

# Adoption of IECC 2012 (International Energy Conservation Code)

## *Making Informed Decisions*

*According to the US Department of Energy, the IECC 2012 results in a net energy savings for Idaho Households. For a 30 year amortization the increase in the mortgage payment is less than 25% of the net savings. This is a result of reducing energy bills by up to 35%.*

*A 2013 homeowner energy survey reveals that 65% of Idahoans prefer energy efficient homes and are willing to pay \$10/month more for a monthly savings of about \$22 for new home purchases.*

# Continually Improving Energy Efficiency

- IECC 2012 is a minimum standard of compliance by home builders in order to insure energy efficiency for homes in the US.
- IECC is developed by local and state building officials who are the Governmental Members of the International Code Council.
- Every three years the IECC raises the level of energy code compliance in order to continually improve on energy efficiency and assist contractors/home builders with using modern building materials and energy saving technologies as they become cost-effective to implement.
- This process of continually reducing demand for energy results in lower utility rates, increases energy independence, and conserves natural resources, and reduces greenhouse gases and pollution.

# Idaho Energy Trends

- Electricity and natural gas utility rates are trending up in Idaho.
- Natural gas and coal power plants now produce more of Idaho's energy needs than do hydroelectric power plants.
- As Idaho electricity providers are required to build more natural gas power plants and purchase more power from coal power plants in other states, electricity rates for Idaho residents will continue to increase at an accelerated pace in order to meet demand.
- Though natural gas prices are trending down due to excess supplies in states such as North Dakota where oil drilling is booming, lack of pipeline distribution to Idaho limits access to those low priced natural gas resources which are a byproduct of the petroleum industry.

# Consumer Protection

- Though increasing emphasis is being placed on energy efficiency and the pros and cons of IECC 2012 vs. IECC 2009, quality control including level of workmanship for new construction and remodeling projects is just as important.
- The largest single investment people make is purchasing a home. Yet most homeowners know less about the quality of construction of their homes than they do about buying a car, an appliance, or a consumer electronic device. Like homeowners, perhaps even more so due to inferior quality of construction, renters are also subject to paying for excessive energy bills due to a lack of energy efficiency provided by builders and landlords.
- Unlike purchasing homes, most of the other purchases listed above come with a 30-90 day money-back guarantee. Most cars come with a 12 year or 100,000 mile drive train warranty. They also come with performance guarantees, e.g., minimum fuel mileage for vehicles that is certified by EPA.
- In contrast, most new homes come with a limited warranty from the contractor, but very few if any provide a guarantee of energy efficiency.

# Blower Door Tests

- At recent collaborative meetings for adoption of IECC 2012 (Dec 2014 & Feb 2015), a contractor presentation in Dec 2014 attempted to indicate little or no cost/benefit for adoption of IECC 2012 vs. IECC 2009. This is in direct opposition to DOE data and analysis as illustrated in this presentation.
- In an attempt to reach a compromise for adoption of an Idaho energy code, which state contractors are vehemently opposed to, it has been suggested that the blower door test requirement of the IECC 2012 could be omitted as a compromise for adoption of IECC 2012.
- However, in the absence of actual energy bills, blower door tests, infrared thermal analysis, and in general home energy audits are the only means of determining the energy efficiency of new homes.

# Home Energy Audits

- If adequate insulation is installed in accord with IECC 2012, and no noticeable improvement is achieved in thermal resistance/overall energy efficiency, according to the laws of physics, the only reason for this would be poor quality materials and/or poor workmanship. Hence, the reason for the blower door test which measures the infiltration rate.
- Thus, one could argue that if contractors/builders are building homes in accord with IECC 2012 and are not seeing an improvement in energy efficiency as a result, we should be requiring not only a blower door test, but a complete home energy audit including thermal/infrared analysis to identify the areas where heat loss is occurring so that it can be addressed/repaired, and possibly a home inspection.
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# Home Inspections

- In the Dec 2014 collaborative meeting a young woman asked “how can we know if a home is energy efficient.” The only way to do this is to conduct a home energy audit.
- If the home energy audit reveals that a new home is not in compliance with the IECC 2012 standard, that is often an indication of poor workmanship and/or inadequate materials.
- In that case, when a new home fails to meet the required energy standard one could argue that in addition to a complete home energy audit, a home inspection should be conducted at the expense of the home builder.
- Obviously, if the new home is built according to the respective IECC code, then contractors have nothing to worry about. They can take pride in the quality workmanship and adequate materials used in construction knowing that their homes will pass any blower door test, home energy audit, or new home inspection.

# Contractor/Builder Guarantee for New Homes

- The concept of a contractor/builder guarantee for new homes is no different from a new car warranty with the exception that a home costs considerably more than a car. Thus, new homes, which are a long term investment and possibly the single largest purchase that the vast majority of consumers will ever make, should come with a home warranty/guarantee that is commensurate with the cost of a new home and the expectation of durability over a 30 year mortgage.
- Obviously, homes are expected to have a life cycle much greater than an automobile and a poorly constructed home that is not in compliance with the respective IECC could end up costing thousands of dollars in additional energy costs over the life of the structure (not including repairs and maintenance not covered by the contractor).
- My first experience in having a contractor build a new home for my family resulted in a leaky roof shortly after we moved in. There was also some leaky plumbing. My contractor's response was, "contact your home owner's insurance." That should never happen to a new home owner! In regards to consumer protection, contractors should take pride in their work and when they don't, they should be obligated by law to correct any and all issues pertaining to inadequate materials and poor quality workmanship.

# Information from the Idaho Attorney General

- A seller (which includes new home builders) is not required to disclose every building defect, and a real estate agent is not trained to recognize structural problems (or energy efficiency problems for new or remodeled homes that do not have a history of energy bills).
- Furthermore, the seller may be completely unaware of leaky pipes in crawlspaces or nonconforming electrical work by prior owners.
- Idaho Code § 55-2508 (Property Condition Disclosure Act) provides a very limited list of the items that a seller must disclose, assuming the seller has knowledge of the item.
- A home and property inspector (including those who conduct home energy audits) is trained to spot nonconformities and can recognize where someone diverted from building standards and codes.

# Modifying Property Condition Disclosure Act

- Since Idaho Code § 55-2508 provides a very limited list of the items that a seller must disclose, assuming the seller has knowledge of the item. This provides an opportunity for contractors and property owners to claim ignorance with no legal recourse when a property defect is discovered. Hence, this law encourages contractors and property owners in general to be deceptive with potential buyers of real estate property.
- Idaho Code & 55-2508 should be amended with a property condition disclosure that makes deliberate deception and gamesmanship illegal. It is the responsibility of the Idaho legislators to do what is in the best interests of the citizens that they represent.

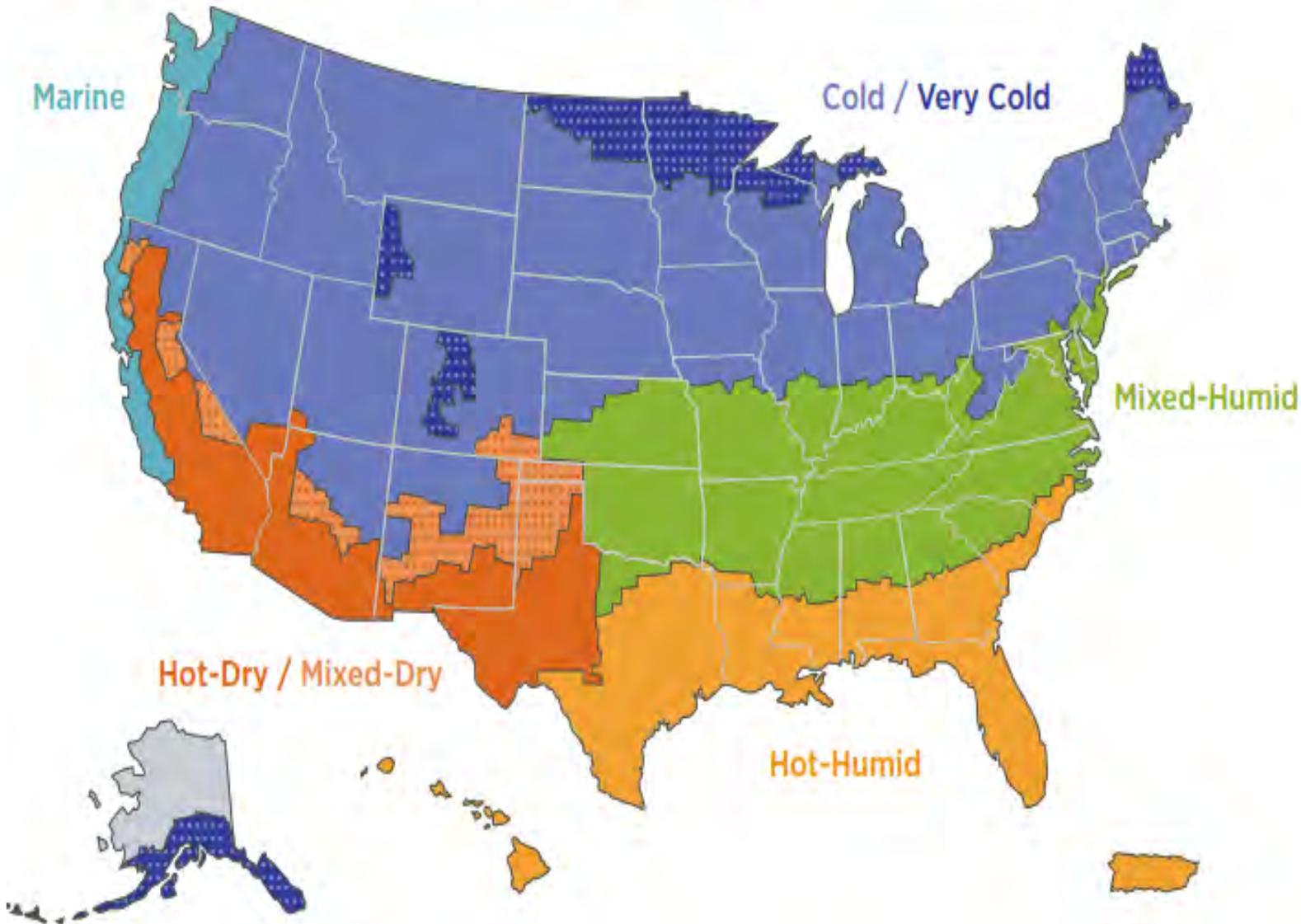
# Changing Idaho Code § 55-2508

- Hence, Idaho legislators should protect the constituents that elected them and insure that they are protected from deception including dishonest property owners.
- This includes contractors who are not building high quality - energy efficient homes and who may or may not provide a limited warranty on quality and workmanship.
- This should include at a minimum, a blower door test (which is included in the IECC 2012) and preferably a more extensive home energy audit for all new homes which do not have a history of energy bills.

# Homeowner Protection

- Similar to appraisals that are required by financial institutions before closing on a real estate property, it is only prudent to expect that home energy audits and home inspections be routinely performed before an existing or newly constructed home is sold.
- Despite good faith efforts to conduct routine inspections, after a house is dry-walled, the best way to insure that it performs properly is through reviewing energy bills. Unfortunately, this occurs months after the home has already been purchased.
- As an alternative to reviewing energy bills, home energy audits can accurately predict how energy efficient a building is and provide an idea of the quality of construction behind the dry wall.
- As already indicated, the IECC 2012 requires a blower door test which is a key component of a home energy audit.

## The Building America Climate Regions



Building America	IECC
Subarctic	Zone 8 (only found in Alaska)
Very Cold	Zone 7
Cold	Zones 5 and 6
Mixed-Humid	4A and 3A counties above warm-humid line
Mixed-Dry	Zone 4B
Hot-Humid	2A and 3A counties below warm-humid line
Hot-Dry	Zone 3B
Marine	All counties with a "C" moisture regime

# IECC Building Climate Zones

- Idaho is generally comprised of two primary IECC building climate zones.
- These climate zones can substantially influence the effect of the IECC 2012 (along with elevation and solar exposure, etc.):
  - Climate Building Zone 5: Cold
  - Climate Building Zone 6: Colder

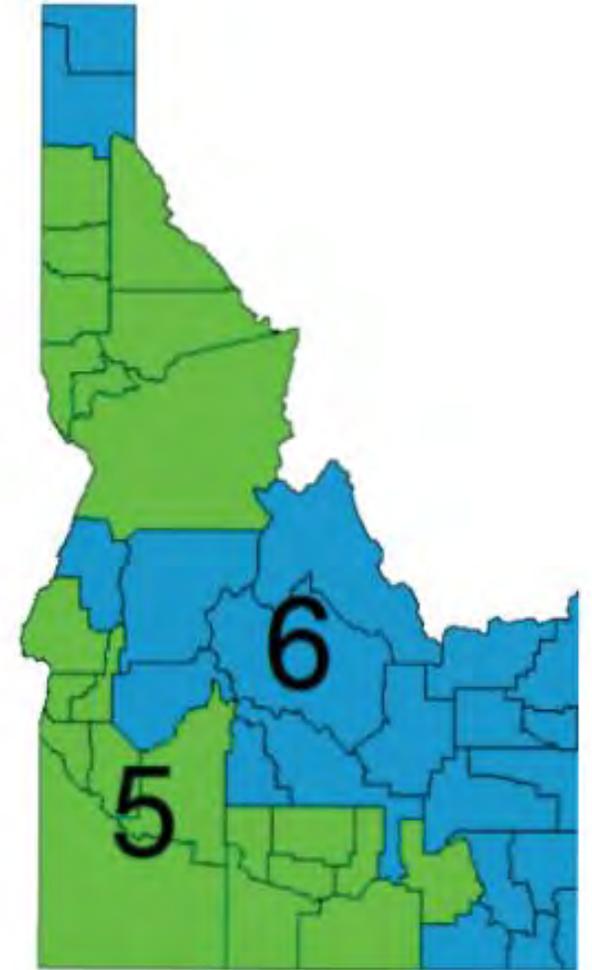
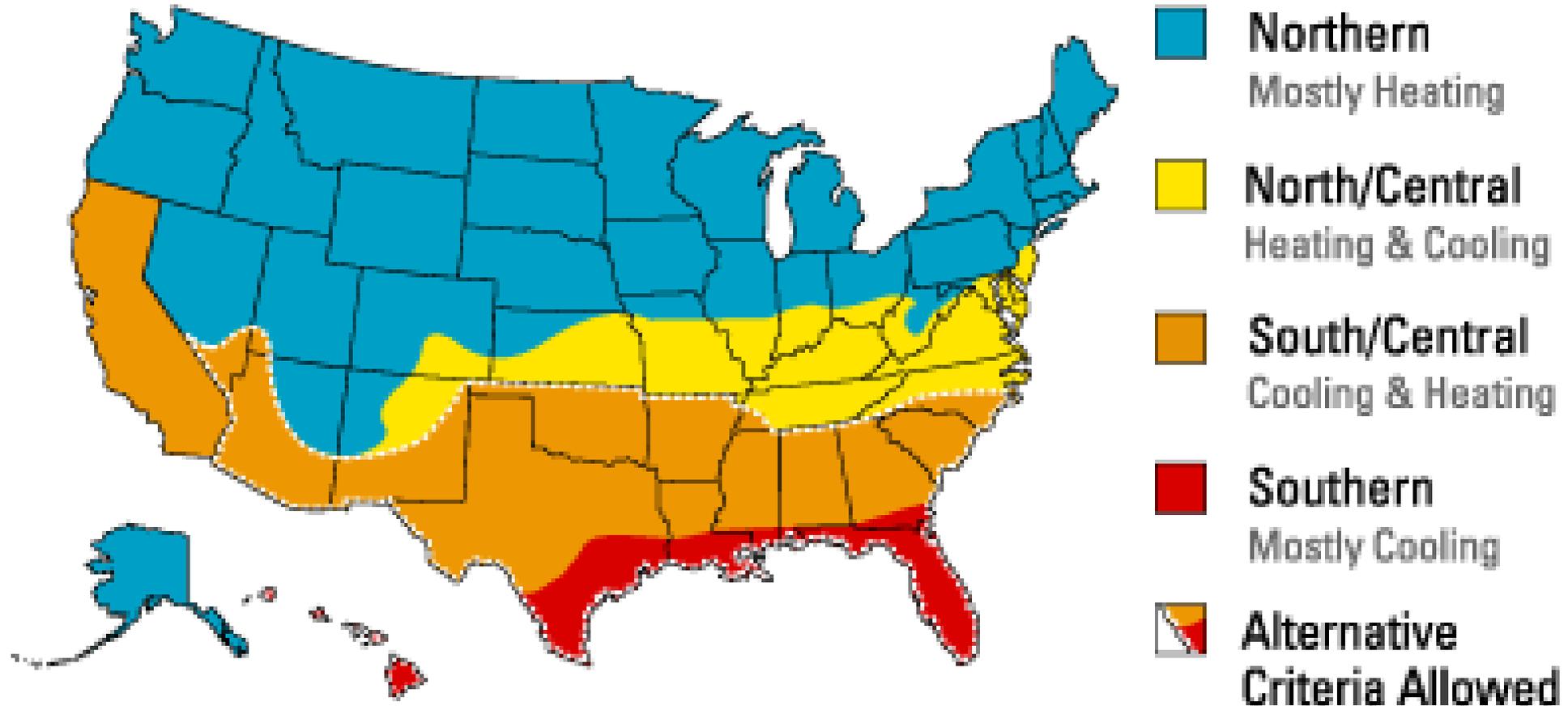


Figure 1. Idaho Climate Zones

# Idaho is Predominantly a Heating Zone



# IECC 2012 Overview

- Idaho Energy and Cost Savings for New Single- and Multifamily Homes: IECC 2012 as Compared to IECC 2009.
- Moving to IECC 2012 from IECC 2009 is cost-effective over a 30-year life cycle.
  - On average, Idaho homeowners will save \$10,000 with the IECC 2012.
  - Each year, the reduction to energy bills will significantly exceed increased mortgage costs.
  - After accounting for up-front costs and additional costs financed in the mortgage, homeowners should see net positive cash flows (i.e., cumulative savings exceeding cumulative cash outlays) in 1 year for IECC 2012.
  - **Average annual energy savings in Idaho is \$422 for IECC 2012 in comparison with IECC 2009.**

# Immediate Energy Savings

- A new 2,400 ft.<sup>2</sup> single family home in Idaho that meets the IECC 2012 may cost an additional \$1,350-1,892 in conventional stick-frame construction costs (but much less using modeling and simulation software, advanced materials, and state-of-the-art construction management). Based on current interest rates of 4.5%, this is equivalent to an increase in a 30 yr. mortgage payment of up to \$9.59/month.
- Based on Idaho weather data, energy cost savings in climate zones 5 & 6 are estimated at between \$320 to \$524 per year. This is equivalent to monthly savings of \$26.67 to \$43.67.
- Stated differently, an Idaho household's monthly utility bill savings are a minimum of 3.9 to 4.6 four fold greater than the portion of the mortgage payment needed to cover the cost of the energy saving features required by IECC 2012.

# IECC 2012 vs. IECC 2009 Highlights

- Cost-effectiveness against a IECC 2009 baseline:
  - Idaho life-cycle cost savings, averaged across climate zones and building types, are ~\$12,660 for IECC 2012 (not including compounded growth obtainable from investments).
  - Simple payback period is less than 5 years for IECC 2012.
- Consumer savings compared to a IECC 2009 baseline:
  - **For Idaho households, net annual consumer savings, including energy savings, mortgage cost increases, and other associated costs in the first year of ownership average \$422 for IECC 2012.**
  - **In Idaho energy costs on average are ~35% lower for IECC 2012 in comparison with IECC 2006, and even lower when compared to homes built prior to 2006.**

# Cost-Effectiveness of IECC 2012 vs. 2009

The U.S. Department of Energy (DOE) evaluates IECC energy codes based on three measures of cost-effectiveness:

**Life-Cycle Cost:** Full accounting over a 30-year period of the cost savings, considering energy savings, the initial investment financed through increased mortgage costs, tax impacts, and residual values of energy efficiency measures

**Cash Flow:** Net annual cost outlay (i.e., difference between annual energy cost savings and increased annual costs for mortgage payments, etc.)

**Simple Payback:** Number of years required for energy cost savings to exceed the incremental first costs of a new code

# Life Cycle Costs

- Life-cycle cost is the primary measure by which DOE assesses the cost-effectiveness of the IECC.
- These savings assume that initial costs are mortgaged, that homeowners take advantage of the mortgage interest deductions, and that long-lived efficiency measures retain a residual value after the 30-year analysis period.
- 30 yr. life-cycle cost savings averaged across climate zones 5-6 in Idaho:
  - **\$9,600-\$15,720 for IECC 2012**
  - **DOE estimates reveal that IECC 2012 is over 32.1% more efficient than IECC 2006.**
  - **For an initial investment of as little as \$1,000 for an Idaho home, in order to comply with IECC 2012, this would result in up to a 15:1 return on the investment for the average Idaho household.**

# Idaho LCA Cost Savings Comparison

Refer specifically to IECC climate zones 5 & 6: \$9,189 to \$11,307

## Life-Cycle Cost Savings Compared to the 2006 and 2009 IECC

IECC Climate Zone	30-Year Life-Cycle Savings		
	IECC 2009 vs. 2006	IECC 2012 vs. 2009	IECC 2012 vs. 2006
1	\$2,877	\$5,347	\$8,256
2	\$2,443	\$2,280	\$4,763
3	\$1,944	\$3,613	\$5,621
4	\$2,259	\$5,320	\$7,625
5	\$2,466	\$6,717	\$9,189
6	\$3,094	\$8,183	\$11,307
7	\$3,622	\$9,502	\$13,166
8	\$9,147	\$23,900	\$33,105

# IECCs Developed by Local & State Officials

- The IECC may be called America's model energy code, but it is developed by local and state officials who are the Governmental Members of the International Code Council.
- The 30% efficiency boost achieved by adoption of the 2009 and 2012 IECCs vs. the 2006 IECC is historic but, most importantly, is the product of code and other officials from across the nation who ensured that it employed readily available "off the shelf" technologies and that its provisions were clear and straightforward enough to ensure builder compliance and ease of enforcement.

# Previous Lull in Building Code Efficiency Gains

- For nearly two decades, successive versions of the IECC – the nation’s only federally-recognized model code –and its predecessor, the Model Energy Code made only modest 1%-2% gains in energy efficiency.
- During that relative lull in building code efficiency gains, significant voluntary programs – such as EPA’s Energy Star and US DOE’s Builders Challenge – were demonstrating that the positive cash flow from energy savings was quickly recouping any efficiency improvement investments.

# Consumer Savings

- Annual consumer cash flows impact the affordability of energy-efficient homes.
- Based on this analysis, Idaho homeowners, on average, should see annual energy cost savings of \$320-\$524 and achieve a net cumulative savings that accounts for an increased down payment in addition to energy costs, mortgage costs, and tax-related costs and benefits in 1 year when comparing the 2012 IECC to the 2006 & 2009 IECCs.

## Impacts to Consumers' Cash Flow from Compliance with 2012 IECC Compared to the 2006 IECC

Cost/Benefit		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
A	Down payment and other up-front costs	\$299	\$302	\$359	\$246	\$255	\$362	\$344	\$500
B	Annual energy savings (year one)	\$557	\$383	\$449	\$494	\$575	\$722	\$807	\$1,862
C	Annual mortgage increase	\$162	\$164	\$194	\$134	\$138	\$196	\$186	\$271
D	Net annual cost of mortgage interest deductions, mortgage insurance, and property taxes (year one)	-\$2	-\$1	-\$2	-\$1	-\$1	-\$2	-\$1	-\$3
E = [B- (C+D)]	Net annual cash flow savings (year one)	\$393	\$218	\$253	\$359	\$436	\$524	\$620	\$1,588
F = [A/E]	Years to positive savings, including up-front cost impacts	1	2	2	1	1	1	1	1

## Impacts to Consumers' Cash Flow from Compliance with 2012 IECC Compared to the 2009 IECC

Cost/Benefit		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
A	Down payment and other up-front costs	\$159	\$172	\$224	\$187	\$162	\$264	\$272	\$400
B	Annual energy savings (year one)	\$344	\$197	\$285	\$351	\$409	\$523	\$592	\$1,360
C	Annual mortgage increase	\$86	\$93	\$121	\$102	\$88	\$143	\$147	\$217
D	Net annual cost of mortgage interest deductions, mortgage insurance, and property taxes (year one)	-\$1	-\$2	-\$1	\$0	-\$1	-\$2	-\$1	-\$1
E = [B- (C+D)]	Net annual cash flow savings (year one)	\$257	\$102	\$163	\$249	\$320	\$378	\$444	\$1,142
F = [A/E]	Years to positive savings, including up-front cost impacts	1	2	2	1	1	1	1	1

# Summary of IECC 2012

- Focus is on building envelope:
  - Ceilings, walls, windows, floors, foundations
  - Sets insulation and fenestration levels, and solar heat gain coefficients
  - Infiltration control - caulk and seal to prevent air leaks, and test
- Ducts, air handlers, filter boxes – seal, insulate, and test
- Limited space heating, air conditioning, and water heating requirements
  - Federal law sets most equipment efficiency requirements, not the codes
- No appliance requirements
  - Federal law sets most equipment efficiency requirements, not the codes
- Lighting equipment – 75% of lamps to be high-efficacy lamps or 75% of lighting fixtures to have only high-efficacy lamps

# Idaho Division of Bldg. Safety Code

## Current Amended IECC 2012

### Prescriptive Approach

**Table R402.1.1**  
**INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT**

Climate Zone	Fenestration U- Factor	Skylight U-factor	Glazed Fenestration SHGC	Ceiling R-Value	Wood Frame Wall R-Value	Mass Wall R-Value	Floor R-Value	Basement Wall R-Value	Slab R-Value	Crawlspace Wall R-Value
5 and Marine 4	0.35	0.60	NR	38	20 or 13+5 <sup>h</sup>	13/17	30 <sup>g</sup>	10/13	10, 2 ft	10/13
6	0.35	0.60	NR	49	20 or 13+5 <sup>h</sup>	15/19	30 <sup>g</sup>	15/19	10, 4 ft	10/13

# Performance vs. Prescriptive Approach

- While the prescriptive approach to complying with IECC 2012 requires adoption of specific energy code requirements such as continuous exterior foam insulation, the performance based approach allows for using modeling and simulation software to accomplish the same level of energy efficiency through a variety of more cost effective energy solutions.
- For example, R-13 fiberglass batting in the walls can merely be upgraded to R-19 fiberglass batting.

# Idaho Division of Bldg. Safety Code Current Amended IECC 2012 cont.

## Performance Based Approach

**IDAHO ADMINISTRATIVE CODE**  
**Division of Building Safety**

**IDAPA 07.03.01**  
**Rules of Building Safety**

**Table R402.1.3**  
**EQUIVALENT U-FACTORS**

<b>Climate Zone</b>	<b>Fenestration U-factor</b>	<b>Skylight U-factor</b>	<b>Ceiling R-Value</b>	<b>Wood Frame Wall R-Value</b>	<b>Mass Wall R-Value</b>	<b>Floor R-Value</b>	<b>Basement Wall R-Value</b>	<b>Crawlspace Wall R-Value</b>
5 and Marine 4	0.35	0.60	0.030	0.057	0.082	0.033	0.059	0.065
6	0.35	0.60	0.026	0.057	0.060	0.033	0.050	0.065

# Performance vs. Prescriptive Approach Using Modeling & Simulation Software

- Using either REScheck or BEopt (publicly available software provided by the DOE) that can be used for modeling and simulation. REScheck can be specifically used for building energy code compliance with IECC 2012.
- For example, in eastern Idaho compliance with the amended items of the IECC 2012 can be accomplished simply by increasing insulation from R-13 to R-19 to basement walls. A similar approach to increasing insulation on above grade walls may comply for western Idaho.
- Upgrade windows from U-0.35 to U-0.32.
- Decrease infiltration by going from 7 to 3 ACPH and conduct a blower door test to confirm 3.0 or less ACPH@50 pascals for IECC 2012 certification.
- Insulate plumbing.
- Lighting upgrade from 50% (IECC 2009) to 75% high efficacy (either florescent or LED bulbs) for IECC.

# Idaho Costs for IECC 2012 Compliance

- Cost to meet the 2012 IECC is minimal and can be achieved in several ways depending on the size and window area of the home. An analysis of a number of houses determined that the most cost effective way to comply with the insulation requirements is to provide R-19 insulation instead of R-13 insulation in the basement walls. This solution was arrived at using REScheck performance based modeling software.
- The cost for a typical 1500 ft<sup>2</sup> home to be insulated to R-19 is between \$128 dollars for batt insulation and \$256 dollars for blown in insulation.
- The cost of a blower door for the air tightness testing is estimated to be around \$200 dollars.
- The total cost would be between \$353 dollars and \$483 dollars which includes lighting upgrades. If not already required by local energy codes, upgrading windows and insulating plumbing may require additional costs for compliance.
- The monthly increase in 30 yr. loan payment at 4% interest would be \$2.31 for almost \$35/month savings in energy costs for a 1500 ft<sup>2</sup> home.

# Northwest ENERGY STAR Homes

- Northwest ENERGY STAR Homes is a regionally coordinated initiative supported by a partnership of Idaho Power and the Northwest Energy Efficiency Alliance.
- The Northwest ENERGY STAR Homes program, which provides incentives for builders, builds homes at least 15% more energy efficient than homes built to standard Idaho code. However, only electrically-heated and cooled homes qualify for Idaho Power incentives to builders.
- In comparison, homes built to IECC 2012 code can exceed the energy efficiency of Energy Star homes and are not required to be electrically heated or cooled.

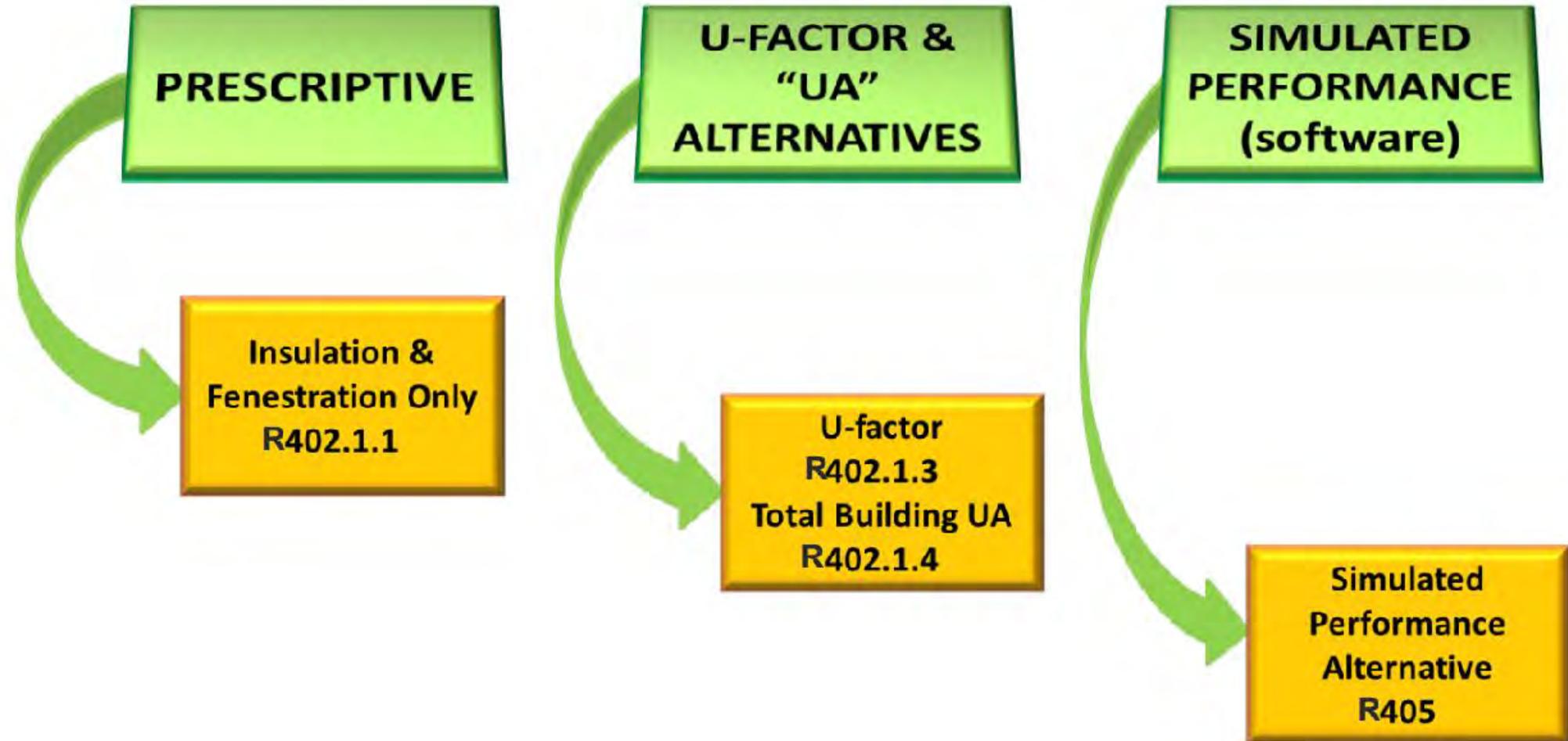
# Green Building & Passive House Design

- Sustainable or green building practices promote the construction of buildings that are healthier for the occupants and healthier for the environment.
- They reduce the tremendous impact that building construction, operation, maintenance, and disposal have on both people and nature.
- According to the US Department of Energy's Center for Sustainable Development, buildings consume 40-50% of the world's total energy, 25% of its wood harvest and 16% of its water.
- The building industry is the nation's largest manufacturing activity, representing more than 50% of the nation's wealth.

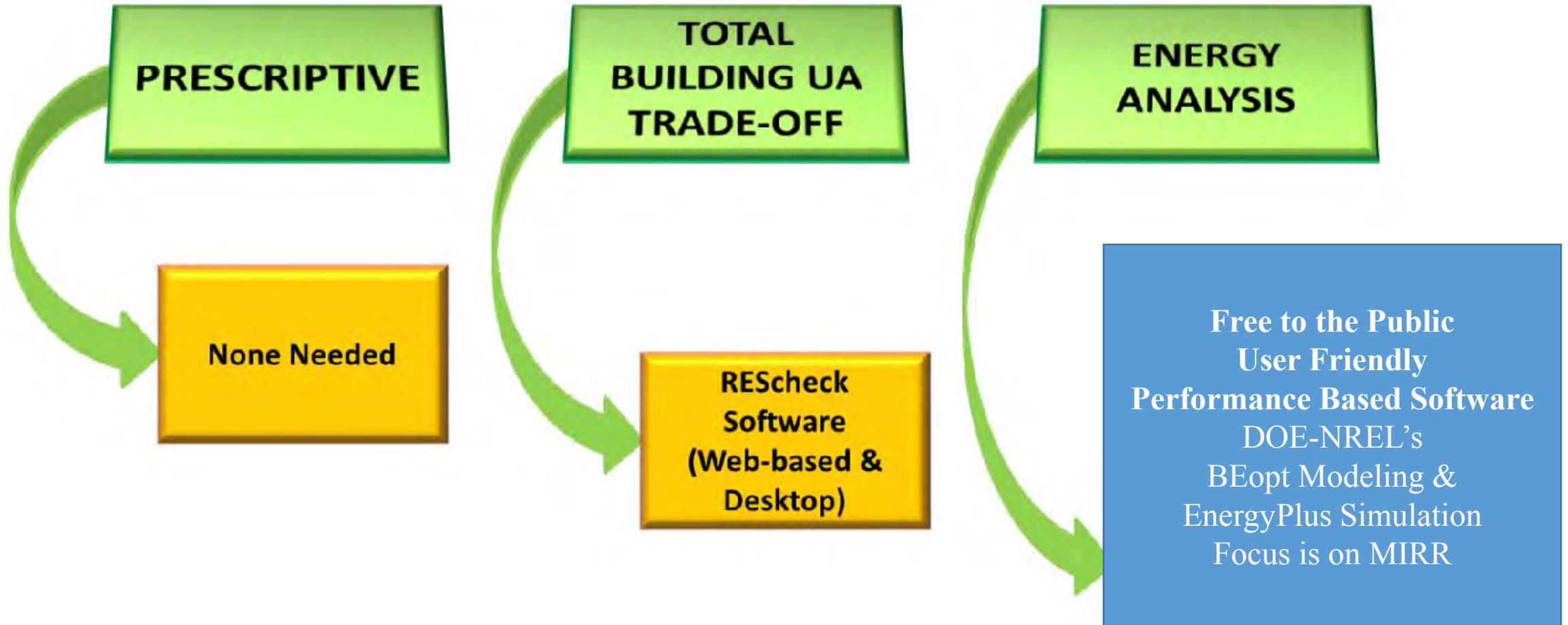
# Technology & Construction Management

- Innovative technologies and construction management can allow for meeting IECC 2012 requirements with little or no additional costs required.
- For example, superior ICF materials cost about 12% more than stick-frame/wood construction, but can reduce labor by over 50% via state-of-the-art construction management in comparison with conventional stick-frame construction. This results in building more energy efficient, higher quality homes for about the same price as stick-frame homes.
- Unfortunately, like agricultural producers, contractors are not early adopters of technology. Like all of us, they simply don't like change and they are slow to incorporate newer more energy efficient technologies. Unless the IECC 2012 is fully adopted, most Idaho contractors will simply not embrace newer more energy efficient and less labor intensive construction technologies.

# Simplifying IECC Compliance - Three Options



# Code Compliance Tools



# Achieving Zero Net Energy (NZE)

- BEopt is a computer program designed to find cost-optimal building designs along the path to a zero net energy (ZNE) building.
- A zero net energy building produces as much energy as it uses on an annual basis, using a grid-tied, net-metered photovoltaic (PV) system and active solar.
- The optimal path to ZNE extends from a base case to the ZNE building through a series of energy-saving building designs with minimal energy-related costs.

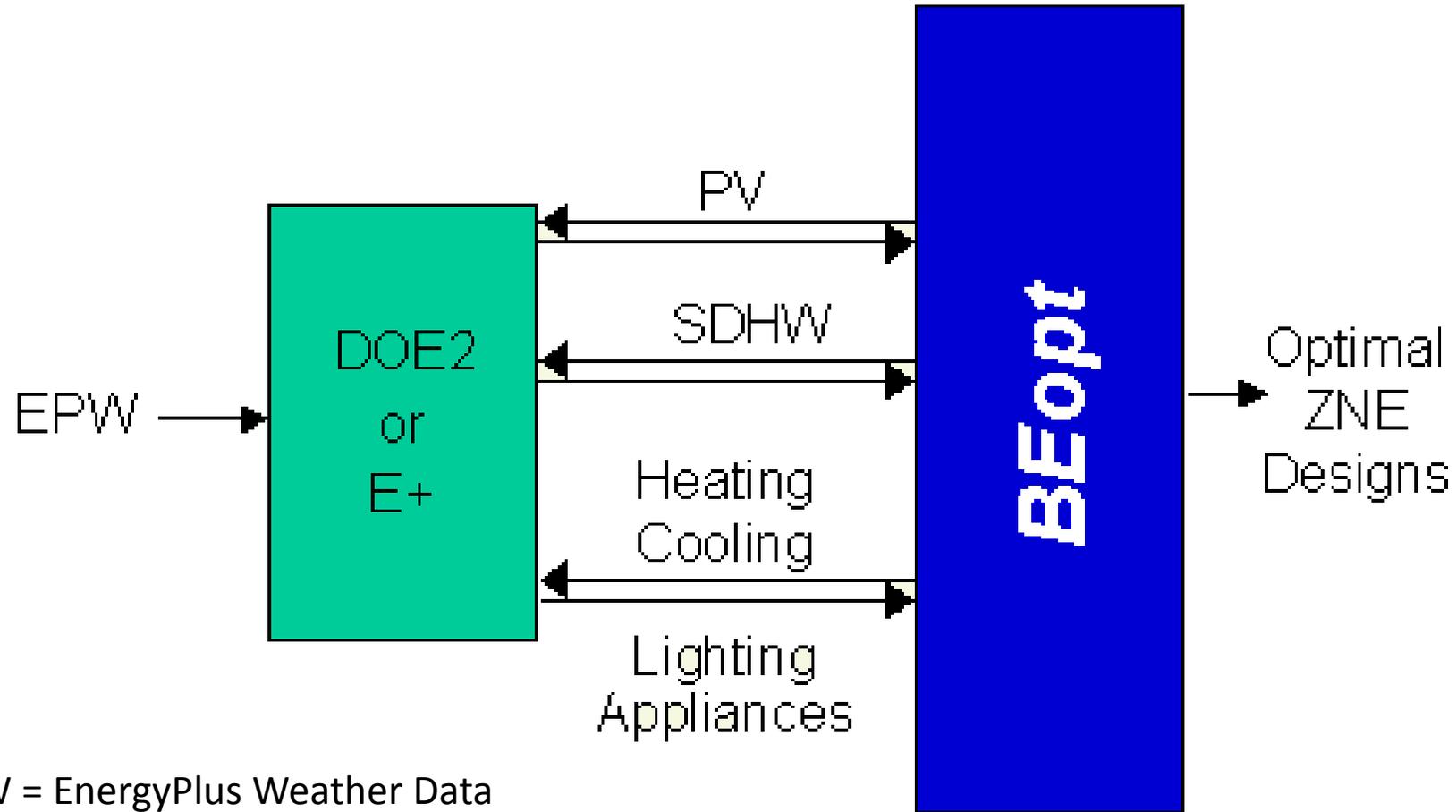
# BEopt Modeling Software

- In BEopt, a user selects from predefined options in various categories to specify options to be considered in the optimization.
- Energy savings are calculated relative to a reference. The reference can be either a user-defined reference, a climate-specific Building America Benchmark for new construction, or an Existing (w/ Min Replace) reference for retrofit.
- The user can also review and modify detailed information on all available options via the library management tools.

# DOE2 or EnergyPlus Simulation Engines

- BEopt calls the DOE2 or EnergyPlus simulation engines and uses a [sequential search technique](#) to automate the process of identifying optimal building designs along the path to ZNE.
- BEopt finds these optimal designs based on discrete building options reflecting realistic construction options.
- BEopt handles [special situations](#) with positive or negative interactions between options in different categories.

# BEopt & E+ Flow Chart



EPW = EnergyPlus Weather Data

PV = Photovoltaic Power System

SDHW = Solar Domestic Hot Water

# Output Screen

- The BEopt software includes an output screen that allows the user to navigate among different design points and retrieve detailed results regarding energy end-use and option costs in different categories.
- Multiple cases, based on a selected parameter such as climate, can be included in a BEopt project for comparative purposes.

# Modes of Analysis

- Currently there are three modes of analysis: design mode, parametric mode, and optimization mode.
- Design mode allows the user to perform a set of building design simulations for analysis.
- Parametric mode allows the user to quickly perform traditional parametric analyses.
- Optimization mode, on the other hand, sequentially searches the available building options for the lowest cost building designs at various levels of energy savings.

# Minimizing PV Investment

- The cost of solar PV technology has dropped 80% in the last 5 years with another 30% drop expected in the next three years.
- Solar PV technology is now less capital intensive than coal or natural gas power plants. Thus, it provides an appealing MIRR for homeowners.
- Before investing in photovoltaic technology to produce a home's energy, it is more cost-effective to first use energy efficient measures to minimize the energy that must be produced.
- In this way, a much smaller, less expensive PV array can meet the home's energy needs.

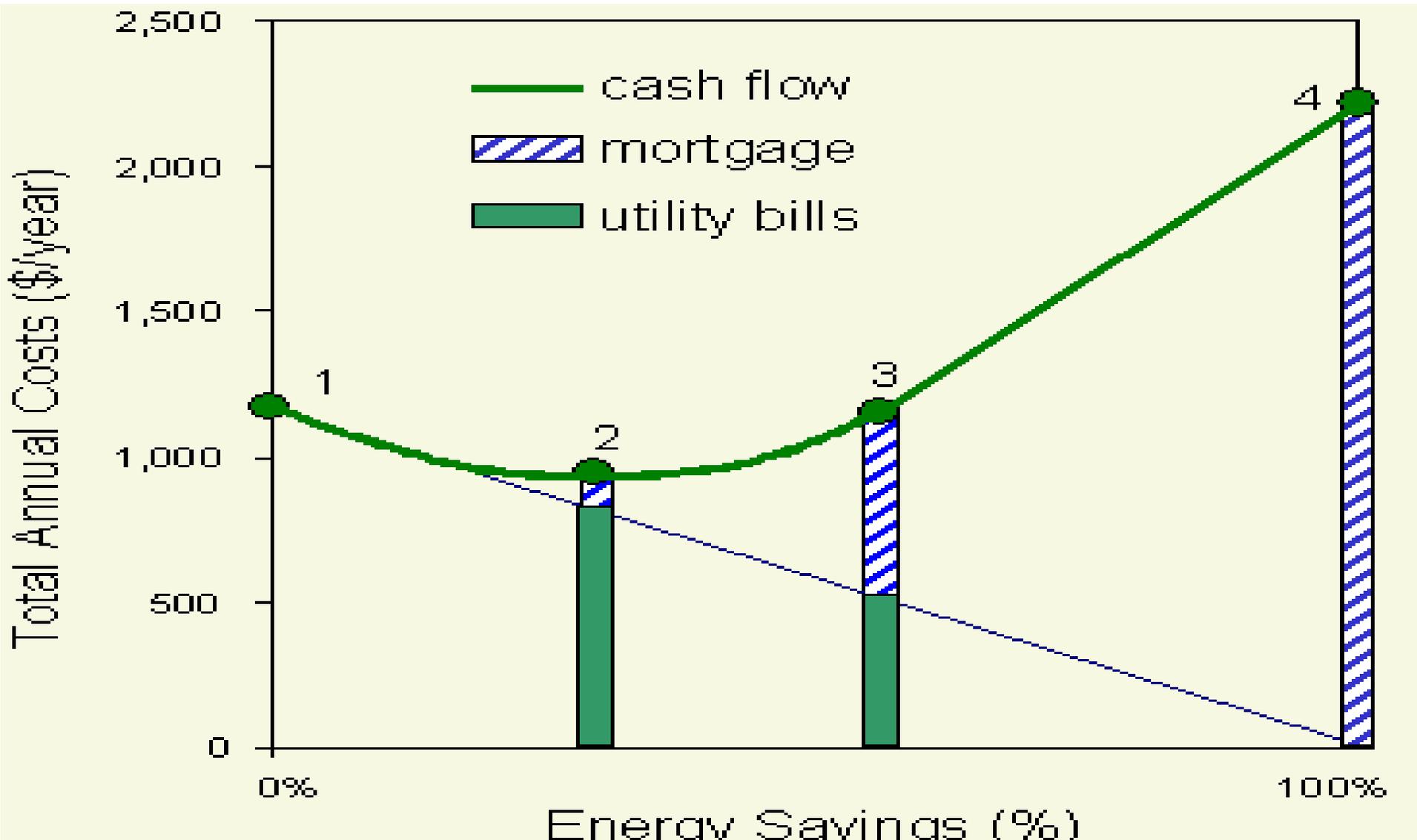
# Path to Zero Net Energy

- BEopt produces a graph referred to as the Path to Zero Net Energy. This Path can answer the following questions:
  - How much should be invested in efficiency before investing in PV?
  - What is the optimal configuration of energy efficiency measures?
  - What if only a partial reduction in energy use (from a reference case) is desired?

# Path to Zero Net Energy cont.

- The following sketch illustrates the concept of a building's path to zero net energy.
- The path falls on a graph of the % energy savings along the x-axis, and the annualized energy costs on the y-axis.
- This annual cost is made up of both the energy costs each year plus the cost of energy efficiency measures that have been incorporated into the mortgage payments.

# Path to Zero Net Energy Graph



# PHMH Objectives

- BEopt and EnergyPlus software will be used to achieve one of the primary objectives of the PHMH, e.g., initial planning and design.
- This will include analysis and adoption of leading edge technologies in conjunction with construction management techniques that will provide a paradigm shift in:
  - Energy Efficiency
  - Quality
  - Affordability

# Passive Building Design

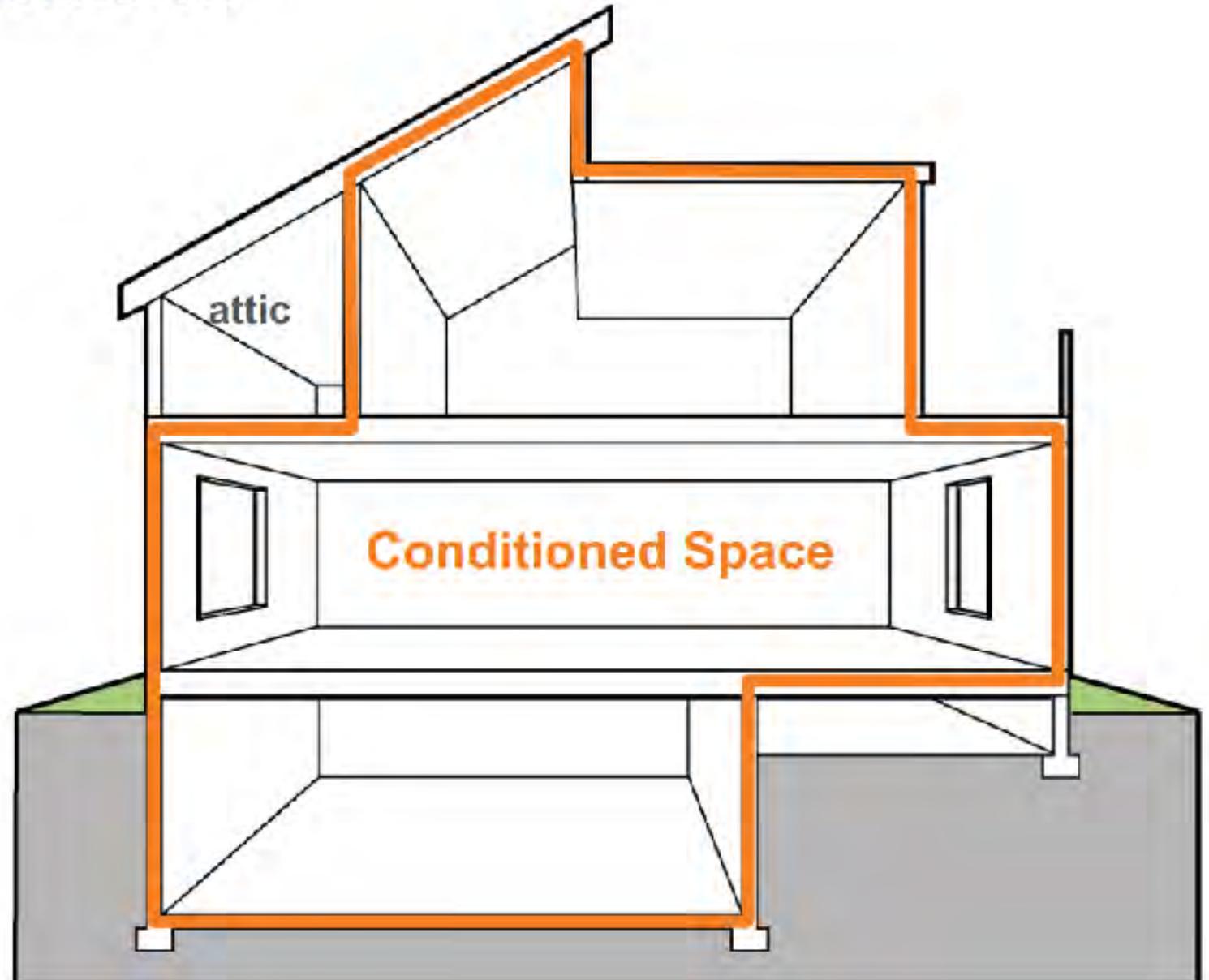
- Every building must be considered from a 'whole system' perspective.
- In addition to walls, roof and slab, windows have a significant impact on performance.
- Windows usually make up 10-20% of the total wall area and range widely in energy efficiency.

# Building Envelope & Computer Analysis

- Building envelope consultants now offer modeling services (such as BEopt and Energy Plus) that provide an accurate picture of how a building will actually perform after construction.
- This small investment in computer analysis assists in formulating the most energy efficient design in order to save tens of thousands - even hundreds of thousands - in energy costs over a building's lifetime.

## Building Envelope consists of:

- ✓ Fenestration
- ✓ Ceilings
- ✓ Walls
  - Above grade
  - Below grade
  - Mass walls
- ✓ Floors
- ✓ Slabs
- ✓ Crawlspace



# Insulation and Fenestration Requirements by Climate Zone

**TABLE R402.1.1  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT<sup>a</sup>**

CLIMATE ZONE	FENESTRATION U-FACTOR <sup>b</sup>	SKYLIGHT <sup>b</sup> U-FACTOR	GLAZED FENESTRATION SHGC <sup>b,c</sup>	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE <sup>e</sup>	FLOOR R-VALUE	BASEMENT <sup>c</sup> WALL R-VALUE	SLAB <sup>d</sup> R-VALUE & DEPTH	CRAWL SPACE <sup>c</sup> WALL R-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5 <sup>b</sup>	8/13	19	5/13 <sup>f</sup>	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 <sup>b</sup>	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 <sup>b</sup>	13/17	30 <sup>g</sup>	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10 <sup>b</sup>	15/20	30 <sup>g</sup>	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10 <sup>b</sup>	19/21	38 <sup>g</sup>	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. U-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed R-value of the insulation shall not be less than the R-value specified in the table.

b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in Climate Zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

c. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall

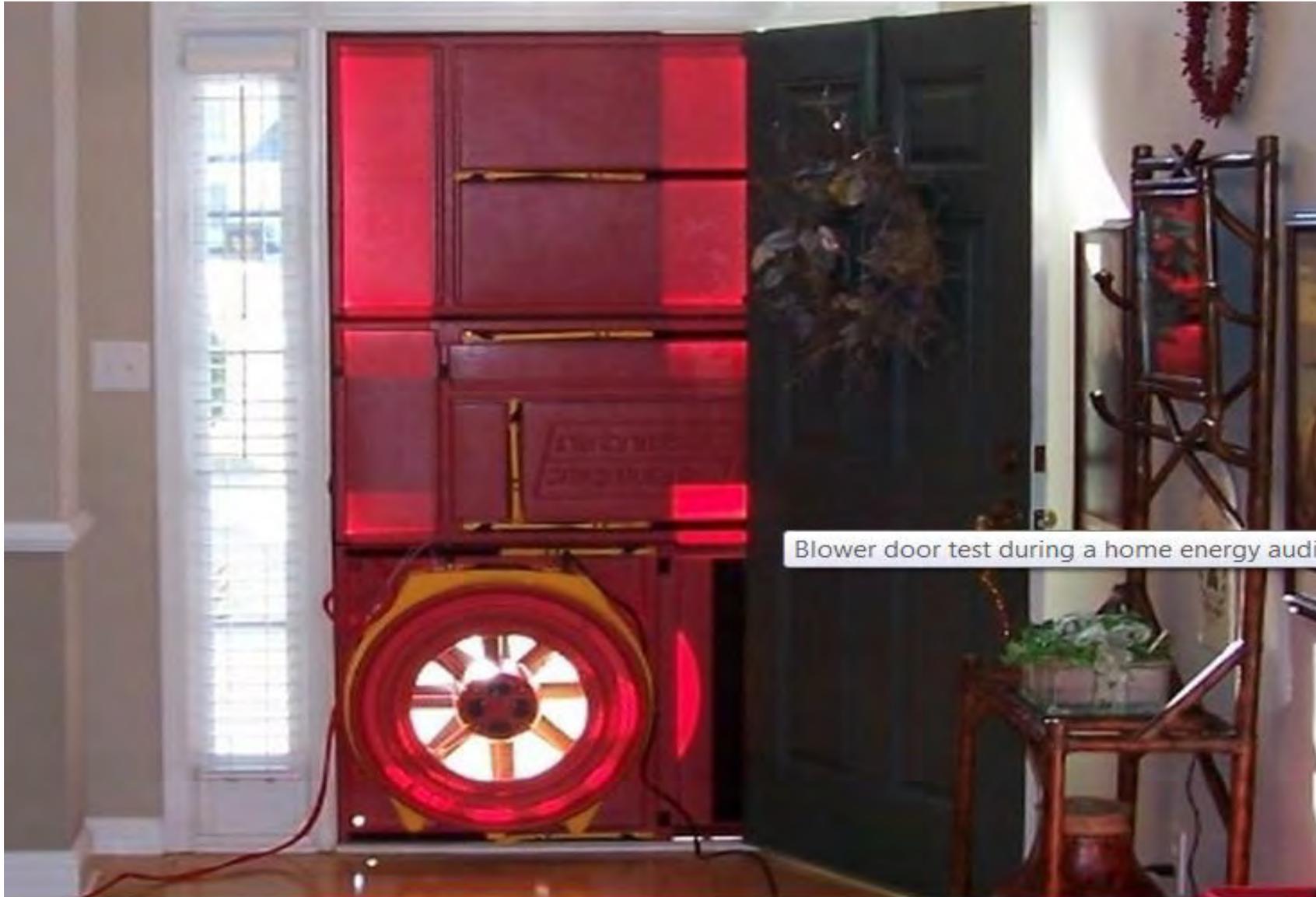
# Home Energy Audit

- <http://energy.gov/energysaver/articles/professional-home-energy-audits>
- Can be used to certify quality of workmanship and home energy efficiency of either existing, remodeled, or new homes.
- Should be conducted in conjunction with reviewing a history of energy costs on all homes that are being marketed/sold as useful criteria for the potential homebuyer.
- The Blower Door Test can be used for:
  - Reducing energy consumption due to air leakage
  - Avoiding moisture condensation problems
  - Avoiding uncomfortable drafts caused by cold air leaking in from the outdoors
  - Determining how much mechanical ventilation might be needed to provide acceptable indoor air quality.

# Vacuum Pressure (Blower Door) Test

- A blower door is a powerful fan that mounts into the frame of an exterior door. The fan pulls air out of the house, lowering the air pressure inside.
- The higher outside air pressure then flows in through all unsealed cracks and openings. The auditors may use a smoke pencil to detect air leaks. These tests determine the air infiltration rate of a building.
- Blower doors consist of a frame and flexible panel that fit in a doorway, a variable-speed fan, a pressure gauge to measure the pressure differences inside and outside the home, and an airflow manometer and hoses for measuring airflow.

# Blower Door Test < 3.0 ACPH@50 pascals



# Blower Door Diagnostic Tools

## Diagnostic Tools

Testing the airtightness of a home using a special fan called a blower door can help to ensure that air sealing work is effective. Often, energy efficiency incentive programs, such as the DOE/ EPA ENERGY STAR Program, require a blower door test (usually performed in less than an hour) to confirm the tightness of the house.



# Compliance/Documentation/Inspections

## Section R405

- Code Official has final authority
  - Software, worksheets
  - Above Code Programs
- Electronic media can be used
- Construction work for which a permit is required is subject to inspection
- Certificate is required

# **Compliance/Documentation/Inspections**

## **Section R405 cont.**

- **Code Officials Inspection**
  - Successive and final inspections, and re-inspections if necessary
- **Code Validity**
  - Code deemed to be illegal or void shall not affect the remainder of the code
- **Codes and standards considered part of the requirements of the code**
  - Provisions take precedence
- **Fees**
  - Must be paid before permit is issued
  - Required in accordance with schedule

# IECC 2012 Certificate

- Permanently posted on or in the electrical distribution panel
- Includes the following:
  - R-values of insulation installed for the thermal building envelope, including ducts outside conditioned spaces
  - U-factors for fenestration
  - SHGC for fenestration
  - Results from any required duct system and building envelope air leakage testing
  - HVAC efficiencies and types
  - SWH equipment
- Certificate lists “gas-fired unvented room heater”, “electric furnace”, or “baseboard electric heater”, or water to water GSHP, etc., rather than listing an efficiency for those heating types.

# Idaho Legislator Requests

- In speaking individually with several Idaho Representatives on the Business Committee who will eventually vote to adopt IECC 2012 (and also with Representatives on the Environment, Energy & Technology Committee), the general sentiment is that they want to insure that there is widespread support among Idahoans for increasing the current energy code (IECC 2009) to the proposed code (IECC 2012).
- The following survey conducted in 2012 and 2013 reveals that over 65% of Idaho homeowners support adoption of IECC 2012. In addition, new homeowners are willing to pay more for energy efficient homes, particularly when it results in a net monthly savings due to lower energy bills.
- It should also be noted that renters (who do not appear to have been included in the following homeowner survey) are supportive of energy efficient homes and apartments since it reduces monthly energy bills.

# Funded by Idaho Office of Energy Resources

- In 2012 the Idaho Office of Energy Resources (OER) sponsored a homeowner energy survey. This survey was expanded upon in 2013 as a result of funding from the Bonneville Power Administration.
- The 2013 Idaho Homeowner Energy Code Survey is a scientifically random and valid representation of Idaho homeowners.
- It was conducted in accordance with ISO 20252:2012 Market Research Standards by Northwest Research Group LLC in collaboration with Boise State University, Office of Energy Resources and Sharon Grant of Eco Edge who prepared the executive summary.

# Idaho OER Outreach Plan

- The results were deemed worthy of publishing in academia and will serve to guide an update to the outreach plan developed during the previous grant by the OER in 2012.
- The study was conducted to assess Idaho homeowner views on energy codes. Survey questions were developed to meet the following objectives: 1) Determine if Idahoans value energy efficiency; 2) Establish a priority of value; 3) Determine if Idaho homeowners value statewide standards for energy efficiency; and, 4) Determine how much Idaho homeowners are willing to pay for energy efficiency.

# 2013 Idaho Homeowner Energy Survey

- To establish a priority of value, survey questions ranked the level of agreement on a 7-point scale, with 7 indicating strongly agree and 1 strongly disagree.
- A telephone sample was conducted with a random sample of 600 Idahoans, ages 18 and older, using a dual-frame (landline and cell phone) random digit dial (RDD) sample in which 30% of all interviews were completed with wireless only or wireless mostly households. The state was stratified by county into three geographic areas and sampling was proportionate to the population.
- A pretest of n=30 respondents was conducted. Final data collection was completed between December 12 and 22, 2013. All work was performed in accordance with ISO 20252:2012 Market Research Standards. The sample plan was designed to achieve a maximum margin of error of +/- 4.9 percent with 95 percent confidence.

# Over 65% of Idahoans Favor Energy Codes

- Idahoans value energy efficiency with 65% being in favor of energy codes and nearly four out of five Idahoans feel their home is at least somewhat energy efficient. During a pretest of the survey questions, it was discovered that there was a lack of understanding of what makes a home energy efficient. Although most homeowners feel their home is at least somewhat energy efficient, they could not identify what about their home made it efficient.
- Respondents' inability to answer these initial questions resulted in those questions being removed from the survey. This tells us that there is a need for more education on what makes a home energy efficient. Based on this survey, the preferred way to reach homeowners is via direct mail or online, and the most believable information sources are local people such as an architect, building inspector or utility.

# Factors Driving Support of Energy Codes

- Reasons for supporting energy codes are primarily financial. The majority feels that having energy codes will have an impact on monthly operating costs of their home, and they strongly agree that energy efficient homes have a higher resale value.
- Monthly operating costs are the top driver of whether someone supports energy codes. Another key driver is the belief that energy code standards ensure quality construction.
- An interesting finding is that none of the statements regarding value and/or purchase price of home have much of an impact on overall agreement with adopting statewide energy codes.

# The Right to Have Energy Efficient Homes

- Respondents also strongly agree that homeowners purchasing a new home should have a right to a home that meets national energy standards.
- Belief in this right is another key driver that determines whether they agree with energy codes.
- Those who disagree with the need for statewide energy codes do so because they feel that it limits homeowners' rights and, to a lesser extent, adds more government regulations.

# Idahoans are Willing to Pay More

- Although Idahoans generally agree that Idaho energy codes should be consistent with national standards, less than half say that they trust the State to adopt to adopt the right energy efficiency standards for Idaho.
- Idahoans appear to be willing to pay as much as \$10 per month in additional rent or mortgage costs to save \$16 per month on energy bills, and indicate that an acceptable payback period is up to 7 years.
- This compares favorably to research on the cost of building to the current energy code (2009 IECC) versus the upcoming energy code (2012 IECC) because the estimated cost is less than \$10 per month and savings are up to \$21.75 per month.

# Higher Resale Value for Energy Efficient Homes

- In other words, there is very strong agreement that an energy efficient home has a higher resale value, but when regression analysis was performed, there was not a strong correlation between this statement and overall agreement with adopting a state energy code consistent with national standards.
- Similarly, we observed strong agreement that energy codes help make homes comfortable, but not a strong correlation.

# Bibliography

- ***DOE Building Energy Codes University*** - Residential Provisions of the 2012 International Energy Conservation Code, July 2011
- ***DOE Building Technologies Program*** – National Energy and Cost Savings for New Single– and Multifamily Homes: A Comparison of the 2006, 2009, and 2012 Editions of the IECC
- ***DOE-National Renewable Energy Lab – Building Energy Optimization (BEopt)*** modeling and simulation software available online (<https://beopt.nrel.gov/>)
- ***FAQ Energy Efficient Codes Coalition (EECC)***
- ***2013 Idaho Homeowners Energy Code Survey***  
(<http://www.idahoenergycode.com/sites/idahoenergycode.com/files/resources/pdf/BPA%20Grant%20Idaho%20Energy%20Code%20Survey%2031May2014.pdf>)