

# How Far Can We Go? (Further Than You Might Think!)

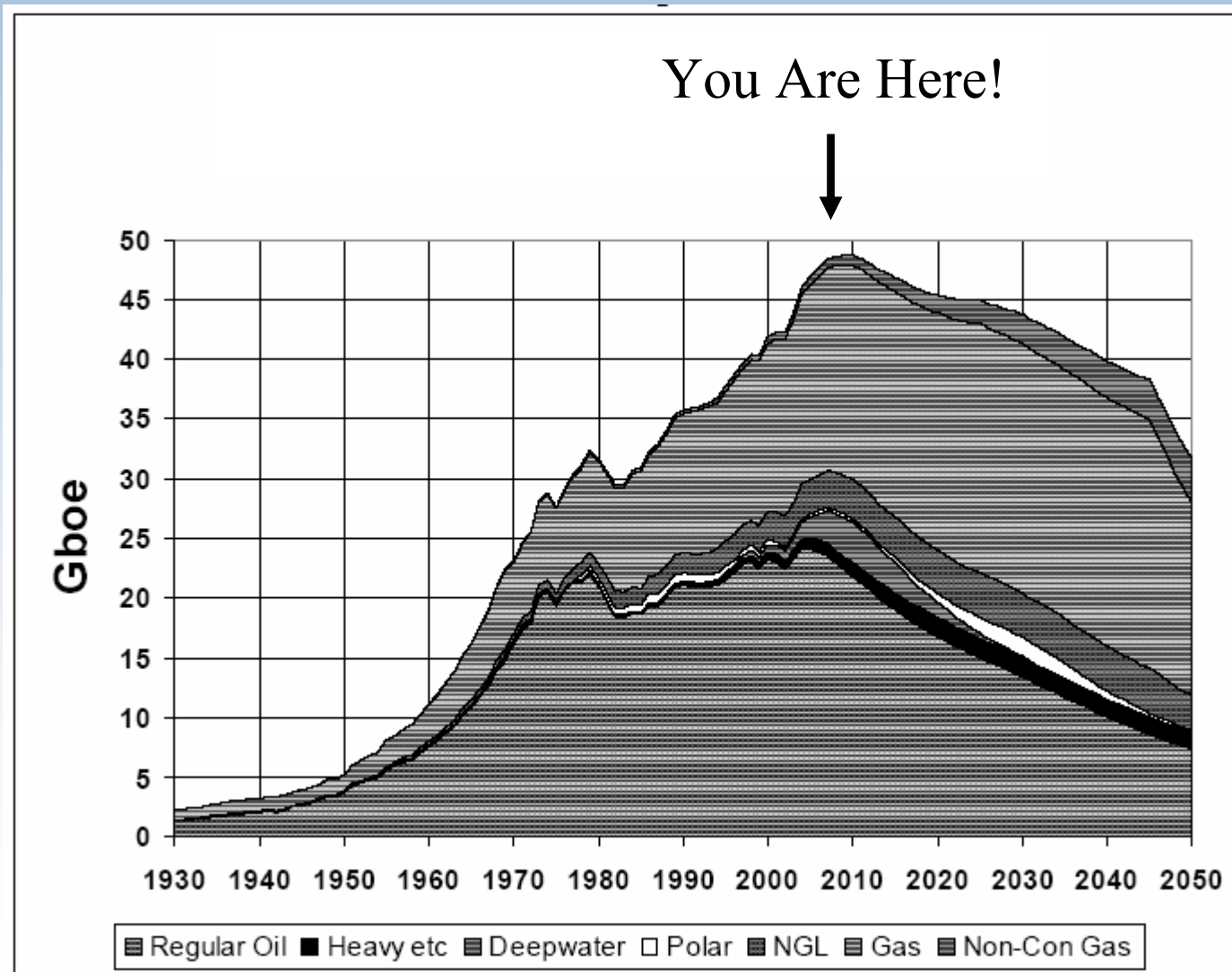
Ren Anderson  
National Renewable Energy Laboratory  
SWEEP Workshop  
November 3, 2005



# How Far Can We Go?

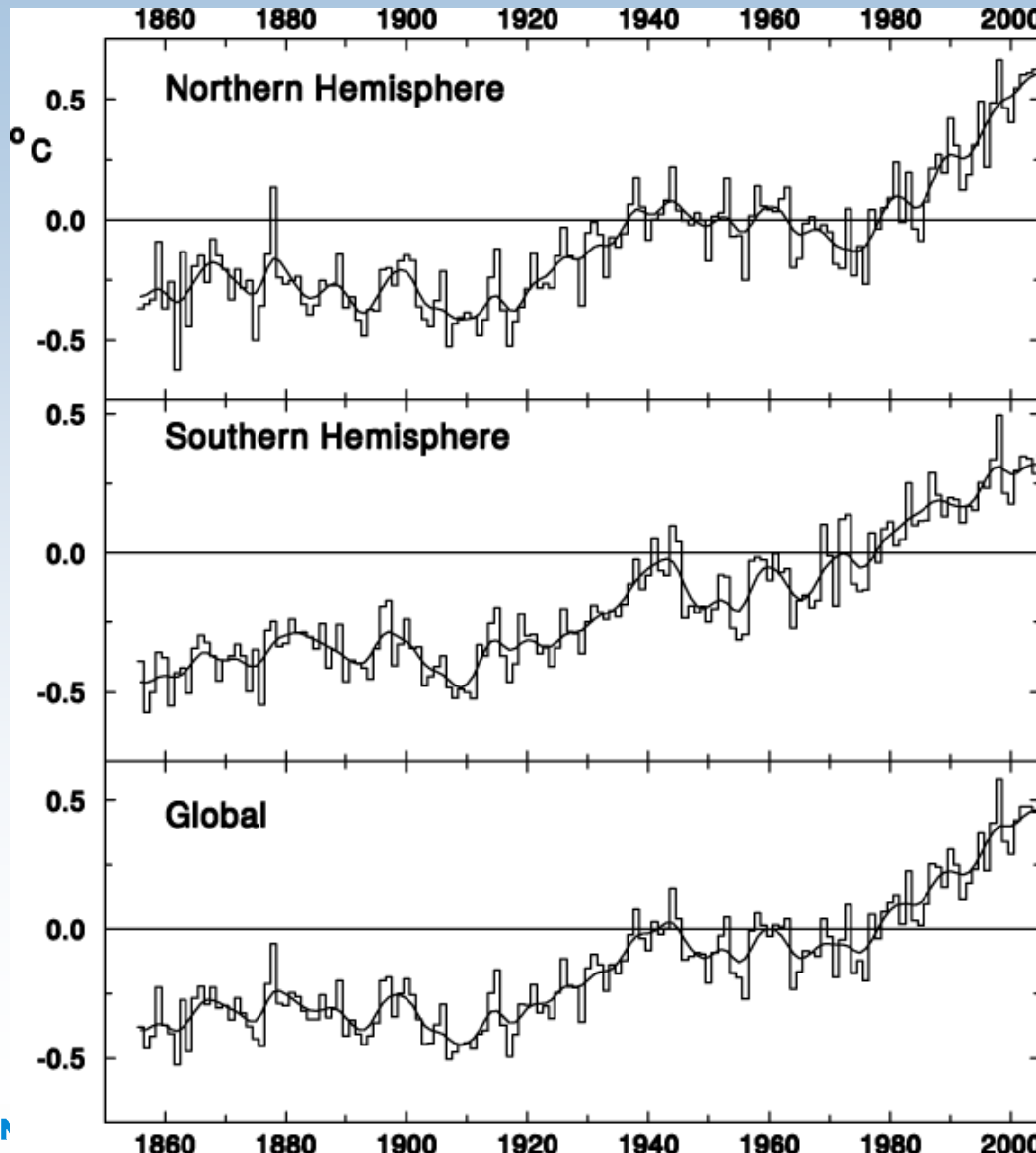


# How Long Will Fossil Fuels Last?



The Association for the Study of Peak Oil and Gas, October 2005 Newsletter, [www.peakoil.ie](http://www.peakoil.ie)

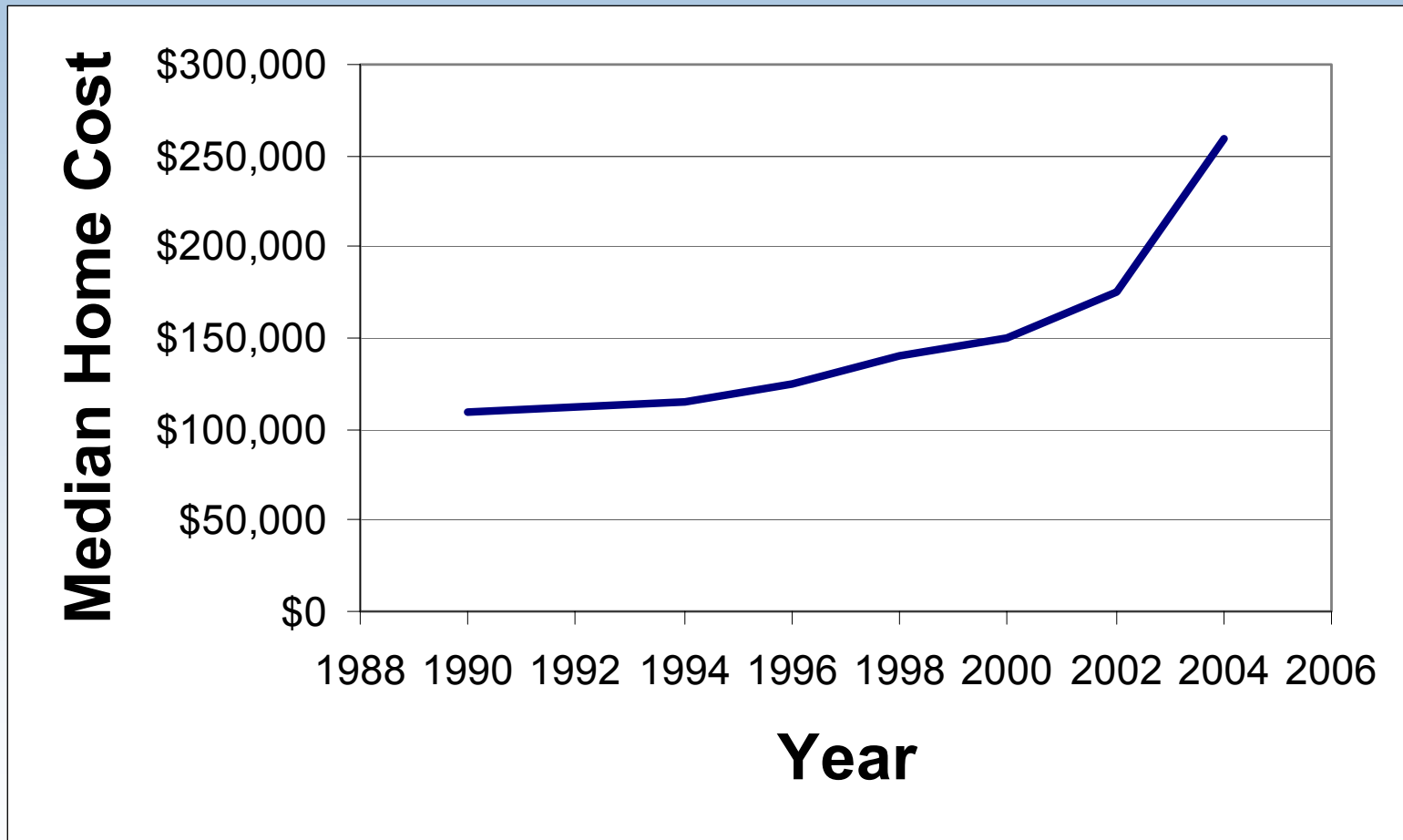
# How Hot Will It Get?



**“World temperatures keep rising. Climate data show 2005 on track to be hottest on record.”**



# How Much are Homebuyers Willing to Pay for High Performance Homes?



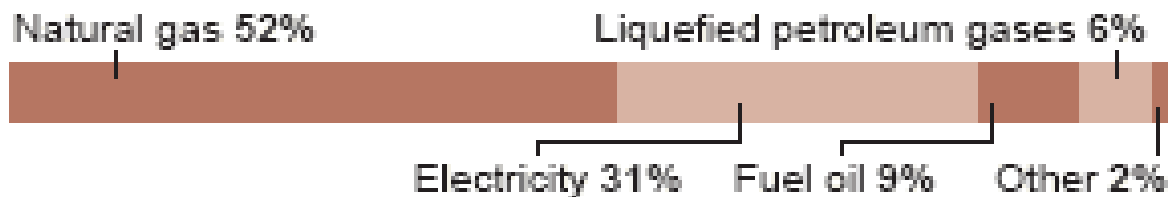
Median Home cost in Las Vegas. Source: Sales Traq, Professional Builder, November 2004.

# How High Will Utility Bills Go?

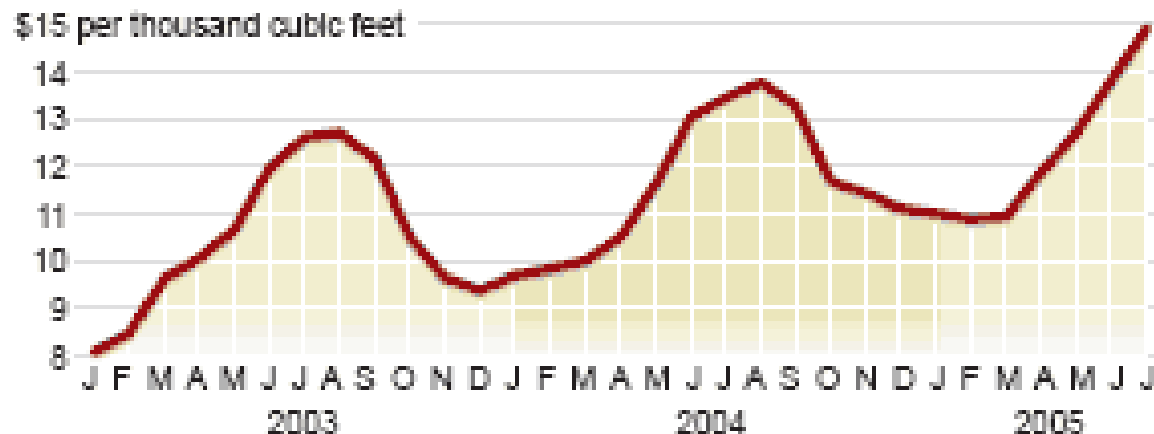
## A costly winter for home heating expected

Industry analysts expect higher than normal heating bills this winter. A majority of homes are heated using natural gas.

### Type of heating in occupied housing units, 2003



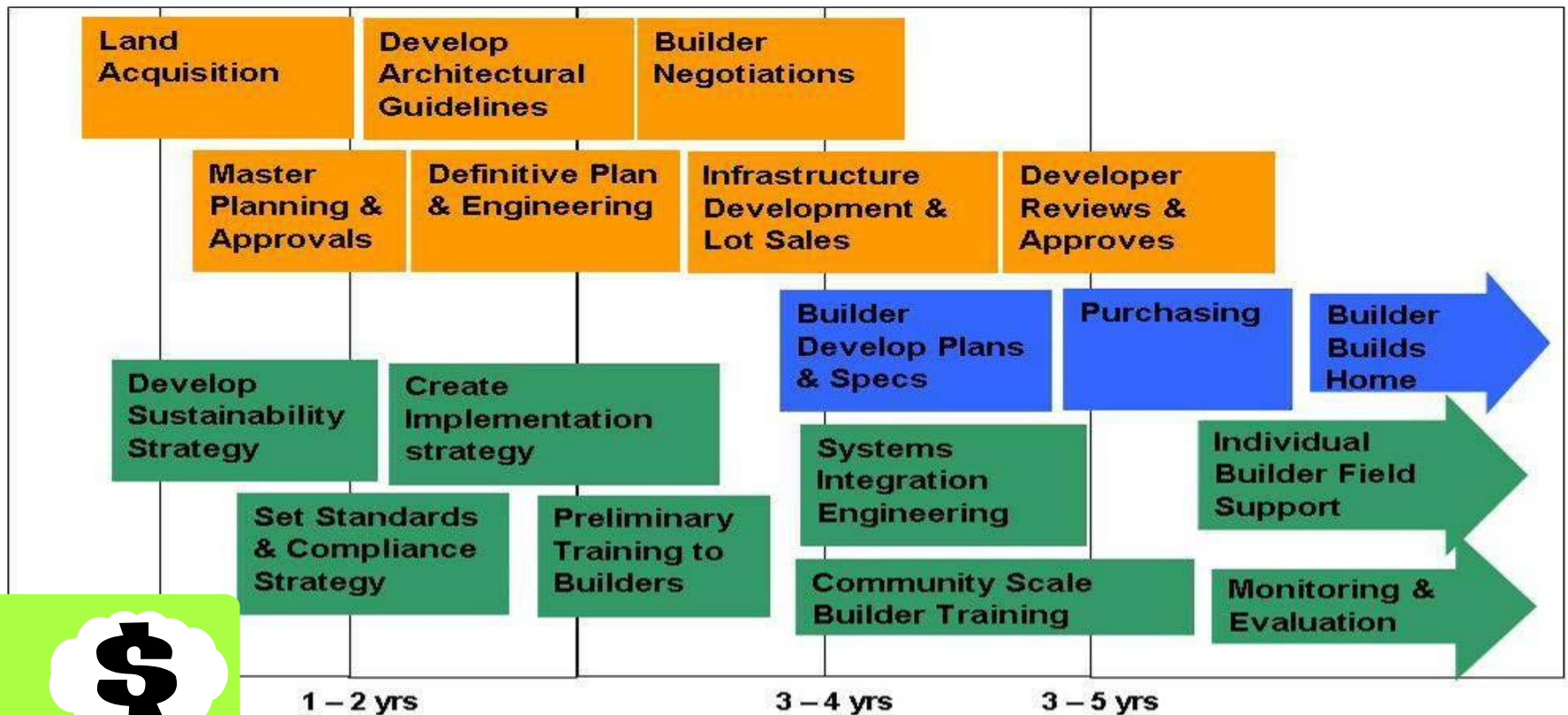
### U.S. natural gas residential price



SOURCE: Energy Information Administration

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# What “Opportunity Cost” are Builders Willing to Pay to Deliver High Performance Homes?



# These Are All Very Good Questions!

However, during this presentation, I'm going to focus on the following questions:

- What combinations of energy savings features provide customers with the most bang for the buck?
- What is the least cost required to achieve different levels of energy savings?
- What are the estimated costs and benefits for the \$2000 residential tax credit for new homes?



# Presentation Overview

These are still very difficult questions, so a specific approach will be used to answer these questions:

- Specific Residential Energy Saving Options
- Consistent Approach for Evaluation of Incremental Costs and Benefits for Energy Efficient Homes
- Simple definition of Energy Saving Strategies
- Simple Method to Determine Market Potential for Energy Efficient Homes

Then We can Discuss the Estimated Impacts of the Tax Credits on Markets for Energy Efficient Homes!

# Residential Energy Saving Options



# Residential Energy Saving Options

The interface displays a tree view of energy-saving options on the left, a central list of categories and sub-items, and an 'Orientation' panel on the right.

**Tree View Selections:**

- Building: 4 3 2 1 (4, 3, 2, 1)
- Envelope: 6 5 4 3 2 1 (6, 5, 4, 3, 2, 1)
- Foundation: 6 5 4 3 2 1 (6, 5, 4, 3, 2, 1)
- Windows & Shading: 7 6 5 4 3 2 1 (7, 6, 5, 4, 3, 2, 1)
- Appliances & Lighting: 2 1 (2, 1)
- Equipment: 8 7 6 5 4 3 2 1 (8, 7, 6, 5, 4, 3, 2, 1)

**Central List:**

- Building**
  - Orientation
  - Neighbors
- Envelope**
  - Walls
  - Ceiling
  - Thermal Mass
  - Infiltration
- Foundation**
  - Slab
  - Basement
  - Crawl Space
- Windows & Shading**
  - Glass Type
  - Total Window Area
  - Window Area per Wall
  - Eaves
- Appliances & Lighting**
  - Refrigerator
  - Cooking Range
  - Dishwasher
  - Clothes Dryer
  - Clothes Washer
  - Lighting
- Equipment**
  - Air Conditioner
  - Furnace
  - Heat Pump
  - Cooling Capacity

**Orientation Panel:**

Options: (Select to include in optimization)

- 1) South-facing
- 2) West-facing
- 3) North-facing
- 4) East-facing

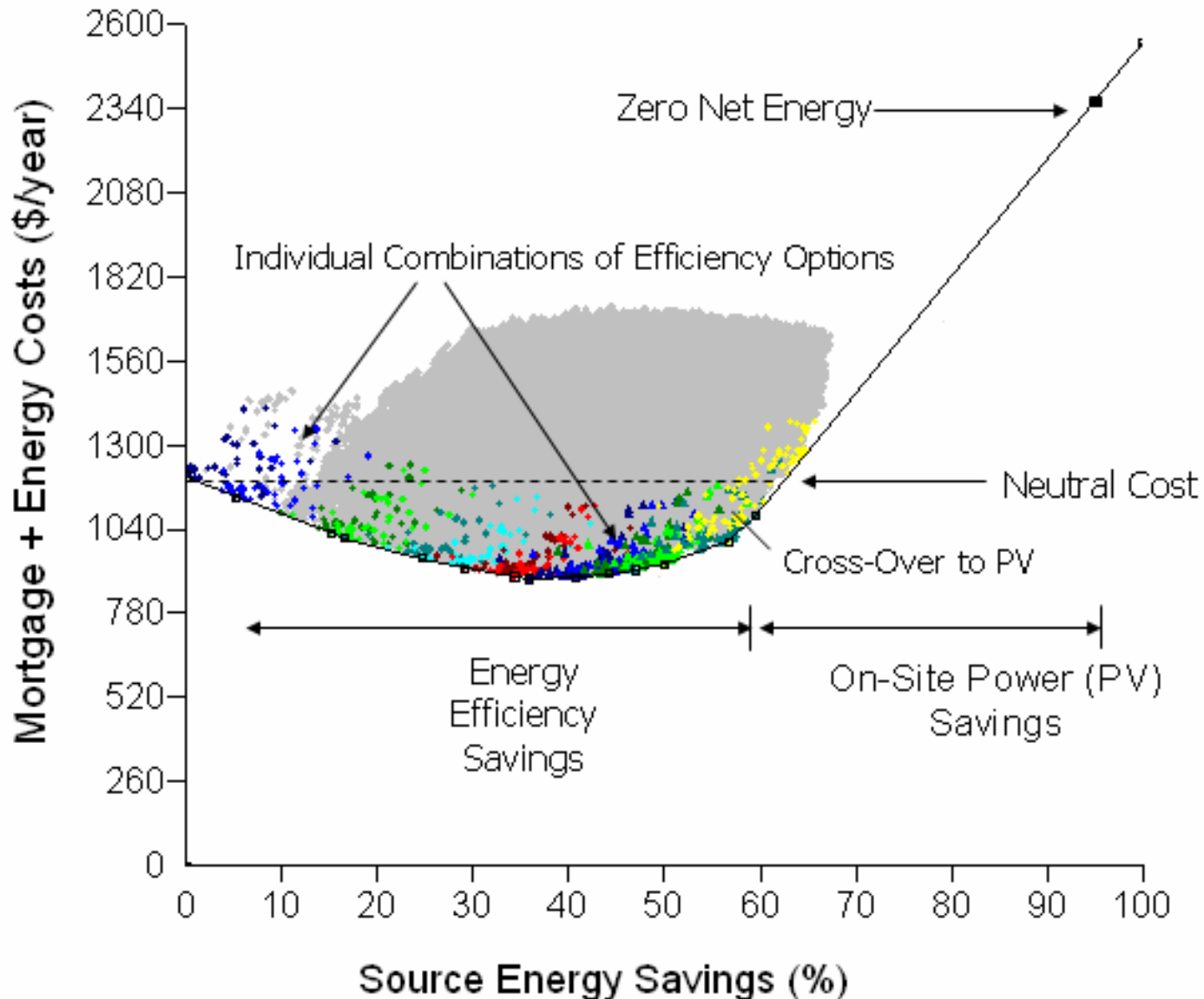
# Residential Energy Saving Options

Building		Walls		
Orientation		Options: (Select to include in optimization)		
Neighbors		Framing Factor	Lifetime (years)	Unit Cost (\$/sq ft)
<b>Envelope</b>				
Walls				
Ceiling				
Thermal Mass				
Infiltration				
<b>Foundation</b>				
Slab				
Basement				
Crawl Space				
<b>Windows &amp; Shading</b>				
Glass Type				
Total Window Area				
Window Area per Wall				
Eaves				
<b>Appliances &amp; Lighting</b>				
Refrigerator				
Cooking Range				
Dishwasher				
Clothes Dryer				
Clothes Washer				

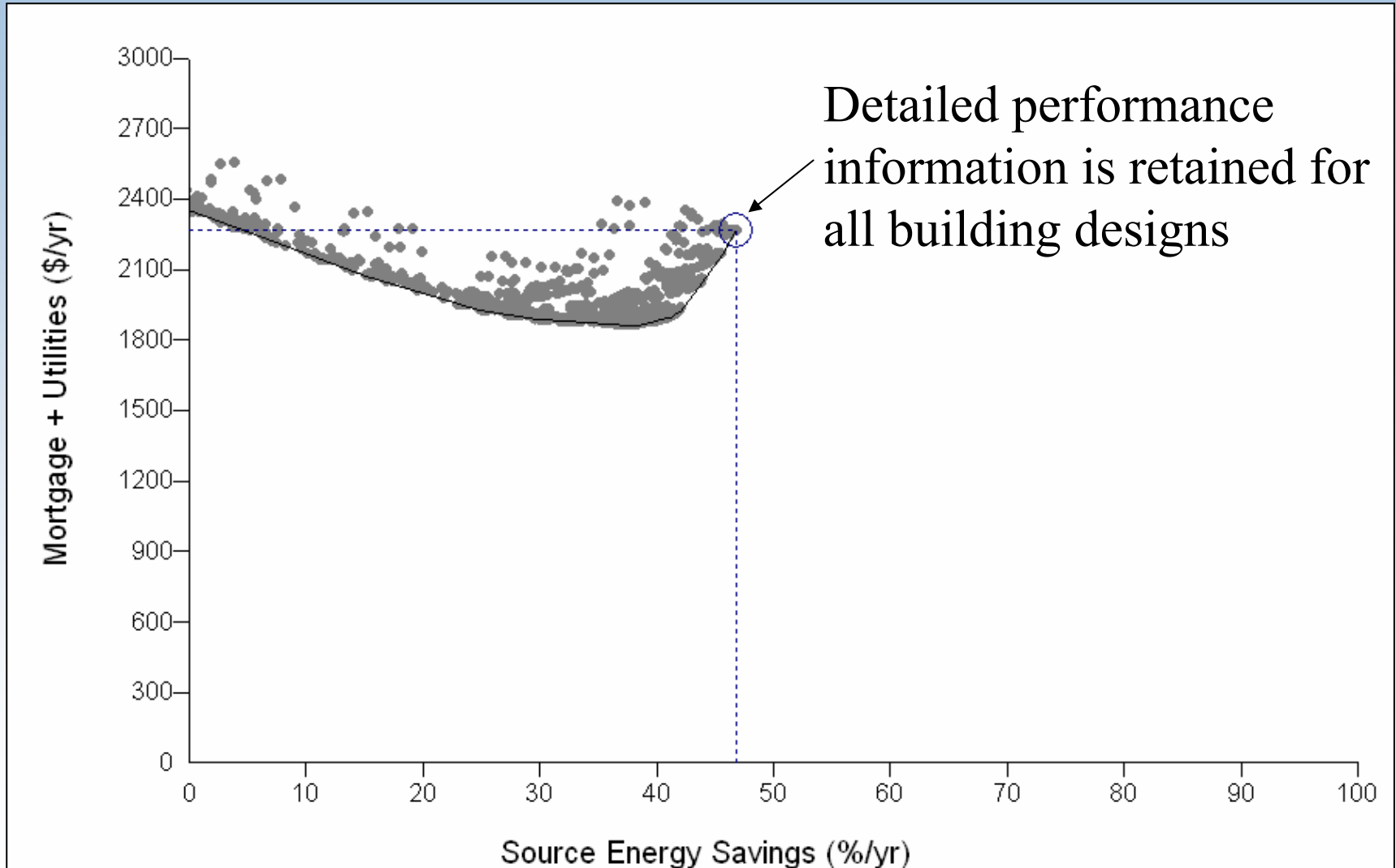
  

Options: (Select to include in optimization)			
	Framing Factor	Lifetime (years)	Unit Cost (\$/sq ft)
1) R11 batts, 2x4, 16"oc	0.25	30	\$3.15
2) R13 batts, 2x4, 16"oc	0.25	30	\$3.17
3) R11 batts, 2x4, 16"oc + 1" foam sheathing	0.25	30	\$3.92
4) R19 batts, 2x6, 24"oc	0.20	30	\$3.28
5) R19 batts, 2x6, 24"oc + 1" foam sheathing	0.20	30	\$4.05
6) R19 batts, 2x6, 24"oc + 2" foam sheathing	0.20	30	\$4.24

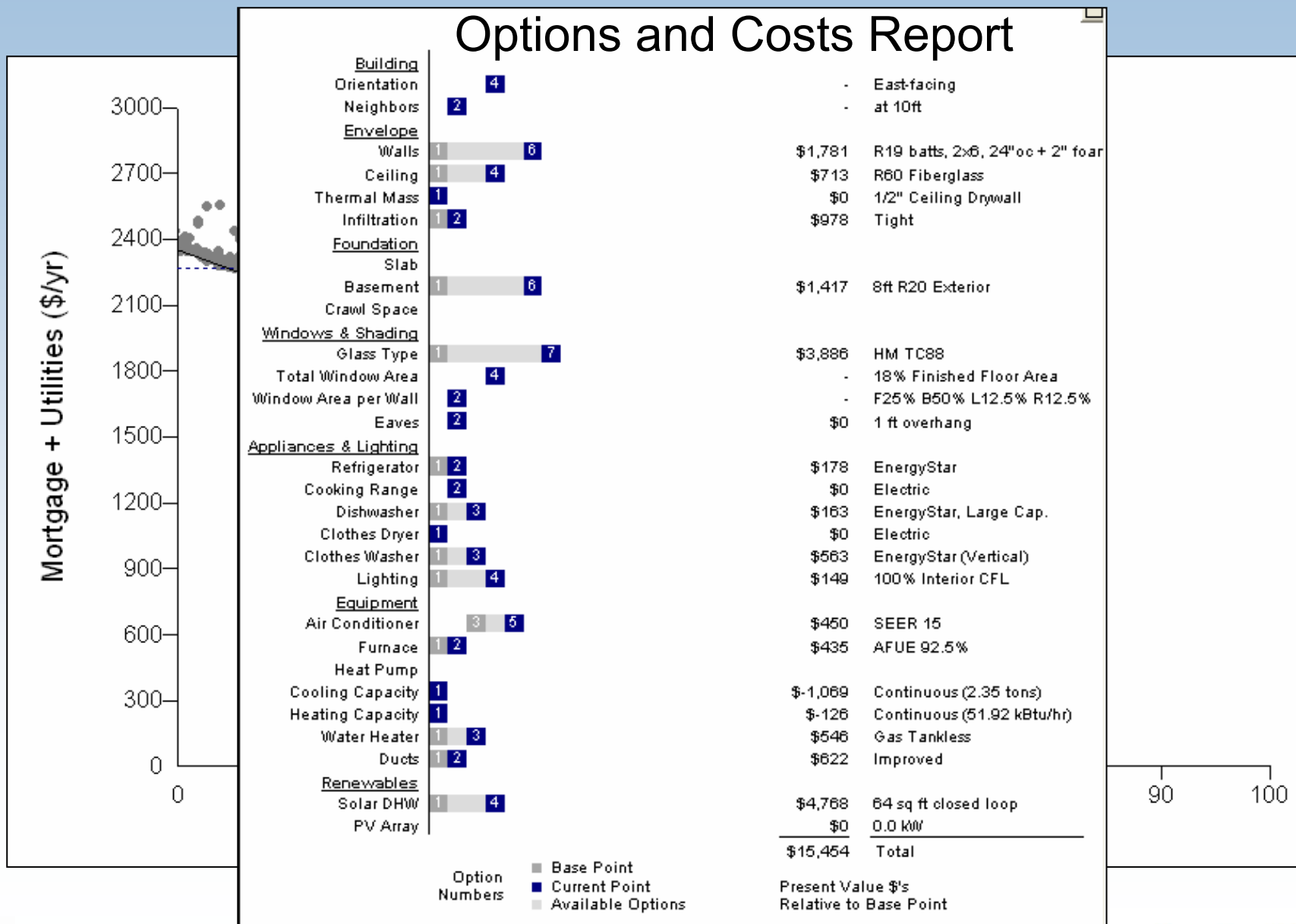
# Determining Incremental Costs and Benefits for Energy Efficient Homes



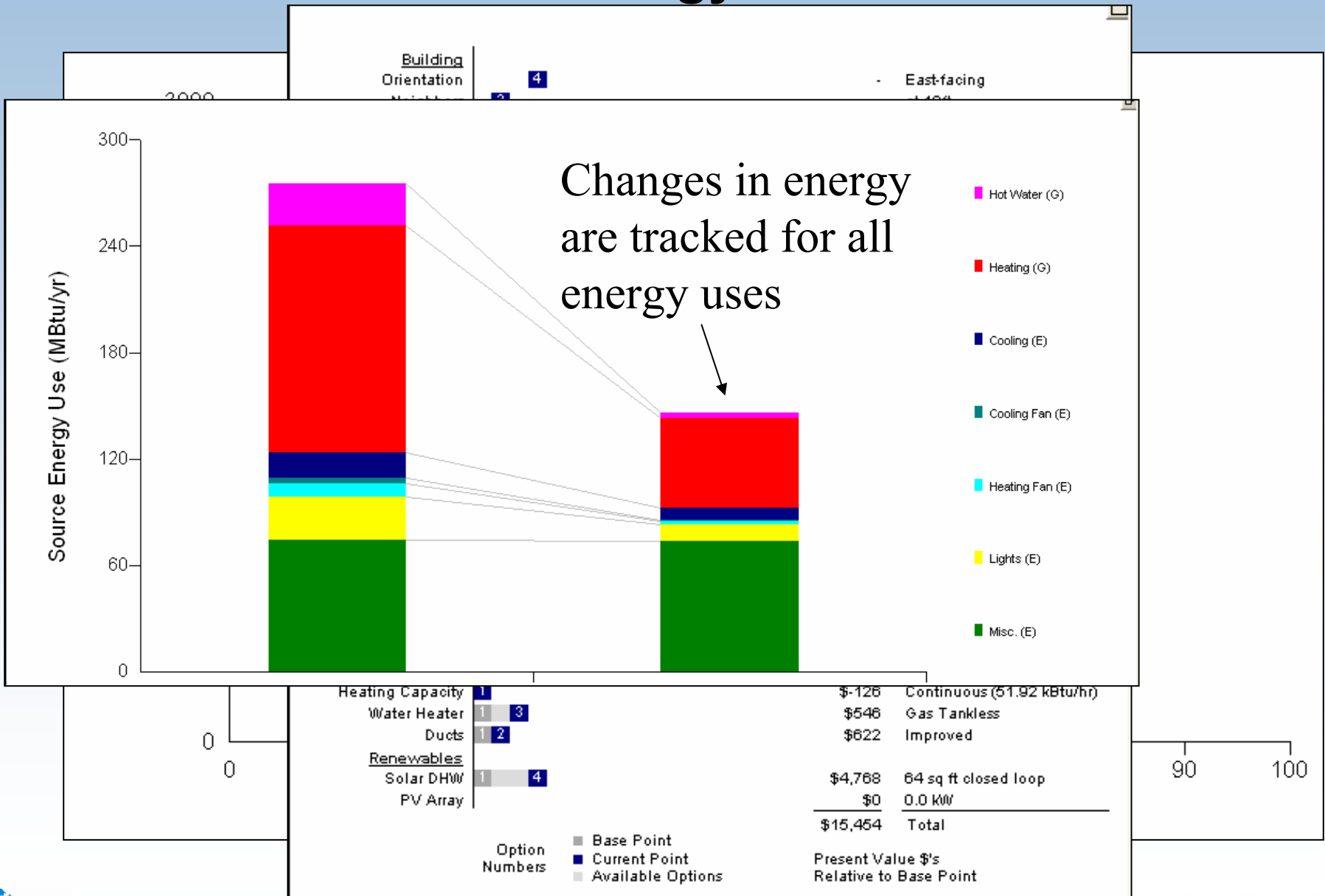
# Determining Incremental Costs and Benefits for Energy Efficient Homes



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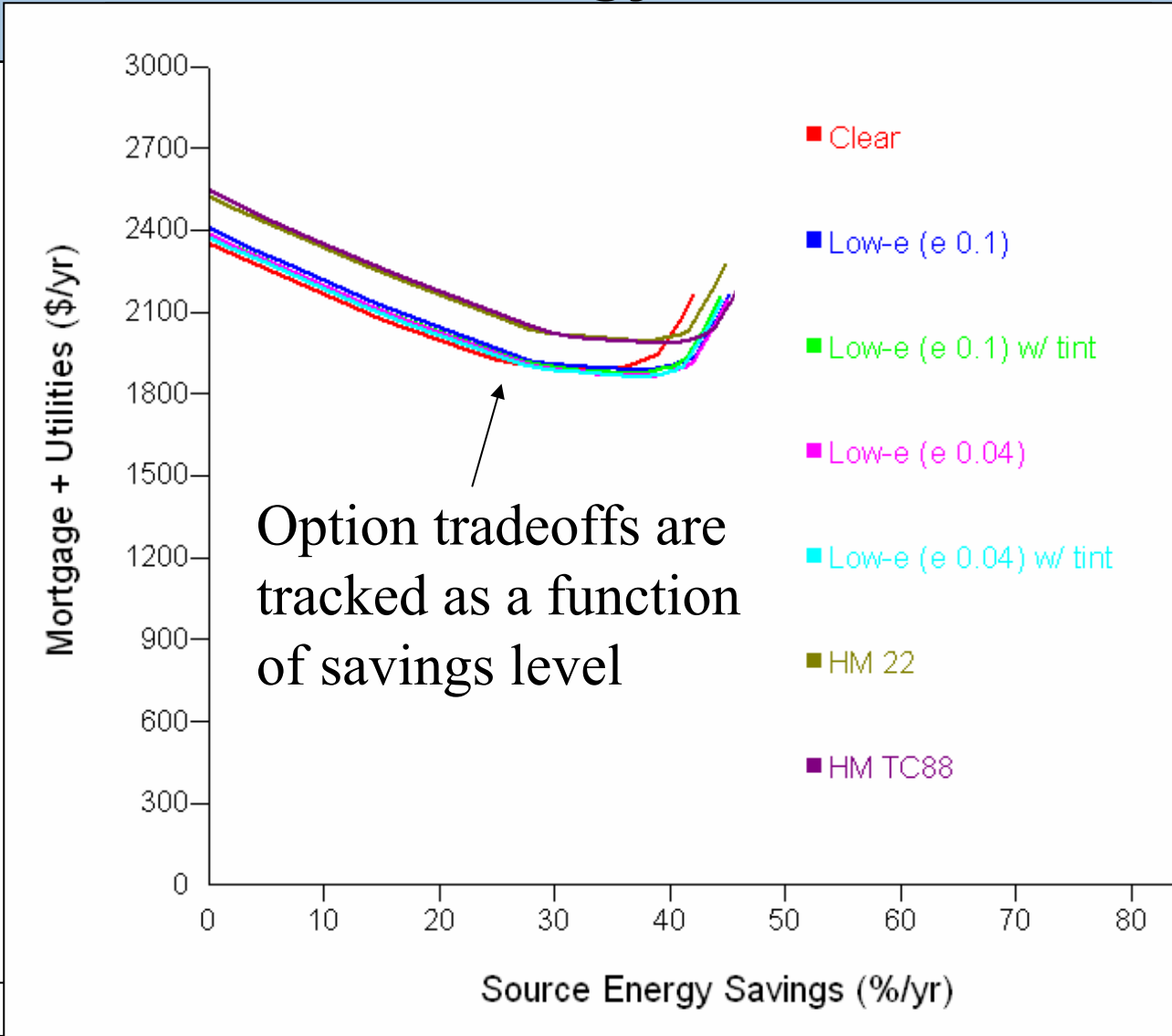
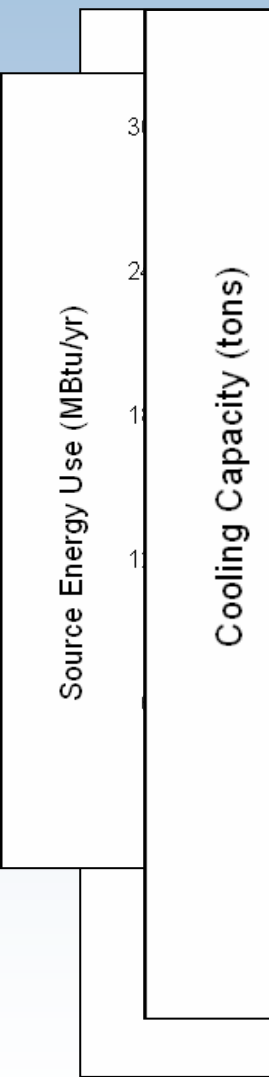
# Determining Incremental Costs and Benefits for Energy Efficient Homes







# Determining Incremental Costs and Benefits for Energy Efficient Homes



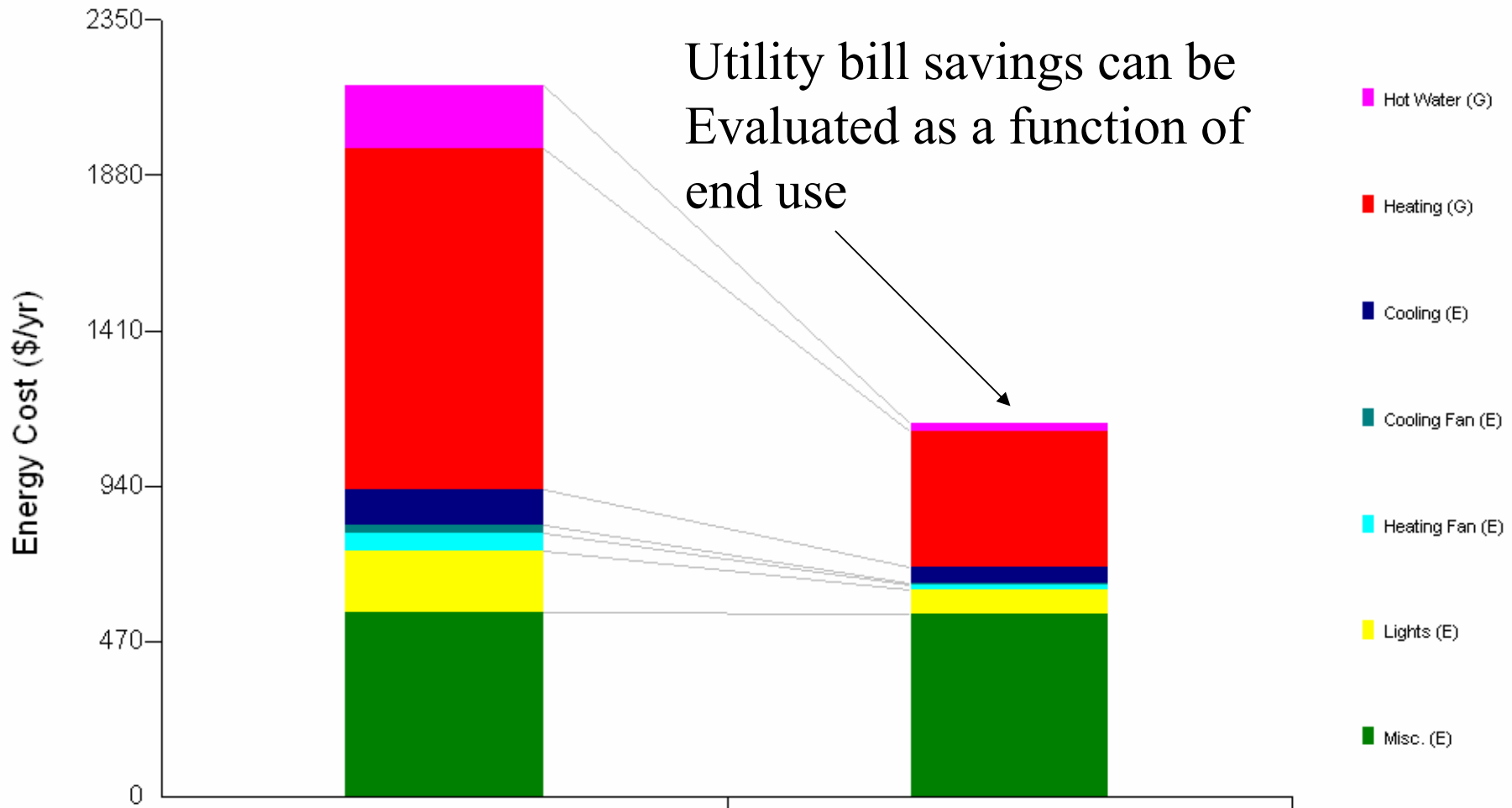
Option tradeoffs are tracked as a function of savings level

Option Numbers: ■ Base Point, ■ Current Point, ■ Available Options  
 Present Value \$'s Relative to Base Point



# Determining Incremental Costs and Benefits for Energy Efficient Homes

3000



Option Numbers

■ Base Point

■ Current Point

■ Available Options

Present Value \$'s  
Relative to Base Point

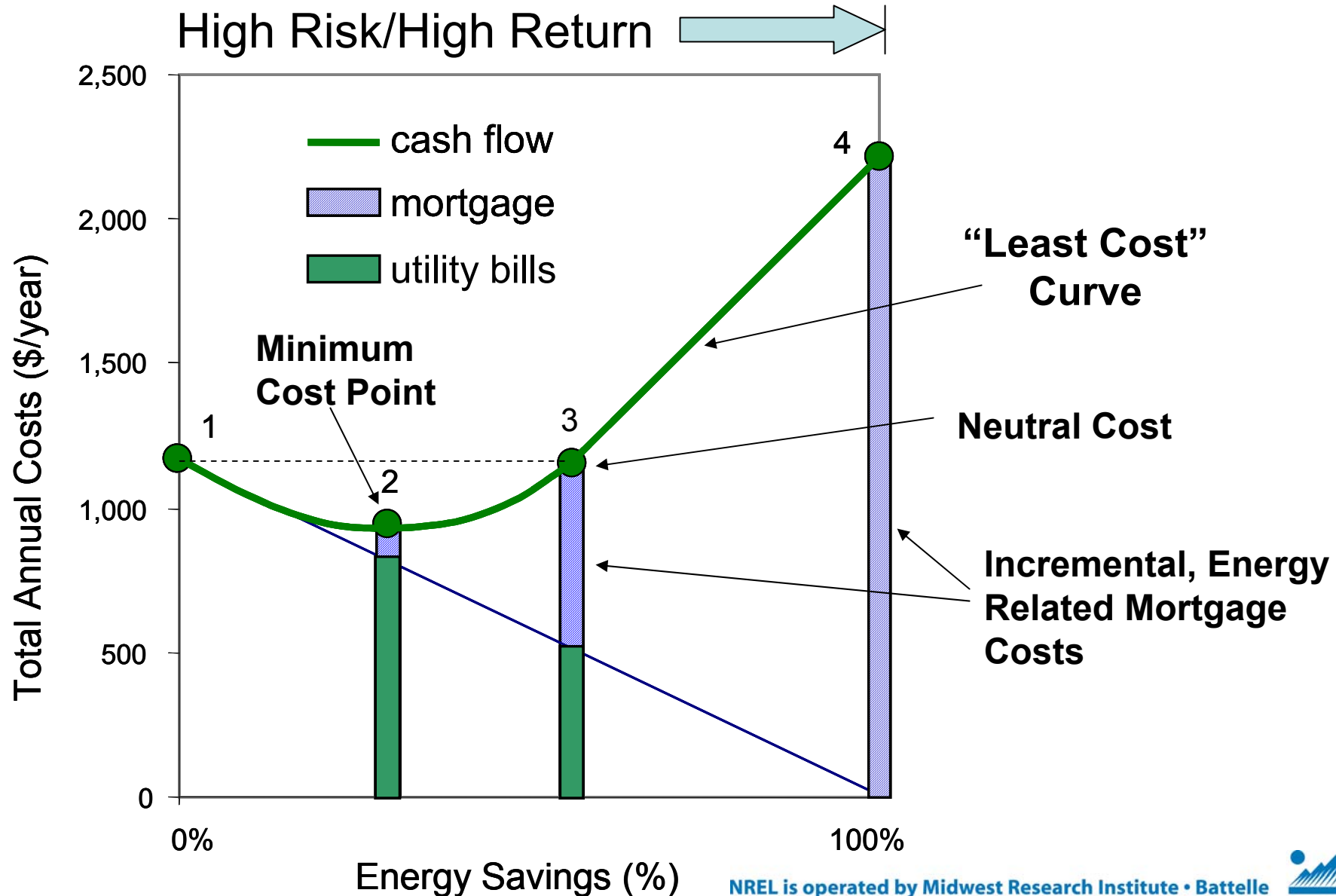
# Comparison of Energy Saving Strategies

The current study focuses on the comparison of three energy saving strategies in a hot dry climate (Phoenix):

- Equipment, Insulation, and Windows Only (“sc”)
- All Space Conditioning Options (“SC”)
- All Options (“All”)

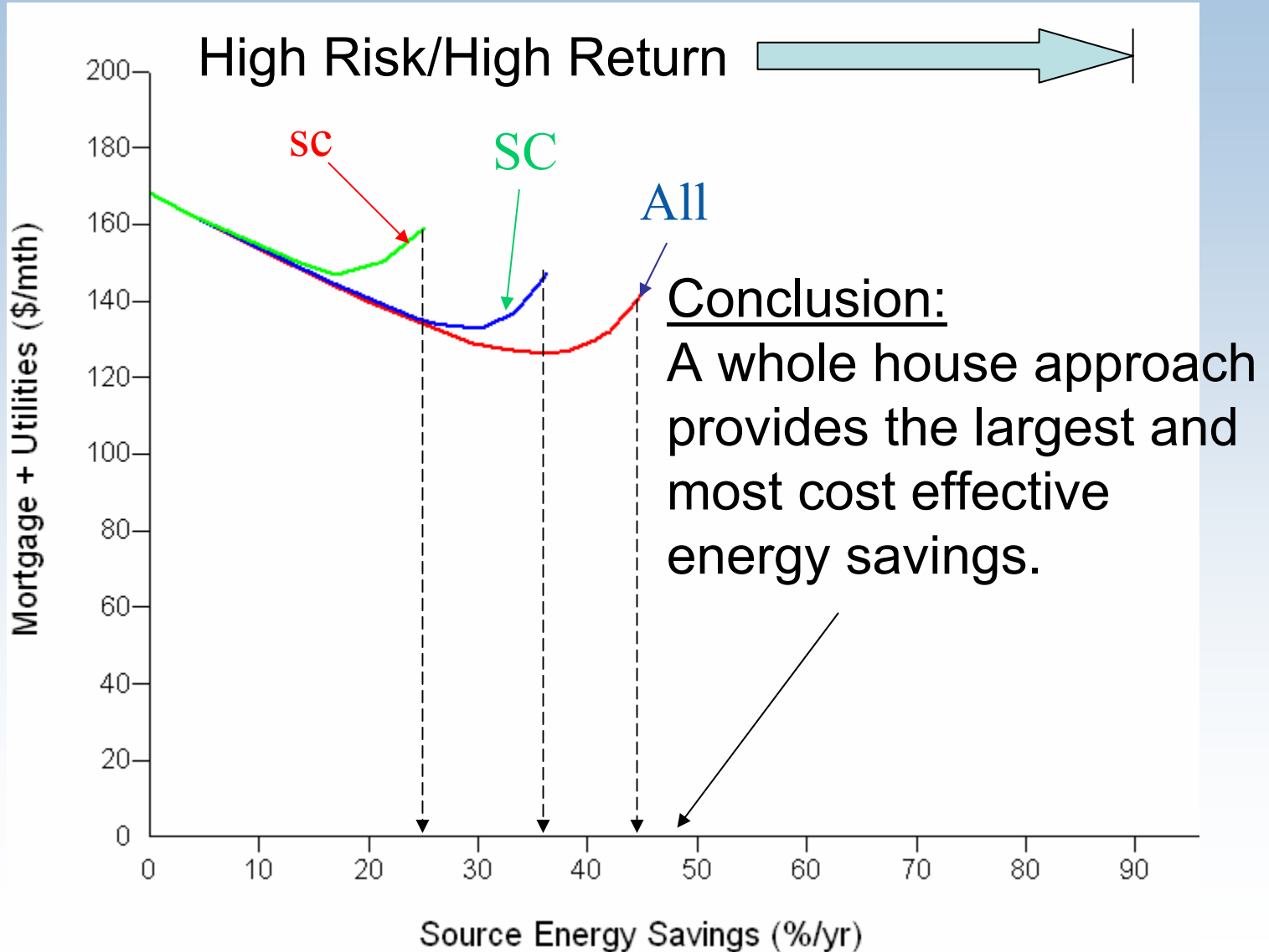
Builder redesign costs and costs to reduce risks are not included in cost estimates

# Determining Incremental Costs and Benefits for Energy Efficient Homes



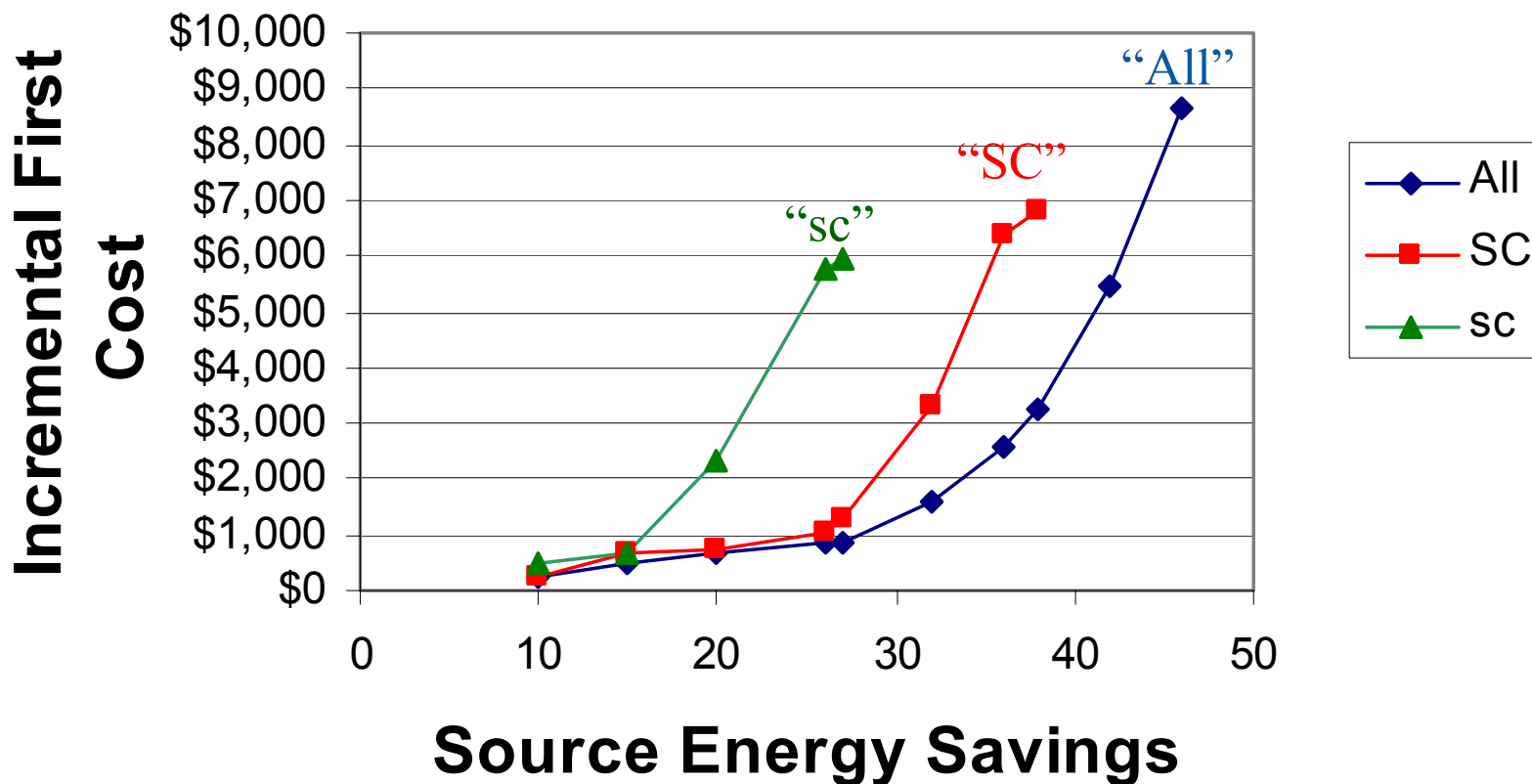
# Comparison of Energy Saving Strategies

Phoenix Base Energy Cost: \$0.08/kWh, \$0.80/Therm



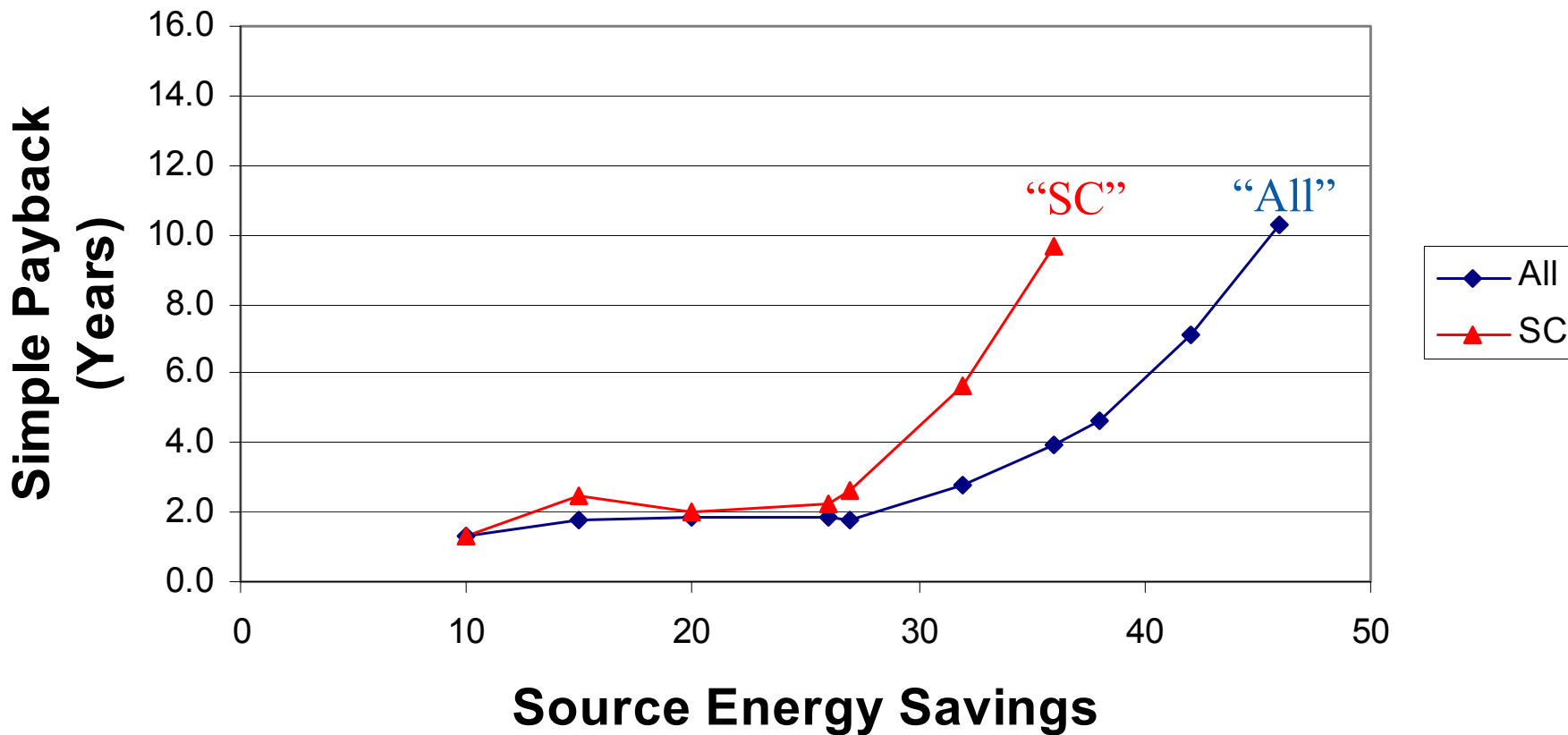
# Comparison of Energy Saving Strategies

## Phoenix First Cost Comparison



# Comparison of Energy Saving Strategies

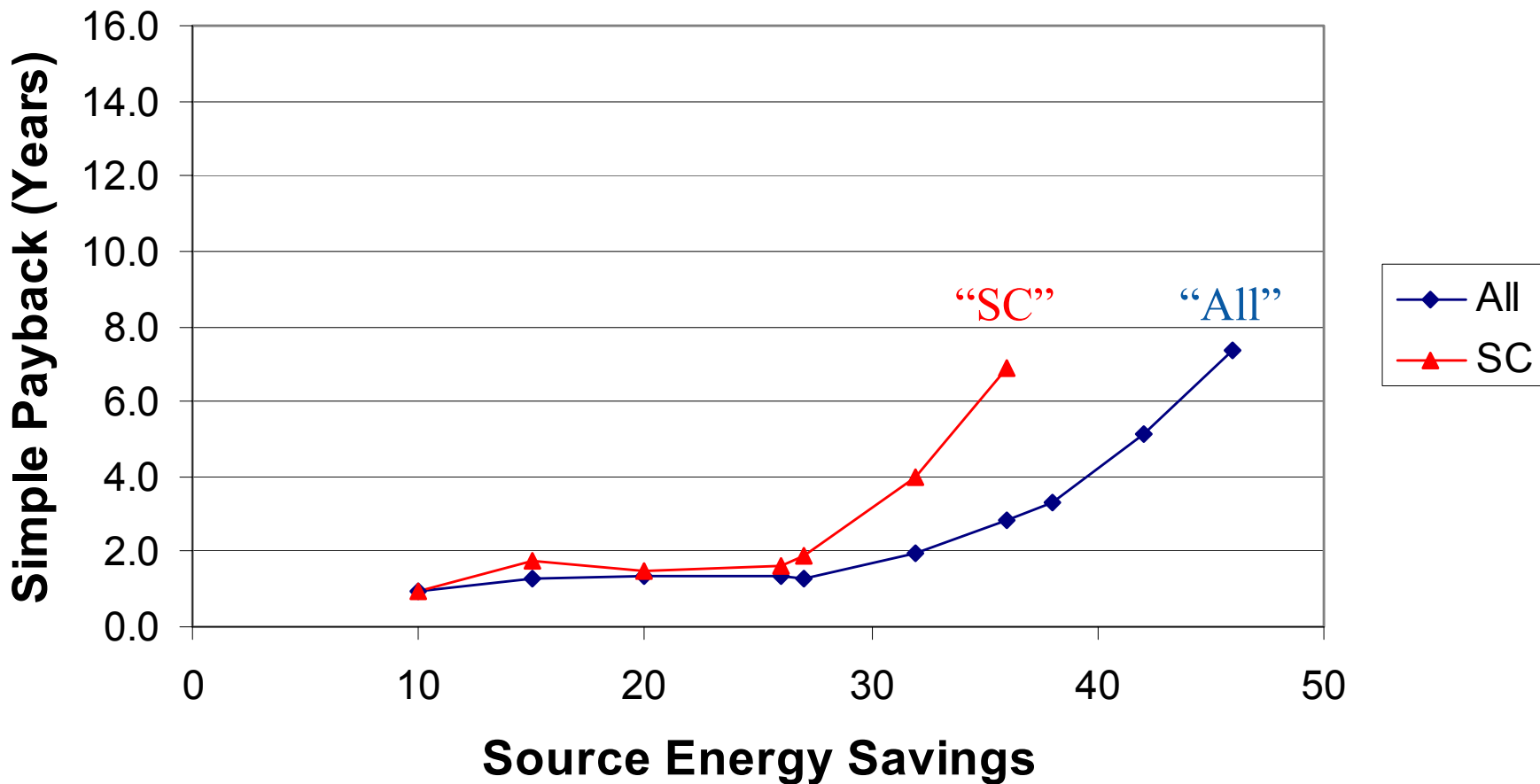
## Phoenix Simple Payback (\$0.80/Therm, \$0.08/kWh)





# Comparison of Energy Saving Strategies

**Phoenix Simple Payback**  
**(40% Increase: \$1.12/Therm, \$0.112/kWh)**



# Estimated Impacts of Current Tax Credit On Market for Energy Efficient Homes

## Cautions:

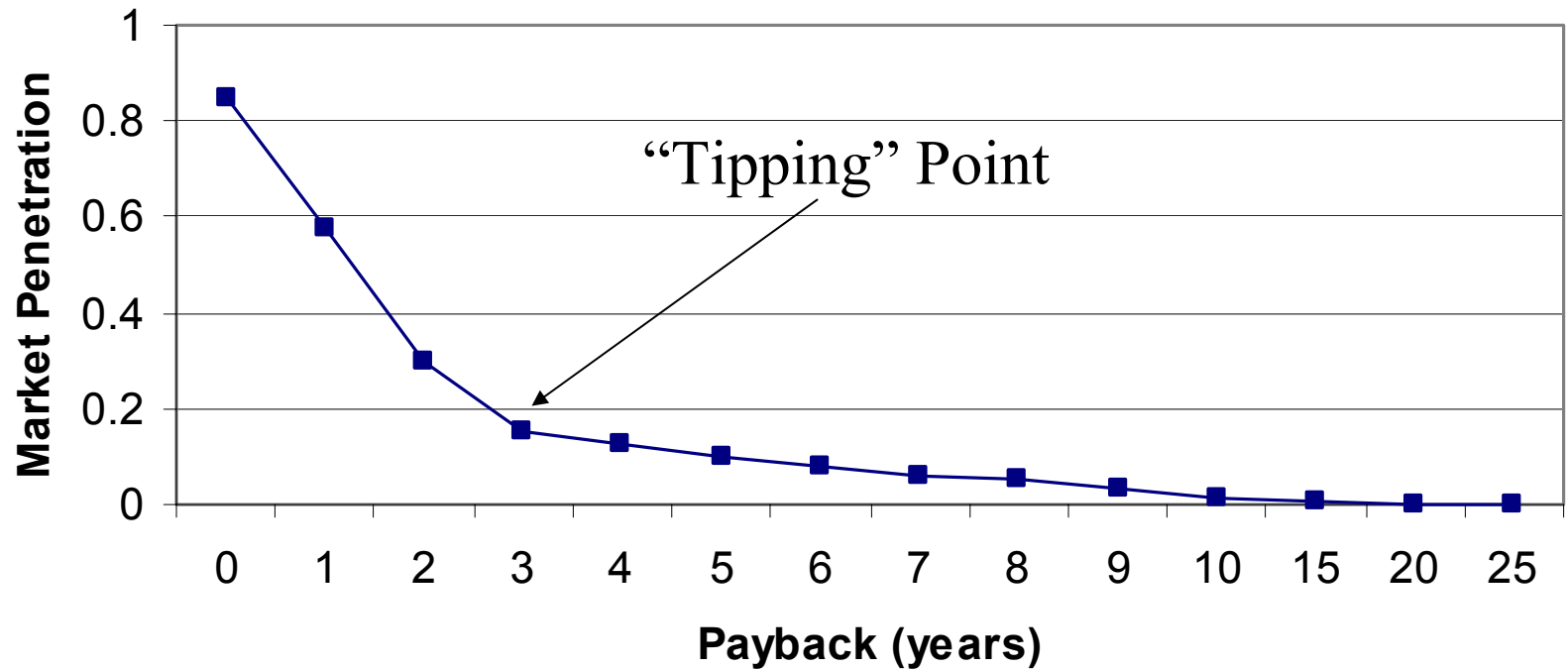
Tax credit guidelines have not been released by the IRS so several assumptions have been made:

- SEER 13 is base AC requirement
- Achieving tax credit is estimated to cost \$1000 (Net tax credit benefit is \$1000)
- IECC is reference for energy savings

Energy Scale Conversion Note: For the current case, 50% space conditioning savings is equivalent to 26% in whole house energy savings.

# Estimated Impacts of Current Tax Credit: Market Model

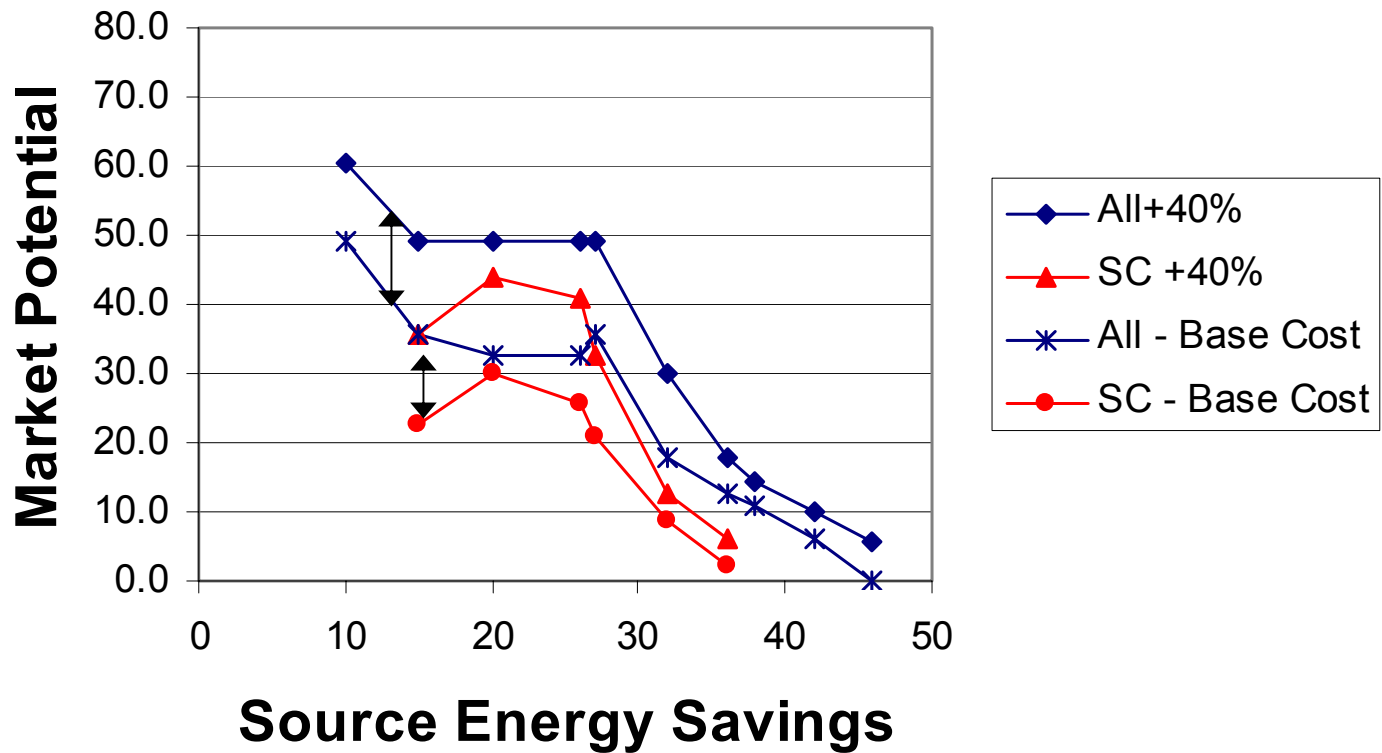
## Long Term Market Potential for Energy Efficient Homes



“Fuel Cells for Building Cogeneration Applications – Cost/Performance Requirements and Markets”; prepared for the Building Equipment Division, Office of Building Technologies, U.S. Department of Energy; prepared by Arthur D. Little, Cambridge, MA; Arthur D. Little, Reference Number 42526; Figure 6.1.2, January 1995.

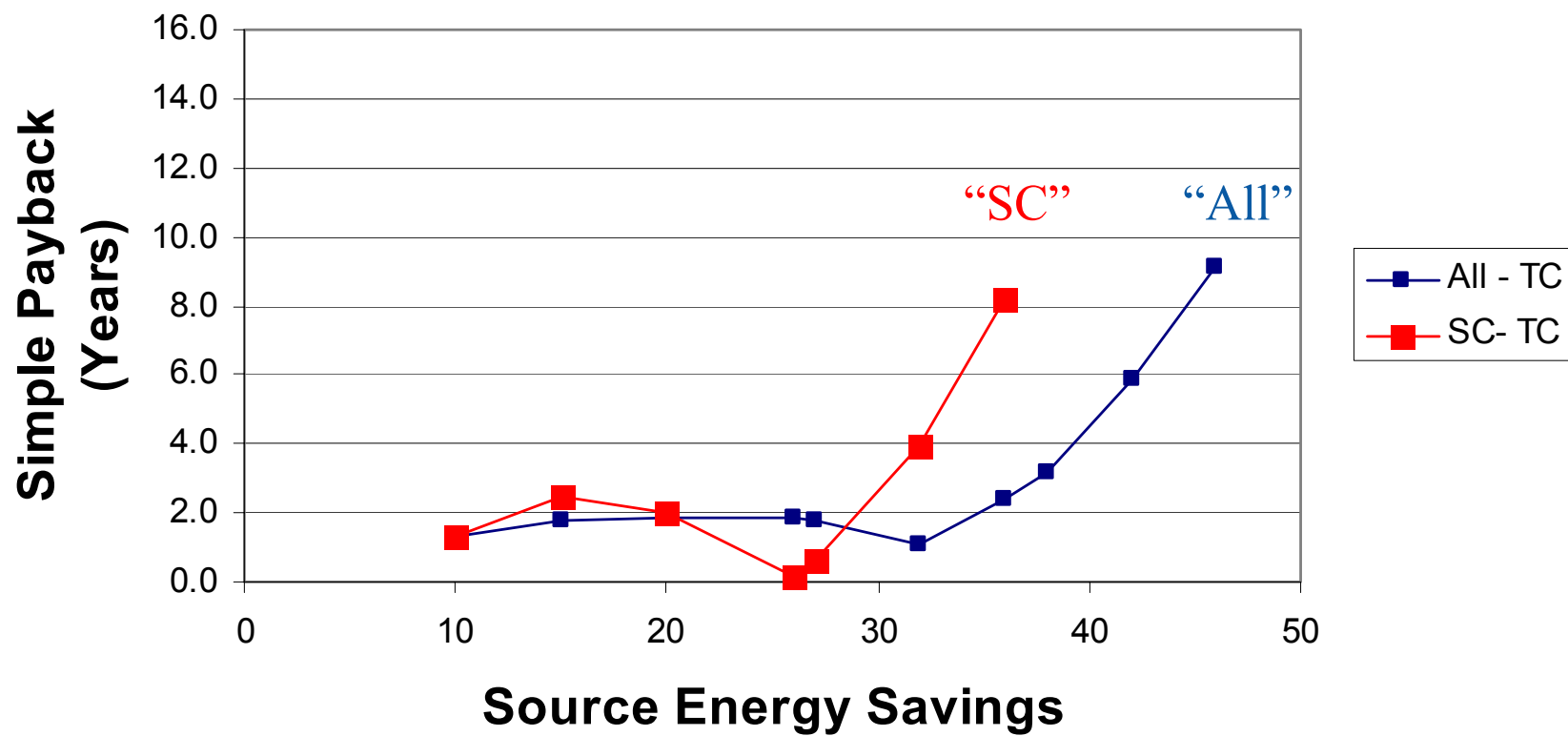
# Estimated Impacts of Energy Costs On Market for Energy Efficient Homes

## Long Term Market Potential 40% Energy Cost Increase



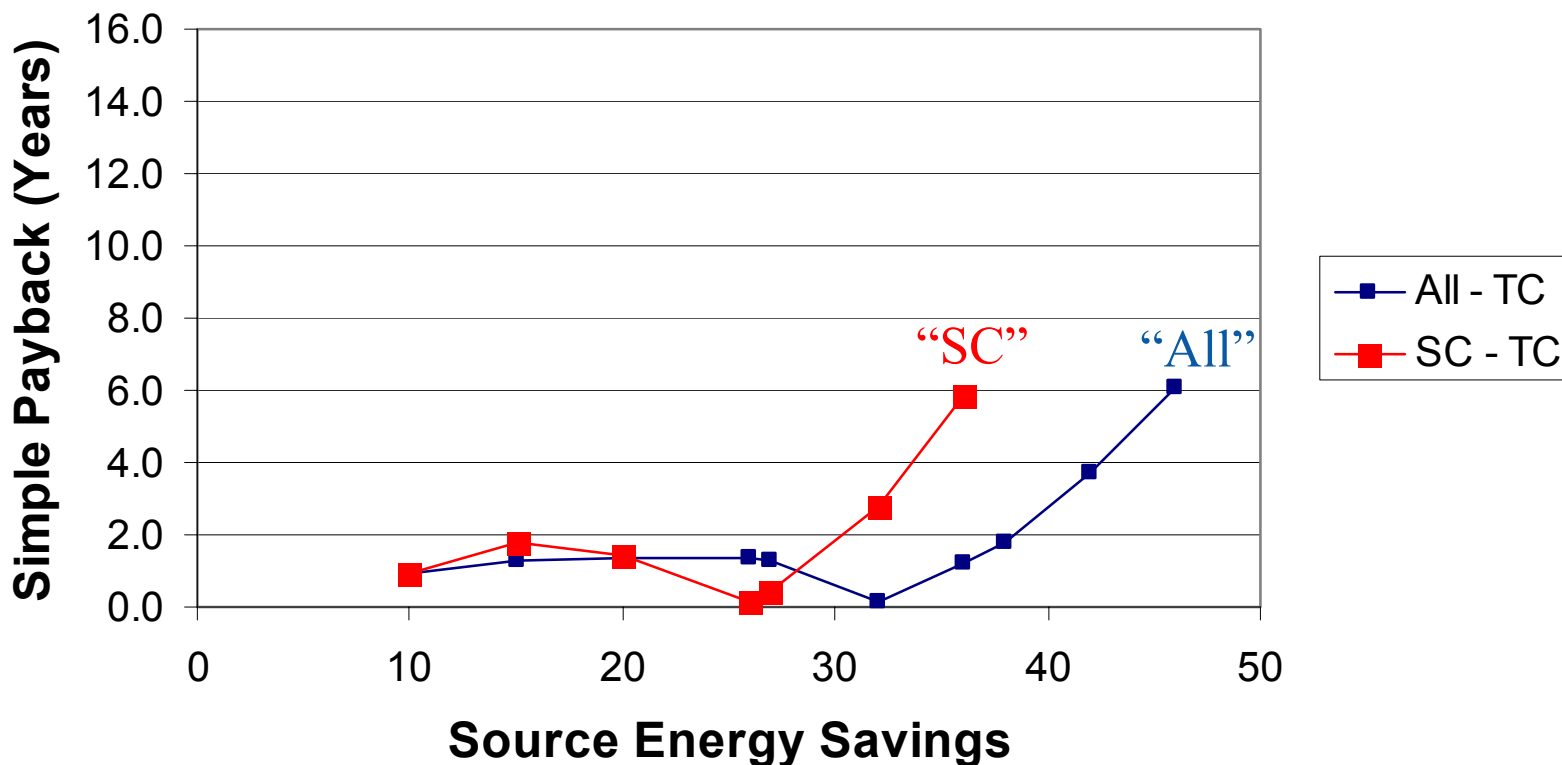
# Estimated Impacts of Current Tax Credit On: Simple Payback

## Phoenix Simple Payback (\$0.80/Therm, \$0.08/kWh)

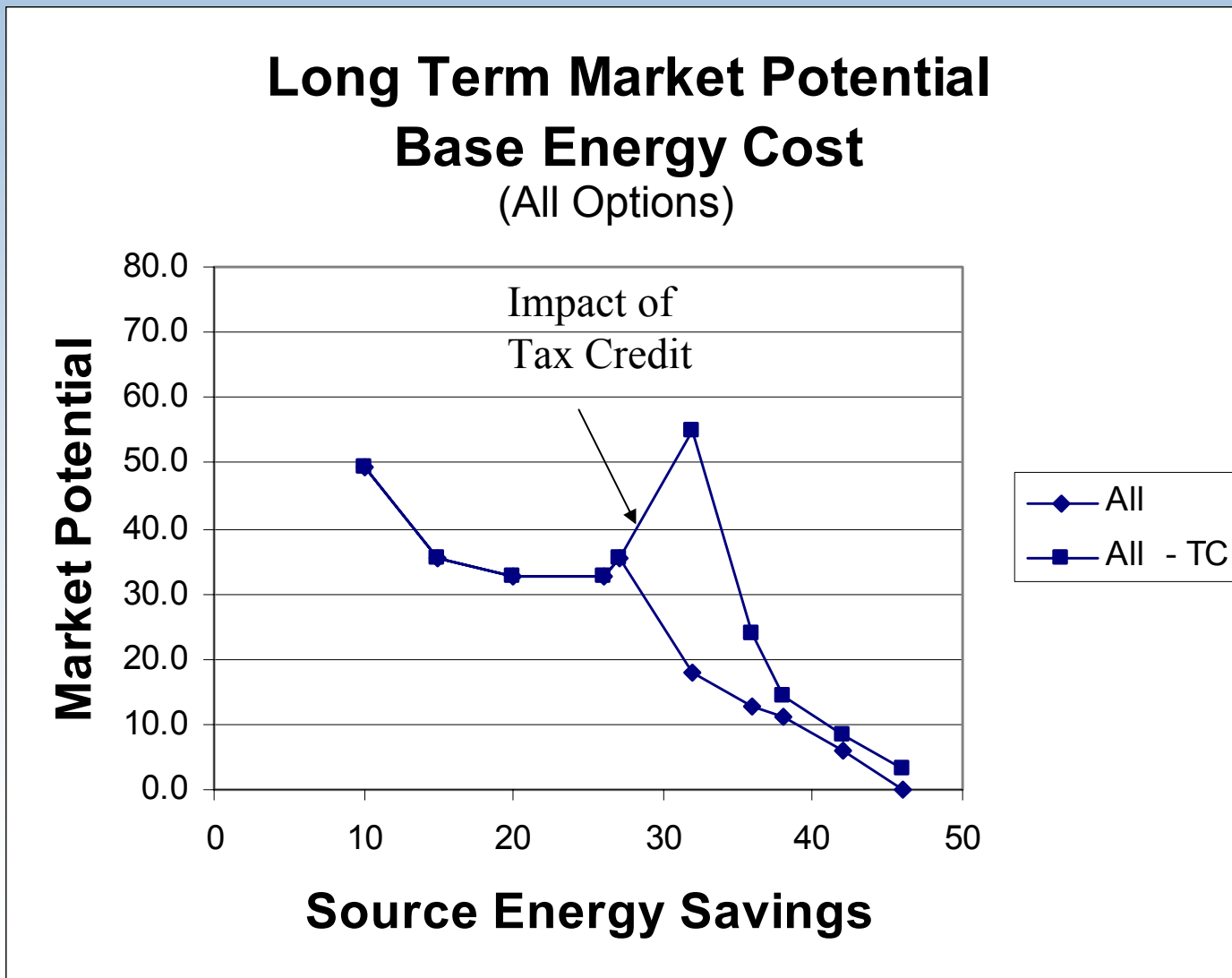


# Estimated Impacts of Current Tax Credit On: Simple Payback with Increased Energy Cost

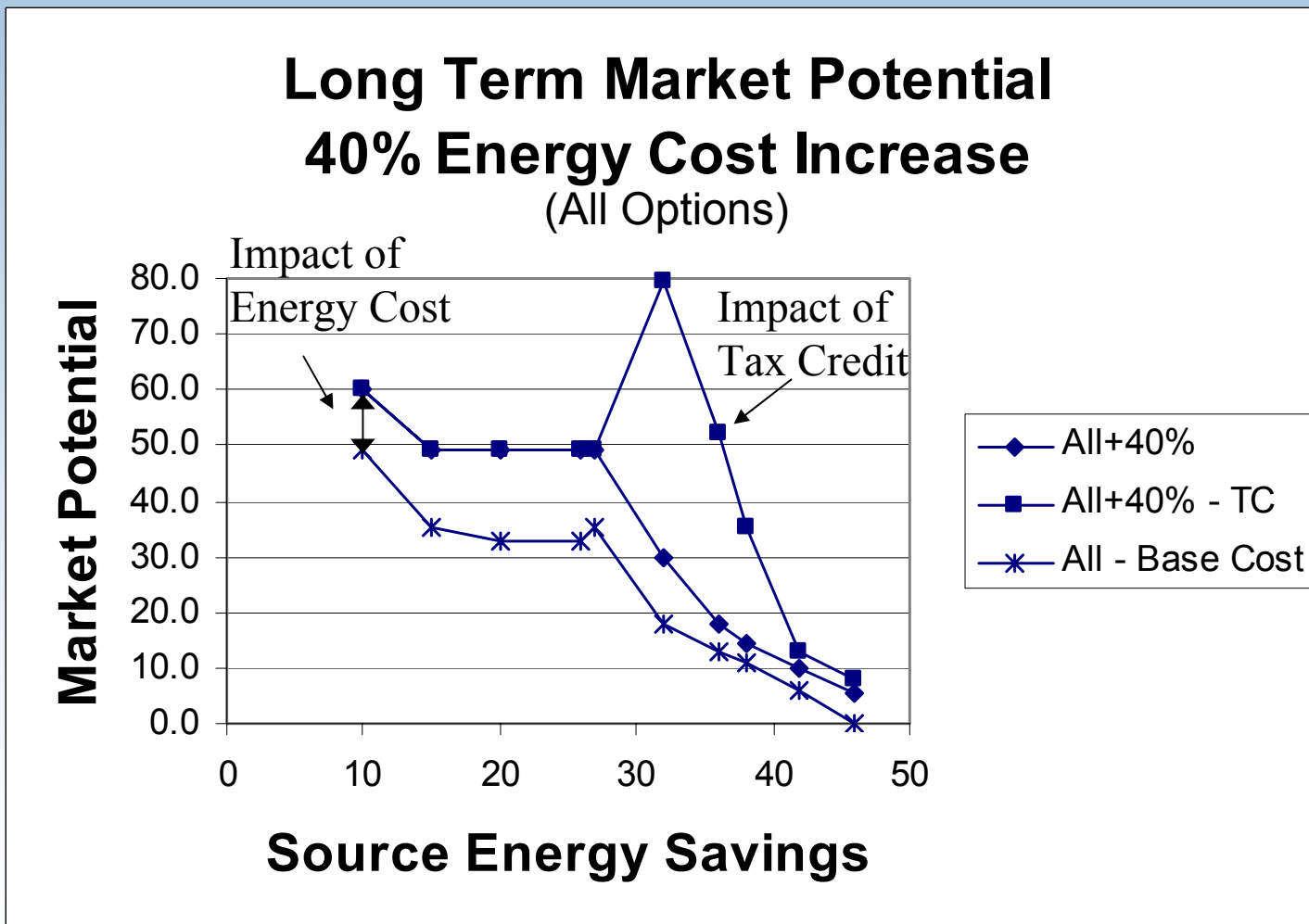
Phoenix Simple Payback  
(40% Increase: \$1.12/Therm, \$0.112/kWh)



# Estimated Impacts of Current Tax Credit On Market for Energy Efficient Homes

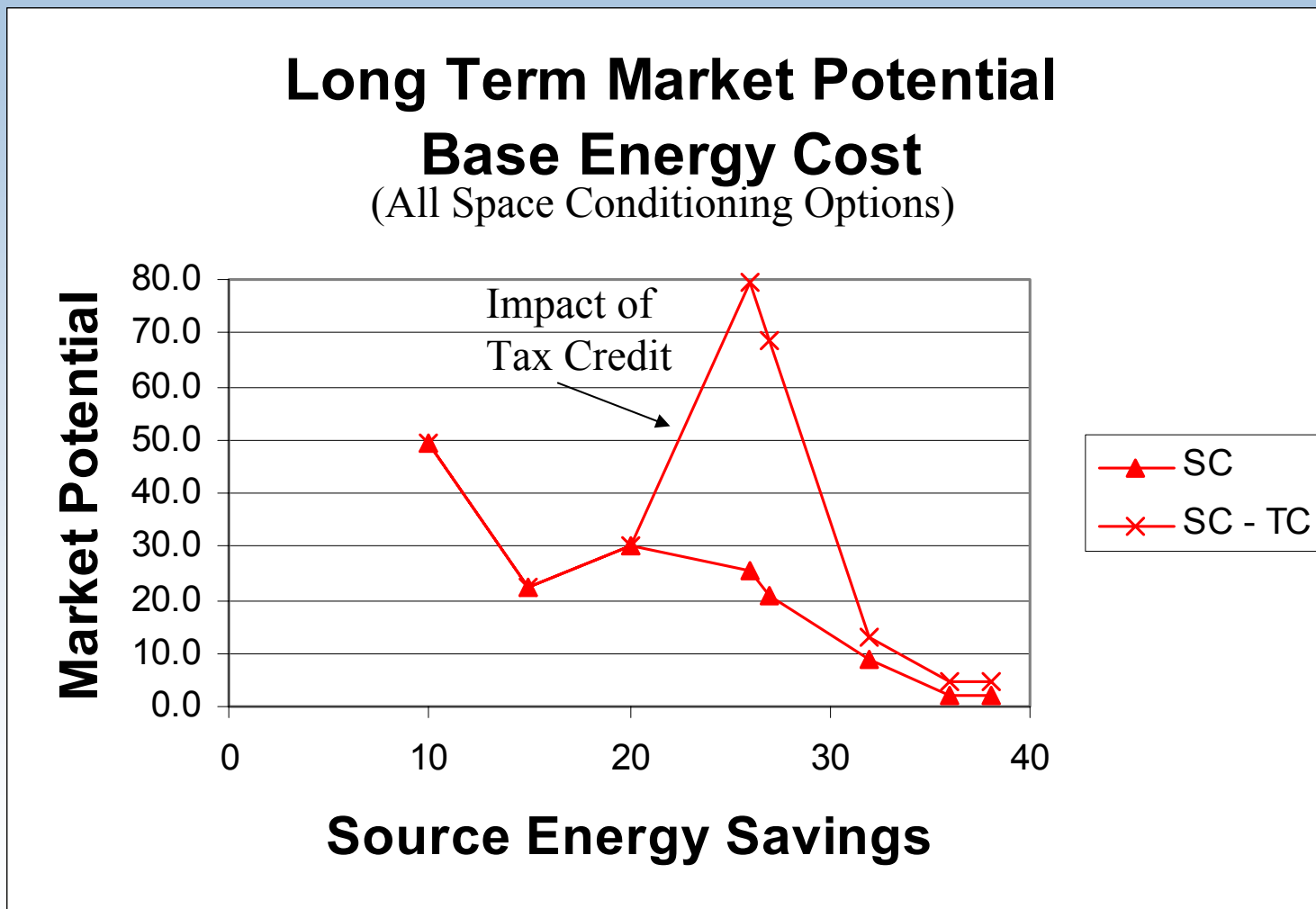


# Estimated Impacts of Current Tax Credit On Market for Energy Efficient Homes

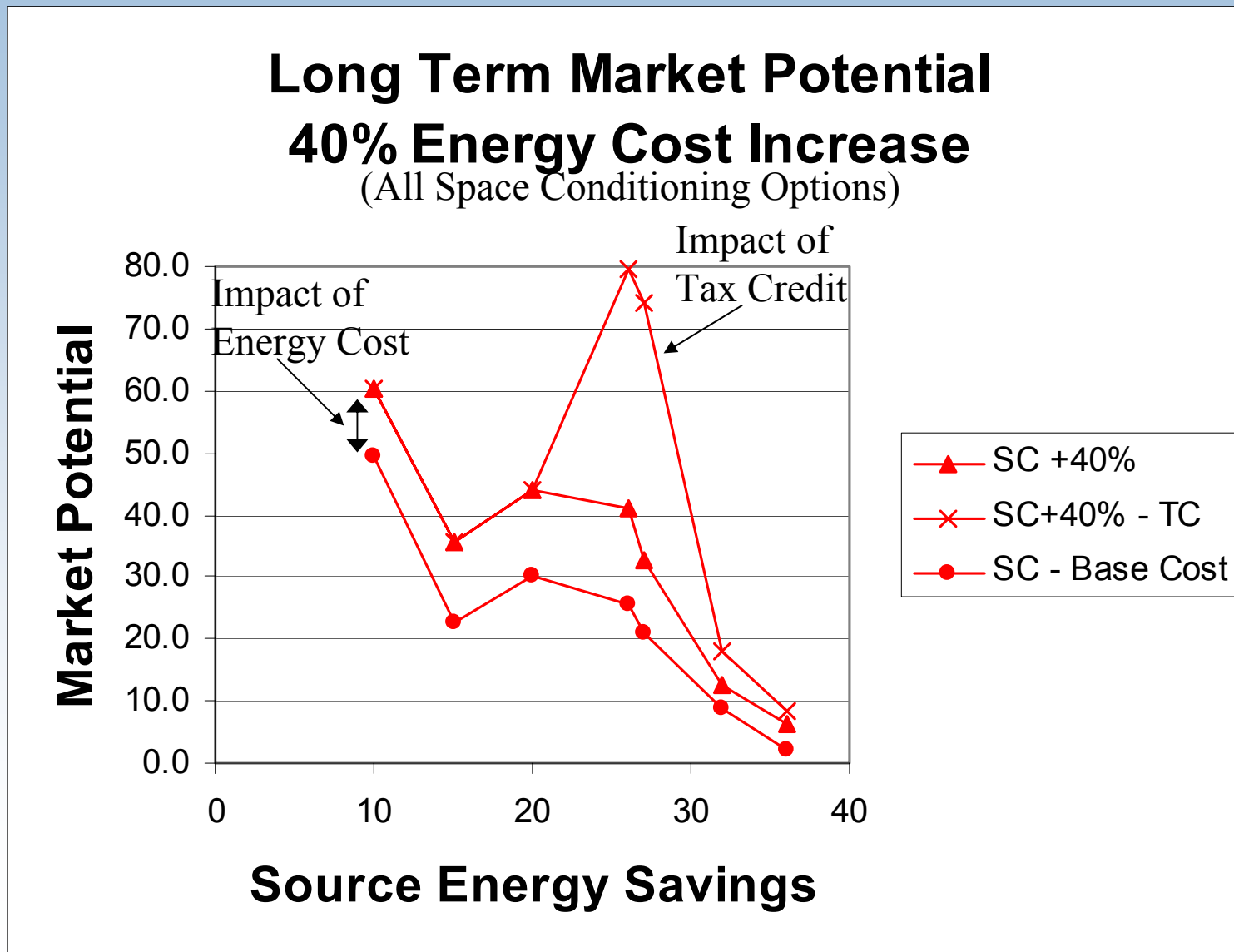




# Estimated Impacts of Current Tax Credit On Market for Energy Efficient Homes

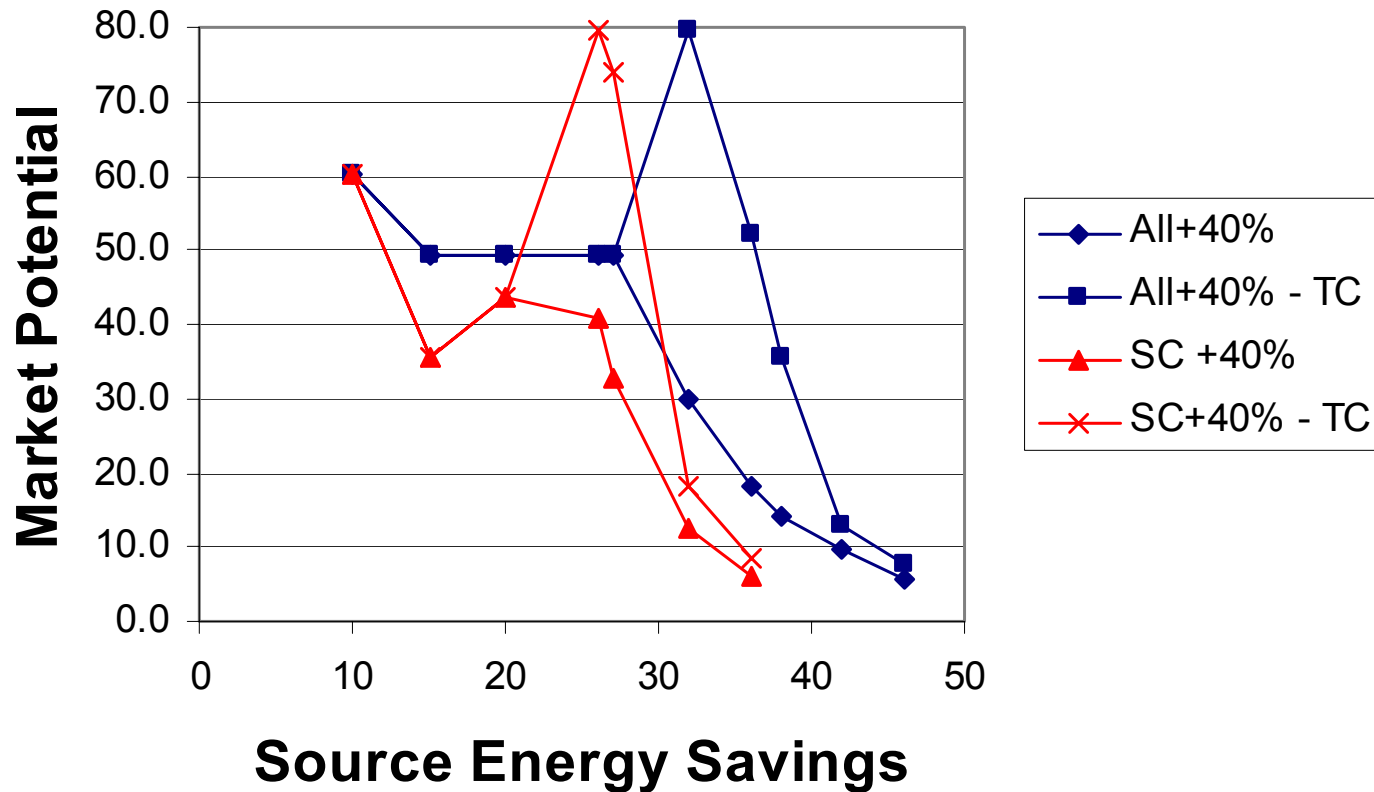


# Estimated Impacts of Current Tax Credit On Market for Energy Efficient Homes



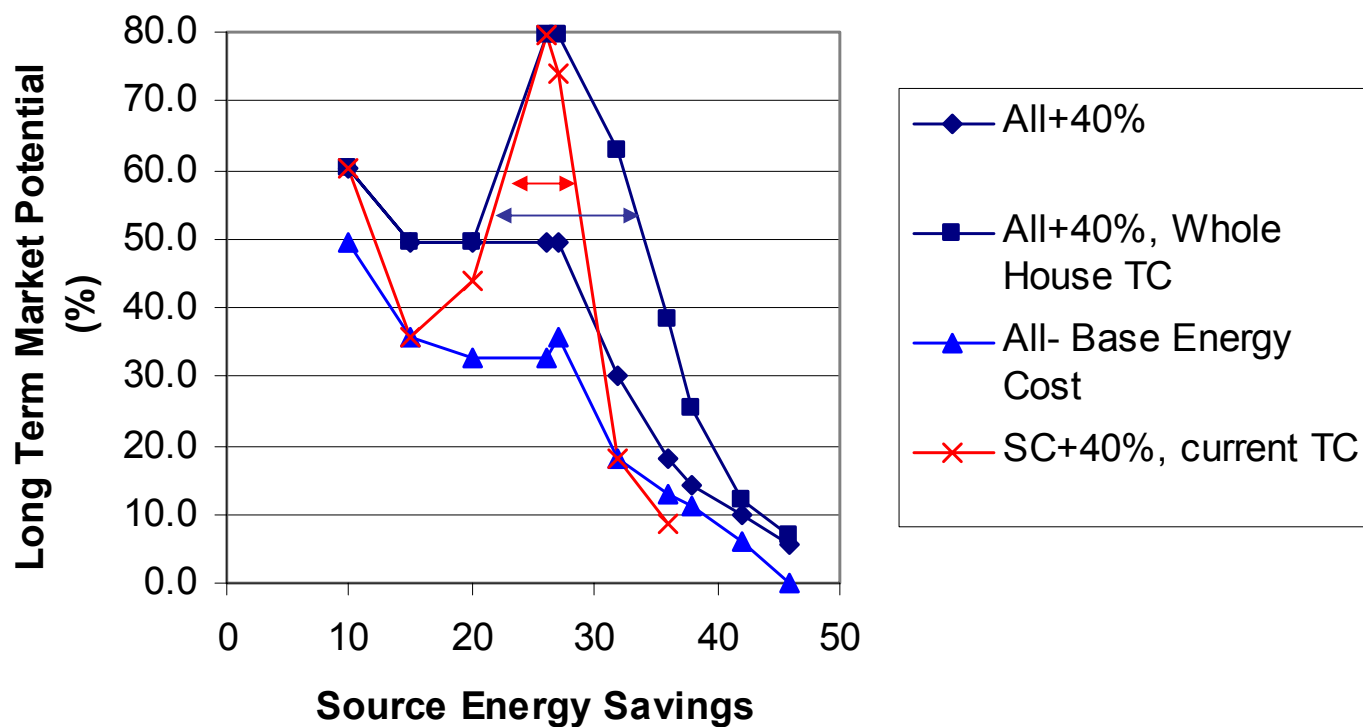
# Estimated Impacts of Current Tax Credit and Increased Energy Costs On Market for Energy Efficient Homes

## Estimated Market Impact of Tax Credit Plus Energy Cost Increase

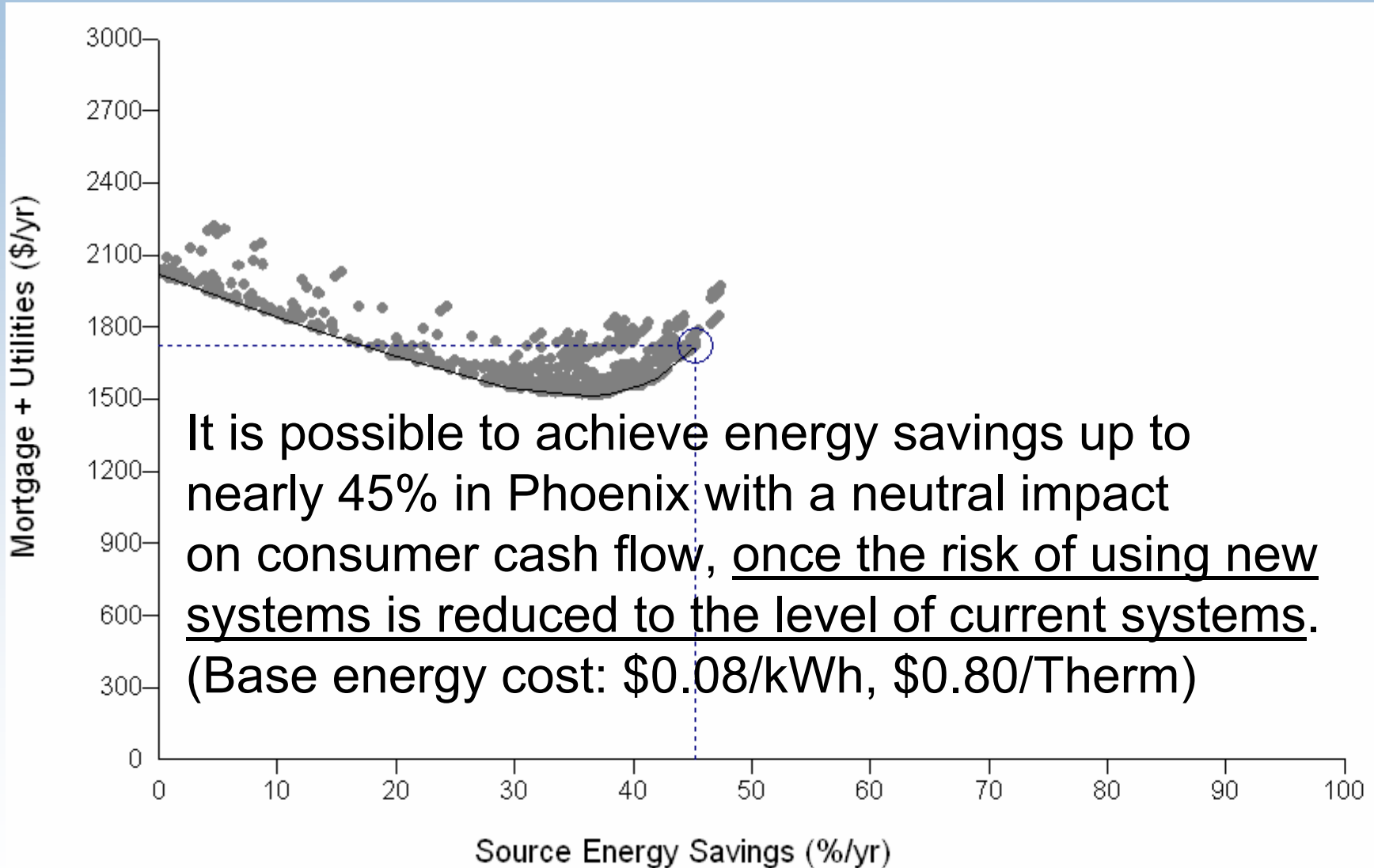


# Estimated Impacts of Hypothetical “Whole House” Tax Credit On Market for Energy Efficient Homes

Estimated Impact of Hypothetical Whole House Tax Credit at the 30% Savings Level with 40% Energy Cost Increase

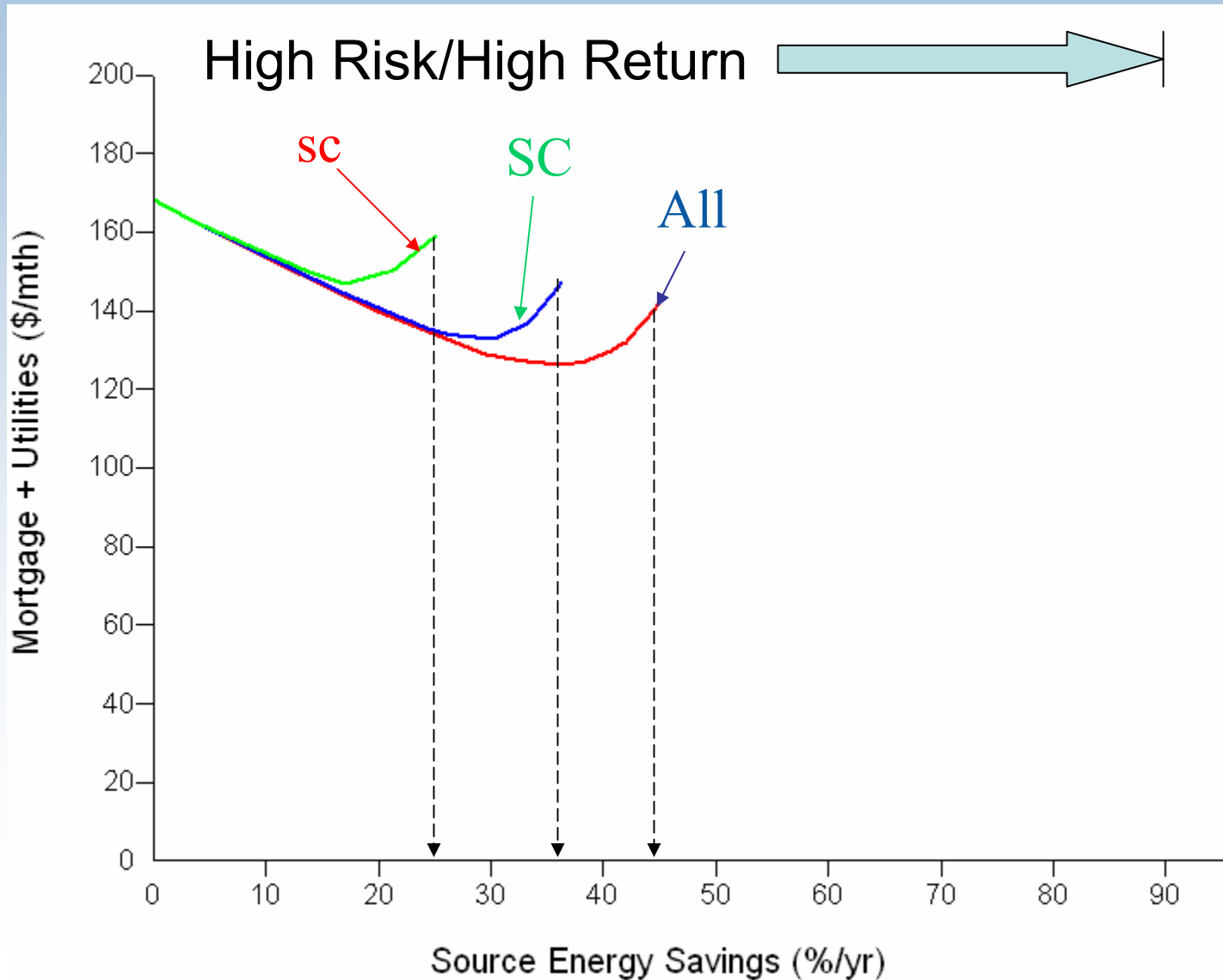


# Conclusions



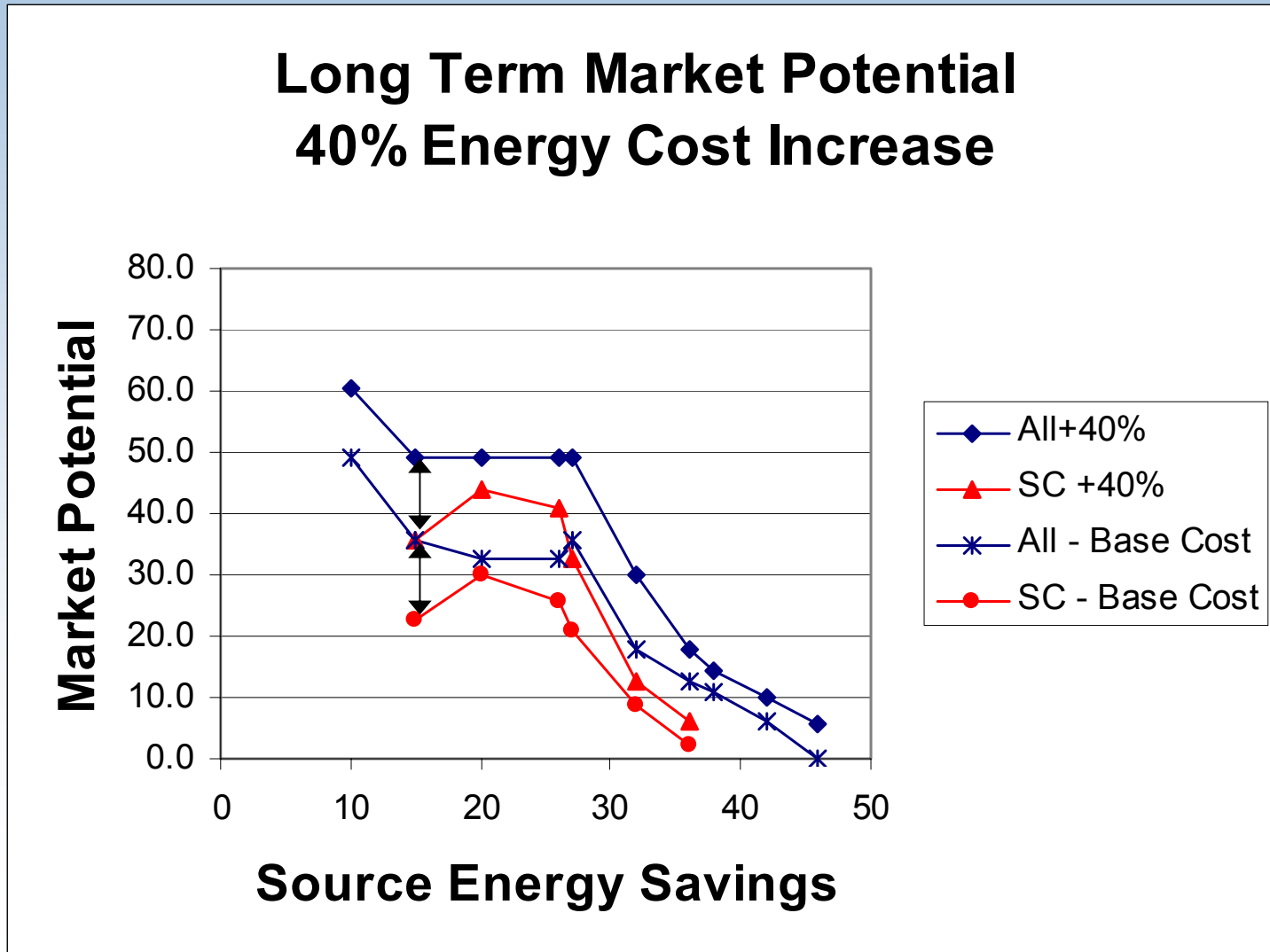
# Conclusions

A “whole house” approach provides the largest and most cost effective energy savings.



# Conclusions

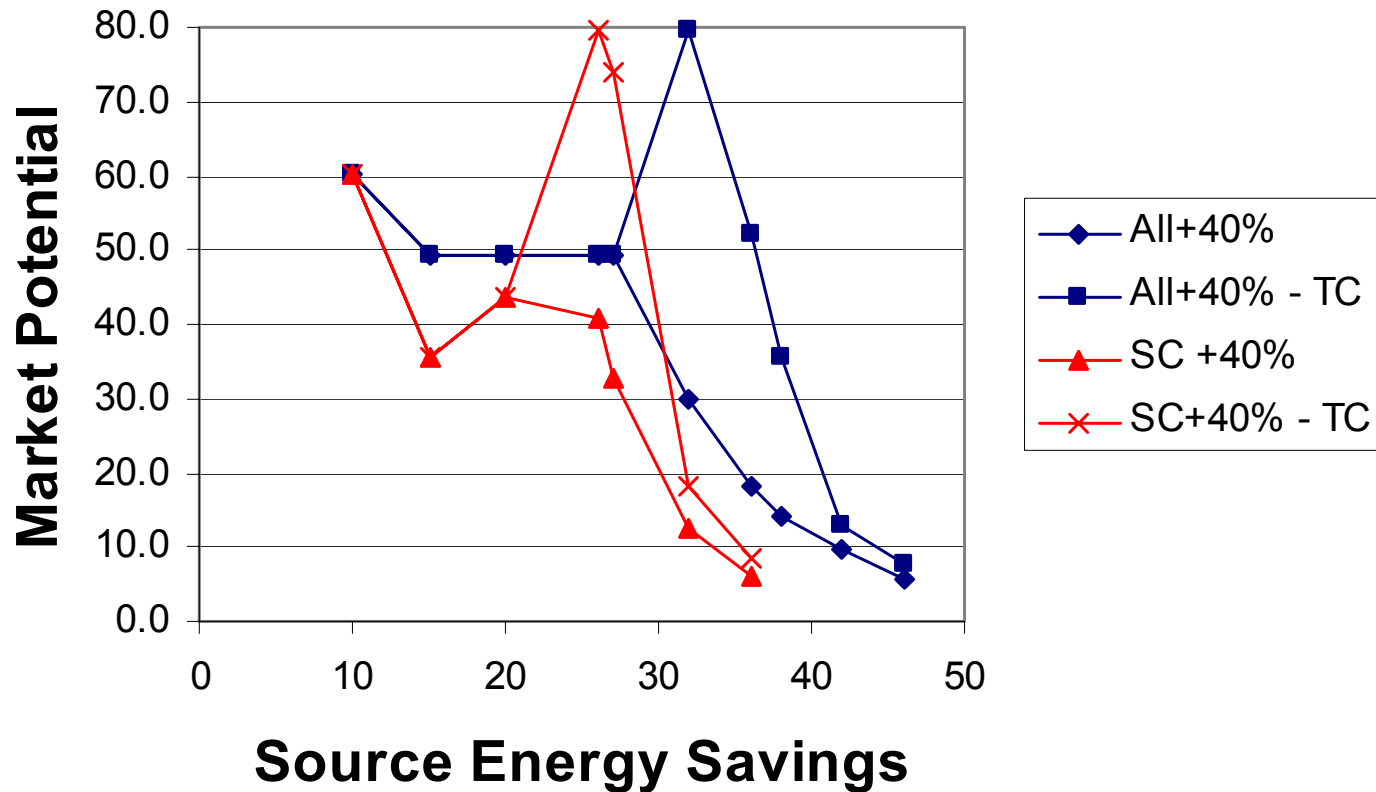
Near term increases in energy costs are expected to contribute to an increase in the demand for houses in the 10-25% savings range.



# Conclusions

The current tax credit is expected to contribute to an increase in the demand for houses in the 25-40% savings range.

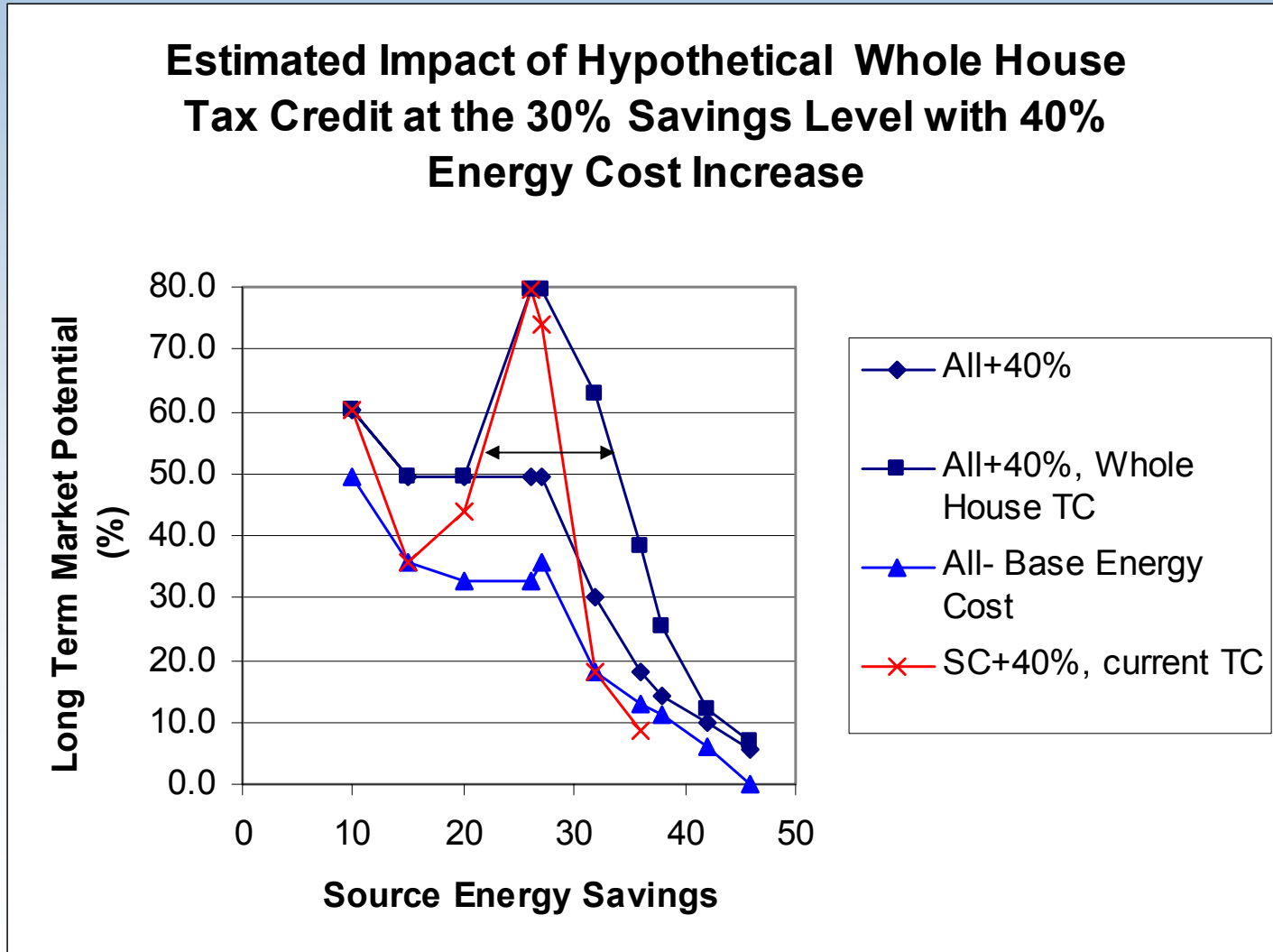
## Estimated Market Impact of Tax Credit Plus Energy Cost Increase





# Conclusions

A “whole house” tax credit could provide more savings than the current tax credit.



# Questions?

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