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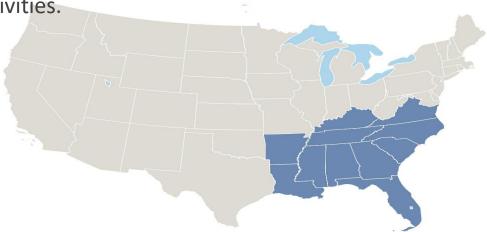
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SEEA Serves The Southeast

The **Southeast Energy Efficiency Alliance (SEEA)** promotes energy efficiency as a catalyst for economic growth, workforce development and energy security. We do this through collaborative public policy, thought leadership, outreach programs, and technical advisory activities.



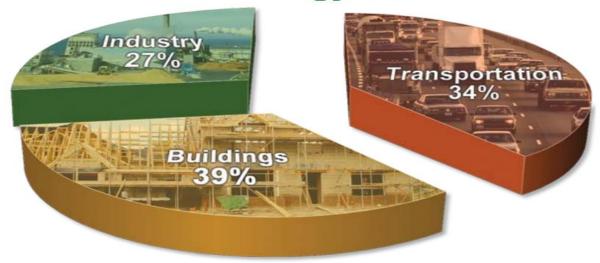
Regional Energy Efficiency Organization

footprint
Non-profit,
non-partisan



Why Energy Codes?

U.S. Energy Use



Energy Code Process- high level

Key points to know:

- Building codes are state laws.
 - States/local governments can choose to adopt the national model energy code, a modified version of the code, or their own state-specific code
- National model energy codes are developed by ASHRAE and ICC every 3 years
 - Any party (industry, governmental, private citizen) can pa submit a code change proposal and/or comment on othe
- The energy code is one of many buildings codes

But why should you care about energy codes?

Reduced energy consumption

Approx. 0.5-quadrillion
Btu saved per year by
2015, and 2.5
quadri y 2030

Consumption

Rising Cost Savings

More than \$4 billion per year back in homeowners pockets by 15



Reduced CO₂ emissions

Roughly 3% saved in terms of projected national CO₂ emission



Regional perspective- Field Study Research





Energy Code Field Studies: Data attack!







AR Code: Visual inspection option 80% of homes passed at less than 7ACH50

Energy Codes in the Southeast



Energy Codes

December 9, 2016



Viridiant and EarthCraft



non-profit organization committed to supporting sustainable building processes through education, consultation, and certification



family of programs serving as a blueprint for energy and resource-efficient structures including single family, multifamily, renovation, light commercial, and communities

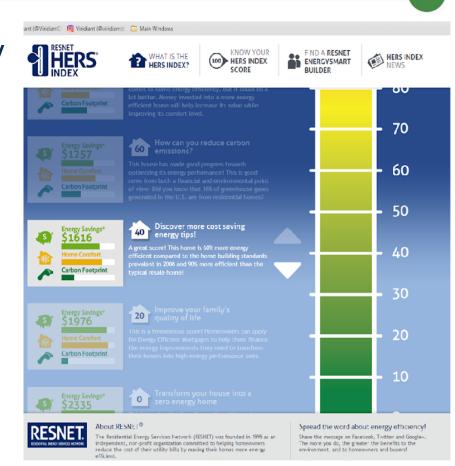
EarthCraft Development & Evolution



Serving builders across the Southeast since 1999, in Virginia since 2006

EarthCraft and Energy Code

- EarthCraft endorsed by HBAV as a voluntary green building program
 - Infiltration, duct leakage, Rvalue, fenestration
 - Energy modeling
 - Inspection/verification
 - Confirmed HERS Rating with EarthCraft Certification



EarthCraft Efficacy

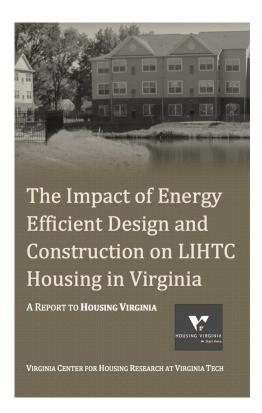
- Annual certification numbers
 - 200 single family new construction and 2,000 multifamily
- "Expect what you inspect"
- Testing outcomes:
 - New construction, duct leakage: <4% leakage to outside required,
 <2% incentivized; <6% total leakage required, <4% incentivized
 - New construction, air tightness: <5 ACH50 required, <3 ACH50 incentivized

Lessons Learned

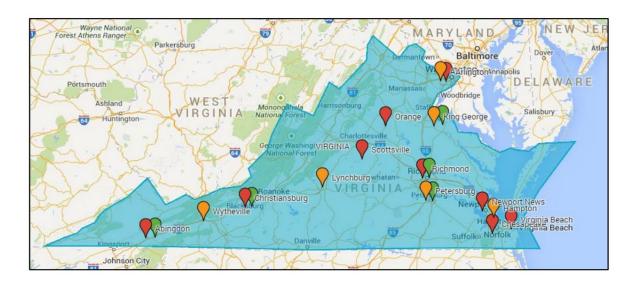
- Model calibration
- Energy Performance
- Comparison to EIA data
- Value in 3rd party



Housing Study

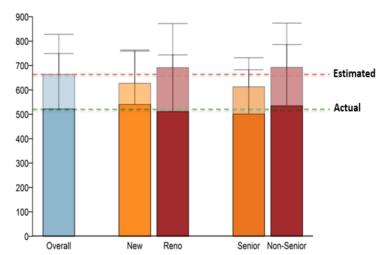


- 1. Policy Efficacy
- 2. Quantitative Benefits: Utility Savings for Residents
- 3. Qualitative Benefits: Thermal Comfort, Education, etc.



Housing Study - Executive Takeaways

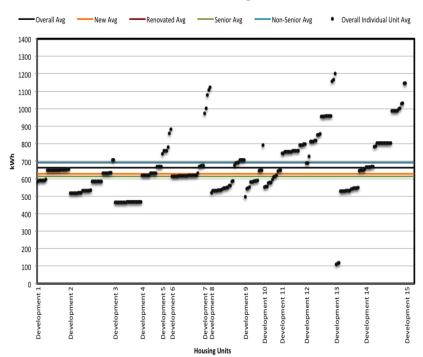
- 1. VHDA's goal of promoting affordability via green building is working
- 2. Energy usage for developments in the study is 16.6% less than estimated and approximately 30% less than new standard construction. Based on an energy rate of \$.1167/ kWh for the Commonwealth of Virginia in 2014 (http://www.eia.gov/), savings equal \$54 per month on average, \$648/year.
- 3. Variability in predicted vs. observed energy
- ECMF housing is generally more affordable, and residents are more satisfied.
- 5. Value in 3rd party verification.
- 6. Disconnect between resident education and



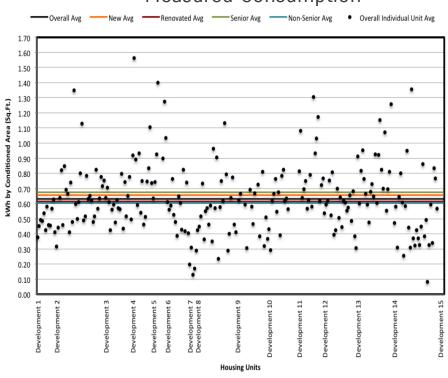
Read More: www.viridiant.org/aboutus/research-and-resources/vt-housing-study/

Energy Consumption

Predicted Energy Consumption



Measured Consumption



¹Virginia Center for Housing Research (VCHR), Virginia Tech, 2015. The Impact of Energy Efficient Design and Construction on LIHTC Housing in Virginia, Contract Report submitted to Housing Virginia, Richmond, VA. Retrieved January 15, 2016, from http://www.vchr.vt.edu/wp-content/uploads/2015/02/Housing-VA-LIHTC-Study-Full-Report.pdf



Founded in 2009, the mission of the Local Energy Alliance Program is to lead the effort to equip Virginia buildings with energy efficient and renewable technologies.

Our overarching goals include cost savings, local economic development, and energy sector decarbonization.

Andrew Grigsby, LEED AP, HERS Rater Executive Director 608 Ridge St. Charlottesville, VA 22902

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- Virginia's building code is known as the Uniform State Building Code (USBC).
- The Department of Housing and Community Development (DHCD) manages the triennial code update process.
- That process includes ~2 years of public meetings and board actions before the updated code is adopted.
- The 14-member Board of Housing and Community Development (BHCD)
 votes on the final content of the updated code.
 - 1 member for each congressional district appointed by the Governor to 3-year terms
 - 3 ex-officio members representing Va. Fire Services Board, Va. Code Officials Association, and Virginia Housing Development Authority







Virginia's Code Update Process:

- By default, the initial draft of an updated USBC includes all new content from the model codes – except when previous Va. amendments contradict that new content.
- Round one of stakeholders submitting amendments occurred summer,
 2016 with multiple large "workgroups" of stakeholders meeting to
 discuss and vote on submitted amendments.
- Fall, 2016: the BHCD's Codes and Standards Committee (CSC) met to consider those amendments and the workgroup votes.
- On 12/19/16, the full board votes on the content of an official draft of the 2015 USBC to be published in the Va. Register for 6 months.
 - This meeting begins with a public comment period.
 - 10 AM at the Virginia Housing Center, 4224 Cox Rd, Glen Allen, VA





Virginia's Code Update Process:

- January to June, 2017: public comment period during which any person or entity may submit written comments on the draft code
- Spring, 2017: specific amendments to the draft code may be submitted via <u>cdpVA</u> on the DHCD website. Stakeholder workgroups begin meeting to discuss and vote on these amendments.
- June 19, 2017 (tentative): Board meeting for a public hearing on code updates
- Fall, 2017: CSC meets to consider amendments.
- November, 2017: Final BHCD vote on final content of updated code

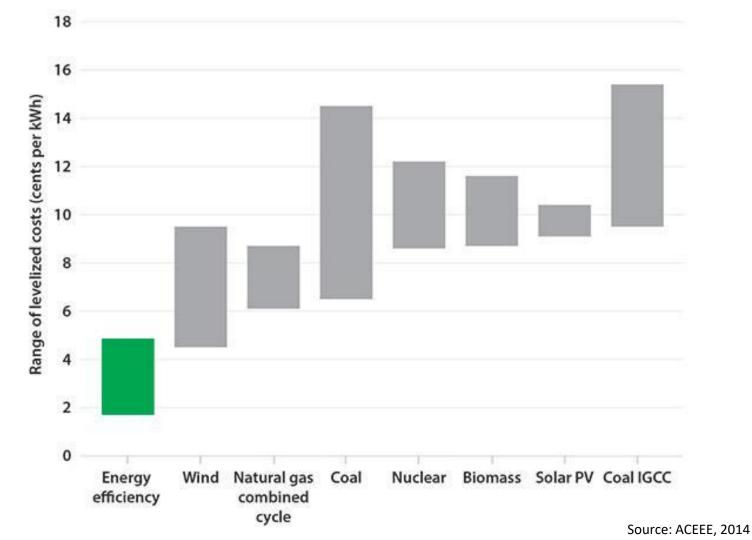




Why this is important for energy efficiency:

- Energy efficiency is generally calculated to be the most cost-effective energy source and provides numerous and widespread security, economic, environmental, health, and equity benefits. (ACEEE)
- Properly implemented, advanced building energy codes quickly pay for themselves in cost-savings – making them among the most costeffective efficiency strategies (BCAP, McKinsey, DOE National Labs, NIST, ACEEE).

So, naturally, energy codes are a priority for the VAEEC.



U.S. MID-RANGE ABATEMENT CURVE - 2030 Abatement cost <\$50/ton Cost Commercial Residential Afforestation buildings -Real 2005 dollars per ton CO2e buildings of cropland HVAC HVAC equipment equipment 90 Coal power plantsefficiency efficiency CCS rebuilds with EOR Industrial Residential Coal mining -Fuel economy process Solar CSP Active forest buildings -Distributed Methane packages - Light improvemanagement Shell solar PV 60 ments mgmt tnicks retrofits Residential Commercial Commercial Nuc ear electronics Residential buildings buildings new water Combined Control build 30 heaters Residential heat and systems buildings power Lighting 0 2.0 2.2 0.2 0.8 1.8 2.4 2.8 3.0 3.2 Potential Gigatons/yea Onshare wind -30 Industry -Low penetration Onshore wind -CCS new Industry -High penetration builds on Combined carbonheat and Biomass power intensive -60 power Cofiring processes Cellulosic Manufacturing biofuels Existing power Car hybridi-HFCs mamt Coal power plants - CCS zation plant new builds with EOR -90 Residential conversion buildings efficiency Onshore wind - Medium New shell Coal-to-gas aprovements penetration Commercial improvements shift - dispatch of Conservation electronics existing plants Winter -120Commercial cover crops Coal power plants buildings -CCS rebuilds Reforestation CFL lighting -230 Commercial buildings -Commercial buildings -Alforestation of pastureland LED lighting Natural gas and petroleum Coal power New snell plants - CCS Fuel economy improvements Systems new builds packages - Cars management Highlighted "Negative Cost" Measures Source: McKinsey analysis Addressed by Building Energy Codes

ENERGY CODE PAYBACK FOR VIRGINIA SINGLE FAMILY HOMES

Month	Mortgage Increase	Monthly Energy Savings	Cumulative Cost/Benefit		umes a 2,400 sq set at 30 years,
1	\$439.50	\$30.67	-\$408.83		erest rate of 4.03
2	\$8.42	\$30.67	-\$386.58		-consumers will b
3	\$8.42	\$30.67	-\$364.33	sooner.	
4	\$8.42	\$30.67	-\$342.08		
5	\$8.42	\$30.67	-\$319.83		
6	\$8.42	\$30.67	-\$297.57		
7	\$8.42	\$30.67	-\$275.32		
8	\$8.42	\$30.67	-\$253.07	4	
9	\$8.42	\$30.67	-\$230.82	All a	
10	\$8.42	\$30.67	-\$208.57		
11	\$8.42	\$30.67	-\$186.32	1	
12	\$8.42	\$30.67	-\$164.07		
19	\$8.42	\$30.67	-\$8.32		
20	\$8.42	\$30.67	\$13.19	BREAK EVEN AND	START EARNING
21	\$8.42	\$30.67	\$36.18		
22	\$8.42	\$30.67	\$58.43	No.	
23	\$8.42	\$30.67	\$80.68	The state of the s	
24	\$8.42	\$30.67	\$102.93		

Source:





Efficiency in the USBC today:

- For commercial buildings, Virginia adopted the 2012 IECC without modification and is on track to do the same with the 2015 IECC.
- For residential buildings, Virginia adopted numerous amendments to the 2012 IECC that eliminated most of the ~25% efficiency gain achieved by that code for our climate zone (4). The 2015 IECC includes almost no efficiency gains for CZ4.
 - Attic insulation not increased to R49, stays at R38
 - Insulation not required on most domestic hot water pipes
 - Wall insulation increases from R13 to R15 or 13+1 instead of to R20 or R3+5
 - Replacement windows not required to meet current efficiency specs
 - High efficiency lighting requirement kept at 50% instead of 75%
 - Performance path glazing assumption formula weakened





Efficiency in the USBC today:

- Whole home air leakage requirement reduced to 5ACH instead of 3ACH. Requirement for mechanical test stricken: visual inspection allowed.
- Duct leakage limit reduced to 6% instead of 4%. Requirement for mechanical test stricken: visual inspection allowed.

Ultimately, the 2012 USBC is only 5-10% more efficient than the 2009 IECC – for residential buildings. But that is impossible to verify without actual testing data.







Mechanical testing of air leakage is vital:

- The code gives the impression that any new homeowner could expect ACH of 5 or less and duct leakage of 6% or less. DOE studies from other states show that visual inspections are inadequate.
- Some homes in Virginia do get tested. Even these often fail to meet these standards on the first try. Some data from 2 Virginia HERS raters:
 - Think Little, Charlottesville, VA:
 - 118 homes tested between 3/2015 and 9/2016
 - 23% did not meet the 5 ACH standard for home
 - 53% did not meet the 6% standard for ductwork
 - EDGE Energy, McLean, VA:
 - 55 homes and 72 duct systems tested between 7/2015 and 7/2016
 - 60% did not meet the 5ACH standard for home
 - 56% did not meet the 6% standard for ductwork





But – what does it cost? To implement these efficiency improvements?

- Answer it doesn't cost, it saves. Based on simple payback, life-cycle, and cashflow analyses.
- How quickly depends on whom you ask. Different organizations calculate the construction costs very differently.
- Implementing 2012 IECC over 2009 IECC in CZ 4
 - DOE says \$2138 for single-family; \$1120 for multi-family
 - NAHB says \$5796 \$8257 for single-family
 - Variables:
 - Cost of labor and materials
 - e.g. insulating water pipes, or framing
 - Complexity/size of homes used in modeling
 - Modeling tools

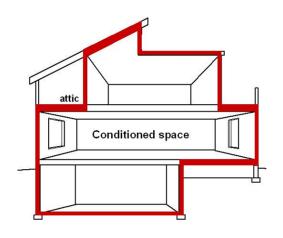






Table 8: 2012 IECC Cost Effectiveness Relative to 2009 IECC

Climate Zone	Annual Energy Savings	Incremental Construction Cost	Simple Payback (yrs)
1	\$206	\$3,224	15.7
2	\$294	\$3,330	11.3
3	\$470	\$7,203	15.3
4	\$410	\$7,091	17.3
5	\$505	\$4,653	9.2
6	\$397	\$6,399	16.1
7	\$609	\$6,465	10.6
8	\$725	\$6,465	8.9
National Weighted Average	\$427	\$5,668	13.3

National Association of Homebuilders (NAHB):

5.78% average annual ROI





Table ES.2. Simple Payback Period for the 2015 IECC

Climate Zone	Compared to the 2012 IECC (Years)	Compared to the 2009 IECC (Years)	
1	0.0	6.6	
2	3.8	8.1	Dept. of Energy (DOE):
3	3.4	7.9	19.6% average annual ROI
4	1.4	5.1	
5	1.6	3.9	
6	1.0	4.9	
7	0.0	3.1	
8	0.2	2.2	





Table ES.3. Impacts on Consumers' Cash Flow from Compliance with the 2015 IECC

	Compared to	the 2012 IECC	Compared to the 2009 IECC	
Climate Zone	Net Annual Cash Flow Savings (for Year 1)	Years to Cumulative Positive Cash Flow	Net Annual Cash Flow Savings (for Year 1)	Years to Cumulative Positive Cash Flow
1	+\$ 13	0	+\$ 103	1
2	+\$ 5	1	+\$ 103	2
3	+\$ 6	0	+\$ 125	2
4	+\$ 7	0	+\$ 236	1
5	+\$ 5	0	+\$ 263	1
6	+\$ 6	0	+\$ 340	1
7	+\$8	0	+\$ 672	0
8	+\$ 18	0	+\$ 1,024	0

Dept. of Energy (DOE):

Positive cashflow in year 2





Rigorous energy codes are a win for

- energy policy (costs, grid stability, predictability)
- environmental policy (global warming, resource use)
- the construction industry (deliver a more valuable, higher-quality product)
- the mortgage industry (32% less risk of default (IMT/UNC report))
- local jobs (framing and insulating don't happen overseas)
- housing affordability (increases predictability of monthly costs and lowers total cost of housing)
- home buyers/renters of all kinds (comfort, savings, predictability, air quality)

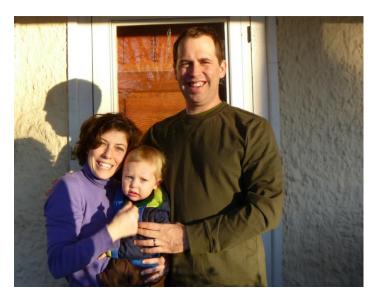
Besides, people want it... A 2013 survey by the National Association of Homebuilders reports that 9 out of 10 homebuyers are willing to pay 2-3% more for a home that includes permanent energy efficiency features.

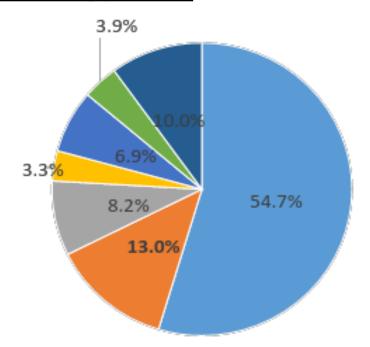




Affordability

- Added up front costs that correspond with reduced monthly bills push folks to more manageable purchases – not completely out of the market.
- Many of the new homes of today will be the affordable homes of tomorrow.





- Shelter
- Energy (Electric, Gas, Fuel Oil, LPG, etc.)
- ■Telephone services
- Water and other public services
- ■Household operations .





According to the US Bureau of Labor Statistics, energy expenses are 13% of "housing" expenses in the US South, on average.

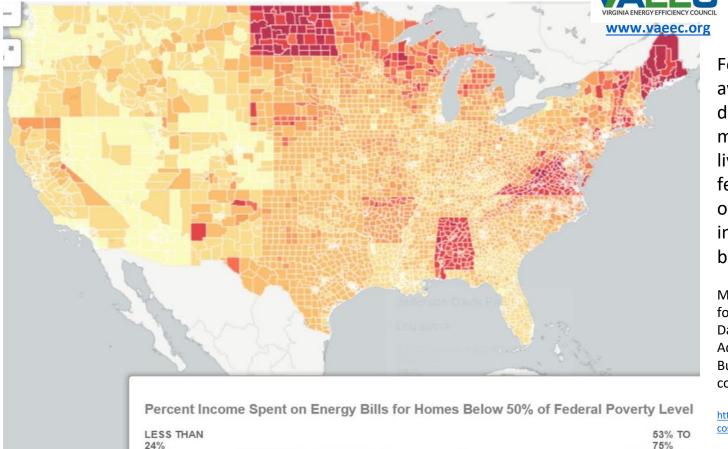


leap-va.org

For each US county: the average annual energy bill divided by the income midpoint for households living under 50% of the federal poverty level obtains the percent of income owed to energy bills.

Map created by Jordan Wirf-Brock for InsideEnergy. Data from the Energy Information Administration (EIA) and US Census Bureau) compiled by Accounting Insights.

http://insideenergy.org/2016/05/08/high-utility-costs-force-hard-decisions-for-the-poor/



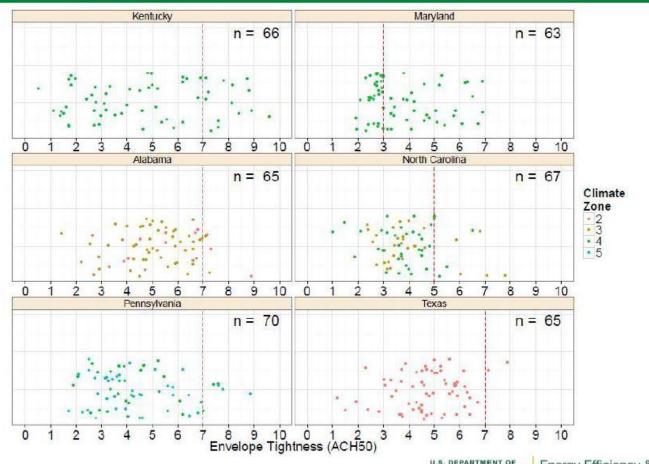




How to get involved:

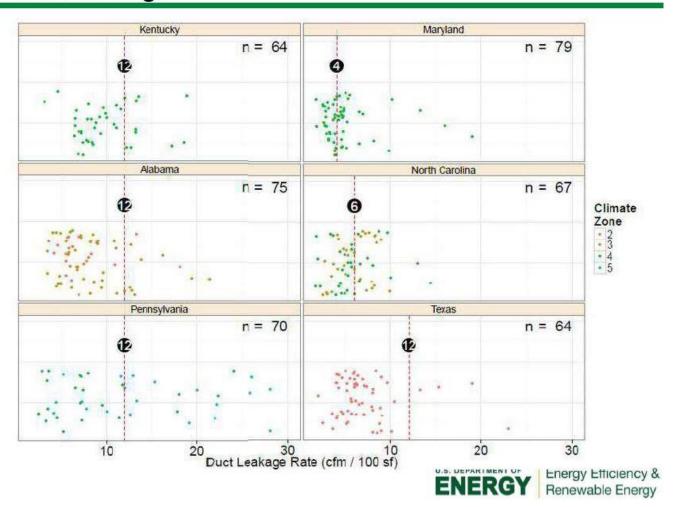
- Attend quarterly BHCD meetings: 12/19 and see DHCD website
- Submit comments on the draft code (published in Va. Register in January)
- Submit amendments to the draft code (cdpVA web platform accessible through DHCD website
- Participate in stakeholder workgroup meetings: spring/summer, 2017 (contact <u>Cindy.Davis@dhcd.virginia.gov</u> to receive email notices)
- Speak at the June 19, 2017 public hearing
- Attend Codes & Standards committee meetings: fall, 2017
- Attend BHCD meeting of final code vote: late fall, 2017

Envelope Tightness





Duct Leakage







Sources:

- EE is cheapest energy source: http://aceee.org/press/2014/03/new-report-finds-energy-efficiency-a
- McKinsey report:
 https://www.mckinsey.com/~/media/McKinsey/dotcom/client_service/Sustainability/PDFs/Reducing%20US%20Greenhouse%20Gas%20Emissions/US_mid_range_abatement_curve_2030.ashx
- BCAP "True Cost": http://bcapcodes.org/wp-content/uploads/2015/11/Virginia-2012-IECC-True-Cost.pdf
- NIST: http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1194.pdf
- ICF report: http://bcap-energy.org/wp-content/uploads/2015/12/ICF-Comparison-of-Cost-effectiveness-Methodologies.pdf
- DOE: 2015 IECC comparisons: https://www.energycodes.gov/sites/default/files/documents/2015IECC CE_Residential.pdf
- IMT: http://www.imt.org/uploads/resources/files/IMT_UNC_HomeEEMortgageRisksfinal.pdf
- NAHB: What Home Buyers Really Want: https://www.nahb.org/~/media/Sites/NAHB/SupportingFiles/8/Wha/WhatHomeBuyersWant 20130430023250.ashx?la=en
- DOE Field Study: https://www.energycodes.gov/compliance/residential-energy-code-field-study