C0$_2$ Cap and Trade—The Importance of Energy Efficiency to CO_2 Reduction

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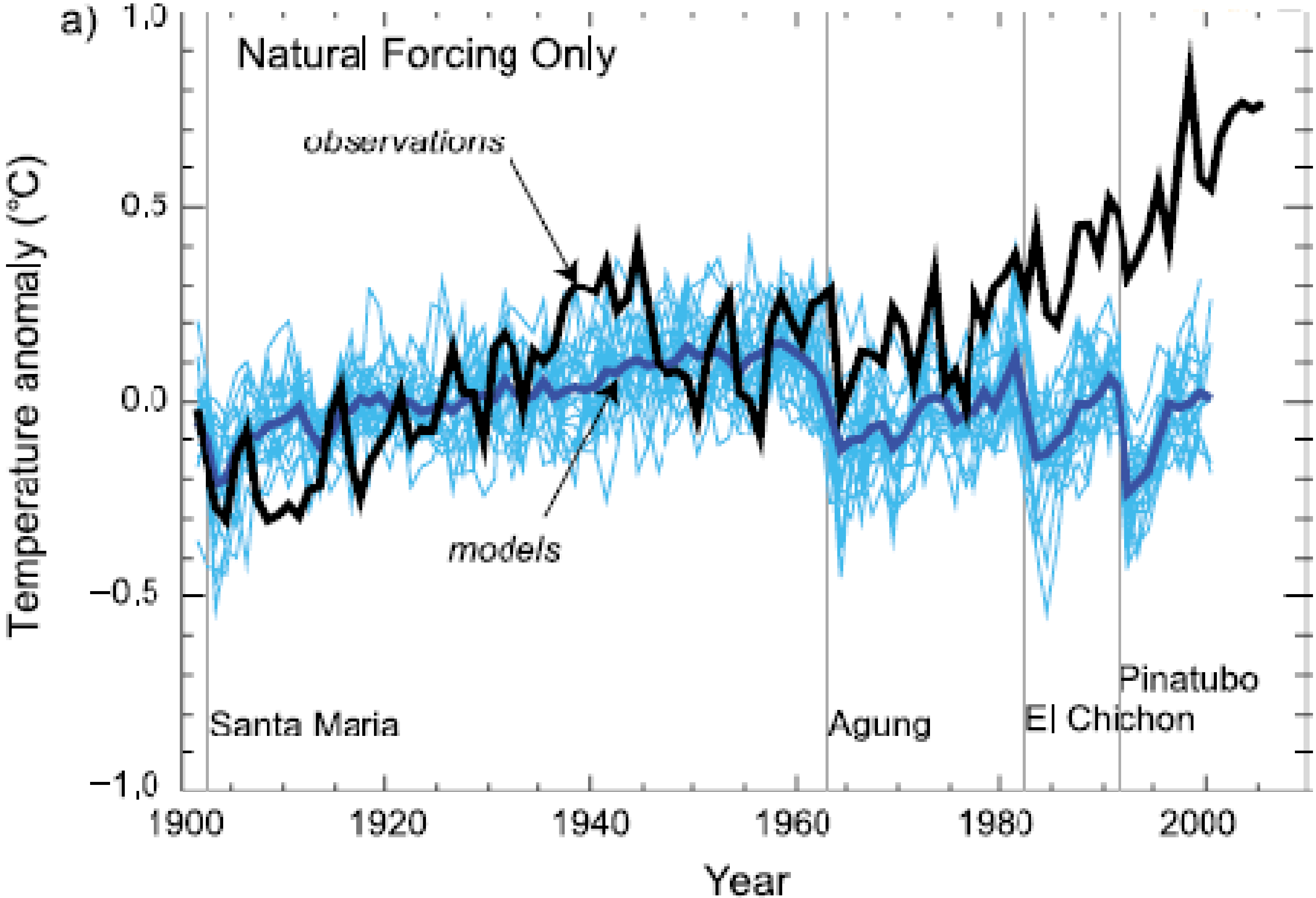
AEI 08
Building Integration Solutions

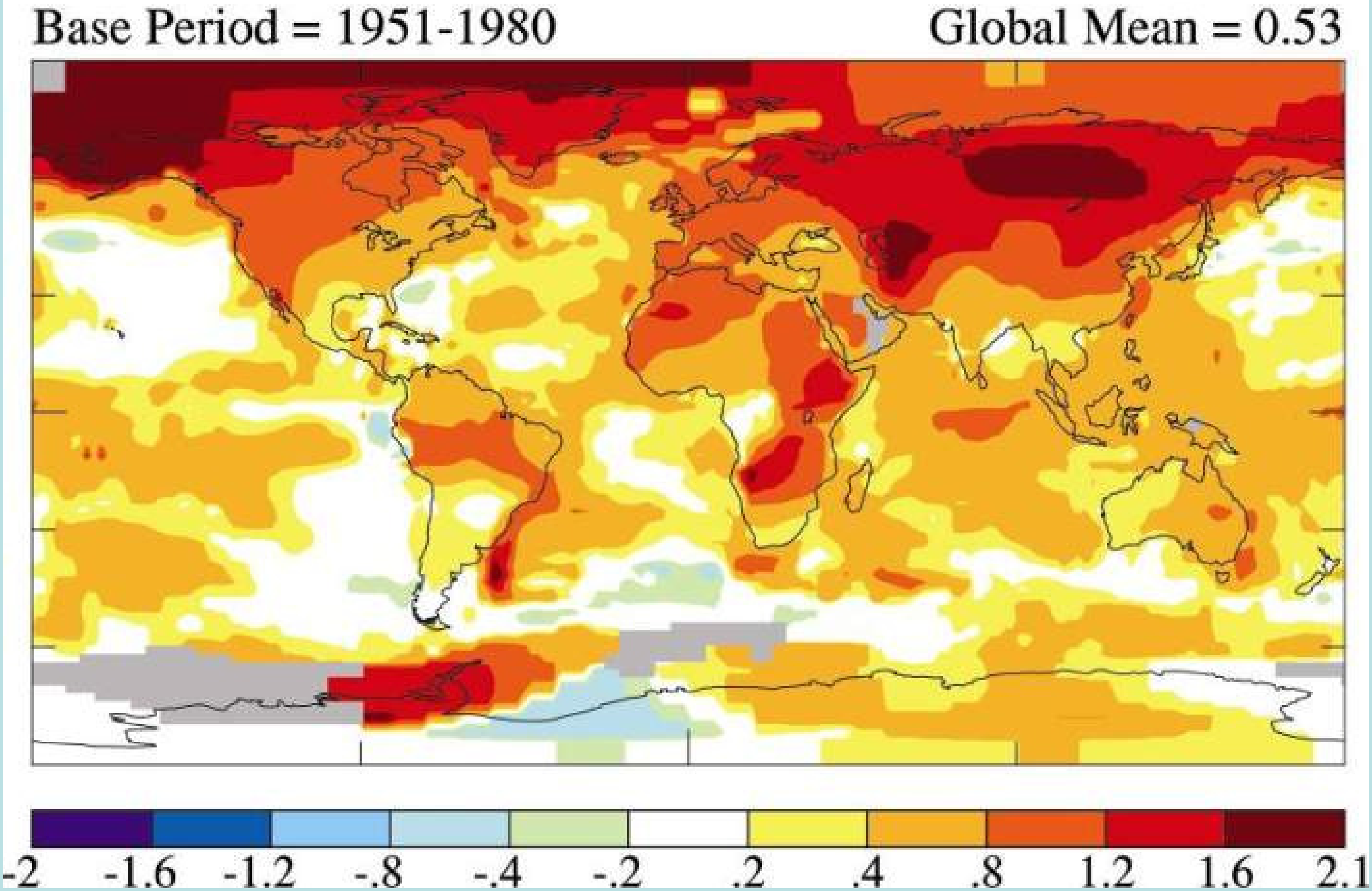
The Argument

- The US and world face enormous challenges from a growing population, economy disparity, rising energy costs, and Climate Change.
- Changes in the building sector offer the fastest, cheapest, and most certain way to meet these challenges
- Cap and trade schemes, while getting most of the attention, rarely include the building sector
- New building technologies, including structural insulated panels (SIPs), have an important role to play in this historic drama



IPCC WG1 2007

Average T in 2001-2005 versus 1951-80 base, °C



J. Hansen et al., *PNAS 103*: 14288-293 (2006)

The Oil Problem

Nations that **HAVE** oil (% of Global Reserves)		Nations that **NEED** oil (% of Global Consumption)	
Saudi Arabia	26%	**U.S.**	**26%**
Iraq	11%	Japan	7%
Kuwait	10%	China	6%
Iran	9%	Germany	4%
UAE	8%	Russia	3%
Venezuela	6%	S. Korea	3%
Russia	5%	France	3%
Mexico	3%	Italy	3%
Libya	3%	Mexico	3%
China	3%	Brazil	3%
Nigeria	2%	Canada	3%
U.S.	**2%**	India	3%

Source: EIA International Energy Annual

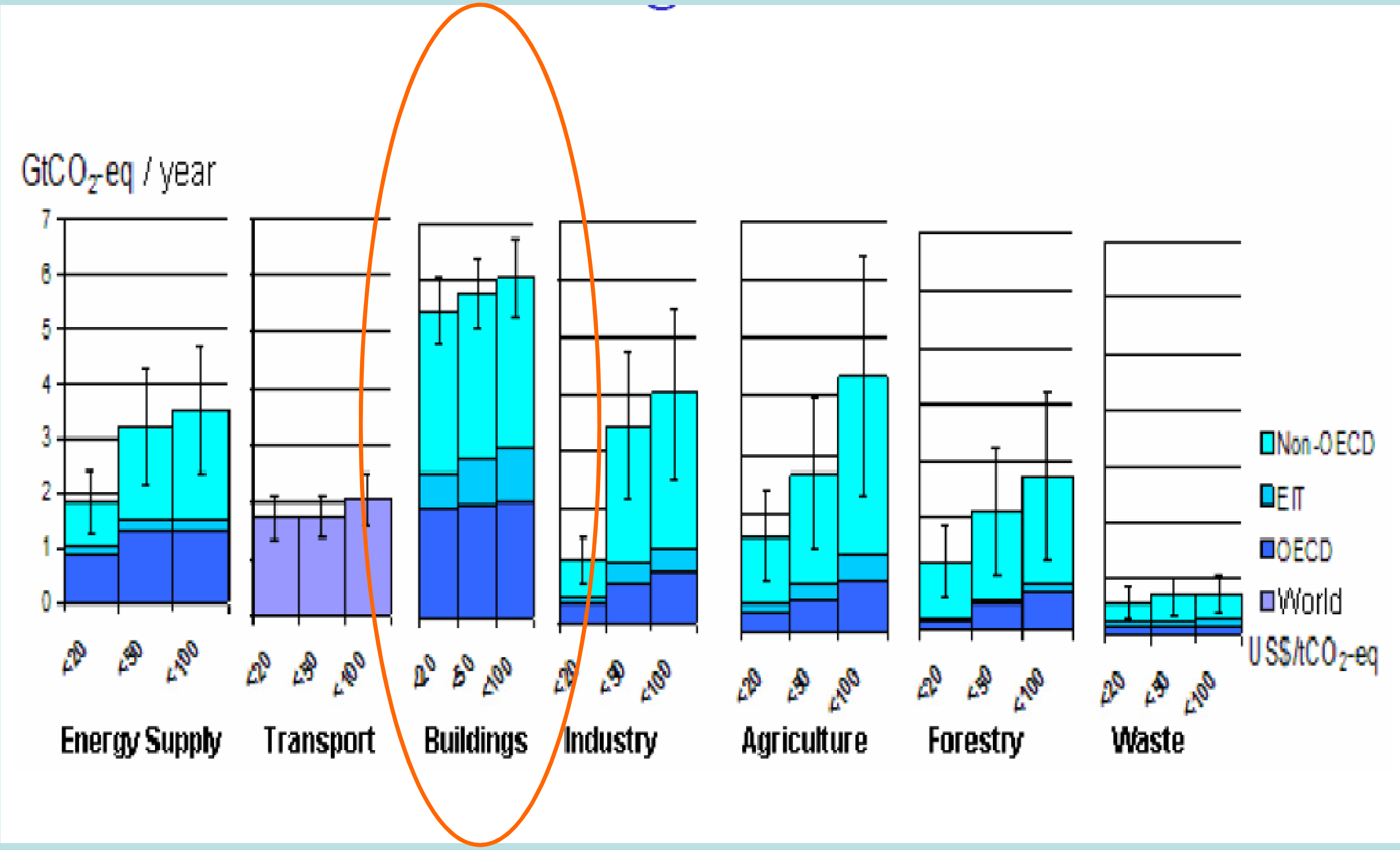
Climate Change Reduction Goals for 2050

John McCain :	70%
Barack Obama:	80%

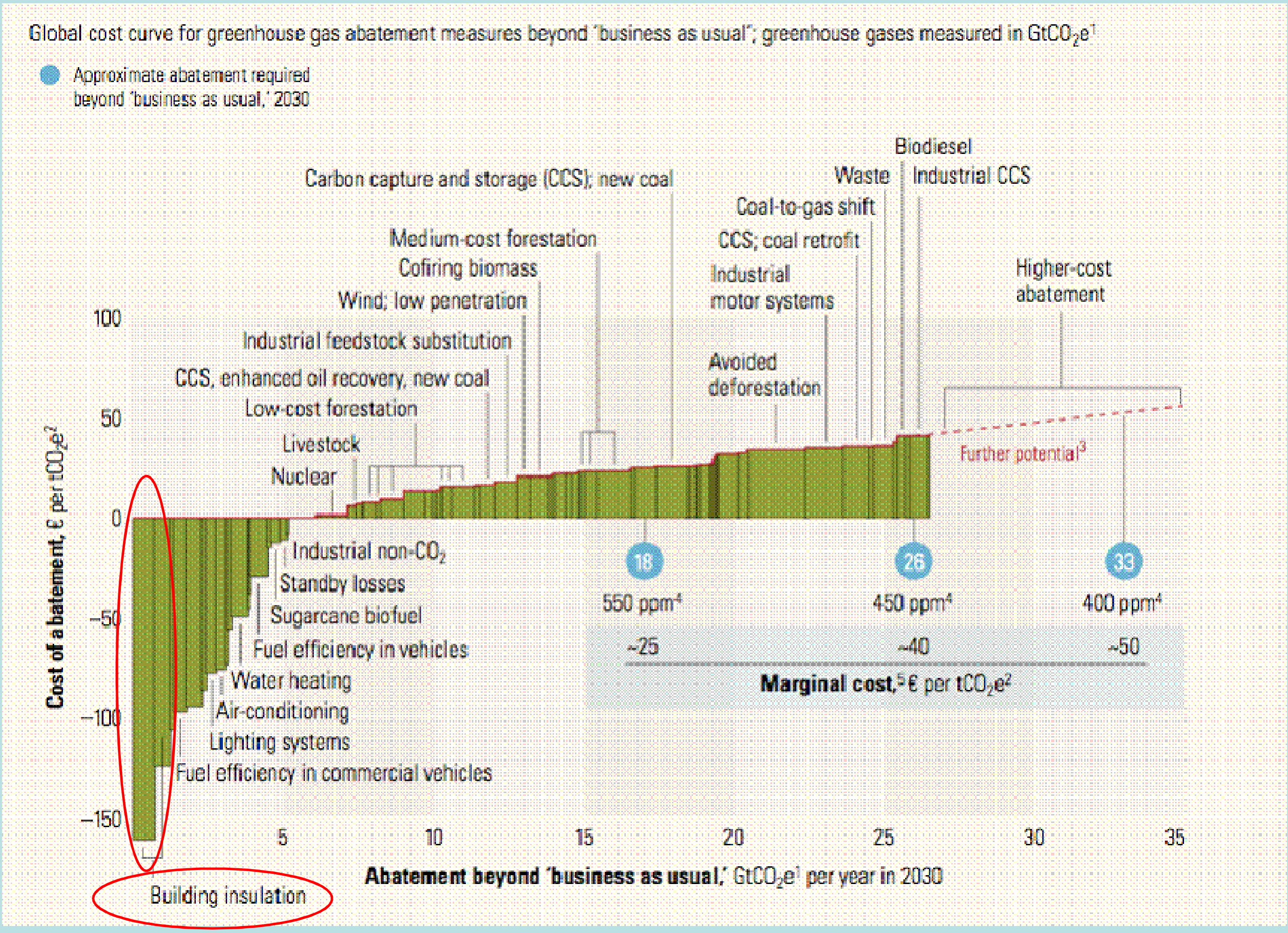
Climate and Buildings

- Buildings are responsible for 1/3 of all energy related greenhouse gas emissions (~68% of electricity)
- Climate change will influence building energy use – more cooling, less heating
- Stabilizing climate will require ~3x reduction in energy use per square meter.

Potential Emission Reductions of CO_2 Emissions



Building Savings Underscored by McKinsey



Mckinsey Report 2007 http://www.mckinseyquarterly.com

Other benefits of building efficiency technology

- Energy imports reduced
- Economic benefits (costs can be lowered)
- Health benefits (indoor air quality– particularly important in developing countries)
- Increased occupant productivity (11% increases measured)
- Increased comfort and occupant control

Design Principles for Advanced Building Technologies

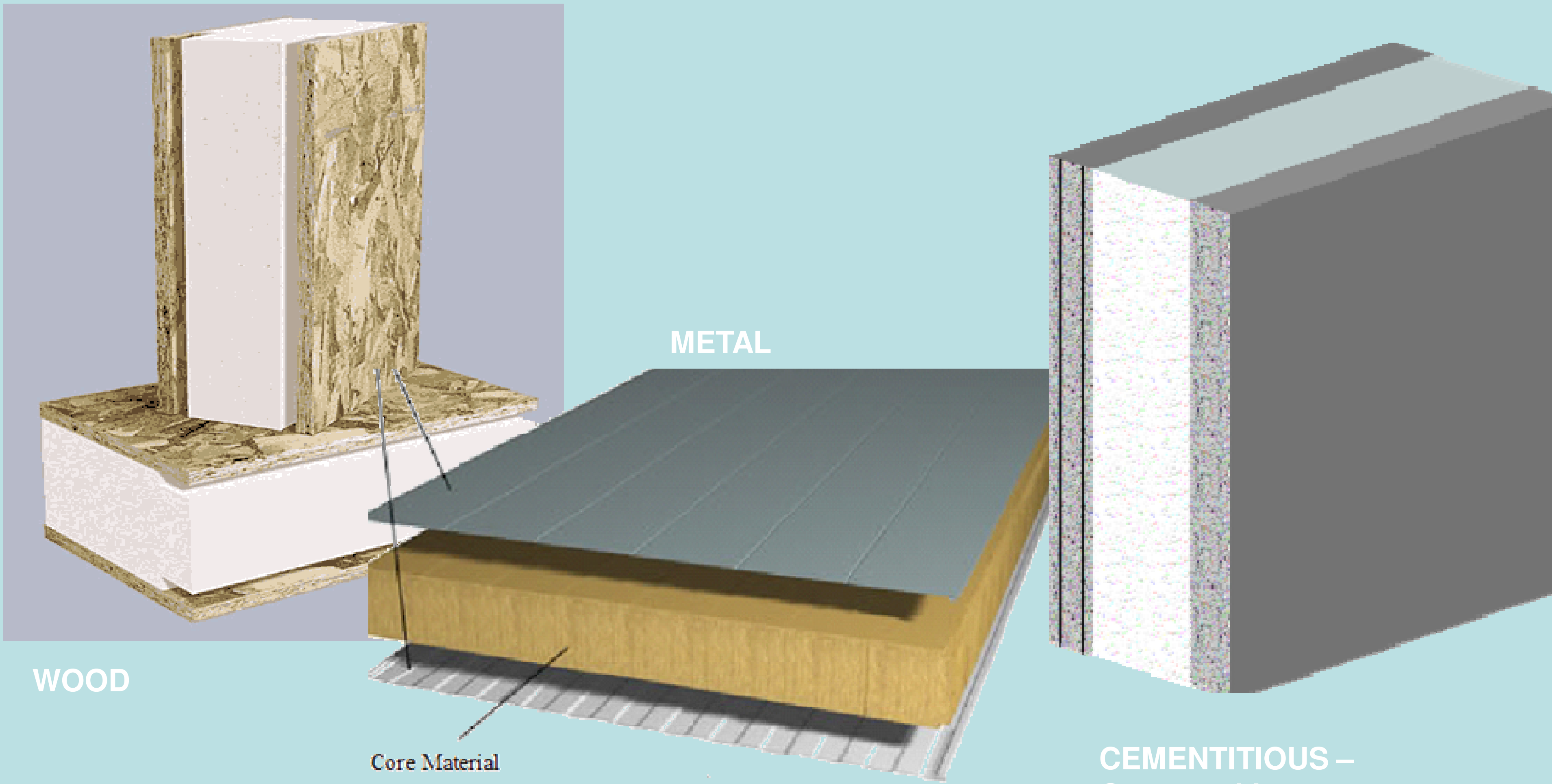
- Energy goals and other design objectives should be part of integrated engineering design:
  - Attractive/flexible designs
  - High energy efficiency
  - Low construction costs/ low maintenance costs
  - Safe for fire, earthquake, strong wind, insects, mould
  - High quality indoor air
  - Accessible
- Ensure reliable performance, quality control
- Proper building commissioning (can save 30% energy)

WHAT ARE SIPS ?

SIPs ARE A COMPOSITE STRESSED-SKIN PANEL WITH AN INSULATING CORE OF RIGID FOAM – USUALLY EPS OR POLYURETHANE – AND “WORKING” SKINS MOST COMMONLY OF 7/16” THICK ORIENTED STRAND BOARD (OSB).

SIPS . ORG

VARIATIONS OF SIPS?



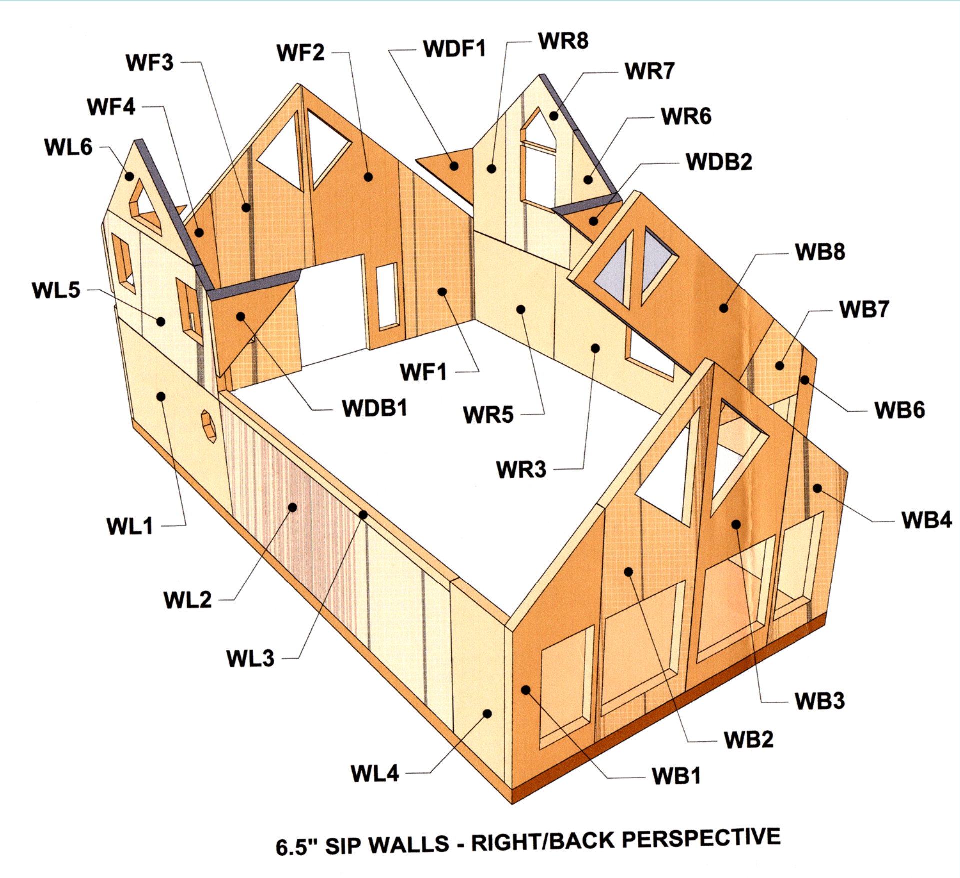
MATURE Technology ← **In DEVELOPMENT**

RIGID FOAM CORE MATERIALS MAY BE:

1. EXPANDED POLYSTYRENE (EPS)
2. EXTRUDED POLYSTYRENE (XPS)
3. POLYURETHANE
4. POLYISOCYANURATE

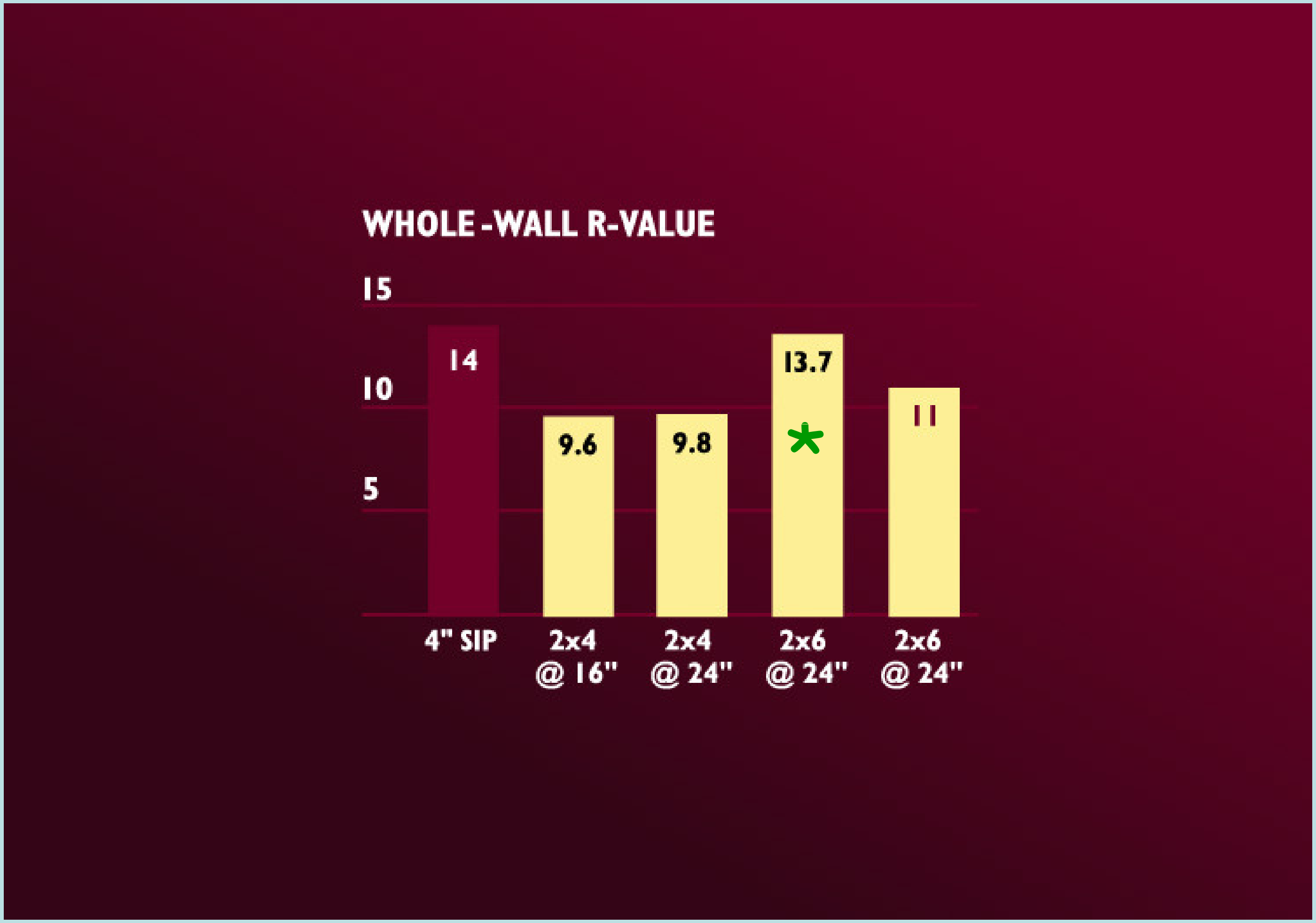
SIPS . ORG

Cut to specific design of structure



Oak Ridge National Laboratory Studies

4" SIP wall out - performs 6" stud wall with R-19 fiberglass



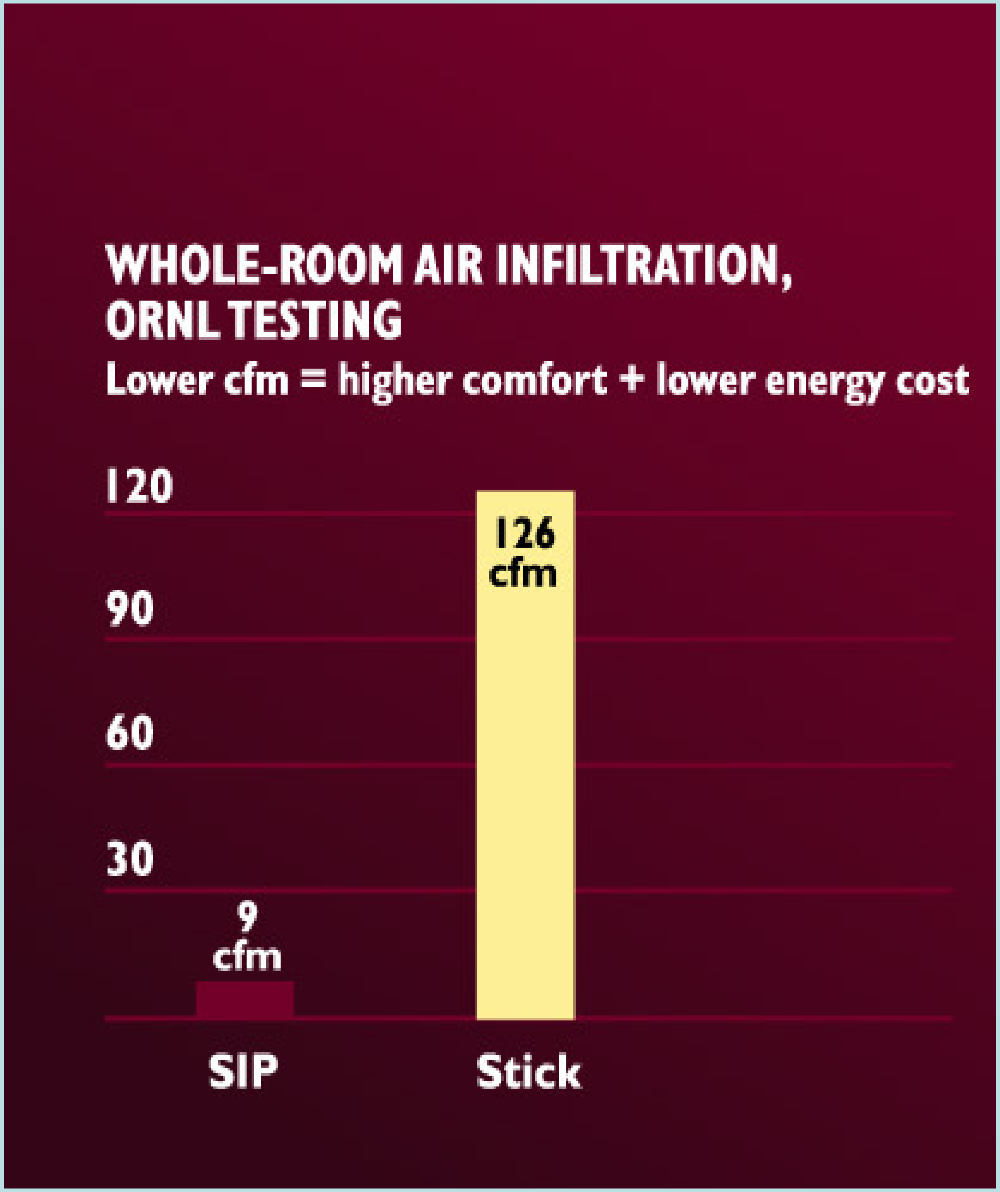
* 2X6 @24" o.c.; with batts with rounded shoulders, 2% cavity voids, no compression around wiring, paper facer stapled to inside of stud

SIPs Save Energy

- Less gaps to seal-
- test room is 15 times tighter than stick built
- 50-70% annual savings over MEC

Framing factor:

3% vs 15-25% stick built



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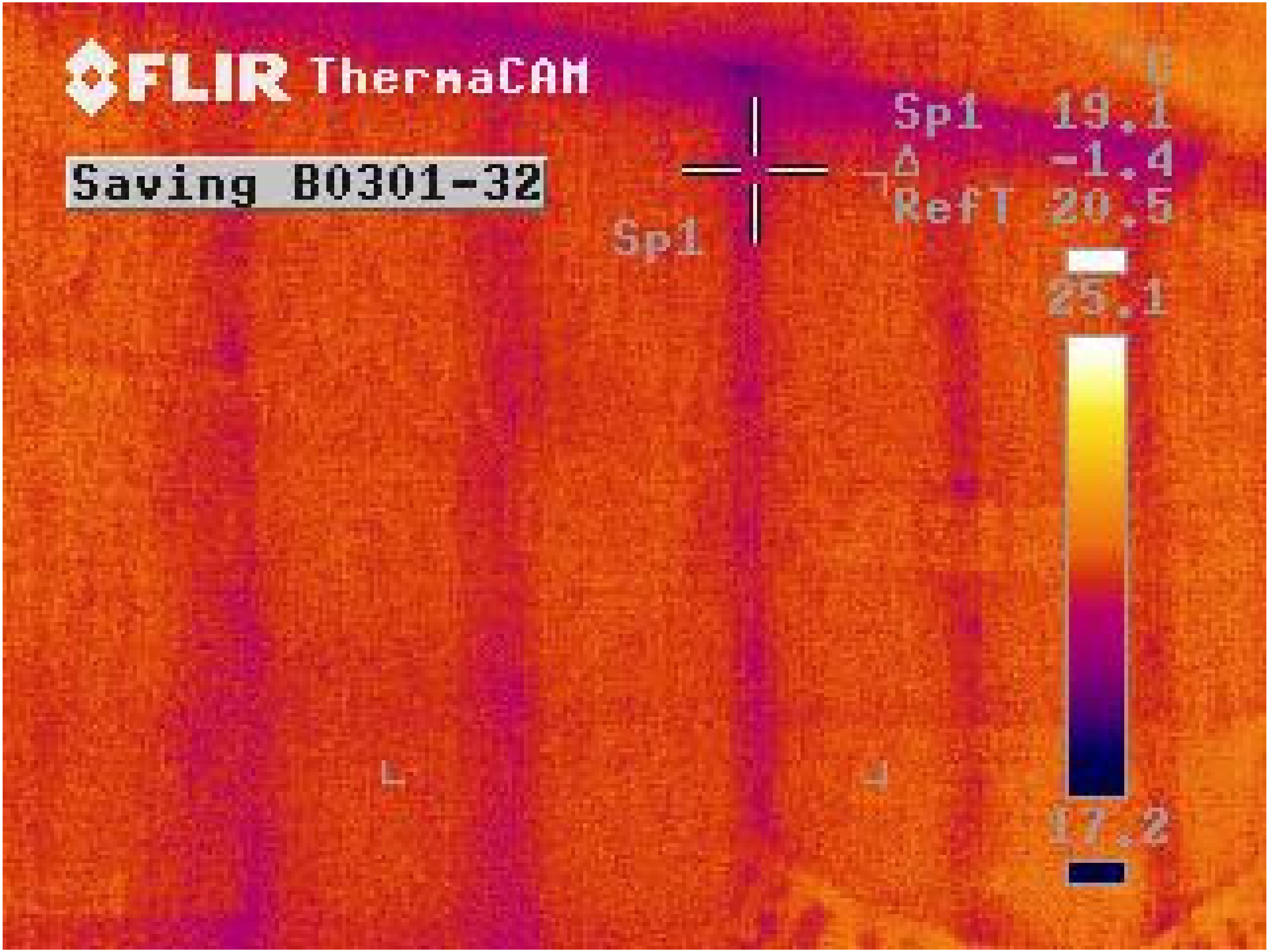
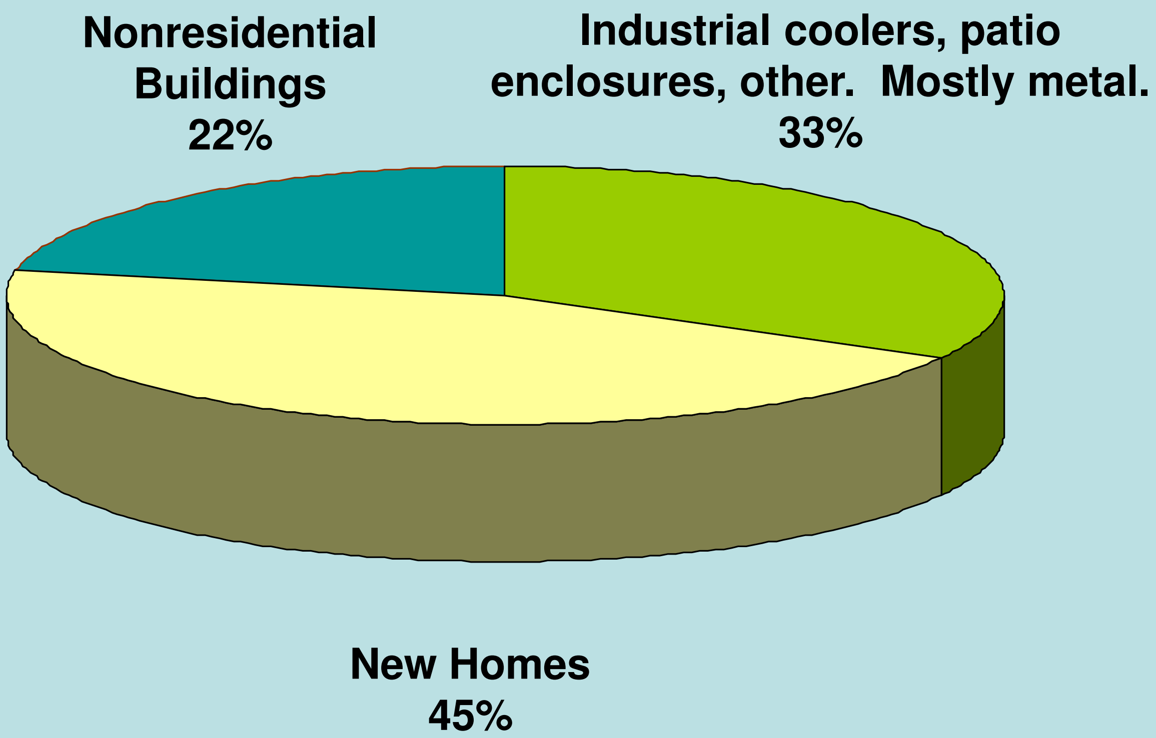

FLIR ThermaCAM
Saving B0301-32
Sp1 19.1
Δ -1.4
RefT 20.5
Sp1
25.1
17.2

End Use markets for SIPs

64.4 Million Square Feet



Million Square Feet	
Homebuilding:	28.9
Nonresidential:	14.2
Industrial, other:	21.3
Total:	64.4

Four strategies for advancing the role of SIPs

1. Upgrade understanding of performance metrics (include high-rise and commercial buildings)
2. Stronger mandatory standards that recognize SIPs' superior, cost-competitive performance
3. Expanded research on material components, connections, hazard reduction, fire safety, high-rise and commercial applications
4. Market transformation: Cap and trade schemes must:

   - include building energy and environment actions,

   - or else, mandatory standards, R&D and incentives must be combined to ensure a cost-minimization investment in reducing GHG emissions

The Bottom Line

Construction Technology, and SIPs in particular, are a key part of the solution to national energy and environmental challenges

For more information see:

www.fas.org look for Buildings Technology

SIP R - VALUES

EPS Core Thickness	3 5/8”	5 5/8”	7 3/8”	9 3/8”	12 3/8”
R-Value @ 75° F	15.34	23.04	29.77	40.36	49.02
@ 40° F	16.57	26.26	32.28	43.80	53.23
@ 25° F	17.15	27.16	33.46	45.42	55.21

(Calculated R-Values) Calculated R-Values are for a generic Structural Insulated Panel, and include 2 sheets of 7/16” OSB at .69 per side. Type I, Expanded Polystyrene Foam that meets ASTM C – 578, calculated per ASHRAE published values at 3.85 per inch at 75° F, 4.19 at 40° F and 4.35 at 25°. Mean temperatures are established for differing regions, and occupancies. Please consult your local jurisdiction for interpretation of Regional or National Model Energy Code Requirements.