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A River of Energy Solutions

Improving Energy Efficiency of the Fifth Wall

Michael DuCharme

Carlisle Construction Materials

Designing for Sustainability

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Dynamic Roofs

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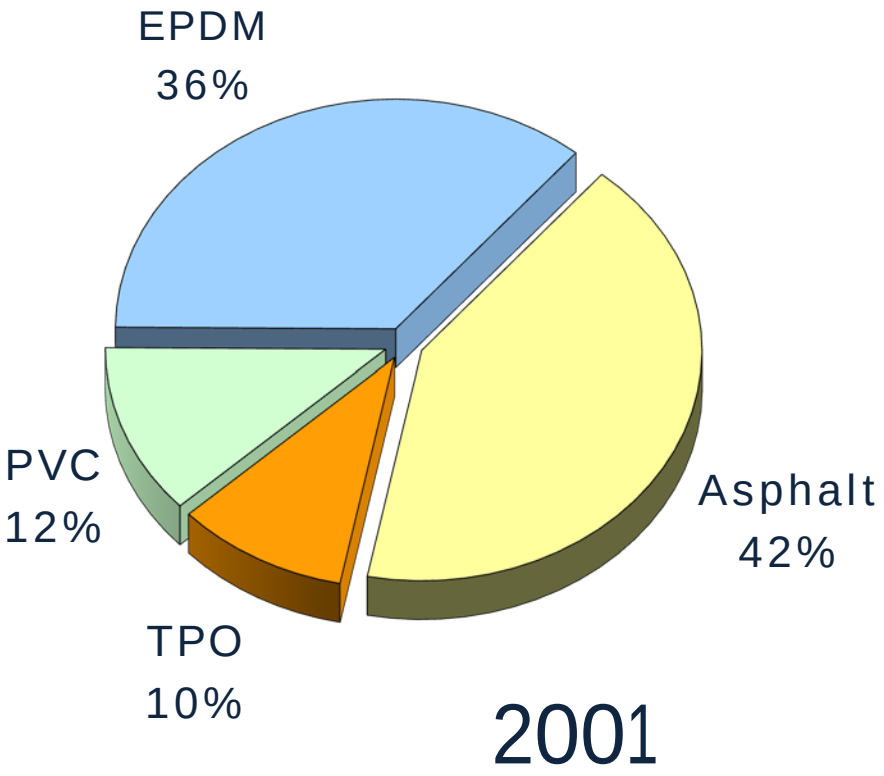
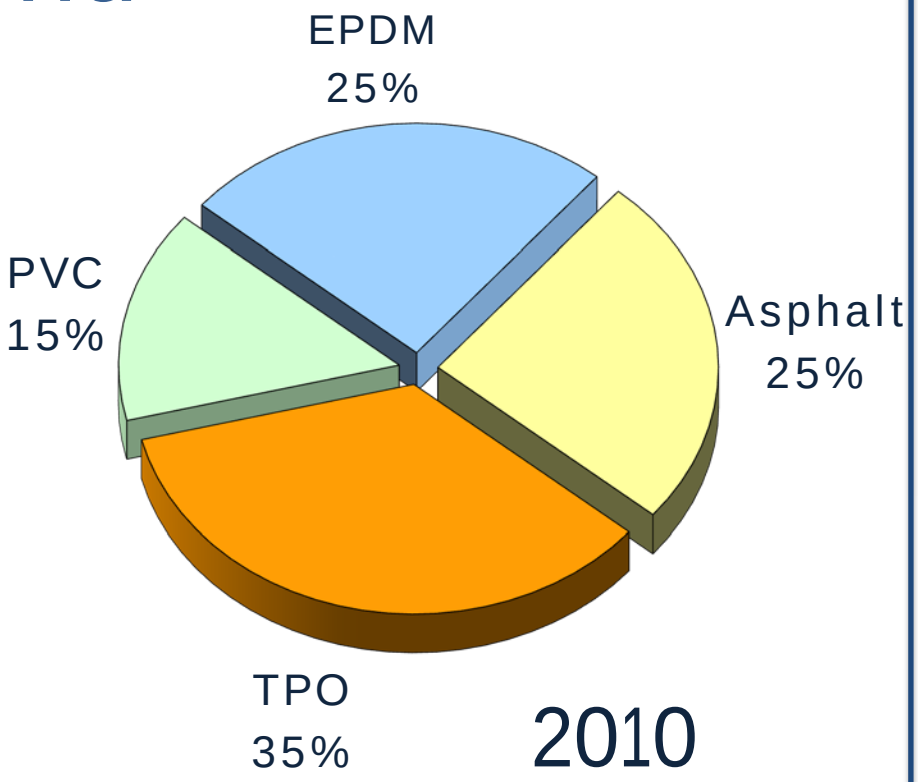
U.S. Low Slope Growth Trend





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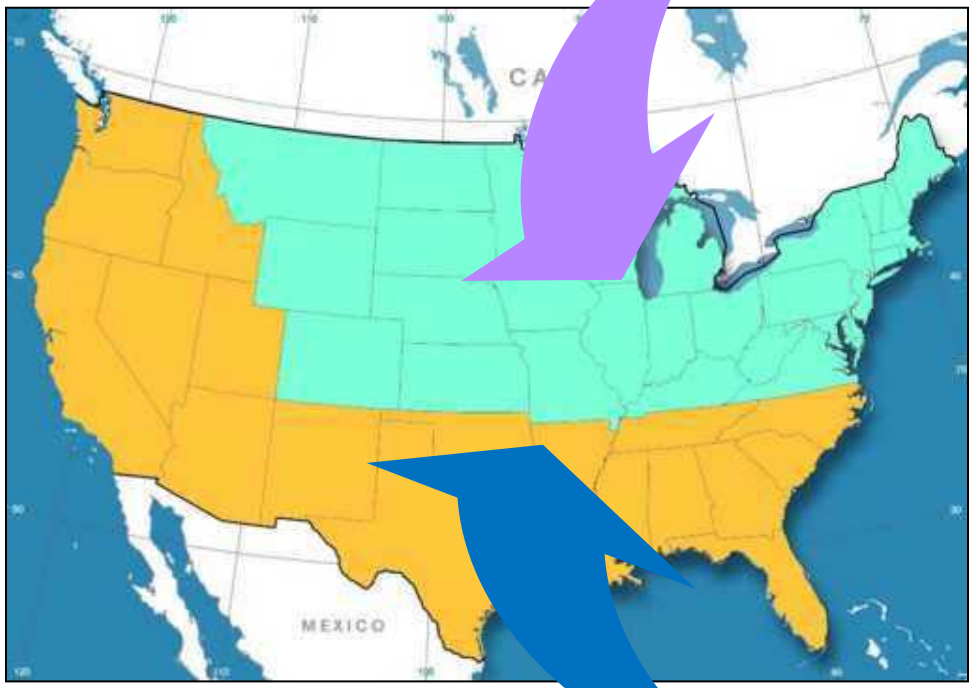
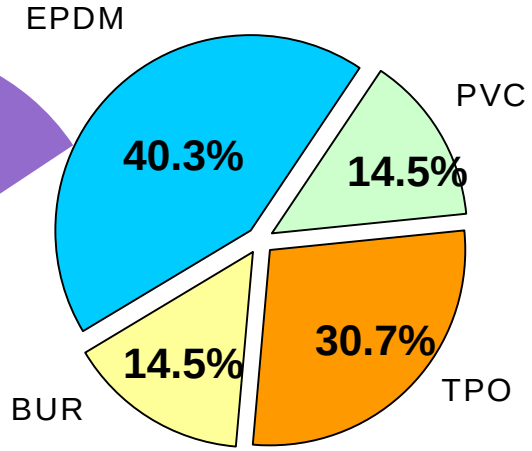
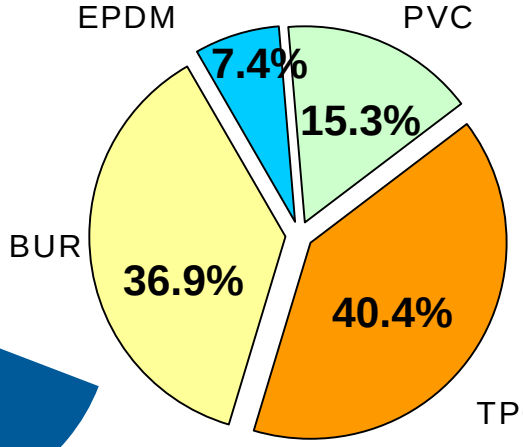
2010 U.S. Regional Trends





Northern U.S.



Southern & Western U.S.

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Black or White!

Making The Right Choice

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Market Trends
Contributing Factors

- LEED
- Cost of Energy
- Air Quality / Heat Island
- Emphasis on Green Construction
- LBNL Research (Lawrence Berkley National Laboratory)

The Ongoing LBNL Research

- Promotes Cooling Energy Savings Potential of Light Colored Roofs
  - Largest savings!!! Non-insulated assembly in Florida
  - Least savings!!! R-19 in Florida
- Heat Island Reduction Strategies

Factors Impacting Energy Performance

- Insulation Levels
- Deflected Heat
- Windows (Solar Gain)
- Mechanical Systems
- Building Internal Loads
- Heating Vs. Cooling

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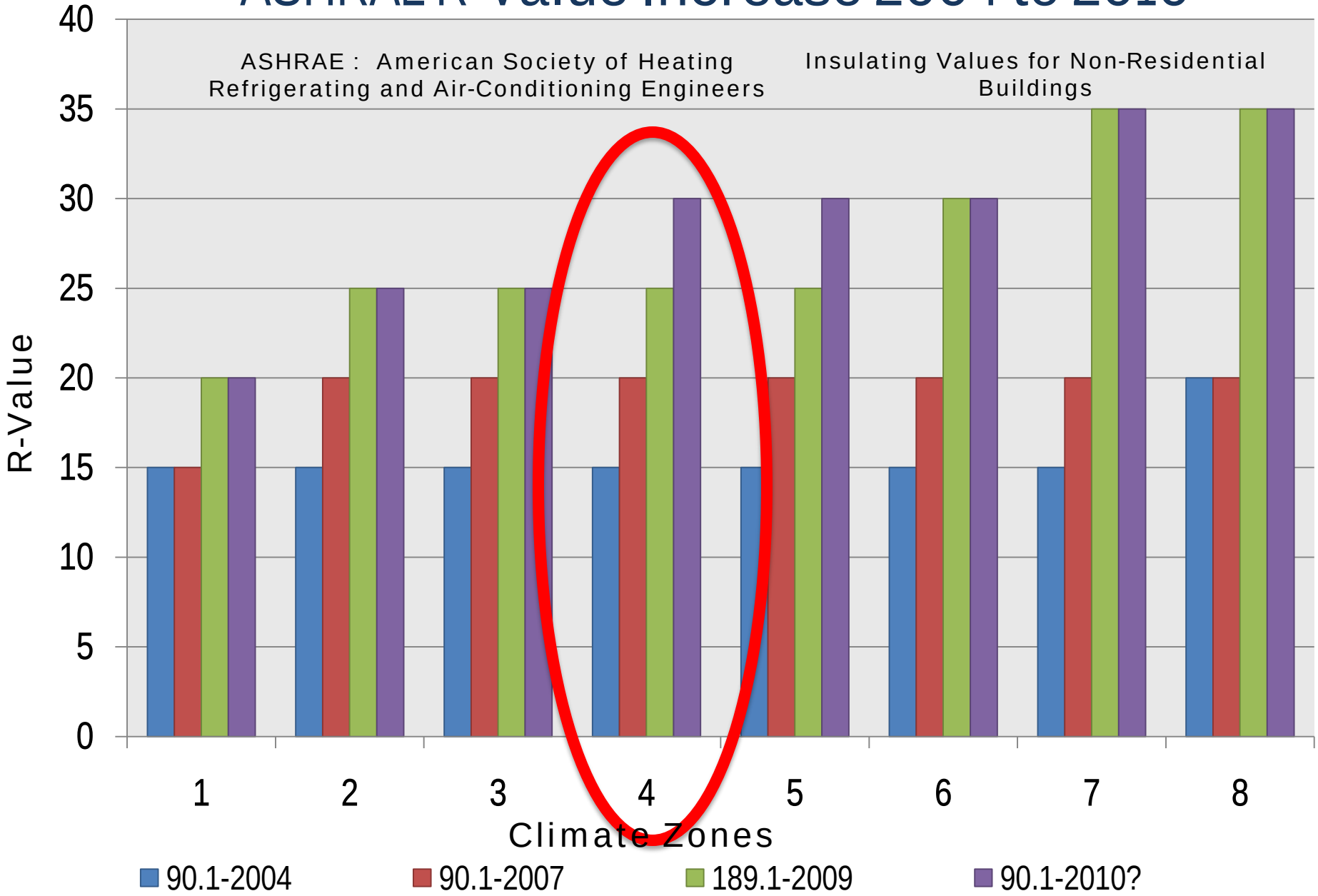
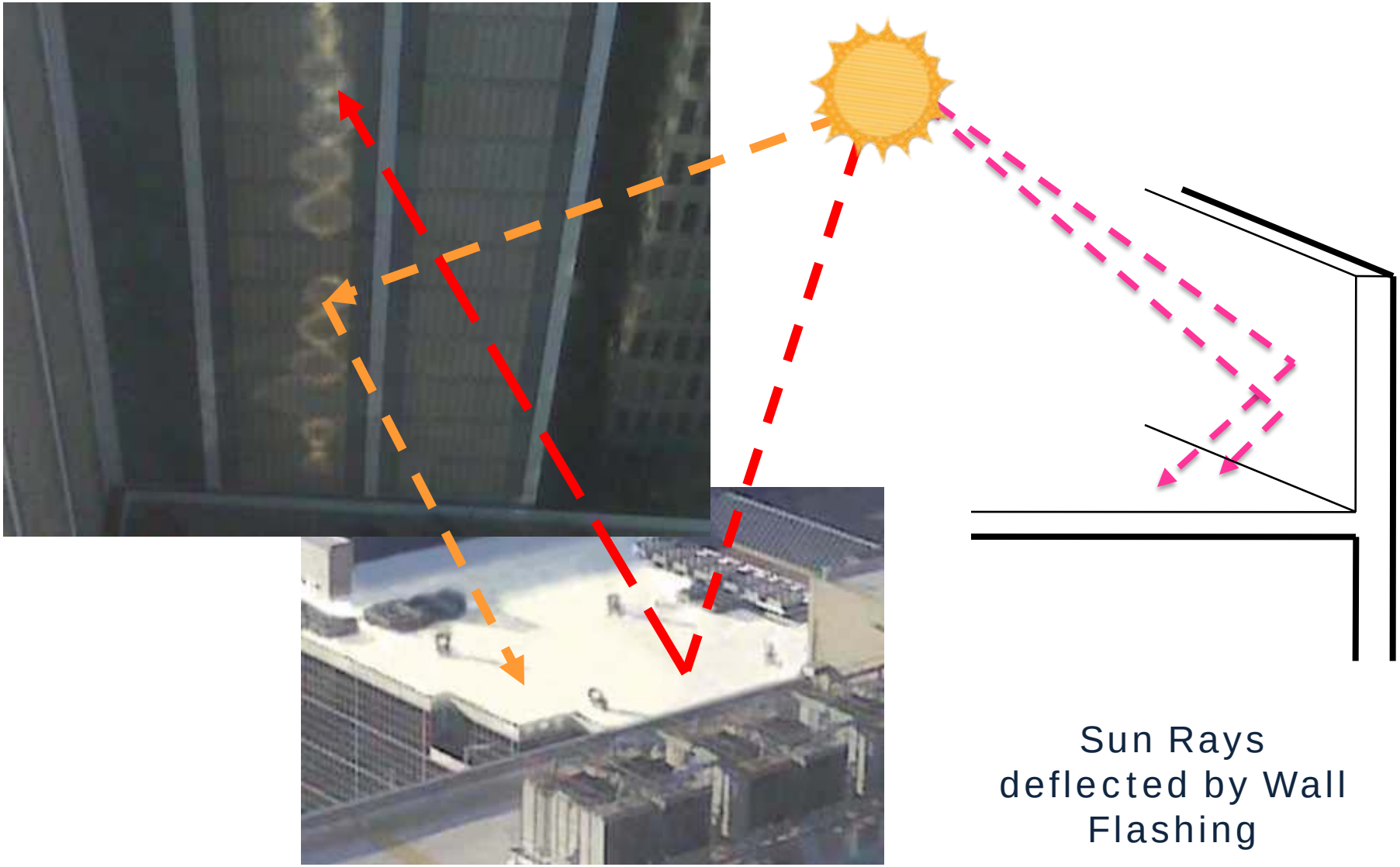
ASHRAE R-Value Increase 2004 to 2010

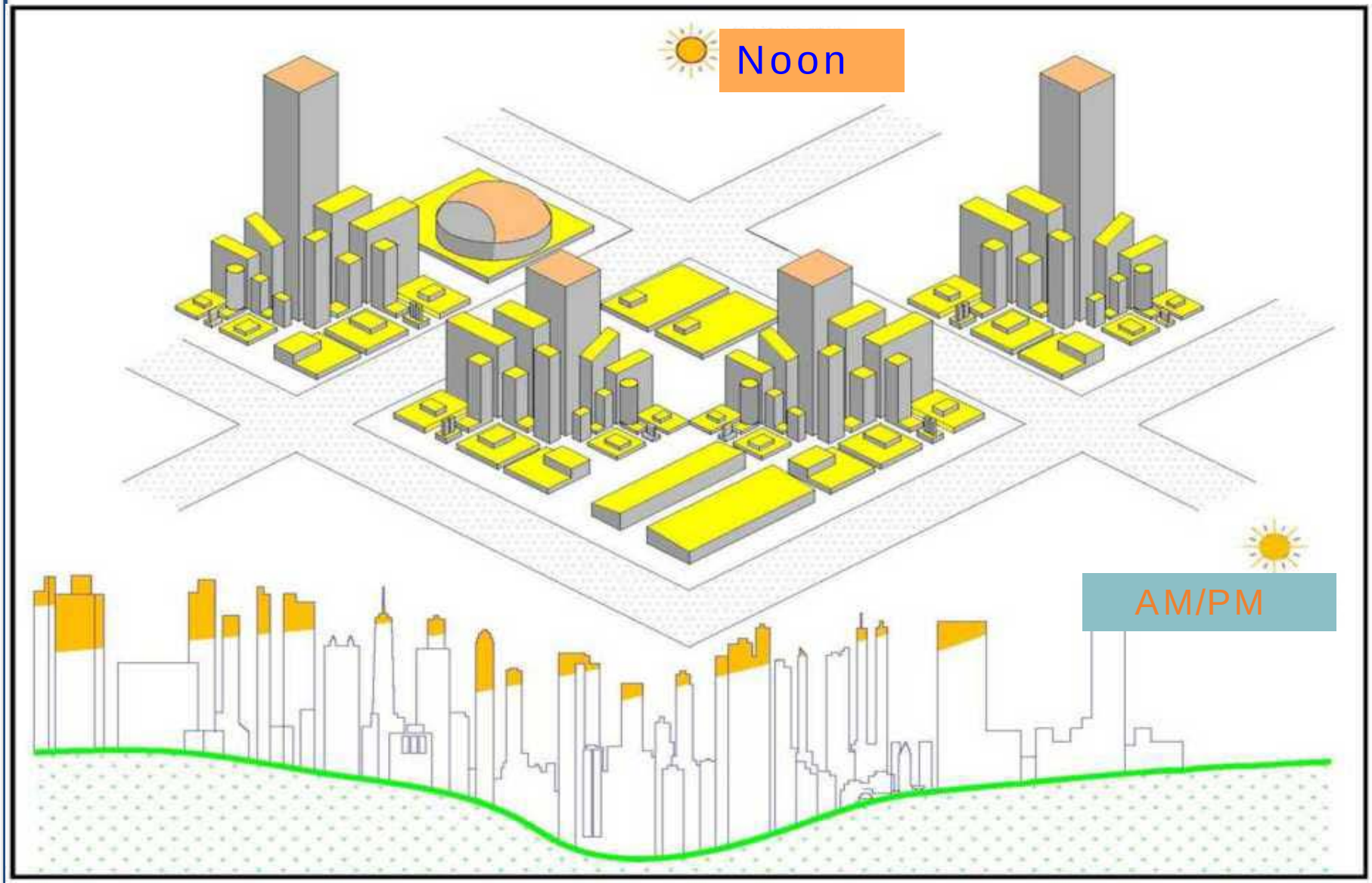


Deflection/ Concentrated UV Loads



Sun Rays
deflected by Wall
Flashing

Sun Angle/ Solar Gain…



Commercial Building-Internal Loads

Component	Loads (quads) & Percent of Totals	
	Heating	Cooling
Roof	12%	1%
Walls (2)	21%	-
Foundation	11%	-
Infiltration	18%	-
Ventilation	15%	-
Windows (conduction)	22%	-
Windows (solar gain)	-	32%
Internal Gains		
Lights	-	42%
Equip. (Elec.)	-	17%
Equip. (Non-Elec.)	-	1%
People	-	7%
Net Load	100%	100%

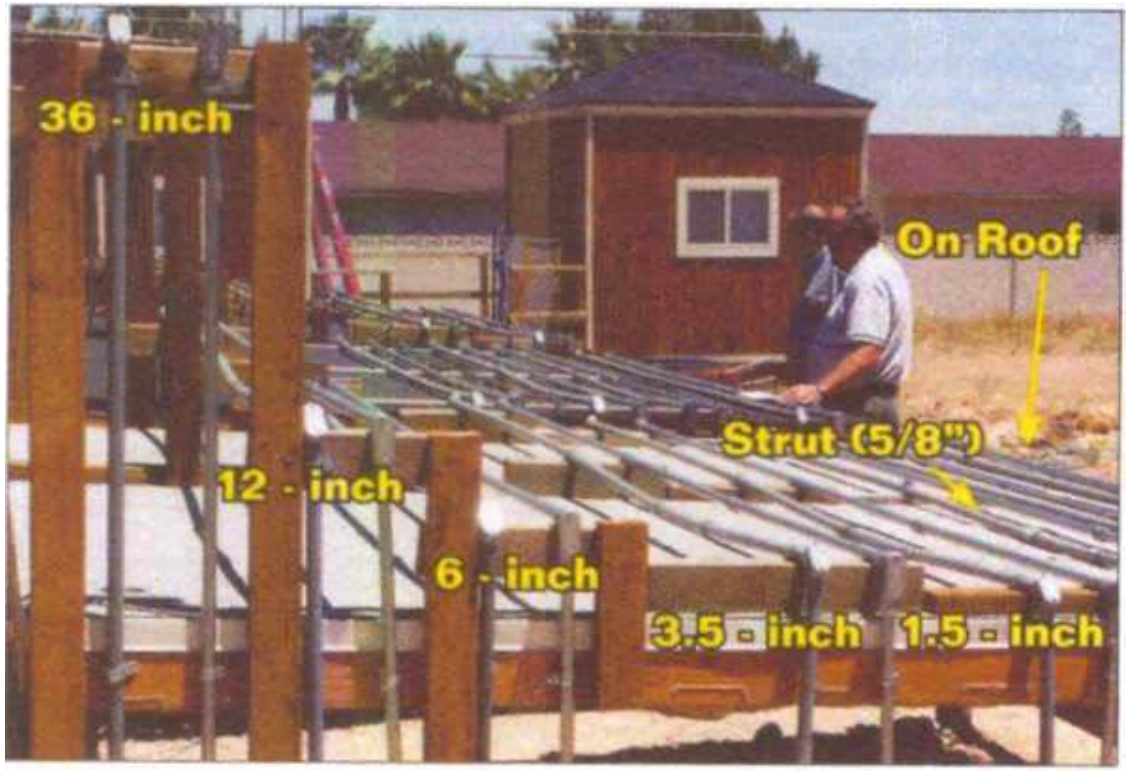
"Loads" represents the thermal energy losses/gains that, when combined, will be offset by a building's heating/cooling system to maintain a set interior temperature (which then equals *site* energy). 2) Includes common interior walls between buildings. Sources: LBNL, Commercial Heating and Cooling Loads Component Analysis, June 1998, Table 24, p/ 45 and Figure 3, p. 61.

CDA 2005 Study

Copper Development Association

International Association of Electrical Inspectors " IAEI "

Published Feb 2006



Effect of Rooftop Exposure on

Ambient Temperatures inside Conduits

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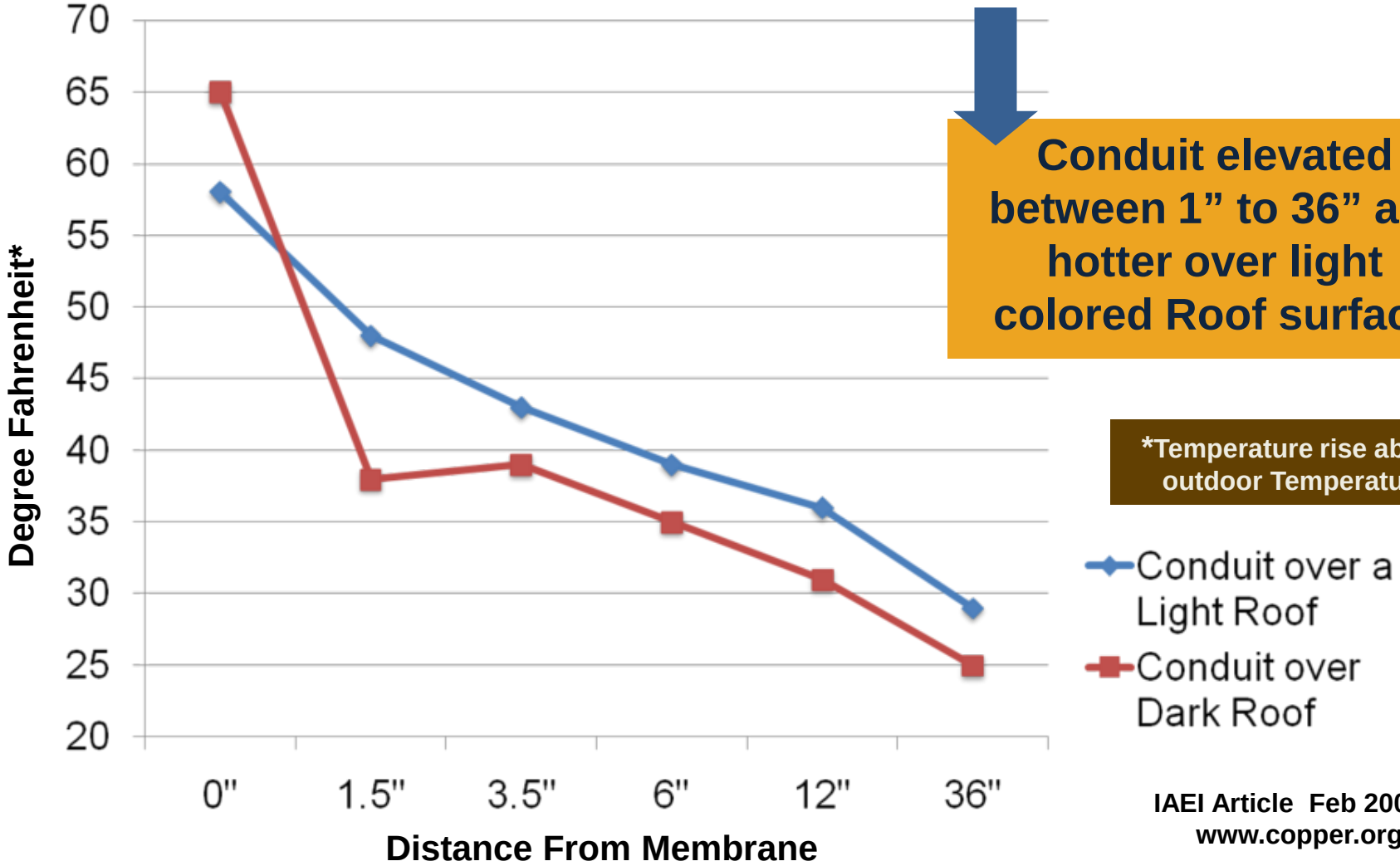
CDA Study Conclusion



Conduit elevated between 1” to 36” are hotter over light colored Roof surface

***Temperature rise above outdoor Temperature**

IAEI Article Feb 2006 – www.copper.org

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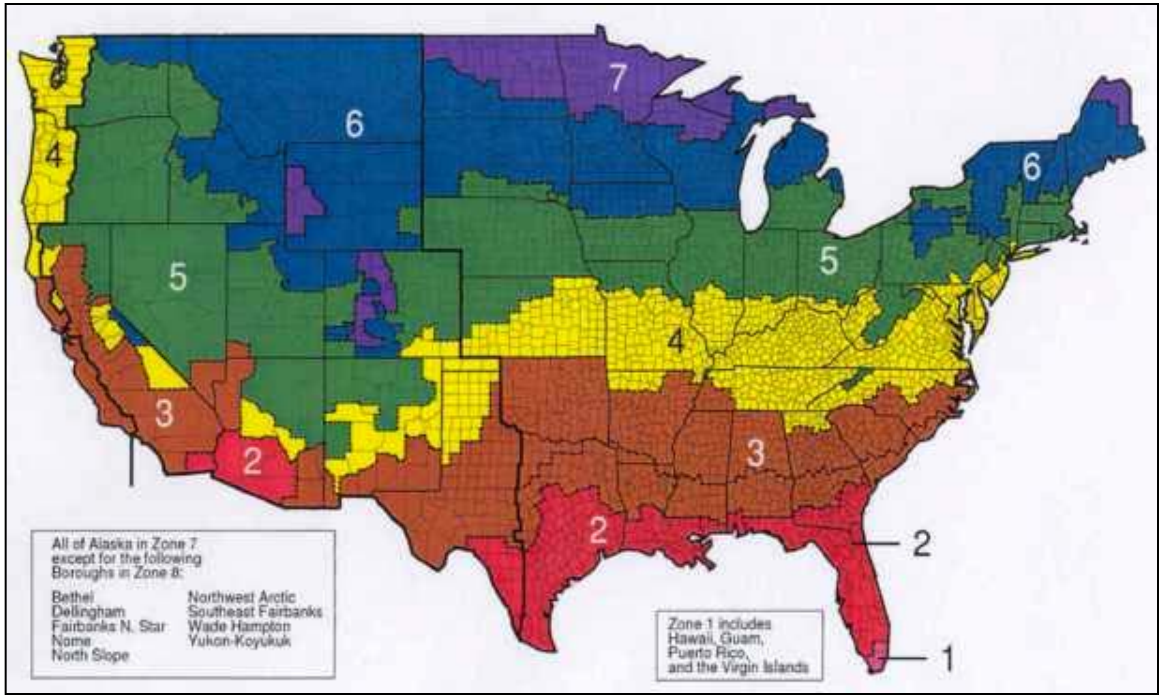
ASHRAE Standard 90.1

Energy Standards for Commercial Buildings

- Updated every 3 years
- Establish Primary Climate Zones
- Establish min. R-Values across the U.S.



ASHRAE 8 Climate Zones

ASHRAE : American Society of Heating Refrigerating and Air-Conditioning Engineers

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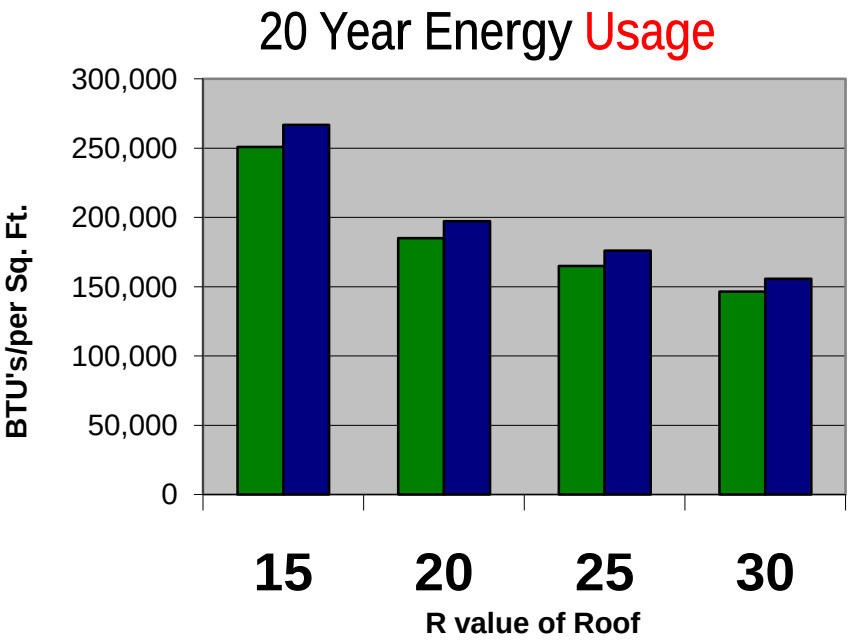
ASHRAE-Heating & Cooling Degree Days

Location	Heating DD	Cooling DD
San Diego, CA	1256	5233
Sacramento, CA	2794	1144
Seattle, WA	4867	127
Norfolk, VA	3489	1439
Philadelphia, PA	5181	1053
Cincinnati, OH	5929	715
Chicago, IL	6450	749
Toronto	7306	1963



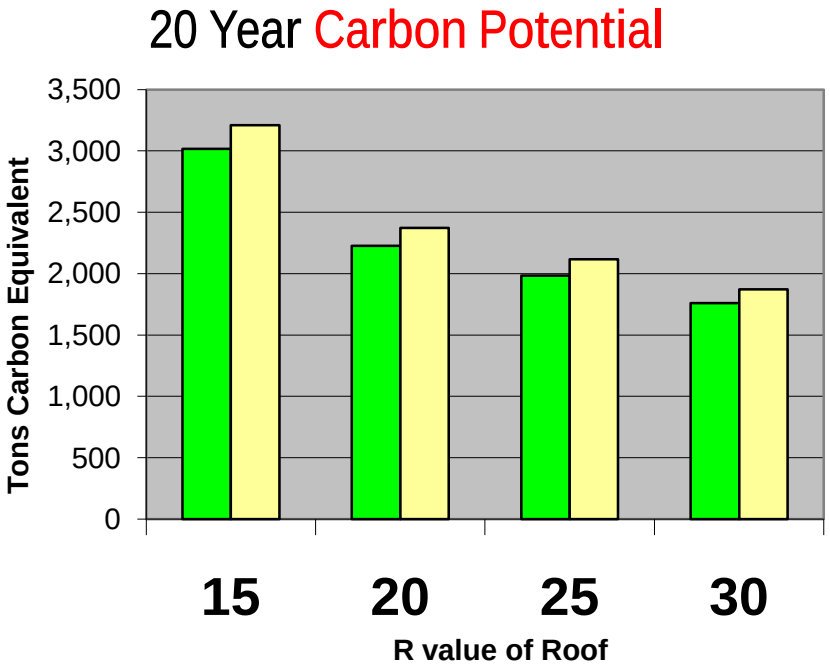
Cincinnati, OH

5929 HDD 715CDD

Based on electric heat

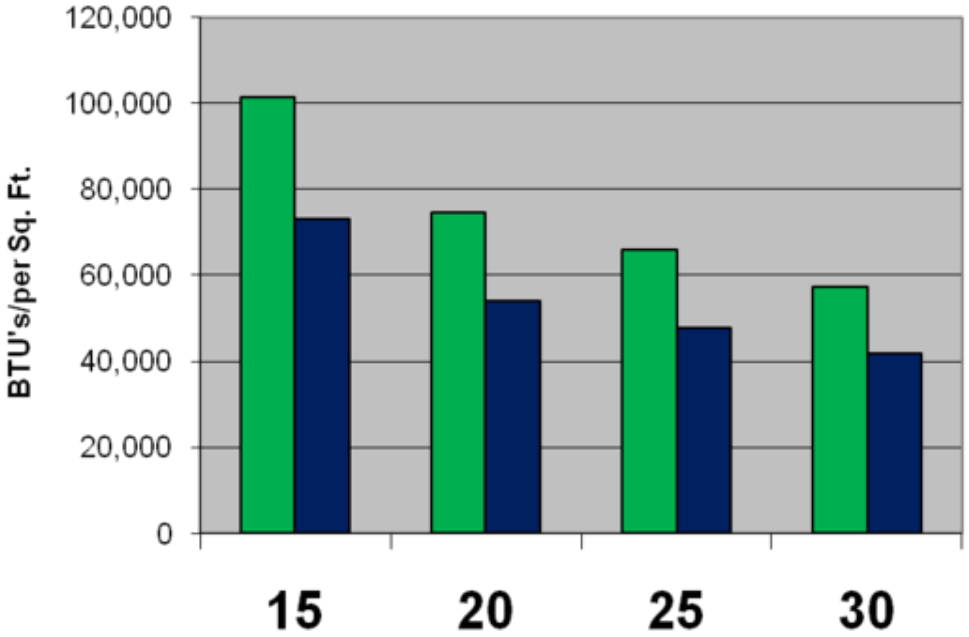
Black Membrane

White Membrane



Corpus Christi, TX
884 HDD 3267 CDD

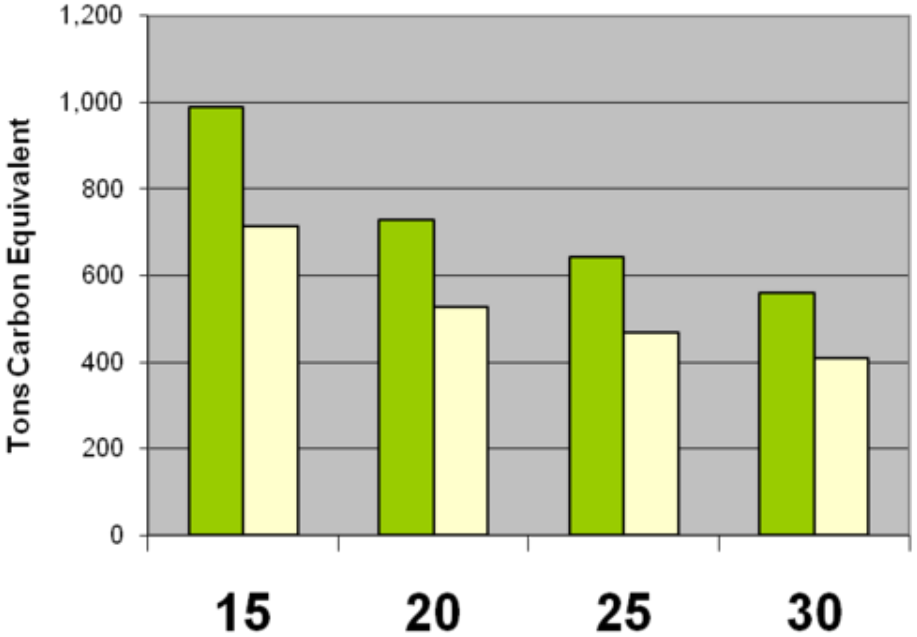
20 Year Energy Usage



Black Membrane

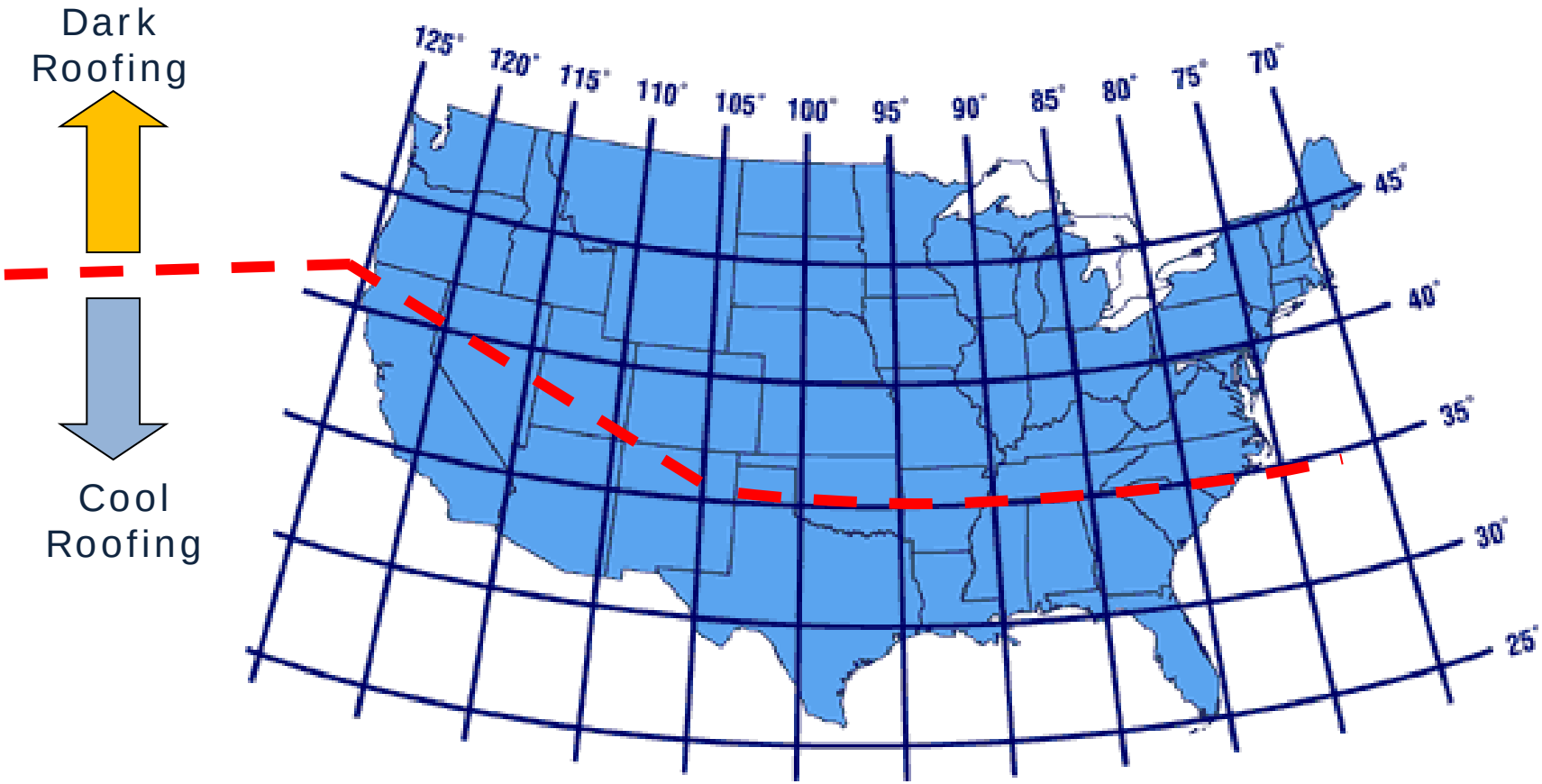
White Membrane

20 Year Carbon Potential



Geographic Locations

Black vs. White Membranes



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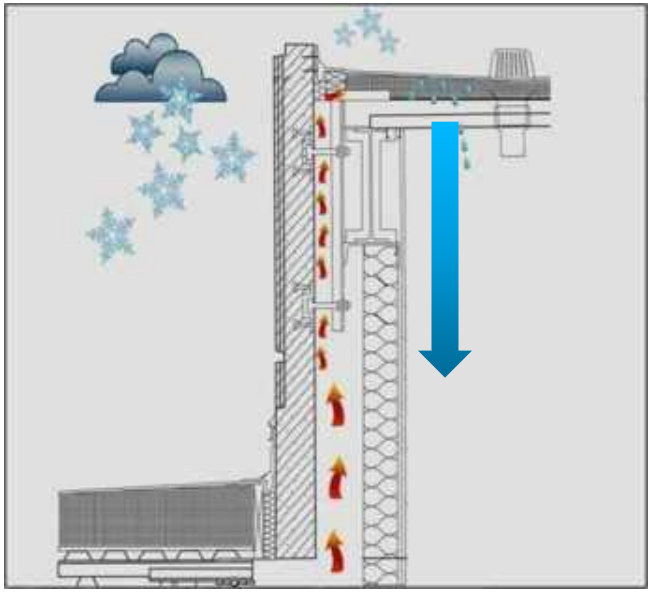
Condensation in Cool Roofing

Cool in the summer = Colder in the Winter

Falls & remains below the dew point frequently.

Diffusion



Warm Air Migration

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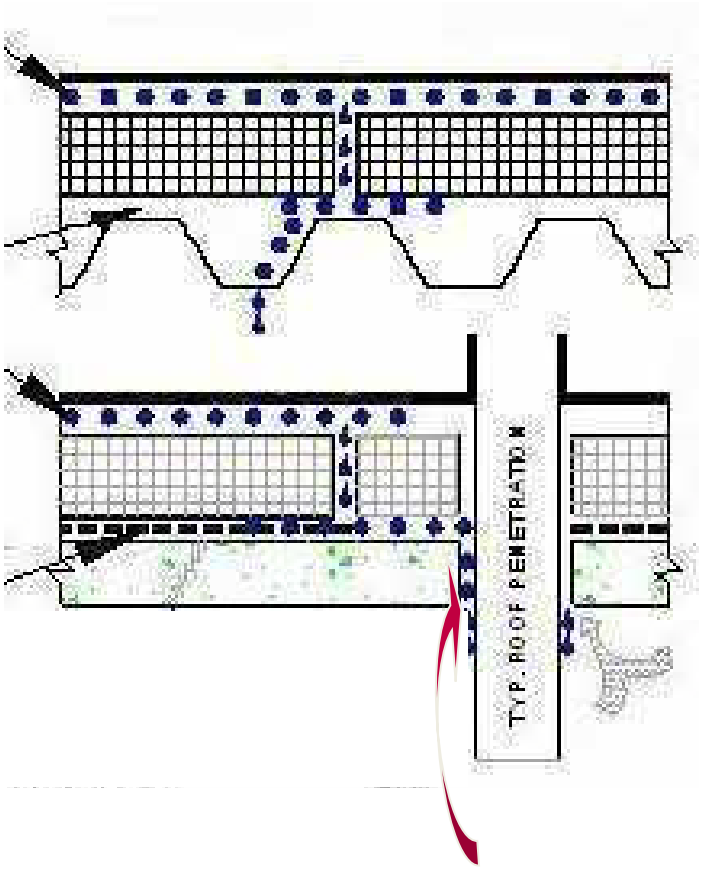
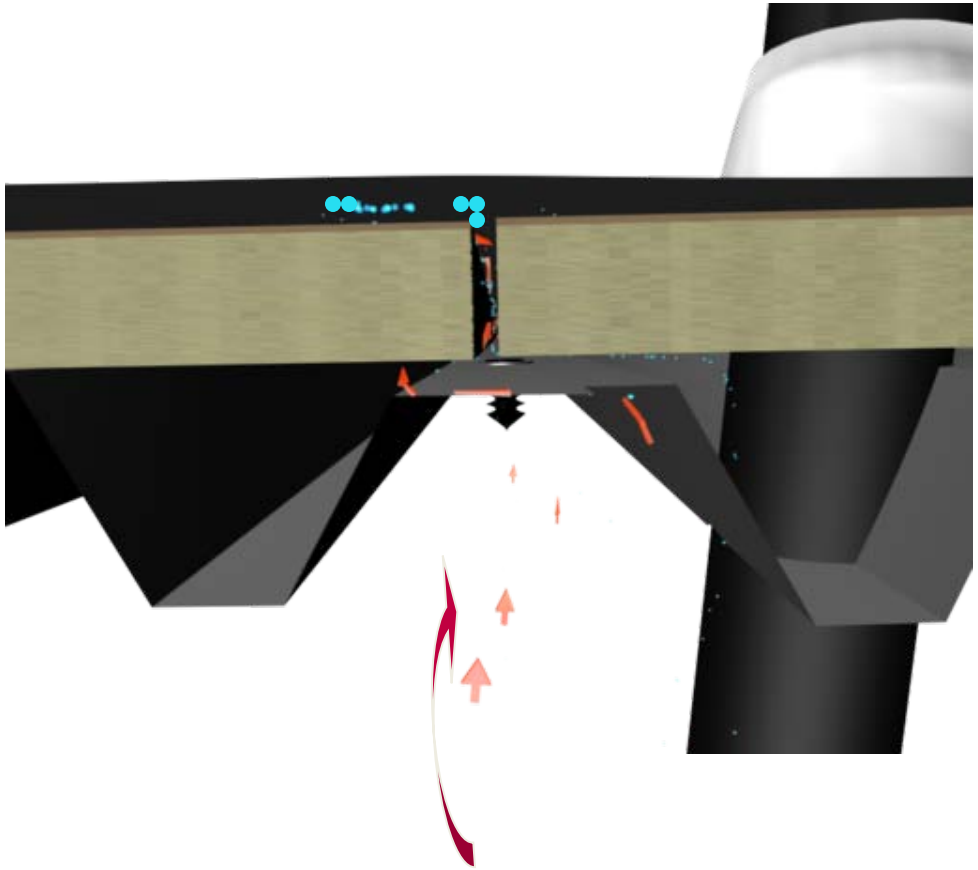
Condensation / Frozen Moisture





White membranes fall frequently below dew point increasing the level of condensing of moisture

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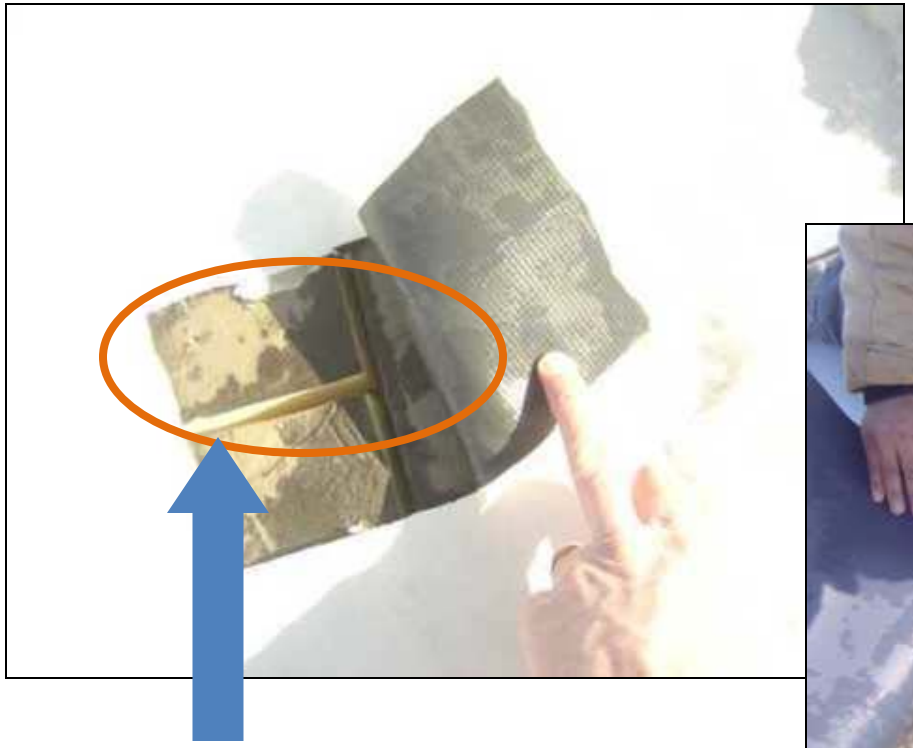
Affects of Condensation



Gaps between Insulation

Wet Facer found beneath membrane

Insulation: Single vs. Multiple Layers

Calculating Energy Losses

ASHRAE Formula: Avg. R-Value = 1 / (% Area A / R-Value A + % Area B / R-Value B)

Gap	Energy Loss
1/8"	10%
1/4"	18%

2005 ASHRAE Handbook of Fundamentals – Chapter 23, Formula #11

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Sustainable Design

- Design "5th Wall" with end use in mind
- Insulate according to ASHRAE Zones
- Determine roof color based on location
  - White membranes – ASHRAE Zones 1- 3
  - Dark membranes – ASHRAE Zones 4 - 8
- Consider use of air / vapor barriers
- Stagger Insulation joints with multiple layers

Carlisle Construction Materials

For More Information

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