

BUILDING ENERGY CODES



National Residential and
Commercial Energy Codes
DOE's Involvement

Pam Cole

Building Energy Codes Program
Pacific Northwest National Laboratory

- 1980's through 2006
 - Minimum codes were truly minimal
 - DOE pushed for marginal improvements (1% to 3% per cycle)
 - DOE proposed (successfully) a major rewrite of the IECC in 2004 (became the 2006 IECC)—emphasis was format, not stringency
- 2009 to Present.....
 - Things are getting more serious

Model Energy Codes

- **50% Goal—for Increased Energy Savings**
 - Need to go beyond prescriptive approaches
 - Exploring performance-based options and alternative paths to compliance
 - Voluntary Codes: Submitted outcome and performance-based proposals
- **70% Initiative for Increased Adoption**
 - Comprehensive adoption strategy
 - Goal: 40 states to adopt ARRA target codes or most current model codes by 2015
 - Goal: 10 states to adopt the ARRA target codes or more efficient in FY2011
- **90% Compliance by 2017**
 - Continue technical and financial support to the states
 - Increase the number and availability of compliance guides and field measurement tools



50% Better Codes
Proposed by 2015

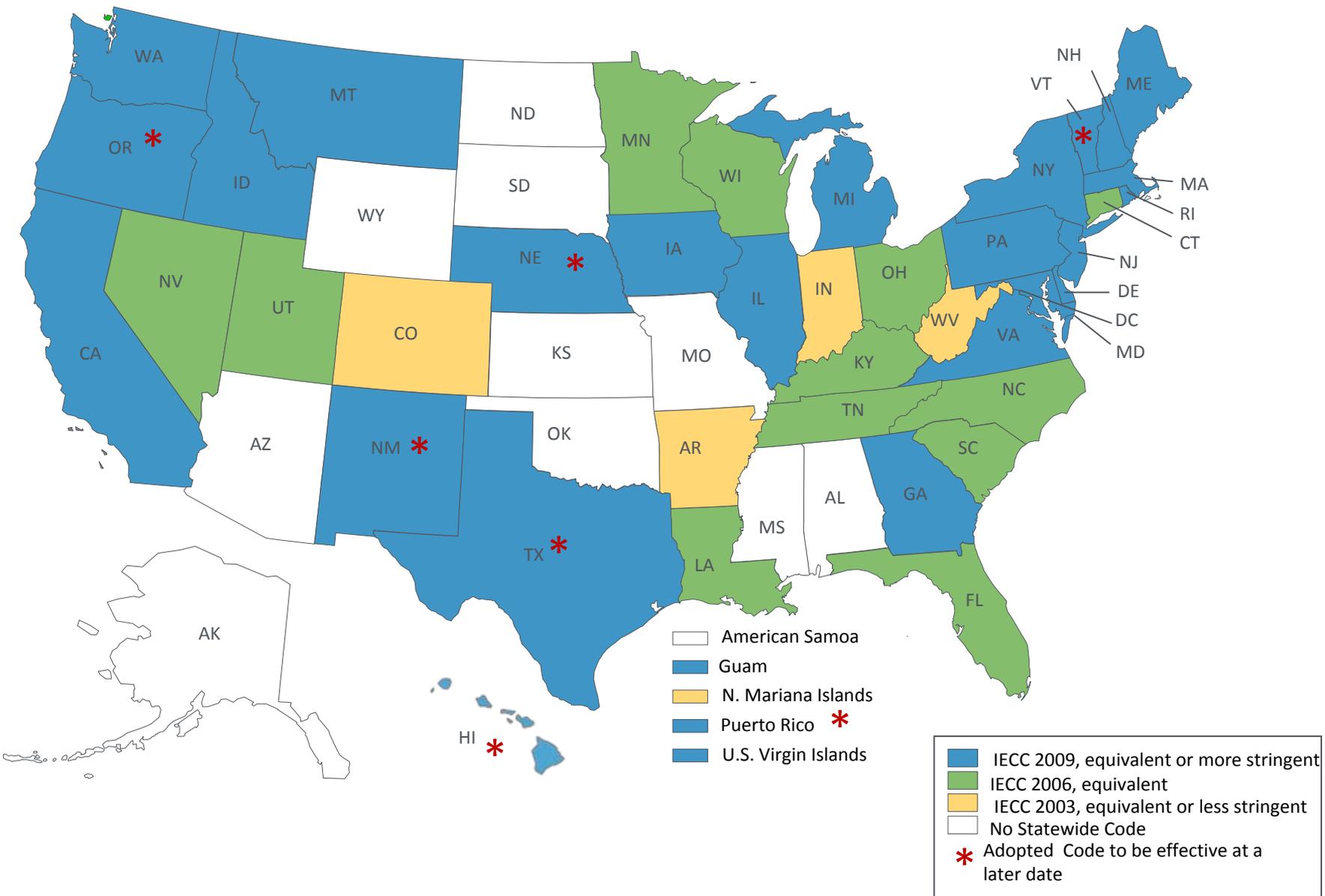


70% Code Adoption
By 2015



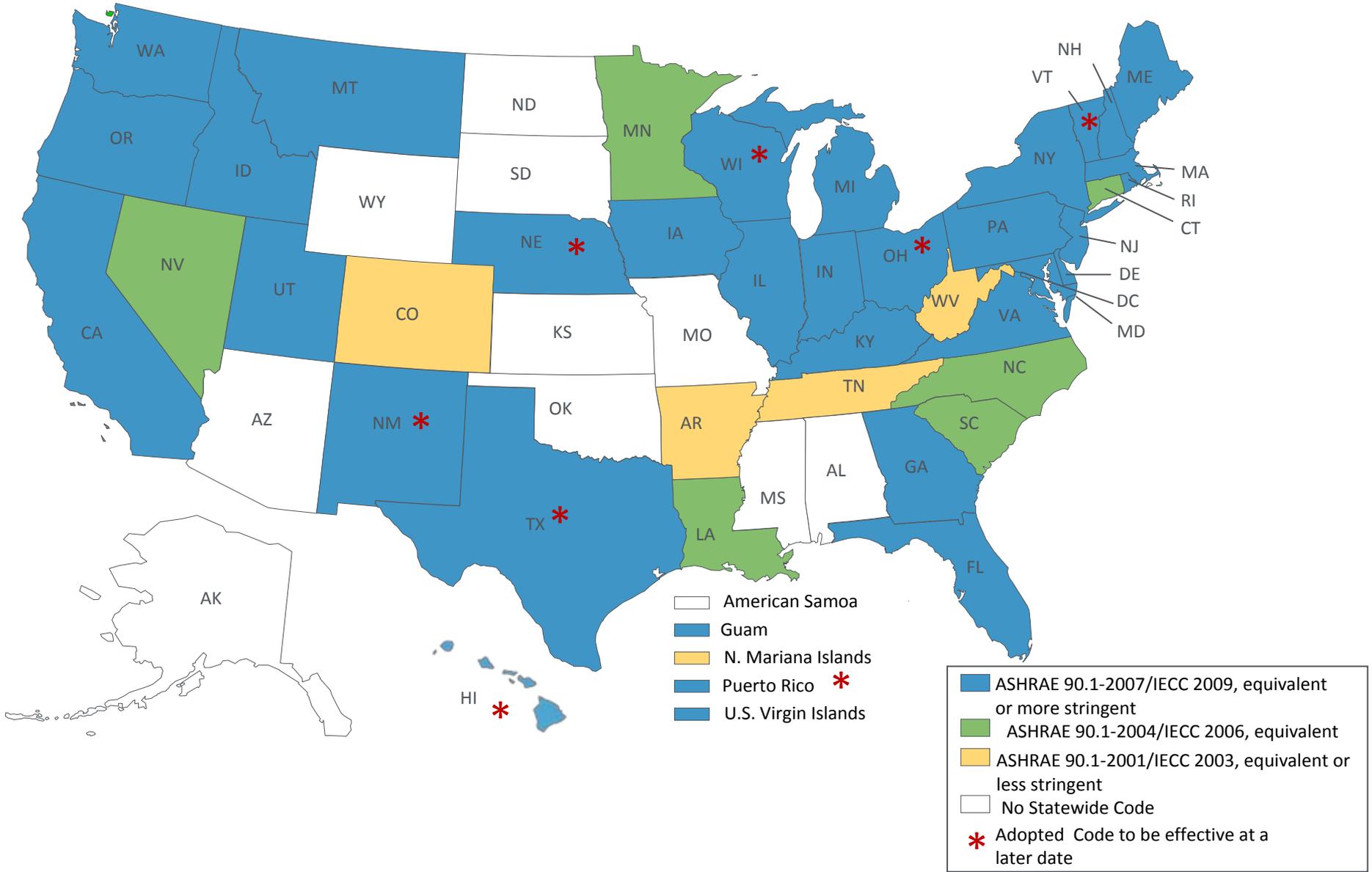
90% Compliance
by 2017

Current Status of Residential Energy Code Adoption



As of April 28, 2011

Current Status of Commercial Energy Code Adoption



As of April 28, 2011

- 2009 IECC - Residential
 - Lighting added to IECC scope (at least 50% of lamps must be “high efficacy”)
 - Mandatory duct system pressure test
 - No equipment-envelope trade-offs
 - 12% to 15% better than 2006 IECC

- Approximately 30% more efficient than the 2006 IECC
- Now constitutes (by reference) the energy chapter of the International Residential Code (IRC)
- Retains 2009 IECC's prohibition on envelope-equipment tradeoffs
- Scheduled for publication June 2011
- Contains a few major and many minor changes

- New mandatory whole-house pressure test (blower door) with stringent required leakage rates
 - Zones 1-3: ≤ 5 ACH @50 Pa
 - Zones 4-8: ≤ 3 ACH @50 Pa
- Domestic hot water piping must be either
 - Insulated to R3, or
 - Short and skinny (i.e., exempted lengths depend on diameter)
- Duct leakage rates lowered
 - Eliminated “leakage to outdoors” option
 - From 12 to 4 CFM/100sf CFA (after construction)
 - From 6 to 4 CFM/100sf CFA (at rough-in)
- Various R-value/U-factor/SHGC improvements

2012 IECC – Major Prescriptive Envelope Changes

Zone	Ceiling R-Value
1	
2	R30 → R38
3	
4 except Marine	R38 → R49
5 and Marine 4	
6	
7 & 8	

2012 IECC – Major Prescriptive Envelope Changes

Zone	Wood-Frame Wall R-Value	Mass Wall R-Value
1		
2		
3	R13 → R20/R13+5	R5/8 → R8/13
4 except Marine		
5 and Marine 4		
6	R20/R13+5 → R20+5/R13+10	R15/19 → R15/20
7 & 8	R21 → R20+5/R13+10	

- 2x6 construction now “required” in some zones
 - Envelope trade-off options limited
 - Equipment trade-off options prohibited
- Log walls difficult to comply without large diameter logs or furred-in finish layer
- Insulating sheathing now “required” in some zones
 - Bracing options limited, especially with recent IRC changes

2012 IECC – Major Prescriptive Envelope Changes

Zone	Basement Wall R-Value	Crawlspace Wall R-Value
1		
2		
3		
4 except Marine		
5 and Marine 4	R10/13 → R15/19	
6		R10/13 → R15/19
7 & 8		

2012 IECC – Major Prescriptive Envelope Changes

Zone	Fenestration U-Factor	Fenestration SHGC
1	1.2 → 0.50	0.30 → 0.25 (except skylights)
2	0.65 → 0.40 (0.75 → 0.65 skylights)	
3	0.50 → 0.35 (0.65 → 0.55 skylights)	
4 except Marine	(0.60 → 0.55 skylights)	NR → 0.40
5 and Marine 4		
6	0.35 → 0.32 (0.60 → 0.55 skylights)	
7 & 8		

- Approximately 30% more efficient than the 2006 IECC
 - The reference standard in the 2012 IECC – ASHRAE Standard 90.1-2010, is about 30% more efficient than Standard 90.1-2004, the reference standard in the 2006 IECC.
 - DOE’s commercial energy code goals are expressed in terms of Standard 90.1, not the IECC.
- Scheduled for publication June 2011
- Contains a number of major changes

Commercial

Continuous Air Barriers

- Focused on reducing infiltration loads on the building.
- Can comply with one of three options:
 - Installing the correct air barrier materials.
 - Installing the correct air barrier assemblies.
 - Testing the building to meet maximum air leakage requirements.



From NIST: <http://www.wbdg.org/resources/airbarriers.php>

WBDG a program of the
National Institute of Building Sciences
WHOLE BUILDING DESIGN GUIDE

Commercial

- Vertical glazing limited to 30% window-to-wall ratio.

BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration								
U-factor								
Fixed fenestration	0.50	0.50	0.46	0.38	0.38	0.36	0.29	0.29
Operable fenestration	0.65	0.65	0.60	0.45	0.45	0.43	0.37	0.37
Entrance doors	1.10	0.83	0.77	0.77	0.77	0.77	0.77	0.77
SHGC								
SHGC	0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45
Skylights								
U-factor	0.75	0.65	0.55	0.50	0.50	0.50	0.50	0.50
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement.

Commercial

- Minimum Skylight Fenestration Area:
 - For enclosed spaces greater than 10,000 ft² directly under a roof in CZ 1 to 5.
 - Total daylight zone \geq 50% of the floor area.
 - All lighting required to be controlled by automatic multi-level lighting controls.



From Advanced Energy Design Guide for Small Warehouses and Self-Storage Buildings

Commercial

Lighting Controls

- Automatic lighting controls required for all buildings
 - Automatic time switch
 - Occupancy sensor
 - Daylighting controls
- Additional controls required for spaces e.g., overnight rooms in hotels
 - High-rise dwelling units
 - 75% high efficacy lighting
- Functional testing required for all automatic lighting controls



Commercial

- Added space-by-space lighting power density compliance approach
- Reduced LPD for
 - Office (10%)
 - Retail (7%)
- Reduced retail display lighting allowance
 - 1,000 Watts to 500 Watts

<u>BUILDING AREA TYPE</u>	
	LPD (w/ft ²)
AUTOMOTIVE FACILITY	0.9
CONVENTION CENTER	1.2
COURTHOUSE	1.2
DINING: BAR LOUNGE/LEISURE	1.3
DINING: CAFETERIA/FAST FOOD	1.4
DINING: FAMILY	1.6
DORMITORY	1.0
EXERCISE CENTER	1.0
FIRE STATION	0.8
GYMNASIUM	1.1
HEALTH CARE CLINIC	1.0
HOSPITAL	1.2
HOTEL	1.0
LIBRARY	1.3
MANUFACTURING FACILITY	1.3
MOTEL	1.0
MOTION PICTURE THEATER	1.2
MULTIFAMILY	0.7
MUSEUM	1.1
OFFICE	0.9
PARKING GARAGE	0.3
PENITENTIARY	1.0
PERFORMING ARTS THEATER	1.6
POLICE STATION	1.0
FIRE STATION	0.8
POST OFFICE	1.1
RELIGIOUS BUILDING	1.3
RETAIL	1.4
SCHOOL/ UNIVERSITY	1.2
SPORTS ARENA	1.1
TOWN HALL	1.1
TRANSPORTATION	1.0
WAREHOUSE	0.6
WORKSHOP	1.4

Commercial

HVAC Commissioning

- Applies to buildings with a total building equipment capacity \geq :
 - 480,000 Btu/h cooling capacity, or
 - 600,000 Btu/h heating capacity
- Requires:
 - Commissioning plan
 - Systems adjusting and balancing
 - Functional performance testing
 - Equipment
 - Controls
 - Economizers
 - Preliminary commissioning report
 - Construction documents and O&M Manuals
 - Final commissioning report and air balancing report



Commercial

• One additional efficiency feature must be selected to comply with the IECC

- More efficient lighting system (consistent with 90.1-2010), or
- More efficient HVAC equipment
- Installation of onsite renewables
 - 3% of the regulated energy



High Efficiency HVAC



More Efficient Lighting System



Onsite Renewables

2015 IECC???

Changes to code format

- It is not clear that 50% improvement can be achieved prescriptively

Zone	Ceiling R	Wall R	Floor R	Glazing U
1	49	22	36	0.25
2	60	30	49	0.15
3	99 (!!)	36 (!!)	60 (I quit)	0.05
...				

- It is not clear that 50% improvement can be achieved prescriptively
- Several new approaches have been discussed
 - Prescriptive baseline with a performance requirement of X% better (“prescriptive plus”)
 - Annual performance budget (Btu/ft²)
 - Annual performance budget (Btu...size matters)
 - Annual Carbon budget
 - Any of the above with post-occupancy metering
 - Required renewables (i.e., regardless of performance budgets, cost effectiveness, etc.)
 - Capacity constraints
 - Commercial modeling
 - Outcome based codes

- **Things are getting more serious**
- If DOE (and others) are successful, the IECC will be as good or better than most current beyond-code programs
- Calculating impacts in a way comparable with beyond-code programs is difficult
- Creative changes to the code format and/or enforcement infrastructure will likely be needed
- Development of a currently nonexistent (or at least inadequate) expert infrastructure will likely be needed

For more information go to www.energycodes.gov

The screenshot shows a Windows Internet Explorer browser window displaying the Building Energy Codes Program website. The browser's address bar shows the URL <http://www.energycodes.gov/>. The website header features the U.S. Department of Energy logo and the text "Energy Efficiency & Renewable Energy". Below this is a green banner with the text "Building Energy Codes Program". A navigation menu includes "ABOUT BECP", "WHY BUILDING ENERGY CODES", and "RELATED LINKS". A search bar is located in the top right corner with the text "Search energycodes.gov". The main content area features a large image of a modern building with a glass facade, overlaid with a green banner that reads "Less Energy. Less Cost. Less Carbon." To the right of the image is a text box titled "ARE YOU SETTING THE STANDARD?" with the subtext "Keep up-to-date on what's happening in the codes world. Read the latest issue!" and a "Learn More" link. Below the image is a pagination control with buttons numbered 1 through 5 and a "Next" button. A caption below the image reads "To learn more about a featured item, click on the corresponding image." On the left side of the page, there are two vertical menus: "LEARN MORE ABOUT..." with links for "Measuring Compliance", "Compliance Evaluation", and "Green Building Codes"; and "BROWSE..." with links for "Publications", "Events Calendar", and "Job/Internship Opportunities". On the right side, there are sections for "POWER TOOLS" (including "Status" and "Helpline" links), "Desktop Tools" (including "REScheck" and "COMcheck" links), "Online Tools" (including "REScheck" and "COMcheck" links), and "RECENT UPDATES" (including a link for "90.1 Prototype Building Models Now Available for Download" dated 04.29.2011 and a link for "Setting the Standard Newsletter Released"). The browser's status bar at the bottom shows "Internet" and "100%".



Washington State Department of Commerce

Washington State Energy Code – Opportunity for additional savings

Chuck Murray
May 2011



Department of Commerce
Innovation is in our nature.

Washington State Energy Code 20+ years

- 1986 Early Adopters
- 1991 Statewide Code
- 25 % of building stock covered by state code
 - 1991 to 2011
- Regional Electric Savings 41 aMW/year
 - (NW Council)



2009 WSEC Single Family Savings

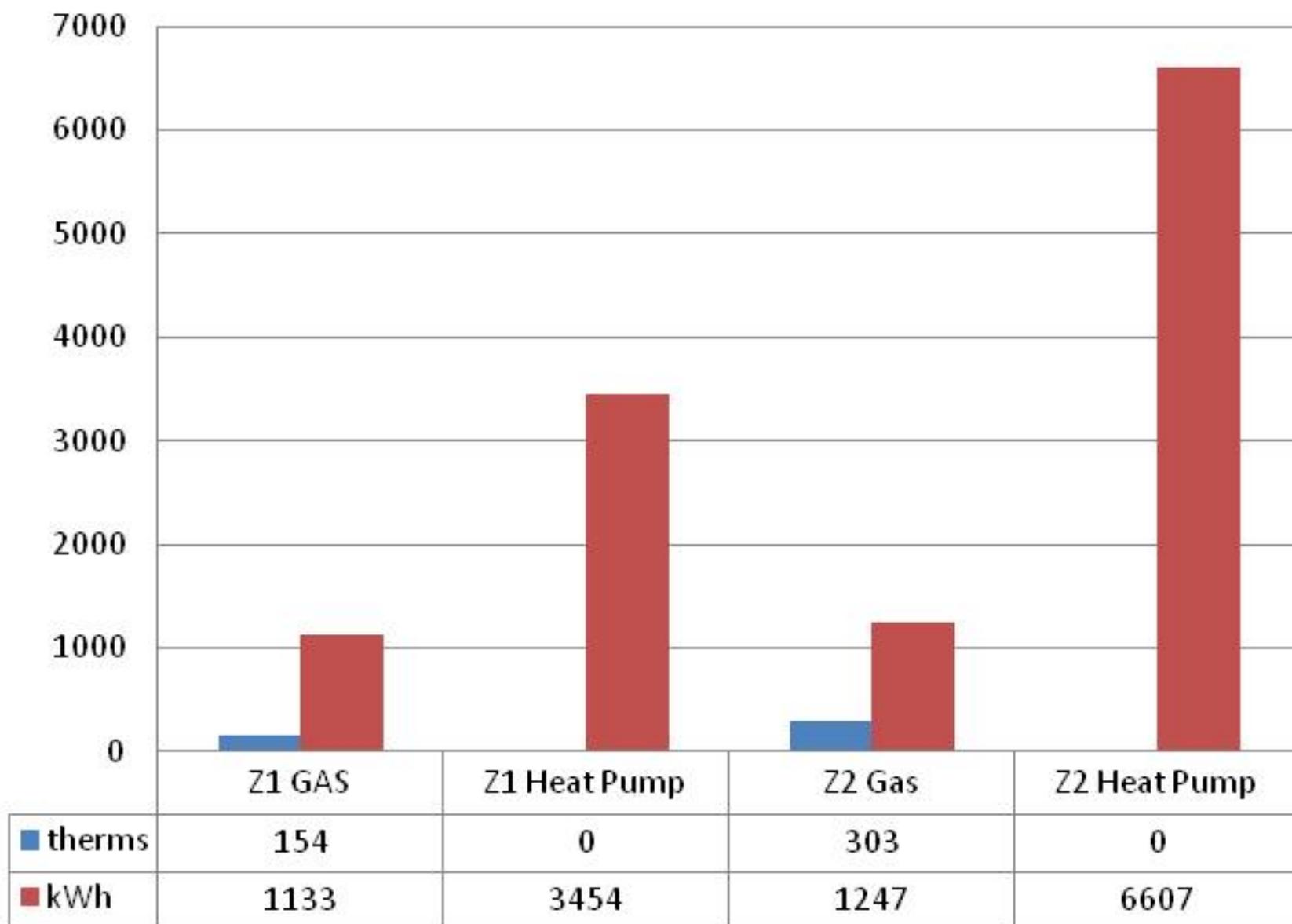
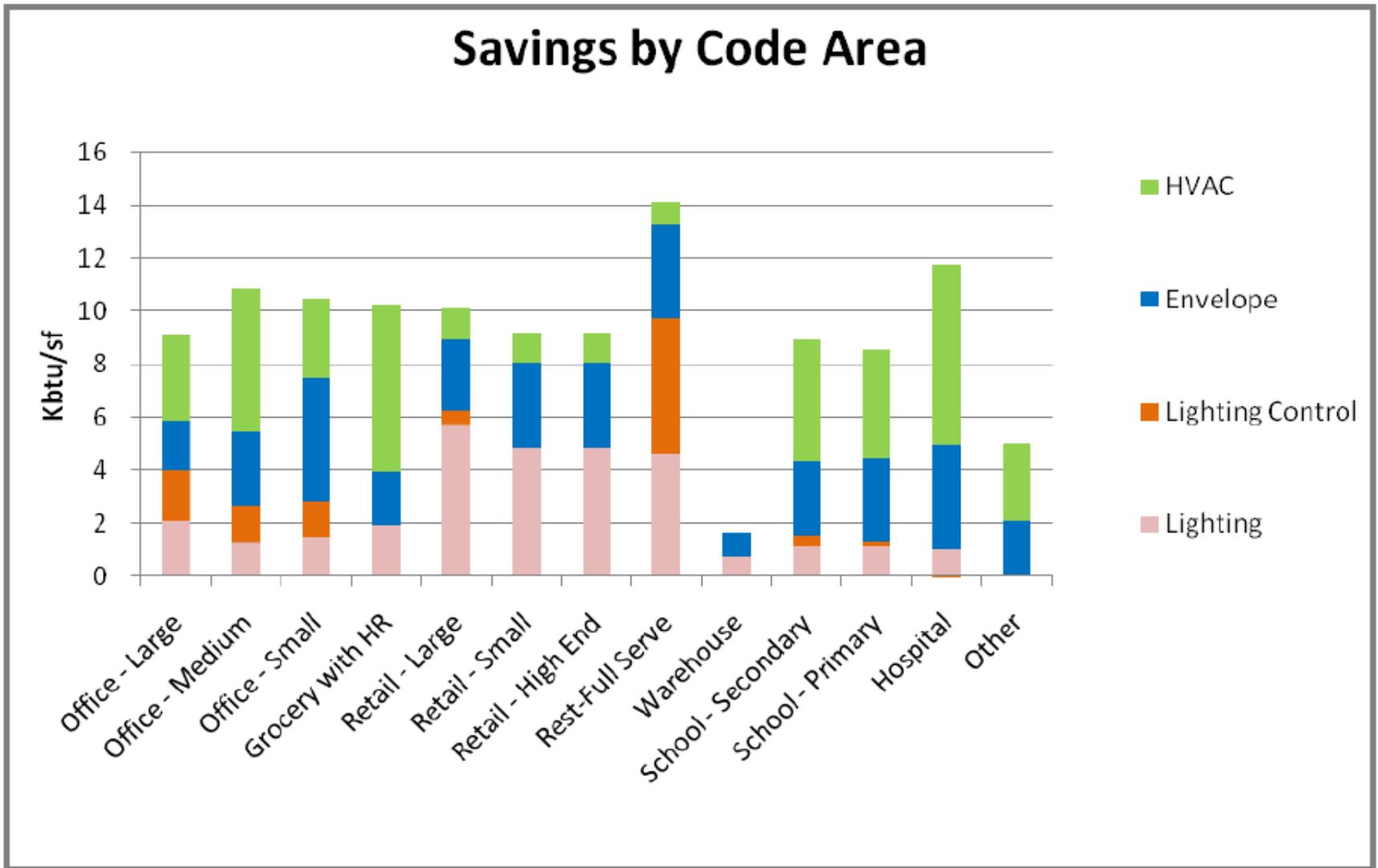


Figure 2: Savings by Building Type and Code Section



I-937

194-37-080

(3) The utility shall count the total first year savings of a conservation measure in the year during which either the measure was installed or the utility paid for it.

(c) Savings from improved federal minimum energy efficiency standards or Washington state building energy code improvements or improved state appliance codes and standards in the biennium in which they become effective, as proportionate to the utility's service territory. After that biennium, a utility may no longer include savings from those specific codes and/or standards in its next ten-year potential.

Biennium 2010, 2011

Code effective date Jan, 2011

Construction – some months later

Net Plan, Remove the code measures from the potential

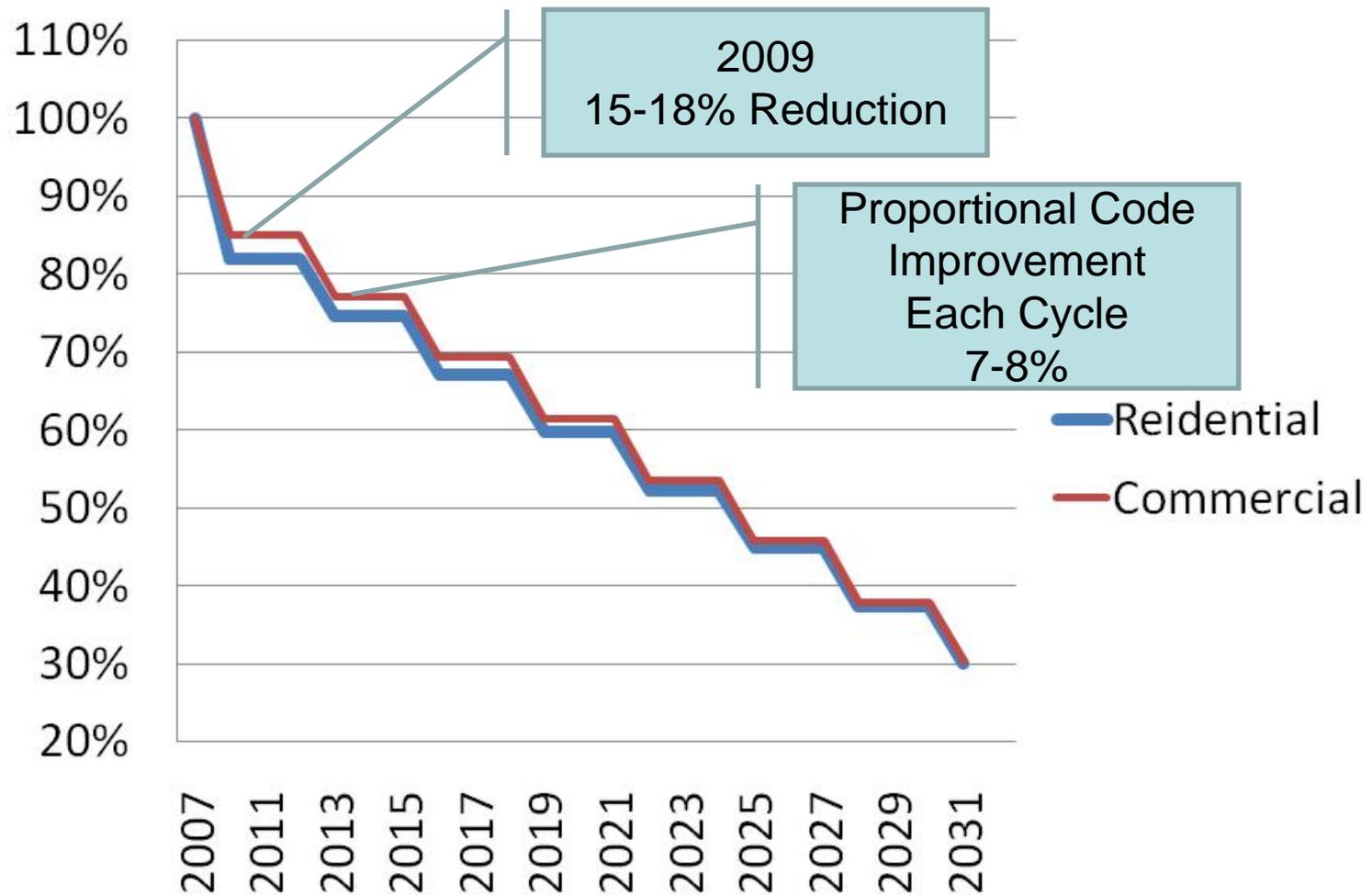
Enabling Legislation / Building Code Council

- **19.27A.160**

2) The council shall adopt state energy codes from **2013 through 2031 that incrementally move towards achieving the seventy percent reduction** in annual net energy consumption as specified in subsection (1) of this section. The council shall report its progress by December 31, 2012, and every three years thereafter.

Code Improvement Schedule

Energy Use Compared to 2006 Codes



Enabling Legislation / Building Code Council

- **19.27A.160**

2) cont.

- If the council determines that economic, technological, or process factors would significantly impede adoption of or compliance with this subsection, the council may defer the implementation of the proposed energy code update and shall report its findings to the legislature by December 31st of the year prior to the year in which those codes would otherwise be enacted.

This meeting is being recorded

Economic Cost / Benefit will be Key

- Revised process under development by SBCC will be more rigorous
- BPA/ Utility / NEEA role in testing new measures and collecting data to support code adoption will be all the more important

2009: Tested Duct Sealing in Code

It took 22 years

- Robison, D. H., and L. A. Lambert. **1988**. “Field Investigation of Residential Duct Leakage.”
- Parker, D. S. **1989**. “Evidence of Increased Levels of Space Heat Consumption and Air Leakage Associated with Forced Air Heating Systems in Houses in the Pacific Northwest.”
- RCDP III Palmiter, L, and P. W. Francisco. **1994**. “Measured Efficiency of Forced-Air Distribution Systems in 24 Homes”. **1991-1993**
- RCDP IV: 41 new homes and 25 retrofits in Idaho, Montana, Oregon and Washington **1993 -1995**.
- Performance Tested Comfort Systems **1998**
- NW Energy Star Homes **2004**



2012 WA Code Development Cycle

- 2011 – Convert WA Code to International Energy Conservation Code Format
 - State Building Code Council Staff
- Feb 28, 2012 – Code Change Proposals Due to State Building Code Council



Table F-1: Illustrative Paths for Model Conservation Standard for New Site Built Electrically Heated Residential Buildings

Component	Climate Zone		
	Zone 1	Zone 2	Zone 3
Ceilings			
• Attic	R-49 (U-0.020) ^{a,b}	R-49 (U-0.020) ^{a,b}	R-49 (U-0.020) ^{a,b}
• Vaults	R-38 (U-0.027)	R-38 (U-0.027)	R-38 (U-0.027)
Walls			
• Above Grade ^c	R-21 Advanced (U-0.051)	R-21 Advanced (U-0.051)	R-21 Advanced (U-0.051)
• Below Grade ^d	R-21	R-21	R-21
Floors			
• Crawlspace and Unheated Basements	R-30 (U-0.029)	R-30 (U-0.029)	R-30 (U-0.029)
• Slab-on-grade - Unheated ^e	R-10 Full Under Slab	R-10 Full Under Slab	R-10 Full Under Slab
• Slab-on-grade - Heated	R-10 Full Under Slab w/R-5 Thermal Break	R-10 Full Under Slab w/R-5 Thermal Break	R-10 Full Under Slab w/R-5 Thermal Break

Below Grade	R-21	R-21	R-21
Floors			
<ul style="list-style-type: none"> Crawlspaces and Unheated Basements 	R-30 (U-0.029)	R-30 (U-0.029)	R-30 (U-0.029)
<ul style="list-style-type: none"> Slab-on-grade - Unheated^e 	R-10 Full Under Slab	R-10 Full Under Slab	R-10 Full Under Slab
<ul style="list-style-type: none"> Slab-on-grade - Heated 	R-10 Full Under Slab w/R-5 Thermal Break	R-10 Full Under Slab w/R-5 Thermal Break	R-10 Full Under Slab w/R-5 Thermal Break
Glazing ^{f,g}	R-3.33 (U-0.30)	R-3.33 (U-0.30)	R-3.33 (U-0.30)
Exterior Doors	R-5 (U-0.19)	R-5 (U-0.19)	R-5 (U-0.19)
Thermal Infiltration Rate ^h	0.35 ach	0.35 ach	0.35 ach
Ventilation and Indoor Air Quality ⁱ	ASHRAE Standard 62.2-2007 with Heat Recovery Ventilation		
Service Water Heater ^j	Energy Factor = 2.2		
Hardwired Lighting	Maximum Lighting Power Density - 0.6 Watts/sq.ft.		
Space Conditioning System	Minimum Heating Season Performance Factor (HSPF) - 9.0		
	Minimum Seasonal Energy Efficiency Rating (SEER) - 14.0		

Implementation

- Tomorrows agenda



2011 Oregon Commercial REACH Code

Reaching to save Energy

Pat Allen

Acting Administrator

State of Oregon Building Codes Division

May 10, 2011

State of Oregon

Building Codes Division

Our Mission: *“Better Buildings for Oregon”*

- Safe
- Energy Efficient
- Function Properly
- Cost Effective to Build
- Affordable to own

State of Oregon

Building Codes Division

How do we accomplish our mission?

- Building Codes
- Plans & Inspections
- Licensing
- Enforcement
- Partnerships

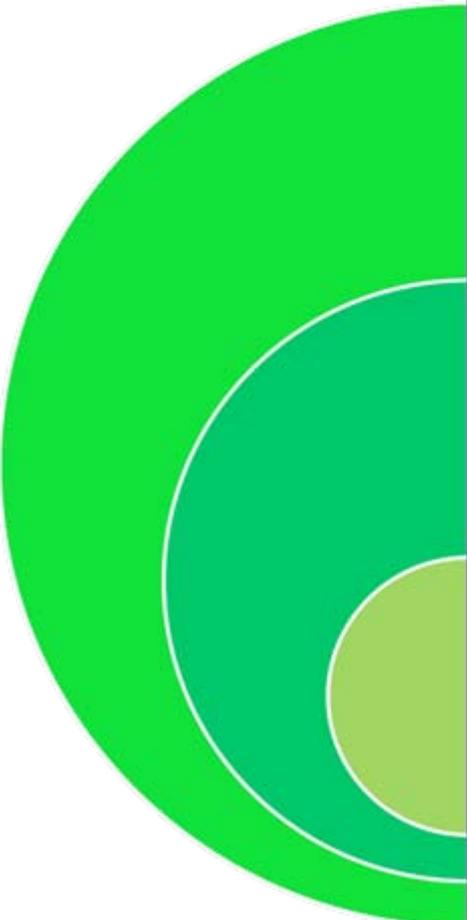
Oregon Energy Policy

“Conservation will help us meet 80% of new demand over the next 20 years”

NW Power and Conservation Planning Council's 6th Power Plan

Oregon Energy Policy

Energy Efficiency Goals Become Law



SB 79	
Increase Code Minimum	<ul style="list-style-type: none">• Commercial 15-25%• Residential 10-15%
Develop REACH Code	<ul style="list-style-type: none">• Optional• High performance

Oregon REACH Code

What will it do?

- Increase predictability
- Serve as a testing ground for new construction methods and technology
- Expedite permitting
- Align with certification and incentive programs
- Measure progress

Code Development

- REACH Code Advisory Committee
 - Formed in March 2010
 - Adapt national model code to Oregon
- Technical sub-committee
 - Vetted energy provisions with technical experts
 - Aligned with 'draft' IGCC and 2012 IECC
- Construction Industry Energy Board
 - Board recommends moving to rulemaking
- Adopt code by rule
 - Anticipated code adoption July 1, 2011

Code Development Process

- Based on *draft* International Green Construction Code (IGCC)
 - Proposed by coalition - US DOE, AIA, ASHRAE and US Green Building Council
 - Allows us to fulfill broad mandate of SB 79 – ‘reducing electricity and fossil fuel use’
 - Begin to address buildings as ‘integrated’ system
 - ‘Reserved’ sections of IGCC will allow code to grow

Reaching for Better Buildings

Focus is on High Performance

- Tight building envelope
- High performing windows
- Efficient heating and cooling systems
- Advanced lighting and controls

Reaching for Better Buildings

Project Electives - Secondary Energy Impacts that Increase Design Flexibility

Examples:

- Water conservation
- Material selection
- Post-occupancy commissioning

Reaching for Better Buildings

How do we get encourage use?

- Work with partners on training
- Develop a marketing strategy

Challenges Ahead

Energy Impacts NOT Regulated by Codes

- Plug Loads
- Occupant Behavior
- Ongoing Maintenance



For more information

REACH Code Advisory Committee:

<http://bcd.oregon.gov/committees/11reachcode.html>

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