BUILDINGENERGY BOSTON

AIA Provider: Northeast Sustainable Energy Association

Provider Number: G338

The Elephant in the Room: How to Affordably Increase the Energy Efficiency of Our Existing Housing Stock?

Course Number :

David Joyce	Synergy Construction
Brian Butler	EnerScore & Good Energy Construction
Sean Jeffords	Beyond Green
Bill Womeldorf	UMass Amherst

Course Curator: Brice Hereford

Course Date: March 9, 2016

Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

enerscore

Insert David's Logo Here

BEYOND GREEN
CONSTRUCTION

"LEADERS IN ENERGY EFFICIENCY"

Family Business Established In 1998

UNIVERSITY OF MASSACHUSETTS AMHERST 1863

BUILDING AND CONSTRUCTION TECHNOLOGY

Course Description

The biggest hurdle for energy efficiency in the built environment today is how to improve the energy efficiency of our existing housing stock in an affordable manner. These three practitioners bring several years of experience to the fore. They have seen what works, what doesn't, and why. The session will review the best building practices of how to view, evaluate and perform an energy upgrade to a property. Average square foot costs on energy efficiency return will be discussed and what can be the expected energy reductions from certain projects. This session will focus on some of the easier energy-efficiency upgrades to be taken now and what to put off to employ our next generation. Evaluation of the existing available financial resources to be used for offsetting the owner costs and how they might be improved. Lastly, they will address when a project is beyond the scope of affordability and what telltale signs to look for.

Learning Objectives

At the end of the this course, participants will be able to:

1. At the end of the session, participants will be able to identify when, where and how a DER will be economically viable.

2. At the end of the session, participants will know how to decide what tasks will be the most cost-effective for a DER.

3. At the end of the session, participants will be able to perform their own DER.

4. At the end of the session, participants will know what programs are available for helping fund their DER.

ELEPHANT in the Room

How do we Affordably Retrofit our Existing Housing Stock?


Brice Hereford


David Joyce


Brian Butler


Sean Jeffords


Bill Womeldorf

Best Building Practices & Pro Tips

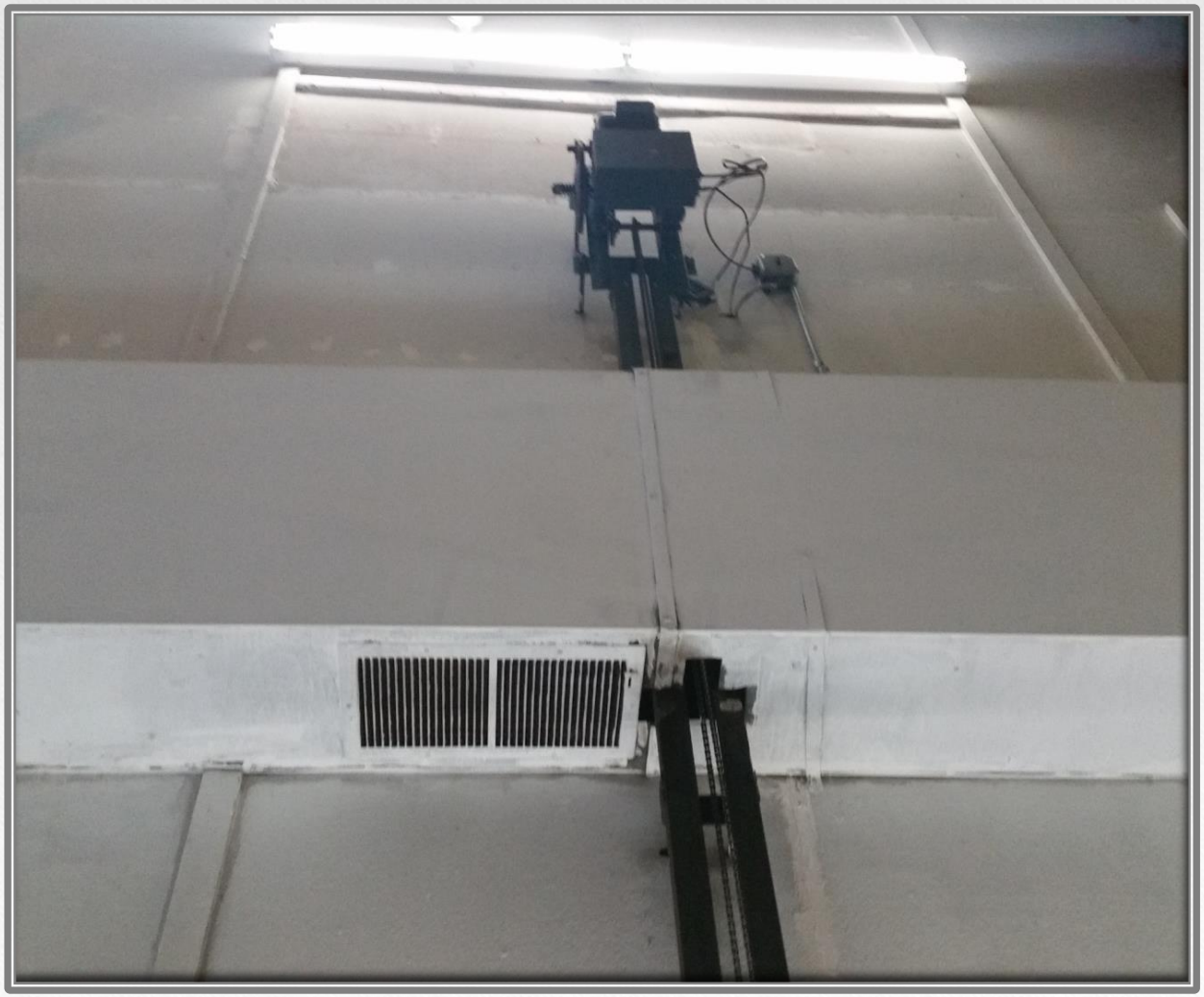
by David Joyce
CEO, Synergy Construction, LLC

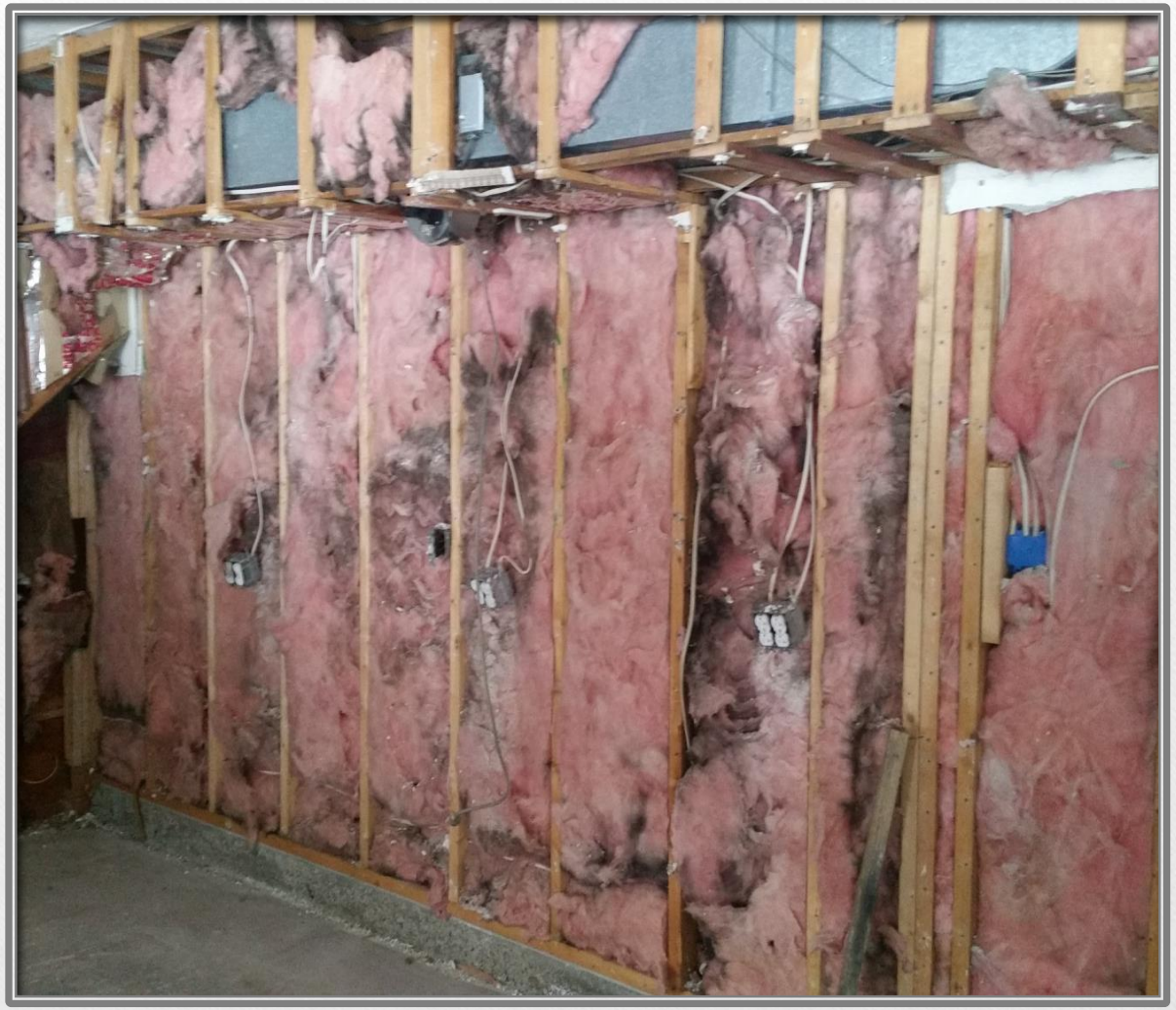
Deep Energy Retrofits

What to expect

Best practices

Controlling costs



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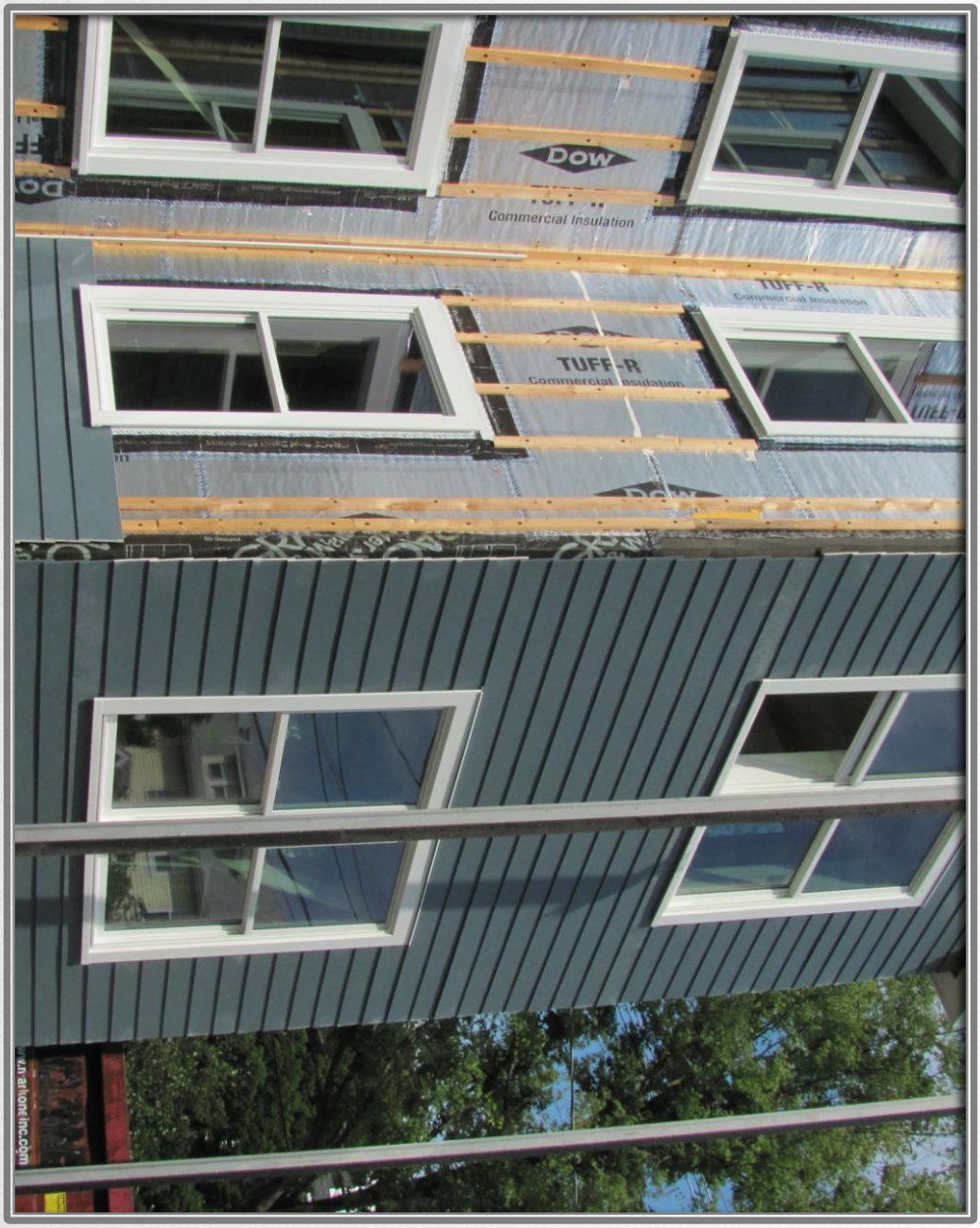
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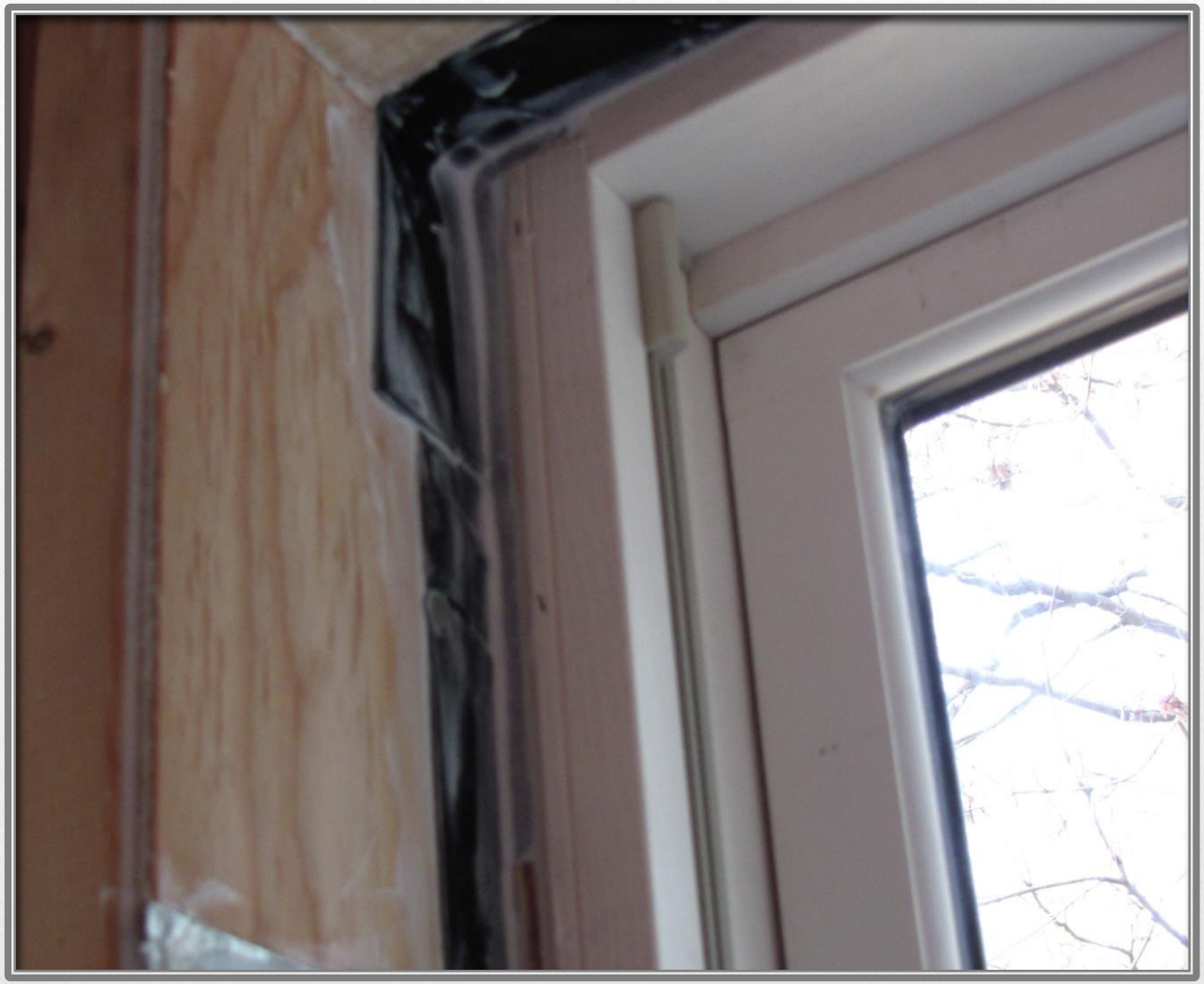
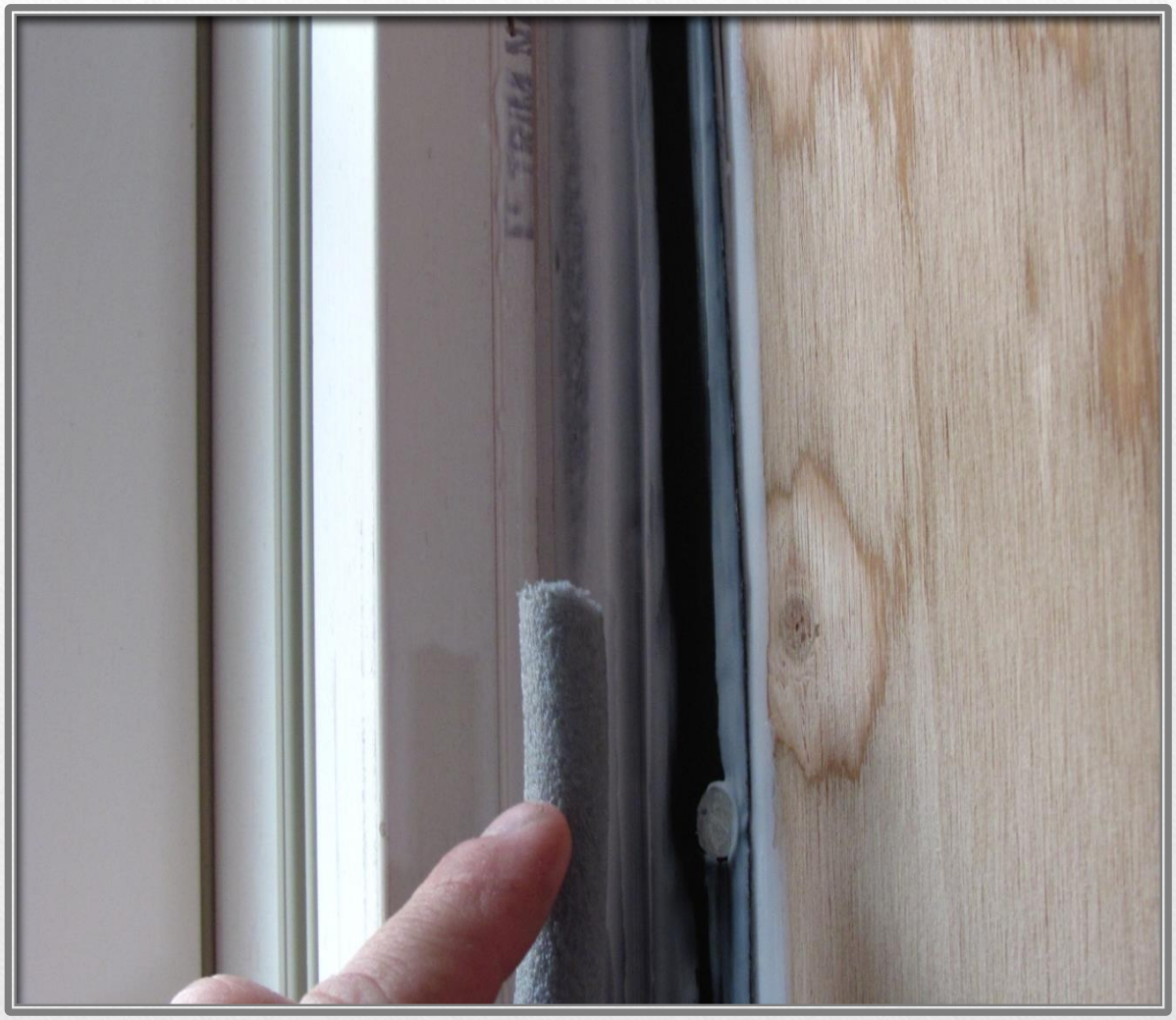
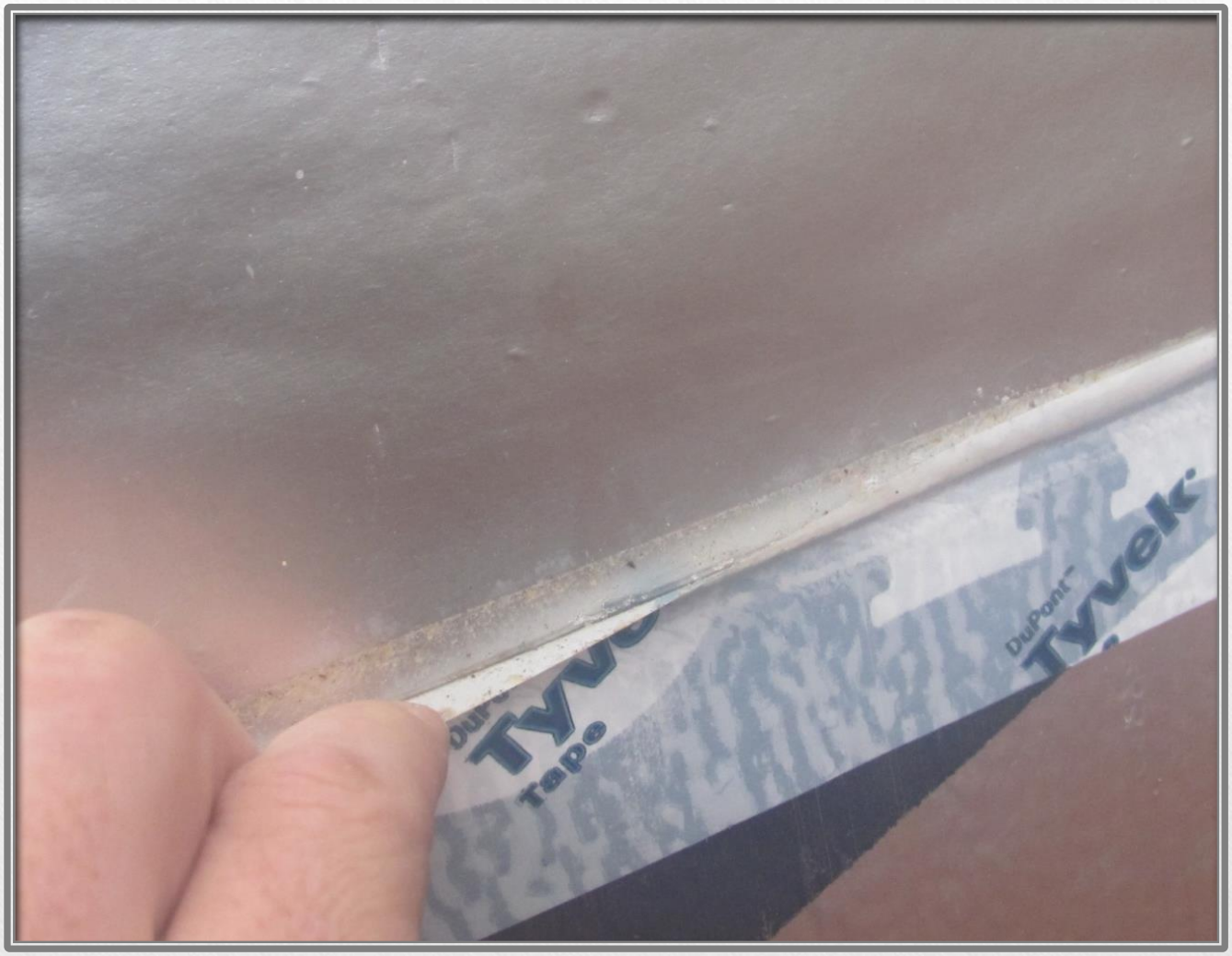





Weathermate
Construction Tape
DOW


Tape
DuPont
Tyvek


Rb


Pro Trade
CRAFT
For Residential Construction Pros

Energy Reductions & Tools for Modeling

by Brian Butler
President, Enerscore

DER: Value Prop

Brian Butler

Creating demand more important than value-engineering?


Berklee
college of
music


ARCTIC SUNRISE
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TUFF

Home Energy Performance Made Visible

The Problem

Energy is invisible in residential real estate so…..

The pace of significant improvement is…..

s…..l…..o……w…..

Problem


Mortgages
Zillow Mortgages
Mortgage payment breakdown for the home price of $848,876
Percent down:
20% ($169,775)
Program:
30yr fixed 3.556%
Credit Score:
760 and above
ESTIMATED PAYMENT $4,235
Principal & Interest $3,071
Taxes $849
Homeowners Insurance $67
Mortgage Insurance $249
See personalized rates
Home Expenses
HOME SECURITY
SimpliSafe
$14.99 /mo
HOME INSURANCE
HonestPolicy.com
$183 /mo
PROPERTY TAX

Solution


Mortgages
Zillow Mortgages
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Principal & Interest $3,071
Taxes $849
Homeowners Insurance $67
Mortgage Insurance $249
See personalized rates
Home Expenses
HOME SECURITY SimpliSafe $14.99 /mo
HOME INSURANCE HonestPolicy.com $183 /mo
PROPERTY TAX $318 /mo
ENERGY enerscore a+ $0 /yr

Consumers drive change

Buyers / Renters show strong interest in data.

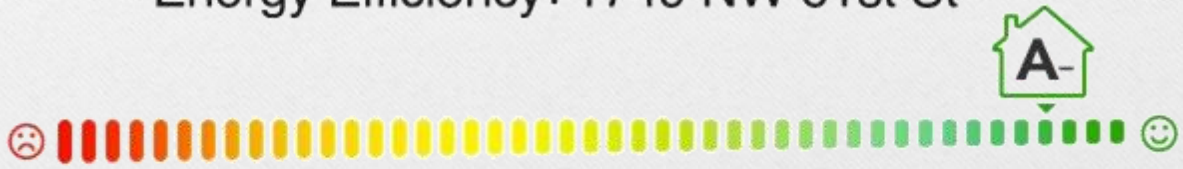
Neighborhood Info for 1749 NW 61st St

WA › Seattle › Adams

Transportation in Adams

This area is very walkable — most errands can be accomplished on foot. Transit is good, with many nearby public transportation options. It's convenient to use a bike for most trips.

Energy Efficiency: 1749 NW 61st St



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Estimated annual utility cost: $240

Great! The building data suggests a very efficient structure.

Improve my EnerScore ›

Predictive profiling not new

Contents lists available at ScienceDirect

Energy and Buildings

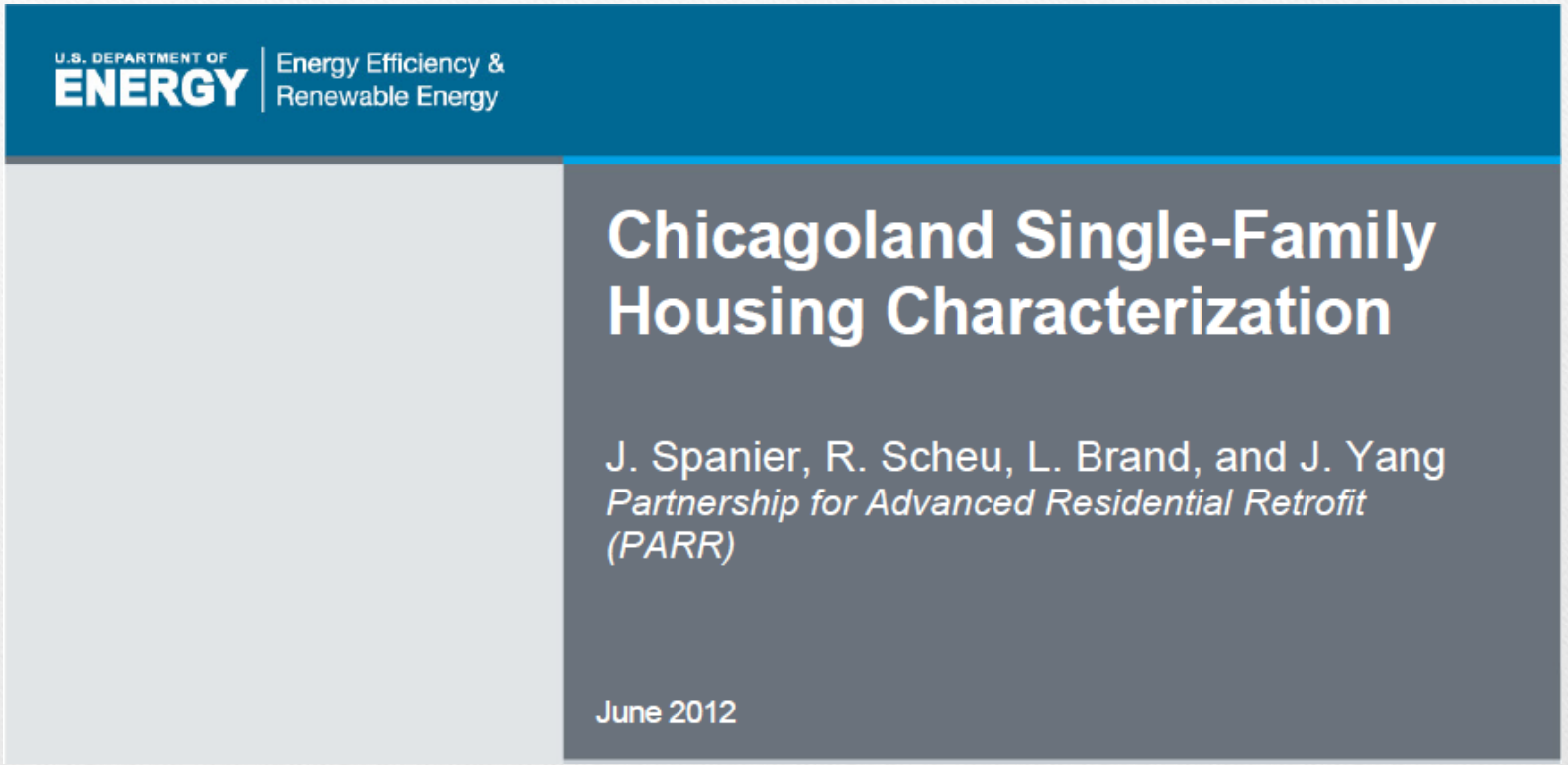
journal homepage: www.elsevier.com/locate/enbuild

Developing a pre-retrofit energy consumption metric to model post-retrofit energy savings: Phase one of a three-phase research initiative

Kate Goldstein[a,*], Michael Blasnik[b], Mike Heaney[c], Ben Polly[c], Craig Christensen[c], Les Norford[a]

[a] Massachusetts Institute of Technology, United States
[b] Michael Blasnik and Associates, United States
[c] National Renewable Energy Laboratory, United States

Predictive profiling not new



U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Group 1: Brick, 1978-Present, 1 to 1.5 stories (no split level)

2.5% of population
Mean Site EUI: 81.8
Mean therms: 1077
Mean kWh: 8887
Mean finished square footage: 1741

Group 2: Brick, 1978-Present, Split level (1.5 stories)

1.9% of population

Mean Site EUI: 112.6

Mean therms: 1205

Mean kWh: 10076

Mean finished square footage: 1404

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Group 3: Brick, 1978-Present, 2 stories

4.7% of population
Mean Site EUI: 76.7
Mean therms: 1446
Mean kWh: 12482
Mean finished square footage: 2506

Group 4: Brick, 1942-1978, 1 to 1.5 stories (no split level)

17.9% of population
Mean Site EUI: 129.6
Mean therms: 1212
Mean kWh: 8859
Mean finished square footage: 1217



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Group 7: Brick, Pre-1942, 1 to 1.5 stories (no split level)

11.6% of population
Mean Site EUI: 161.3
Mean therms: 1442
Mean kWh: 8927
Mean finished square footage: 1141

	Source EUI, Btu/sq. ft.			Gas in Therms			Electricity in kWh		
GROUP	BEopt, Today	CNT Mean	Dev, %	BEopt, Today	CNT Mean	Dev, %	BEopt, Today	CNT Mean	Dev, %
1	132.7	126.2	5%	1161.5	1077.0	8%	9074.7	8887	2%
2	164.1	176.1	-7%	1146.5	1205.0	-5%	9159.2	10076	-9%
3	118.7	120.2	-1%	1502.9	1446.0	4%	11607.5	12482	-7%
4	196.4	192.3	2%	1215.7	1212.0	0%	9254.1	8859	4%
5	195.1	198.2	-2%	1350.6	1344.0	0%	9227.1	9643	-4%
6	155.2	147.7	5%	1712.9	1553.0	10%	11533.5	11714	-2%
7	224.7	227.8	-1%	1430.6	1442.0	-1%	8724.6	8927	-2%
8	177.1	169.3	5%	1940.9	1757.0	10%	10607.6	11062	-4%
9	132.0	135.7	-3%	1209.5	1217.0	-1%	9203.6	9719	-5%
10	193.9	199.1	-3%	1473.6	1480.0	0%	8771.6	9321	-6%
11	111.8	114.0	-2%	1706.0	1749.0	-2%	14733.4	14914	-1%
12	191.0	199.0	-4%	1204.6	1268.0	-5%	8256.8	8483	-3%
13	163.9	172.0	-5%	1395.6	1467.0	-5%	9367.3	9802	-4%
14	216.4	222.9	-3%	1578.7	1608.0	-2%	8624.4	9050	-5%
15	168.6	164.8	2%	2034.9	1913.0	6%	10869.8	11348	-4%

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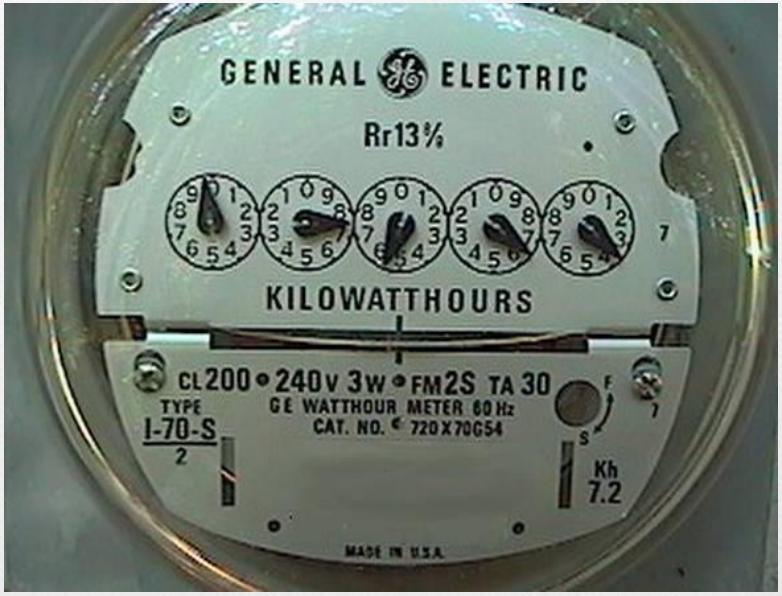
Table 1. Cook County Assessor Data Snapshot

Variable	Description
PIN	13-digit unique identifier
Address	
City	Mailing city
ZIP	5-digit zip code
Township	Assessor township within Cook County
Assessor class	Class is based on age, square footage, and number of units
Number of units	Number
Square footage	Measured as finished space
Year built	
Bedrooms	Number
Bathrooms (full)	Number
Bathrooms (half)	Number
Exterior Construction	Type of exterior construction
Roof	Type of roof construction
Basement	Type of basement
Attic	Type of attic
Heating System	Type of heating system
Air Conditioning	Type of air conditioning system
Fireplace	
Garage	Number of spaces available
Garage (exterior construction)	Exterior construction of garage

So… why not utility bills?



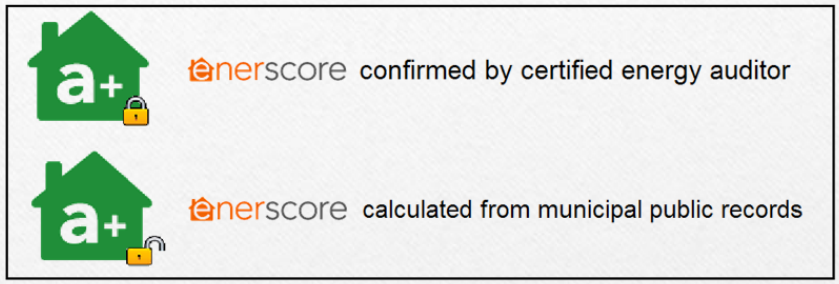
So… why not utility bills?

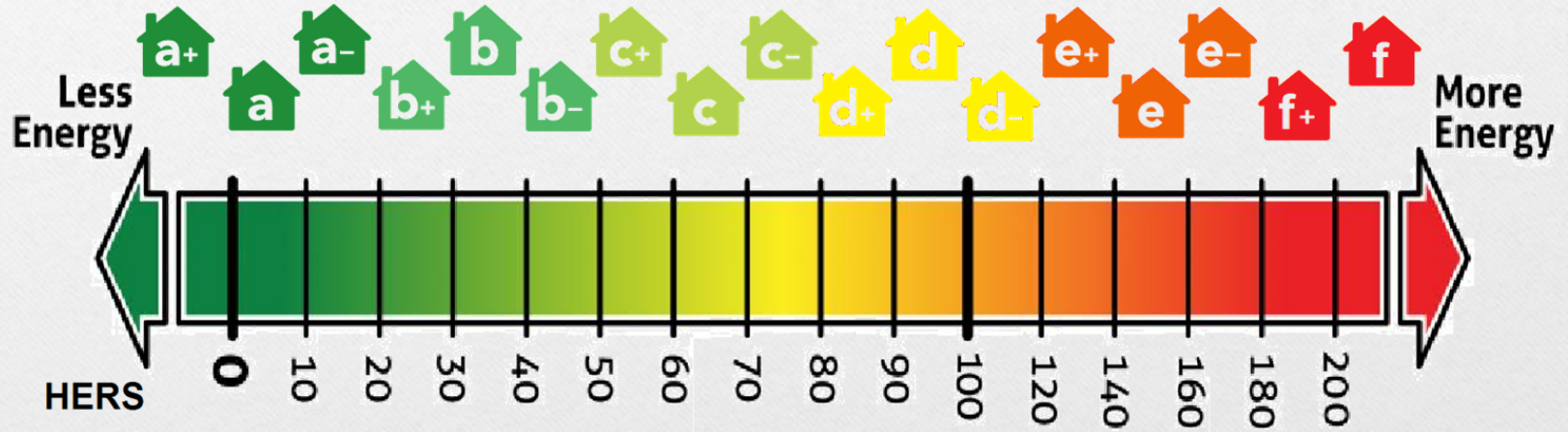
Home "MPG"

- Existing HERS ratings

- Calculated HERS ratings

Key:


a+
enerscore confirmed by certified energy auditor
a+
enerscore calculated from municipal public records


Less Energy
More Energy
HERS
a+
a
a–
b+
b
b–
c+
c
c–
d+
d
d–
e+
e
e–
f+
f
0
10
20
30
40
50
60
70
80
90
100
120
140
160
180
200

Method

- Basic processing by age of home and "Effective Year Built"
- ACH50 tied primarily to age
- ACH50 also tied to type: more complex geometry = more leakage
- Fuel type: oil systems typically less efficient
- System type: steam systems less efficient

Method, cont.

- Table of assumptions from surveys of IC's, Chicagoland DOE study and other sources
- Identify trends in SF assessed values to glean levels of envelope performance.
- Assumptions are then modeled by Michael Blasnik's SIMPLE Audit to generate EUI &
- A ~ F rating

Testing

- Raters in multiple states supplying data to tune predictive algorithms
- Energy auditors push audit data back to EnerScore at user's request.

Results

- Ratings for all homes
- Buyers, sellers, renters "see" home performance
- Owners and landlords respond to a market that values and *openly* compares metrics of home performance.

Level playing field

Square foot Costs & Avoiding Financial Trouble

by Sean Jeffords
President And CEO,
Beyond Green Construction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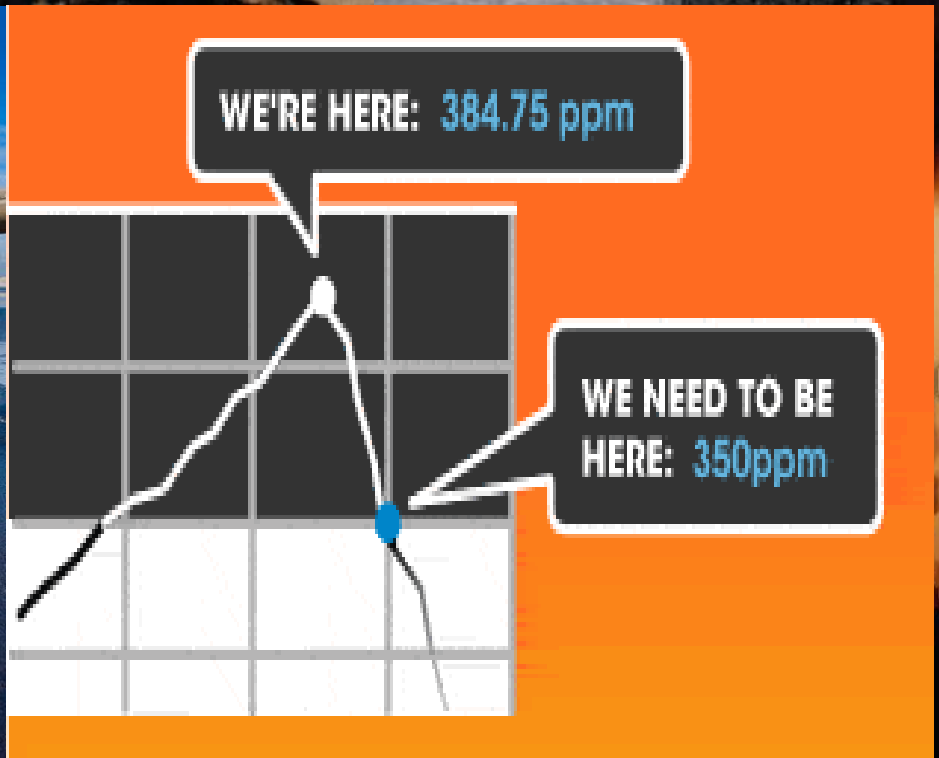
WE'RE HERE: 384.75 ppm
WE NEED TO BE HERE: 350ppm


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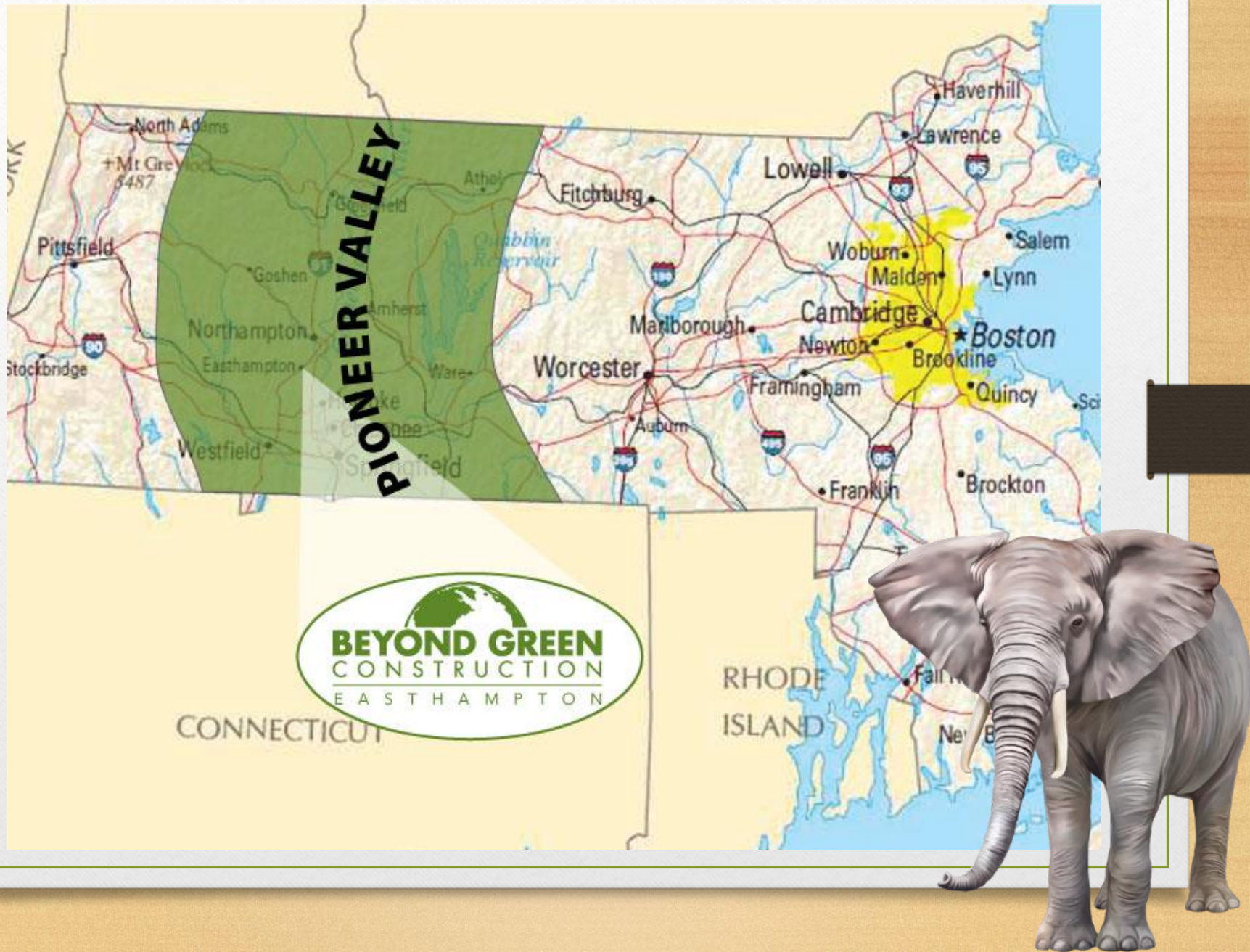
Barriers to Growth

- **Access to reliable information:** The current state of information for consumers is not consistent, reliable or readily available.. ..Mass Save? ..DER's? ..Solar? ..New Pipeline?
- **Lack of Financing options:** We currently lack mortgages that can assist in a large upfront expense for energy efficiency on a DER level..
- **Home Inflation and Appraise-abilty:** A good % of our homes are inflated above the market value and banks do not have appraisal formulas for homes that are exceptionally energy efficient..
- **Lack of Incentives** and programs that support deeper more advanced deep energy retrofits...


PIONEER VALLEY
North Adams
Mt Greylock
3487
Pittsfield
Goshen
Amherst
Northampton
Easthampton
Westfield
Stockbridge
Athol
Fitchburg
Lowell
Haverhill
Lawrence
Salem
Woburn
Malden
Lynn
Cambridge
Boston
Brookline
Newton
Marlborough
Worcester
Framingham
Quincy
Auburn
Franklin
Brockton
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EASTHAMPTON
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Insight on Costs

- ..Deep Projects
- ..Phased Projects
- ..Avoiding Trouble?

Case #1
Ranch home
no basement...

Before…

After…

Results…

ROI: 2.9% | Payback: 34 ½ Years | $141.8 $/SF

$1 Invested → .03 Cents Gained

EUI
55.4

Retrofit Costs After Incentives
$266,739

Purchase Price
$194,700

Value Returned
($199,153)

Appraised Value
$282,286

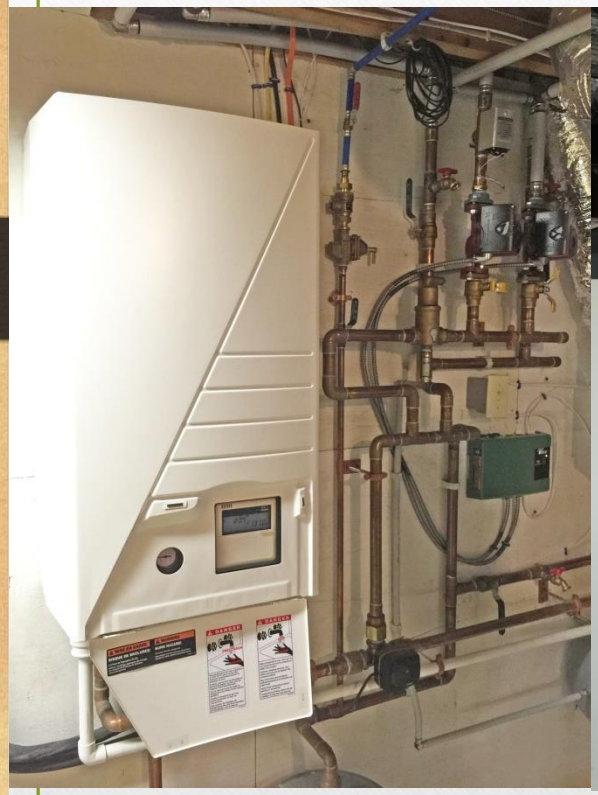
EUI
6.21

Purchase Price + Retrofit Costs = $ 461,439

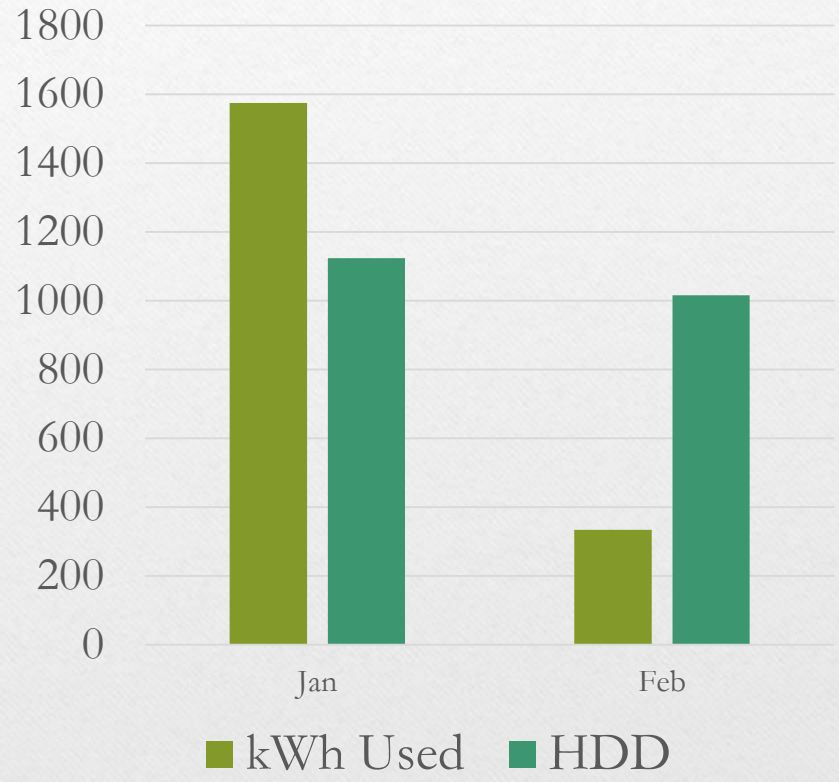
Appraised Value $ 282,286

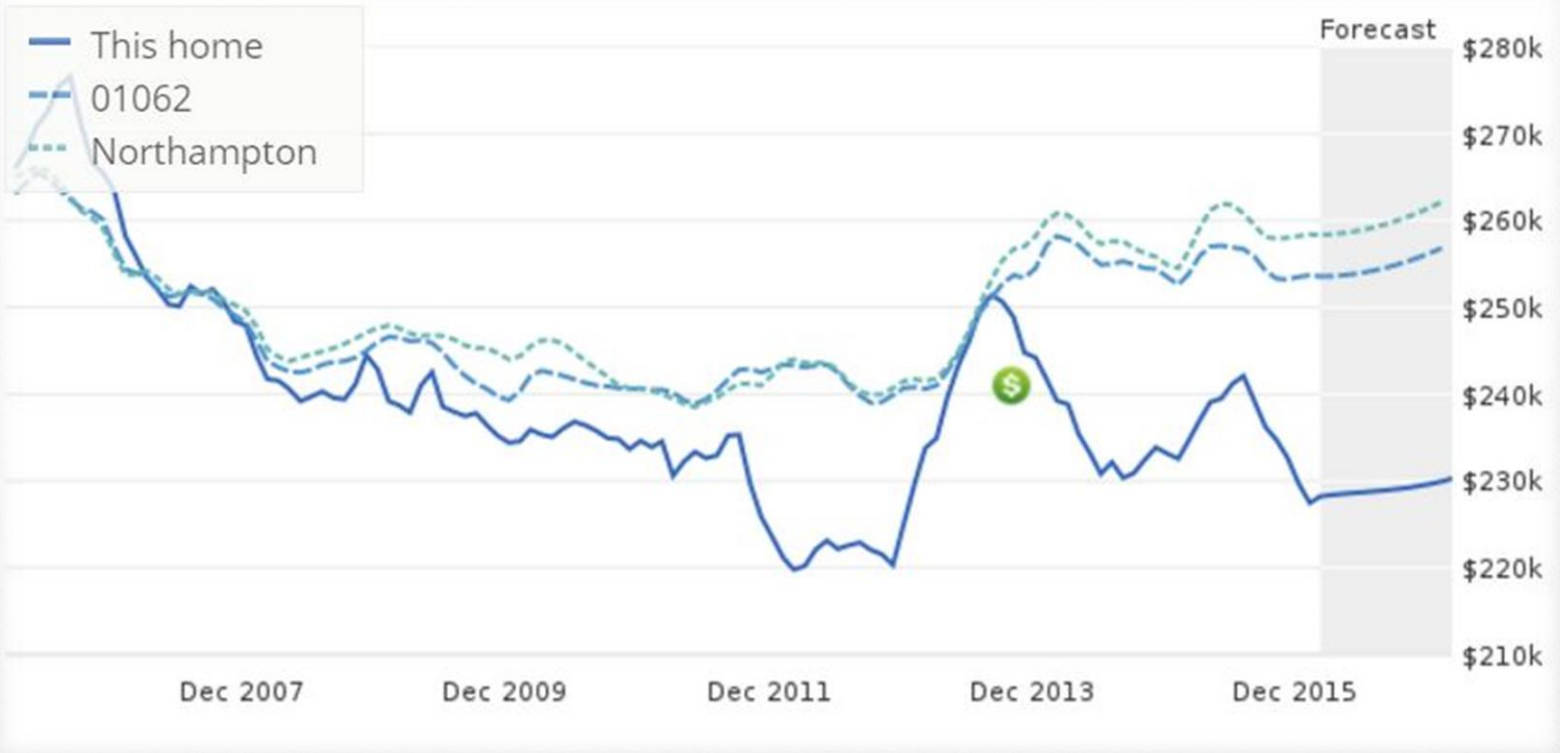
Case #2 Ranch with basement

We tried the air to water heat pump..



We ended up needing a back up..





Courtesy of Zillow

Results…

ROI: 4% | Payback: 25 Years | $113 $/SF

$1 Invested → .04 Cents Gained

EUI
62.8

EUI
23.8

Purchase Price + Retrofit Costs = $ 390,741

Appraised Value $ 227,378

Case #3 Historic Home

Results…

ROI: 7.5% | Payback: 13 Years | $39 $/SF

$1 Invested → .07 Cents Gained

EUI 150

Retrofit Costs $78,854

Purchase Price $178,000

Value Returned ($64,854)

Appraised Value $192,000

EUI 58.8

Purchase Price + Retrofit Costs = $ 256,854

Appraised Value $ 192,000

Case #4
Phased DER Project

Phase 1 Results…

ROI: 91.5% | Payback: 1 Year | $1.11 $/SF

$1 Invested ➔ .91 Cents Gained

EUI
37.2

Project Details:

- 12 Hours Air Sealing
- Attic Insulation R60
- Polyiso on Kneewalls
- New LED Lighting
- Attic Venting

EUI
22.9

Total Project Costs (After Incentives) $644

Phase 2 Results…

ROI: 15.25% | Payback: 6 ½ Years | $25.87 $/SF

$1 Invested ➔ .15 Cents Gained

EUI
22.9

Project Details:

- New 5kW PV Solar System
- (Solarize MA, $2.30 /Watt)
- (Does Not Include SRECs)
- New Asphalt Roof

EUI
7.76

Total Project Costs (After Incentives) $15k

Phase 3 Options…

Option A: Heat Pump

ROI: 20.4% | Payback: 5 Years | 4.49 $/SF

Option B: Replace Windows

ROI: 1.7% | Payback: 58 Years | 13.07 $/SF

Option C: Rigid Foam Exterior Walls

ROI: 1% | Payback: 92 Years | 25.09 $/SF

Finances & Incentives... Room for Improvement?

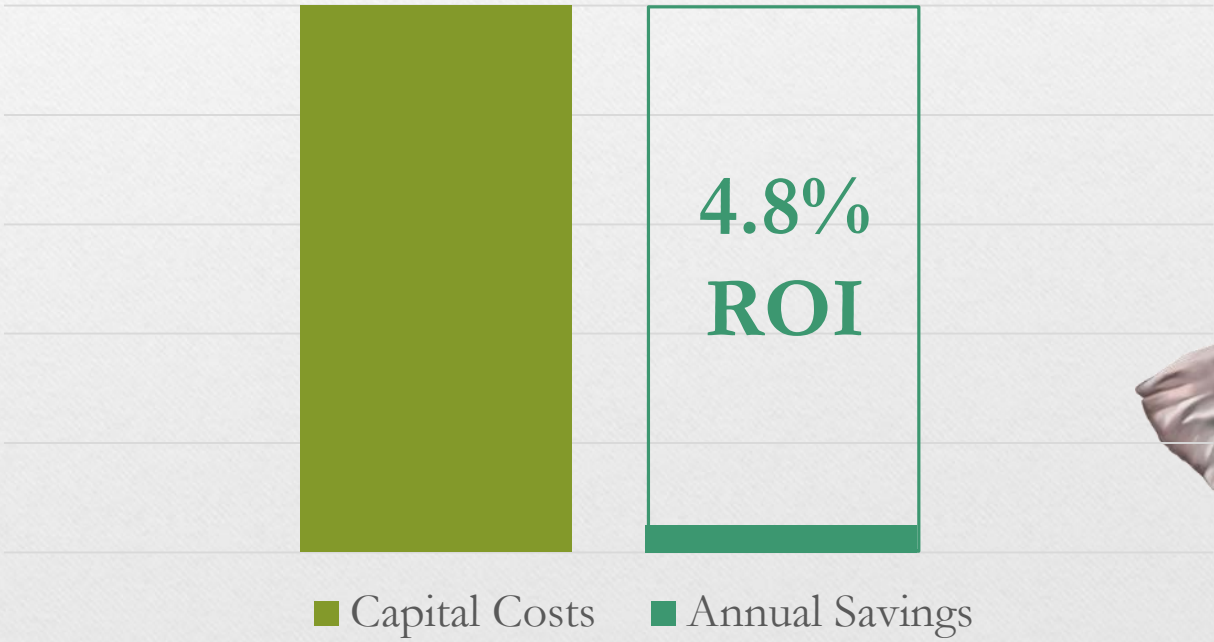
by Bill Womeldorf
Graduate Student, University of Massachusetts, Amherst

Existing Policies

- DER Incentive Programs
- Mass Save
- Solarize MA
- Financing

DER Incentives

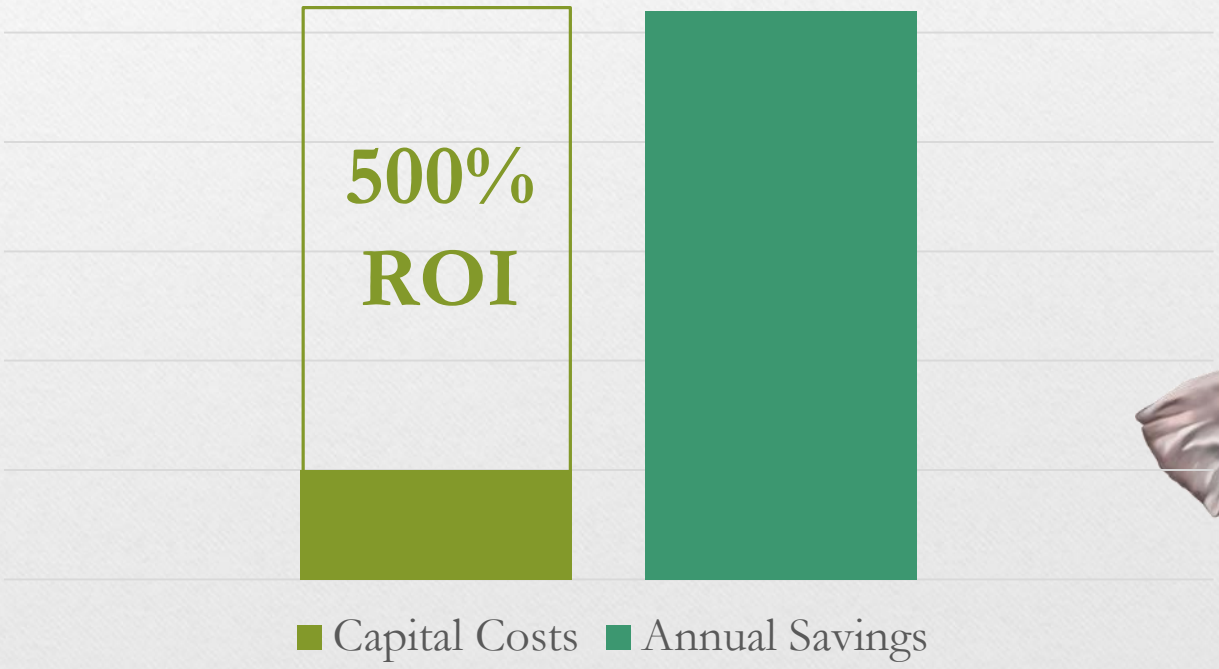
$1 Invested → .05 Cents Gained



Average returns associated with the DERs case studies from Sean

Mass Save

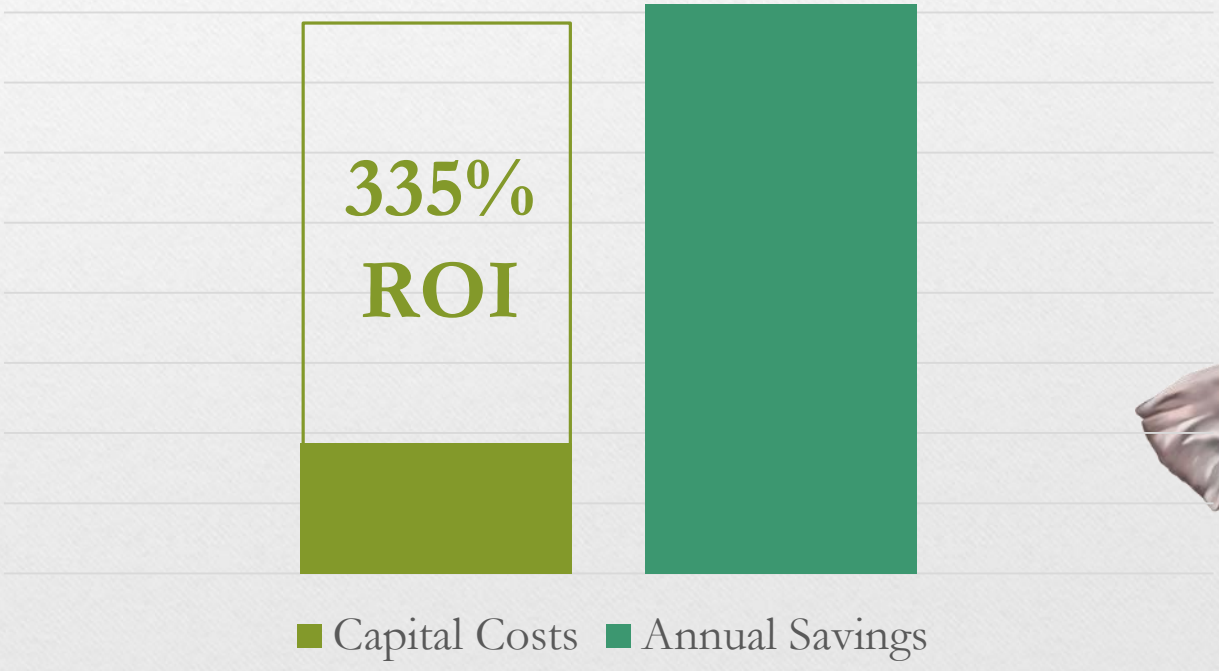
$1 Invested → $5 Dollars Gained



From the Mass Save's database 2013-2014

Solarize MA

$1 Invested → $3.35 Dollars Gained



From the Solarize MA database 2012-2013

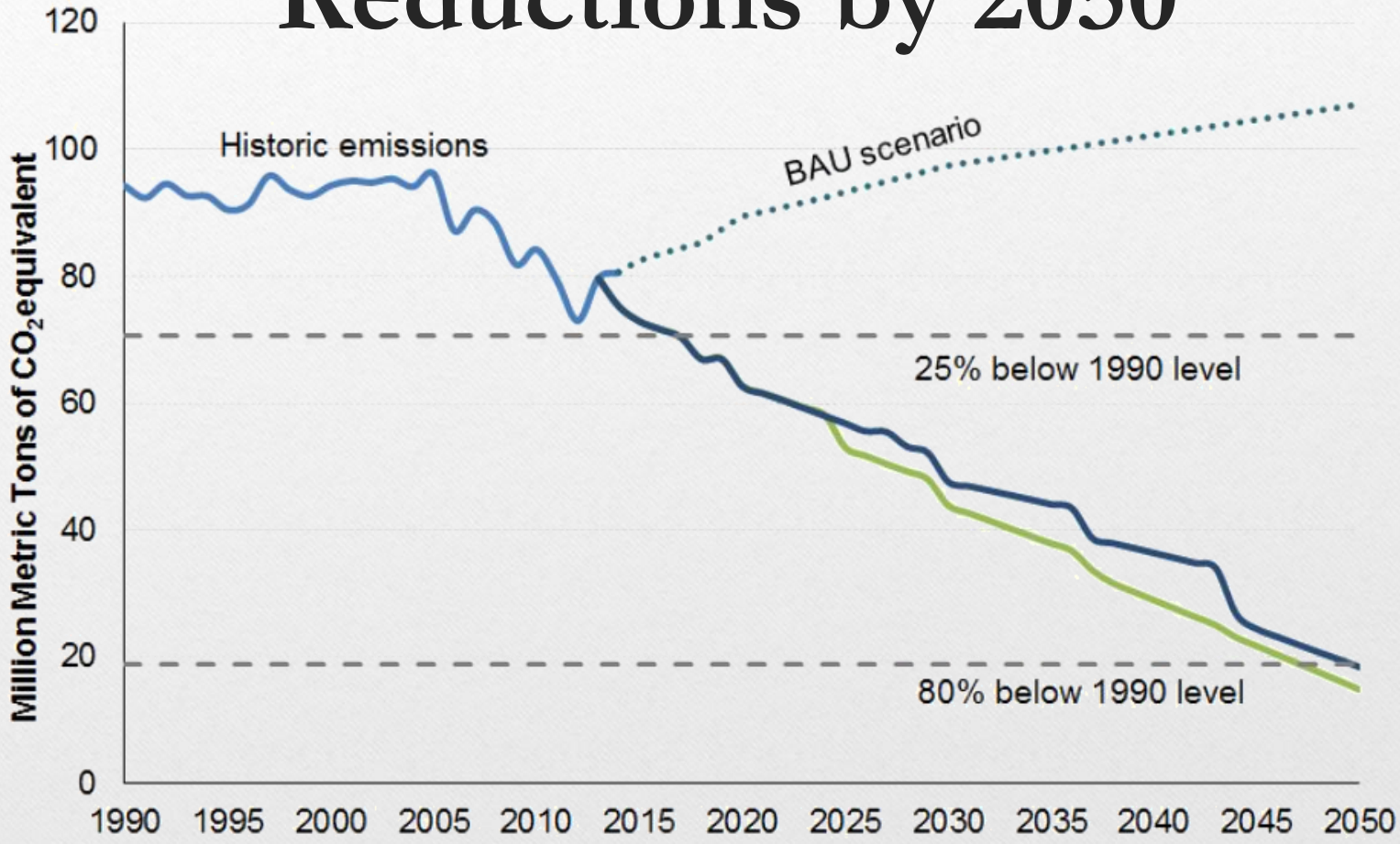
Financing Options

- 0% Heat Loans up to 50K
- Expanded Heat Loans
- Barrier Mitigation Grants
- MA Solar Loan

Room for Improvements

- Green Leases
- Net Metering
- Zero Energy Building Code
- Other Suggestions?

Big Picture: 80% Reductions by 2050



Source: Abt Associates (2015).

From the 2015 Update of the Massachusetts Clean Energy and Climate Plan for 2020

This concludes The American Institute of Architects Continuing Education Systems Course