

#### The Commercial Energy Code: Session 7 COMcheck Basics and Advanced Technologies

Instructor: Matt Belcher Tuesday, February 21, 6-8p.m.





## Housekeeping

- Attendees are muted upon entry
- Questions? Enter them in the chat box
- Webinar is being recorded slides and recording will be sent to attendees
- CEUs available for AIA and ICC
- Email <u>canderson@mwalliance.org</u> with questions

Course information available at: <u>https://www.mwalliance.org/metropolitan-</u> <u>community-college-energy-code-course</u>



Basics of using the COMcheck software, reviewing generated compliance reports and the latest and greatest new features.

- 1. Obtain an overview of the basic functions and how COMcheck calculates compliance for the building envelope, interior and exterior lighting.
- 2. Be able to identify the construction specifications needed to complete a compliance calculation in the software.
- 3. Learn how to enter the building envelope, lighting, and mechanical components into the software.
- 4. Understand how the compliance reports are created and what they entail.

## **States That Allow COMcheck**



#### **Commercial Compliance Tools**





**COM***check-Web* simplifies commercial and high-rise residential energy code compliance.

It performs just like <u>COM*check*</u>, the desktop version, but you don't need to download or install any software on your computer.

 Can exchange files between desktop and web

## **COMcheck/COMcheck Web**

- The COMcheck software product group makes it easy to determine whether new commercial or high-rise residential buildings, additions and alterations meet the requirements of the IECC and ASHRAE Standard 90.1.
- COMcheck also simplifies compliance for building officials, plan checkers and inspectors by allowing them to quickly determine if a building project meets the code.

# **Commercial Compliance Options**

#### ASHRAE 90.1-2016

#### OR



# 2018 IECC - Prescriptive ✓ C402 - Envelope ✓ C403 - Mechanical ✓ C404 - SWH ✓ C405 - Lighting AND Pick at Least One C406: □C406.2 - Eff. HVAC Performance □C406.3 - Reduced Lighting Power □C406.4 - Enhanced Lighting Controls □C406.5 - On-site Supply of Renewable Energy □C406.6 - Dedicated Outdoor Air

- System C406.7 – High Eff. Service Water
- Heating
- C406.8 Enhanced Envelope Performance
- C406.9 Reduced Air Infiltration



#### 2018 IECC - Performance

- C407 Total Building Performance
- C402.5 Air Leakage
- C403– Mandatory Mechanical Provisions
- C404 SWH
- C405 Lighting
- Building energy cost to be < 85% of standard reference design building



## COMcheck: Who May Submit?

- The commercial energy code requires that a registered professional submit compliance documentation (construction documents and compliance verification).
- In the IECC, Section C103.1 Construction Documents, General, the wording states that construction documentation and other supporting data shall be submitted in one or more sets with each application for a permit.
- The construction documents shall be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed. Where special conditions exist, the code official is authorized to require necessary construction documents to be prepared by a registered design professional.

# Landing Page

<b>COM</b> check•Web <sup>™</sup>		P 20	Project title			Email Ad Register	Idress Pa	ssword
New Project	PROJECT	VELOPE	INT. LIGHTING	EXT. LIGHTING	MECHANICAL			Reports
- Code/Location		Build	ding Envelope and I	nterior Lighting Are	as Exterior Lighting A	Areas		
Code: 2009 IECC	~		Add Building Area	C Duplicate	X Delete			
City: Abbeville	•		Buil	ding Area	Area Description	Space Conditioning	Area	W/ft <sup>2</sup>
If your location is not included location with similar weather co	here, choose a nearby inditions.	1	Select Area Categ	jory 💊	•			
Project Type								
New Construction $\bigcirc$ Addi	tion O Alterations							
Project Details (optional)			4					×.
This information will appear on the compliance report.	Edit Project Details							

#### **Commercial Buildings**



#### What is COMcheck?

#### Envelope

- trade-off calculations are based on envelope loads only
- defines a proposed design and a budget design

Lighting

- Watts/square foot (LPDs)
- Mechanical
  - short wizard to customize a list of requirements applicable to the system identified



9

## **Envelope Trade-Off Methods:**

 ASHRAE 90.1 (Pre-2013) Normative Appendix C Methodology for Building Envelope Trade-Off Option
 90.1-2007/2010
 2009/2012 IECC

ASHRAE 90.1-2013 Appendix C has limited performance method (EnergyPlus) (New)

2015 IECC Component Performance Alternative (Total UA) (New)

## **Project Types:**

New Construction: Trade-off compliance method

Addition: Trade-off compliance method

Alteration: Prescriptive compliance

#### **Commercial Building Envelope Requirements**

- Mandatory Requirements:
  - Moisture Control
  - Air Leakage
- Climate Specific Requirements:
  - Roof
  - Above Grade Walls
  - Below Grade Walls
  - Floor
  - Slab
  - Skylights, Windows, and Doors



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# Landing Page

<b>COM</b> check•Web <sup>™</sup>		P 20	Project title			Email Ad Register	Idress Pa	ssword
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Project Details (optional)			4					×.
This information will appear on the compliance report.	Edit Project Details							



## **COMcheck Basics**

COMcheck is a reflection of the difference between a 'design' building energy performance factor (EPF) and a 'code' or budget building EPF.

The methodology used to determine EPF is provided in ASHRAE 90.1 Normative Appendix C: Methodology for Building Envelope Trade-off Option.

## **COMcheck Project Specification Steps**

- Project
- Building Envelope Components
- Lighting
- Mechanical
- Requirements/View/Print/Save

## **Information You Will Need:**

- Energy Code
- Builder and project location
- Area take-offs for envelope assemblies
- Insulation R-values and fenestration performance data
- Lighting fixture details
- Heating and cooling system details
- Service water heating details

# Landing Page

<b>COM</b> check•Web <sup>™</sup>		P 20	Project title			Email Ad Register	Idress Pa	ssword
New Project	PROJECT	VELOPE	INT. LIGHTING	EXT. LIGHTING	MECHANICAL			Reports
- Code/Location		Build	ding Envelope and I	nterior Lighting Are	as Exterior Lighting A	Areas		
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This information will appear on the compliance report.	Edit Project Details							



#### **Envelope Requirements**

		Project Envelo	ipe li	nterior Lighting	Exte	nor l	Lighting	Mechanix	cal		_
0	loof) (škyli	ght (Ext. Wall) (	Window	Doar )	Basemer	n)	Floor	)			
	Component	Assembly	Concrete Density	Construction Details	Gress Area or Siah Perimeter		Cavity Insulation R-Value	Cortinusus Insolation R-Value	Q-Factor	9400	Projection
	Building									-	
I	Roof 1	Insulation Entirely Ab., +	0		138129	h2		25.0	0.039	1	
2	Exterior Wall 1	Concrete Block.32%	Media	Furring +	38130	112	-	0.0	0.280		
ř.	Window 1	Wood-Framed, 16"	0.5.	Glazing: +	152	112			0.550	0.35	1.45
4.	Window 2	Wood-Framed, 24"	0.0.	Glazing	\$12	m2			0.190	0.25	6.00
\$1	Window 3	Steel-Framed, 16*	5.C.	Glaring *	207	m2			0.550	0.35	1.45
6	Deer 1	Steel-Framed, 24" (	b.£.	Swinging -	378	112		-	0.100	1000	10000
7	Deer 2	Metal Building Wall		Non-Swi *	162	m2	-		0.130		
8	Deer 3	Solid Concrete		10 c 1 d 1		-		-	0.130		
				6", Unreinf 6", Solid G 8", Partially 8", Partially 8", Unreinf	orced, Cel routed Crouted, Crouted, orced, Cel	Cell Cell Ils Er	isulated Is Empty Is Insulate mpty	d			
				10°, Solid ( 10°, Partial 10°, Partial 10°, Unreir 10°, Unreir 12°, Solid ( 12°, Partial 12°, Partial 12°, Unceir	Grouted by Grouted forced, C forced, C Grouted by Grouted by Grouted forced, C	i, Ce elis i elis i i, Ce i, Ce elis i	ells Empty ells insulat Empty Insulated ells Empty ells insulat Empty	ed ed			

Envelope PASSES: Design 3% better than Code

Envelope +1% Interior Lighting TRO Exterior Lighting TRO

## U/A Trade-Off Compliance

#### Compliance: Passes using UA trade-off

Compliance: 12.2% Better Than Code Maximum UA: 500 Your UA: 439

The % Reflect or Worke Than Code Index reflects how obles to compliance the house is based on code trade-off rules. It DORS NOT provide an estimate of energy use or cost relative to a minimum-iode house.

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Glazing or Door U-Factor	UA
Exterior Wall Type A: Steel Frame, 16" o.c.	1260	13.0	5.0	11.07 edited to be	88
Window 2: Wood Frame Double Pane with Low-E	75			0.330	25
Door B: Solid	41			0.420	17
Exterior Wall Type B: Steel Frame, 16" o.c.	2513	13.0	5.0		173
Window 1: Wood Frame: Double Pane with Low-E	210			0.330	69
Window 2: Wood Frame: Double Pane with Low-E	30			0.330	10
Window 3: Wood Frame Double Pane with Low-E	5			0.330	2
Door A: Glass	24			0.310	7
Roof Type 1: Steel Joist/Rafter, 16" o.c.:2x10	823	0.0	35.0		21
Window 4 - Skylight: Metal Frame with Thermal Break: Triple Pane	32			0.700	22
Window 5 - Skylight: Other	9			0.540	5

Compliance Statement: The proposed building design described here is consistent with the building plans, specifications, and other calculations submitted with the permit application. The proposed building has been designed to meet the 2010 New York Energy Conservati Construction Code requirements in RESoheck Version 4.4.1 and to comply with the mandatory requirements listed in the RESoheck Inspect Checklist.

Name - Tide

Signature

Date

#### **Envelope Screen**

谢 EZ-Casestudy.co	ck - COMcheck		Code: 200	I IEC	c	
File Edit View O	ptions Code Help					
D 🖙 🖬 🐰						
Project Envel	ope Lighting Mechani	cal				
Roof Skylight	Ext. Wall Int. Wall	Window Do	or Basen	nent	Floor	
Component	Assembly	Construction Details	Gross Area		Cavity Insulation R-Value	
Building						
1 Roof 1	Non-Wood Joist/Ratter/Tr		20532	ft2	19.0	
E	Building Components are ad	lded by clicking	g on these.		9	17

#### Windows – U-Factors

Table 102.3(1) U-Value Default For Windows Glazed Doors and Skylights

Frame Material and Product Type	Single Glazed	Double Glazed
Metal without thermal break		
Operable (including Sliding and swinging		5 C
glass door)	1.27	D.87
Fixed	1.13	0.69
Genden Window	2.60	1.81
Curtain Wal	1.22	D.79
Skylight	1.98	1.31
Site-assembled Slopedroverhead glazing	1.36	0.82
Metal with the mail break		1
Operable (including Sliding and swinging glass door)	1014 10-12	
Faced	1.08	D.625
Genden Window	1.07	D.63
Curtain Well	1.11	D.68
Skylight	1.89	1.11
Site assembled Sloped/overhead glazing	1.25	D.70
Reinforced vinytimetal clad wood		
Operable (including sliding and saringing glass	1	
daars)	D.90	0.57
Faced	D.98	D.56
Skylights	1.75	1.05
Woodvinyilliterglass		
Operable (including sliding and swinging		
gless doors)	D.89	0.55
Faced	D.98	D.56
Gerden Window	2.31	1.61
Skylight	1.47	D.84



- NFRC tested and certified or default window U-value range
- Use assembly U-value
- All windows must meet or exceed

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Type in chat or unmute

## **QUESTIONS SO FAR?**



#### **Interior Lighting Compliance**



#### **Adding Lighting**

谢 EZ-Casestudy.cck - COMchee	k		Code: 2001 IECC				
File Edit View Options Code	Help						
	42 8						
Project Envelope Lightin	ng Mechanical						
T8/T12 Fluorescent Compact F	luorescent   HID	Incandes	cent Add Space				
Component	Fixture ID Fixture	e Description	Lamp Description/ Wattage Per Lamp	Ballast	Lamps Per Fixture	Number of Fixtures	Fixture Wattage
Building							
1 Space 1							
<sup>2</sup> Lighting compone	nts are	polic Troffer	48" T12 40W	Magnetic 💌	4 -	174	139
<sup>3</sup> added by clicking	on those	polic Troffer	48" T12 40VV	Magnetic 💌	2 🔹	31	70
4 added by clicking	on these	policTroffer	48" T12 40W	Magnetic 💌	2 -	5	70
5 187112 Hubrescent 4 D	2 X 2 Prist	matic Troffer	24" T12U 40W	Magnetic 💌	2 -	53	70
6 T8 / T12 Fluorescent 2 E	2 x 4 Prisr	matic Troffer	48" T12 40W	Magnetic 💌	Lightin		te
					Lightin	ig Resul	13
						1	
			Allowed Wattage 2	8295	Proposed W	/attage	31186
				Envelop	TBD	Lighting	-10%
Use the Options Menu to Arrange L	ighting Fixtures by S	Spaces.					

#### Lighting Using Space-by-Space

 Office A:
 400 ft²

 Office B:
 850 ft²

 Bathrooms:
 350 ft²

 Corridor:
 50 ft²

 Retail A:
 500 ft²

 Retail B:
 500 ft²

 Future:
 350 ft²



з

#### Mechanical

Component	Guantity	Equipment	. [	Fuel Type/ Heat Source	Condens	er	System Details		
Building	-		-			-		_	
Water Heating 1	2						Click here		
HVAC System 4	1								
Rooftop Packaged Heat Pu		Select	-		Select	-			
HVAC System 1	1								
Rooftop Packaged Heat Pu		<65 kBtu/h	-		Air-Cooled	-			
B HVAC System 2	7		144						
Rooftop Packaged Heat PL		<65 kBtu/h	-		Air-Cooled	-			
HVAC System 3	2	8							
Rooftop Packaged Heat Pu		>=90 - <135 k			Air-Cooled	-	Air Economizer		
	Component Suilding •Water Heating 1 = HVAC System 4 Rooftop Packaged Heat PL = HVAC System 1 Rooftop Packaged Heat PL = HVAC System 3 Rooftop Packaged Heat PL	Component     Quantity       Suilding     2       Weter Heating 1     2       HVAC System 4     1       Roottop Packaged Heat Pt       HVAC System 1     1       Roottop Packaged Heat Pt       HVAC System 2     7       Roottop Packaged Heat Pt       HVAC System 3     2       HVAC System 3     2	Component     Quantity     Equipment Capacity       Suilding     2       Water Heating 1     2       HVAC System 4     1       Rooftop Packaged Heat Pt     Select       HVAC System 1     1       Rooftop Packaged Heat Pt     <65 kBtu/h	Component     Quantity     Equipment Capacity       Suilding     2       Water Heating 1     2       HVAC System 4     1       Rooftop Packaged Heat Pt     Select       HVAC System 1     1       Rooftop Packaged Heat Pt     <65 kBtu/h	Component     Quantity     Equipment Capacity     Fuel Type/ Heat Source       Suilding     Image: Component of the stress	Component       Quantity       Equipment Capacity       Fuel Type/ Heat Source       Condens Type         Suilding       2	Component     Quantity     Equipment Capacity     Fuel Type/ Heat Source     Condenser Type       Suilding     0     0     0       Water Heating 1     2     0     0       HVAC System 4     1     0     0       HVAC System 4     1     0     0       HVAC System 1     1     0     0       HVAC System 1     1     0     0       HVAC System 2     7     0     0       HVAC System 3     2     0     0       HVAC System 3     2     0     0	Component       Quantity       Equipment Capacity       Fuel Type/ Heat Source       Condenser Type       System Details         Suilding       0       0       0       0       0         Water Heating 1       2       0       0       0       0         HVAC System 4       1       0       0       0       0       0         HVAC System 4       1       0	Component       Quantity       Equipment Capacity       Fuel Type/ Heat Source       Condenser Type       System Details         Suilding            Details         Water Heating 1       2              HVAC System 4       1                HVAC System 1       1

TEZ-Casestudy.ccl	k - COMcheck-EZ	Code: 2001 IECC	
File Edit View Op	ntions Code Help		
		<b>N</b>	
Project     Envelop       HVAC System     F       Component     Building       1     -Water Heating 1       2     HVAC System 4       3     Rooftop Pace       4     HVAC System 1       5     Rooftop Pace       6     HVAC System 2       7     Rooftop Pace       8     HVAC System 3       9     Rooftop Pace	HVAC System HVAC Equipment Type: Heating Equipment Type: None Central Furnace Duct Furnace Hydronic or Steam Coll Heat Pump Packaged Terminal Radiant Heater Unit Heater Other	Cooling Equipment Type: None Field-Assembled DX System Hydronic Coil Packaged Terminal DX Unit Rooftop Package DX Unit Split DX System Other	
	E Single Zone	Perimeter System Perimeter System OK Cancel Envelope TBD Lig	nting 10%



#### **Building Controls are Complicated**

- Since 2004, about 30% of all new requirements have been related to building controls
- Control requirements can be difficult to implement, and verification is beyond the expertise of most building code officials
- Assumption is that they are implemented and working correctly

Source: https://www.pnnl.gov/main/publications/external/technical\_reports/PNNL-26348.pdf

#### Mandatory Requirements in COMcheck Software

- Requirements Checklist generated automatically based on input
  - applicable code
  - building location



### Systems Commissioning and Completion Requirements Section C408

- Commissioning is critical to ensure that buildings are working as designed
- Preliminary and final reports required
- Mechanical and lighting commissioning detailed in section C408



Efficient and optimal performance from the systems leading to lower complaints

Increase in the asset and expected rental value associated with a building, etc.
# Functional Testing of Lighting Controls Section C408.3.1

Prior to passing final inspection, registered design professional to provide evidence that lighting control systems have been tested to ensure that control hardware and software are calibrated, adjusted, programmed and in proper working order per construction documents and manufacturer's installation instructions

## **Compliance Certificate for Permit**

#### COMcheck

#### COMcheck Software Version COMcheck-Web Envelope Compliance Certificate

#### Project Information

Energy Code: Project Title: Location: Climate Zone: Project Ture:	2012 Ontario Building Code and Chapt OAA Festival Project 44% Toronto / Downtown, Ontario 5a	er 2 of Division 3 of SB-10(2017)			
Vertical Glazing / Wall Area:	43%	42%			
Performance Sim. Specs:	EnergyPlus 8.1.0.009 (EPW: CAN_ON	EnergyPlus 8.1.0.009 (EPW: CAN_ON_Toronto.716240_CWEC.epw)			
Construction Site: 666 Park AVe, Toronto, Ontario M4M 4M4	Owner/Agent: Ima Driven CanDo Developments 666 Park Ave Toronto, Ontario M4M 4M4 6136015689 Ima.Driven@CanDo,ca	Designer/Contractor: Gerry Conway Conway Architect Inc 185 Mafeking Ave Ottawa K1K2V4 6136015689 ConwayArchitect@gmail.con			
Building Area	Floor	Area			
1-Gnd FI. Retail (Retail) : Nonresid	dential 1	0000			
2-2nd - 10th (Office) : Nonresiden	tial 9	90000 10000			
3-Bsmt. (Warehouse) : Nonreside	ntial 1				

Advanced Building Envelope Components - Section C406.8

#### C406.8: Enhanced Envelope Performance.

The total UA of the building thermal envelope as designed shall be not less than 15 percent below the total UA of the building thermal envelope in accordance with Section C402.1.5.

## Advanced Building Envelope Components - Section C406.9

#### C406.9: Reduced Air Infiltration

Air infiltration shall be verified by whole-building pressurization testing conducted in accordance with ASTM E779 or ASTM E1827 by an independent third party. The measured air-leakage rate of the building envelope shall not exceed 0.25 cfm/ft2(2.0 L/s × m2) under a pressure differential of 0.3 inches water column (75 Pa), with the calculated surface area being the sum of the above- and below-grade building envelope. A report that includes the tested surface area, floor area, air by volume, stories above grade, and leakage rates shall be submitted to the code official and the building owner.

Exception: For buildings having over 250,000 square feet (25 000 m2) of conditioned floor area, air leakage testing need not be conducted on the whole building where testing is conducted on representative above-grade sections of the building. Tested areas shall total not less than 25% of the conditioned floor area and shall be tested in accordance with this section.

## **Advanced Technologies**

- Advanced Insulation/Building Envelope
- Phase Change Materials
- Systemic Approach to Building
- Advanced Fenestration
- Advanced HVAC Equipment
- Smart Homes
- Electric Vehicles
- Grid-Integrated Efficient Buildings (GEB)
- Carbon Defined

## **Building Envelope**

Sometimes you can get a free lunch! FREE ENERGY starts with good, thoughtful design!



## **Continuous Insulation - Typical Framing**

- Typical wall with continuous insulation on the exterior
- Be sure to seal all seams in continuous insulation
- Stud cavity can accommodate various types of insulation



Image: buildingscience.com

# Continuous Insulation - Advanced Framing

- Double stud wall allows for continuous insulation to be placed between interior and exterior studs
- Can accommodate various types of insulation, or even mixed types of insulation



## **3 Main Types of Rigid Insulation**



Image: finehomebuilding.com

#### Expanded Polystyrene – EPS

- Least expensive
- Most vapor permeable
- R-value: 3.6 to 4.2 per inch

#### Extruded Polystyrene – XPS

- High compressive strength
- High initial water resistance
- R-value: 5 per inch

#### Polyisocyanurate -Polyiso

- No ozone depleting blowing agent
- Absorbs water/ requires facing
- R-value: 6 to 6.5 per inch

# **Comparing EPS and XPS**

 Standardized tests show XPS has much lower water absorption, but one study of a below grade installation showed a different result. The takeaway – *carefully research before selecting materials.*



Property	Units	ASTM Test	Type I
Density	pcf, minimum	C303	.90
Thermal Resistance Value (R)	per 3/4" thickness @ 75°F (23.9°C)	C518	2.7
Compressive Resistance 10% Deformation	psi, minimum	D1621	10
Water Vapor Permeance	perm-in; maximum	E96	5.0
Water Absorption	% by volume max	C272	4.0

Property	Units	ASTM Test	Type I
Density	pcf, minimum	C303	1.6
Thermal Resistance Value (R)	per 3/4" thickness @ 75°F (23.9°C)	C518	3.8
Compressive Resistance 10% Deformation	psi, minimum	D1621	25
Water Vapor Permeance	perm-in; maximum	E96	1.1
Water Absorption	% by volume max	C272	.1

Images: guardianexts.com; globenewswire.com

## **Phase Change Materials**

- Store thermal energy via the latent heat of phase transitions
- Buffers thermal swings in buildings
- Stores solar thermal energy for short-term or seasonal applications



Image: sciencedirect.com

# Systems Built Components: Reimagining the Process

#### Time!

- Engineered or "Manufactured" Off-Site Construction
- Local Labor/Trades/Material Suppliers
- Local Trade School Engagement
- Potential of Utilizing Local Facilities
  - Allows for expansion of market
  - Local lenders/appraisers

Prefab/Modular Largest growth segment in housing market

## Panelized, Systemic Construction



#### Time = Money! Enclosed and Insulated < Week

Images: sips.org

## Modular/Volumetric

- Highest Growth Segment of the Housing Market
- Non-chassis based
- Can be custom built
- Built indoors/climate controlled
- Higher quality control
- Inspected by ICC or other 3rd party
- Very cost competitive



Image: nashuabuilders.com

## Modular/Volumetric

## Gaining single family market share

## REALLY gaining multifamily market share



Image: bonestructure.ca; columnandbeam.com

# Cutting Edge Windows: Thin Triple Pane and Vacuum Insulated Glazing



Image: eta.lbl.gov



Image: agc-glass.eu

#### Thin Triple Pane

- Lighter than standard triple pane
- Adds strong, thin, nonstructural center pane
- As high as R-8 (standard double pane is R-2 to R-4)

#### Vacuum Insulated Glazing

- Very thin vacuum gap 1/10 mm!
- Clear structural spacers maintain gap
- Thinner than standard double pane
- Could be as high as R-14

# Window Technologies – Dynamic Glazing

Any fenestration product that has the fully reversible ability to change its performance properties, including U-factor, solar heat gain coefficient (SHGC), or visible transmittance (VT)



Image: dwmmag.com

## **Phase Change Materials**

- Phase Change Materials (PCMs)
- Ability to store heat gains then release stored energy at appropriate time

### PCMs can

- Reduce energy usage
- Increase thermal comfort
- Smooth out temperature fluctuations throughout the day and night
- Help reduce and/or shift in peak loads

# **High Performance HVAC**

High Efficiency Furnace

- 98 AFUE
- Variable Speed Motors
- Heat Pumps
  - As much as 400% efficient
  - Cold Climate Heat Pumps
  - Mini-Splits
  - Geothermal Heat Pump





Image: catamountsolar.com



Images: oldhouseonline.com

# High Performance Air Conditioning

## Condensing Unit

Variable speed

## Performance Levels

- 13 SEER required by code
- 14.5 SEER = EnergyStar
- Units over 20 SEER are available
- Tighter envelope increases efficiency
- Advancements in Technology
  - National Renewable Energy Lab (NREL) is developing an air conditioner with integral phase change materials!



Images: bobmims.com

## **High Performance Water Heating**



Image: tankleswaterheaterhub.com

#### **Tankless Water Heater**

- Gas or electric
- 24% to 34% more efficient in low use homes (<41 gal/day)</li>
- 8%-14% more efficient in high use homes (~86 gal/day)
- Higher initial cost but offset by longer life and lower maintenance



Image: energy .gov

#### **Heat Pump Water Heater**

- Typical efficiency factor (EF) of 2.0-3.0
  - Typical gas fired EF is 0.5-0.7
- Can be efficiently combined with geothermal heat pump system
- Install in tempered space (40°-90°F)
- · Fairly new to the market

## System Technologies & Management

## Rapid growth

- According to some estimates there will be 63 million smart homes in U.S. by 2022
- Mainstream use
  - 86% of millennials would pay more for a smart home
- Lower costs
  - System management
  - Appliances
- Competition!



Image: home.howstuffworks.coma

#### Systems Commissioning and Completion Requirements Section C408

- Commissioning is critical to ensure that buildings are working as designed
- Preliminary and final reports required
- Mechanical and lighting commissioning detailed in section C408



Benefits of Commissioning

## EV Ready and EV Capable

- EVs are growing fast and quickly becoming cost competitive
  - Estimated to be cost comparable by 2023

### ► EV Ready:

- Capacity on the electrical panel for at least a 40 amp, 240V dedicated branch circuit.
- Conduit pre-installed
- Level 2-ready outlet installed



Image: Verdatek Solutions

# EV Ready and EV Capable

#### EV Chargers

- Level 1 EVSE Charging through 120V AC plug
  - Adds 2-5 miles of range per hour of charging
  - No special equipment, but does require dedicated branch circuit
- Level 2 EVSE Charging through 240
  V AC plug
  - Adds 10-60 miles of range per hour of charging
  - Requires special charging equipment and dedicated electrical circuit of 20-100 amps
  - More expensive than Level 1
- EVs can also serve as a home battery in the future



Images: tesla.com; wsj.com



## Solar

- Solar-ready homes: Same design considerations as a home with solar. Panels to be added later.
- Solar installation:
  - Best perform on south facing roofs, with 15-40 degree slope
  - Ensure roofing materials can support panels and a racking structure
  - Electrical panel installed to handle the load, and wiring to connect to solar panels



Image: Homedepot.com

## **Energy/Battery Storage**

Growing part of Energy design – AC, DC and hybrid converter systems - 2.5 kW to 10kW Benefits Pair with solar Energy and peak savings Next Step towards a micro grids



# Microgrids

- A small, decentralized group of electricity sources and loads
- Normally operates connected to the traditional grid
- Can "island mode" and function autonomously
  - Resilience benefits
- Saves energy because of the reduced transmission losses
- Saves even more energy, depending on the microgrid's storage capability, power source and other factors



Image: strategicmicrogrid.com

## Grid-integrated Efficient Building (GEB)

- Highly efficient building
- Smart technology
- Two-way communication with the grid



## Carbon

What is a carbon credit?

A carbon credit represents one unit of greenhouse gas (GHG) emissions reduced or carbon dioxide removed from the atmosphere.

Carbon credits can be used to offset emissions.



## Carbon

#### CARBON IMPACTS OF INSULATION



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Carbon impacts data source: Builders for Climate Action - 2019 White Paper "Low-Rise Buildings as a Climate Change Solution", Chris Magwood, 2019; The Low Impact, Energy Efficient, Resilient, Healthy, Cost Effective, Comfortable, Grid Interactive, Place we call Home!



## **QUESTIONS?**

## **Next Week**

► February 28, 6-8 p.m.

Topic: Business Benefits, Marketing, Course Review and FINAL EXAM!

Contact Matt with Questions: <u>matt@verda-solutions.com</u>



# **Upcoming Events**

## Online Energy Code Training

- Nebraska Commercial Energy Code: Air Infiltration, Lighting and HVAC
- Wednesday, March 15, 2023, 10 a.m. 11:30 a.m.

## Energy Codes Collaborative Meeting

- In-person in Lincoln at NDEE
- Wednesday, April 26, 9 a.m. 11:30 a.m.
- Lunch provided
## **SEE YOU NEXT WEEK!**

