

Performance Path Survival Guide

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Energy Codes Specialist

DOE National Energy Codes Conference
Austin, TX

July 16, 2018



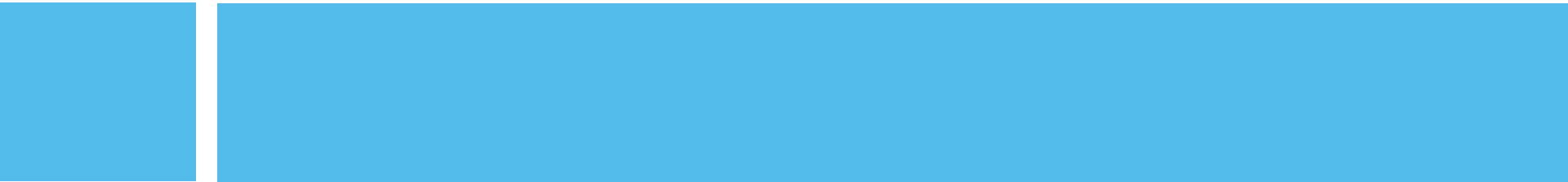
IMT's Mission and Codes Work

Thought Leadership

- Intersection of codes, efficiency and resilience
- Develop practices that can be used to assess savings from code compliance

Implementation

- Helping cities save energy through better enforcement
- Making buildings more efficient across their life cycle



IT'S

COMING

Faster than you think...

CHAPTER 1: Why Performance Path?

**WE ARE
STILL IN**

City Commitments



Model Code Trajectory



Design Goals

City Commitments: Climate Change

C40 Cities

MAKE A DIFFERENCE

Each city in the C40 is unique in its infrastructure and progress in addressing climate change. C40 works to empower cities to connect with each other and share technical expertise on best practices.

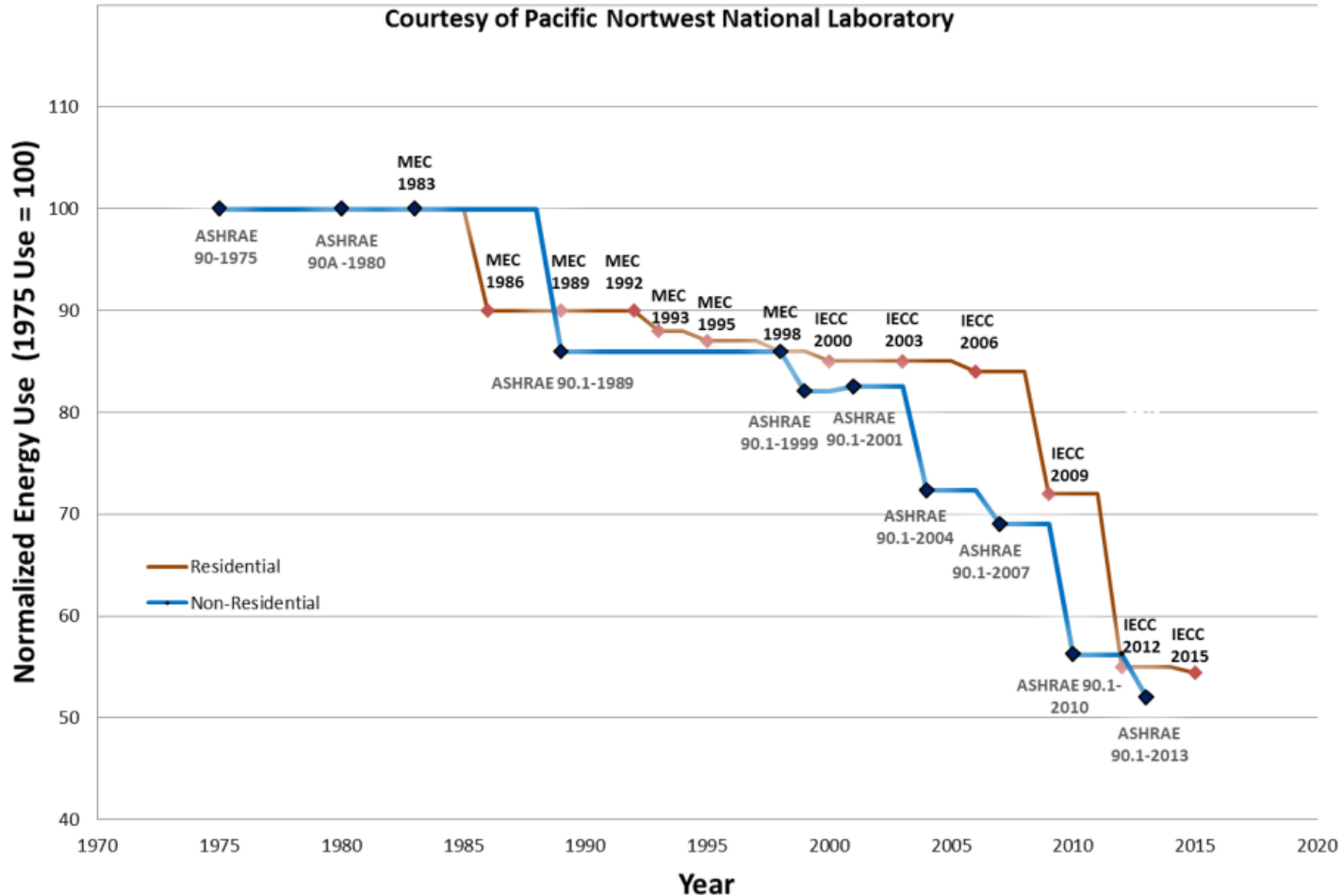


City Commitments: Resilience

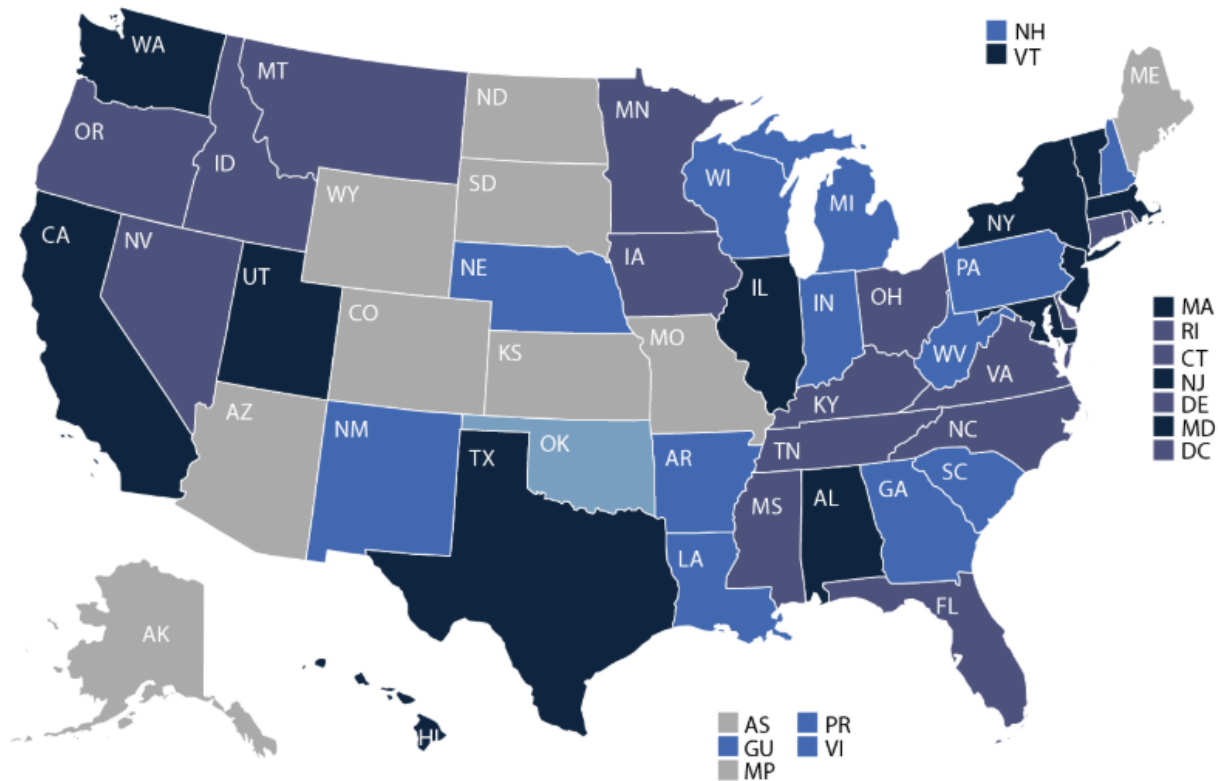


Model Codes: to Date

Improvement in Residential and Non-Residential Model Energy Codes (Year 1975-2015)



Model Codes: to Date



Meets or exceeds ASHRAE 90.1-2013 or equivalent (12)

Meets or exceeds ASHRAE 90.1-2010 or equivalent (17)

Meets or exceeds ASHRAE 90.1-2007 or equivalent (15)

Meets or exceeds ASHRAE 90.1-2004 or equivalent (1)

No statewide code or predates ASHRAE 90.1-2004 (11)

Model Codes: Trajectory

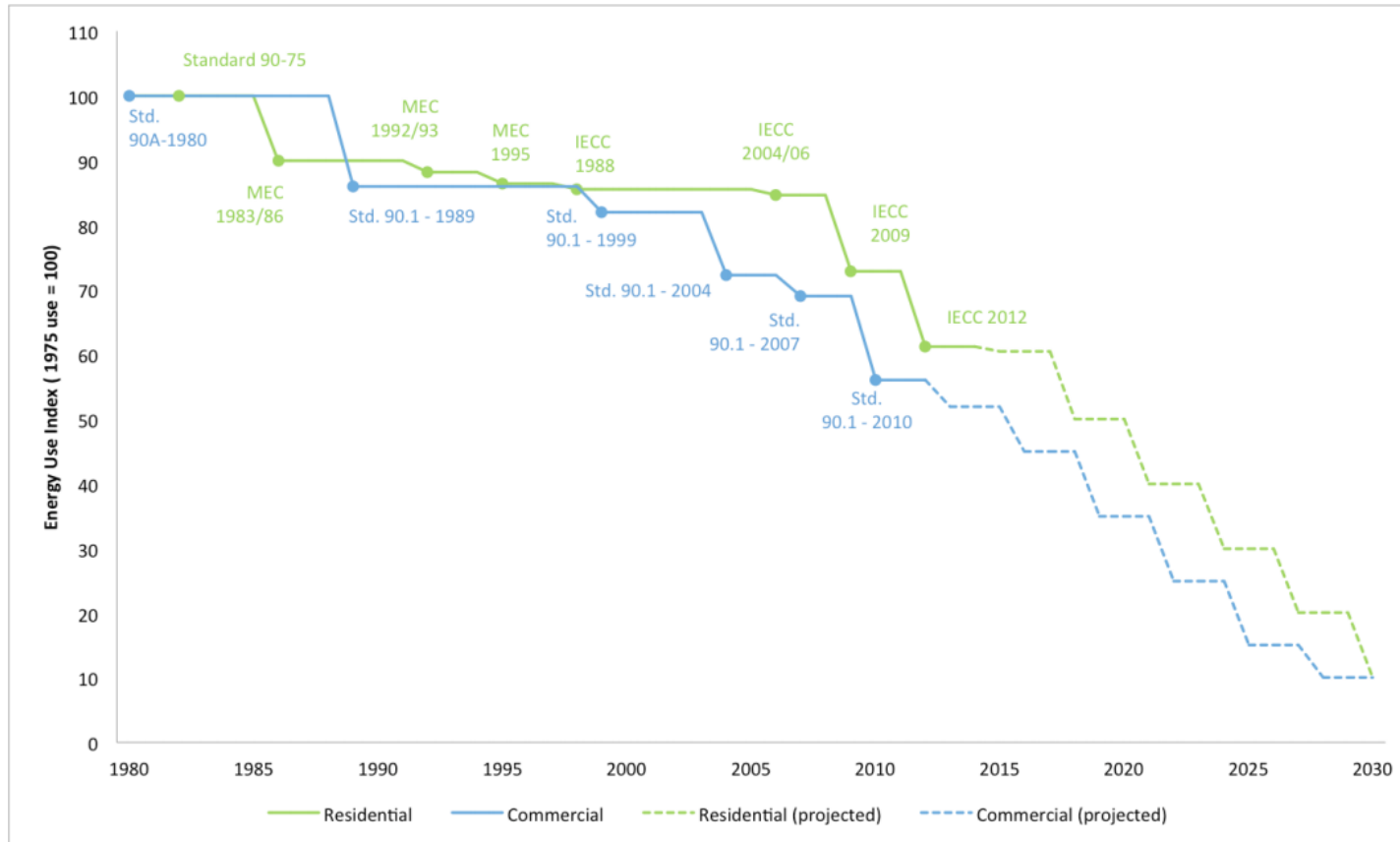
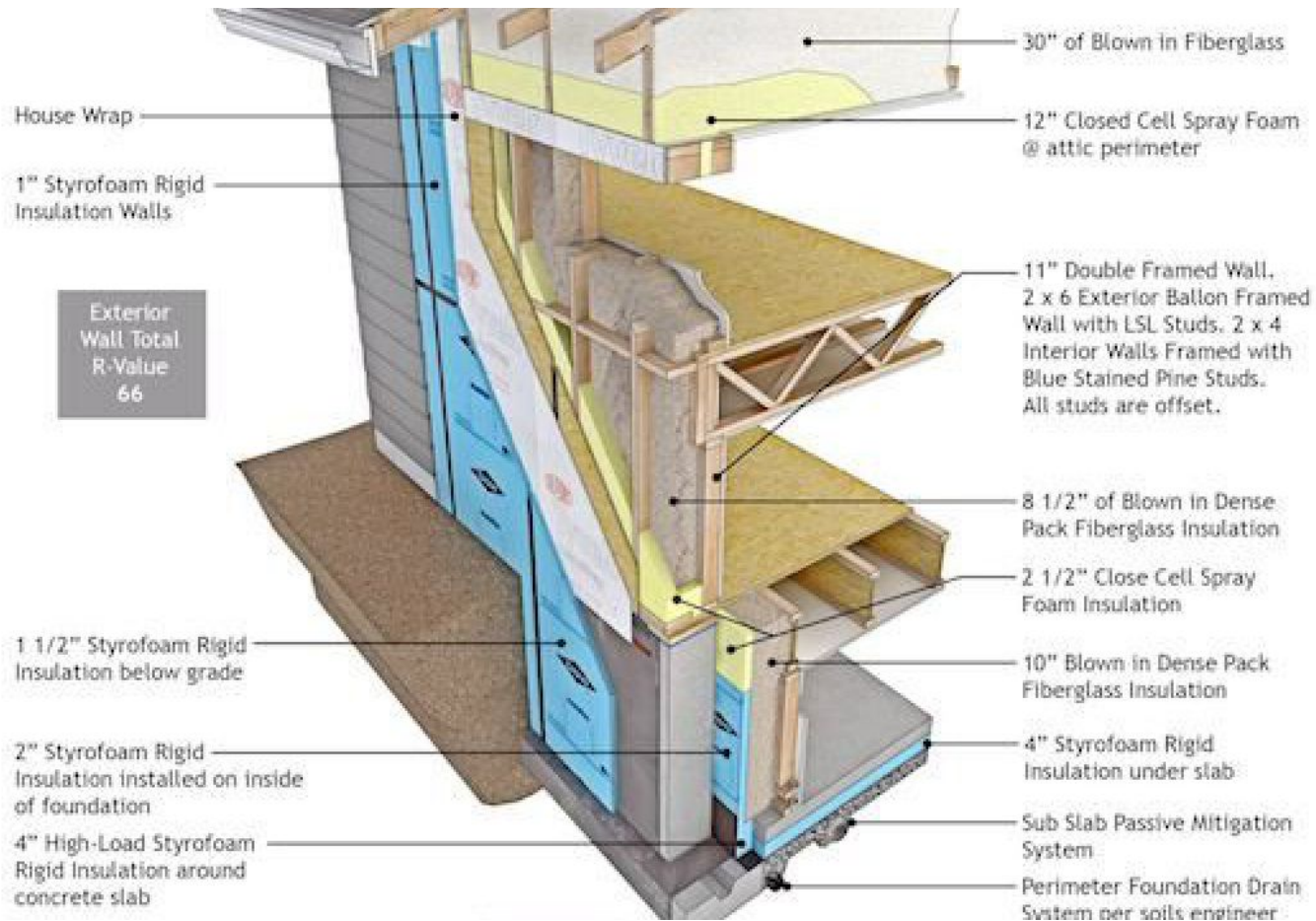


Figure ES1. History of U.S. building codes, 1980–2012. *Source:* Data from U.S. DOE Building Codes Program.

Design: and Prescriptive Path



<https://www.rexdixon.com/topic/cross-section-detail-of-wooden-frame-house>

Design Goals: Flexibility



Design: High Performance Buildings

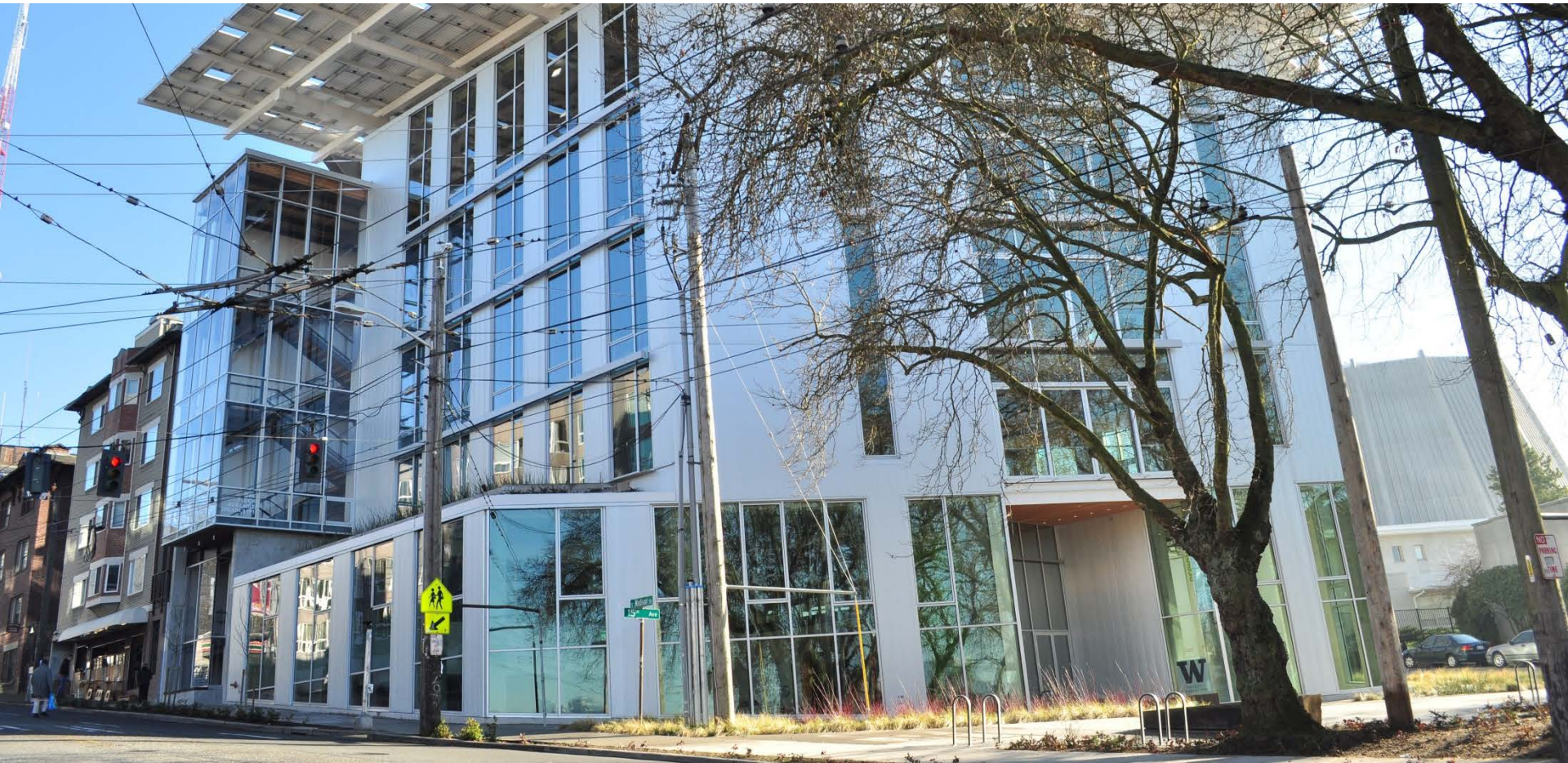


Image courtesy of Joe Mabel, Wikimedia Commons

... And ASHRAE 90.1-2016

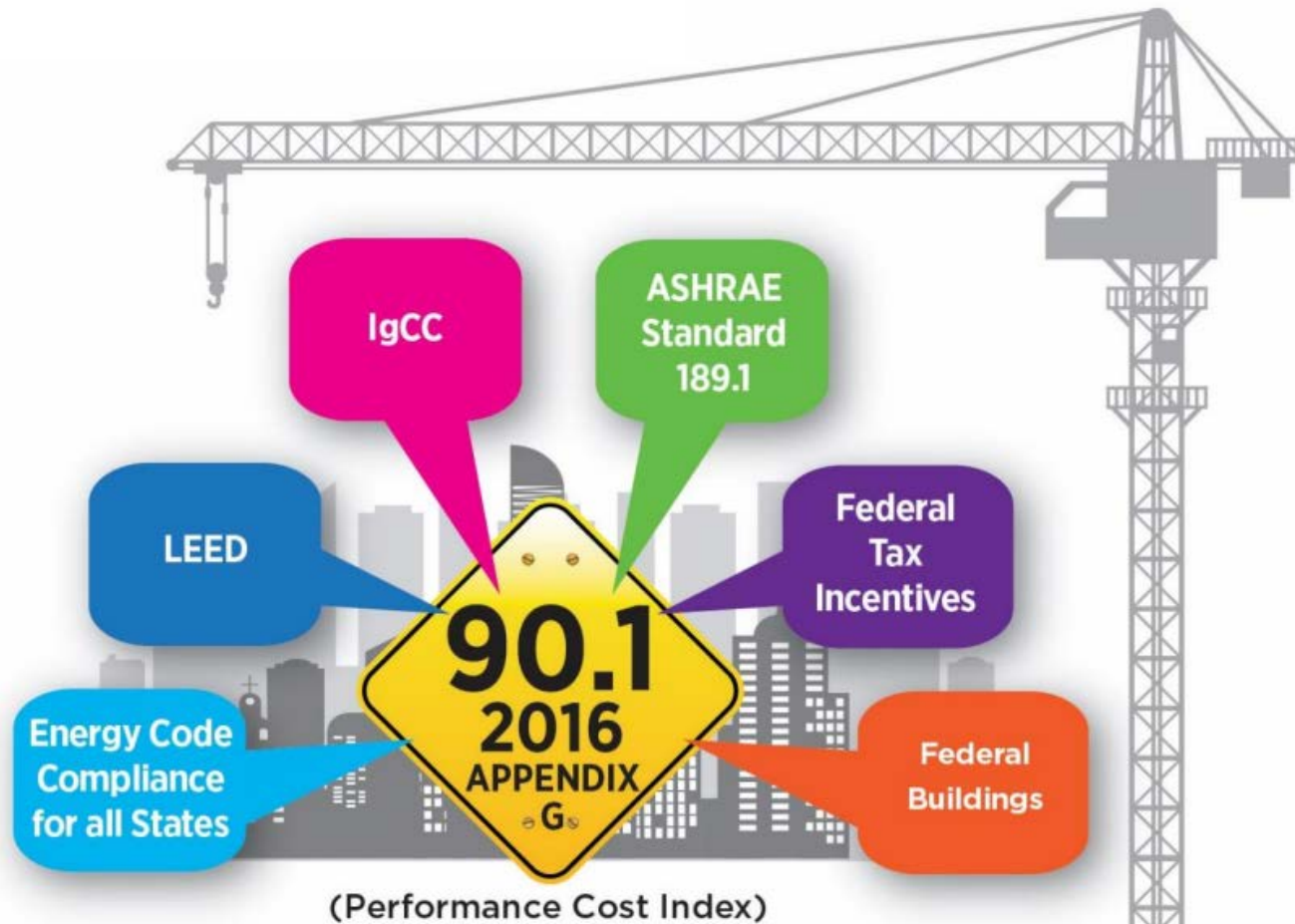


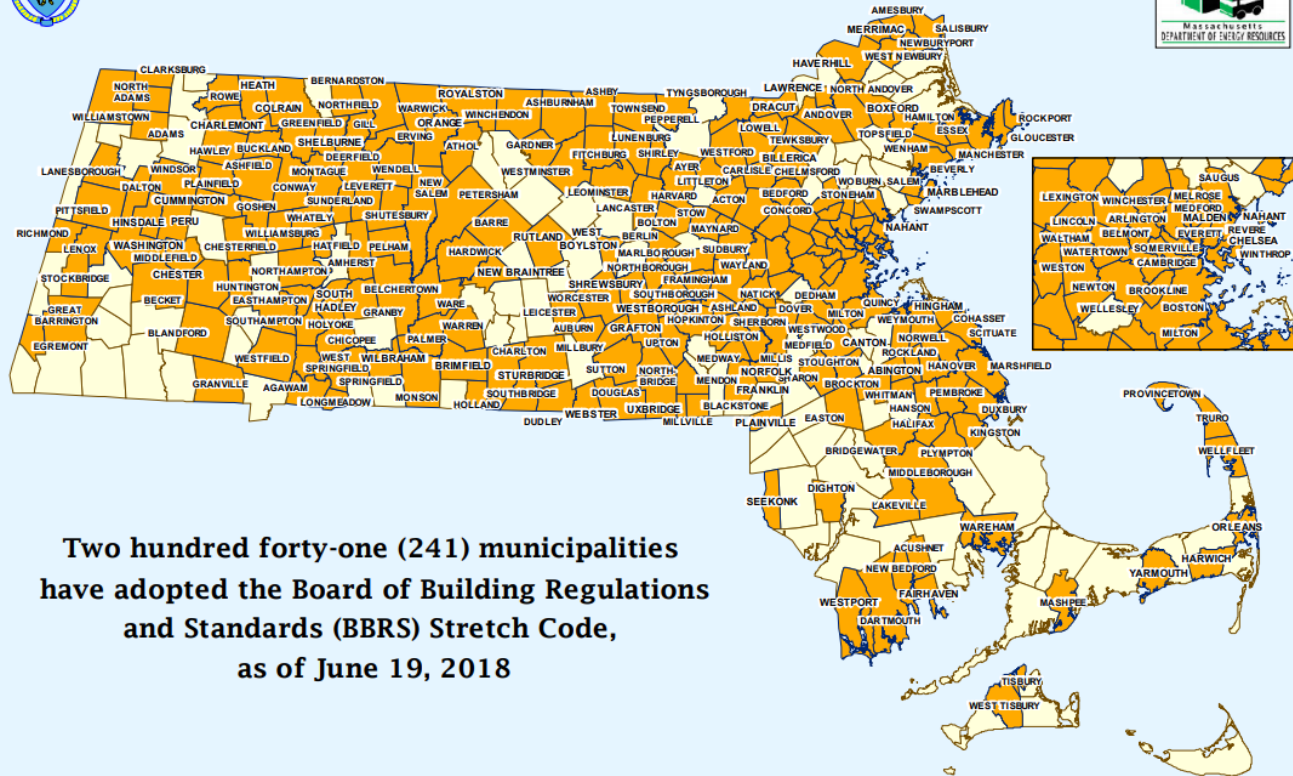
Image courtesy of PNNL

CHAPTER 2: Who is Acting?

Massachusetts

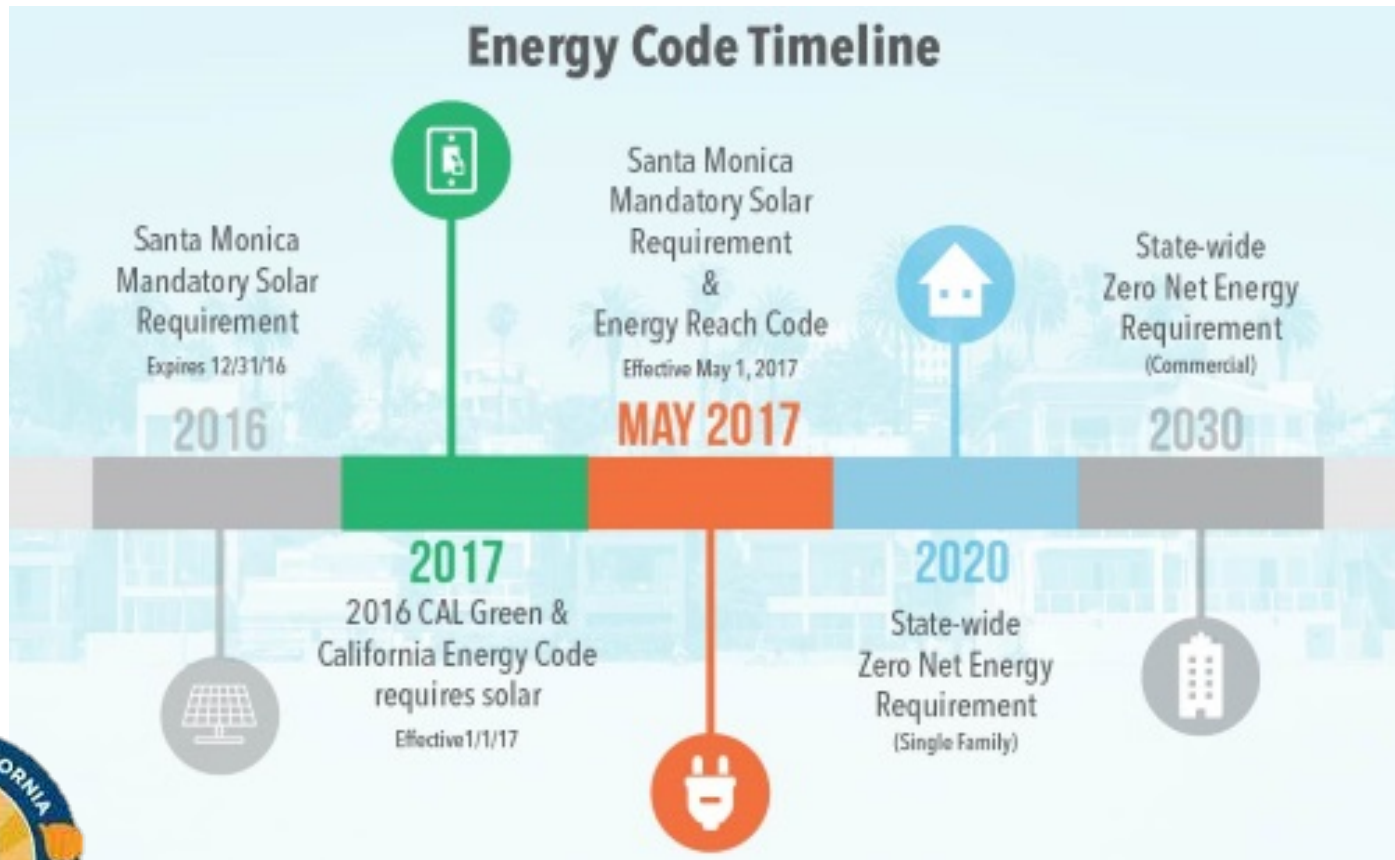


Stretch Code Adoption, by Community



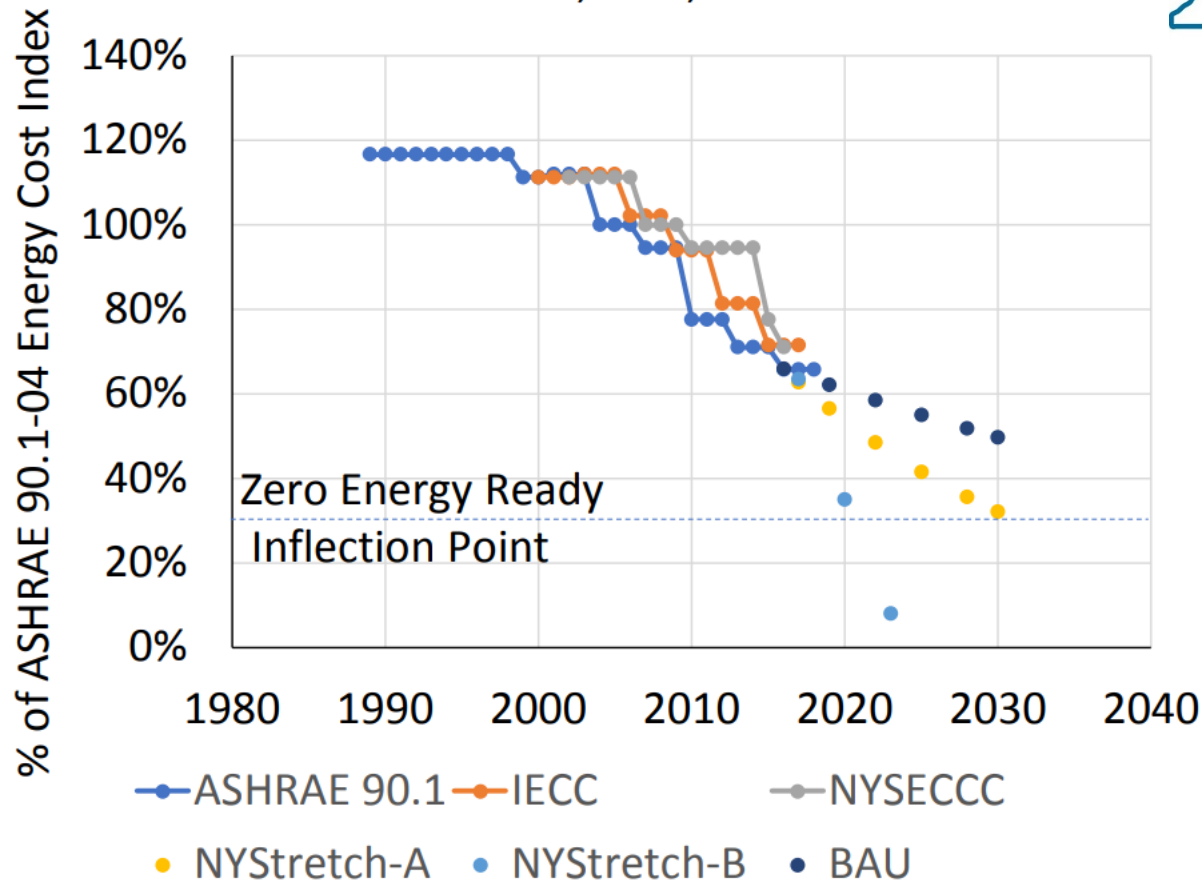
DOER, 6-20-18, jpf/ler

California

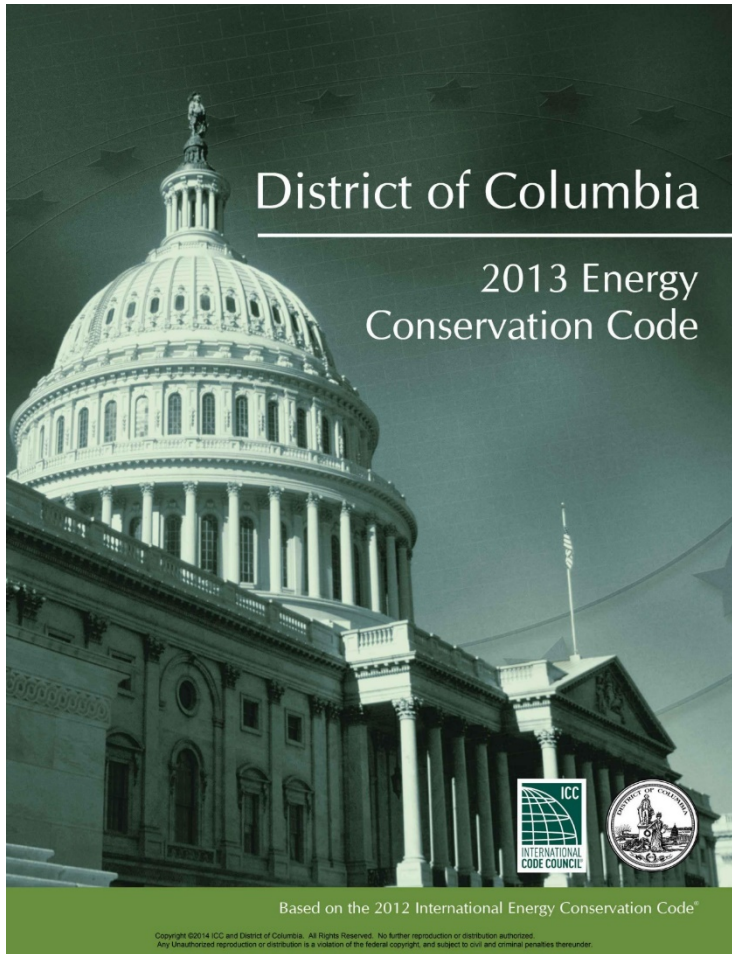


New York

Commercial Energy Code History & Projections ASHRAE 90.1, IECC, NYSECCC



District of Columbia



PNNL-27081


Pacific Northwest
NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

Energy Savings Analysis of the Proposed Revision of the Washington, D.C. Non-Residential Energy Code

December 2017

Michael Rosenberg
Rahul Athalye
Reid Hart

U.S. DEPARTMENT OF
ENERGY

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830


IMT
INSTITUTE
FOR MARKET
TRANSFORMATION

New Buildings Institute

Want Greener Buildings? Stretch Codes Get You There Faster.

Adopting stretch codes can drastically improve building energy efficiency beyond existing codes, and put buildings on the path to zero energy by 2050.



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Architecture 2030

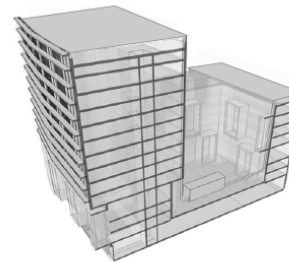
ZERO CODE™

Commercial • Institutional • Mid-Rise/High-Rise Residential Buildings

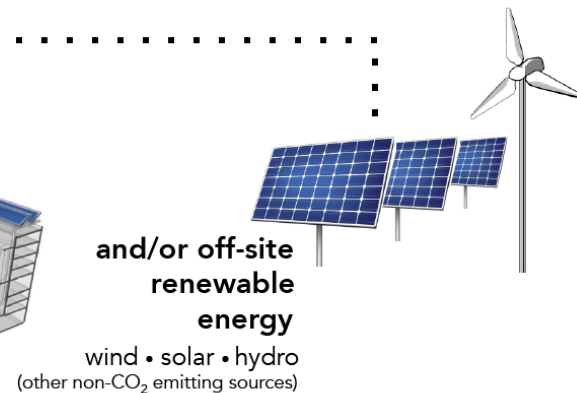
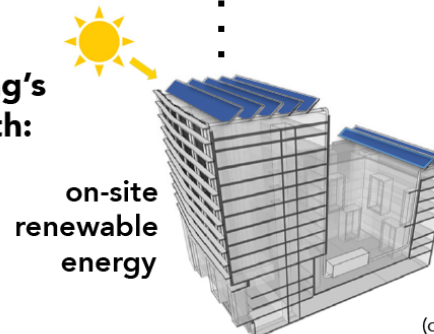
1 Design an energy efficient building

Efficiency Standard: ASHRAE 90.1-2016 minimum;
ASHRAE 189.1-2017; others

- Efficient building envelope / daylighting
- Passive heating / cooling / ventilation
- Efficient systems / equipment / controls



2 Address the remaining building's energy needs with:



Source: Architecture 2030
Graphic adaptations: Sefaira; DOE

CHAPTER 3: Key Groups

Major Stakeholders



TRANE[®]

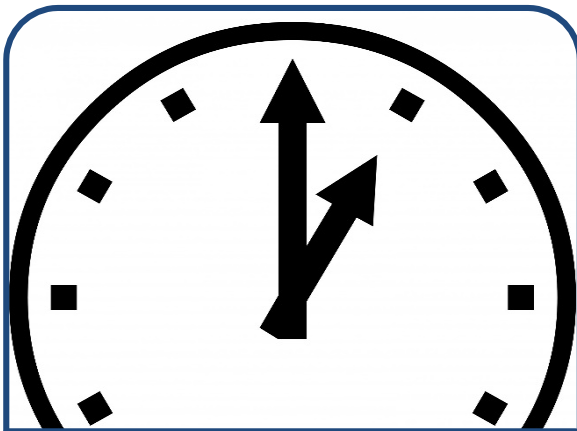


Stakeholders

- + Modeling Firms
- + Designers
- + Owners/ Developers
- + Building Officials

CHAPTER 4: Surviving a New World

Challenges for Building Officials



Time and Resources

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Building Energy Codes Program

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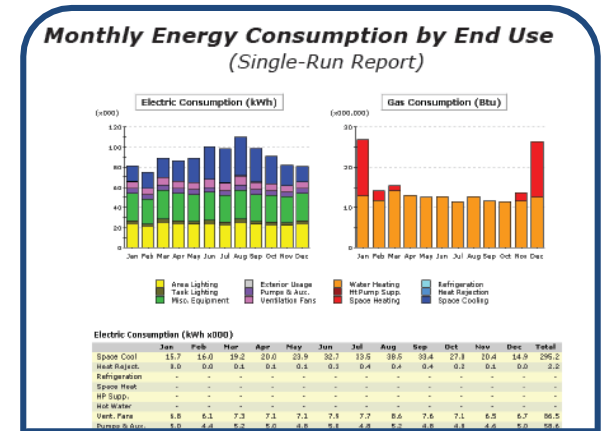
Resource Center

The U.S. Department of Energy (DOE), through the Building Energy Codes Program (BECP) Resource Center, provides a comprehensive collection of information, resources, and technical assistance designed to answer questions and address issues related to energy codes. This includes frequently asked questions, publications, model adoption policies, compliance software and tools, and training modules based on best practices. BECP's team of building energy codes experts is also available to answer specific questions submitted through the web-based help desk.

Compliance Software and Tools

- [COMcheck™ Desktop](#) or [COMcheck-WEB](#)
- [BEScheck™ Desktop](#) or [BEScheck-WEB](#)
- [Residential Prescriptive Requirements](#)
- [State Sample Generator™ tool](#)

Technical Support



Documentation

Time and Resources



Technical Support

Energy Modeling Training from Industry Experts

Get Energized & Get Noticed with GBRI's Training Today

Learn only from top experts! GBRI is proud to announce its partnership with Energy-Models.com to bring you high-quality training on Energy Modeling. Be ranked among the elite, as part of the next big thing for Architects, Engineers, Sustainability Consultants and other building professionals. Get noticed by building the desired energy modeling skill set needed to land that dream job or promotion, or master it as you lead your LEED project. From general energy modeling intros to in-depth LEED models, we'll take care of you! Register now and soon you, too, will be hot in demand!



14 Things You Need to Know about Energy Modeling

1 FREE GBCI/AIA CE Hour available now. Hear the top 14 things you need to know (including the break down of energy modeling misconceptions) while earning CE.



Mastering eQUEST in 7 Days

Extensive eQUEST training package includes the how-to's of basic wizards through advanced functions including step by step demo's within the popular eQUEST software.

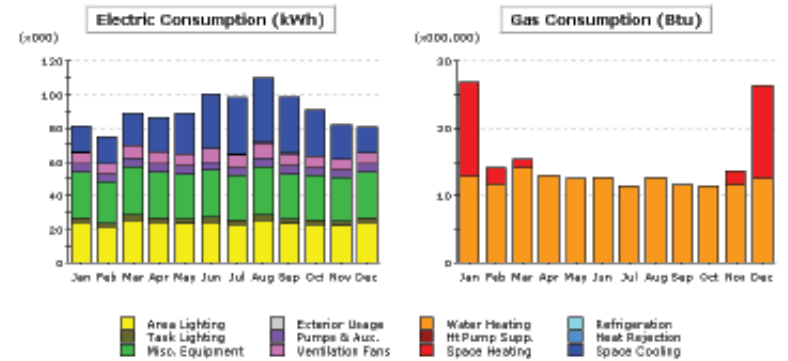
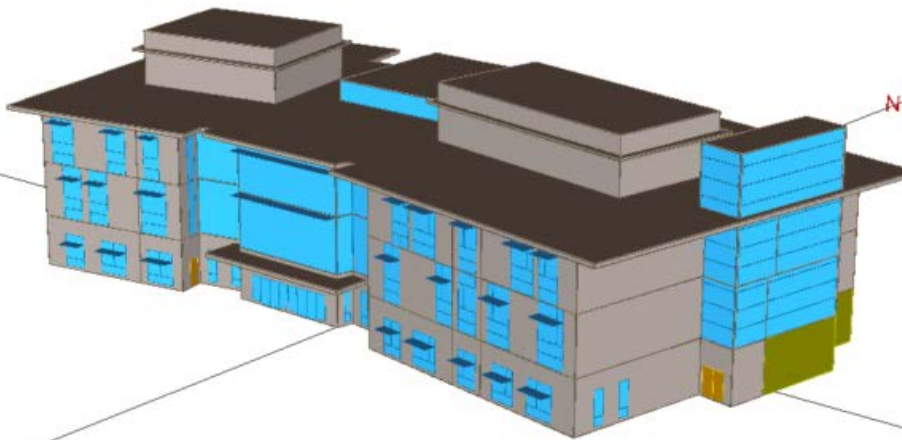


LEED Case Studies

LEED Case Studies feature energy modeling software, uses and techniques giving you insight into how modeling is utilized on live projects.

Documentation

Monthly Energy Consumption by End Use (Single-Run Report)



Electric Consumption (kWh x1000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	15.7	16.0	19.2	20.0	23.9	32.7	33.5	38.5	33.4	27.3	10.4	14.9	295.2
Heat Reject.	3.0	0.0	0.1	0.1	0.1	0.3	0.4	0.4	0.4	0.1	0.1	0.0	2.2
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	5.8	5.1	7.3	7.1	7.1	7.8	7.7	8.6	7.5	7.1	6.5	6.7	86.5
Pumps & Aux.	5.0	4.4	5.2	5.0	4.8	5.8	4.8	5.2	4.8	4.8	4.6	5.0	58.6
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Miso. Equip.	27.3	34.3	39.9	27.3	26.4	27.7	36.1	28.9	26.6	26.1	15.5	27.3	322.6
Task Lights	2.6	2.3	2.8	2.6	2.6	2.7	2.5	2.8	2.6	2.3	2.5	2.6	31.0
Area Lights	23.9	23.3	25.2	23.9	23.2	24.1	22.9	25.2	23.2	22.3	22.3	23.9	282.1
Total	81.3	74.6	88.7	85.9	88.3	100.6	97.9	109.6	99.6	90.6	81.7	80.4	1,078.1

Gas Consumption (Btu x100,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	14.02	2.43	1.36	-	-	-	-	-	-	-	1.99	13.75	33.55
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	12.79	11.64	13.97	12.88	12.40	12.62	13.40	12.66	11.60	11.38	11.49	12.81	147.81
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Miso. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	26.81	14.07	15.33	12.88	12.40	12.62	13.40	12.66	11.60	11.38	13.47	26.25	180.87

Images courtesy of eQuest

What the Building Official Sees

$V = V(x_0^2 + x_1^2 + x_2^2) \subset \mathbb{P}^2$

$x_0^2 + x_1^2 + x_2^2 = 0$

mean
 range of
 ordinates

$x_0 \mapsto \frac{z_0 + z_1}{2}$
 $x_1 \mapsto \frac{z_0 - z_1}{2}$
 $x_2 \mapsto z_0 z_1$

$V \xrightarrow{z} \mathbb{P}^1$

$V \stackrel{\Delta}{=} V(x_0^2 + x_1^2 + x_2^2) \subset \mathbb{P}^2$
 $\langle (0, 0, 1), (0, 0, 0) \rangle$

Is this a trivial
 Fibration? Mukai?
 ask Ramadoss

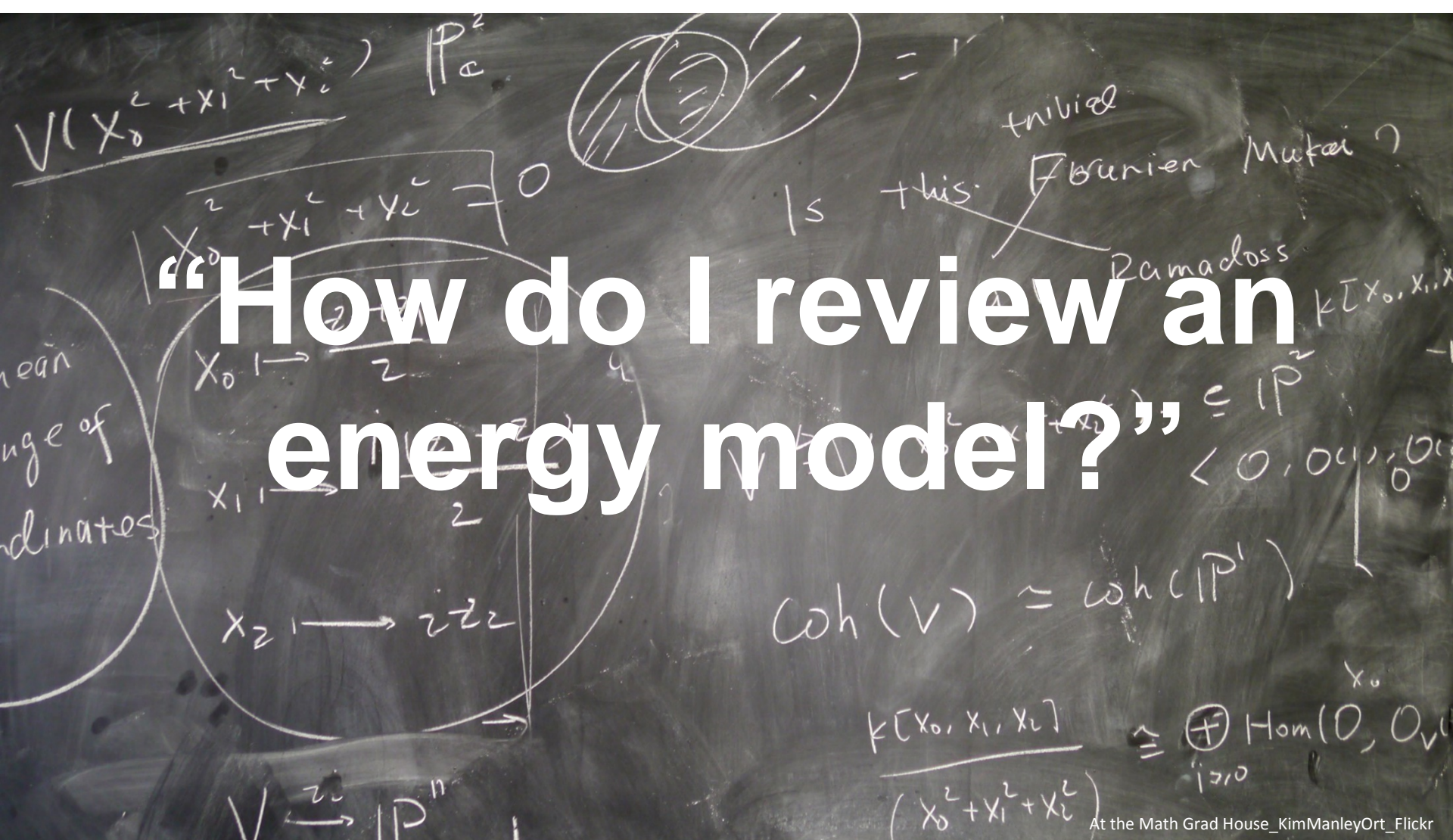
$\text{Coh}(V) \cong \text{Coh}(\mathbb{P}^1)$

$\frac{k[x_0, x_1, x_2]}{(x_0^2 + x_1^2 + x_2^2)} \cong \bigoplus_{i \geq 0} \text{Hom}(\mathcal{O}, \mathcal{O}_V(i))$

x_0

At the Math Grad House_KimManleyOrt_Flickr

“How do I review an energy model?”





**“How can we
support energy
model review?”**

CHAPTER 5: Resources Review



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- [State Sample Generator™ tool](#)
- [State Energy Code Jurisdictional Survey](#)
- [Compliance Checklists](#)
- [Score + Store™ tool](#) - NOTICE: this tool will be discontinued soon.

[Technical Assistance](#)
 For state energy offices and policymakers, as well as designers, builders, code officials, or anyone involved in the building energy codes process.

- [State Assistance](#) —various types are available, including the formation of adoption and compliance plans, economic analysis, cost impacts and analysis
- Submit a question to our [help desk](#)

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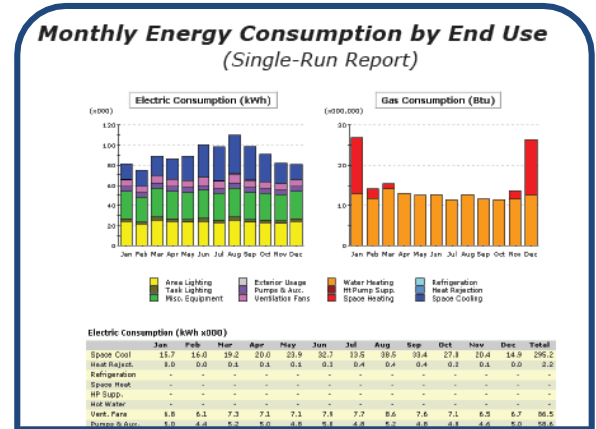
Training & Support

[Contact Us](#) or [Feedback](#) form or building energy codes experts also available to answer specific questions submitted through the web-based help desk.

COOLING COIL PEAK				CLG SPACE PEAK				HEATING COIL PEAK					
Peaked at Time: Outside Air OADB/DB/HR: 83 / 85 / 89				Mo/Hr: 7 / 23 OADB: 83				Mo/Hr: Heating Design OADB: 0					
Space Sens. + Lst. Btu/h	Plenum Sens. + Lst. Btu/h	Net Total Btu/h	Percent Of Total (%)	Space Sensible Btu/h	Percent Of Total (%)	Space Peak Space Sens. Btu/h	Coil Peak Tot Sens Of T Btu/h	Percent Of Total (%)	Space Sensible Btu/h	Percent Of Total (%)	Space Peak Space Sens. Btu/h	Coil Peak Tot Sens Of T Btu/h	Percent Of Total (%)
Envelope Loads				Envelope Loads				Envelope Loads					
Skyline Solar	0	0	0	0	0	0	0	0	0	0	0	0	0
Skyline Cond	0	0	0	0	0	0	0	0	0	0	0	0	0
Roof Cond	0	0	0	0	0	0	0	0	0	0	0	0	0
Glass Solar	0	0	0	0	0	0	0	0	0	0	0	0	0
Glass/Door Cond	0	0	0	0	0	0	0	0	0	0	0	0	0
Wall Cond	3,640	0	3,640	36	3,640	36	-8,302	-8,302	89	-8,302	-8,302	89	
Partition/Door	0	0	0	0	0	0	0	0	0	0	0	0	
Floor	0	0	0	0	0	0	0	0	0	0	0	0	
Adjacent Floor	0	0	0	0	0	0	-1,407	-1,407	14	-1,407	-1,407	14	
Infiltration	0	0	0	0	0	0	0	0	0	0	0	0	
Sub Total ==>	3,640	0	3,640	36	3,640	36	-9,709	-9,709	100	-9,709	-9,709	100	
Internal Loads				Internal Loads				Internal Loads					
Lights	929	232	1,160	12	929	10	0	0	0	0	0	0	
People	0	0	0	0	0	0	0	0	0	0	0	0	
Misc	0	0	0	0	0	0	0	0	0	0	0	0	
Sub Total ==>	929	232	1,160	12	929	10	0	0	0	0	0	0	
Ceiling Load				Ceiling Load				Ceiling Load					
Ventilation Load	0	0	0	0	0	0	0	0	0	0	0	0	
Adj Air Trans Heat	0	0	0	0	0	0	0	0	0	0	0	0	
Dehumid. Ov Sizing	0	0	0	0	0	0	0	0	0	0	0	0	
Ov/Undr Sizing	5,241	0	5,241	53	5,241	64	0	0	0	0	0	0	
Exhaust Heat	0	0	0	0	0	0	0	0	0	0	0	0	
Sup. Fan Heat	0	0	0	0	0	0	0	0	0	0	0	0	
Ret. Fan Heat	0	0	0	0	0	0	0	0	0	0	0	0	
Duct Heat Pksp	0	0	0	0	0	0	0	0	0	0	0	0	
Underflr Sup HI Pksp	0	0	0	0	0	0	0	0	0	0	0	0	
Supply Air Leakage	0	0	0	0	0	0	0	0	0	0	0	0	
Grand Total ==>	9,709	232	9,941	100.00	9,709	100.00	-9,709	-9,709	100	-9,709	-9,709	100	

COOLING COIL SELECTION				AREAS			
Total Capacity ton	Sens Cap. Mtn	Coil Airflow Mtn	Enter DB/DB/HR °F °F gr/s	Leave DB/DB/HR °F °F gr/s	Gross Total Floor	Glass Area (%)	
3.8	8.8	8.8	68	76.67	68.6	65.0	67.8

Documentation



Automatic Baseline

What's Not Working Training: Trial by Fire

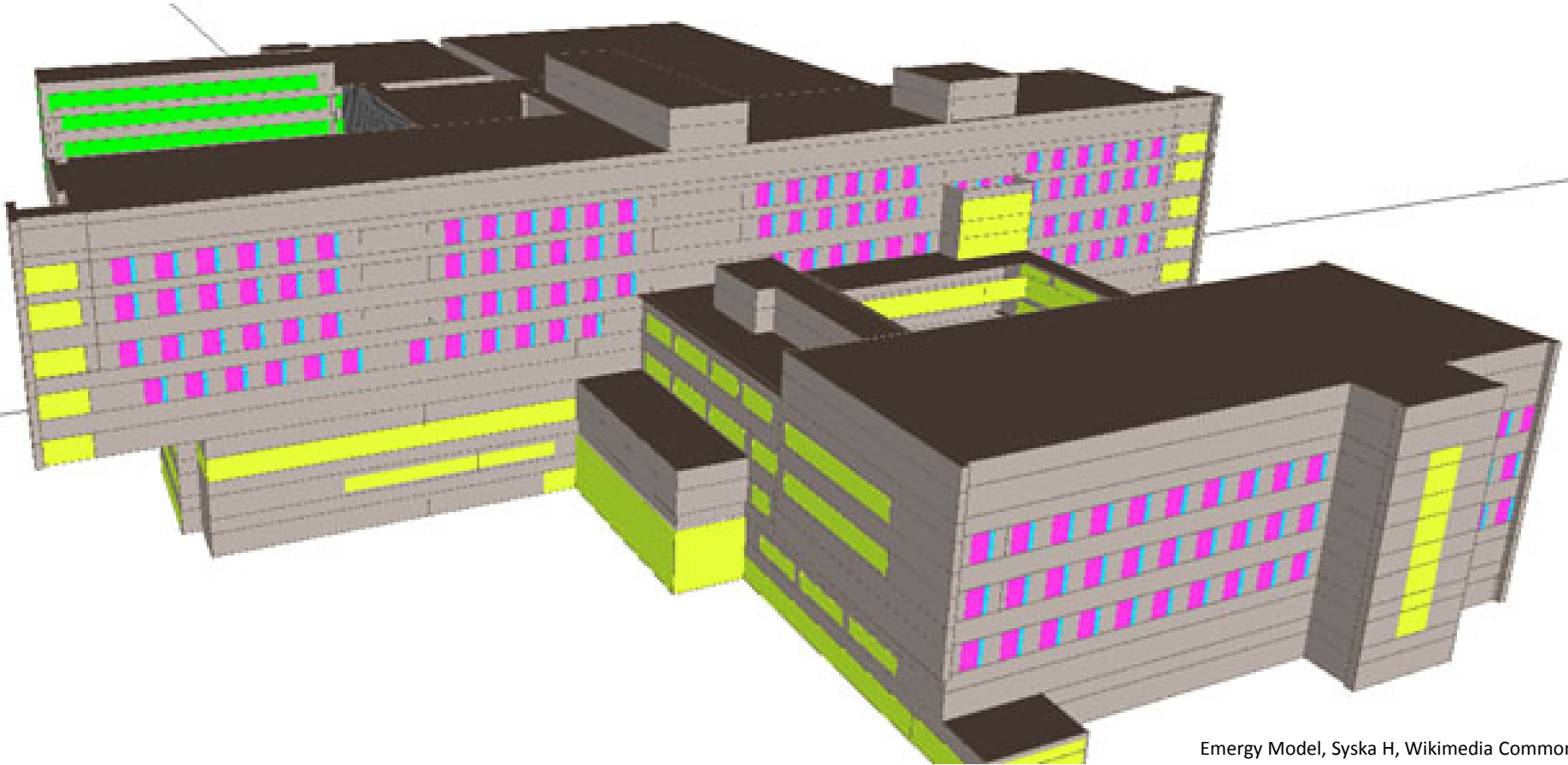


What's Not Working Training: Infrastructure



180127ubno1270315, Ria Tan, Flickr

What's Not Working Training: To be Energy Modelers



Energy Model, Syska H, Wikimedia Commons

Standard Training Modules



What's Not Working Documentation: Lack of Standard

DOE-2.2-4782 11/20/2013 18:20:32 BDL RUN 1

REPORT: SS-D Building HVAC Load Summary

COOLING					HEATING					ELEC		
MONTH	COOLING ENERGY (MBTU)	TIME OF DAY	DAY-MAX TEMP	WHT-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF DAY	DAY-MAX TEMP	WHT-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC ENERGY (KWH)	MAXIMUM TISSC LOAD (KW)
JAN	0.00129	29 17	43.F	37.F	0.560	-25.925	23 8	4.F	2.F	-175.009	3762.	11.650
FEB	0.00000	28 24	29.F	25.F	0.000	-18.876	5 8	19.F	17.F	-168.875	3405.	11.650
MAR	0.11304	28 15	69.F	53.F	26.591	-14.971	12 8	34.F	33.F	-131.950	3795.	12.840
APR	0.32660	30 15	74.F	55.F	35.054	-6.839	3 8	35.F	28.F	-87.415	3585.	13.365
MAY	5.30432	11 15	84.F	65.F	73.934	-1.009	7 8	42.F	34.F	-47.670	3918.	16.770
JUN	16.26566	18 11	76.F	70.F	106.160	-0.007	1 8	55.F	49.F	-3.004	4561.	19.057
JUL	24.82984	23 11	84.F	72.F	119.349	0.000	31 1	71.F	67.F	0.000	5257.	20.369
AUG	23.71019	27 15	83.F	75.F	121.300	0.000	31 1	70.F	65.F	0.000	5228.	19.694
SEP	14.76745	4 10	78.F	69.F	118.795	-0.090	26 8	60.F	56.F	-4.802	4328.	19.604
OCT	2.56139	9 15	76.F	61.F	63.537	-2.113	31 8	40.F	33.F	-55.397	3746.	15.365
NOV	0.12968	5 11	46.F	43.F	7.356	-9.118	23 8	39.F	35.F	-106.157	3550.	12.268
DEC	0.00738	11 17	45.F	40.F	3.408	-17.617	26 8	28.F	24.F	-157.968	3700.	11.726
TOTAL	88.017					-96.565					48835.	
MAX					121.300					-175.009		20.369

MAXIMUM DAILY INTEGRATED COOLING LOAD (DES DAY) 0.000 (KBTU)
MAXIMUM DAILY INTEGRATED COOLING LOAD (WTH FILE) 0.000 (KBTU)

Hourly Zone Loads for VRF

Zone	OA TDB	Zone Temp	WHT	Zone Sens Load	Zone Latent Load	Zone Total Load	Thermal Cooling Coil	Thermal Heating Coil	Zone Heating Unit
0000	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
0100	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
0200	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
0300	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
0400	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
0500	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
0600	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
0700	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
0800	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
0900	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
1000	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
1100	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
1200	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
1300	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
1400	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
1500	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
1600	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
1700	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
1800	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
1900	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
2000	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
2100	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
2200	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
2300	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000
2400	81.1	81.1	81.1	0.000	0.000	0.000	0.000	0.000	0.000

COOLING COIL PEAK				CLG SPACE PEAK				HEATING COIL PEAK				TEMPERATURES			
Peaked at Time: Month: 7/23 Outside Air: OADB/WBHR: 83/65/69				Month: 7/23 Outside Air: OADB: 93				Month: Heating Design OADB: 0				Cooling Heating			
Space Sens. + Lat.	Plenum Sens.	Net Total	Percent Of Total	Space Sensible	Percent Of Total	Space Peak Space Sens	Coil Peak Percent	Space Sens	Coil Peak Percent	Return	Room	Auxiliary	Leakage Dwn	Leakage Ups	No. People
Btuh	Btuh	Btuh	(%)	Btuh	(%)	Btuh	(%)	Btuh	(%)	Btuh	Btuh	Btuh	Btuh	Btuh	
Envelope Loads															
SkyLite Solar	0	0	0	0	0	0	0.00	0	0.00	75.0	70.0	0.0	0.0	0.0	
SkyLite Cond	0	0	0	0	0	0	0.00	0	0.00	56.9	90.0	0.0	0.0	0.0	
Roof Cond	0	0	0	0	0	0	0.00	0	0.00	75.5	70.0	0.0	0.0	0.0	
Glass Solar	0	0	0	0	0	0	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
GlassDoor Cond	0	0	0	0	0	0	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
Wall Cond	3.540	0	3.540	36	3.540	36	-8.302	-3.540	-100.00	0.0	0.0	0.0	0.0	0.0	
PartitvDoor	0	0	0	0	0	0	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
Floor	0	0	0	0	0	0	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
Adjacent Floor	0	0	0	0	0	0	0.00	-1.407	-100.00	0.0	0.0	0.0	0.0	0.0	
Infiltration	0	0	0	0	0	0	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
Sub Total	3.540	0	3.540	36	3.540	36	-8.302	-3.540	-100.00	0.0	0.0	0.0	0.0	0.0	
Internal Loads															
Lights	928	232	1,160	12	928	10	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
People	0	0	0	0	0	0	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
Misc	0	0	0	0	0	0	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
Sub Total	928	232	1,160	12	928	10	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
Ceiling Load	0	0	0	0	0	0	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
Ventilation Load	0	0	0	0	0	0	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
Adj Air Trans Heat	0	0	0	0	0	0	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
Dehumid. Ov Sizing	0	0	0	0	0	0	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
OV/Undr Sizing	5,241	0	5,241	53	5,241	53	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
Exhaust Heat	0	0	0	0	0	0	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
Sup. Fan Heat	0	0	0	0	0	0	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
Ret. Fan Heat	0	0	0	0	0	0	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
Duct Heat PkUp	0	0	0	0	0	0	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
Underflr. Sup HI PkUp	0	0	0	0	0	0	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
Supply Air Leakage	0	0	0	0	0	0	0.00	0	0.00	0.0	0.0	0.0	0.0	0.0	
Grand Total	9,709	232	9,941	100.00	9,709	100.00	-8,709	-9,709	100.00	0.0	0.0	0.0	0.0	0.0	



What's Not Working Documentation: Engineering Stamp

Project Name: VRF Office	Hourly Zone Loads for VRF	03/20/2016 11:58:58
Project Loc: 2000		

Zone: North Zone Official Section 4.8.1.1										
Hour	OA TEMP TDB	Zone TEMP TDB	RH	Zone AOP Load KWH	Zone Sensible Load KWH	Zone Latent Load KWH	TE Energy Cooling COP	TE Energy Heating COP	Zone Heating Unit BTU/KWH	
0000	41.2	21.2	45	0.0	0.000	0.000	1.000	0.0	0.0	
0100	41.0	20.3	45	0.0	0.000	0.000	1.000	0.0	0.0	
0200	40.7	19.5	45	0.0	0.000	0.000	1.000	0.0	0.0	
0300	40.3	18.8	45	0.0	0.000	0.000	1.000	0.0	0.0	
0400	39.7	18.2	45	0.0	0.000	0.000	1.000	0.0	0.0	
0500	39.0	17.7	45	0.0	0.000	0.000	1.000	0.0	0.0	
0600	38.2	17.2	45	0.0	0.000	0.000	1.000	0.0	0.0	
0700	37.3	16.7	45	0.0	0.000	0.000	1.000	0.0	0.0	
0800	36.3	16.2	45	0.0	0.000	0.000	1.000	0.0	0.0	
0900	35.2	15.7	45	0.0	0.000	0.000	1.000	0.0	0.0	
1000	34.0	15.2	45	0.0	0.000	0.000	1.000	0.0	0.0	
1100	32.7	14.7	45	0.0	0.000	0.000	1.000	0.0	0.0	
1200	31.3	14.2	45	0.0	0.000	0.000	1.000	0.0	0.0	
1300	29.8	13.7	45	0.0	0.000	0.000	1.000	0.0	0.0	
1400	28.2	13.2	45	0.0	0.000	0.000	1.000	0.0	0.0	
1500	26.5	12.7	45	0.0	0.000	0.000	1.000	0.0	0.0	
1600	24.7	12.2	45	0.0	0.000	0.000	1.000	0.0	0.0	
1700	22.8	11.7	45	0.0	0.000	0.000	1.000	0.0	0.0	
1800	20.8	11.2	45	0.0	0.000	0.000	1.000	0.0	0.0	
1900	18.7	10.7	45	0.0	0.000	0.000	1.000	0.0	0.0	
2000	16.5	10.2	45	0.0	0.000	0.000	1.000	0.0	0.0	
2100	14.2	9.7	45	0.0	0.000	0.000	1.000	0.0	0.0	
2200	11.8	9.2	45	0.0	0.000	0.000	1.000	0.0	0.0	
2300	9.5	8.7	45	0.0	0.000	0.000	1.000	0.0	0.0	



Prof. Eng. Stamp, XA7761B,
Wikimedia Commons

Standard Submission Format



COMcheck Software Version 3.9.1 Envelope Compliance Certificate

2009 IECC

Section 1: Project Information

Project Type: **New Construction**
Project Title : Marvins Gardens

Construction Site:
123 Main
Bozeman, MT 59715

Owner/Agent:

Designer/Contractor:

Section 2: General Information

Building Location (for weather data): **Bozeman, Montana**
Climate Zone: **6b**
Building Type for Envelope Requirements: **Non-Residential**
Vertical Glazing / Wall Area Pct.: **8%**
Skylight Glazing / Roof Area Pct.: **2%**

Activity Type(s)	Floor Area
Office	1000
Retail	5000
Workshop	2700

Section 3: Requirements Checklist

Envelope PASSES: Design 5% better than code.

Climate-Specific Requirements:

Component Name/Description	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor ^(a)
Roof 1: Non-Wood Joist/Rafter/Truss	6112	40.0	0.0	0.033	0.027
Skylight 1: Metal Frame, Double Pane, Tinted, SHGC 0.80	112	---	---	0.500	0.600
Exterior Wall 1: Solid Concrete: 8" Thickness, Medium Density, Furring, Metal	6000	11.0	10.0	0.063	0.080
Door 1: Glass (> 50% glazing) Metal Frame, Entrance Door, SHGC 0.30	42	---	---	0.500	0.800
Window 1: Metal Frame, Double Pane with Low-E, Tinted, SHGC 0.63	1500	---	---	0.600	0.550
Window 2: Metal Frame, Double Pane, Clear, SHGC 0.72	56	---	---	0.700	0.550
Door 2: Insulated Metal, Non-Swinging	288	---	---	0.140	0.500
Door 3: Insulated Metal, Swinging	40	---	---	0.200	0.700
Exterior Wall 2: Solid Concrete: 8" Thickness, Medium Density, Furring, Metal	6000	11.0	10.0	0.063	0.080
Exterior Wall 3: Solid Concrete: 8" Thickness, Medium Density, Furring, Metal	6000	11.0	10.0	0.063	0.080
Exterior Wall 4: Steel-Framed, 24" o.c.	1000	19.0	0.0	0.094	0.064
Floor 1: Slab-On-Grade: Unheated, Vertical 2 ft.	180	---	10.0	---	---

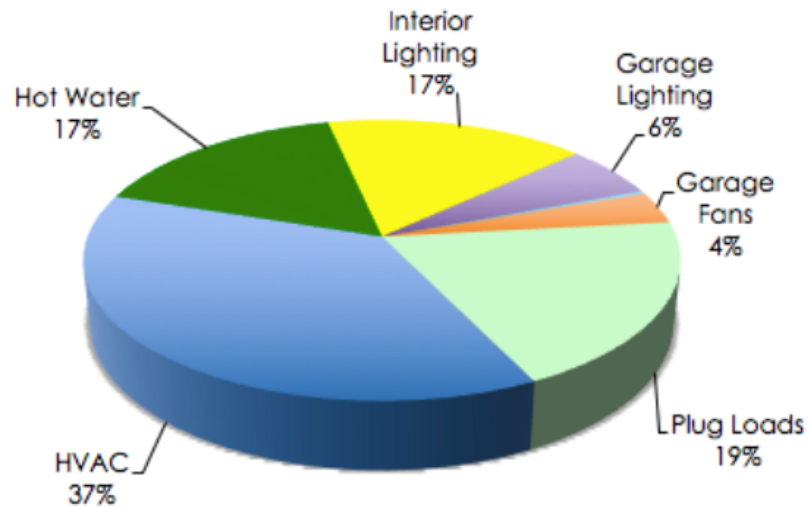
(a) Budget U-factors are used for software baseline calculations ONLY, and are not code requirements.

Air Leakage, Component Certification, and Vapor Retarder Requirements:

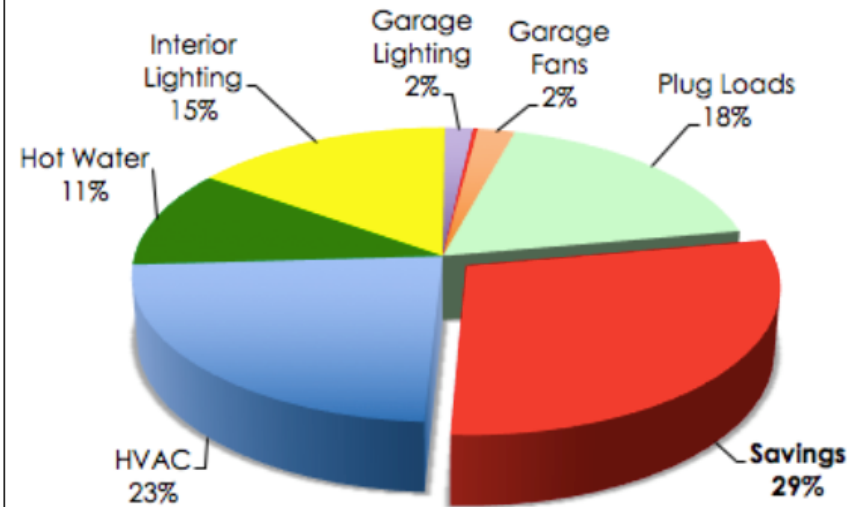
1. All joints and penetrations are caulked, gasketed or covered with a moisture vapor-permeable wrapping material installed in accordance with the manufacturer's installation instructions.

Automatic Baseline Generation

Baseline Annual Energy Cost by End-Use



Proposed Annual Energy Cost by End-Use





Thank You

Kimberly Cheslak
Energy Codes Specialist

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codes@imt.org

