BOARD OF ALDERMEN
Work Session Agenda
CITY OF PARKVILLE, MISSOURI
Tuesday, May 2, 2023 6:00 PM
City Hall Board Room

1. GENERAL AGENDA

A. 2021 International Energy Conservation Code and Designated Appendices to 2018 International Family of Building Codes (Community Development)

2. ADJOURN

Posted Date & Time: 4/28/23; 1:15 p.m. By: MM

CITY OF PARKVILLE
Policy Report

Date: April 26, 2023

Prepared By:
Stephen Lachky, Community Development Director

Reviewed By:
Alexa Barton, City Administrator

ISSUE:
2021 International Energy Conservation Code and Designated Appendices to 2018 International Family of Building Codes (Community Development)

BACKGROUND:
The International Building Code (IBC) is a model building code developed by the International Code Council (ICC) and has been adopted for use as a base code standards by most jurisdictions in the United States. ICC updates the IBC on a three-year schedule after extensive research, development and review by code enforcement officials, industry representatives and design professionals; and most jurisdictions update their building codes on a six-year schedule. The purpose of building codes are to protect public health, safety and general welfare as they relate to the construction and occupancy of buildings and structures. On January 7, 2020 the Board of Aldermen approved Ordinance No. 3027 adopting the 2018 International Family of Building Codes and designated appendices (as amended), following six months of information discussions with area builders and developers; and after being publicly displayed and made available for the required minimum 90-day public comment period.

On September 21, 2021, the Board of Aldermen approved Resolution No. 21-010 endorsing the KC Regional Climate Action Plan, a voluntary, flexible and collaborative framework to help mitigate climate change by achieving net zero greenhouse gas emissions by 2050. Other jurisdictions, such as the City of Kansas City, Mo. (KCMO), have also endorsed the plan; as well as committing to become climate neutral by 2040 and establishing their own goals for greenhouse gas emission reductions via the adoption of modern building codes. Earlier this year, KMCO began looking at adopting the 2021 International Energy Conservation Code (IECC) as an instrumental way to achieve this goal.

Throughout 2022, KCMO held a series of meetings and discussions regarding the 2021 IECC with their Neighborhood Planning and Development Committee. This included hearing testimony from area builders, developers, the Greater Kansas City Homebuilders Association, and Spire Energy. On October 13, 2022, following six months of meetings and discussions, KCMO's City Council passed Ordinance No. 220364 adopting the 2021 IECC as an amendment to their existing 2018 Building Codes. In doing so, KCMO became the first city in the nation to adopt the 2021 IECC. It should be noted that local amendments were included, and KCMO did NOT adopt the Zero Energy Commercial Building Provisions (but will allow them if builders want to voluntarily).

Earlier this year, Ed Gault (Building Official, City of Parkville) attended a workshop training on the 2021 IECC. From discussions with other Building Official around the Kansas City metropolitan region, the majority of jurisdictions around the Kansas City metropolitan region have no plans to adopt the

2021 IECC; rather, they have interest in reviewing and adopting the 2024 IECC alongside the 2024 IBC per their six-year schedule of updating the building codes. Stephen Lachky (Community Development Director) reached out to a group of Community Development Directors around the region, and the following jurisdictions plan to skip adoption of the 2021 IECC, but look at adopting the 2024 IECC alongside the 2024 IBC:

- City of Belton, Mo.
- City of Independence, Mo.
- Johnson County, Kan.
- Lenexa, Kan.

The following states have adopted the 2021 IECC in some form or another, or have plans for adoption in 2023:

- California
- Colorado
- Connecticut
- Illinois
- Louisiana
- Montana
- Massachusetts
- Nevada
- New Jersey
- Oregon
- Vermont
- Washington

It should be noted that the State of Missouri has not adopted the 2021 IECC, and legislation (ex: HB 580) has been proposed to limit the regulation of construction standards pertaining to the 2021 IECC.

<u>NEXT STEPS:</u>
If the Board of Aldermen is interested in pursuing adoption of the 2021 International Energy Conservation Code (IECC), staff would like to solicit feedback from area builders and developers, much like we did throughout 2019 prior to the adoption of the 2018 IBC. Additionally, any proposed amendments would be publicly-displayed at Parkville City Hall for public comment for at least 90 days.

<u>BUDGET IMPACT</u>:
The only budgetary impact would be required codification and enforcement, as building permit fees are currently established according to the 2018 IBC. Adoption of the 2021 IECC would have little-to-no impact on the Community Development Department’s daily operations, as compliance with the 2021 IECC is done via registered third-party inspectors.

<u>ALTERNATIVES</u>:

1. Receive information regarding the 2021 IECC and next steps for adoption.
2. Provide feedback to staff regarding the 2021 IECC and next steps for adoption.

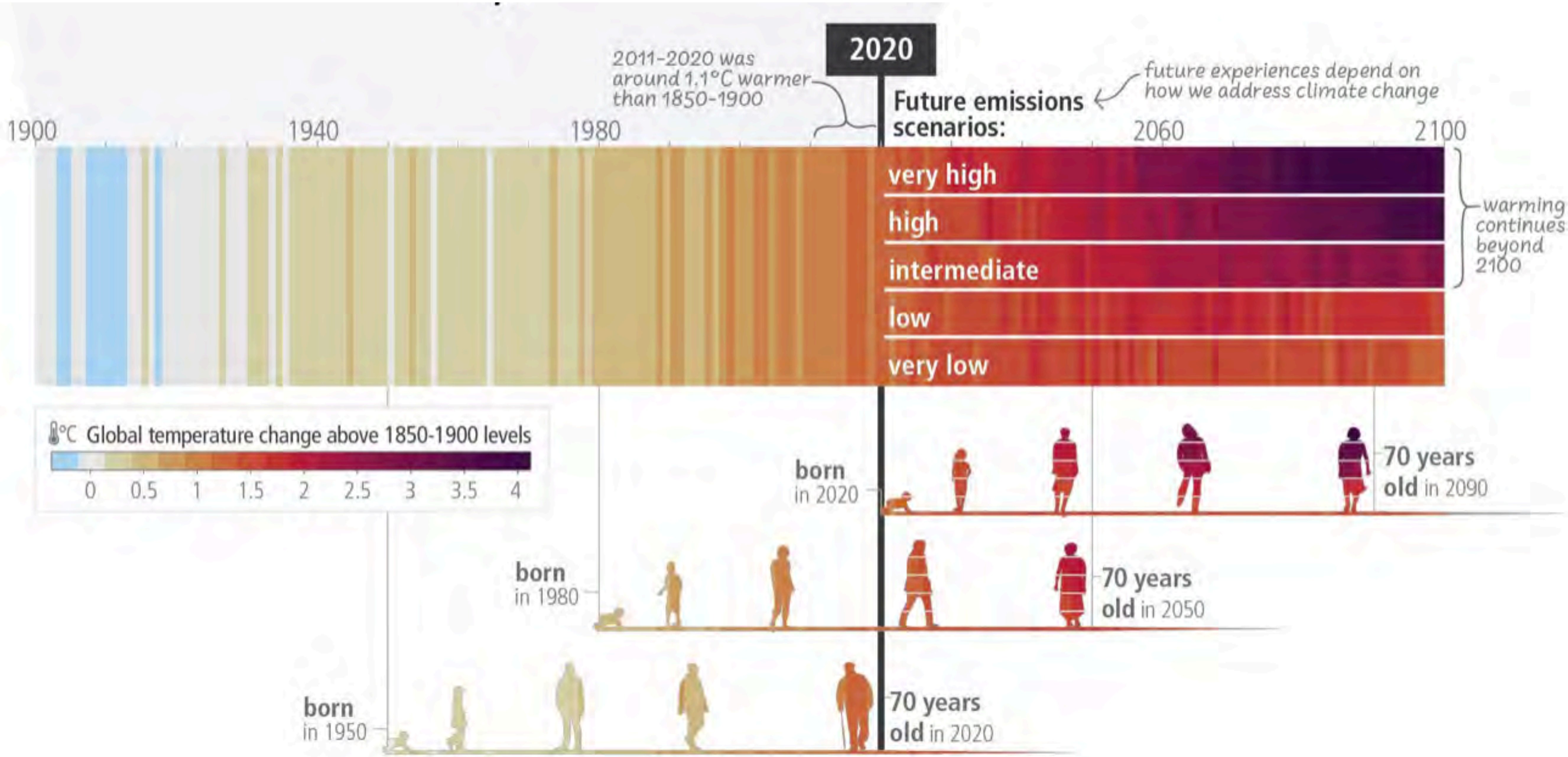
3. Have staff conduct additional research.

STAFF RECOMMENDATION:
Staff recommends the Board of Aldermen receive information regarding the 2021 IECC and provide feedback to staff regarding next steps for adoption.

ATTACHMENTS:
1. IPCC Report Infographic
2. Resolution No. 21-010
3. MARC Climate Action Plan Summary
4. Presentation
5. Cost-Effectiveness for Residential Buildings
6. IECC Consumer Impact

“The extent to which current and future generations will experience a hotter and different world depends on choices now and in the near-term”

IPCC Report 2023



Parkville
Missouri

CITY OF PARKVILLE • 8880 Clark Avenue • Parkville, MO 64152 • (816) 741-7676 • FAX (816) 741-0013

CITY OF PARKVILLE, MO.
RESOLUTION No. 21-010

A RESOLUTION ENDORSING THE REGIONAL CLIMATE ACTION PLAN

WHEREAS, Climate Action KC (CAKC) is a regional non-profit formed to promote strategies and solutions that drawdown greenhouse emissions and promotion economic opportunity and quality of life; and

WHEREAS, the Mid-America Regional Council (MARC) is a non-profit association of city and county governments and the metropolitan planning organization for the bi-state Kansas City region; and

WHEREAS, CAKC and MARC partnered together to complete a Regional Climate Action Plan containing a regional emissions inventory and climate risk and vulnerability assessment; and

WHEREAS, the Climate Action Plan creates a voluntary framework to guide and align local action in ways that make a difference for the entire Kansas City region; and

WHEREAS, the Climate Action Plan contains a comprehensive set of goals and strategies that can be tailored to meet local community needs and priorities; and

WHEREAS, the strategies in the Climate Action Plan build stronger, healthier, more vibrant and economically vital communities; and

WHEREAS, the Climate Action Plan serves 10 counties, 123 municipalities in two states, with a population of 2.14 million. In Kansas, these include Douglas, Johnson, Leavenworth, Miami and Wyandotte counties; in Missouri, these include Cass, Clay, Jackson, Platte and Ray counties; and

WHEREAS, over 1,000 regional residents participated in the planning, prioritization and drafting of the Climate Action Plan; and

WHEREAS, success will only be achieved if there is equitable access to the benefits among the entire population of the metropolitan area without regard to race, gender, ethnicity, religion, nationality, sexual orientation, income, age, disability or any other classification;

NOW, THEREFORE, BE IT RESOLVED that the Board of Aldermen hereby endorses the KC Regional Climate Action Plan; and

BE IT FURTHER RESOLVED to review and implement, as appropriate, the solutions and strategies enumerated therein.

IN TESTIMONY WHEREOF, I have hereunto set my hand, in the City of Parkville this 21st day of September 2021.

Mayor Nanette K. Johnston

ATTESTED:

SEAL OF THE CITY OF PARKVILLE
PLATTE COUNTY MISSOURI

City Clerk Melissa McChesney

Regional
CLIMATE ACTION PLAN

MARC
MID-AMERICA REGIONAL COUNCIL

CLIMATE ACTION KC

Regional
CLIMATE ACTION PLAN

https://kcmetroclimateplan.org

Net Zero Kansas City Region by 2050

The Kansas City Regional Climate Action Plan (CAP) aims to transform the metropolitan area into a more resilient, equitable and healthy community. An ambitious set of interrelated strategies will help to mitigate climate change by achieving net zero greenhouse gas emissions by 2050, and adapt to and bounce forward from the many risks climate change poses. Linkages among plan strategies are abundant and intentional.

Our plan is ambitious, comprehensive and urgent.

It creates a new platform to build on, accelerate and scale up existing efforts through new models of collaborative regional leadership. Resilience-focused investment will catalyze long-term prosperity and health.

Interim net zero goals focus on local government operations (by 2030), energy generation (by 2035), and homes and buildings (by 2040).

DOWNLOAD THE PLAN

DOWNLOAD THE EXECUTIVE SUMMARY

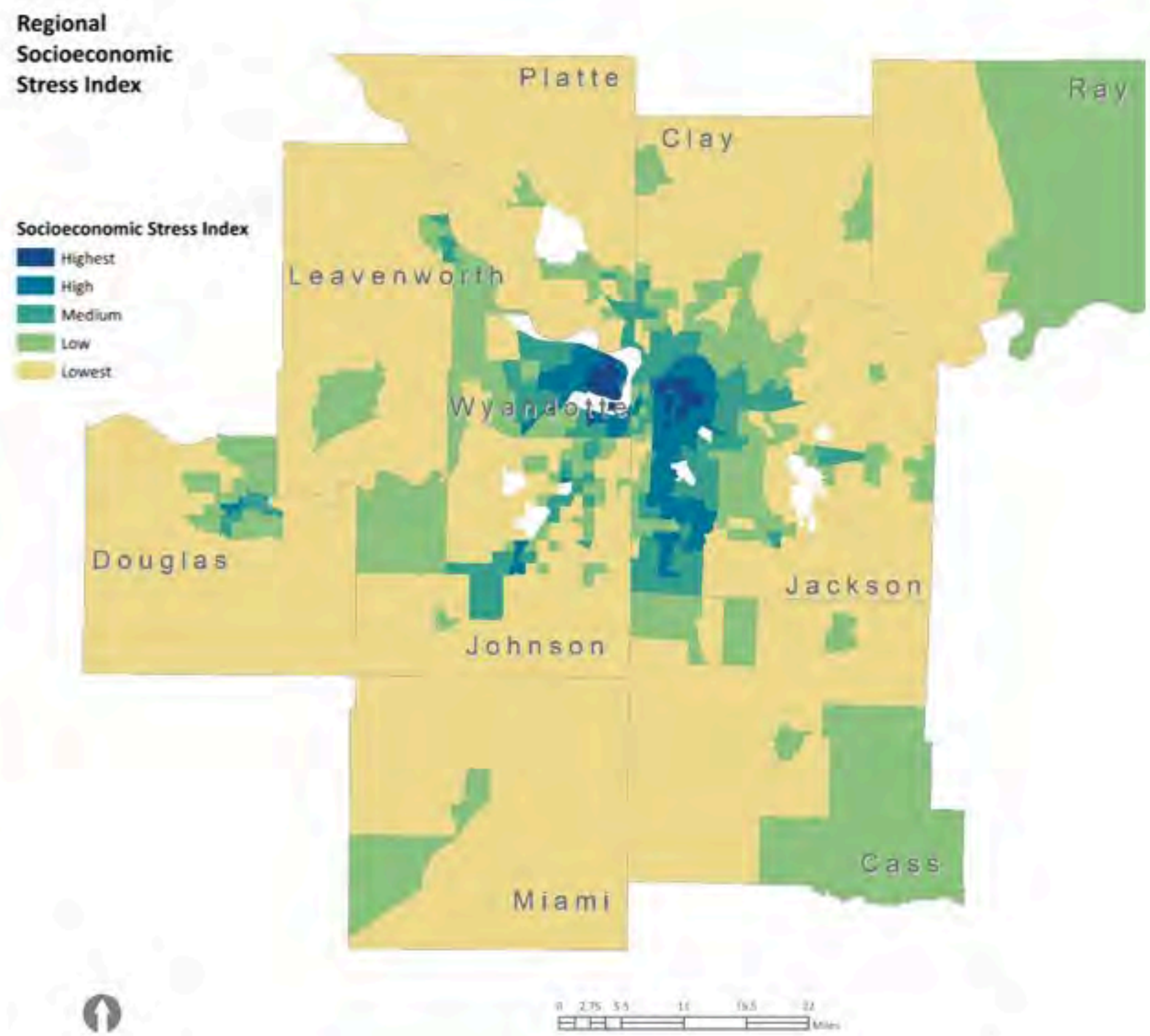
DOWNLOAD THE EQUITY GUIDE

3. Solutions must match the scale of the challenge.

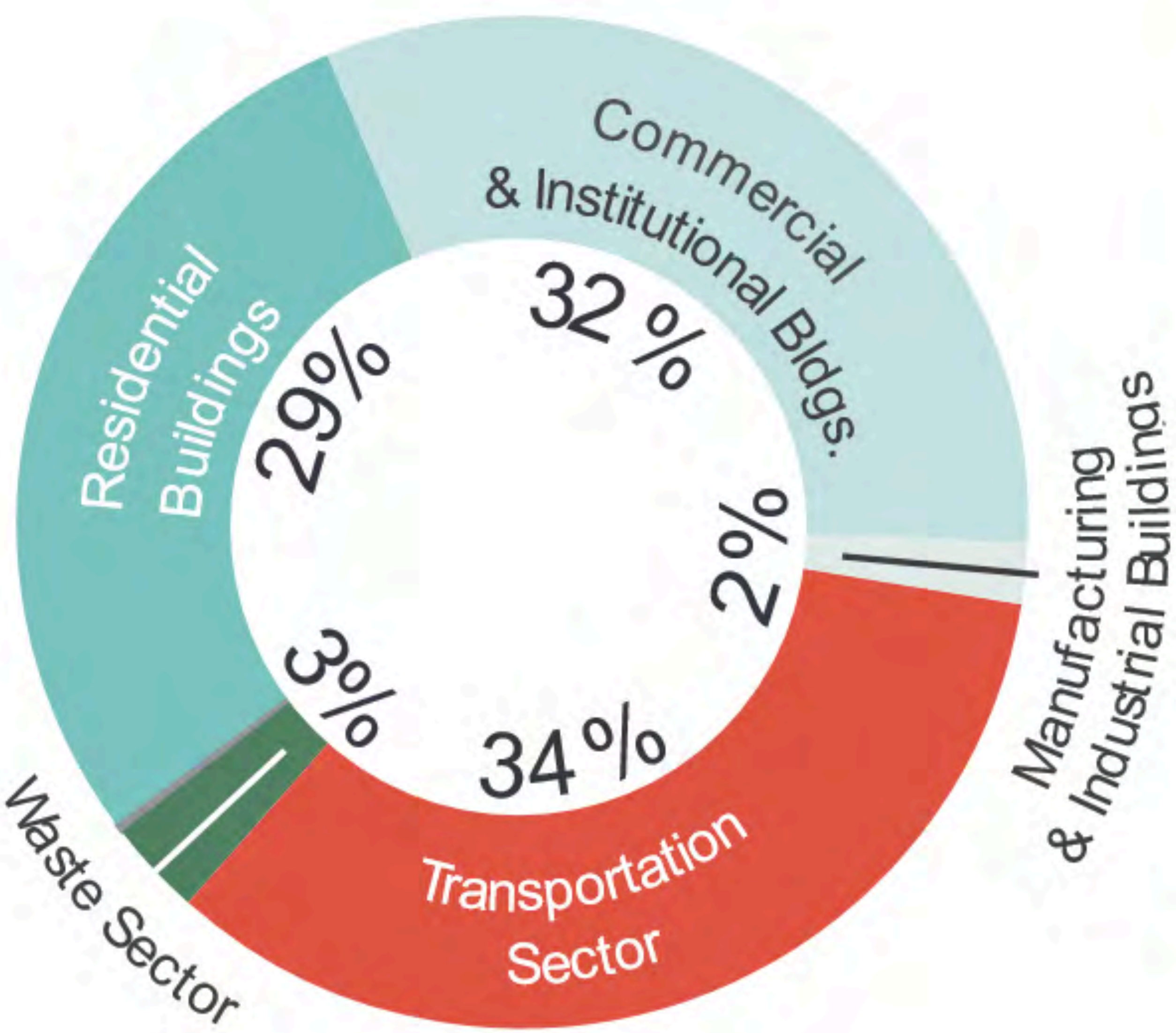
Climate Risk & Vulnerability

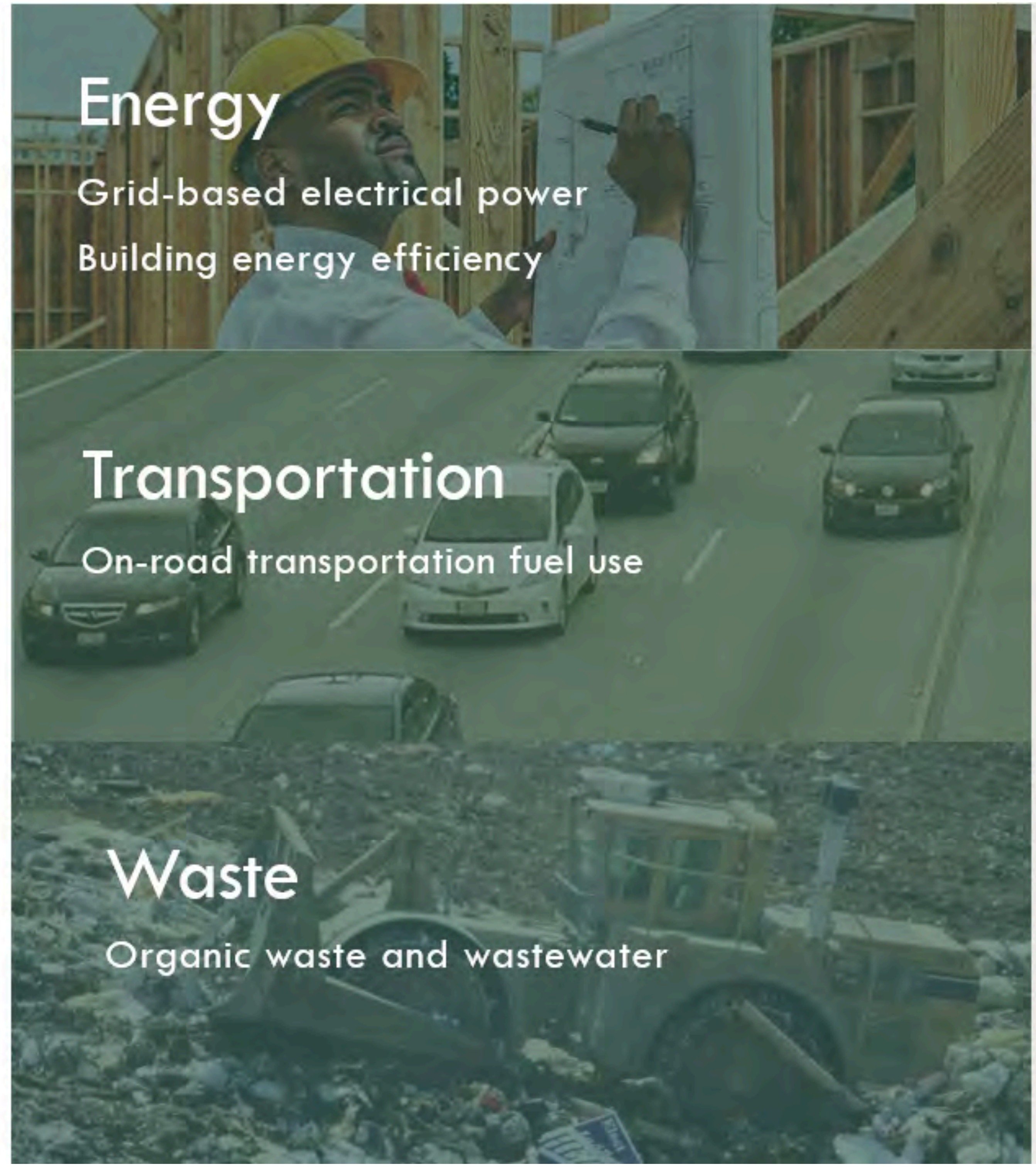
Risk Matrix

Hazard	Probability	Consequence
Flooding ⚠	High	High
Extreme heat ⚠	High	High
Drought ⚠	High	High
Severe storms	High	Moderate
Tornados	Moderate	High
Severe winter storms	Moderate	Moderate



GHG Inventory



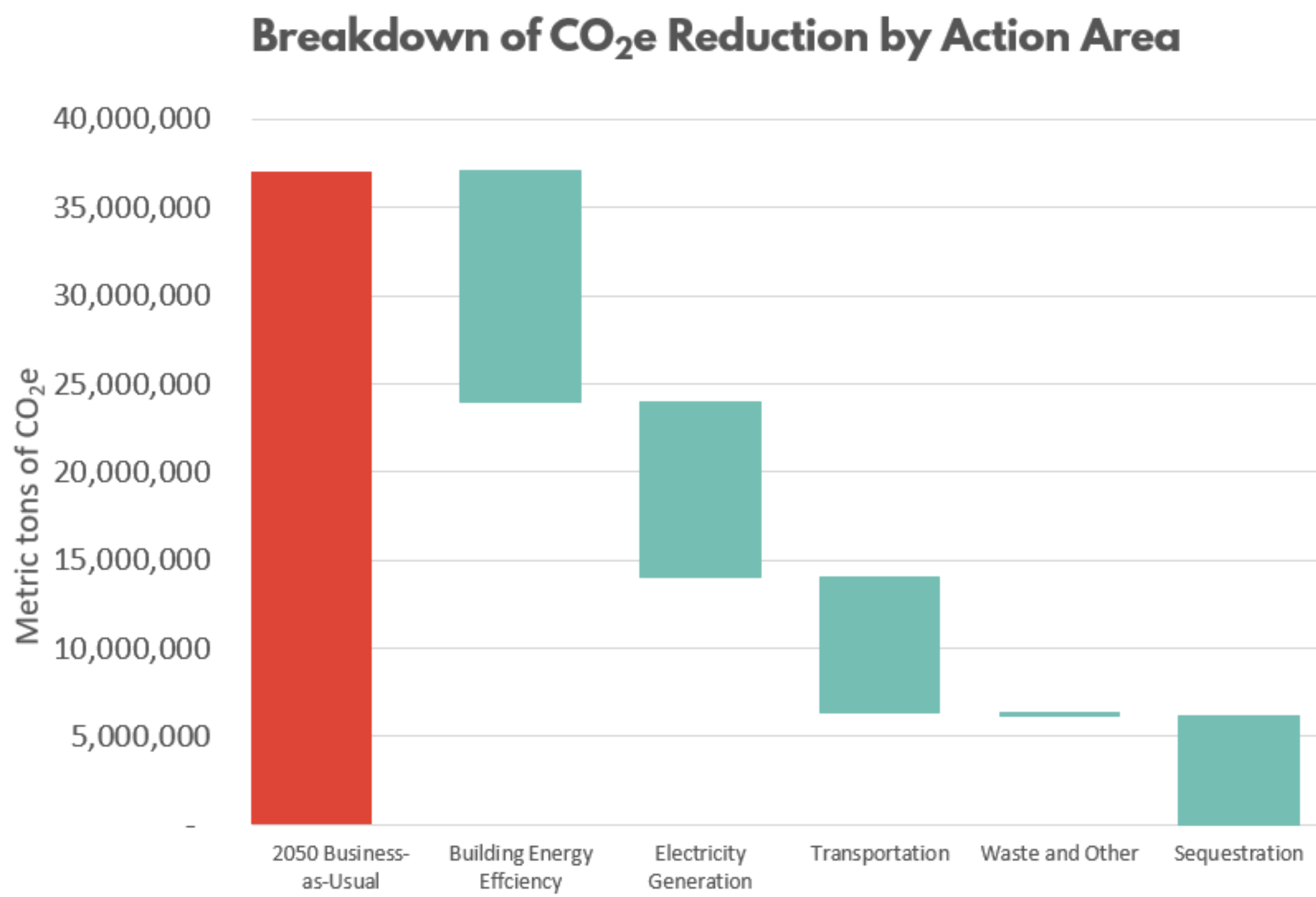


GHG Mitigation

- <u>37 million metric tons</u> of CO_2E must be reduced by 2050.

- Actions in the energy, transportation, and waste sectors reduce GHG by 83%.

- Sequestration will offset remaining emissions.




Action Areas
Collaboration & Leadership
Innovation & Finance
Community Resilience
Urban Greening
Renewable Energy
Energy Efficiency
Transportation & Land Use
Industry & Resource Management
Food & Agriculture

Regional
CLIMATE ACTION PLAN

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MARC
MID-AMERICA REGIONAL COUNCIL

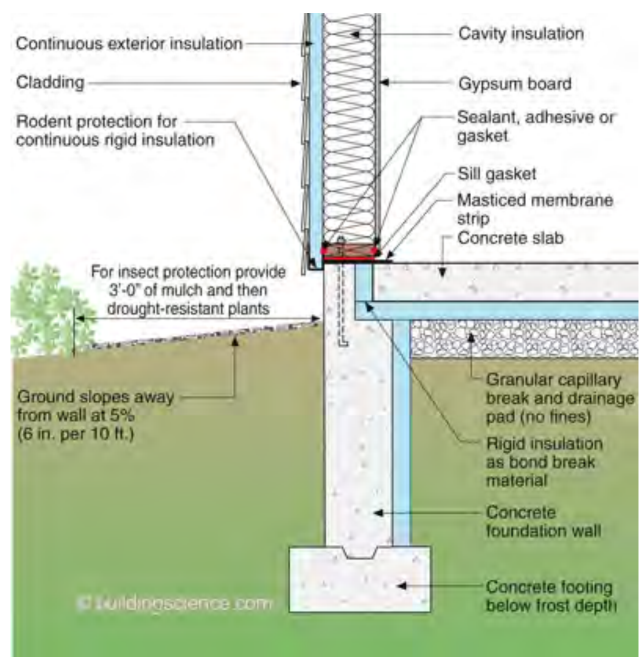
CLIMATE ACTION KC

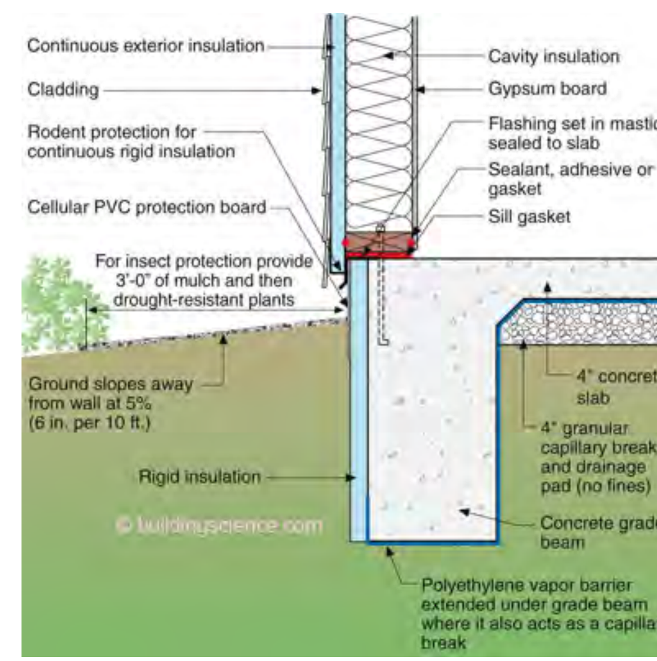
2021 International Energy Efficiency Codes


RESIDENTIAL
UPDATES

Envelope Changes

	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	GLAZED FENESTRATION SHGC	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE	FLOOR R-VALUE	BASEMENT WALL R-VALUE	SLAB R-VALUE + DEPTH	CRAWL SPACE WALL R-VALUE
2018 IECC	0.32	0.55	0.40	49	20 or 13+5h	8/13	19	10/13	10, 2 ft	10/13
2021 IECC	0.32	0.55	0.40	60	20&5 or 13&10h or 0&15h	8/13	19	10ci/13	10ci, 2 ft	10ci/13

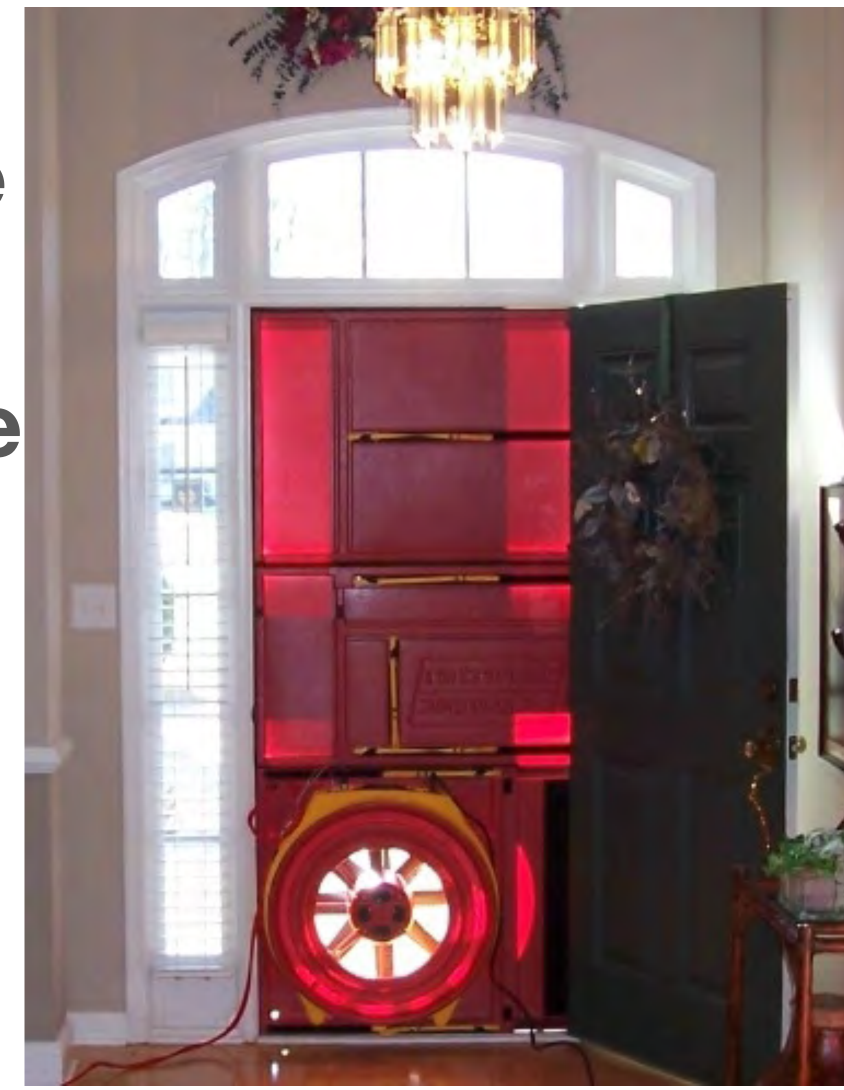




Builders have flexibility in how to meet R-value standards!

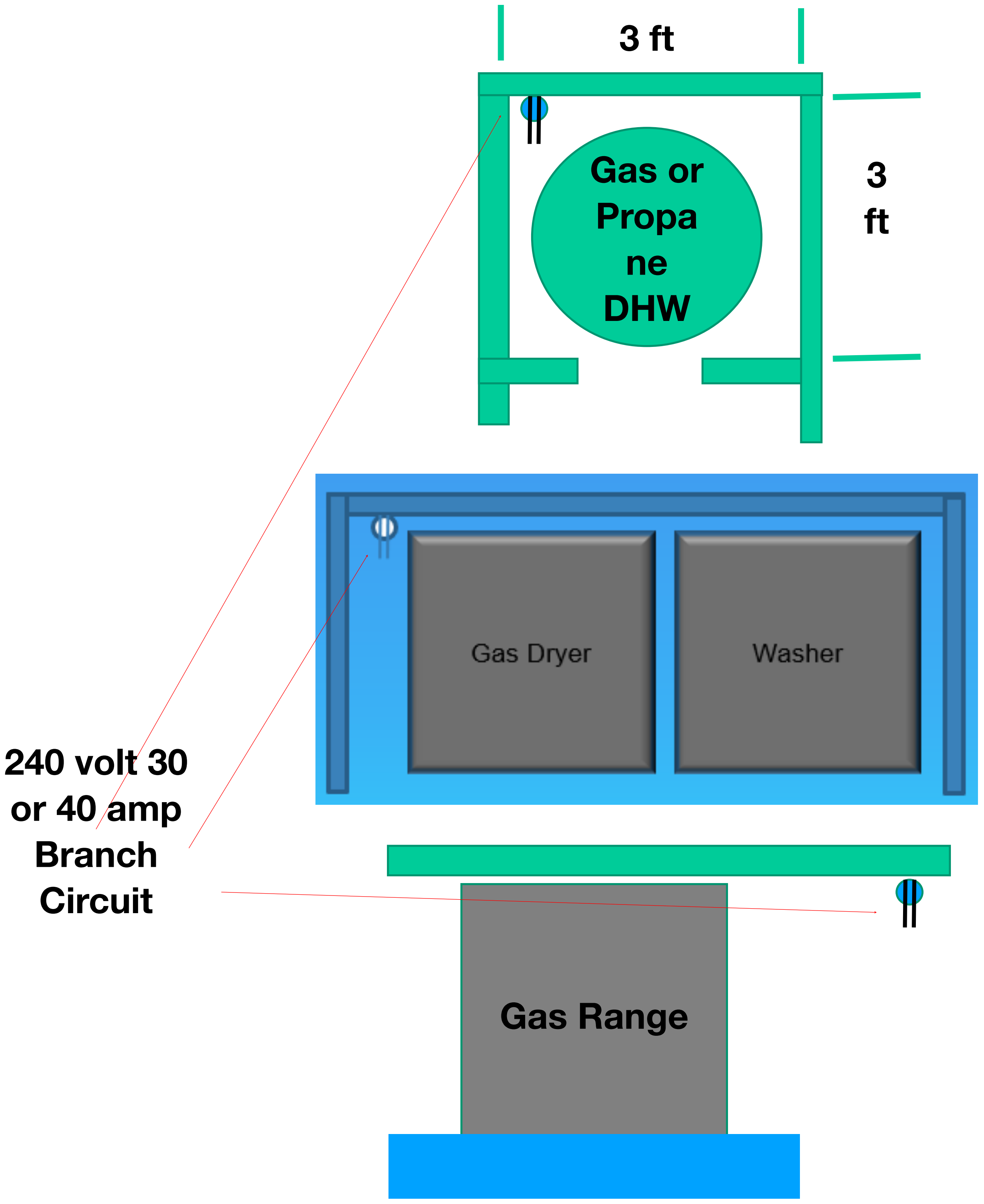
Leakage

- Testing is mandatory
- The building or dwelling unit shall be tested for air leakage.
- Max leakage rate for any compliance path </ 5.0 ACH (ERI, performance)
- Leakage rate is added and prescriptive
- </5.0 ACH in CZ 1-2
- </3.0 ACH in CZ 3-8



Electrification Readiness

- Dedicated electrical receptacle within 3 feet of gas appliances
- Provide space in electrical panel labeled SPARE
- Single pole circuit breaker labeled w/ Future 240V Use
- Water heater space min of 3 ft. X 3 ft. X 7ft.



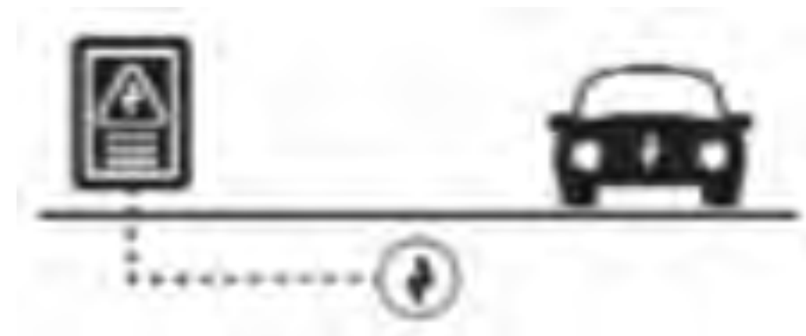
COMMERCIAL UPDATES

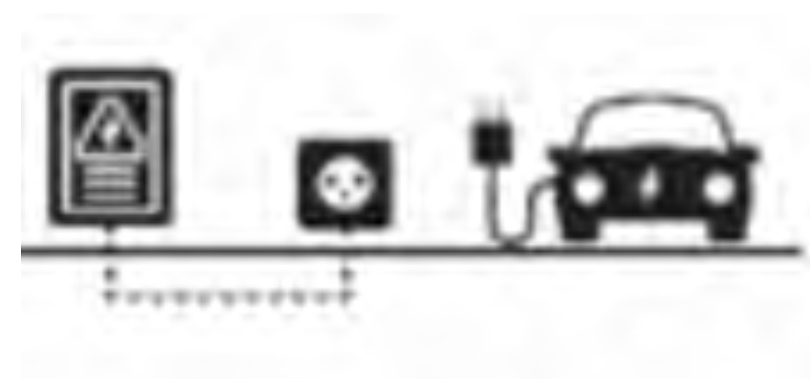
Commercial

- Energy Improvement, 10% Savings
- Building Enclosure Changes
- Lighting Improvements
- Flexibility for Builders to Comply
- EV Infrastructure
- Solar Ready Appendix includes Storage Readiness
- Electrification Ready
- Zero Code Appendix

Electrification and Readiness

- EV Ready and Capable for commercial buildings
- Solar Ready Appendix includes Storage Readiness
- Electrification Readiness






ZERØCODE™

ZERO CODE™

Commercial • Institutional • Mid-Rise/High-Rise Residential Buildings

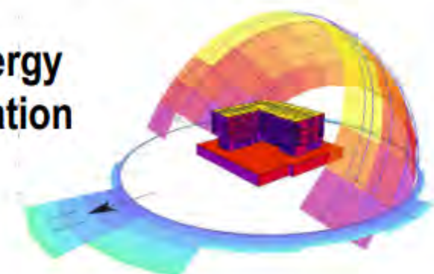
1

Design an energy efficient building in compliance with the 2021 IECC *or better*.

2

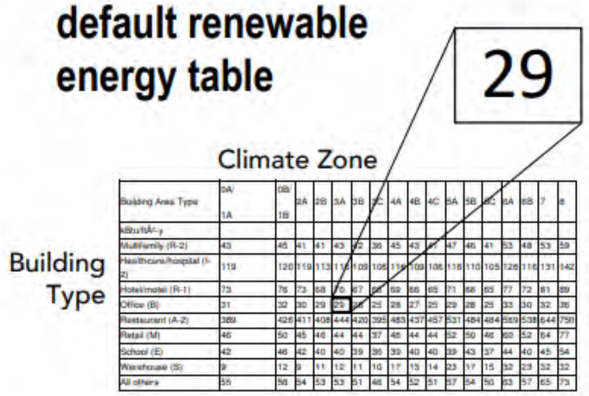
Establish the building's renewable energy requirement from:

an energy simulation



or

default renewable energy table



3

Meet the requirement by integrating onsite renewable energy when feasible.

4

If necessary, procure offsite renewable energy.

Source: Architecture 2030
Graphic adaptations: Sefaira; DOE, Green Ideas


Questions

Pacific Northwest
NATIONAL LABORATORY

PNNL-31607

Cost-Effectiveness of the 2021 IECC for Residential Buildings in Missouri

July 2021

Victor R Salcido
Yan Chen
YuLong Xie
Zachary T Taylor

U.S. DEPARTMENT OF ENERGY

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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PNNL-31607

Cost-Effectiveness of the 2021 IECC for Residential Buildings in Missouri

July 2021

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Zachary T Taylor

Prepared for
the U.S. Department of Energy
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Pacific Northwest National Laboratory
Richland, Washington 99354

Highlights

The 2021 IECC provides cost-effective levels of energy efficiency and performance for residential buildings in Missouri

Moving to the 2021 International Energy Conservation Code (IECC) is cost-effective for both single-family and low-rise multifamily residential buildings in Missouri. The 2021 IECC will provide statewide energy savings of 26% across all climate zones compared to the current state energy code. This equates to $ 657 of annual utility bill savings for the average Missouri household. It will reduce statewide CO_2 emissions over 30 years by 13,710,000 metric tons, equivalent to the annual CO_2 emissions of 2,981,000 cars on the road (1 MMT CO_2 = 217,480 cars driven/year). Updating the state energy code based on the 2021 IECC will also stimulate the creation of high-quality jobs across the state. Adopting the 2021 IECC in Missouri 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 2021 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 with amendments
Life-cycle cost savings of the 2021 IECC	$13,298
Net annual consumer cash flow in year 1 of the 2021 IECC[2]	$381
Annual (first year) energy cost savings of the 2021 IECC ($)[3]	$657
Annual (first year) energy cost savings of the 2021 IECC (%)[4]	26%

[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, $	3,746,000	1,219,000,000
CO_2 emission reduction, Metric tons	29,100	13,710,000
CH_4 emissions reductions, Metric tons	2.71	1,274
N_2O emissions reductions, Metric tons	0.386	182
NOx emissions reductions, Metric tons	21.22	9,994
SOx emissions reductions, Metric tons	19.52	9,193

Statewide Impact – Jobs Created

Statewide Impact	First Year	30 Years Cumulative
Jobs Created -- Reduction in Utility Bills	190	5,128
Jobs Created -- Construction Related Activities	590	15,930

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

Contents

Figures

Tables

1.0 Cost-Effectiveness Results for the 2021 IECC for Missouri

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 2021 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 2021 IECC compared to the 2015 IECC with amendments.

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

Table 1. Life-Cycle Cost Savings of the 2021 IECC compared to the 2009 IECC

Climate Zone	Life-Cycle Cost Savings ($)
3A	9,468
4A	13,215
5A	15,648
State Average	**13,298**

Note: Warm-humid climate zones are labeled "WH"

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 2021 IECC on Consumer Cash Flow compared to the 2009 IECC.

Table 2. Consumer Cash Flow from Compliance with the 2021 IECC Compared to the 2009 IECC

	Cost/Benefit	3A	4A	5A	State Average
A	Incremental down payment and other first costs	$640	$703	$638	$700
B	Annual energy savings (year one)	$542	$675	$743	$677
C	Annual mortgage increase	$221	$243	$221	$242
D	Net annual cost of mortgage interest deductions, mortgage insurance, and property taxes (year one)	$49	$54	$49	$54
E = [B-(C+D)]	Net annual cash flow savings (year one)	$272	$377	$473	$381
F = [A/E]	Years to positive savings, including up-front cost impacts	3	2	2	2

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 2021 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 2021 IECC Compared to the 2009 IECC

Climate Zone	Payback Period (Years)
3A	9.4
4A	8.3
5A	6.9
State Average	**8.3**

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 2021 edition of the IECC, relative to the 2009 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 2021 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 2021). Energy savings of the 2021 IECC relative to the 2015 IECC with amendments, 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.

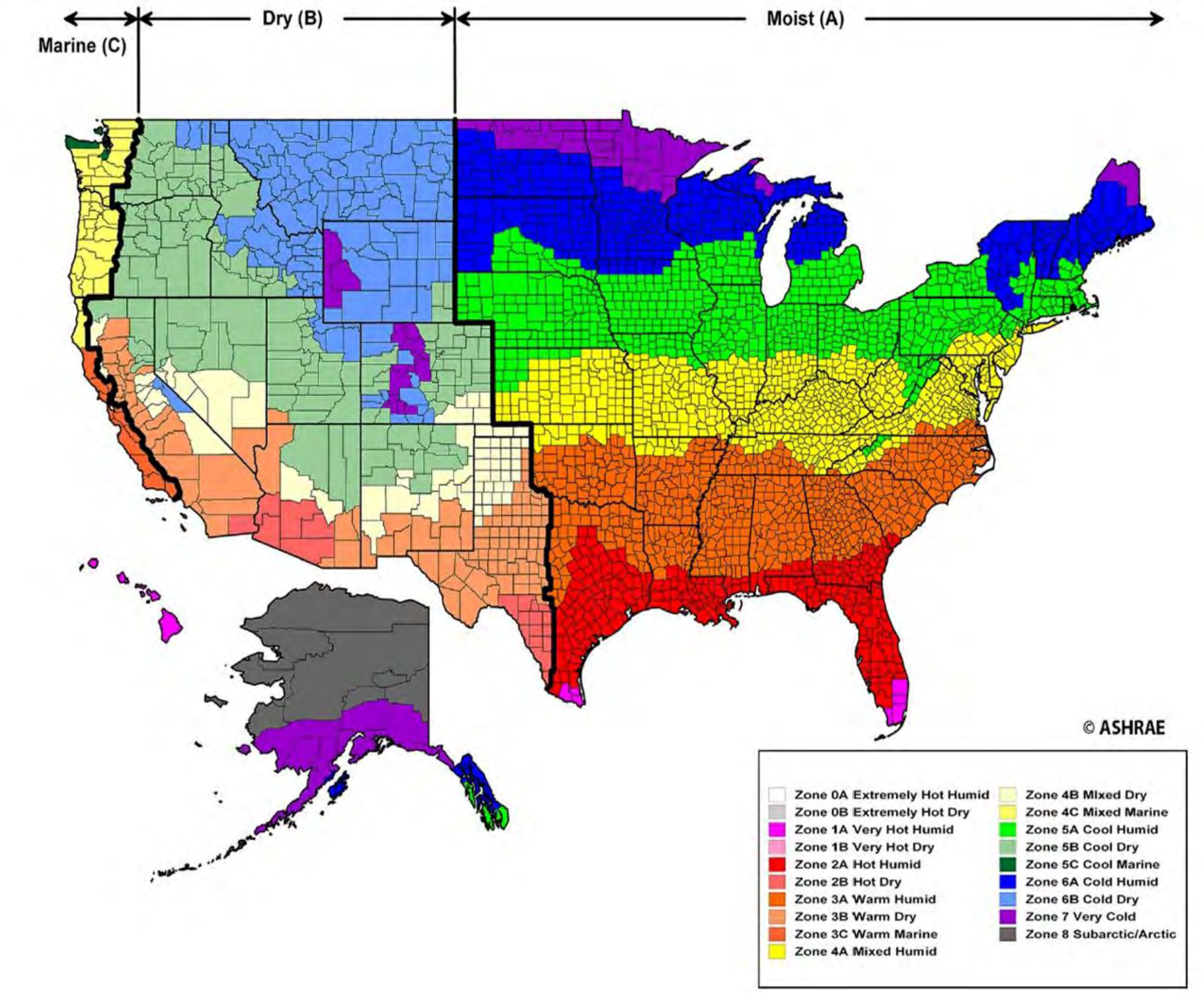

Figure 1. National Climate Zones

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)
0.111	0.892	2.279

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	5.4%
Property tax	0.91%

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 Missouri 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	59.2	59.2
Heat Pump	36.3	36.3
Electric Resistance	3.6	3.6
Oil	0.8	0.8

Table 7. Foundation Type Shares

Foundation Type	Slab-on-grade	Heated Basement	Unheated Basement	Crawlspace
Share of New Homes (percent)	24	36	20	20

Table 8. Construction Shares by Climate Zone

Climate Zone	Share of New Homes (percent)	
	Single-Family	Multifamily
3A	70.6	29.4
4A	70.6	29.4
5A	70.6	29.4

3.0 Incremental Construction Costs

In order to evaluate the cost-effectiveness of the changes introduced by the 2021 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 2021).

The estimated costs of implementing the prescriptive provisions of the 2021 IECC over the 2009 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 2021 IECC compared to the 2009 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, 1.0054, to reflect local construction costs based on location factors provided by RSMeans (2020).

Table 9. Total Single-Family Construction Cost Increase for the 2021 IECC Compared to the 2009 IECC ($)

Single-family Prototype House				
Climate Zone	**Crawlspace**	**Heated Basement**	**Slab**	**Unheated Basement**
3A	$5,899	$5,899	$6,415	$5,899
4A	$6,616	$6,616	$7,132	$6,616
5A	$5,674	$6,355	$6,190	$5,674

Table 10. Total Multifamily Construction Cost Increase for the 2021 IECC Compared to the 2009 IECC ($)[1]

Multifamily Prototype Apartment/Condo				
Climate Zone	**Crawlspace**	**Heated Basement**	**Slab**	**Unheated Basement**
3A	$2,425	$2,425	$2,502	$2,425
4A	$2,365	$2,365	$2,441	$2,365
5A	$2,290	$2,391	$2,367	$2,290

[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 2021 IECC and the 2009 IECC

Table 11. Annual (First Year) Energy Costs for the 2009 IECC

Climate Zone	2009 IECC						
	Heating	**Cooling**	**Water Heating**	**Lighting**	**Fans**	**Vents**	**Total**
3A	$522	$346	$203	$184	$106	$39	$2,215
4A	$850	$276	$229	$184	$114	$39	$2,510
5A	$1,212	$214	$253	$184	$131	$39	$2,850
State Average	**$865**	**$274**	**$230**	**$184**	**$115**	**$39**	**$2,523**

Table 12. Annual (First Year) Energy Costs for the 2021 IECC

Climate Zone	2021 IECC						
	Heating	**Cooling**	**Water Heating**	**Lighting**	**Fans**	**Vents**	**Total**
3A	$301	$258	$81	$143	$74	$19	$1,689
4A	$487	$216	$94	$143	$83	$19	$1,855
5A	$768	$175	$105	$143	$105	$19	$2,128
State Average	**$499**	**$214**	**$94**	**$143**	**$83**	**$19**	**$1,866**

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 2021 IECC Compared to the 2009 IECC

Climate Zone	First Year Energy Cost Savings	First Year Energy Cost Savings (percent)
3A	$526	23.8%
4A	$655	26.1%
5A	$721	25.3%
State Average	**$657**	**26.0%**

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 Missouri 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, 2021, 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

[1] Architecture 2030

[2] Exec. Order No. 13990, 86 Fed. Reg. 7037 (January 20, 2021) <https://www.federalregister.gov/documents/2021/01/25/2021-01765/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 2021a). 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 2021b). 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 Missouri by Fuel Type

GHG	Electricity lb/MWh	Natural Gas (lb/mmcf)	Fuel Oil (lb/1000 gal)
CO_2	1,827	120,000	23,000
SO_2	1.507	0.6	12
NO_X	1.301	96	19
N_2O	0.032	0.23	0.45
CH_4	0.203	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.

Table 15. Societal Benefits of the 2021 IECC

Statewide Impact	First Year	30 Years Cumulative
Energy cost savings, $	3,746,000	1,219,000,000
CO_2 emission reduction, Metric tons	29,100	13,710,000
CH_4 emissions reductions, Metric tons	2.71	1,274
N_2O emissions reductions, Metric tons	0.386	182
NOx emissions reductions, Metric tons	21.22	9,994
SOx emissions reductions, Metric tons	19.52	9,193

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 2021 IECC. Results are weighted by single- and multifamily housing starts, foundation type, and heating system type.

Table 16. Jobs Created from the 2021 IECC

Statewide Impact	First Year	30 Years Cumulative
Jobs Created -- Reduction in Utility Bills	190	5,128
Jobs Created -- Construction Related Activities	590	15,930

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2021 IECC Adoption Consumer Impact

The Home Builders Association of Greater Kansas City represents more than 600 companies while supporting more than 22,000 Kansas City jobs and $1.5 billion in annual economic activity. While the residential construction industry makes up our membership, it's the consumer that has our full and undivided attention.

The KCHBA is motivated by the wants and needs of past, current, and future home buyers. Home ownership remains one of the best ways to establish long term financial stability for the average American. By building equity and contributing to the tax base, home ownership fuels our local economies and serves as a foundation of our society. Every new directive enacted by policymakers results in a financial consequence for the consumer.

Various groups have claimed that homeowners in the state of Missouri would experience energy savings of $675/year by adopting the unamended 2021 IECC. *(These numbers were calculated comparing the 2018 IECC to the 2021 IECC; they are not KC specific calculations)*

The KCHBA asked several builders to provide cost data for achieving the unamended 2021 IECC requirements on locally built homes. The cost breakdown is provided on the following page.

Key data points to consider:

-The average new home price in Kansas City is currently $406,503.
-Income needed to qualify is $103,323.
-Median income in Kansas City is $56,179

With these code changes, there would be an additional increase in price of $31,853. With energy cost savings of only $675/year, the simple average payback for this would be 48+ years.

If the consumer had to finance these costs in a 30-year mortgage at 4% interest, the additional annual mortgage expense would be $1104/year, costing them $429 MORE than what they were saving in energy costs.

As drafted, the ordinance to adopt the 2021 IECC is not appropriate for KCMO at this time.

Further, for every $1,000 added to the price of a home, 951 families are priced out of the market. This code update would price 30,292 families out of the Kansas City market.

Currently, newly built homes are exponentially more efficient than older homes, without the 2021 IECC code update. This was proven by blower door testing performed by Kansas City on random new homes just a few years ago. The test results led to KC not adopting additional requirements.

Mandating this code and its associated price increases will substantially decrease new home affordability. Fewer new homes results in more people staying in “old” homes. By lowering the replacement rate of old for new, the rate at which actual environmental improvement occurs will slow as well. The HBA and its members want to put as many people as possible into new homes, which will have the greatest overall positive impact on our climate and energy efficiency. Adopting this new code is not the way to do so.

Cost Analysis of Implementing the 2021 IECC vs the KCMO current 2012 IECC

Item	Reference House: 2434 Sq Ft 2 story
Certificate: Additional Required Info	$99
*Frame wall: R0c.i. to R10c.i. (2x4)	$18,137
Slab edge: R10/2 to R10/4	$993
Ceiling insulation R49 to R60	$1,366
Attic access hatch: no direct cost; cost of additional insulation	$13
Baffles at attic access	$12
Air seal narrow framing cavities	$156
Air seal rim (basement; unvented crawlspace)	$1,252
Air seal rim (slab, vented crawlspace)	$417
Air seal electrical & communication outlet boxes	$369
Removes exception for duct test (basement, unvented crawl)	$247
Adds requirement to test whole-dwelling ventilation	$62
Updates ventilation fan efficacy (affects bath EF)	$66
Lighting: 100% high-efficacy; controls (slab)	$49
Lighting: 100% high-efficacy; controls (basement, crawl)	$60
Lighting: exterior controls	$25
Insulation certificate if no manufacturer mark (i.e., blown)	$15
Additional Energy Package: Ventilation, Gas House	$3206
Cost to Builder	$26,544
TOTAL PRICE TO CONSUMER	**$31,853**

** Reflects the additional local cost of a double-wall home, a requirement to meet 2021 IECC*

Note: The numbers above reflect a combination of locally sourced costs, as well as costs verified by Home Innovation Research Labs (HIRL), and reported in similar fashion as the “2021 IECC Residential Cost Effectiveness Analysis” report published in June 2021 by HIRL.