local energy code Action Kit

For Municipalities in Missouri

All Missourians deserve safe and energy-efficient buildings.

This **Local Energy Code Action Kit** provides municipalities and counties with information and resources to support the adoption of the model energy code—the 2009 IECC—and its enforcement.

BCAP

MISSOURI DEPARTMENT OF NATURAL RESOURCES

energy codes Basics

What Are Energy Codes?

Energy codes set the **minimum standard for the energy efficiency of buildings** to ensure that homes and commercial buildings reduce their energy use, lower utility bills and improve occupant comfort.

Who Creates Them?

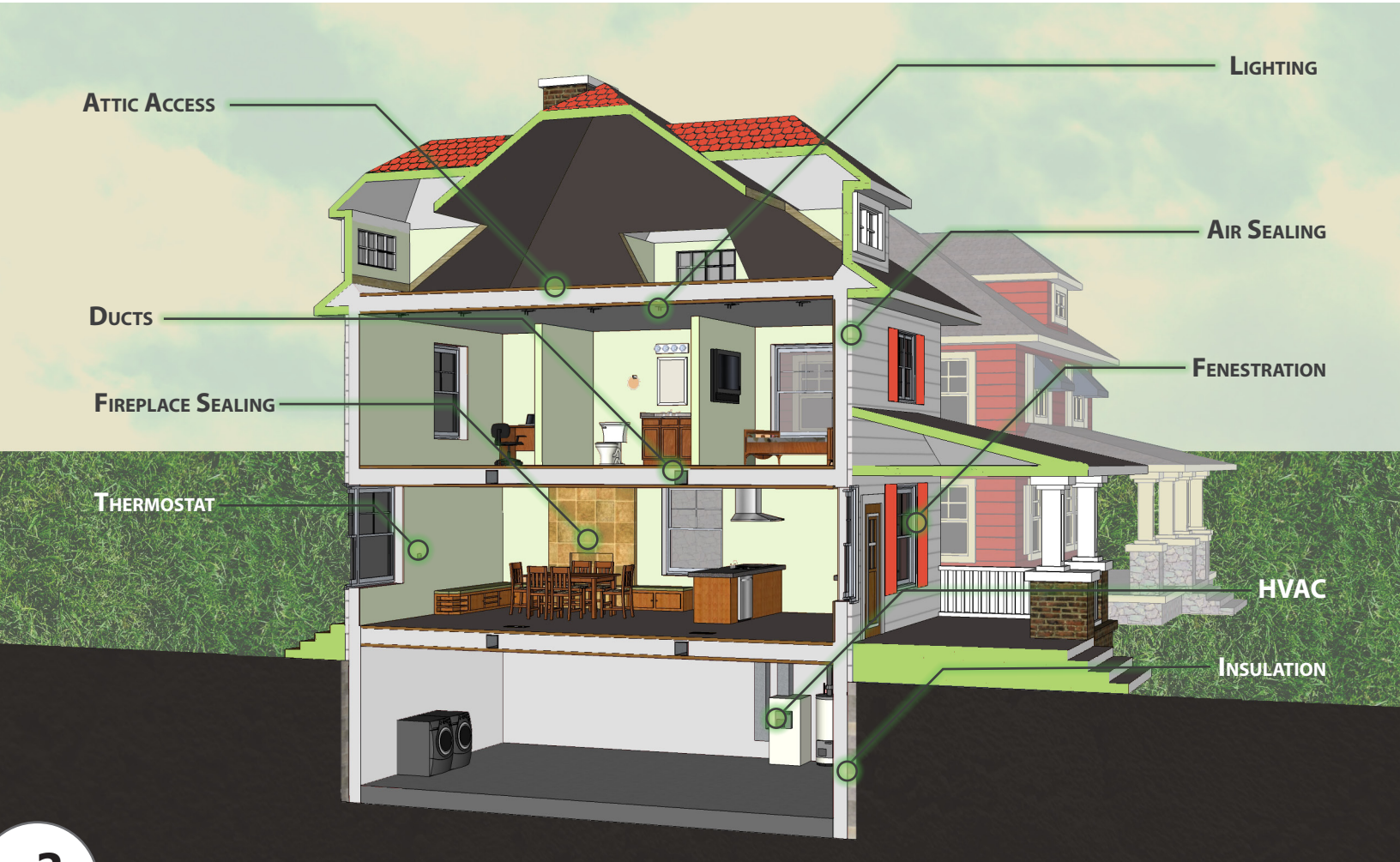
The International Code Council (ICC) and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) develop and update building codes and standards on three-year cycles. **The U.S. Department of Energy (DOE)** reviews them to determine their efficiency and cost-effectiveness and makes recommendations for state adoption.

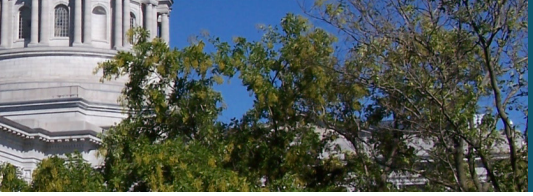
What is the Current Code?

The ICC 2009 International Energy Conservation Code (IECC) is the current model energy code. It references ASHRAE Standard 90.1-2007 for commercial construction. It is approximately 15 percent more energy efficient than the 2006 IECC.

What Do They Cover?

Energy codes address wall and ceiling insulation, window and door specifications, HVAC and ventilation equipment efficiency, and lighting fixtures, among other building features.

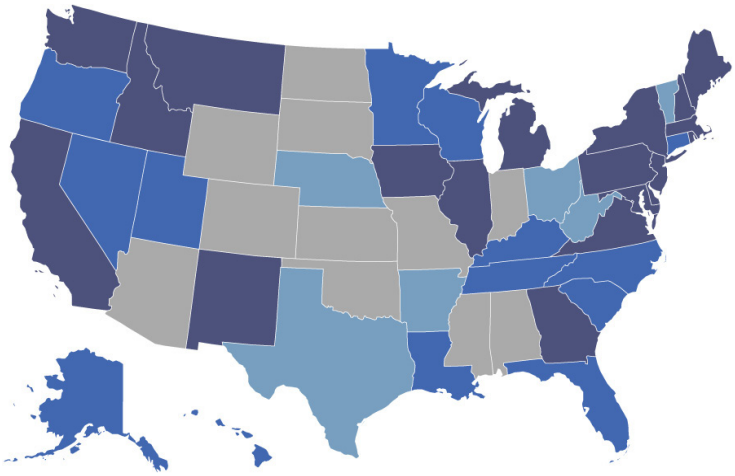




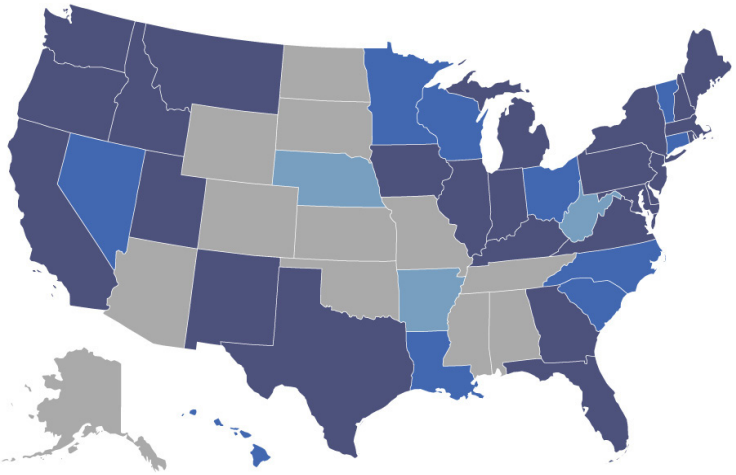
The National Picture

Energy codes are adopted on the state and local levels. The majority of states have adopted some version of the model energy code.

Residential Energy Code Status



Commercial Energy Code Status

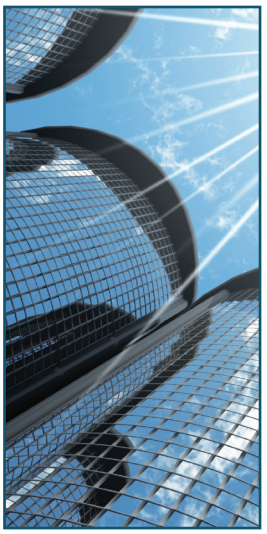


- meets or exceeds 2009 IECC or ASHRAE Standard 90.1-2007 or equivalent
- meets or exceeds 2006 IECC or ASHRAE Standard 90.1-2004 or equivalent
- meets or exceeds 1998-2003 IECC or ASHRAE Standard 90.1-1999 or equivalent
- no statewide code or precedes 2000 IECC or ASHRAE Standard 90.1-1999

Missouri: A Patchwork of Codes

Due to its history of strong local government, **Missouri does not have a mandatory statewide energy code**, however all local jurisdictions except class III counties have the right to adopt an energy code. As expected, this system creates a sometimes confusing patchwork of different codes throughout the state.

Regardless of the system in place, the bottom line is that **many jurisdictions in Missouri still don't have an energy code—**meaning that many residents do not receive the benefits of energy-efficient construction.



costs and savings for Missouri

Energy Costs

$20 billion	Amount spent annually on energy in Missouri.
95%	Percentage of primary energy imported from other states.
22%	The rise in the cost of residential electricity, 2004 to 2009.[1]

Missouri residents spend billions every year importing energy from other states and abroad. Energy codes can help the state retain some of these dollars and improve Missouri's economy.

Energy Code Savings

18-26%	Energy savings for each new home.
$337-559	Annual savings in reduced utility bills per home.
10-11%	Energy savings in reduced utility bills in office buildings.[2]

Energy codes reduce energy use and have the potential to **put money back into the hands of Missouri residents and businesses.**

Statewide Savings

$318 million	Annual energy savings by 2030.
26 trillion	Btu of energy avoided annually by 2030.
1.4 million	Metric tons of CO_2 prevented annually by 2030.[3]

By adopting and enforcing the 2009 IECC starting in 2011, Missouri municipalities and counties would **significantly improve the state's economy and environment** now and into the future.

why do energy codes Matter?

Save Residents and Businesses Money

Ensure Health and Safety

Protect Against Substandard Construction

Help Consumers Make Informed Decisions

Provide Quality and Comfort

Reduce Pollution and Increase Grid Reliability

spotlight on:

Making a Cost-Effective Investment

It's much more cost-effective to build to the model energy code during construction than try to improve efficiency later through expensive retrofits that do not achieve comparable savings. For sense of scale, consider that in 2008 Missouri received $227.2 million in Weatherization Assistance Program (WAP) funds to improve the energy efficiency of low-income housing.[4]

If they buy a new home in 2011 built to the latest energy code, **Missouri homeowners will see net savings within no more than two years. After breaking even, low utility bills will help them realize a profit of up to $31 per month.**

the adoption Process

Tried-and-True Steps for an Efficient and Effective Adoption Process

Stakeholder Group

Form a stakeholder group of knowledgeable professionals to conduct the adoption process. Participants could include code officials, energy-efficient design and building professionals, utility and local government representatives, community leaders, and environmental and consumer advocates.

Conduct Outreach

Raise awareness of the model energy code and its many far-reaching benefits to create buy-in from a number of other involved parties. Design and building professionals, policymakers, the general public and other interested groups need to know why adopting an energy code is important.

Review the Code

Meeting regularly, review the 2009 IECC to understand its requirements and determine whether they meet your local needs and conditions. Some municipalities and counties choose to strengthen the code through amendments. Local, regional, or national advocates can help support this process if needed.

Local Adoption Process

Carry through with your jurisdiction's legislative or regulatory process. If you are holding a public hearing, gather public testimony and support from stakeholder groups and other regional and state organizations.

Enact the Code

Set an effective date for the energy code that gives all parties time to adjust to the new requirements. Six months is a reasonable time period.

spotlight on The 2012 IECC

The ICC is in the process of finalizing the 2012 IECC, which is expected to be about 15 percent more efficient than the 2009 IECC. Preparing now to adopt the 2012 IECC is a great opportunity for eligible municipalities and counties to provide their citizens with even stronger energy-efficient construction.

+ Adopt the Latest Model Energy Code

Jackson County, Lake St. Louis, Marshall, O'Fallon, and **the City of St. Louis** have adopted the 2009 IECC. **Creve Coeur** and **Independence** are currently in the adoption process.

St. Charles County and St. Louis County have adopted the 2009 IRC with amendments.

+ Build Stakeholder Support for Energy Codes

Kansas City incorporates energy codes into its broader sustainability effort:

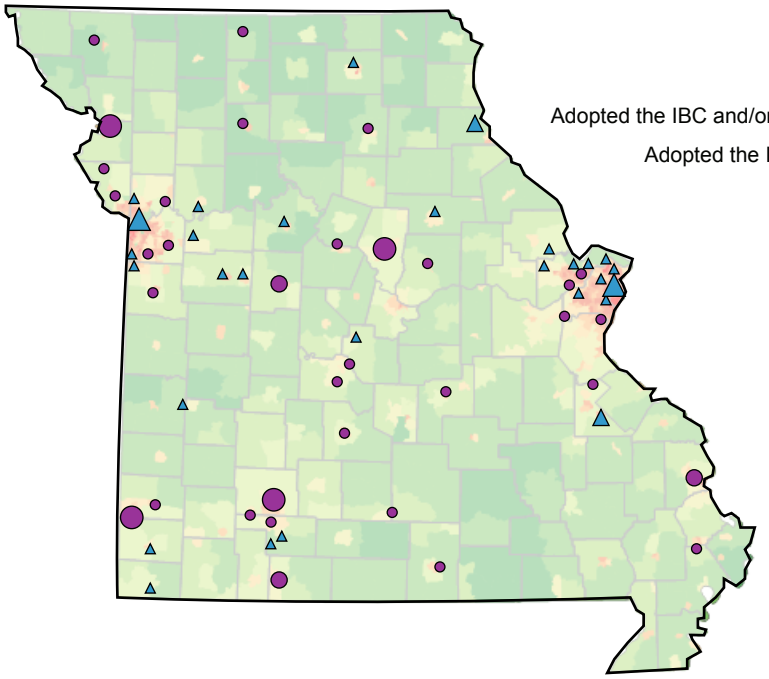
1) The Environmental Management Commission advises the city on energy/environmental issues.
2) The Chamber of Commerce's Climate Protection Partnership brings together 180 businesses and institutions that support energy efficiency implementation.
3) The Sustainability Coordinator works regionally to promote energy efficiency efforts.
4) The *Climate Protection Plan* includes energy codes as a policy tool.
5) Kansas City joined with ten municipalities and the Mid-America Regional Council to create a regional energy strategy and promote the adoption of the 2012 IECC.

Columbia created commissions to advise the city council on energy code issues:

1) The Building Construction Codes Commission (BCCC) reviews codes and provides a construction industry perspective.
2) The Environment and Energy Commission adds input on the benefits of energy codes, stimulates public interest, and engages public/private agencies.

The **University City** Green Practices Committee provides input into energy code adoption efforts.

local jurisdiction
Adoption Status



Adopted the IBC and/or IRC
Adopted the IECC

population>100,000	50,000-100,000	<50,000
Arnold	Higginsville	Pacific
Ballwin	Highlandville	Park Hills
Belton	Joplin	Pineville
Bethany	Kansas City	Platte City
Boonville	Kirksville	Raytown
Branson	Kirkwood	Republic
Camdenton	Knob Noster	Riverside
Cape Girardeau	Lake St. Louis	Rolla
Carthage	Loch Lloyd	Sedalia
Chillicothe	Lebanon	Sikeston
Clayton	Lee's Summit	Sni Valley
Columbia	Macon	Springfield
Eldon	Marshall	St. Charles
El Dorado Springs	Maryville	St. Joseph
Farmington	Mexico	St. Louis
Florissant	Mountain Grove	St. Peters
Fulton	Neosho	Sugar Creek
Gladstone	Nixia	Troy
Hannibal	O'Fallon	Warrensburg
Harrisonville	Osage Beach	Wentzville
Hazelwood	Ozark	West Plains

Includes only jurisdictions reporting code status to International Code Council as of June 1, 2010. International Building Code (IBC) is the model general code for commercial construction. International Residential Code (IRC) is the model general code for residential construction.

the implementation Process

Training

Code officials and building professionals must learn energy code requirements and stay up-to-date on code changes. Classroom training is the most common and feasible method. On-site training is preferred. There are also a number of resources available for online training, though ideally this should supplement in-person training.

Enforcement and Compliance

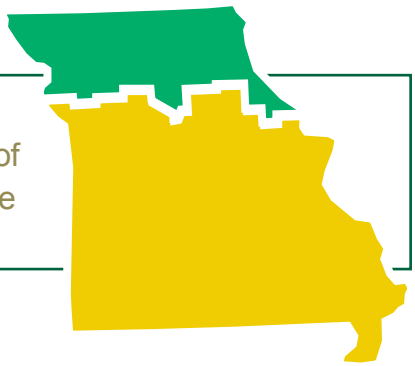
Code officials must work with building professionals to set clear expectations for energy code compliance. They must be proactive about discussing code requirements and providing corrections at every step of the plan review and enforcement process. It is also important for code officials to seamlessly incorporate energy code enforcement into their established inspection procedures.

Green and Advanced Codes

Green and above codes achieve even greater energy savings. Options range from local amendments to national codes and standards. More efficient construction often requires stronger enforcement, including efficiency testing from third-party organizations. Green and above codes are also an excellent option for public buildings in jurisdictions that want to lead by example.

2009 IECC Climate Zones

Most of Missouri falls under the Climate Zone 4 (yellow) similar to much of the Upper South. The northern quarter of the state is in the colder Climate Zone 5 (green), which has stricter insulation requirements.



best practices in Missouri

Enforcement Practices

Code officials in **Springfield**, **Kansas City,** and **Columbia** use energy code inspection checklists.

Columbia conducts an "open wall" inspection for insulation as one of five required inspections.

The City of St. Louis ties pay raises for code officials to ICC certifications.

Columbia has developed its own energy checklist for new homes.

Leading by Example

Kansas City

1) City-owned facilities must meet LEED Gold standards; city-funded residential projects must meet ENERGY STAR qualifications.

2) The city tracks utility bills for renovated city-owned facilities. **It saves about $2 million annually.**

Clayton's 2006 Municipal Building Standard requires new construction and major renovations of city-owned and occupied buildings over 5,000 square feet to earn LEED Silver certification.

Springfield's 2008 Green Building Policy requires renovations of city-owned buildings to incorporate LEED for Existing Buildings to the greatest extent practical.

Other Best Practices

Columbia Water and Light's Home Performance with ENERGY STAR home renovation program results in an average energy bill reduction of 29%. They also offer free energy audits to customers.

Springfield modified the Multiple Listing Service (MLS) to include "ENERGY STAR" (and similar) rated homes. Realtors can use this information to market homes and track whether they sell faster and at a higher price.

additional Resources

Missouri Department of Natural Resources **dnr.mo.gov**

OCEAN Missouri Page **bcap-ocean.org/state-country/missouri**

Building Energy Codes University **energycodes.gov/becu**

Midwest Energy Efficiency Alliance (MEEA) **mwalliance.org**

Mid-America Regional Council (MARC) **marc.org**

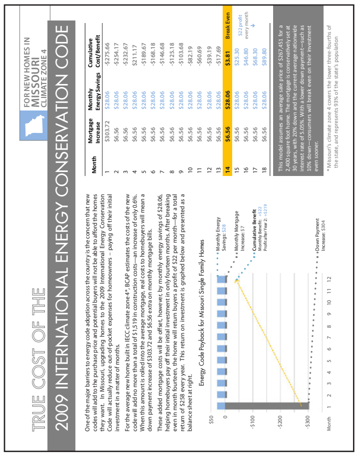
International Code Council (ICC) **iccsafe.org**

American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) **ashrae.org**

Code College Network **codecollegenetwork.com**

Note: This is not an exhaustive list of resources on the web. For additional information on Missouri and best practices from around the country, please visit: www.bcap-ocean.org

Further Reading

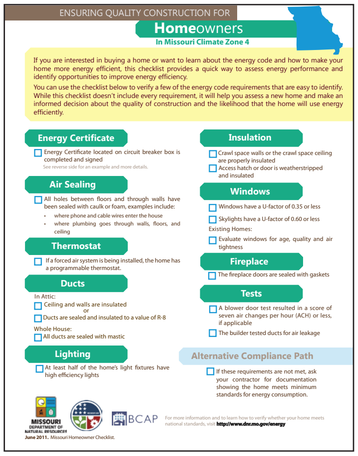


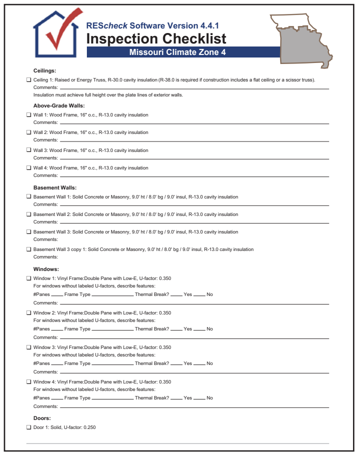
Incremental Cost Analysis

One of the major barriers to energy code adoption is the concern that the cost of upgrading to the latest model energy code would be prohibitive. To address this concern, the toolbox contains BCAP analysis that quantifies the incremental construction cost of upgrading to the 2009 IECC in Missouri's climate zone 4 and 5. Each two page resource also includes cost-benefit analysis that compares incremental costs to anticipated utility bill savings. Although local codes may differ, this analysis presents the difference between an assumed state baseline (the 2003 IECC) and the latest model code, the 2009 IECC. To explain these and other details, an incremental cost fact sheet is also included to provide an explanation for how incremental costs are calculated.

Consumer Guides

Traditionally, inspecting for a home's energy efficiency was the sole responsibility of builders and inspectors. But consumers can also play a major role to ensure that their homes are built to a high standard. To equip homeowners to ask the right questions about home energy performance, this packet includes two consumer energy code checklists aimed at prospective and existing homebuyers, home inspectors, and the construction community. Presented as both a two-page checklist and a five page guide, consumers can learn more about which building features are affected by the latest energy code, the 2009 IECC.





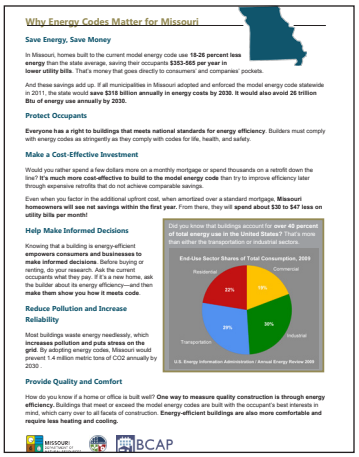
Inspector Guides

These checklists, generated by the Department of Energy's REScheck program, provide code inspectors with a list of building specifications that should be met under the latest energy code. Checklists are included for Missouri's climate zones 4 and 5.

Further Reading

Why Energy Codes Matter

A two page handout that provides context for the energy code and discusses their benefits.



Why Energy Codes Matter for Missouri

Save Energy, Save Money

In Missouri, homes built to the current model energy code use **18-26 percent less energy** than the state average, saving their occupants **$353-565 per year in lower utility bills**. That's money that goes directly to consumers' and companies' pockets.

And these savings add up. If all municipalities in Missouri adopted and enforced the model energy code statewide in 2011, the state would **save $318 billion annually in energy costs by 2030. It would also avoid 26 trillion Btu of energy use annually by 2030.**

Protect Occupants

Everyone has a right to buildings that meets national standards for energy efficiency. Builders must comply with energy codes as stringently as they comply with codes for life, health, and safety.

Make a Cost-Effective Investment

Would you rather spend a few dollars more on a monthly mortgage or spend thousands on a retrofit down the line? **It's much more cost-effective to build to the model energy code** than try to improve efficiency later through expensive retrofits that do not achieve comparable savings.

Even when you factor in the additional upfront cost, when amortized over a standard mortgage, **Missouri homeowners will see net savings within the first year.** From there, they will **spend about $30 to $47 less on utility bills per month!**

Help Make Informed Decisions

Knowing that a building is energy-efficient **empowers consumers and businesses to make informed decisions**. Before buying or renting, do your research. Ask the current occupants what they pay. If it's a new home, ask the builder about its energy efficiency—and then **make them show you how it meets code**.

Did you know that buildings account for **over 40 percent of total energy use in the United States**? That's more than either the transportation or industrial sectors.

End-Use Sector Shares of Total Consumption, 2009

Residential 22% · Commercial 19% · Industrial 30% · Transportation 29%

U.S. Energy Information Administration / Annual Energy Review 2009

Reduce Pollution and Increase Reliability

Most buildings waste energy needlessly, which **increases pollution and puts stress on the grid**. By adopting energy codes, Missouri would prevent 1.4 million metric tons of CO2 annually by 2030 .

Provide Quality and Comfort

How do you know if a home or office is built well? **One way to measure quality construction is through energy efficiency.** Buildings that meet or exceed the model energy codes are built with the occupant's best interests in mind, which carry over to all facets of construction. **Energy-efficient buildings are also more comfortable and require less heating and cooling.**

Coming Down the Road:

Achieving 90 Percent Compliance with the Energy Code

The Recovery Act of 2009 mandates that states show that they have achieved 90 percent compliance with the energy code by 2017. Compliance measurement is likely to differ from state to state, as each will have to collaborate with local code officials to find an ideal strategy that fits with the state's unique needs, infrastructure, and resources available.

State Strategies

States will not have to tackle the problem of developing a 90% compliance strategy by themselves. The Department of Energy (DOE) has created a dedicated State Compliance Evaluation Procedures website[1] that provides videos, resources, and web tools to show states and local inspections departments what the compliance measurement process could look like. DOE staff members are also available to answer questions and research best practices.

In addition, by the fall 2011, DOE will have completed pilot studies in nine states across the country to develop local strategies for measuring compliance. Examples and lessons learned from this program will be published on the website noted above to help develop and inform strategies that will work in other states and localities. In addition, sparked by the launch of DOE's pilot studies on compliance, several states have started their own measurement and verification (M&V) projects using all or part of the DOE pilot methodology and tools. DOE will also have information and results on these projects available for interested parties.

[1] http://www.energycodes.gov/arra/compliance_evaluation.stm

Kansas City at night

Program Structure

While the state is responsible for reporting compliance results, the responsibility will fall to local governments—usually their inspections departments—to either make available the needed information on construction projects in progress or to collect data themselves on how designers and construction professionals are designing and constructing buildings. DOE has suggested that evaluation of design and building practice for each state can be structured a number of ways: through 1st party evaluation by local inspections departments, 2nd party inspection by the state, or third-party evaluation by private sector firms. Missouri's strong home rule tradition may mean that 1st party evaluation is the most likely option, but a final determination can be made at a later date.

Stockton Lake

Courtesy of Flickr Creative Commons - davo56.

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Page 1

Measuring Code Compliance

A two page handout that describes what to expect from forthcoming DOE-mandated energy code compliance efforts.

The Missouri Department of Natural Resources
www.dnr.mo.gov

The American Recovery and Reinvestment Act of 2009
www.recovery.gov

The Building Codes Assistance Project
www.bcap-ocean.org

References
1. U.S. Energy Information Administration: http://www.eia.gov/emeu/states/hf.jsp?incfile=sep_prices/total/pr_tot_mo.html&mstate=MISSOURI; Missouri Governor's Office: http://governor.mo.gov/newsroom/2009/Energy_Efficient_Investment_Act
2. U.S. Dept. of Energy: http://www.energycodes.gov/publications/techassist/residential/Residential_Missouri.pdf; http://www.energycodes.gov/publications/techassist/commercial/Commercial_Missouri.pdf
3. The BCAP Energy Codes Calculator
4. Missouri Department of Natural Resources, Missouri Resources, Winter 2011: www.dnr.mo.gov/magazine/2011-winter.pdf

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TRUE COST OF THE

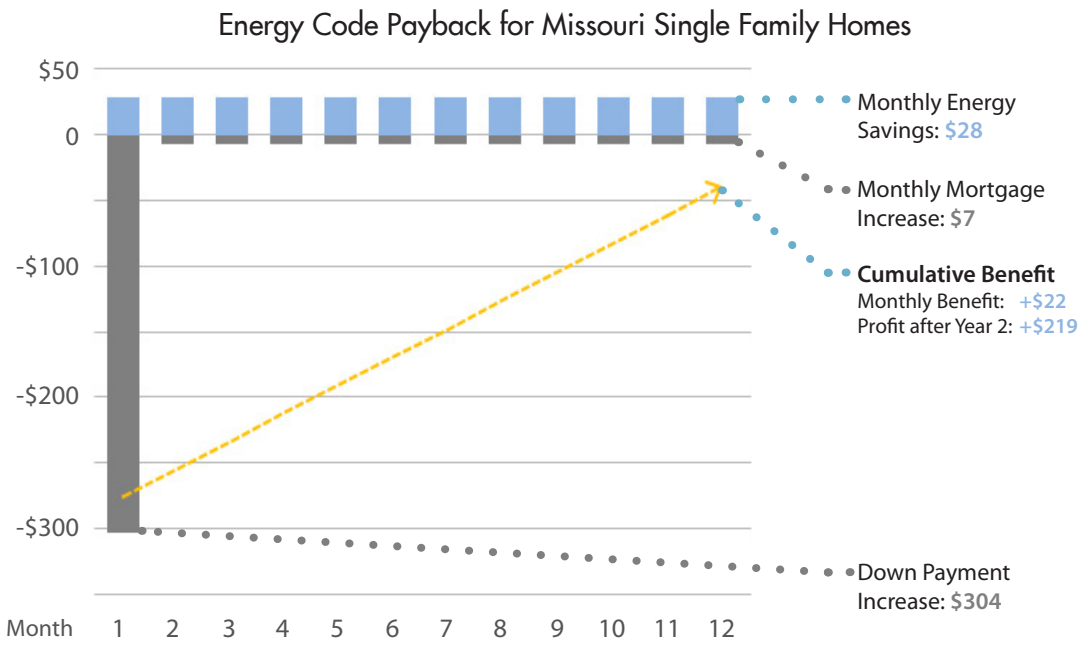
FOR NEW HOMES IN
MISSOURI
CLIMATE ZONE 4

2009 INTERNATIONAL ENERGY CONSERVATION CODE

One of the major barriers to energy code adoption across the country is the concern that new codes will add to the purchase price and potential buyers will not be able to afford the homes they want. In Missouri, upgrading homes to the 2009 International Energy Conservation Code will actually reduce out-of-pocket expenses for homeowners – paying off their initial investment in a matter of months.

For the average new home built in IECC climate zone 4*, BCAP estimates the costs of the new code will add no more than a total of $1,519 in construction costs—an increase of only 0.6%. When this amount is rolled into the average mortgage, real costs to homebuyers will mean a down payment increase of $303.72 and $6.56 extra on monthly mortgage bills.

These added mortgage costs will be offset, however, by monthly energy savings of $28.06, helping homebuyers pay off their initial investment in only fourteen months. After breaking even in month fourteen, the home will return buyers a profit of $22 per month—for a total return of $258 every year. This return on investment is graphed below and presented as a balance sheet at right.



Month	Mortgage Increase	Monthly Energy Savings	Cumulative Cost/Benefit	
1	$303.72	$28.06	-$275.66	
2	$6.56	$28.06	-$254.17	
3	$6.56	$28.06	-$232.67	
4	$6.56	$28.06	$211.17	
5	$6.56	$28.06	-$189.67	
6	$6.56	$28.06	-$168.18	
7	$6.56	$28.06	-$146.68	
8	$6.56	$28.06	-$125.18	
9	$6.56	$28.06	-$103.68	
10	$6.56	$28.06	-$82.19	
11	$6.56	$28.06	-$60.69	
12	$6.56	$28.06	-$39.19	
13	$6.56	$28.06	-$17.69	
14	**$6.56**	**$28.06**	**$3.81**	**Break Even**
15	$6.56	$28.06	$25.30	$22 profit every month ↓
16	$6.56	$28.06	$46.80	
17	$6.56	$28.06	$68.30	
18	$6.56	$28.06	$89.80	

This model assumes an average sale price of $267,451 for a 2,400 square foot home. The mortgage is conservatively set at 30 years, with 20% down and the current average nationwide interest rate of 5.05%. With a lower down payment—such as 10% down—consumers will break even on their investment even sooner.

* Missouri's climate zone 4 covers the lower three-fourths of the state, and represents 93% of the state's population

TRUE COST OF THE

2009 INTERNATIONAL ENERGY CONSERVATION CODE

FOR NEW HOMES IN
MISSOURI
CLIMATE ZONE 4

Homes are the biggest investment we make—and everyone deserves a home that meets national minimum energy efficiency standards. While it's true that homeowners can always improve the efficiency of their homes, it is far more cost-effective to upgrade building components during construction, putting in better windows or swapping out one grade of insulation for a better one. Here's what buyers get with the 2009 IECC:

Payback Period
14 months

3-year Profit
$476.75

Annual Energy Reduction
18%

5-year Profit
$992.69

Climate Zone 4

u-factor:	.5 ⇨ .35	WINDOW
		INSULATION
r-value:	30 ⇨ 38	CEILING

BCAP

MISSOURI DEPARTMENT OF NATURAL RESOURCES

For the full Incremental Cost Analysis study, please visit **bcap-ocean.org**

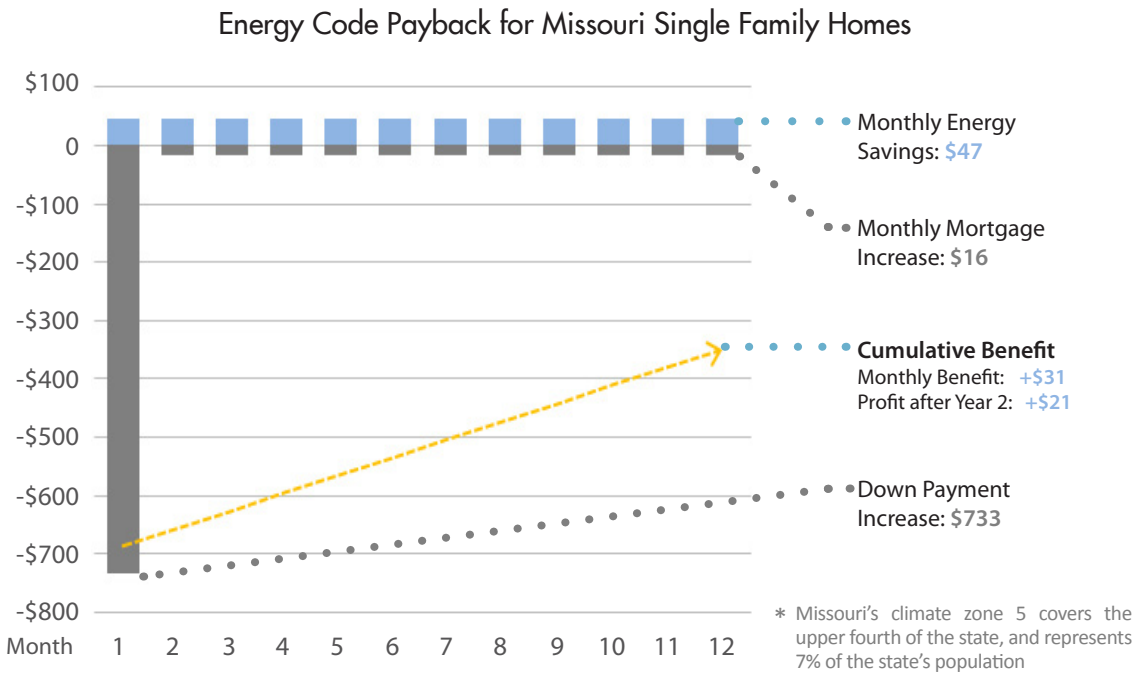
TRUE COST OF THE 2009 INTERNATIONAL ENERGY CONSERVATION CODE

FOR NEW HOMES IN MISSOURI CLIMATE ZONE 5

One of the major barriers to energy code adoption across the country is the concern that new codes will add to the purchase price and potential buyers will not be able to afford the homes they want. In Missouri, upgrading homes to the 2009 International Energy Conservation Code will actually reduce out-of-pocket expenses for homeowners – paying off their initial investment in a matter of months.

For the average new home built in IECC Climate Zone 5*, BCAP estimates the costs of the new code will add no more than a total of $3,665 in construction costs—an increase of only 1.4%. When this amount is rolled into the average mortgage, real costs to homebuyers will mean a down payment increase of $733.05, and $15.83 extra on monthly mortgage bills.

These added mortgage costs will be offset, however, by monthly energy savings of $46.57, helping homebuyers pay off their initial investment in only twenty-four months. After breaking even in month twenty-four, the home will return buyers a profit of $31 per month—for a total return of $369 every year. This return on investment is graphed below and presented as a balance sheet at right.



* Missouri's climate zone 5 covers the upper fourth of the state, and represents 7% of the state's population

Month	Mortgage Increase	Monthly Energy Savings	Cumulative Cost/Benefit	
1	$733.05	$46.57	$686.48	
2	$15.83	$46.57	$655.74	
3	$15.83	$46.57	$625.00	
4	$15.83	$46.57	-$594.26	
5	$15.83	$46.57	-$563.52	
6	$15.83	$46.57	-$532.78	
7	$15.83	$46.57	-$502.04	
8	$15.83	$46.57	-$471.30	
9	$15.83	$46.57	-$440.56	
10	$15.83	$46.57	-$409.82	
11	$15.83	$46.57	-$379.08	
12	$15.83	$46.57	-$348.34	
13	$15.83	$46.57	-$317.60	
14	$15.83	$46.57	-$286.86	
15	$15.83	$46.57	$256.12	
16	$15.83	$46.57	-$225.38	
17	$15.83	$46.57	-$194.64	
18	$15.83	$46.57	-$163.90	$31 monthly profit ↓
19	$15.83	$46.57	-$133.16	
20	$15.83	$46.57	-$102.42	
21	$15.83	$46.57	-$71.68	
22	$15.83	$46.57	-$40.94	
23	$15.83	$46.57	-$10.20	
24	**$15.83**	**$46.57**	**$20.54**	**Break Even**

This model assumes an average sale price of $267,451 for a 2,400 square foot home. The mortgage is conservatively set at 30 years, with 20% down and the current average nationwide interest rate of 5.05%. With a lower down payment—such as 10% down—consumers will break even on their investment even sooner.

TRUE COST OF THE

2009 INTERNATIONAL ENERGY CONSERVATION CODE

FOR NEW HOMES IN
MISSOURI
CLIMATE ZONE 5

Homes are the biggest investment we make—and everyone deserves a home that meets national minimum energy efficiency standards. While it's true that homeowners can always improve the efficiency of their homes, it is far more cost-effective to upgrade building components during construction, putting in better windows or swapping out one grade of insulation for a better one. Here's what buyers get with the 2009 IECC:

Payback Period
24 months

3-year Profit
$393.50

Annual Energy Reduction
26%

5-year Profit
$1,143.50

Climate Zone 5

u-factor:	.5 ⇨ .35	WINDOW
		INSULATION
r-value:	13 ⇨ 19	FRAME WALL
r-value:	30 ⇨ 38	CEILING
r-value:	19 ⇨ 30	FLOOR

BCAP

MISSOURI DEPARTMENT OF NATURAL RESOURCES

For the full Incremental Cost Analysis study, please visit **bcap-ocean.org**

Incremental Cost Estimates in Missouri

A Background on the Data and Analysis

Summary

This analysis indicates that incremental costs to build new homes to the 2009 International Energy Conservation Code (IECC) in Missouri will conservatively add no more than a total of approximately $1,519 (in climate zone 4) to $3,665 (in climate zone 5) to the cost of a new home—although this figure could increase or decrease depending on local practices.

Model House Specifications

To determine the incremental construction costs for new homes in Missouri resulting from the implementation of the 2009 IECC, this study relies on model home specifications (and estimated energy savings) provided by a 2009 U.S. Department of Energy (DOE) report, *Impacts of the 2009 IECC for Residential Buildings*.[1] For the purposes of completing statewide energy modeling analysis for an "average" home statewide, the house model selected by DOE has the following construction specifications:

- 2-story, single-family colonial style home
- Conditioned floor area: 2,400 ft^2
- 8.5-ft high ceilings
- Total ceiling area: 1,200 ft^2
- Unconditioned attic
- Gross exterior wall area: 2,380 ft^2
- Total window area: 357 ft^2 (15% of wall area, oriented equally to the north, south, east and west)
- Perimeter: 140 linear feet

The 2,400 square foot model home was chosen by DOE in its research because this approximates the size of the average new home built nationwide. This analysis acknowledges that all new homes in Missouri will not be 2,400 square feet. Homes that are either smaller or larger than the model home used in this study should expect incremental costs (and energy savings) that are roughly proportional to the change in size from the average home size—although some fixed costs, such as duct testing, will mean that buyers of homes larger than 2,400 square feet are likely to enjoy a faster payback time.

Data Sources

To calculate baseline construction costs which serve as the basis for cost-benefit analysis, this study relies on a construction data source, *RS Means Residential Cost Data 2011,* in order to approximate baseline cost and the costs of specific building component changes.[2] This analysis uses *RS Means* to approximate a baseline construction cost, inclusive of material costs, labor costs, and contractor overhead and profit. Each material cost is not product-specific, and represents an average component cost that contractors use throughout the country. Because standard construction materials and labor rates range widely across the United States, the *RS Means* national average prices are modified to reflect building costs and labor for Missouri. To make this adjustment, *RS Means* provides location factors that are georeferenced to cities and towns. As this study sought an average construction cost adjustment factor for each climate zone within Missouri, U.S. Census housing start data was used to determine the county within each climate zone with the greatest number of construction starts. Using this county data, this study used the *RS Means* location factor for the city located in the county with the most construction starts. Thus, in order to approximate climate-zone specific cost, this

[1] *Impacts of the 2009 IECC for Residential Buildings.* Pacific Northwest National Laboratory. September 2009.

[2] RS Means is a well-respected construction cost reference that includes square foot costs for thousands of building products, including those used in this study.

analysis uses 103 percent of the national average in climate zone 4 and 93 percent of the national average in climate zone 5. These location factors correspond to St Louis in Climate Zone 4 and St Joseph in Climate Zone 5.

Prescriptive Compliance Methodology

Although energy code compliance can be met in some instances through performance measures, for the sake of simplicity this analysis estimates energy code improvements through the prescriptive method. The prescriptive compliance method "prescribes" energy efficient building attributes represented in the 2009 IECC, including R-values for walls and ceilings, window U and SHGC factors, and other requirements, such as energy efficient lighting. Following the statewide analysis conducted by DOE (described above) this analysis assumes that the statewide baseline of current practice is equivalent to the requirements of the 2003 IECC. The prescriptive requirements assumed in this analysis are represented in figure 1, below.

Figure 1: Missouri Incremental Cost Estimates for Climate Zones 4 and 5

Missouri Climate Zone 4

Components	Current Practice	2009 IECC	Change Per Sq. Ft.	Sq. Feet	Location Factor	Total Change
Ceiling (R Factor)	30	38	$0.31	1,200	$1.03	$383.16
Window (U Factor/ SHGC Factor)	.5/.3	.35/NR	$2.00	357	$1.03	$735.42
Wood Frame Wall (R Factor)	13	13	N/A	2,380	$1.03	N/A
Floor (R Factor)	19	19	N/A	1,200	$1.03	N/A
Basement (R Factor)	N/A	N/A	N/A	1,120	$1.03	N/A
Slab (R Factor)	N/A	N/A	N/A	140	$1.03	N/A
Crawlspace (R Factor)	N/A	N/A	N/A	1,200	$1.03	N/A
Improved Duct Sealing/Testing						$350.00
Lighting						$50.00
Climate Zone 4 Total						**$1,518.58**

Missouri Climate Zone 5

Components	Current Practice	2009 IECC	Change Per Sq. Ft.	Sq. Feet	Location Factor	Total Change
Ceiling (R Factor)	30	38	$0.31	1,200	$0.93	$345.96
Window (U Factor/ SHGC Factor)	.5/.3	.35/NR	$2.00	357	$0.93	$664.02
Wood Frame Wall (R Factor)	13	19	$0.55	2,380	$0.93	$1,217.37
Floor (R Factor)	19	30	$0.93	1,200	$0.93	$1,037.88
Basement (R Factor)	N/A	N/A	N/A	1,120	$0.93	N/A
Slab (R Factor)	N/A	N/A	N/A	140	$0.93	N/A
Crawlspace (R Factor)	N/A	N/A	N/A	1,200	$0.93	N/A
Improved Duct Sealing/Testing						$350.00
Lighting						$50.00
Climate Zone 5 Total						**$3,665.23**

Incremental Cost Estimate, Climate Zone 4

Incremental costs of compliance with 2009 IECC in Missouri's climate zone 4 are estimated at $1,518.58. The largest cost is expected to be the possible cost of upgrading windows. Although stakeholder interviews indicated that many builders were already meeting 2009 IECC windows requirements, this study includes an incremental cost for windows of $2.00 per window square foot in order to present a conservative cost estimate. This incremental cost is provided by the Efficient Windows Collaborative (EWC), and was confirmed with interviews with window manufacturers as the cost of upgrading to 2009 IECC compliant windows. Additionally, to raise attic insulation from R-30 to R-38, this analysis assumes that attic insulation is upgraded to R-38 blown in fiberglass at a cost of $1.74 per square foot, compared to $1.43 for R-30. Additionally, this analysis includes $350 for improved duct sealing and/or duct pressure testing, also known as "duct blaster" testing.[3] As well, to meet the IECC requirement that 50 percent of fixtures be equipped with high efficiency lights (such as compact florescent bulbs) this analysis assumes an additional $50 in incurred costs per home.

Incremental Cost Estimate, Climate Zone 5

Incremental costs of compliance with 2009 IECC in Missouri's climate zone 5 are estimated at $3,665.23. Although this may seem high, it can be significantly lowered through exemptions in the code and avoided costs where current practice exceeds the values used in this analysis. In addition to the requirements listed in climate zone 4, above, the climate zone 5 analysis includes insulation costs for building walls and basement ceiling insulation. To calculate the incremental cost of upgrading from R13 to R19 walls, this analysis assumes a change from 2 x 4 walls with R-13 insulation to 2 x 6 walls with high-density R-19 insulation. The cost of this change is estimated by RS Means as $1,217.37.[4]

This study also assumes an additional $1,037 in basement ceiling insulation costs in climate zone 5. However, it should be noted that the estimated basement ceiling cost included in this analysis is not necessary under the 2009 IECC. As in other parts of the study, this analysis assumes the most conservative (and high cost) solution to meet code compliance. In the case of climate zone 5, this analysis assumes the prescriptive code requirement of increasing the floor insulation level from R30 to R38. To build the R38 floor, this analysis assumes that floor joists are increased from 2 x 10 inches to 2 x 12 inches to accommodate a larger fiberglass batt. However, the code does not actually require that change. In fact, it allows builders to instead use "insulation sufficient to fill the framing cavity, R-19 minimum." As a result, builders do not have to incur the cost of basement ceiling insulation and thus can avert $1,037.88 of the estimated total.

Energy Savings: Conventional HVAC Systems

The Department of Energy estimates that annual energy savings of $353 in Missouri's climate zone 4 and $565 in climate zone 5 for homes with standard HVAC systems. In order to normalize these values to reflect current Missouri prices, DOE's estimated savings were adjusted to $336.69 in climate zone 4 and $558.79 in climate zone 5.[5] It should be noted that if current trends continue, these energy prices will continue to rise, thus increasing energy savings for homeowners.

[3] This analysis assumes $350 for duct tightness tests required by the 2009 IECC. This cost can be avoided if builders reroute HVAC ducts through the building envelope, but this analysis assumes the majority will elect to keep ducts in non-conditioned space.
[4] This analysis assumes that builders will continue to space studs at 16" on center, although with 2 x 6 wall framing, builders could save lumber and minimize added cost by spacing studs 24" on center.
[5] Missouri natural gas prices are sourced from EIA. $12.70 per thousand cubic foot, an average of winter months October 2010 through March 2011, was used as the Missouri average. Missouri electricity prices are assumed to be 8.54 cents per kWh, also sourced from EIA.

Energy Savings: Homes Heated with Propane

Energy savings may be still greater for homeowners who heat their homes with propane. Approximately thirteen percent of Missouri residents use propane to heat their homes, and many of them are located in climate zone 5, where incremental costs (and energy savings) are already significant. Converting from therms of natural gas (used in standard HVAC systems) to therms of propane, savings increase in climate zone 4 to $478.26 annually and savings in climate zone 5 climb to $818.34.[6] These savings, which reflect the high cost of propane for some Missourians, would dramatically improve payback time compared to initial incremental costs estimates. In climate zone 4, break-even would occur in month 9, and in climate zone 5, breakeven would occur in month 14. Also, yearly profits to homeowners would be significantly higher. After break-even, homeowners would achieve profits (propane savings minus added mortgage costs) of $399.54 in climate zone 4 and $628.38 in climate zone 5.

Estimated Payback: Baseline Scenario

According to this analysis, compliance with the 2009 IECC represents a nominal 0.6% increase to the retail price of an average new home in climate zone 4 and 1.4% in climate zone 5—an incremental cost which is fully paid off within 14 or 24 months, for climate zones 4 and 5, respectively. This analysis is based on the following assumptions:

- $337 and $559 in annual energy savings for climate zones 4 and 5, respectively
- Mortgage particulars: 20% down payment, 30 year term, 5.05% interest rate

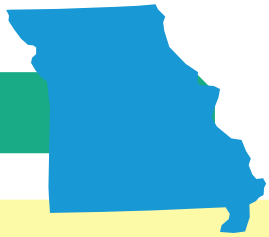
It is worth noting that this conservative break-even scenario is subject to significant fluctuations in input variables. For example, under prospects of rising energy costs, both payback and break-even on the incremental cost of code improvements would be accelerated significantly. Similarly, variations in lending interest rates and required money down would each alter this projection. Increases in incremental cost would also increase payback time, whereas decreases in incremental cost, such as the choice not to insulate basement ceilings in climate zone 5, would speed up payback time.

[6] These conversions assume a price of 1.958 per them, the average propane price for the winter months of October 2010 through March 2011. Data is sourced from EIA.

ENSURING QUALITY CONSTRUCTION FOR

Homeowners

In Missouri Climate Zone 4



If you are interested in buying a home or want to learn about the energy code and how to make your home more energy efficient, this checklist provides a quick way to assess energy performance and identify opportunities to improve energy efficiency.

You can use the checklist below to verify a few of the energy code requirements that are easy to identify. While this checklist doesn't include every requirement, it will help you assess a new home and make an informed decision about the quality of construction and the likelihood that the home will use energy efficiently.

Energy Certificate

- ☐ Energy Certificate located on circuit breaker box is completed and signed.

See reverse side for an example and more details.

Air Sealing

- ☐ All holes between floors and through walls have been sealed with caulk or foam, examples include:
  - where phone and cable wires enter the house
  - where plumbing goes through walls, floors, and ceiling

Thermostat

- ☐ If a forced air system is being installed, the home has a programmable thermostat.

Ducts

In Attic:

- ☐ Ceiling and walls are insulated

or

- ☐ Ducts are sealed and insulated to a value of R-8.

Whole House:

- ☐ All ducts are sealed with mastic.

Lighting

- ☐ At least half of the home's light fixtures have high efficiency lights.

Insulation

- ☐ Crawl space walls or the crawl space ceiling are properly insulated.
- ☐ Access hatch or door is weatherstripped and insulated.

Windows

- ☐ Windows have a U-factor of 0.35 or less.
- ☐ Skylights have a U-factor of 0.60 or less.

Existing Homes:

- ☐ Evaluate windows for age, quality and air tightness.

Fireplace

- ☐ The fireplace doors are sealed with gaskets.

Tests

- ☐ A blower door test resulted in a score of seven air changes per hour (ACH) or less, if applicable.
- ☐ The builder tested ducts for air leakage.

Alternative Compliance Path

- ☐ If these requirements are not met, ask your contractor for documentation showing the home meets minimum standards for energy consumption.

MISSOURI DEPARTMENT OF NATURAL RESOURCES

BCAP

For more information and to learn how to verify whether your home meets national standards, visit **http://www.dnr.mo.gov/energy**

June 2011. Missouri Homeowner Checklist.

SAMPLE ENERGY CERTIFICATE — Missouri Homes — Climate Zone 4

This energy certificate from the 2009 International Energy Conservation Code (IECC) illustrates the energy efficiency standards which are required in many new homes in Missouri. This sample form has been completed with the **minimum** standards for each building element in the home, meaning that the certificate in your home should meet or exceed these standards. Look for this certificate in or near the home's circuit breaker box or electric panel box. Make sure that it has been signed by the builder and identifies the other contractors.

If you have any questions about what is reported on the certificate, ask your builder or your local building permits office.

Climate Zone 4 Highlighted in Blue

U-factors

These are the requirements for the insulation value of a home's windows, doors, and skylights. U-values on the home's energy certificate should be **less than or equal to** those shown in the certificate below.

R-values

These are the minimum requirements allowed for the home's insulation in order to meet the code. R-values on the form should be **greater than or equal to** those shown here.

2009 IECC Energy Certificate

Compliance Method	Date
PERSCRIPTIVE	5/1/2011
Insulation	**r-value**
Ceiling/Roof	38
Walls	13
Floors	19
Ducts	8
Basement Walls	10/13
Window and Door Ratings	**u-factor**
Windows	0.35
Doors	0.40
HVAC Equipment	**Type** / **Rating**
GAS BOILER		75% AFUE
Water Heating	**Type**	**EF value**
Water Heater	50 GAL, GAS	0.60
General Contractor:	K+M CONTRACTORS	
Insulation Contractor:	RKM INSULATION	
Form Completed By:		

Heating and Cooling (HVAC)

The way heating and cooling systems are rated and the minimum levels for efficiency depend on the type installed, and fuel used. These abbreviations: SEER, AFUE, and HSPF indicate efficiency. The higher the rating, the more efficient the heating or cooling system is. Use the chart below to determine the minimum rating allowed for each system.

type	min rating
air conditioner	SEER-13
electric furnace	AFUE: 78%
electric boiler	AFUE: 80%
gas boiler	AFUE: 75%
heat pump	HSPF: 7.7

Water Heater

The minimum efficiency factor (EF) for water heaters depends on the size and fuel type used. The higher the number, the more efficient the water heater is.

Minimum EFs for Water Heaters

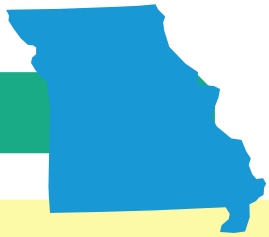
size	gas	electric
30 gal	0.63	0.95
40 gal	0.62	0.95
50 gal	0.60	0.95
65 gal	0.75	1.98
75 gal	0.74	1.97

* "10/13" means R-10 continuous insulated sheathing on the interior or exterior of the home (sealed at joints) or R-13 cavity insulation at the interior of the basement wall.

ENSURING QUALITY CONSTRUCTION FOR

Homeowners

In Missouri Climate Zone 5



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Thermostat

- ☐ If a forced air system is being installed, the home has a programmable thermostat.

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Whole House:

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Lighting

- ☐ At least half of the home's light fixtures have high efficiency lights.

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- ☐ Access hatch or door is weatherstripped and insulated.

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Alternative Compliance Path

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MISSOURI DEPARTMENT OF NATURAL RESOURCES

RECOVERY.GOV

BCAP

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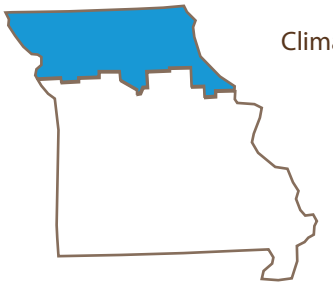

Climate Zone 5 Highlighted in Blue

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Compliance Method	Date
PERSCRIPTIVE	5/1/2011
Insulation	**r-value**
Ceiling/Roof	38
Walls	13+5
Floors	19
Ducts	8
Basement Walls	10/13
Window and Door Ratings	**u-factor**
Windows	0.35
Doors	0.40
HVAC Equipment	**Type** / **Rating**
GAS BOILER		75% AFUE
Water Heating	**Type**	**EF value**
Water Heater	50 GAL, GAS	0.60
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75 gal	0.74	1.97

* "10/13" means R-10 continuous insulated sheathing on the interior or exterior of the home (sealed at joints) or R-13 cavity insulation at the interior of the basement wall.

Energy Provisions of the Residential Building Code

2009 IECC: Guide for Homeowners

MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Missouri Energy Code **Guide**

FOR **HOMEOWNERS**

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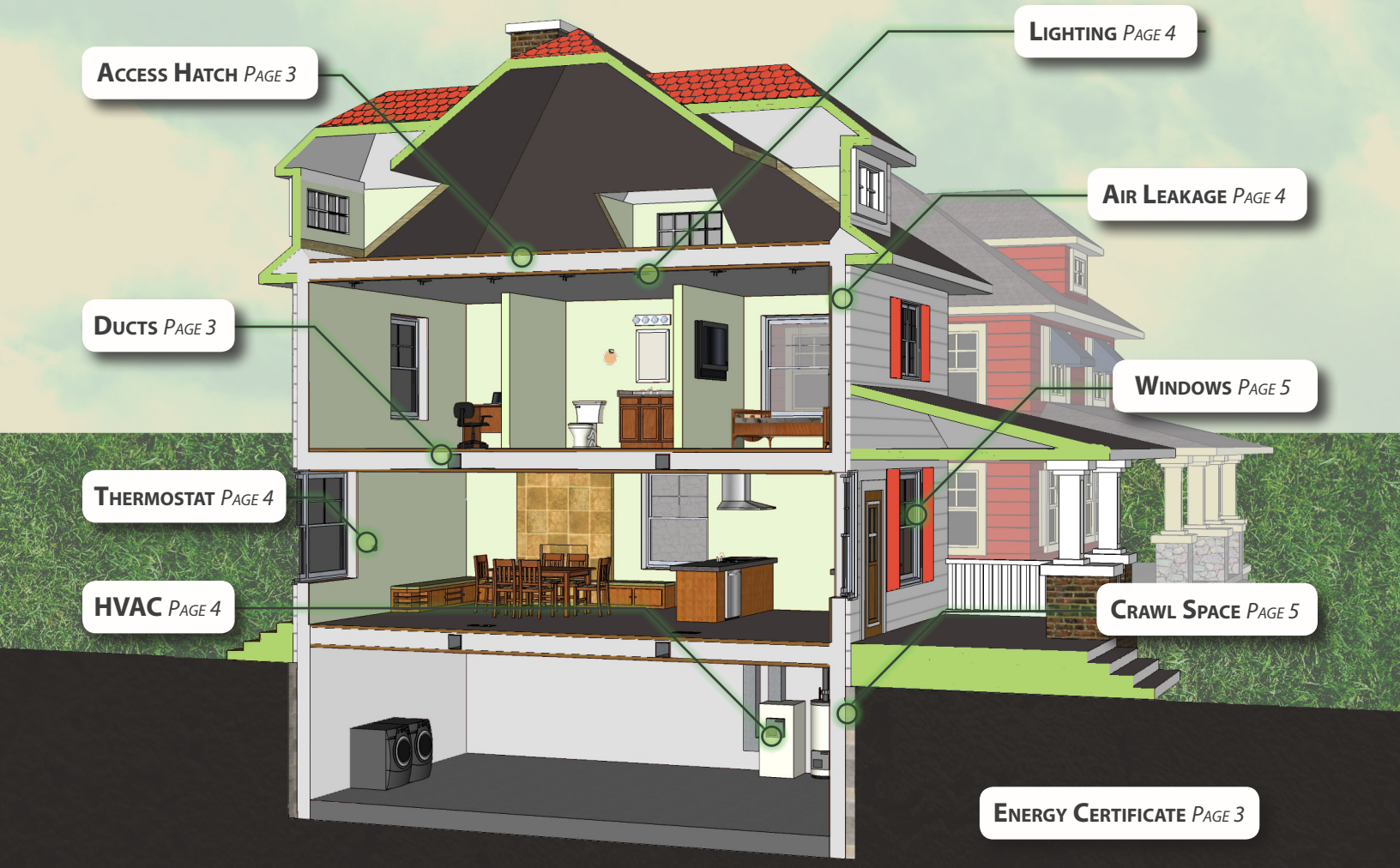


This checklist covers aspects of the **2009 International Energy Conservation Code**, which has been adopted or under consideration by many local governments in Missouri. The contents do not cover every aspect of the code, but it does address the requirements that are easiest to understand and see in a home after construction is complete. Energy-efficient homes are more comfortable, cost less to operate and reduce air pollution.

Energy Certificate

The 2009 IECC requires builders to attach permanent certificates on or in the circuit breaker box (i.e. electrical panel box) listing the materials and equipment values and ratings that demonstrate that a new home meets code requirements. The certificate is an important means by which the consumer can verify that the home complies with the code. Is there a certificate attached to your electrical panel?

2009 IECC Energy Certificate

Compliance Method		Date
PERSCRIPTIVE		5/1/2011
Insulation		**r-value**
Ceiling/Roof		38
Walls		13
Floors		19
Ducts		8
Basement Walls		10/13
Window and Door Ratings		**u-factor**
Windows		0.35
Doors		0.40
HVAC Equipment	**Type**	**Rating**
GAS BOILER		75% AFUE
Water Heating	**Type**	**EF value**
Water Heater	50 GAL, GAS	0.60
General Contractor:	K+M CONTRACTORS	
Insulation Contractor:	RKM INSULATION	
Form Completed By:		

2009 IECC Certificate Example

Attic Access Hatch/Door Insulation

Attic access can be a major source of air leakage in homes, causing utility bills to be high and creating uncomfortable drafts. According to national minimum standards, hatches/doors to the attic must be weather-stripped and insulated. They should be well-made so that they are airtight when you close them. (Test by closing door or hatch on a piece of paper. Can the paper be easily pulled out when the hatch/door is closed? If yes, the door/hatch is not airtight.) The insulation should be the same value as the surrounding areas and attached so that it isn't damaged or become loose when the hatch or door is opened and closed.

Insulated attic hatch and insulated ducts 1

Ductwork

Ductwork should be insulated and sealed. Leaky ducts can be responsible for 10-30% of energy loss in a home.

- Unless the attic ceiling (underside of the roof) and walls are insulated, when ducts run through attic space, the 2009 IECC requires that they be insulated to a minimum of R-8. Are the ducts in the attic insulated? Look at the label on the ductwork insulation – what R-level is it?
- Is ductwork sealed properly? All ducts and air handlers should be sealed with mastic (a special type of caulk that is easily visible); duct tape isn't sufficient. Either foil tape or mastic is preferable as they will stand the test of time and help reduce energy waste. Without proper sealing, your system will simply be heating (or cooling) the attic or crawl space – wasting considerable energy. In existing homes, leakage should be assumed and mastic should be applied along every seam and connection.

This duct has been sealed but not insulated 2

FOR **HOMEOWNERS**

Programmable Thermostat

Programmable thermostats can generate annual energy savings of 10%. According to the national code, homes with forced-air furnaces must have programmable thermostats installed. Regardless of the heating and cooling system in a home, programmable thermostats can save money. The average cost of a programmable thermostat ranges from $30 to $50.

A programmable thermostat

Heating, Ventilation, and Air Conditioning (HVAC) Systems

Improper installation of heating and air conditioning systems can waste significant energy and result in costly utility bills. If you are getting a system installed or replaced, ensure the quality of your new system by asking the contractor to apply for a permit and have the system professionally inspected after the installation is complete. To determine whether a contractor is licensed, get the name of the person who did the installation and contact your local government to find out if it registers local contractors.

Energy Efficient Lighting

Lighting has an enormous impact (approximately 12%) on the energy use in homes. The national minimum energy conservation code requires that builders put high efficiency light bulbs in at least 50 percent of hardwired lighting fixtures. High efficiency bulbs can include compact fluorescents, high-efficiency halogens, LEDs, etc.


A compact florescent (CFL) bulb

Air Leakage

Look for sources of air leaks into and out of the home. Air leakage is responsible for 30% or more of the energy loss in homes. All joints, seams, and penetrations between the inside and outside of the home should be sealed. Typically, caulk, spray foam or weather stripping is used to seal air leaks.

- Check to see whether leaks have been sealed in a home by looking at where phone lines, electrical lines, plumbing and other services enter the house. Are the holes plugged with caulk or other sealants?
- Check the holes in the attic floor where pipes and ducts lead to the rooms below. Are they sealed with foam, caulk, or other materials to prevent airflow?
- Open the cabinets under the kitchen sink, under the kitchen island, under bathroom sinks, etc., and look at pipes leading to the floor below or out through walls. Are the spaces around the pipes filled with caulk, foam, or other materials to prevent airflow?
- In the basement, look at exterior walls where pipes and wires lead to the outside. Are there airspaces around the pipes/wires or have they been sealed?
- Check where pipes and ducts pass up through the basement ceiling to the floor above. Are there gaps and spaces that create drafts and waste energy or are they sealed tightly?

Why Do Air Leaks Matter?

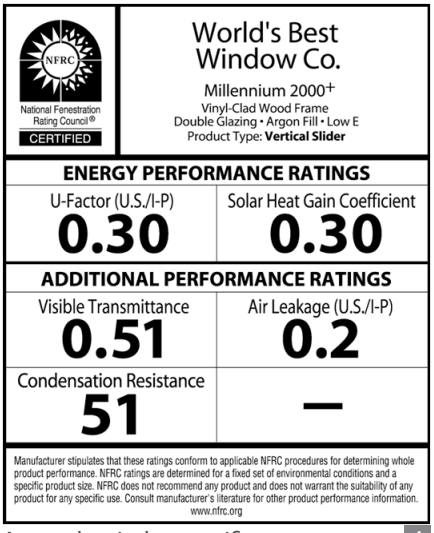
If a home is not properly sealed, dirt, dust, and moisture enters the home and can lead to a variety of respiratory problems including asthma and allergies. Did you know that up to 40 percent of the air we breathe on the first floor of our home comes from the crawlspace?

Windows

Windows and doors account for 18-20% of energy loss in homes. There are a number of factors that should be considered in evaluating older windows, as energy performance varies significantly based on the material that windows are made from and the condition they are in.

- Can you see daylight around the sides of the window frame or sash?
- Are windows loose in their tracks; can you slip a piece of paper between the sash and frame when they are closed and locked?
- What are the windows made of? Aluminum is typically known as a poor insulator. Fiberglass, wood, and vinyl do a better job, but much depends on the construction of the windows.
- Are windows single, double, or triple-paned? Note: storm windows installed over single-paned windows can perform about as well as conventional double-paned windows, but do not match the performance of high-performance windows with low-E glass and gas fills.
- The ability of double or triple-paned windows to block heat transfer depends greatly on whether they are "low-E coated". Low-E coatings are invisible, but can be detected by specialists.

Double-paned window with an insulated fiberglass frame 3



A sample window certificate 4

To learn more about window technology and benefits, please visit the Efficient Windows Collaborative web site: http://www.efficientwindows.org/code_overview.cfm

Crawl Space

Get under the house and get to know the crawl space. Either the floor over the crawl space should be insulated or (preferred) the crawl space walls should be insulated and the crawl space should not be vented. Insulation should be attached securely without gaps.

Crawl space vent 5

Proper installation (no vent) 6

Improper installation 7

June 2011. Missouri Homeowner Guide

Additional information can be found at the Missouri Department of Natural Resources' Division of Energy web site:
http://www.dnr.mo.gov/energy/index.html

Funds are made possible through the American Recovery and Reinvestment Act and the Transform Missouri initiative and administered by the Missouri Department of Natural Resources. This material is based upon work supported by the Department of Energy under Contract Number 136115. This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

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4 Courtesy of the Efficient Windows Collaborative
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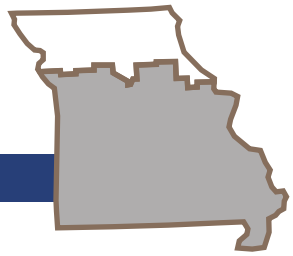
RES*check* Software Version 4.4.1

Inspection Checklist

Missouri Climate Zone 4



Ceilings:

❑ Ceiling 1: Raised or Energy Truss, R-30.0 cavity insulation (R-38.0 is required if construction includes a flat ceiling or a scissor truss).
Comments: _____
Insulation must achieve full height over the plate lines of exterior walls.

Above-Grade Walls:

❑ Wall 1: Wood Frame, 16" o.c., R-13.0 cavity insulation
Comments: _____

❑ Wall 2: Wood Frame, 16" o.c., R-13.0 cavity insulation
Comments: _____

❑ Wall 3: Wood Frame, 16" o.c., R-13.0 cavity insulation
Comments: _____

❑ Wall 4: Wood Frame, 16" o.c., R-13.0 cavity insulation
Comments: _____

Basement Walls:

❑ Basement Wall 1: Solid Concrete or Masonry, 9.0' ht / 8.0' bg / 9.0' insul, R-13.0 cavity insulation
Comments: _____

❑ Basement Wall 2: Solid Concrete or Masonry, 9.0' ht / 8.0' bg / 9.0' insul, R-13.0 cavity insulation
Comments: _____

❑ Basement Wall 3: Solid Concrete or Masonry, 9.0' ht / 8.0' bg / 9.0' insul, R-13.0 cavity insulation
Comments:

❑ Basement Wall 3 copy 1: Solid Concrete or Masonry, 9.0' ht / 8.0' bg / 9.0' insul, R-13.0 cavity insulation
Comments:

Windows:

❑ Window 1: Vinyl Frame:Double Pane with Low-E, U-factor: 0.350
For windows without labeled U-factors, describe features:
#Panes ____ Frame Type _____ Thermal Break? ____ Yes ____ No
Comments: _____

❑ Window 2: Vinyl Frame:Double Pane with Low-E, U-factor: 0.350
For windows without labeled U-factors, describe features:
#Panes ____ Frame Type _____ Thermal Break? ____ Yes ____ No
Comments: _____

❑ Window 3: Vinyl Frame:Double Pane with Low-E, U-factor: 0.350
For windows without labeled U-factors, describe features:
#Panes ____ Frame Type _____ Thermal Break? ____ Yes ____ No
Comments: _____

❑ Window 4: Vinyl Frame:Double Pane with Low-E, U-factor: 0.350
For windows without labeled U-factors, describe features:
#Panes ____ Frame Type _____ Thermal Break? ____ Yes ____ No
Comments: _____

Doors:

❑ Door 1: Solid, U-factor: 0.250

Comments: _____

❑ Door 2: Solid, U-factor: 0.250

Comments: _____

Air Leakage:

❑ Joints (including rim joist junctions), attic access openings, penetrations, and all other such openings in the building envelope that are sources of air leakage are sealed with caulk, gasketed, weatherstripped or otherwise sealed with an air barrier material, suitable film or solid material.

❑ Air barrier and sealing exists on common walls between dwelling units, on exterior walls behind tubs/showers, and in openings between window/door jambs and framing.

❑ Recessed lights in the building thermal envelope are 1) type IC rated and ASTM E283 labeled and 2) sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

❑ Access doors separating conditioned from unconditioned space are weather-stripped and insulated (without insulation compression or damage) to at least the level of insulation on the surrounding surfaces. Where loose fill insulation exists, a baffle or retainer is installed to maintain insulation application.

❑ Wood-burning fireplaces have gasketed doors and outdoor combustion air.

Air Sealing and Insulation:

❑ Building envelope air tightness and insulation installation complies by either 1) a post rough-in blower door test result of less than 7 ACH at 33.5 psf OR 2) the following items have been satisfied:

(a) Air barriers and thermal barrier: Installed on outside of air-permeable insulation and breaks or joints in the air barrier are filled or repaired.

(b) Ceiling/attic: Air barrier in any dropped ceiling/soffit is substantially aligned with insulation and any gaps are sealed.

(c) Above-grade walls: Insulation is installed in substantial contact and continuous alignment with the building envelope air barrier.

(d) Floors: Air barrier is installed at any exposed edge of insulation.

(e) Plumbing and wiring: Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.

(f) Corners, headers, narrow framing cavities, and rim joists are insulated.

(g) Shower/tub on exterior wall: Insulation exists between showers/tubs and exterior wall.

Sunrooms:

❑ Sunrooms that are thermally isolated from the building envelope have a maximum fenestration U-factor of 0.50 and the maximum skylight U-factor of 0.75. New windows and doors separating the sunroom from conditioned space meet the building thermal envelope requirements.

Materials Identification and Installation:

❑ Materials and equipment are installed in accordance with the manufacturer's installation instructions.

❑ Insulation is installed in substantial contact with the surface being insulated and in a manner that achieves the rated R-value.

❑ Materials and equipment are identified so that compliance can be determined.

❑ Manufacturer manuals for all installed heating and cooling equipment and service water heating equipment have been provided.

❑ Insulation R-values, glazing U-factors, and heating equipment efficiency are clearly marked on the building plans or specifications.

Duct Insulation:

❑ Supply ducts in attics are insulated to a minimum of R-8. All other ducts in unconditioned spaces or outside the building envelope are insulated to at least R-6.

Duct Construction and Testing:

❑ Building framing cavities are not used as supply ducts.

❑ All joints and seams of air ducts, air handlers, filter boxes, and building cavities used as return ducts are substantially airtight by means of tapes, mastics, liquid sealants, gasketing or other approved closure systems. Tapes, mastics, and fasteners are rated UL 181A or UL 181B and are labeled according to the duct construction. Metal duct connections with equipment and/or fittings are mechanically fastened. Crimp joints for round metal ducts have a contact lap of at least 1 1/2 inches and are fastened with a minimum of three equally spaced sheet-metal screws.
Exceptions:

Joint and seams covered with spray polyurethane foam.

Where a partially inaccessible duct connection exists, mechanical fasteners can be equally spaced on the exposed portion of the joint so as to prevent a hinge effect.

Continuously welded and locking-type longitudinal joints and seams on ducts operating at less than 2 in. w.g. (500 Pa).

❑ Duct tightness test has been performed and meets one of the following test criteria:

(1) Postconstruction leakage to outdoors test: Less than or equal to 161.3 cfm (8 cfm per 100 ft2 of conditioned floor area).

(2) Postconstruction total leakage test (including air handler enclosure): Less than or equal to 241.9 cfm (12 cfm per 100 ft2 of conditioned floor area) pressure differential of 0.1 inches w.g.

(3) Rough-in total leakage test with air handler installed: Less than or equal to 121.0 cfm (6 cfm per 100 ft2 of conditioned floor area) when tested at a pressure differential of 0.1 inches w.g.

(4) Rough-in total leakage test without air handler installed: Less than or equal to 80.6 cfm (4 cfm per 100 ft2 of conditioned floor area).

Temperature Controls:

❑ At least one programmable thermostat is installed to control the primary heating system and has set-points initialized at 70 degree F for the heating cycle and 78 degree F for the cooling cycle.

Heating and Cooling Equipment Sizing:

❑ Additional requirements for equipment sizing are included by an inspection for compliance with the International Residential Code.

❑ For systems serving multiple dwelling units documentation has been submitted demonstrating compliance with 2009 IECC Commercial Building Mechanical and/or Service Water Heating (Sections 503 and 504).

Circulating Service Hot Water Systems:

❑ Circulating service hot water pipes are insulated to R-2.

❑ Circulating service hot water systems include an automatic or accessible manual switch to turn off the circulating pump when the system is not in use.

Heating and Cooling Piping Insulation:

❑ HVAC piping conveying fluids above 105 degrees F or chilled fluids below 55 degrees F are insulated to R-3.

Swimming Pools:

❑ Heated swimming pools have an on/off heater switch.

❑ Pool heaters operating on natural gas or LPG have an electronic pilot light.

❑ Timer switches on pool heaters and pumps are present.
Exceptions:

Where public health standards require continuous pump operation.

Where pumps operate within solar- and/or waste-heat-recovery systems.

❑ Heated swimming pools have a cover on or at the water surface. For pools heated over 90 degrees F (32 degrees C) the cover has a minimum insulation value of R-12.
Exceptions:

Covers are not required when 60% of the heating energy is from site-recovered energy or solar energy source.

Lighting Requirements:

❑ A minimum of 50 percent of the lamps in permanently installed lighting fixtures can be categorized as one of the following:

(a) Compact fluorescent

(b) T-8 or smaller diameter linear fluorescent

(c) 40 lumens per watt for lamp wattage <= 15

(d) 50 lumens per watt for lamp wattage > 15 and <= 40

(e) 60 lumens per watt for lamp wattage > 40

Other Requirements:

❑ Snow- and ice-melting systems with energy supplied from the service to a building shall include automatic controls capable of shutting off the system when a) the pavement temperature is above 50 degrees F, b) no precipitation is falling, and c) the outdoor temperature is above 40 degrees F (a manual shutoff control is also permitted to satisfy requirement 'c').

Certificate:

❑ A permanent certificate is provided on or in the electrical distribution panel listing the predominant insulation R-values; window U-factors; type and efficiency of space-conditioning and water heating equipment. The certificate does not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels.

NOTES TO FIELD: (Building Department Use Only)

2009 IECC Energy Efficiency Certificate

Insulation Rating	R-Value
Ceiling / Roof	30.00
Wall	13.00
Floor / Foundation	13.00
Ductwork (unconditioned spaces):	_____

Glass & Door Rating	U-Factor	SHGC
Window	0.35	0.30
Door	0.25	NA

Heating & Cooling Equipment	Efficiency
Heating System:_____	_____
Cooling System:_____	_____
Water Heater:_____	_____

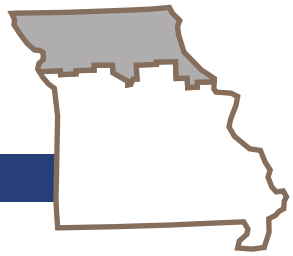
Name: _____ Date: _____

Comments:

RES*check* Software Version 4.4.1

Inspection Checklist

Missouri Climate Zone 5



Ceilings:

❑ Ceiling 1: Raised or Energy Truss, R-38.0 cavity insulation
Comments: _____
Insulation must achieve full height over the plate lines of exterior walls.

Above-Grade Walls:

❑ Wall 1: Wood Frame, 16" o.c., R-19.0 cavity insulation
Comments: _____

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Comments: _____

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Comments: _____

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Comments: _____

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NOTES TO FIELD: (Building Department Use Only)

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Insulation Rating	R-Value
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Floor / Foundation	13.00
Ductwork (unconditioned spaces):	_____

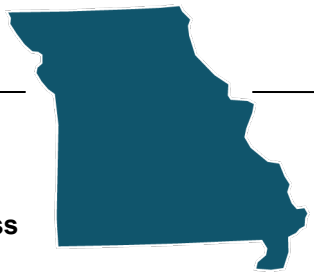
Glass & Door Rating	U-Factor	SHGC
Window	0.35	0.30
Door	0.25	NA

Heating & Cooling Equipment	Efficiency
Heating System:_____	_____
Cooling System:_____	_____
Water Heater:_____	_____

Name: _____ Date: _____

Comments:

Why Energy Codes Matter for Missouri



Save Energy, Save Money

In Missouri, homes built to the current model energy code use **18-26 percent less energy** than the state average, saving their occupants **$337-559 per year in lower utility bills**. That's money that goes directly to consumers' and companies' pockets.

And these savings add up. If all municipalities in Missouri adopted and enforced the model energy code statewide in 2011, the state would **save $318 billion annually in energy costs by 2030. It would also avoid 26 trillion Btu of energy use annually by 2030.**

Protect Occupants

Everyone has a right to buildings that meets national standards for energy efficiency. Builders must comply with energy codes as stringently as they comply with codes for life, health, and safety.

Make a Cost-Effective Investment

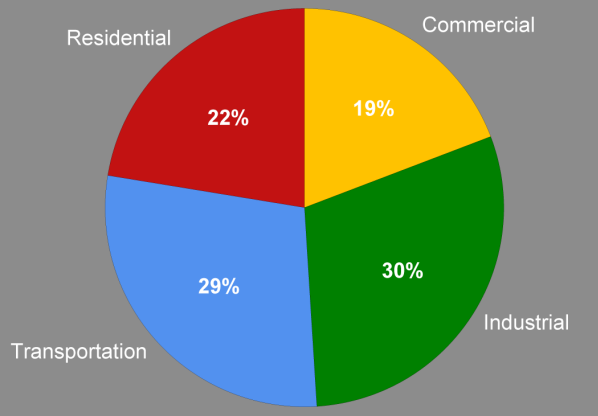
Would you rather spend a few dollars more on a monthly mortgage or spend thousands on a retrofit down the line? **It's much more cost-effective to build to the model energy code** than try to improve efficiency later through expensive retrofits that do not achieve comparable savings.

Even when you factor in the additional upfront cost, when amortized over a standard mortgage, **Missouri homeowners will see net savings within the first year.** From there, they will **spend about $28 to $47 less on utility bills per month!**

Help Make Informed Decisions

Knowing that a building is energy-efficient **empowers consumers and businesses to make informed decisions**. Before buying or renting, do your research. Ask the current occupants what they pay. If it's a new home, ask the builder about its energy efficiency—and then **make them show you how it meets code**.

Did you know that buildings account for **over 40 percent of total energy use in the United States?** That's more than either the transportation or industrial sectors.



Reduce Pollution and Increase Reliability

Most buildings waste energy needlessly, which **increases pollution and puts stress on the grid**. By adopting energy codes, Missouri would prevent 1.4 million metric tons of CO_2 annually by 2030 .

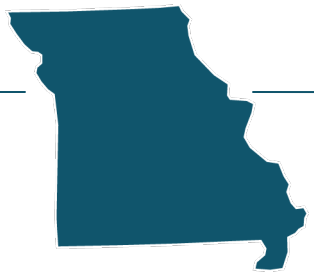
Provide Quality and Comfort

How do you know if a home or office is built well? **One way to measure quality construction is through energy efficiency.** Buildings that meet or exceed the model energy codes are built with the occupant's best interests in mind, which carry over to all facets of construction. **Energy-efficient buildings are also more comfortable and require less heating and cooling.**

MISSOURI DEPARTMENT OF NATURAL RESOURCES

BCAP

Missouri Costs and Savings: By The Numbers



Energy Costs

Energy isn't cheap. Just look at the numbers:

95%	Primary energy imported.
$20b	Annual spending on energy statewide.
22%	The rise in the cost of residential electricity in Missouri, 2004 to 2009.

By not adopting the model energy code, **Missouri residents spend billions** importing energy that could go back into the state economy. Why throw away a perfect opportunity to **put money back into the pockets of consumers and businesses**?

Energy Code Savings

The savings from building to the model energy code are significant. Consider:

18-26%	Energy savings in homes.
$337-559	Annual savings from reduced utility bills.
10-11%	Energy savings and reduced utility bills in office buildings.

What's more, **these savings add up**. If all municipalities and counties in the state adopted and enforced the model energy code in 2011:

$318 million
Annual energy savings by 2030.

18-26%
Annual utility bill savings for new homes.

26 trillion
Btu of energy avoided annually by 2030.

1.4 million
Metric tons of CO_2 prevented annually by 2030.

MISSOURI DEPARTMENT OF NATURAL RESOURCES

BCAP

Sources: Energy and CO2 savings calculated by BCAP's code estimator. Energy Savings estimates for homes and commercial buildings are sourced from DOE. Baseline energy consumption data sourced from EIA.

Coming Down the Road:

Achieving 90 Percent Compliance with the Energy Code

The Recovery Act of 2009 mandates that states show that they have achieved 90 percent compliance with the energy code by 2017. Compliance measurement is likely to differ from state to state, as each will have to collaborate with local code officials to find an ideal strategy that fits with the state's unique needs, infrastructure, and resources available.

State Strategies

States will not have to tackle the problem of developing a 90% compliance strategy by themselves. The Department of Energy (DOE) has created a dedicated State Compliance Evaluation Procedures website[1] that provides videos, resources, and web tools to show states and local inspections departments what the compliance measurement process could look like. DOE staff members are also available to answer questions and research best practices.

Kansas City at night 1

In addition, by the fall of 2011, DOE will have completed pilot studies in nine states across the country to develop local strategies for measuring compliance. Examples and lessons learned from this program will be published on the website noted above to help develop and inform strategies that will work in other states and localities. In addition, sparked by the launch of DOE's pilot studies on compliance, several states have started their own measurement and verification (M&V) projects using all or part of the DOE pilot methodology and tools. DOE will also have information and results on these projects available for interested parties.

[1] http://www.energycodes.gov/arra/compliance_evaluation.stm

Program Structure

While the state is responsible for reporting compliance results, the responsibility will fall to local governments—usually their inspections departments—to either make available the needed information on construction projects in progress or to collect data themselves on how designers and construction professionals are designing and constructing buildings. DOE has suggested that evaluation of design and building practice for each state can be structured a number of ways: through 1st party evaluation by local inspections departments, 2nd party inspection by the state, or third-party evaluation by private sector firms. Missouri's strong home rule tradition may mean that 1st party evaluation is the most likely option, but a final determination can be made at a later date.

Stockton Lake 2

MISSOURI DEPARTMENT OF NATURAL RESOURCES

BCAP

1 Courtesy of Flickr Creative Commons - danoStL

2 Courtesy of Flickr Creative Commons - smysnbrg

Coming Down the Road:
Achieving 90 Percent Compliance with the Energy Code

Measuring Compliance

Measuring compliance will require responsible parties to evaluate compliance for a small sample of Missouri construction projects. DOE guidelines outline how to select and evaluate samples in four categories: new commercial construction projects, commercial renovations, new residential construction and, lastly, residential renovations. To help states determine appropriate sample sizes, DOE created a State Sample Generator that creates a suggested sample size for each type of project. Sample sizes are relatively small and are based on the recent number of permits over preceding years. (See Figure 1, at right). For example, for new single family construction, a single run of the State Sample Generator suggests that fast-growing Jackson County would require a sample of only two residential buildings -- out of over 1,000 that have been built anually in recent years.

CONSTRUCTION SAMPLES

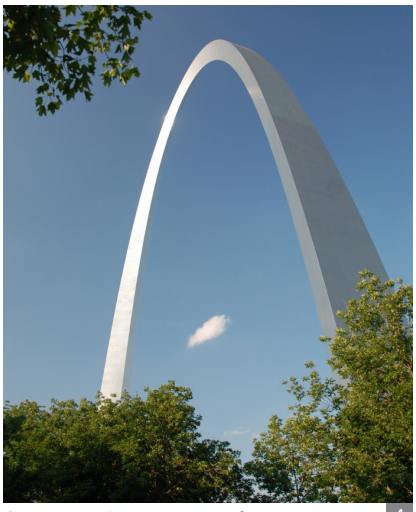
Commercial New Construction

Construction starts represent an annual average from 2008-2010 data.

Location	Construction Starts	Sample Size				
		Small	Medium	Large	X-Large	XX-Large
State Totals	359	14	13	13	0	0
Climate Zone 4 Totals	346	13	12	12		
Boone County	12	·	·	1		
Camden County	1	1	·	·		
Cape Girardeau County	11	·	1	·		
Cass County	7	1	·	2		
Clay County	17	·	·	1		
Cole County	7	·	1	·		
Franklin County	4	1	·	·		
Greene County	30	1	2	·		
Jackson County	71	3	2	·		
Phelps County	6	1	·	·		
Platte County	8	·	2	2		
Pulaski County	6	·	2	1		
Reynolds County	2	1	·	·		
St. Charles County	16	·	·	3		
St. Louis County	67	1	2	2		
Taney County	5	2	·	·		
Wright County	0	1	·	·		

Figure 1: Example construction sample generator result 3

Determining a method for choosing which particular buildings to include in the sample can be left up to responsible local jurisdictions. For each building in the sample, officials are not required to track specific buildings throughout every stage of the inspection process. Instead, officials may perform inspections to evaluate compliance of various code requirements across a larger group of buildings (each at a different level of completeness) simultaneously. By allowing this flexibility, DOE believes the burden on local communities will be lowered while still helping to collect valuable data on compliance. More information on this approach is available on the DOE website described above.



St. Louis Gateway Arch 4

Collecting Data

To measure code compliance, DOE has produced sample checklists which can be used to evaluate compliance during plan review and construction. Suggested checklists are likewise posted to DOE's State Compliance Evaluation Procedures website. Data collected from these evaluations can be entered on the same website, via DOE's Score and Store tool. By aggregating data in this location, the state will be able to demonstrate energy code compliance.

Not One-Size-Fits-All

Still a work in progress, efforts to measure energy code compliance should not be viewed as a one size fits all process. Instead, states can work with their constituent jurisdictions and call on resources from DOE to craft a plan that is right for their needs.

3 Courtesy of U.S. Department of Energy

4 Courtesy of Flickr Creative Commons - Robert Jackson