

# Show Me the Costs!

## Energy Code Adoption Support Using Hard Data

**Paul Karrer**

Project Manager – National Advocacy

October 17, 2012

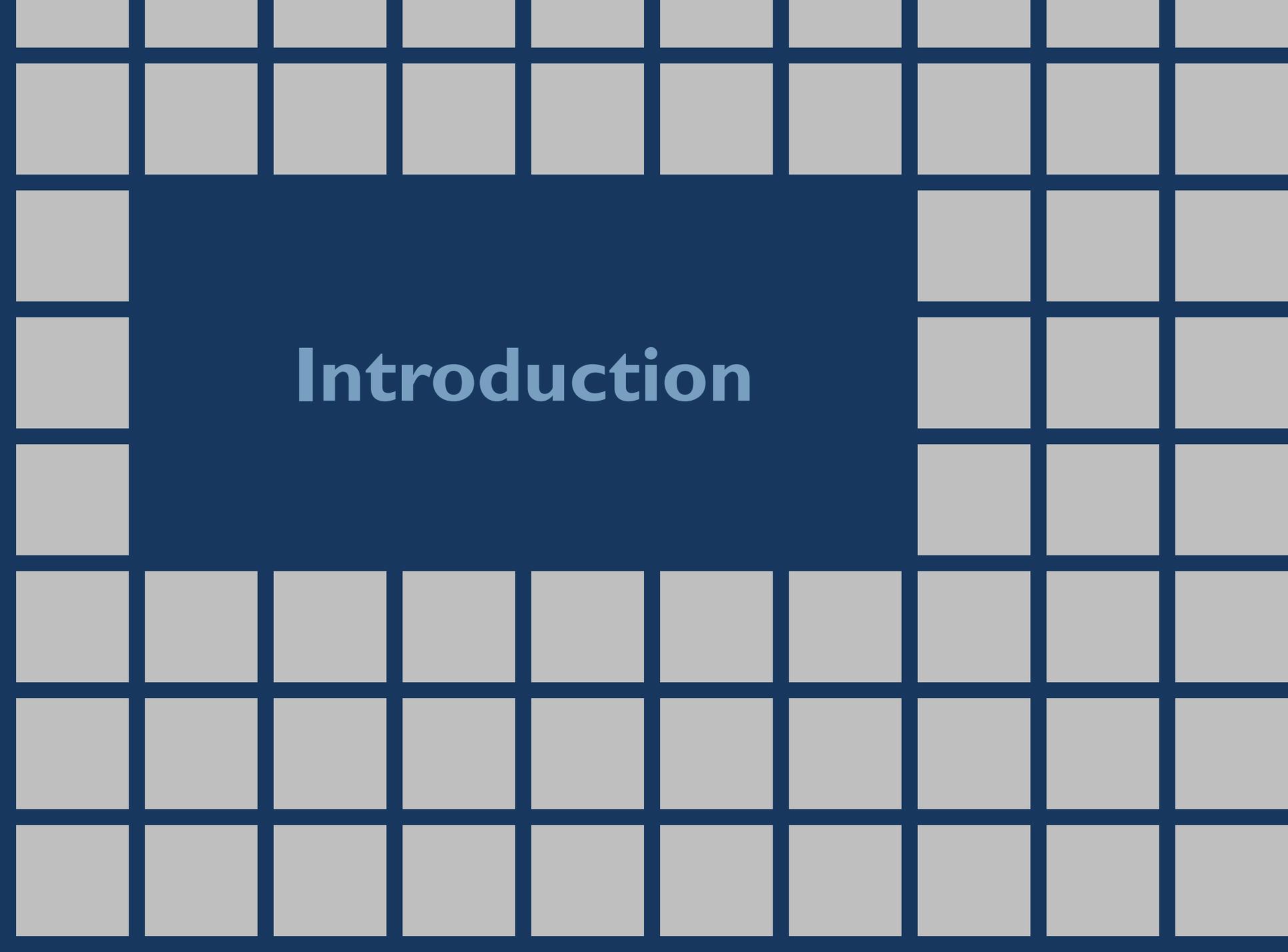


**BCAP** Dedicated to the adoption, implementation,  
and advancement of building energy codes

# Agenda

# Agenda

- Introduction
- Role of Cost Analyses in Adoption Support
- Prototype Home
- BCAP Analysis in Three Steps
  1. Energy Savings Analysis
  2. Construction Cost Analysis
  3. Financing & Mortgage Payback
- Other National Cost Studies



# Introduction

# What is BCAP?

- The **Building Codes Assistance Project (BCAP)** is an ongoing initiative of the Alliance to Save Energy, a nonprofit organization that promotes energy efficiency worldwide through research, education and advocacy.
- BCAP strives to be the premier resource for energy code support, coordination, technical assistance, news, and information.



# Our Mission

- Our mission is to reduce the energy consumed in the construction and operations of buildings by working with national, state, and local governments and other stakeholders to promote the adoption and implementation of building codes and standards.



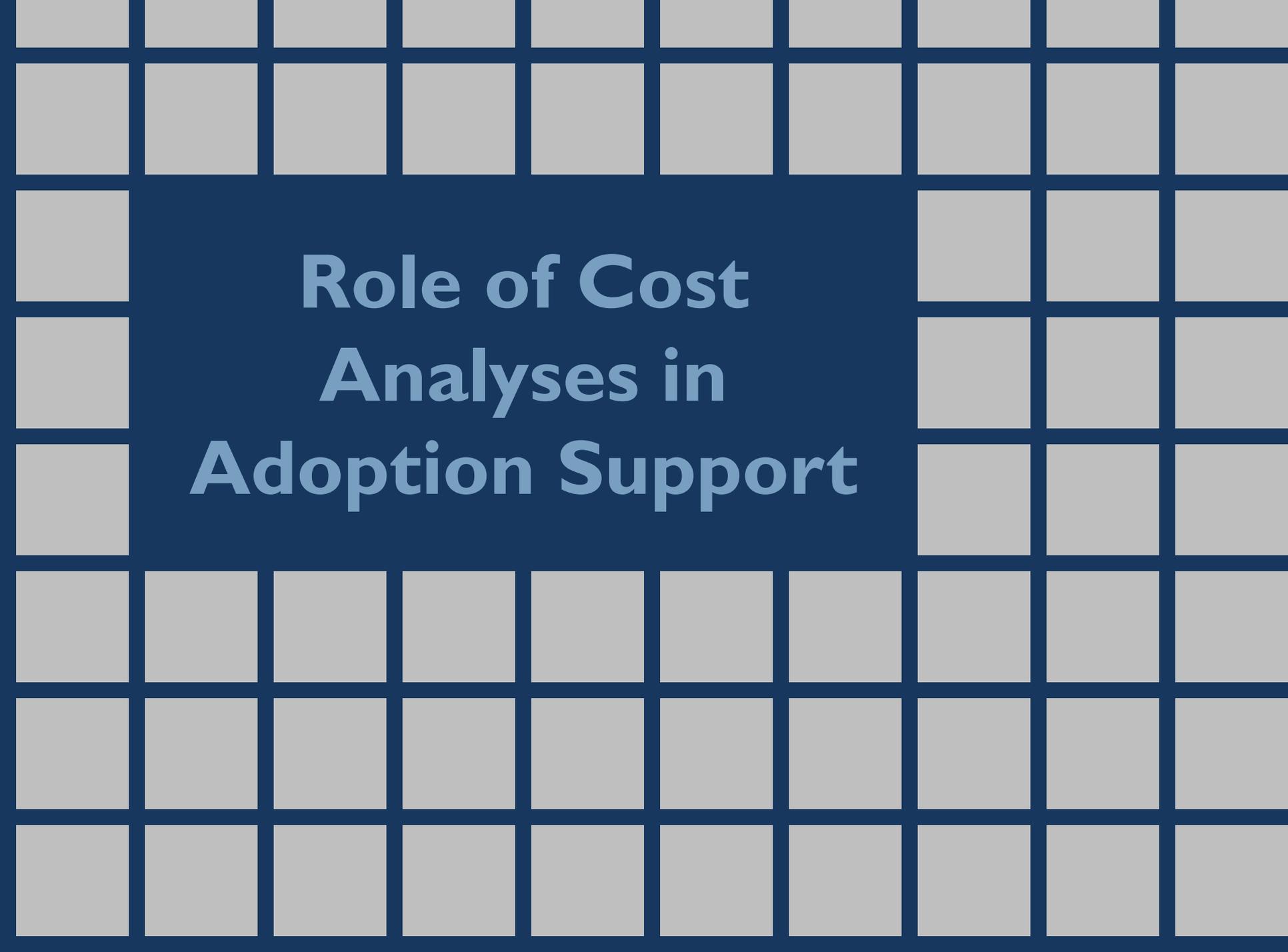
# Online Code Environment & Advocacy Network

[www.energycodesocean.org](http://www.energycodesocean.org)



[Launch OCEAN>](#)

- An online portal of building energy code resources, best practices, tools, news, and more
- All of BCAP's work is kept on the site
- Other organizations and individuals encouraged to upload resources and work, comment and participate in discussions
- Site maintained by BCAP



# **Role of Cost Analyses in Adoption Support**

# On-Location, Customizable Adoption Support



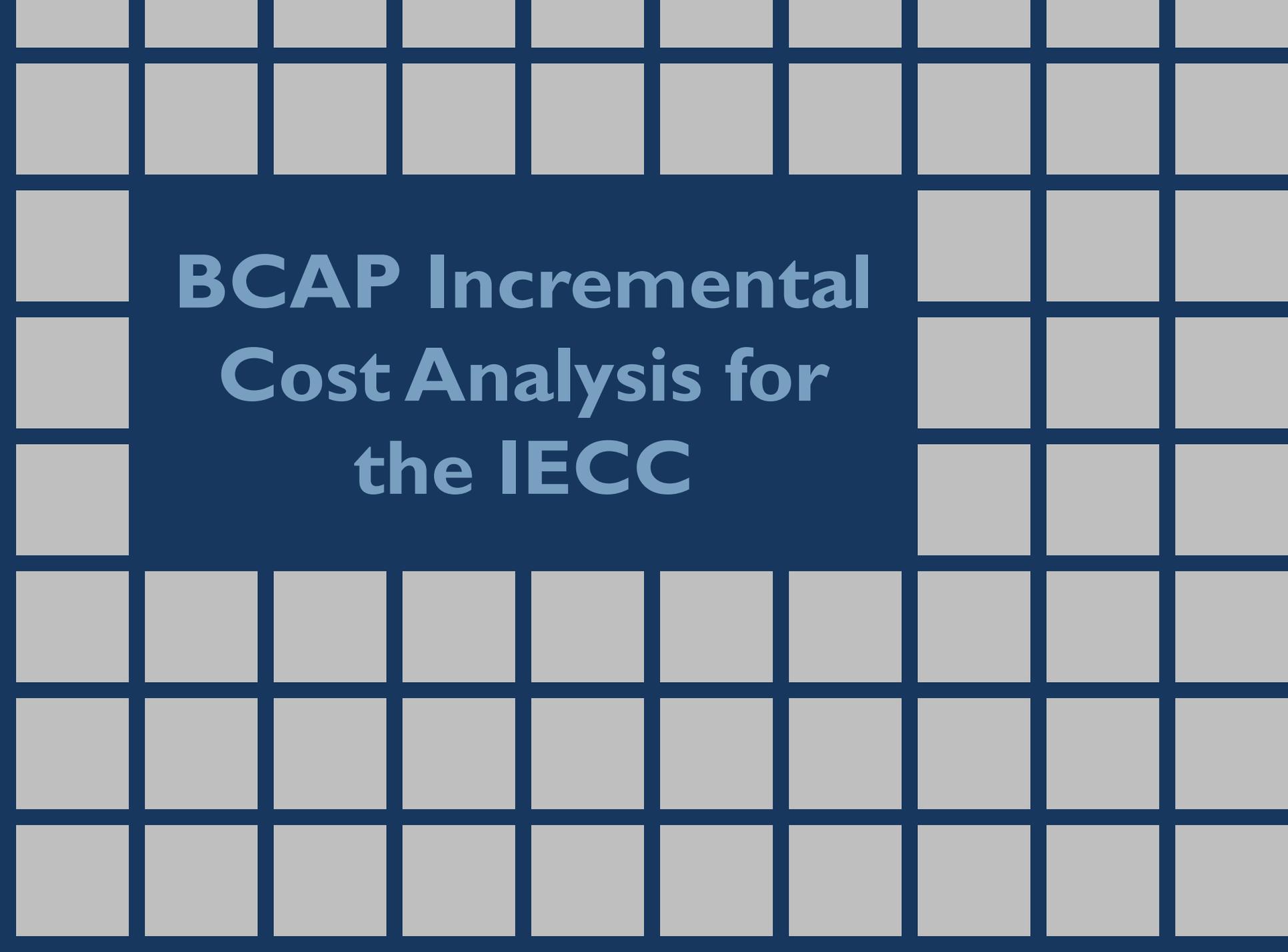
- Attend and testify at code hearings
- Customize adoption support materials for a state or municipality
- Coordinate with local stakeholders
- Bring national perspective and best practices to local situations



# But What Does It Cost?

- Probably the most common question received from stakeholders ranging from policymakers to building industry professionals
- Confined to residential sector mostly, but DOE is starting a commercial cost analysis project
- Local estimates often have range wildly
- Concerns that the added cost of complying with the IECC will price people out of the market, especially first-time homebuyers.
- *BCAP: We know the energy code saves \$, we just have to document and explain it*

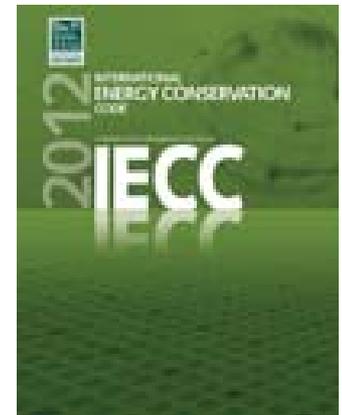
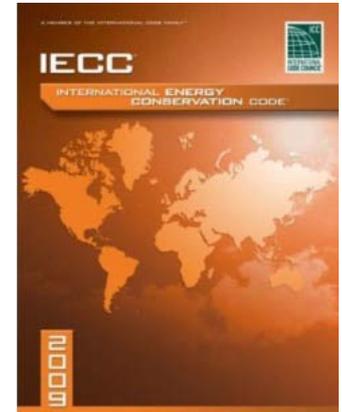




**BCAP Incremental  
Cost Analysis for  
the IECC**

# Project Goals

- Provide 2009 and/or 2012 IECC Incremental Cost Analysis for as many states and key cities as possible
- Create a accurate, detailed, and persuasive analysis that will support code adoption at the state and local levels
- Help stakeholders counter misinformation with easy-to-understand resources



# Project Funding

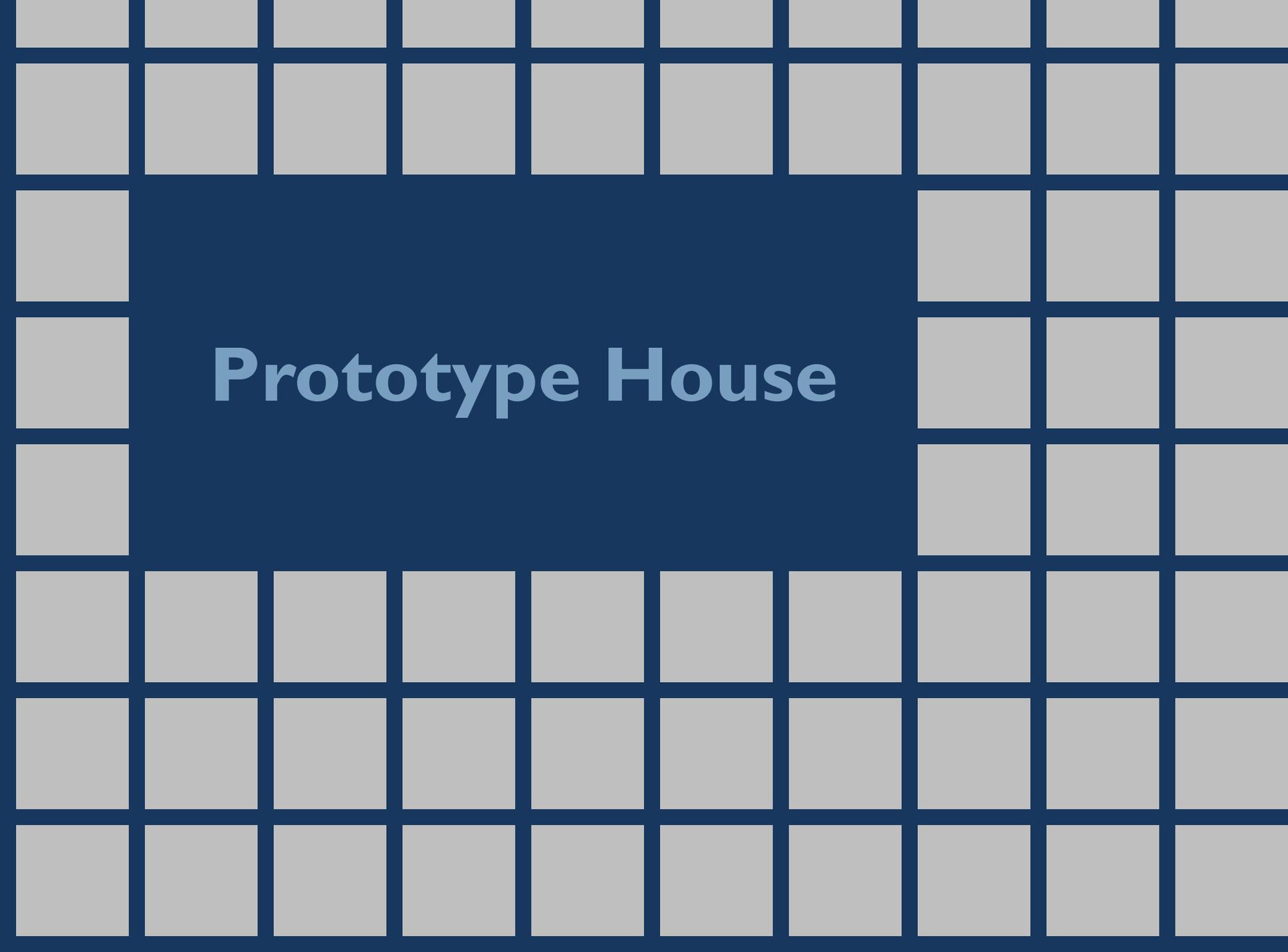
- Energy Foundation
- Energy Efficient Codes Coalition (EECC)
- Analyses on request; Prioritize states or cities expressing interest in adopting updated IECC versions



# Project Staff

- **John Miller** (*project lead and inspiration*)
- **Mike DeWein** (*technical determinations, God-fatherly guidance*)
- **Mark Lessans** (*technical assistance, graphic design for two-page handouts, resources, and webpage layout*)
  
- **Maureen Guttman, Cosimina Panetti, and Jeff Harris** (*oversight, strategy, deployment*)
- **Paul Bostrom** (*data analysis, fit, and finish*)
- **Seul Rhee** (*assisted production of two-page handouts & other graphic resources*)
- **Abi Kallushi** (*assisted on graphic presentation of two-pagers*)
- **Nils Petermann** (*windows data*)



The image features a dark blue background with a grid of light gray squares. The grid is composed of 10 columns and 10 rows. The central area, where the text is located, is a solid dark blue rectangle that overlaps the grid. The text 'Prototype House' is centered within this dark blue area.

# Prototype House

# Establishing a Prototype House

- Attempt to be representative of new residential development in the area of investigation
- But also consistent with characteristics in the average home nationwide to allow for comparability



# Prototype House Dimensions

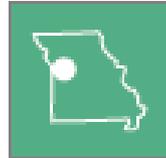
- 2,400 square feet (approximate size of average new house nationwide)
- 30 feet wide by 40 feet long
- Two stories above grade (a 1,200 square foot basement can also be added depending on the area)



# Choose an Area to Investigate

TRUE COST OF THE

2012 INTERNATIONAL ENERGY CONSERVATION CODE



FOR NEW HOMES IN  
KANSAS CITY, MO



KANSAS CITY  
CLIMATE ZONE 4



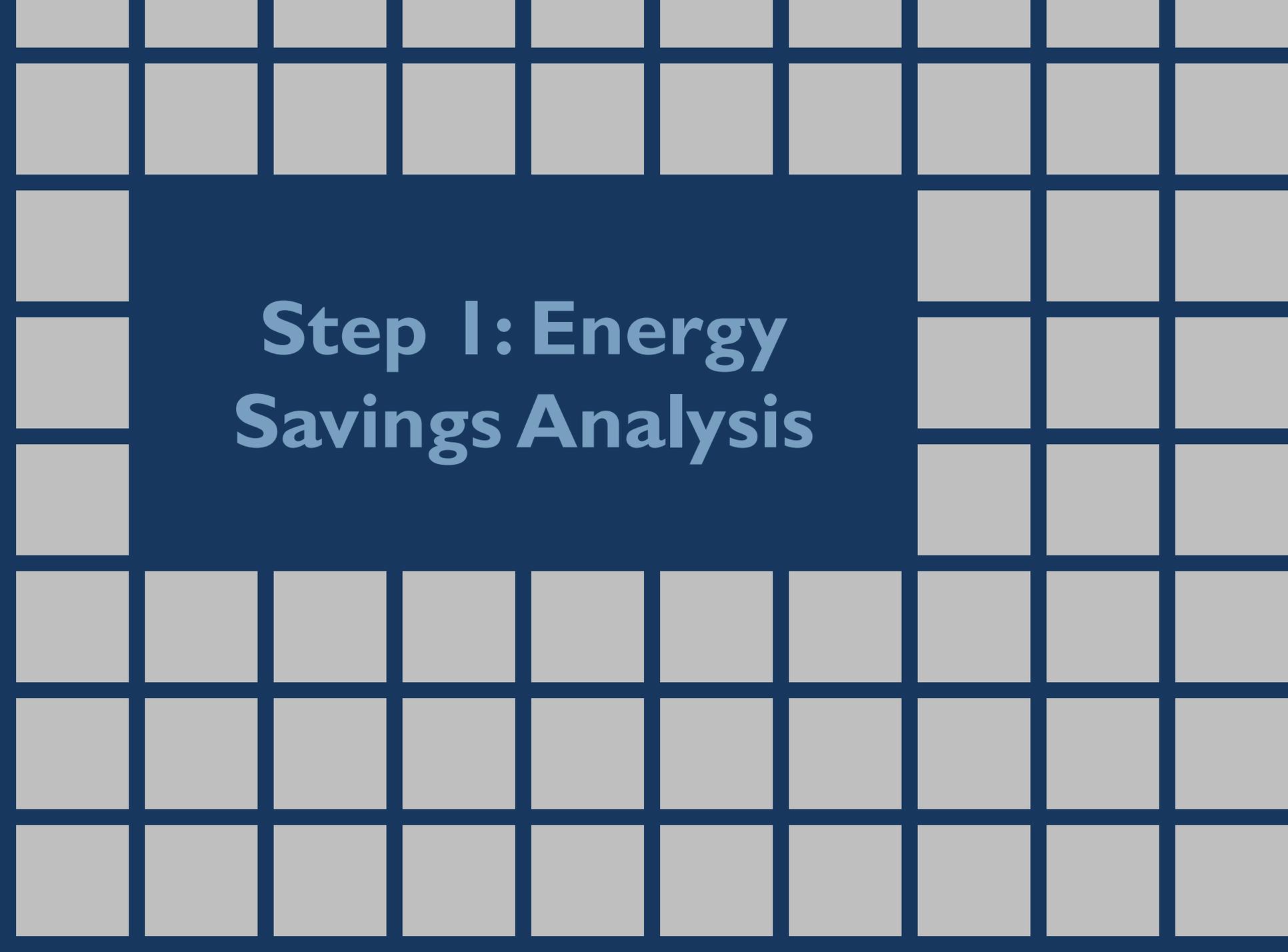
# Then... a Process in 3 Steps

1. Energy Savings Analysis
2. Construction Cost Analysis
3. Financing & Mortgage Payback



KANSAS CITY  
CLIMATE ZONE 4





# **Step 1: Energy Savings Analysis**

# Establish a Code Baseline

- At the time of this analysis, Kansas City enforced the 2006 IECC
- We assume a baseline home that exactly meets the requirements of the 2006 IECC.
- Also, although we err on the side of good building practice, in an effort to be conservative we have included some incremental costs that may not be necessary.



# Identify Changes Between Codes

- Ceiling insulation: R-38 → R-49
- Wall insulation: R-13 → R-20 or R-13+5
- Window upgrades to lower U-factor
- Attic hatch or door sealed and insulated
- Bathroom ventilation fan upgrades



# Identify Changes Between Codes

- Add programmable thermostats
- Improved home air sealing
- Blower door and duct blaster testing
- Insulated hot water pipes
- High efficacy lighting fixtures: 0%→75%
- Upgrading from panned to “hard ducted” return ducts.



# Energy Savings Modeling

- Modeled by ICF International (ICFI)
- International energy consulting firm with extensive experience in the use of hourly building energy simulation software
- Estimate energy performance and energy savings of alternative building codes and design concepts.



# Modeling by ICFI Beacon



- ICFI's Building Energy Analysis Console™ (Beacon) energy modeling platform
- Hourly simulation model that using DOE-2 EnergyPlus, summarizes building performance in terms of estimated annual energy costs
- Both the existing 2006 IECC and the new 2012 IECC codes allow a builder to choose among a number of alternatives to comply with the code.
- In this case, ICFI conservatively chose to compare the results from the prescriptive path of each version of the code.



# Modeling by ICFI Beacon

- Costs based on long-term average weather conditions in a given climate zone (city)
- State-level energy price data from DOE's EIA, updated monthly
- Estimates energy consumption by end-use, fuel type, electricity peak demand, and air conditioner size in each prototype home.



# Some Assumptions Likely Understate Savings

- We assume energy prices will remain constant over the full 30-year mortgage term.
- A down payment smaller than 20% would reduce the breakeven point.
- Energy savings are calculated from prescriptive measures only.
- HVAC downsizing estimation rounded down to the nearest half-ton.



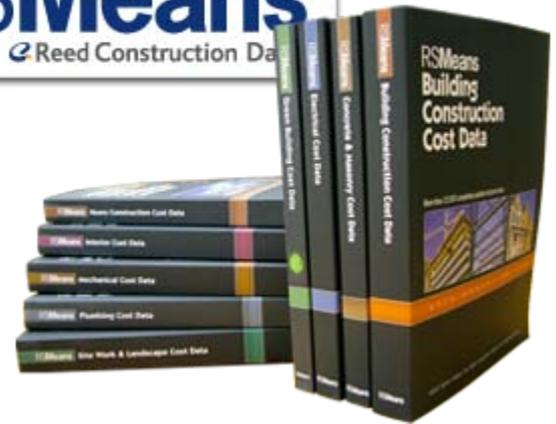


**Step 2:  
Construction Cost  
Analysis**

# Main Information Source: RS Means

- Use well-regarded *RS Means Contractor's Pricing Guide* to approximate actual costs of new home construction.
- Known to be conservative; useful for this analysis because all estimated construction costs are inclusive of material costs, labor, contractor overhead, profit, and location

**RSMeans**  
Reed Construction Data



# Other Information Sources

- Major industry suppliers (Lowe's, Home Depot)
- Building industry experts
- Interviews with local homebuilders in the area being investigated.
- Fenestration data from the Efficient Windows Collaborative (EWC)



# Estimated Incremental Cost Tables

**Table 1: Kansas City Missouri 2012 IECC Incremental Costs**

Building Component	Total Area	Incremental Cost/Square Ft	Total	Location Factor	Adjusted Total
Wall Option 1: R-13 + 5	2,380	\$0.34	\$ 809.20	103%	\$833
Wall Option 2: R-20 Walls with Studs Spaced 16" on Center	2,380	\$0.59	\$1,404.20	103%	\$1,446
Wall Option 3: R-20 Walls with Studs Spaced 24" on Center	2,380	\$0.25	\$ 595.00	103%	\$613
Ceiling insulation Upgrade to R-49	1,200	\$0.41	\$ 492.00	103%	\$507
1 <sup>st</sup> Floor Panned Return Ducts Upgraded to Flexible Ducts	75 linear ft	\$2.29/lf	\$ 171.75	103%	\$177
Upgrade Windows to Argon Fill	357	\$0.50	\$ 178.50	N/A	\$179
Programmable Thermostat Upgrade	N/A	N/A	N/A	N/A	\$ 50
Increased Air Sealing and Testing	N/A	N/A	N/A	N/A	\$350
Insulating Hot Water Pipes	N/A	N/A	N/A	N/A	\$100
75% CFLs in hardwired fixtures	N/A	N/A	N/A	N/A	\$ 50
Bathroom Vent Fan Upgrades	N/A	N/A	N/A	N/A	\$150
Sealing/Insulating Attic Hatch	N/A	N/A	N/A	N/A	\$100
HVAC System Savings (downsizing 1 ton)	N/A	N/A	N/A	N/A	-\$815
<b>Total Incremental Costs (Varies Based on Wall Type Above)</b>					<b>\$1,460 to \$2,293</b>



# Results for 2012 IECC – Kansas City

- Energy cost savings: **\$621 per year**
- Net incremental costs: Range from **\$1,460 to \$2,293** (depending on which wall construction type is selected)

Wall Type	Incremental Costs
R-13+5 Walls	\$1,681
R-20 Walls, Studs 16" on center	\$2,293
R-20 OVE Walls, Studs 24" on center	\$1,460



# Results for 2012 IECC – Kansas City

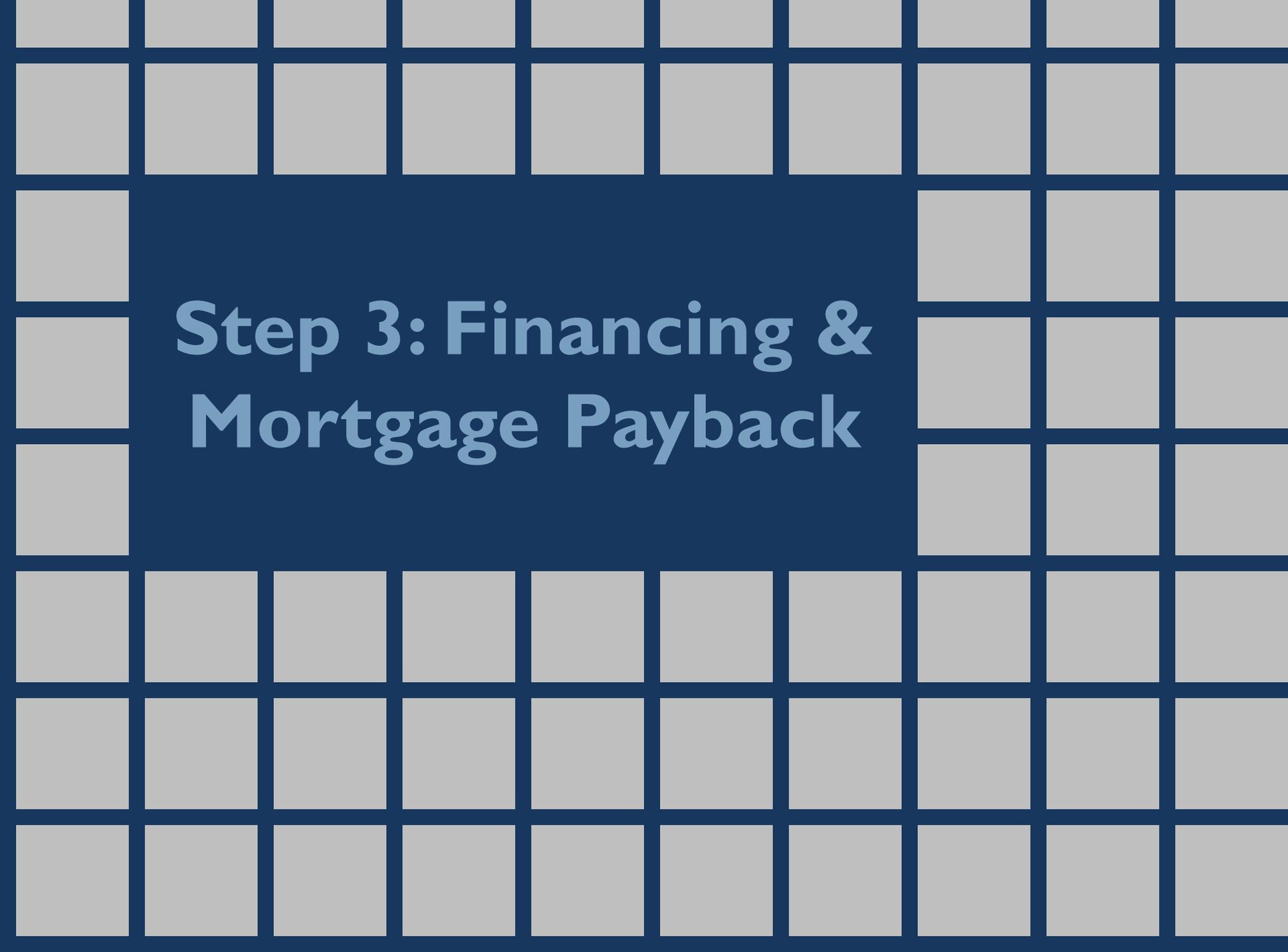
- The “**simple payback**” for these costs would range from **2.4 to 3.7 years** (or 28 to 44 months)...
- ...But homebuyers would not actually pay thousands of dollars up front and wait years to recoup their investment
- >>> **Is there a better, more accurate way** to express how consumers pay for this and how much their wallets benefit?



# Some Assumptions Likely Overstate Costs

- The well-regarded *RS Means* is known as a cost estimator that – if anything – overstates costs
- Model home exactly meets jurisdiction's existing energy code (i.e., builders do not exceed the energy code)
- Additional cost savings could be obtained by downsizing heating equipment, but our analyses do not attempt to calculate those savings.
- Energy savings are calculated from prescriptive measures only.
- Some incremental costs included for upgrades that may not be necessary (e.g. hard ducted return air)





# **Step 3: Financing & Mortgage Payback**

# Mortgage Payback: Assumptions

- **Mortgage Term:** 30 years
- **Down Payment:** 20%
- **Interest Rate:** 4.03% (based on current national average) nationwide interest rate of 4.03%.
- *With a lower down payment—such as 10% down or less—consumers will break even on their investment even sooner.*



# Mortgage Payback: Results

- **Additional down payment amount: \$292 to \$459**
- **Additional monthly mortgage cost: \$5.55 to \$8.72.**
- **Breakeven point: 7 months to 11 months**
- **Annual profit after breakeven: \$516 to \$544**
- **30-year net energy savings: \$15,033 to \$16,338**

**Table 2: Mortgage Payback for Homebuyers by Exterior Wall Type**

Wall Type	Incremental Costs	Energy Savings/ Month per home	Down Payment Increase (and Mortgage Increase per Month)	Breakeven Point	Annual Profit for Homeowner after Breakeven Point
R-13+5 Walls	\$1,681	\$52	\$336 (plus \$6/month)	<b>8 months</b>	<b>\$544</b>
R-20 Walls, Studs 16" on center	\$2,293	\$52	\$459 (plus \$9/month)	<b>11 months</b>	<b>\$516</b>
R-20 OVE Walls, Studs 24" on center	\$1,460	\$52	\$292 (plus \$6/month)	<b>7 months</b>	<b>\$554</b>



# Resource: Fact Sheet Handout

## TRUE COST OF THE 2012 INTERNATIONAL ENERGY CONSERVATION CODE



FOR NEW HOMES IN  
ILLINOIS  
CLIMATE ZONE 5

Upgrading new homes in Illinois' Climate Zone 5 to the 2012 International Energy Conservation Code (IECC) will reduce out-of-pocket expenses for homeowners—paying off their initial investment in a matter of months.

For the average new home, the 2012 IECC will only increase construction costs by a total of \$1,513. When this amount is rolled into the average mortgage, real costs to homebuyers will mean a down payment increase of only \$302.66, and \$5.79 extra on monthly mortgage bills.

The added mortgage costs will be offset by monthly energy savings of \$33.17, helping homebuyers pay off their initial investment in only eleven months. After breaking even during that time, the home will return buyers a profit of at least \$27 per month—for a total return of \$329 every year. This return on investment is shown in balance sheet below.

For additional Incremental Cost Analysis, please visit [energycodesocean.org](http://energycodesocean.org).

**11 MONTHS**  
Break-Even Point

**\$360.25**  
2-year Profit

**17%**  
Annual Energy Reduction

**\$1,345.93**  
5-year Profit

**ENERGY CODE PAYBACK FOR ILLINOIS SINGLE FAMILY HOMES**

Month	Mortgage Increase	Monthly Energy Savings	Cumulative Cost/Benefit
1	\$302.66	\$33.17	-\$269.49
2	\$5.79	\$33.17	-\$242.11
3	\$5.79	\$33.17	-\$214.73
4	\$5.79	\$33.17	-\$187.35
5	\$5.79	\$33.17	-\$159.97
6	\$5.79	\$33.17	-\$132.59
7	\$5.79	\$33.17	-\$105.21
8	\$5.79	\$33.17	-\$77.83
9	\$5.79	\$33.17	-\$50.45
10	\$5.79	\$33.17	-\$23.07
11	\$5.79	\$33.17	\$4.31
12	\$5.79	\$33.17	\$31.89
13	\$5.79	\$33.17	\$59.07
14	\$5.79	\$33.17	\$86.45
15	\$5.79	\$33.17	\$113.83
16	\$5.79	\$33.17	\$141.21
17	\$5.79	\$33.17	\$168.59
18	\$5.79	\$33.17	\$195.97

This model assumes 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 4.03%. With a lower down payment—such as 10% down—consumers will break even on their investment even sooner.



**BREAK EVEN AND START EARNING \$27 IN PROFIT EVERY MONTH.**

## 2012 ENERGY CODE PAYBACK:

### YOUR HOME, MORE AFFORDABLE WITH THE 2012 IECC



FOR NEW HOMES IN  
ILLINOIS  
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 2012 IECC:



-  High-efficiency Lighting **\$25**
-  Whole-house Sealing and Testing **\$350**
-  Programmable Thermostat **\$50**
-  Hot Water Insulation **\$100**
-  Insulation Upgrades **\$595 (LOUIS) \$651 (MINNESOTA)**

ADDITIONAL UPGRADES:

- Increased Sealing at Air Handlers and Furnaces **\$100**
- Improved Bathroom Ventilators **\$100**
- HVAC System Savings **+\$400**

**HOMES BUILT TO THE 2012 IECC COULD YIELD A \$38 PROFIT EVERY MONTH AND \$12,300 OVER 30 YEARS.**

For additional Incremental Cost Analysis, please visit [energycodesocean.org](http://energycodesocean.org)

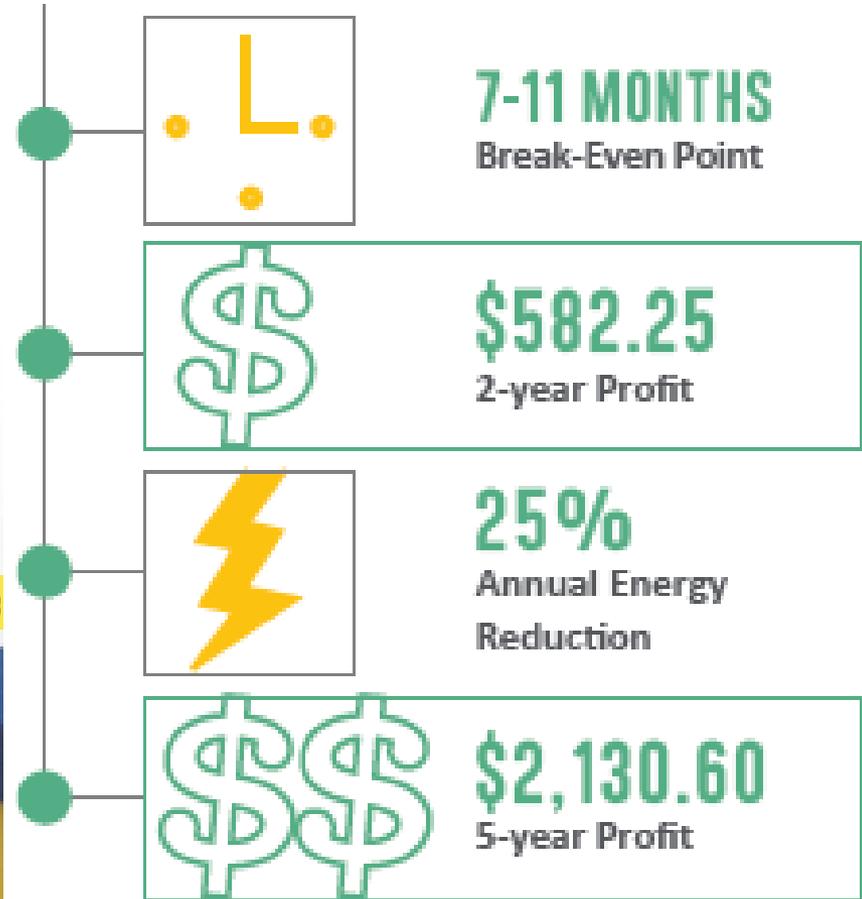


**BCAP** Dedicated to the adoption, implementation, and advancement of building energy codes.



# Resource: Fact Sheet Handout

Month	Mortgage Increase	Monthly Energy Savings	Cumulative Cost/Benefit
1	\$458.70	\$51.73	-\$406.97
2	\$8.72	\$51.73	-\$363.96
3	\$8.72	\$51.73	-\$320.95
4	\$8.72	\$51.73	-\$277.94
5	\$8.72	\$51.73	-\$234.93
6	\$8.72	\$51.73	-\$191.92
7	\$8.72	\$51.73	-\$148.91
8	\$8.72	\$51.73	-\$105.90
9	\$8.72	\$51.73	-\$62.89
10	\$8.72	\$51.73	-\$19.88
11	\$8.72	\$51.73	\$23.13
12	\$8.72	\$51.73	\$66.14
13	\$8.72	\$51.73	\$109.15
14	\$8.72	\$51.73	\$152.16
15	\$8.72	\$51.73	\$195.17
16	\$8.72	\$51.73	\$238.18
17	\$8.72	\$51.73	\$281.19
18	\$8.72	\$51.73	\$324.20



# Resource: Detailed Memo



**BCAP** Dedicated to the adoption, implementation, and advancement of building energy codes

## **Kansas City Residents Buying 2012 IECC Homes Will Save Thousands** **An Analysis of Cumulative Homeowner Profit after Paying Incremental Construction Costs for New Single Family Homes Meeting Building Energy Code**

### Summary

Kansas City Residents buying new single family homes meeting the 2012 International Energy Conservation Code (IECC) will pocket between \$15,033 to \$16,338 in net energy savings over the mortgage term, according to an analysis of energy savings and incremental construction costs by the Building Codes Assistance Project and ICF, International.

**[Link to 2012 IECC Kansas City Memo >](#)**

**[Link to 2012 IECC Kansas City Fact Sheet >](#)**



# BCAP 2012 IECC Analysis Homepage [Link >](#)

State	Incremental Cost Range	Annual Energy Savings	Payback
Arizona   CZ 2   CZ 3   CZ 4   CZ 5	\$798-2,870	\$185-418	7-48 mo.
Illinois   CZ 4   CZ 5	\$958-1,775	\$326-370	7-13 mo.
Pennsylvania   CZ 4   CZ 5   CZ 6	\$1,403-3,375	\$276-650	6-29 mo.
Tennessee   CZ 3   CZ 4	\$2,080-2,451	\$270-707	10-41 mo.
Utah   CZ 5   CZ 6	\$1,926-3,081	\$250-532	10-21 mo.
Virginia   CZ 4	\$1,452-2,303	\$196-368	15-52 mo.
City	Incremental Cost Range	Annual Energy Savings	Payback
Dallas, TX   Fact Sheet	\$2,358-2,440	\$271-277	33-37 mo.
Denver, CO   Fact Sheet	\$1,412	\$205-221	16-17 mo.
Houston, TX   Fact Sheet	\$1,623	\$252	7-22 mo.
Kansas City, MO   Fact Sheet	\$1,460-2,293	\$516-544	7-11 mo.
Philadelphia, PA	\$1,456-1,837	\$194-205	30-45 mo.
Salt Lake City, UT	\$1,926-2,215	\$347-361	17-22 mo.
San Antonio, TX   Fact Sheet	\$939	\$248	11
<b>Total Range</b>	<b>\$798-3,375</b>	<b>\$185-707</b>	<b>6-52 mo.</b>



# BCAP 2009 IECC Analysis Homepage [Link >](#)

- Over a number of years, BCAP has also completed memos and fact sheets for 28 states upgrading to the 2009 IECC.
- As of January 1, 2013: 14 of those states will have adopted and implemented residential codes based on the 2009 IECC.

State	Weighted Average Incremental Cost	Median Energy Savings	Mortgage Payback (Months)
Weighted National Average	\$ 840.77	\$ 243.37	Avg: 10.25 months





# Other National Cost Analyses

# DOE Cost-Effectiveness Study [Link >](#)

- Study covering the 2009 and 2012 IECC for new single- and multi-family homes against 2006 IECC baseline taking state-specific code amendments into consideration.
- National Cost Analysis: An overview of cost-effectiveness by climate zone
- State-level analyses for 43 states and DC

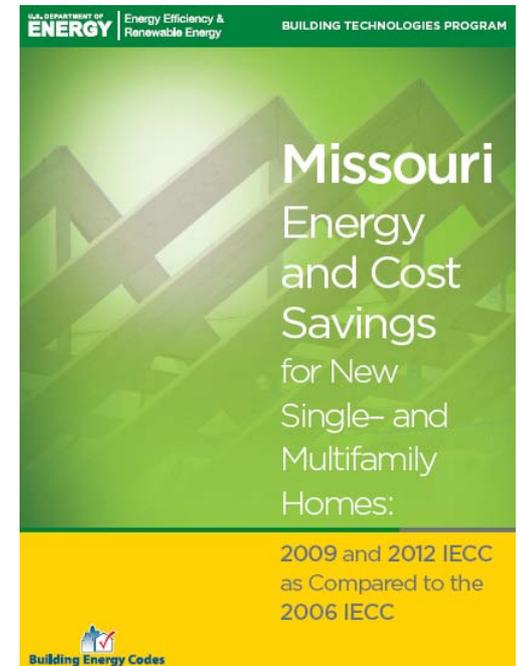


Table 1. Average Life-Cycle Cost Savings from Compliance with 2009 and 2012 IECC, Relative to the 2006 IECC

	Life-Cycle Cost Savings (\$)	Net Positive Cash Flow (Years)	Simple Payback (Years)
2009 IECC	\$2,229	1	4.1
2012 IECC	\$7,826	1	4.7



# DOE Cost-Effectiveness Study [Link >](#)

- Uses a life-cycle approach, balancing first costs against longer-term energy savings over the life of the home.
- Energy analysis is conducted using the DOE *EnergyPlus*<sup>TM</sup> software.

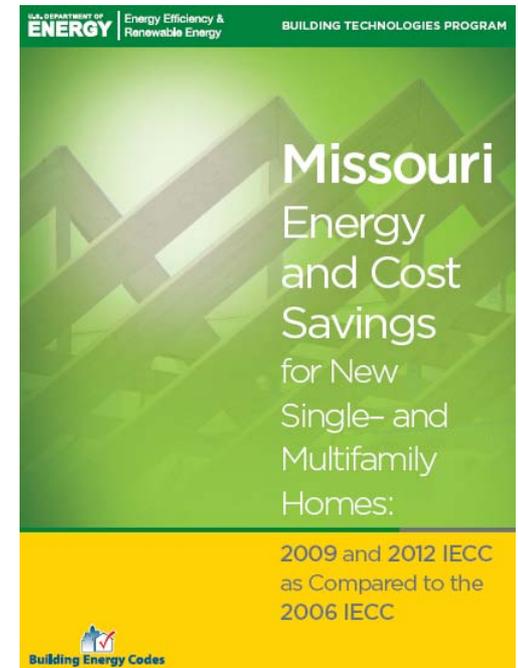


Table 1. Average Life-Cycle Cost Savings from Compliance with 2009 and 2012 IECC, Relative to the 2006 IECC

	Life-Cycle Cost Savings (\$)	Net Positive Cash Flow (Years)	Simple Payback (Years)
2009 IECC	\$2,229	1	4.1
2012 IECC	\$7,826	1	4.7



# Two Analyses – Similar Results

## BCAP 2012 - DOE 2012 Analysis Comparison

State	Net Energy Savings		Break-Even Point	
	BCAP	DOE	BCAP	DOE
Arizona	\$2,642 - \$9,233	\$6,550	7 months	2 years
Minnesota	\$19,197 - \$23,479	\$9,973	8-14 months	1 year
Pennsylvania	\$5,460 - \$19,832	\$9,632	22-45 months	1 year
Utah	\$7,052 - \$15,543	\$4,979	10-21 months	2 years
Virginia	\$2,502 - \$7,644	\$5,936	15 months	1 year



# NAHB Cost-Effectiveness Study [Link](#)>

- 2006 IECC baseline vs. 2009 IECC and 2012 IECC
- Standard Reference House and methodology developed by NAHB Research Center's 2008 and 2009 Annual Builder Practices Survey (ABPS)



## 2012 IECC Cost Effectiveness Analysis



# NAHB Cost-Effectiveness Study [Link](#)>

- Eight representative cities for each climate zone studied
- Roughly comparable energy savings figures
- Significantly higher cost figures than BCAP or DOE studies
- Simple payback method used

Table 7: 2012 IECC Cost Effectiveness Relative to 2006 IECC

Climate Zone	Annual Energy Savings	Incremental Construction Cost	Simple Payback (yrs)
1	\$470	\$4,521	9.6
2	\$556	\$4,499	8.1
3	\$732	\$8,871	12.1
4	\$627	\$8,072	12.9
5	\$728	\$5,872	8.1
6	\$687	\$8,734	12.7
7	\$978	\$8,403	8.6
8	\$1,180	\$8,403	7.1
<b>National Weighted Average</b>	<b>\$673</b>	<b>\$7,034</b>	<b>10.4</b>



# The NAHB Conundrum

- NAHB Resolution Approved 5/29/2009:
  - Simple payback of 10 Years (*NAHB Policy*) won't be enough to achieve 30%
  - NAHB supports 2012 IECC that increases residential energy efficiency requirements by 30% above the 2006 edition
- NAHB cost-effectiveness study: 2012 IECC has 10.4 year simple payback



# Conclusions

- Updated energy code requirements >> create a modest increase in first cost of new homes
- However >> Homeowners will enjoy the benefits of a more efficient home over the lifetime of the building
- Benefits >> Lower utility costs, quieter & more comfortable homes
- Energy prices WILL go up >> The savings will be higher than BCAP estimates



# Questions?

**Paul Karrer**

Project Manager – National Advocacy

202-530-4347

[pkarrer@ase.org](mailto:pkarrer@ase.org)

[www.energycodesocean.org](http://www.energycodesocean.org)

