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

Ren Anderson
National Renewable Energy Laboratory
SWEEP Workshop
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How Far Can We Go?
How Long Will Fossil Fuels Last?

You Are Here!

The Association for the Study of Peak Oil and Gas, October 2005 Newsletter, 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?

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
- Natural gas 52%
- Liquefied petroleum gases 6%
- Electricity 31%
- Fuel oil 9%
- Other 2%

U.S. natural gas residential price

$15 per thousand cubic feet

SOURCE: Energy Information Administration
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

## Walls

<table>
<thead>
<tr>
<th>Options: (Select to include in optimization)</th>
<th>Framing Factor</th>
<th>Lifetime (years)</th>
<th>Unit Cost ($/sq ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) R11 batts, 2x4, 16&quot; oc</td>
<td>0.25</td>
<td>30</td>
<td>$3.15</td>
</tr>
<tr>
<td>2) R13 batts, 2x4, 16&quot; oc</td>
<td>0.25</td>
<td>30</td>
<td>$3.17</td>
</tr>
<tr>
<td>3) R11 batts, 2x4, 16&quot; oc + 1&quot; foam sheathing</td>
<td>0.25</td>
<td>30</td>
<td>$3.92</td>
</tr>
<tr>
<td>4) R19 batts, 2x6, 24&quot; oc</td>
<td>0.20</td>
<td>30</td>
<td>$3.28</td>
</tr>
<tr>
<td>5) R19 batts, 2x6, 24&quot; oc + 1&quot; foam sheathing</td>
<td>0.20</td>
<td>30</td>
<td>$4.05</td>
</tr>
<tr>
<td>6) R19 batts, 2x6, 24&quot; oc + 2&quot; foam sheathing</td>
<td>0.20</td>
<td>30</td>
<td>$4.24</td>
</tr>
</tbody>
</table>

## Envelope
- Orientation
- Neighbors
- 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
Determining Incremental Costs and Benefits for Energy Efficient Homes

Detailed performance information is retained for all building designs.
Determining Incremental Costs and Benefits for Energy Efficient Homes

Changes in energy are tracked for all energy uses.
Cost savings due to reductions in equipment size are included in determination of net cost increases.
Determining Incremental Costs and Benefits for Energy Efficient Homes

Option tradeoffs are tracked as a function of savings level.
Option tradeoffs are tracked as a function of savings level. Utility bill savings can be evaluated as a function of end use.
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

High Risk/High Return

Minimum Cost Point

Neutral Cost

"Least Cost" Curve

Incremental, Energy Related Mortgage Costs

0% 100%

Energy Savings (%)
Comparison of Energy Saving Strategies
Phoenix Base Energy Cost: $0.08/kWh, $0.80/Therm

Conclusion:
A whole house approach provides the largest and most cost effective energy savings.
Comparison of Energy Saving Strategies

Phoenix First Cost Comparison

Incremental First Cost vs. Source Energy Savings

- "All"
- "SC"
- "sc"

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Comparison of Energy Saving Strategies

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

Source Energy Savings

Simple Payback (Years)

“SC”  “All”

All  SC

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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

“Tipping” Point

“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

Source Energy Savings vs. Market Potential

- All +40%
- SC +40%
- All - Base Cost
- SC - Base Cost
Estimated Impacts of Current Tax Credit On: Simple Payback

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

Source Energy Savings

Simple Payback (Years)

“SC”  “All”

All - TC
SC - TC

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

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

Source Energy Savings
Simple Payback (Years)
0 10 20 30 40 50
0 4 8 12 16

"SC" "All"

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

Long Term Market Potential
Base Energy Cost
(All Options)

Impact of Tax Credit

Market Potential

Source Energy Savings

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

Long Term Market Potential
40% Energy Cost Increase
(All Options)

Source Energy Savings

Impact of Energy Cost
Impact of Tax Credit

Market Potential

- All+40%
- All+40% - TC
- All - Base Cost

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

Long Term Market Potential
Base Energy Cost
(All Space Conditioning Options)

Source Energy Savings

Impact of Tax Credit

SC
SC - TC

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

Long Term Market Potential
40% Energy Cost Increase
(All Space Conditioning Options)

Impact of Energy Cost
Impact of Tax Credit

Source Energy Savings
Market Potential

SC +40%
SC +40% - TC
SC - Base Cost
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

Source Energy Savings vs. Market Potential

- All+40%
- All+40% - TC
- SC +40%
- SC+40% - TC

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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

Source Energy Savings vs. Long Term Market Potential

- All+40%
- All+40%, Whole House TC
- All- Base Energy Cost
- SC+40%, current TC

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Conclusions

It is possible to achieve energy savings up to nearly 45% in Phoenix with a neutral impact on consumer cash flow, once the risk of using new systems is reduced to the level of current systems. (Base energy cost: $0.08/kWh, $0.80/Therm)
Conclusions

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

High Risk/High Return
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.
Conclusions

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

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

Ren_Anderson@nrel.gov
NREL
1617 Cole Blvd
Golden, Colorado
80401