The Passive House Program

David Peabody
Peabody Architects
Email: david@greenhaus.org
Blog: http://passivehouse.greenhaus.org
Web: www.greenhaus.org

PEABODY ARCHITECTS

What makes the Passive House approach different?

- It's all about energy.
  - Cuts heating and cooling energy use by 90%.
- Focus upon the demand side of the energy equation.
- Affordability.
  - Slightly higher first cost.
  - Drastically lower energy costs:
  - Lower monthly cost of ownership

first Passive House 1991

PEABODY ARCHITECTS

Key elements

How Does It Work?

- Improve the building envelope
- Use and control the sun's energy
- Provide ventilation
- Use energy efficient appliances and lighting
- Value engineer through energy modeling

PEABODY ARCHITECTS

Focus on the envelope

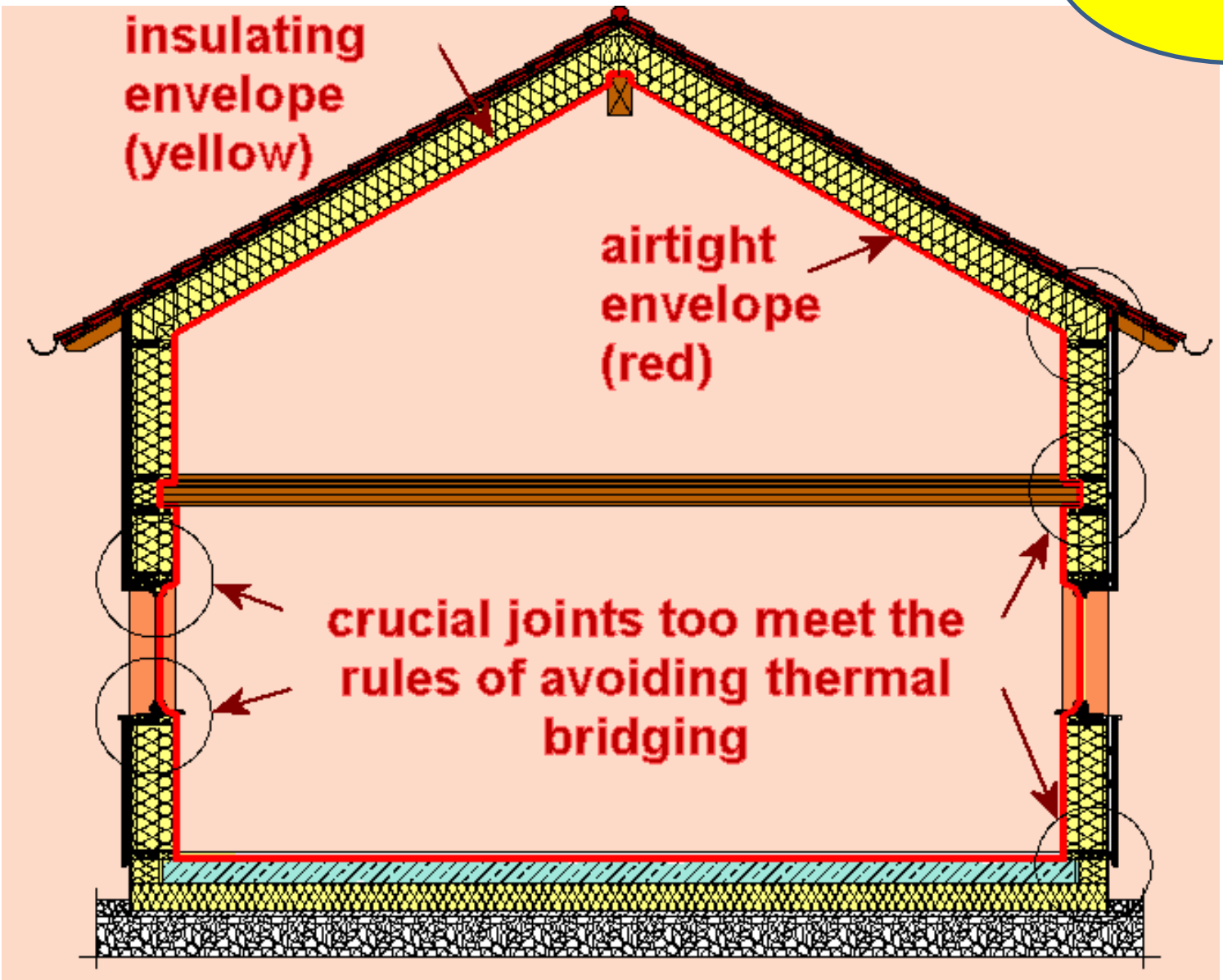
How Does It Work?

Think of a Thermos!

PEABODY ARCHITECTS

Focus on the envelope

How Does It Work?



PEABODY ARCHITECTS

Focus on the envelope

How Does It Work?

- Insulation
  - Walls: R38
  - Roof: R45
  - Basement: R20

Numbers for our climate

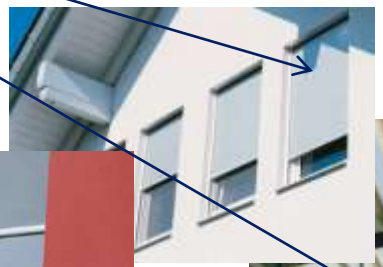
- Windows
  - Triple glazed
  - R7 to R11,with insulated sash and frames
- Eliminate thermal bridges
- Airtight construction
  - Continuous airtight membrane
  - .06 air changes per hour (10x Energy Star)

PEABODY ARCHITECTS

Use and control the sun

How Does It Work?

- **Maximize solar heat gain in winter**
  - South facing glass admits winter sun
- **Protect glass in summer**
  - Overhangs at south facing glass
  - Shades or awnings at west facing glass

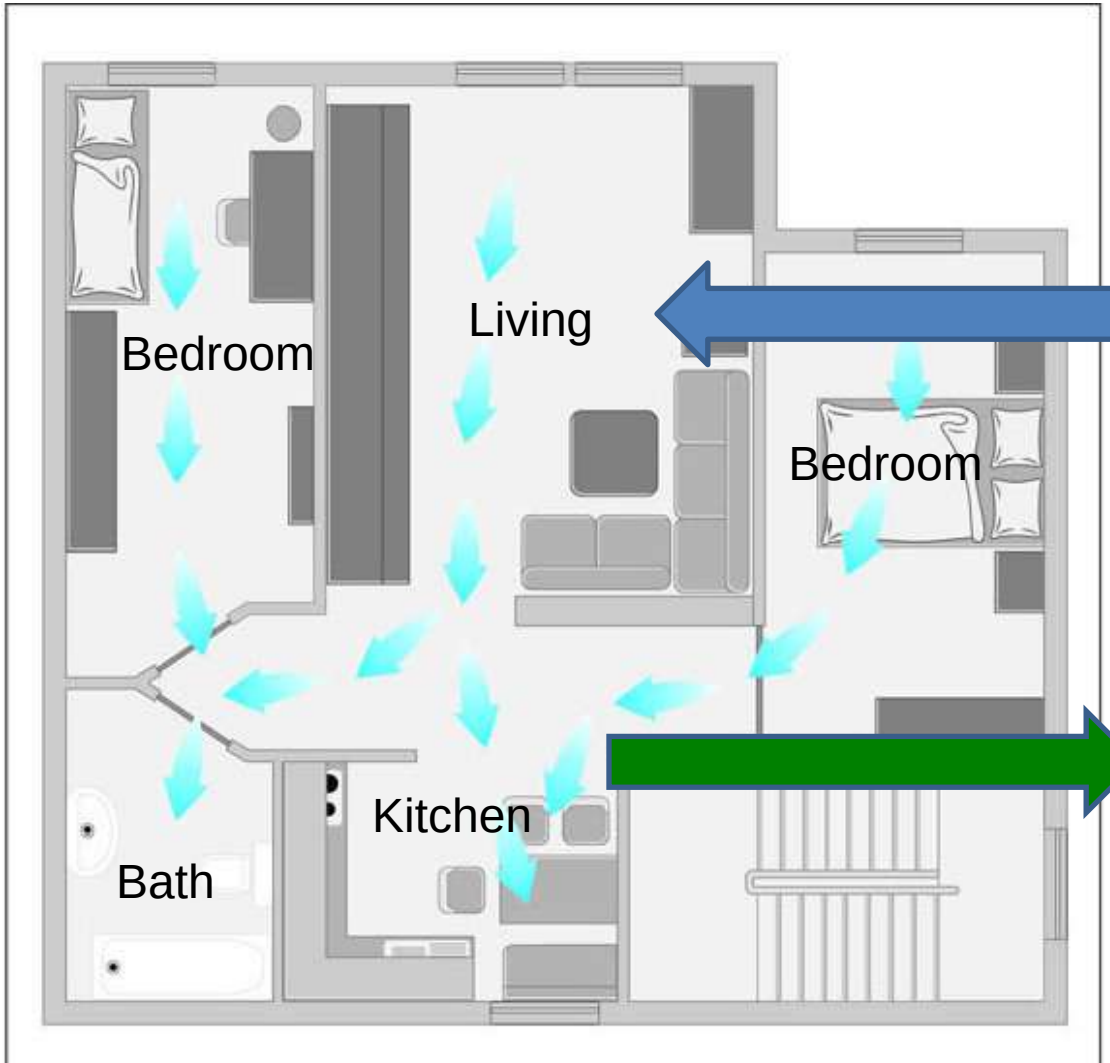


PEABODY ARCHITECTS

Provide good ventilation

How Does It Work?

- **Simplified mechanical system**



Conditioned fresh air supplied to living spaces

Stale air exhausted from kitchen and bath spaces

PEABODY ARCHITECTS

High efficiency appliances + lighting

How Does It Work?

- Reduce internal heat gains
- Reduce overall energy use

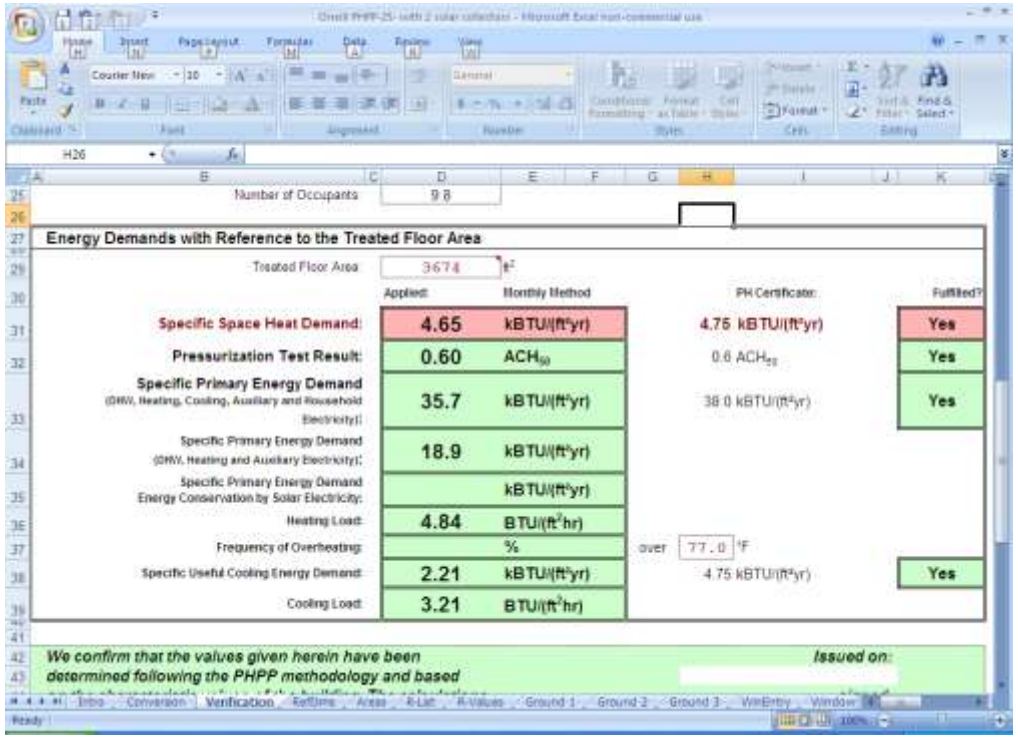
ENERGY STAR

PEABODY ARCHITECTS

Energy Modeling

The PHPP

- The Passive House Planning Package
  - Accessible to architects
  - Excel based
  - Transparent
  - Open source
  - Flexible
  - $250



Number of Occupants: 9.8

Energy Demands with Reference to the Treated Floor Area

Treated Floor Area: 3674 ft²

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	4.65	kBTU/(ft²yr)	4.75 kBTU/(ft²yr)	Yes
Pressurization Test Result:	0.60	ACH_{50}	0.6 ACH_{50}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	35.7	kBTU/(ft²yr)	38.0 kBTU/(ft²yr)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	18.9	kBTU/(ft²yr)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		kBTU/(ft²yr)		
Heating Load:	4.84	BTU/(ft²hr)		
Frequency of Overheating:		%	over 77.0 °F	
Specific Useful Cooling Energy Demand:	2.21	kBTU/(ft²yr)	4.75 kBTU/(ft²yr)	Yes
Cooling Load:	3.21	BTU/(ft²hr)		

We confirm that the values given herein have been determined following the PHPP methodology and based

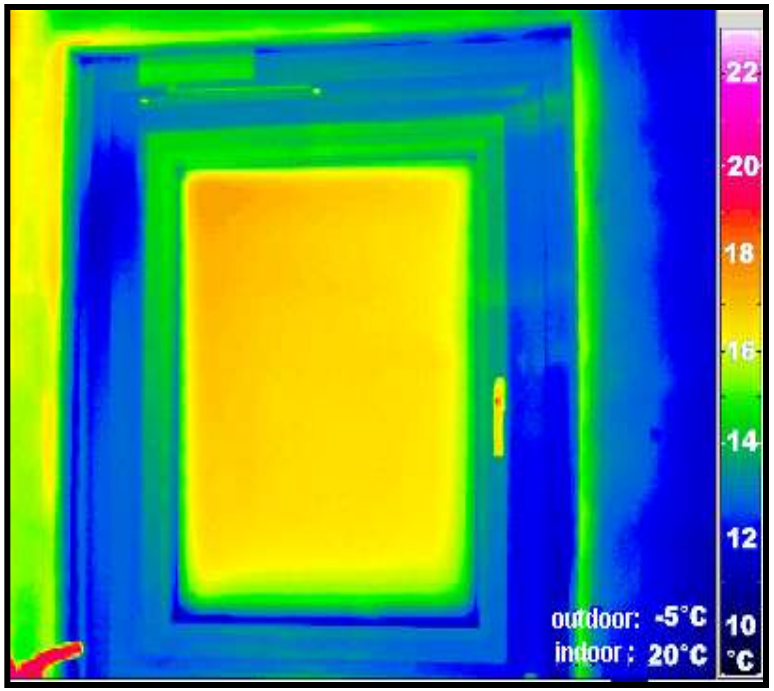
Issued on:

WHO NEEDS BIM?!

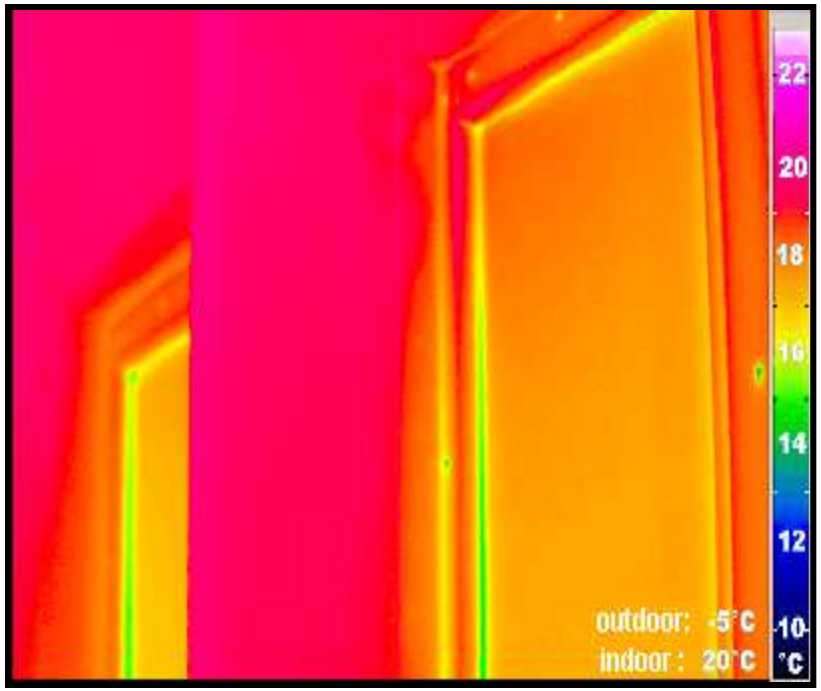
PEABODY ARCHITECTS

Comfort

- No stratification of air.
- You are not cold in front of a window.



Standard double glazed window



Passive House windows

PEABODY ARCHITECTS

Health

- **IAQ better than on standard houses.**
  - Lower radon
  - Lower CO_2
  - Less incidence of asthma

Is it healthy?

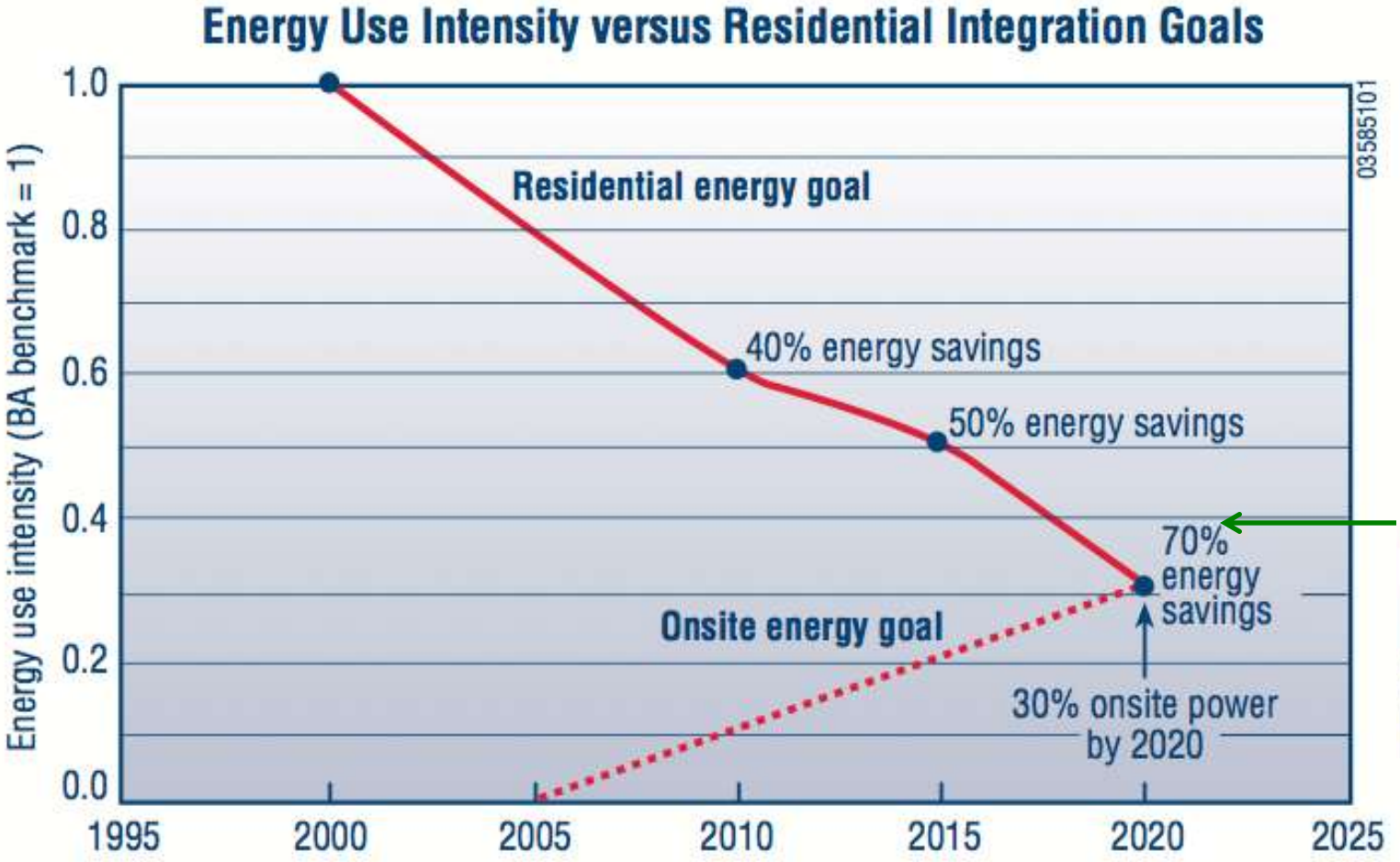
PEABODY ARCHITECTS

PHIUS + Certification – An American Standard

- DOE Challenge Certification – a Reach Code
  - Energy efficiency
  - Health
  - Comfort
  - Durability
- EPA Energy Star Certification
  - Building envelope efficiency
  - HVAC efficiency
  - Water management
- HERS Rating
- US Passive House Institute Certification

PEABODY ARCHITECTS

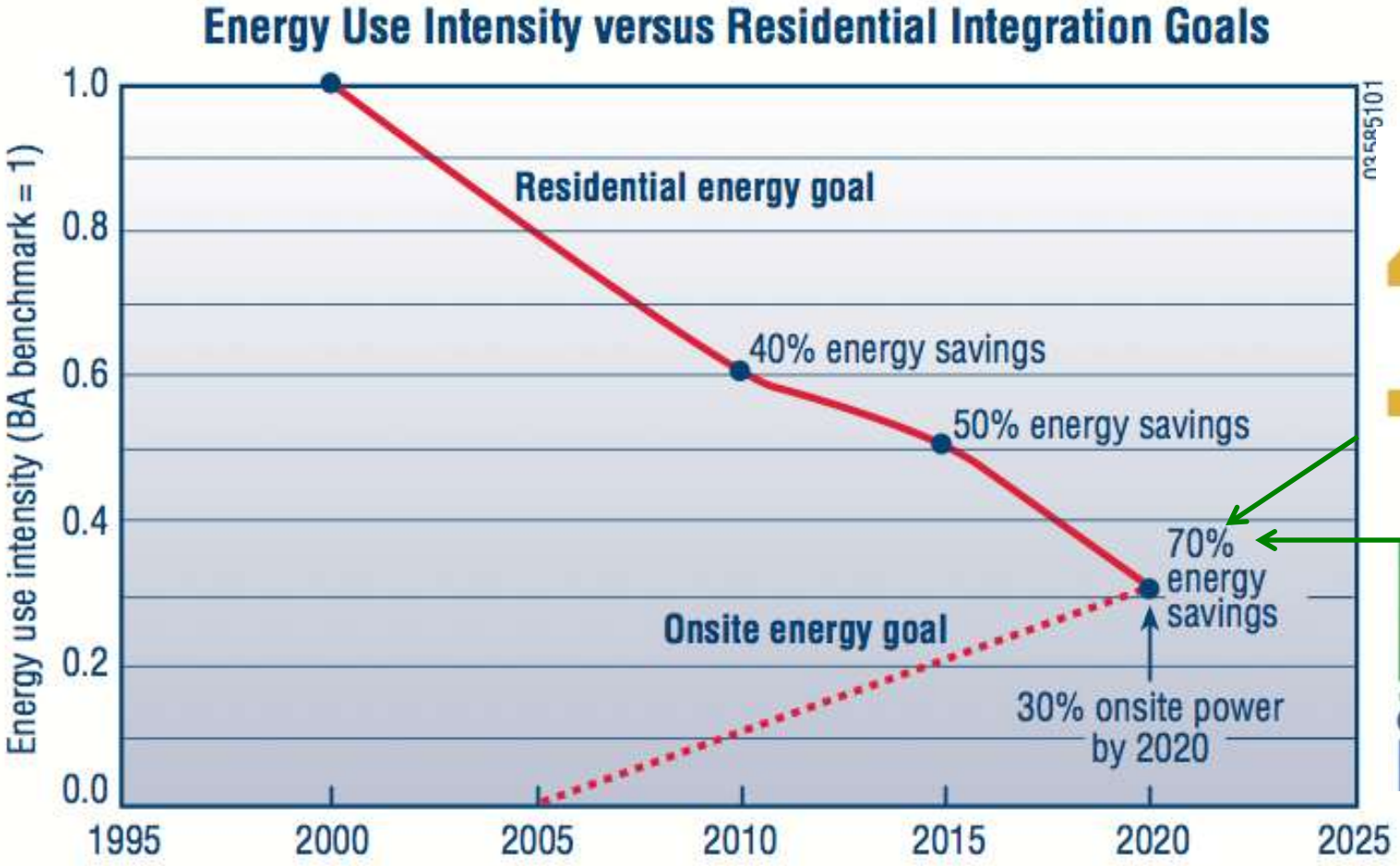
Why did DOE partner with PHIUS?



U.S. DEPARTMENT OF ENERGY
CHALLENGE HOME

PEABODY ARCHITECTS

Why did DOE partner with PHIUS?



PH®

U.S. DEPARTMENT OF ENERGY
CHALLENGE HOME

PEABODY ARCHITECTS

Larger buildings are easier

European Apartment Buildings

PEABODY ARCHITECTS

Larger buildings are easier

German office buildings

PEABODY ARCHITECTS

Larger buildings are easier

Charlottesville Passive House School
Adam Cohen, Structures Design/Build, LLC

PEABODY ARCHITECTS

Passive House offers Highest ROI

- Bethesda Passive House
  - $900K = construction cost
  - $90K = upgrades over 2006 code to reach PH
  - 15% = $\frac{\text{PH heating and cooling energy}}{\text{2006 code house heating and cooling energy}}$
  - $280K = cost of PV system to generate equivalent of annual energy saved by PH.

PV calculation based on source energy saved and costs of array without government incentives.

PEABODY ARCHITECTS

Why is it hard for PH to compete in the market?

- Unfamiliarity
  - Perceived as foreign/funny name
  - Threatening to established groups: USGBC; NAHB
  - No lobby in Congress
- Few incentives available.
  - $500 total for energy conservation measures
  - Large rebates for solar and geothermal investment

PEABODY ARCHITECTS

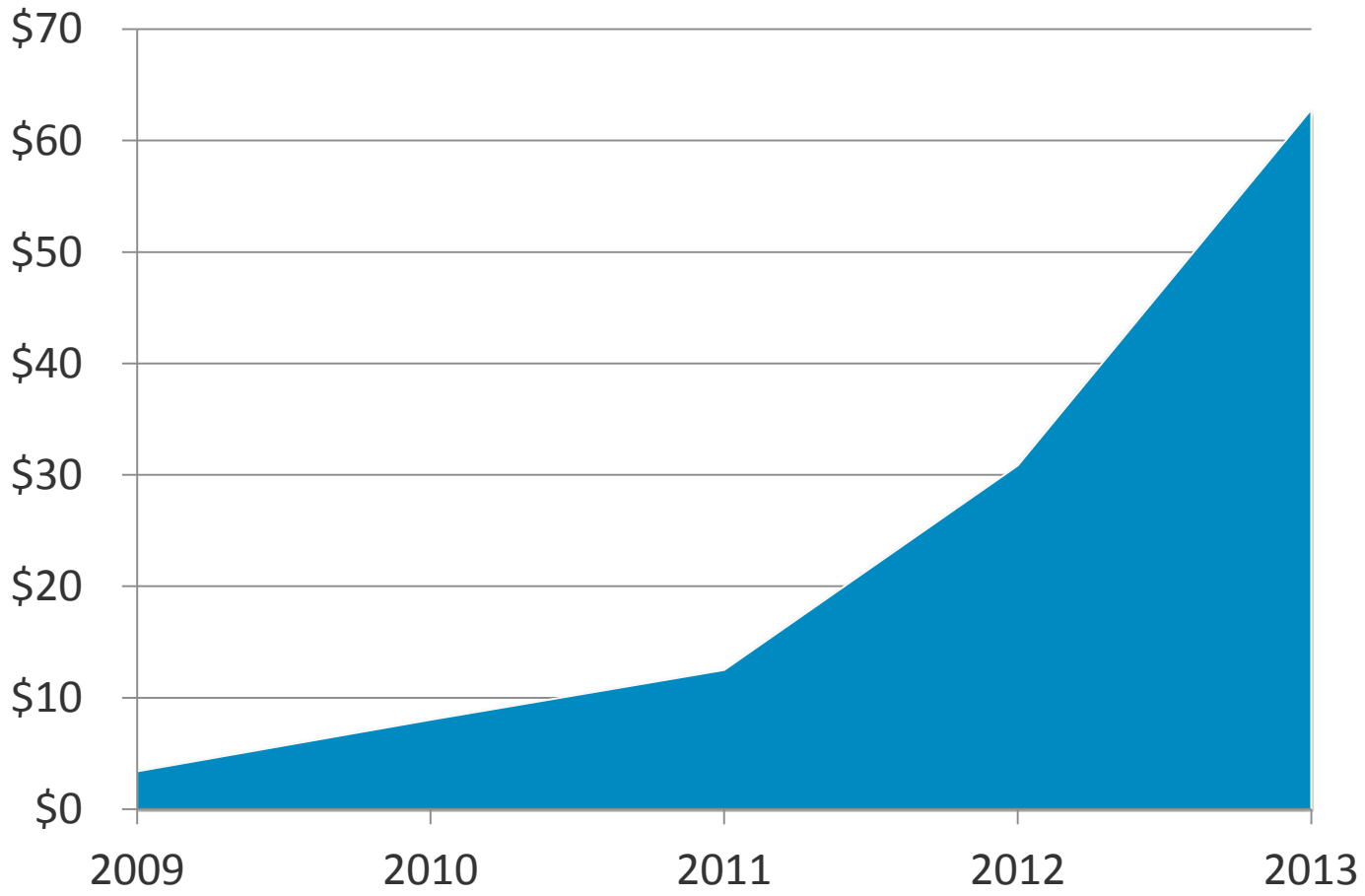
How can local governments level the playing field?

- Property tax incentives
  - Baltimore County
  - Montgomery County
- Greater density incentives to developers
  - Arlington Metro Corridor
- Require HERS ratings for all local home sales
  - Austin, Tacoma, Seattle
  - WS, MN, CO, NH, ME, VT

- PACE Financing is growing again

PEABODY ARCHITECTS

How can local governments level the playing field?

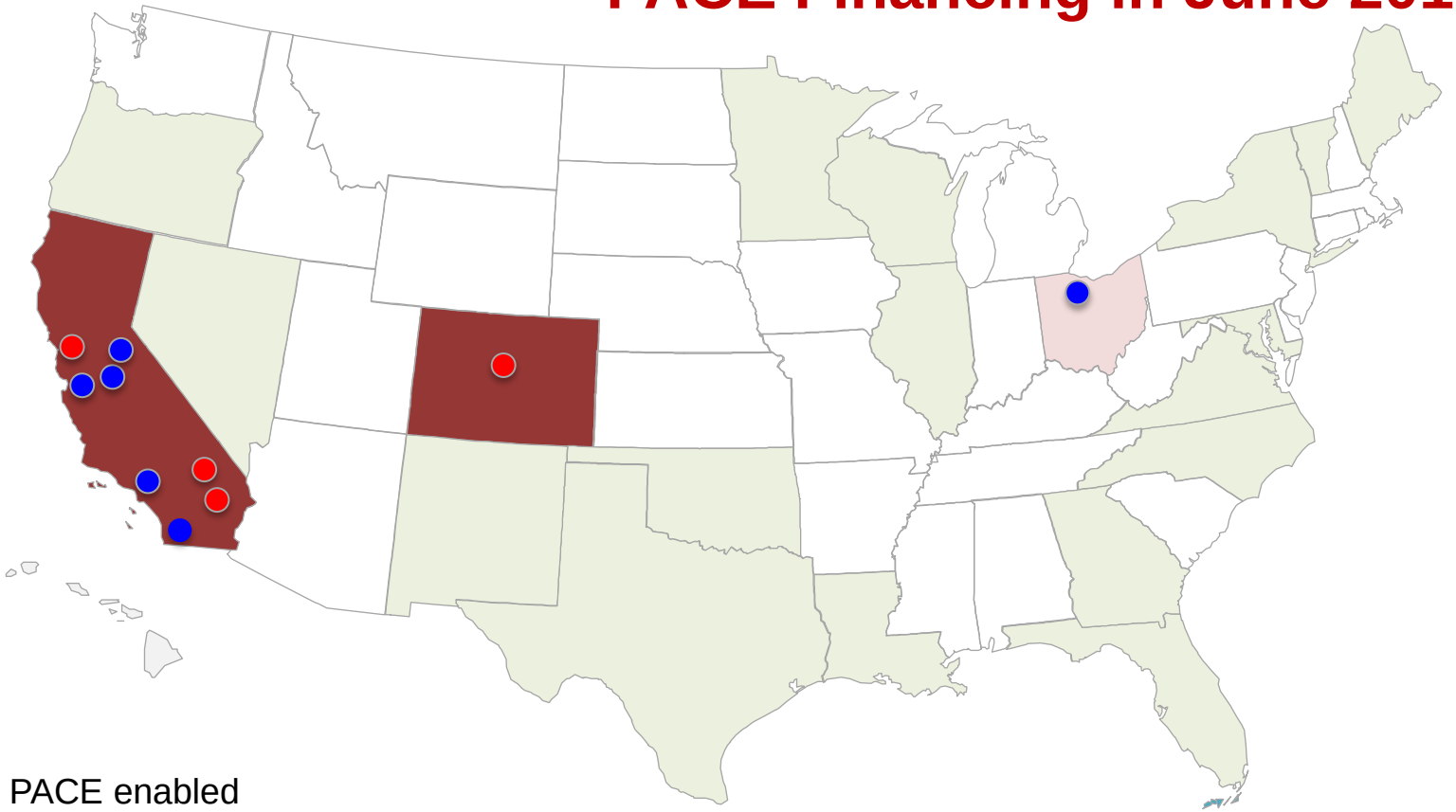


Cumulative PACE Financing, in millions

PEABODY ARCHITECTS

How can local governments balance the playing field?

PACE Financing in June 2010



PACE enabled

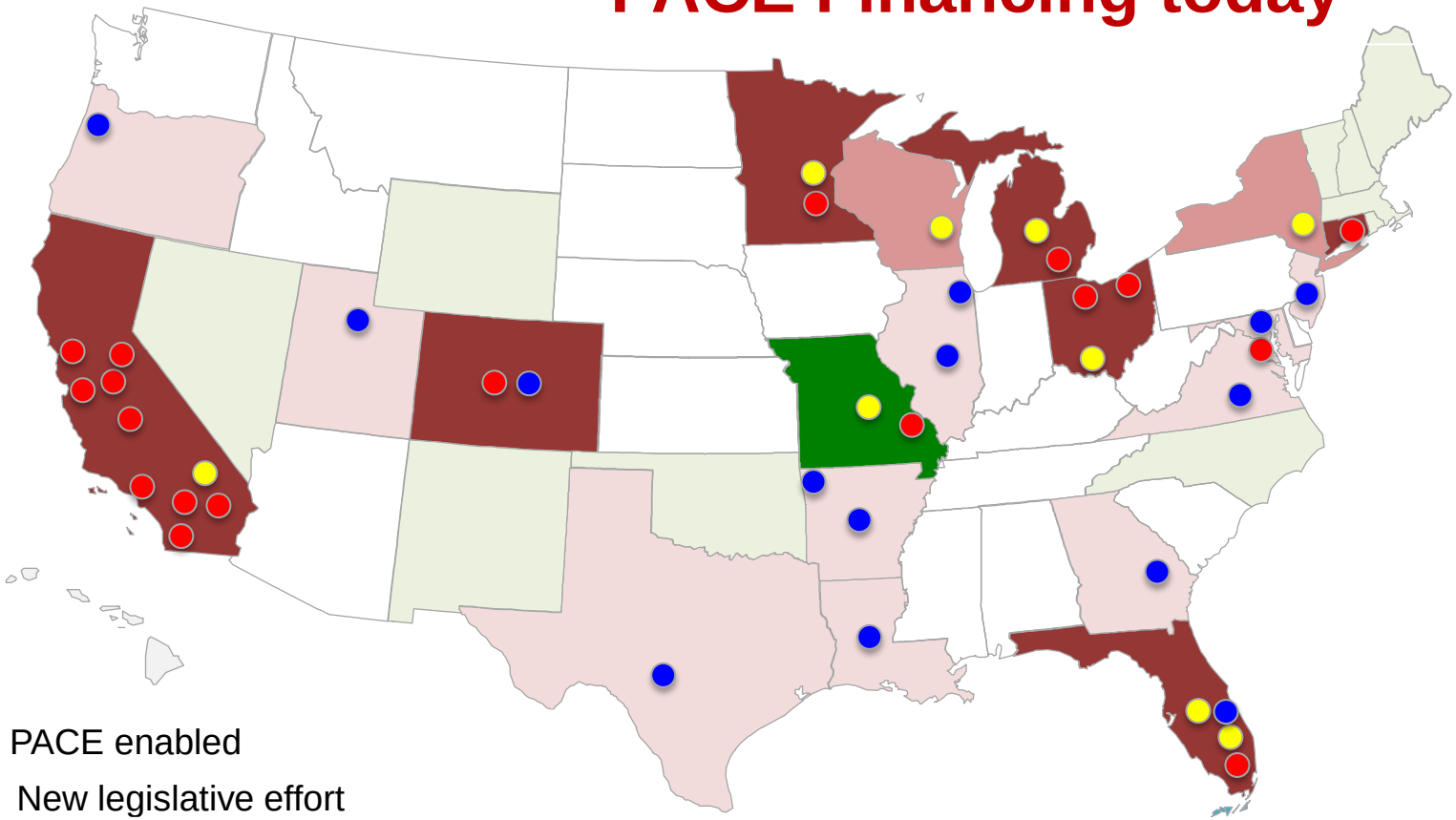
Early stage PACE program development

PACE programs with funded projects

27 Projects completed - $5 million

How can local governments level the playing field?

PACE Financing today



- PACE enabled
- New legislative effort
- Early stage PACE program development
- Launched PACE programs
- PACE programs with funded projects

More than 208 Projects completed = $63 million
Pipeline Projects = $220+ million

PEABODY ARCHITECTS

How can local governments level the playing field?

- Set examples with local government buildings

TC Williams High School
Moseley Architects

PEABODY ARCHITECTS