but does not monetize these.

AVERT does not develop associated marginal emissions factors for CH_4 or N_2O. To provide estimates for the associated emission reductions for CH_4 and N_2O, this report uses emission factors separately provided through the U.S. Environmental Protection Agency (EPA) Emissions & Generation Resource Integrated Database (eGRID) dataset. eGRID is a comprehensive source of data on the environmental characteristics of almost all electric power generated in the United States and the emission characteristics for electric power generation for each of the above emissions can also be found aggregated down to the state level in eGRID (EPA 2018a). The summary emission factor data provided by eGRID does not provide marginal emission factors, but instead summarizes emission factors in terms of total generation emission factors and non-baseload generation emission factors. Non-baseload emission factors established in eGRID are developed based on the annual load factors for the individual generators tracked by the EPA (EPA 2018b). Because changes in building codes are unlikely to significantly impact baseload electrical generators, the current analysis uses the 2019 non-baseload emission factors established in eGRID by state to estimate CH_4 or N_2O emission reductions due to changes in electric consumption.

Table 14 summarizes the marginal carbon emission factors available from AVERT, eGRID and the EPA Greenhouse Gas Equivalencies Calculator.

Table 14. Greenhouse Gas Emission Factors for Colorado by Fuel Type

GHG	Electricity lb/MWh	Natural Gas (lb/mmcf)	Fuel Oil (lb/1000 gal)
CO_2	1,883	120,000	23,000
SO_2	0.571	0.6	12
NO_X	1.041	96	19
N_2O	0.022	0.23	0.45
CH_4	0.133	2.3	0.7

Table 15 shows the annual first year and projected 30-year energy cost savings. This table also shows first year and projected 30-year greenhouse gas (CO_2, CH_4, and N_2O) emission reductions, in addition to NOx and SO_2 reductions.[1]

[1] 30-year cumulative savings are conducted using the same approach as outlined in the PNNL Report: Impacts of Model Building Energy Codes – Interim Update. https://www.energycodes.gov/sites/default/files/2021-07/Impacts_of_Model_Energy_Codes_2010-2040_Interim_Update_07182021.pdf

Table 15. Societal Benefits of the 2018 IECC

Statewide Impact	First Year	30 Years Cumulative
Energy cost savings, $	528,100	184,070,000
CO_2 emission reduction, Metric tons	4,570	2,227,500
CH_4 emissions reductions, Metric tons	0.25	122
N_2O emissions reductions, Metric tons	0.035	17
NOx emissions reductions, Metric tons	2.8	1,368
SOx emissions reductions, Metric tons	1.0	509

5.3 Jobs Creation through Energy Efficiency

Energy-efficient building codes impact job creation through two primary value streams:

1. Dollars returned to the economy through reduction in utility bills and resulting increase in disposable income, and;
2. An increase in construction-related activities associated with the incremental cost of construction that is required to produce a more energy efficient building.

When a home or building is built to a more stringent energy code, there is the long-term benefit of the home or building owner paying lower utility bills.

- This is partially offset by the increased cost of that efficiency, establishing a relationship between increased building energy efficiency and additional investments in construction activity.
- Since building codes are cost effective, (i.e., the savings outweigh the investment), a real and permanent increase in wealth occurs which can be spent on other goods and services in the economy, just like any other income, generating economic benefits in turn creating additional employment opportunities.

Table 16 also shows the number of jobs created because of efficiency gains in the 2018 IECC. Results are weighted by single- and multifamily housing starts, foundation type, and heating system type.

Table 16. Jobs Created from the 2018 IECC

Statewide Impact	First Year	30 Years Cumulative
Jobs Created -- Reduction in Utility Bills	2	820
Jobs Created -- Construction Related Activities	9	251

6.0 References

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Pacific Northwest National Laboratory

902 Battelle Boulevard
P.O. Box 999
Richland, WA 99354
1-888-375-PNNL (7665)

www.pnnl.gov