



# The Shell Game: Finding Thermal Savings in Residential Retrofit Programs

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# Outline

- Background
- Programs
- Evaluations
- Savings
- Reasons
- Conclusions





# Ten Thousand Meter View

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- Rigorous evaluation can tell us not only how well a program is doing but also provide a range of what a program can do.
- Impact evaluations of 7 residential retrofit programs in the northeast US shows remarkable similarity in the percent savings of pre-treatment usage.
- The limiting factors are likely investment costs and the potential savings available in the housing stock



# BACKGROUND





# The Stage

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- Residential space and water heating are a potentially large source of energy savings
- Residential efficiency programs have been operating in the United States for several decades. There is a wide range of program designs addressing this market
- Our focus is programs attempting to obtain large savings from a substantial investment



# Northeastern United States

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- Demographically and Geographically diverse
- Include some of most urban and rural areas of the United States
- Heating degree days ( $^{\circ}\text{F}$ ) for this area range from 4,590 to over 10,000
- Analysis confined to NE region where housing stock and market characteristics are relatively similar



# The Programs





# Types of Programs

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- **Market Based**

- Contractor provides a home assessment to homeowner.
- Homeowners discretion as to which recommendations to follow.
- Incentives provided to homeowner and contractor

- **Direct Program**

- Utility or agency offers audit and referral to contractor
- Incentives provided directly to homeowner

- **Low income**

- Audit is provided for eligible dwellings
- Measures with the greatest benefit within funding constraints are installed at no cost to participant



# All Programs

- Provide an assessment by a trained auditor
- Provide a relatively large incentive for completing work
  - Market based programs have incentives in the range of \$2,000 to \$3,000
  - Low income programs usually start with ~\$6,500 this may be leveraged with other sources. Can cover 100% of project cost.
- Provide assistance with contracting



# The Evaluations



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# Evaluation Criteria

- Only included programs with a similar level of evaluation rigor
- All evaluations used billing analysis with pre and post consumption to estimate savings
- The programs needed to install major energy savings measures such as insulation and heating system replacement



# Residential Programs of the Northeast

Program	Delivery Entity	Service Territory	Program Type	Program Year of Most Recent Impact Evaluation
Home Energy Services (HES)	Multiple Program Administrators	Massachusetts	Market Based and Direct Programs	2010/early 2011
Residential Retrofit Market Rate Program (RMR)	Vermont Gas (VGS)	Vermont	Direct Program	2008-2010
Residential Retrofit Low Income Program (RLI)	Vermont Gas	Vermont	Low Income	2008-2010
Home Performance with Energy Star (HPwES)	Efficiency Vermont (EVT)	Vermont	Market Based	2008-2010
EmPower	NYSERDA	New York	Low Income	2007-2008
Home Performance with Energy Star (HPwES)	NYSERDA	New York	Market Based	2007-2008
EnergyWise	National Grid	Rhode Island	Market Based	2010



# The Savings





# Program Estimating of Savings

Program	State	Program Type	Average Pre Install Use (Therms/ year)	Program Reported Savings (% of Pre Install Use)	Evaluated Savings (% of Pre Install Use)	Overall Realization Rate
HES*	MA	Direct and Market	1,195	15%	12%	76%
VGS RMR	VT	Direct	1,255	26%	22%	89%
VGS RLI	VT	Low Income	882	26%	16%	62%
EmPower	NY	Low Income	1,090	13%	9%	70%
HPwES	VT	Market Based	915	35%	18%	51%
HPwES	NY	Market Based	1,055	25%	16%	65%
EnergyWise	RI	Market Based	1,168	13%	13%	99%
*Includes only insulation and air sealing measures						



# The Great Divide

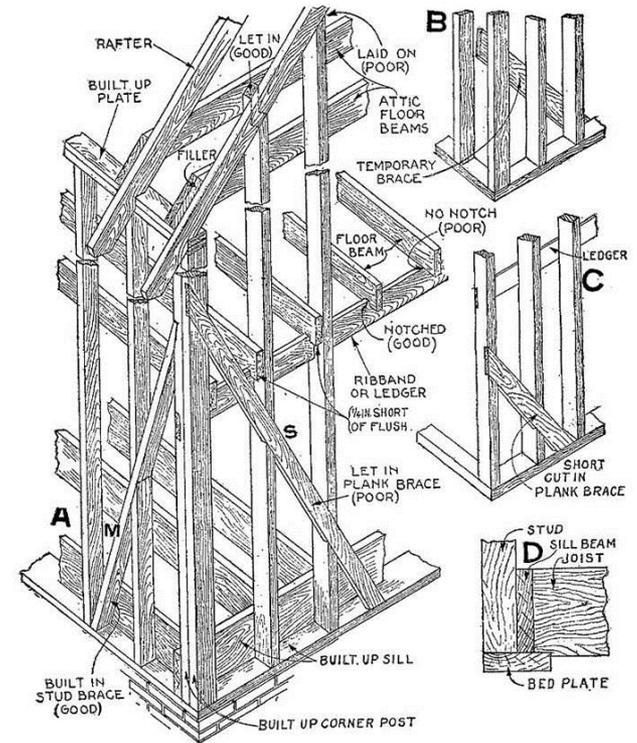
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- Projections by Build America Program suggest the potential for savings of 30% to 50% annual consumption. This is an often cited policy goal.
- Current programs are increasing the thermal efficiency of the housing stock in the northeast states from 9% to 22%

Why is there such a large divide between the program's results, the suggested potential and policy goals?



# Reasons





# Availability of Financial Assistance

Program	Service Territory	Measures	Percent of Cost Incentivized	Maximum Incentive
HES	Massachusetts	Shell Measures	75%	\$2,000
RMR	Vermont	All Measures	33%	\$2,100
EnergyWise	Rhode Island	Shell Measures	75%	\$2,000
HPwES	Vermont	All Measures	Performance Based	\$2,100
HPwES	New York	All Measures	10%	\$3,000

A deep energy retrofit pilot in Massachusetts completed by the US Department of Energy and National Grid, Inc. found that the average cost for completing work on a single family home was \$34.6/ft<sup>2</sup> (USDOE 2014). (\$30,000 or €25.000/1000m<sup>2</sup> )



# Existing Housing Stock

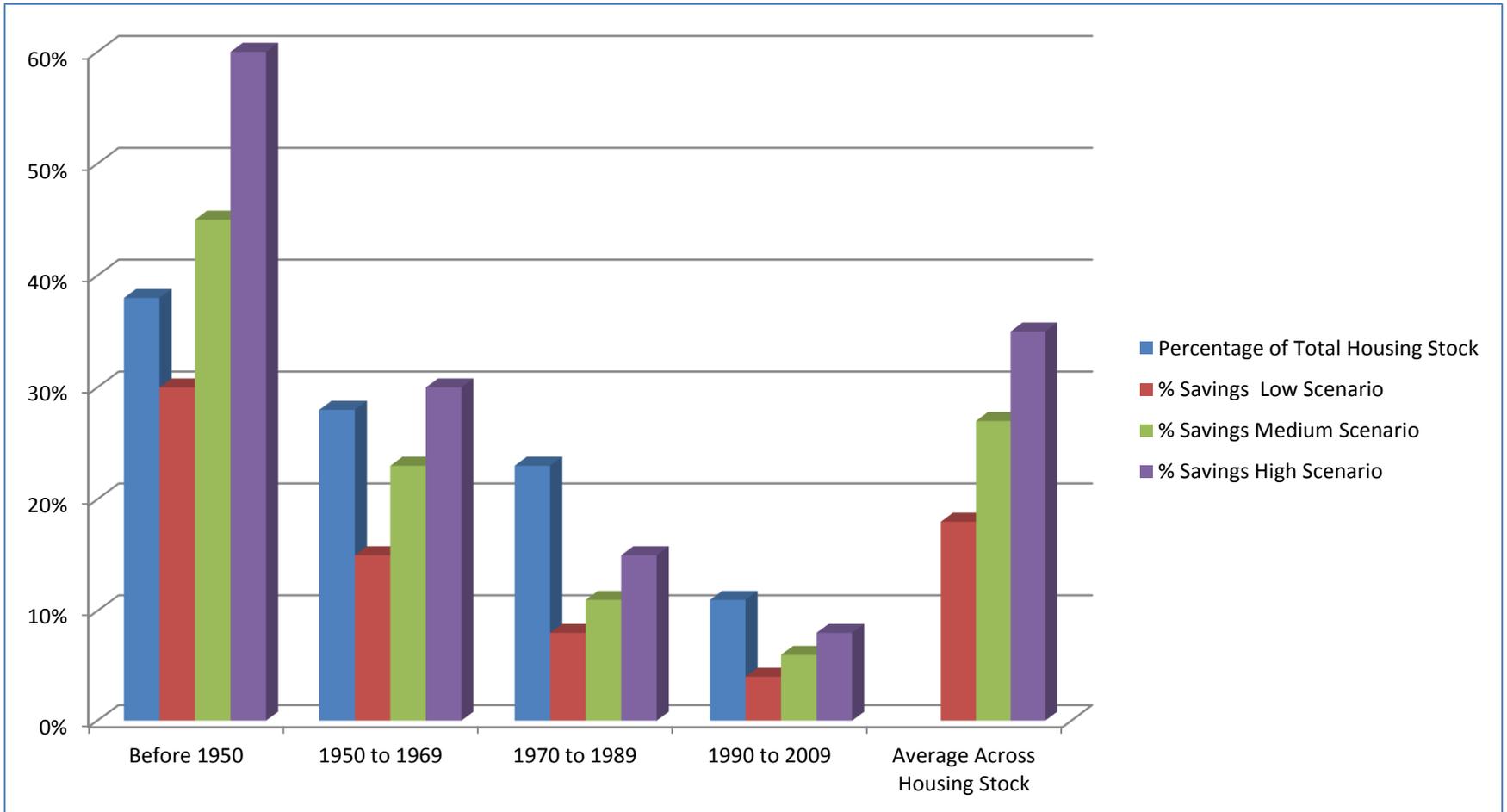
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Age of building is a defining factor in savings opportunities

- there are greater savings opportunities in older housing stock than in new housing stock
- New homes are built to higher thermal standards
- Older construction styles such as balloon framed buildings have many thermal bypasses or may have health and safety issues that need remediation
- Heating equipment efficiencies have improved over time
- Other factors include maintenance and operational characteristics of the home

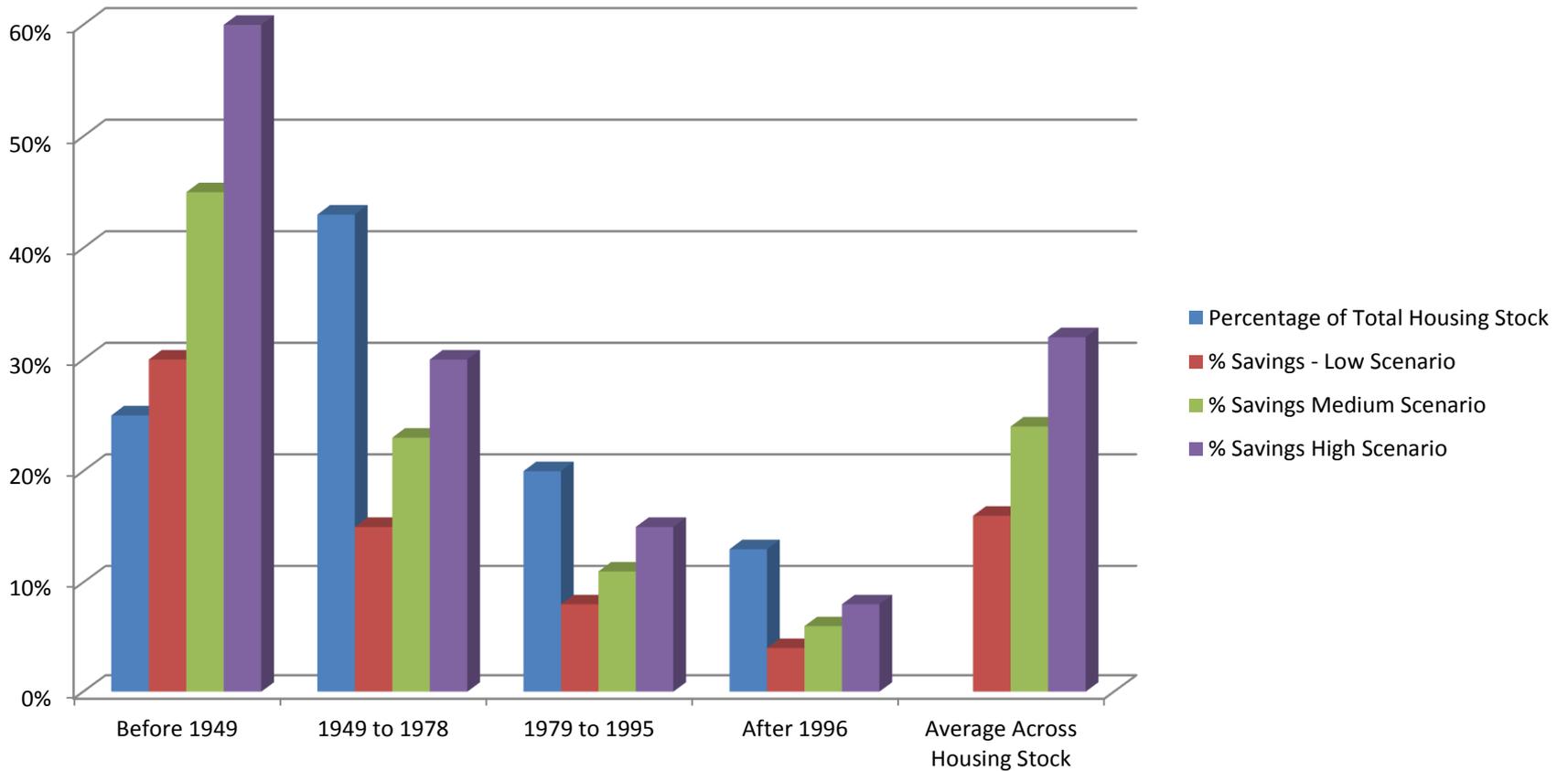


# Savings Potential By Age of Home United States





# Savings Potential By Age of Home Germany





# Conclusions

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- Impact evaluations of similar program, using rigorous methods, can provide a benchmark for the effectiveness of the programs potential in a market
- A profile of the age of residential housing stock provides a method of assessing potential savings
- Current program designs in the US residential retrofit market may not be providing sufficient financial incentives to achieve policy goals



# Questions?

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