



High Performance Zero Net Energy Construction Workshop

The Faregrounds
Nantucket, MA
May 8th, 2019



High Performance Zero Net Energy Construction Presentation

- MA Stretch Code Overview
- Mass Save Residential New Construction Program, 3 Paths
 - Low-Rise
 - High-Rise
 - Renovations & Additions (*new*)
 - Deep Dive
- Massachusetts Clean Energy Center
 - Clean Heating and Cooling
 - Solar Electricity
 - Commonwealth Woodstove Change-out
- Mass Save Case Studies
- Q&A



Helping Massachusetts Municipalities Create a Cleaner Energy Future



COMMONWEALTH OF MASSACHUSETTS

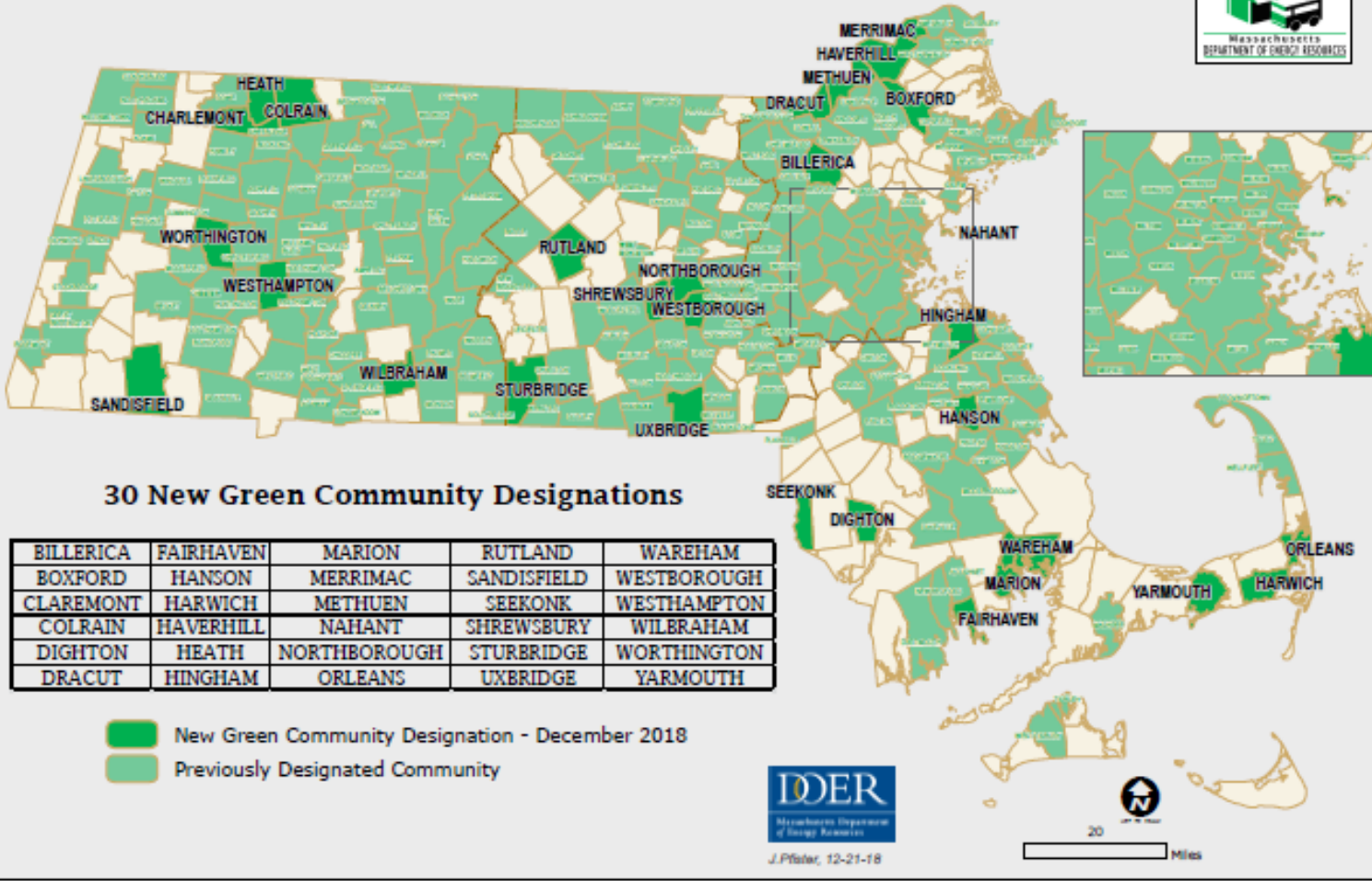
*Charles D. Baker, Governor
Karyn E. Polito, Lt. Governor
Matthew A. Beaton, Secretary
Judith Judson, Commissioner*

The Green Communities Division
Partnering with Massachusetts
Cities and Towns

Town of Nantucket
Green Communities &
Stretch Code
Presentation
5/8/2019

ACK

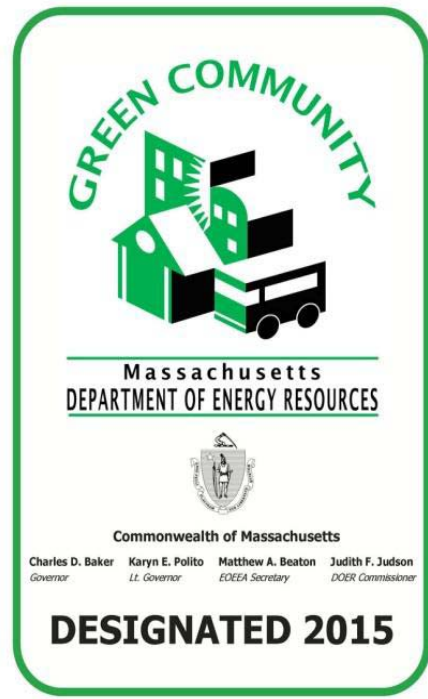
GREEN COMMUNITY DESIGNATIONS REACH TWO HUNDRED FORTY



Creating a Clean, Affordable and Resilient Energy Future for the Commonwealth

Green Communities Designation and Grant Program

Up to \$20M/yr in grants and loans to *qualifying communities*



Grants fund energy efficiency initiatives & renewable energy, innovative projects



Designation and Grant Program

>\$105M grants awarded



>\$10M savings/yr



270 grants completed



Projected Savings

316,346 MMBTUs

28,091 mt CO₂ eq.

 x 2,822

 x 5,914



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Designation and Grant Program

- Designation Grant = \$125K + population & per capita income formula

Nantucket estimated designation grant amount:

\$150,000

- Competitive Grants available annually, up to **\$250,000** per applicant, for existing Green Communities that have completed all prior grants



Slide 7

BM1

Hey Seth, do you want to update this slide?

Berry, Michael, 8/21/2018

Green Communities Designation and Grant Program

- Designation grant allocations based on a \$125K base plus a population/per capita income formula; maximum \$1M.
- Competitive grants available annually up to \$250,000 per applicant for Green Communities. More than \$100M awarded in total for both designation and competitive grant programs
- Projects being funded include energy conservation measures

Nantucket's Green Communities Neighbors:

Community	Year	Grants
Marion	2018	\$132,672
Harwich	2018	\$ 152,910
Orleans	2018	\$ 134,709
Mashpee	2010	\$ 619,394
Yarmouth	2018	\$ 191,601



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Green Communities Designation and Grant Flowchart

Step 1

- Review Green Communities Designation Criteria Guidance
- Contact your Green Communities Regional Coordinator

Step 2

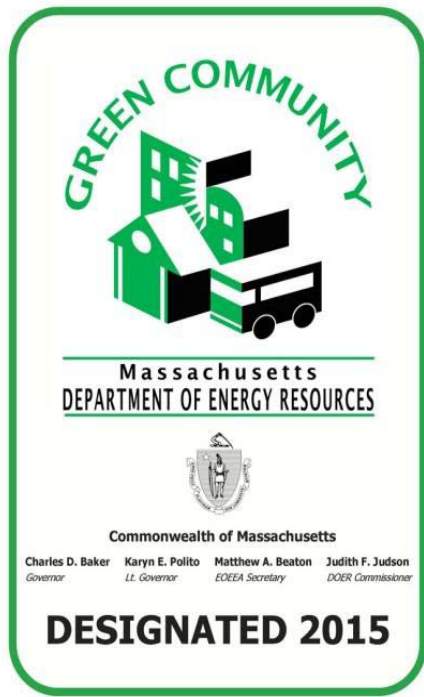
- Discuss Green Communities Designation with Local Government
- Receive local approval to apply for Green Communities status

Step 3

- Meet the 5 Green Communities Criteria and submit a Designation Application
- Receive Green Community Designation from DOER
- Apply for Green Community Grants



Designation and Grant Program



Qualification Criteria - Designation

1. Adopt as-of-right siting for RE/AE generation, R&D, or manufacturing -
2. Adopt expedited permitting process
3. Create an Energy Reduction Plan to reduce energy use by 20% in 5 years
4. Adopt Fuel Efficient Vehicle Purchase Policy
5. Minimize life cycle cost in new construction → adopt the Stretch Code



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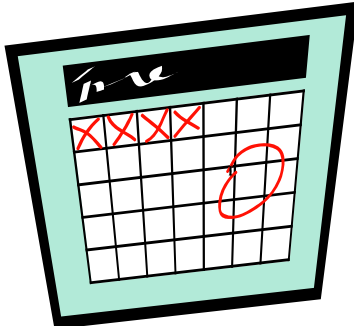


Criteria 1 – As-Of-Right Siting

1. Renewable or Alternative Energy Generating Facilities or;
 - A. Solar = 250KW or greater ground mounted solar PV
 - B. Discreet parcel(s) that can support a solar facility of that capacity = approximately one (1) acre for 250KW
2. Renewable or Alternative Energy Research and Development (R&D) Facilities or;
3. Renewable or Alternative Energy Manufacturing Facilities in designated locations.



Criteria 2 – Expedited Permitting



12 months: date of initial application to date of final approval

1. Applies only to the proposed facilities subject to the As-of-Right Siting provision.
2. Can apply the MGL c 43D permitting process to these zoning districts



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Criteria 3 – Energy Baseline & 20% Energy Reduction Plan



Calculate a Municipal Energy Use Baseline that includes:

- 1. Municipal Buildings & Schools**
- 2. All Vehicles**
- 3. Municipally Owned Street & Traffic Lights**



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Criteria 4 – Fuel Efficient Vehicles

1. Purchase only fuel-efficient vehicles for municipal use whenever such vehicles are commercially available and practicable.
2. Police cruisers are exempt until commercially available.
3. Heavy-duty vehicles > 8,500 pounds are exempt.



Criteria 5 – Minimize Life Cycle Costs

Require all new residential construction and all new commercial and industrial real estate construction to minimize, to the extent feasible, the life-cycle cost of the facility by utilizing energy efficiency, water conservation and other renewable or alternative energy technologies.

The DOER recommended way for cities and towns to meet this requirement is by adopting the BBRS Stretch Code (780 CMR 115.AA) an appendix to the MA State Building Code.

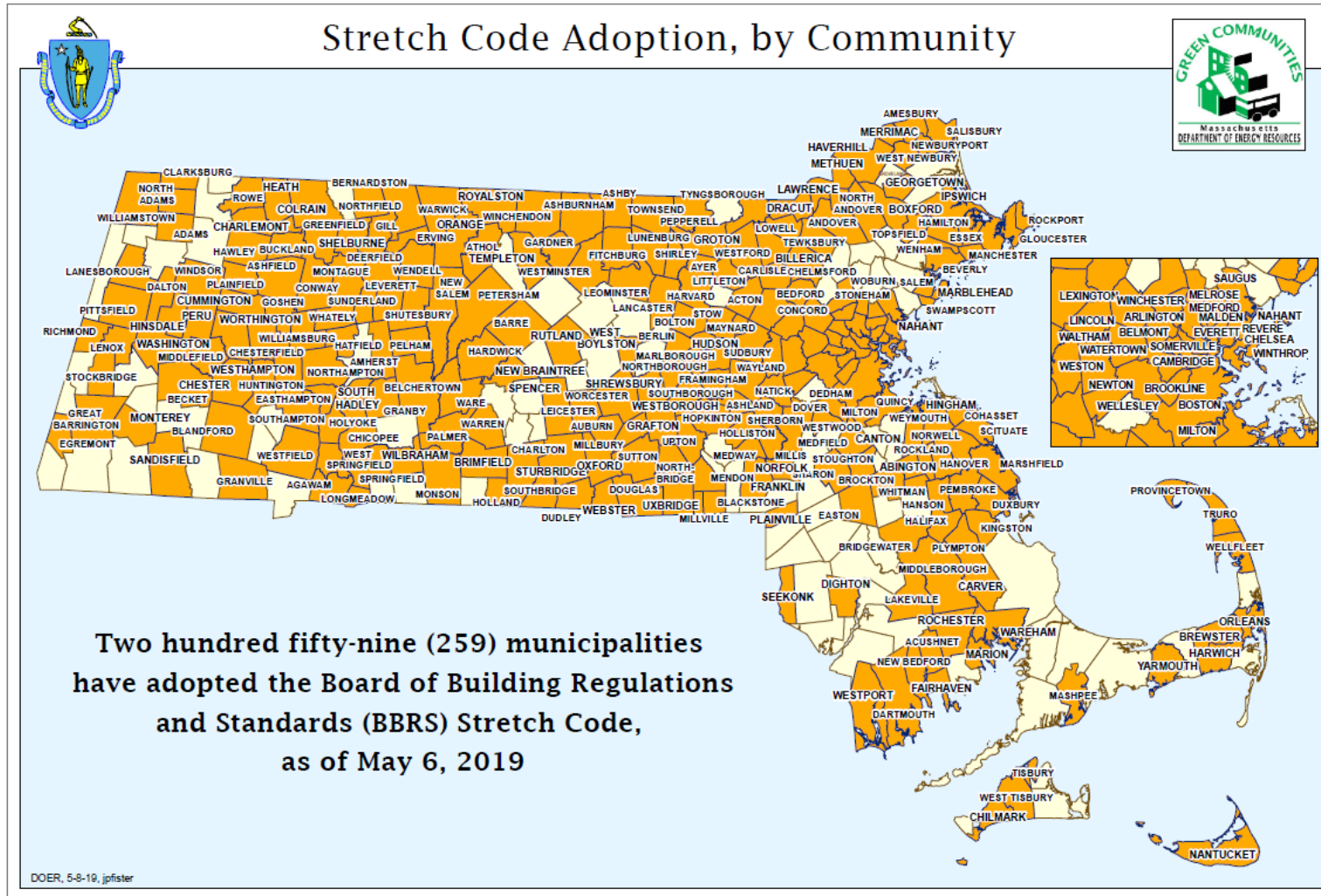
- In a town, the Stretch Code must be adopted as a general bylaw by its Town Meeting.
- <https://www.mass.gov/files/documents/2018/08/10/guidance-5-criterion.pdf>



Creating a Clean, Affordable and Resilient Energy Future for the Commonwealth



Stretch Code Communities



Creating a Clean, Affordable and Resilient Energy Future for the Commonwealth



Stretch Code

- The Stretch Code **ONLY** applies to:
 - **NEW** residential construction and
 - **NEW** commercial construction > 100,000 sq. ft. or > 40,000 sq. ft. for conditioned spaces = Labs & Supermarkets
- **Additions, Renovations & Repairs are EXEMPT from the Stretch Code**



The Stretch Code is No Longer Much of a Stretch

- Base Energy Code (IECC 2015) and Stretch Code adopted by Massachusetts on 1/1/2017
- Current Base Code allows builders **two options** for residential and commercial new construction:

Prescriptive

- Checklist of Compliance Measures
- Inspections During and Post Construction

Performance

- Pre & Post Construction Energy Modeling
- Inspections During and Post Construction



The Stretch Code is No Longer Much of a Stretch

- Major differences between the Base & Stretch Code are:
 - Removal of the prescriptive path option
 - HERS Rater needs to provide an Energy Model.
 - The cost to perform the modelling required by the Stretch Code can be covered by utility incentive.

~~Prescriptive~~

- ~~• Checklist of compliance measures~~
- ~~• Inspections during and post construction~~

Performance

- Pre & Post construction energy modeling
- Inspections during and post construction



Why Test Performance?

- Prescriptive codes don't guarantee good installation, air and water tightness, or that thermal insulation is effective.
- Small air gaps can reduce insulation R-values by 50% or more.
- HERS Raters provide third party verification



What is the HERS Process?

1. Review Building Plans via
Computer Energy Modeling
2. In-process inspections
 - First inspection
 - Duct tightness test (if applicable)*
 - Second Inspection
(usually combined with 1st)
 - Insulation
 - Final Inspection
 - Blower door test*
3. Finalize energy model based on
verified performance and
equipment

*Required by Base Energy Code 2015 IECC



What is the HERS Process?

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*Required by Base Energy Code 2015 IECC



What is a HERS Rating? (Home Energy Rating System)

Annualized energy analysis

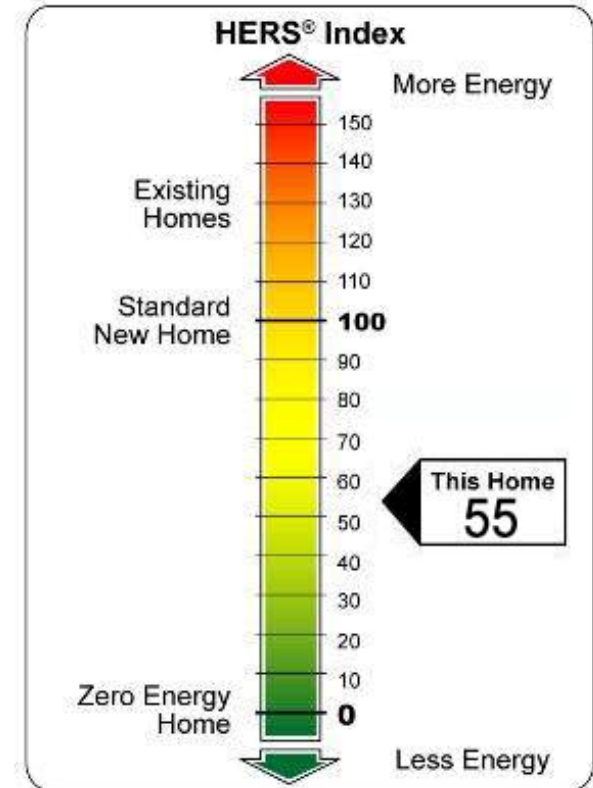
Heating, Cooling, Water Heating,
Lighting and Appliances....

On site power generation-renewable energy

Reference Home

- Based on IECC **2006** Code
(International Energy Conservation Code)
Defined as 100 Points
- 1 percent change in consumption = 1 point

**HERS 55 means about
45% more efficient than reference home**





Mass Save Residential New Construction Program



About Mass Save



Mass Save is an initiative sponsored by the Massachusetts Gas and Electric utilities and energy efficiency service providers, including Berkshire Gas, Blackstone Gas, Cape Light Compact, Columbia Gas of Massachusetts, Eversource, Liberty Utilities, National Grid, and Unitil. The sponsors of Mass Save work closely with the Massachusetts Department of Energy Resources to provide a wide range of services, incentives, trainings, and information promoting energy efficiency that help residents and businesses manage energy use and related costs. Visit <http://www.masssave.com/> for more information.



Electric Sponsor



nationalgrid
HERE WITH YOU. HERE FOR YOU.

Residential New Construction Program



- **Single point of contact** that covers projects with multiple fuel types, multiple utilities, and both commercial and residential meters
- All incentives are **performance-based**, with some exceptions
- A portion of utility bills paid in Massachusetts is allocated to a **fund for energy efficiency** programs in the state. This fund is then used to support Mass Save Programs
- Program requirements and performance targets align with **MA Base and Stretch Energy Codes**
- ICF is the Program Administrators' lead vendor for the program

Residential New Construction Program: *Three Paths*



■ Low-Rise

- Single Family Homes
- Multi-Family ≤ 3 Stories and residential-metered heat
- New construction



■ Renovations & Additions (R&A)

- Single Family Homes
- Multi-Family ≤ 3 Stories and residential-metered heat



■ High-Rise

- All multi-family with master-metered heat
- ≥ 4 stories and ≥ 5 units with residential-metered heat
- New construction and $\geq 50\%$ rehab projects



Residential New Construction Program, *Three Paths*



Low-Rise / R&A Paths

- Single Family and Low-Rise Multifamily
- Residential Energy Code
- Residential HVAC and DHW Systems only
- Development time (0.5-2 years)
- On-site testing and verification completed by program-approved HERS Raters or 3rd Party Verifiers
- Incentives for commercially metered systems are not available

High-Rise Path

- Mid and High-Rise Multifamily
- Commercial Energy Code
- Commercial and residential HVAC & DHW configurations
- Development time (2-5 years)
- Verification completed utilizing architect and/or engineer approved submittals



Low-Rise and R&A Performance Paths

3 Stories or less with residentially metered heat



Pay for Savings Calculation:

$$A * kWh + B * MMBtu + C * \%Savings$$

- Participant Incentive:
 - $A = \$0.35/kWh$
 - $B = \$35.00/MMBtu$
 - $C = \$3,000$ single family (1-4 units)
 - $C = \$2,000$ multifamily (5+ units)
 - No Cost LED lighting
 - **Average incentive = \$1,500-\$1,800**
 - Max incentive = \$10,000

- Rater/Verifier Incentive:
 - $\$350/unit$: Single Family (1-4 units)
 - $\$100/unit$: Multifamily (5+ units)



Overview & Requirements



- **Additional ENERGY STAR incentive**
 - \$100 per single family, \$25 per multifamily unit
- *General Rule of Thumb:*
 - Tight envelope & mechanical ventilation
 - All homes are required to meet 3 ACH50
 - Tight ducts
 - 6 CFM to outdoors per 100 sq. ft. of conditioned floor area
 - A/C system sizing
 - All cooling equipment must be sized according to the latest editions of ACCA Manuals J and S
 - Insulation and air sealing inspection
 - Compliance with the Air Sealing and Insulation Section of the EPA Thermal Enclosure Checklist required
 - High-efficacy lighting (90%)

Overview & Requirements



- Participants include builders, developers, & homeowners
- Program approved HERS Rating companies
- Current Stretch Code requires a HERS 55
- Process includes:
 - Hire a HERS Rater
 - Plans Analysis/Energy Savings Assessment
 - Mid-Point Inspection
 - Final Inspection
 - Savings/Incentive Processing

Nantucket Participation



- Since 2018, 114 Low-Rise projects have completed the Program
- A total of 67,372 kWh saved!
 - On average, 632 kWh per project saved
- Average project incentive ~\$1,900
- Highest incentive awarded ~\$5,500



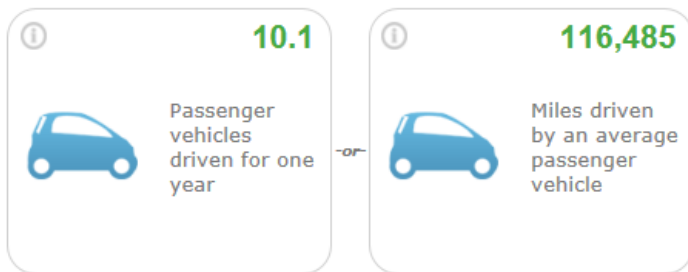
Equivalency Results of 67,372 kWh saved



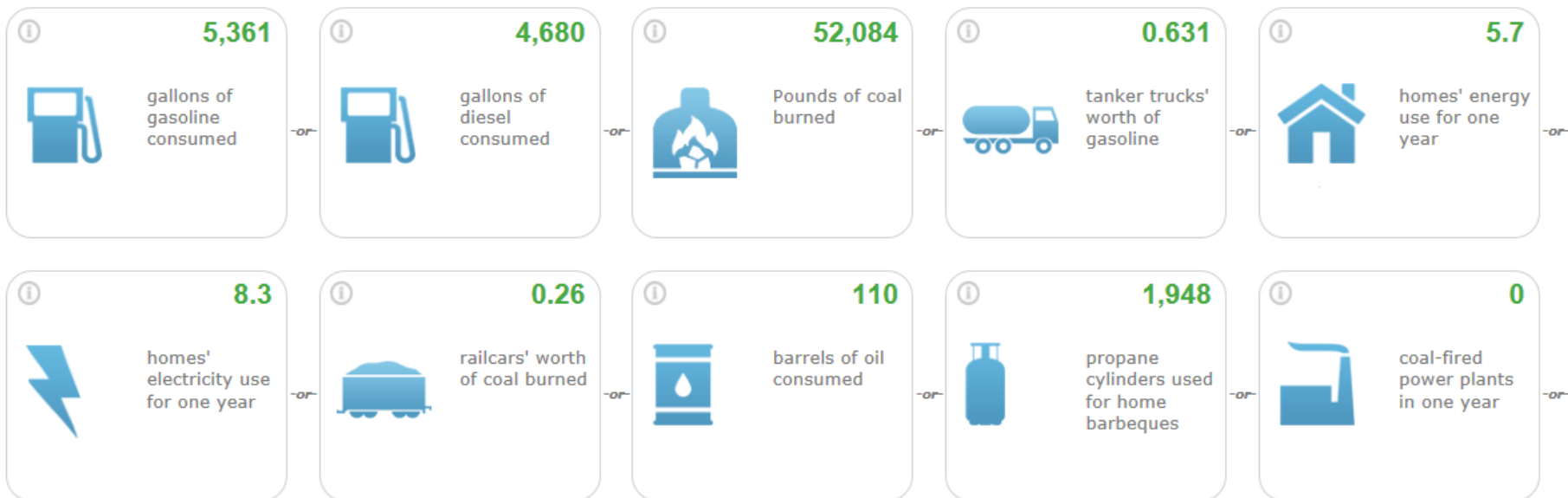
The sum of the greenhouse gas emissions you entered above is of Carbon Dioxide Equivalent. This is equivalent to:

47.6 Metric Tons

Greenhouse gas emissions from



CO₂ emissions from



Equivalency Results of 67,372 kWh saved



Greenhouse gas emissions avoided by



Carbon sequestered by





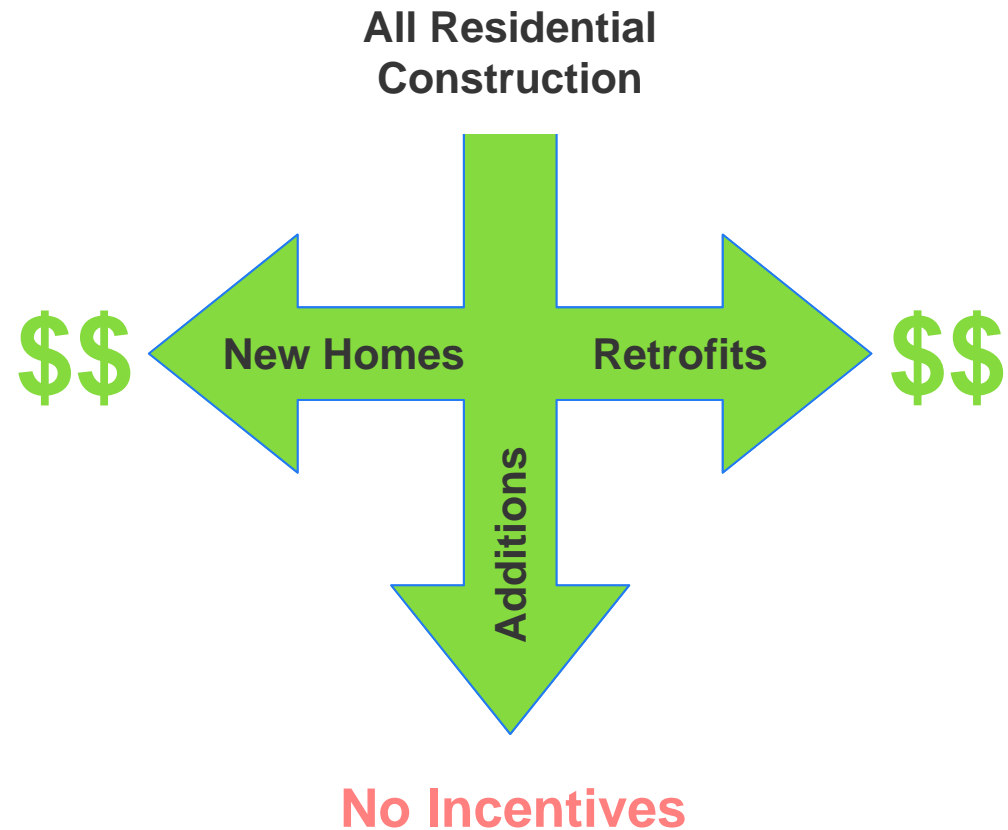
R&A Deep Dive



The Problem



- High volume of inbound R&A projects
- R&A projects fell through the gap between New Homes and Retrofits
- No incentive available and no savings influenced by program for large number of projects



The Problem



- Determining savings for R&A projects is typically very time consuming:
 - 2+ site visits required
 - Multiple energy models to calculate savings for existing footprint and addition footprint
 - Competing EE incentives/rebates for HVAC and LI/Affordable programs



The Solution



- 1st of its kind Renovations and Additions Program
- Custom software to generate hybrid baseline and reduce modeling time
- Savings claimed for previously lost projects
- Incentives for both raters and homeowners



Eligibility Requirements



- **Single family and multifamily projects**
 - Dwellings 3 stories or less are eligible to participate
- **Renovation or addition of at least 500 S.F. total enclosure area**
 - This includes floors, walls, and ceilings
- **Projects must achieve at least 5% savings above the baseline to qualify for incentives**
- **Partner HERS Rating Companies**
 - Verification services

General Overview



Project Completions	Average Incentive	Average kWh	Average MMBTu
46	\$2,946.52	2062.57	78.84

- Program incentives cap out at \$10,000 per unit
- No-cost LEDs available
 - Evaluating inclusion of instant savings measures (*low-flow fixtures, smart strips, thermostats*) for late 2019
- 2019 unit goal of 1,500
 - Currently working with 375+ active leads
- DIY projects are not allowed
 - Projects must have a valid building permit to enroll



Massachusetts Clean Energy Center



Overview of Mass CEC Programs

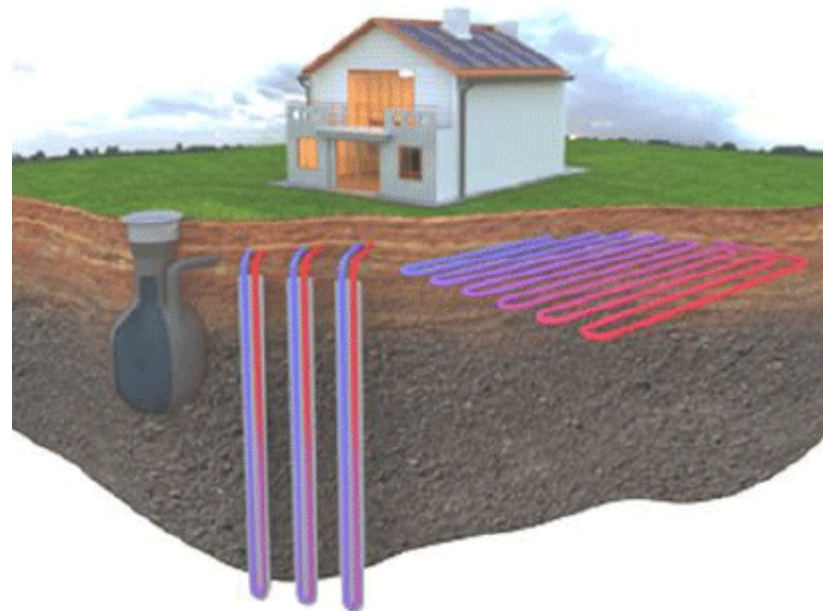


- Clean Heating and Cooling
 - Ground-Source Heat Pumps
 - Solar Hot Water
- Solar Electricity
 - Solar Access – Affordable Home Heating
 - Mass Solar Loan
 - Solarize Massachusetts
- Commonwealth Wood Stove Change-Out
 - Modern Wood Heating

Geothermal



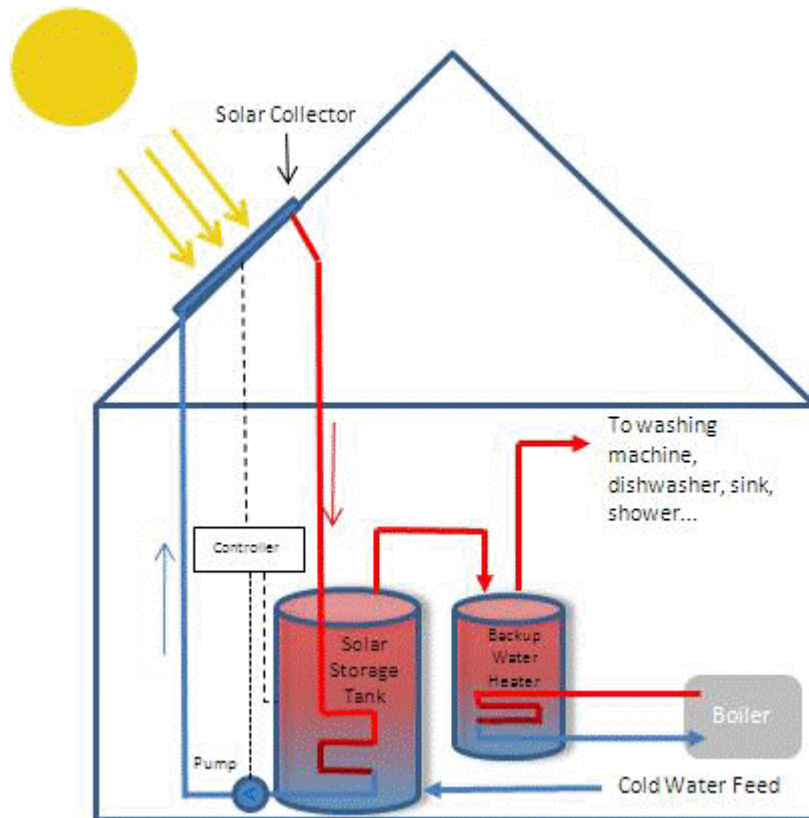
- Ground Source Heat Pumps
 - Uses earth's constant underground temperature
 - Wells can be drilled for vertical loops
 - Loops can also be horizontal



Solar Hot Water



- Solar Hot Water
 - Use small panels
 - Can be used on most roofs
 - Potentially reduce electricity consumption, running costs and environmental impact by 2/3rds



Wood Heating



- Modern Wood Heating
 - Wood & Pellet Stoves
 - Several new systems are Automated PM8



Wittus Inc.
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T 914.764.5679
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www.wittus.com
info@wittus.com

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FIRE BY DESIGN

Suite

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Slide 47

PM8

How so?

Pignatelli, Mark, 4/25/2019

Overview of Incentives



- Ground-Source Heat Pumps
 - Rebates of up to \$10,000 are available, with higher incentive for low and moderate income customers
- Solar Hot Water
 - Rebates of up to \$3,500 are available, with higher incentive for low and moderate income customers
- Modern Wood Heating
 - Rebates of up to \$12,000 are available, with higher incentives for low and moderate income customers and those removing cord wood heaters

Visit www.masscec.com for more info

Massachusetts Offers Rebates for Electric Vehicles



Mass Save Case Studies



**Juniper Street
Florence, MA**

Background

The home
New Car
Raters"
Progra

Brien
(sim
lifer
pa
2f

Juniper Street in Florence, MA participated in the Massachusetts Residential New Construction (MARNC) Program and was completed in January 2018. New England Energy Services, Inc. was the contractor for this home, which received a National Grid Energy Services Company (NGESC) Energy Star certification. The home was designed by City Studio.

Background

The Boyde's Crossing project located in Norfolk, MA participated in the Massachusetts Residential New Construction (MARNC) Program, with homes completed in 2017 and 2018. Located in Eversource Electric and Columbia Gas territory, this sustainable community is comprised of 40 single-family homes on nine acres of land, situated just outside the Norfolk town center. Coined a "pocket neighborhood," Boyde's Crossing features smart, high performance homes grouped around a shared green space. Green building practices, solar PV, and smart home technology allows these homes to use less than 45 percent of the energy that a typical new home consumes.

Project Description

Boyde's Crossing consists of 40 single-family detached homes with a variety of options. The project was designed for maximum energy efficiency.



Project Team

- Designer and Architect: Piatt Associates
- HERS Rater: Advanced Building Analysis

Equipment

- Panasonic U-26PEIU6 air source heat pump 2.87 COP
- Rheem PROPH5050 T2 RH350 D hybrid water heater
- Panasonic U-26PEIU6 air source heat pump 16.2 SEER
- Roof mounted 45 kW PV system





R&A Case Studies

Cape Cod

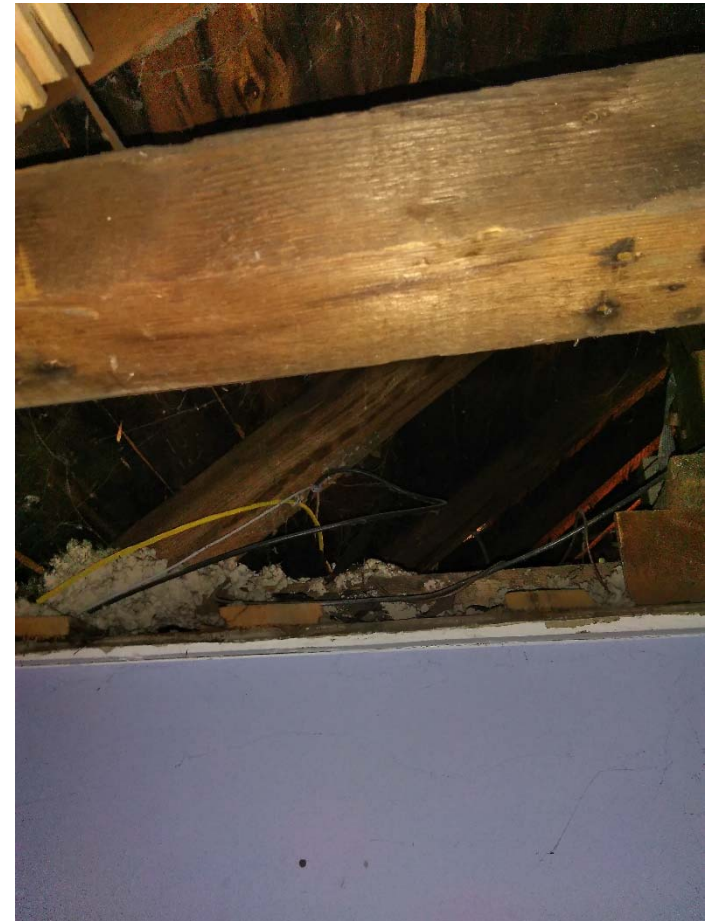


- Customer wanted to spray foam the attic to accommodate a new high efficiency furnace as part of their renovation/addition
- When they learned they could not participate through a Home Energy Assessment, they were referred to the R&A Program
- What options are there for a new system?

Cape Cod



- Are you going up or down there to change the filter?



- How about here?



Yarmouth, MA



- How about crawling behind that wall?



- You might do it here?



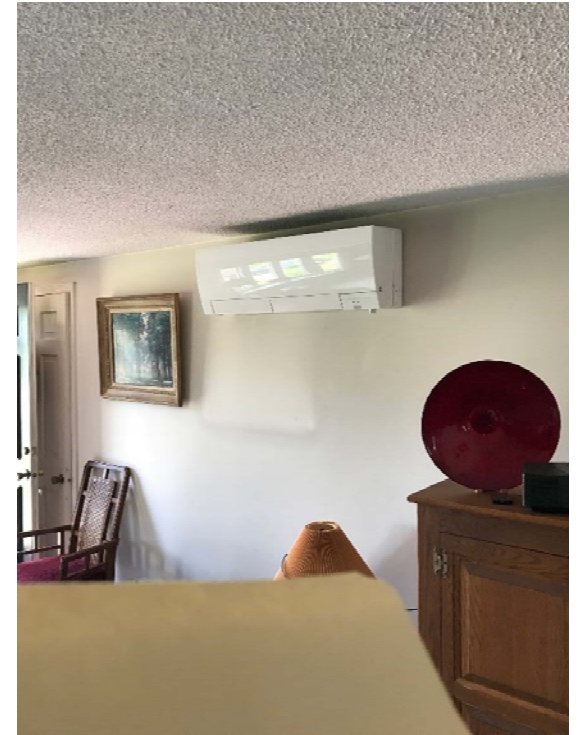
Provincetown, MA



- Better Solution?



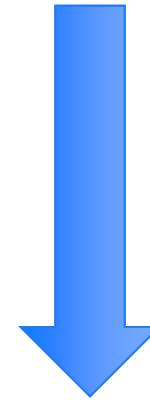
Yarmouthport, MA



Yarmouth, MA



Easy way to surpass code?



Hyannis, MA



Savings

- 42.98 Mbtu
- 70.3 kWh

Incentives

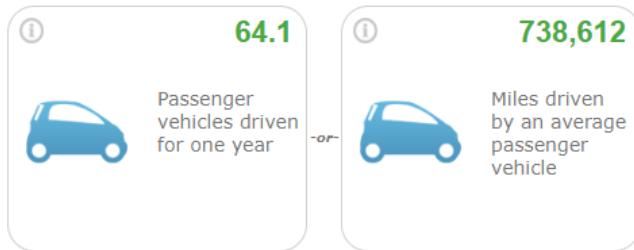
- Free LED lighting
- \$2,139.04

Bigger Picture.....

Massachusetts Average Savings from R&A 2018 PM12



Greenhouse gas emissions from



CO₂ emissions from



Slide 60

PM12

Can we update this slide so it aligns with the data #s on slide 19?

Pignatelli, Mark, 5/1/2019



Nantucket Case Studies

Low Rise Path

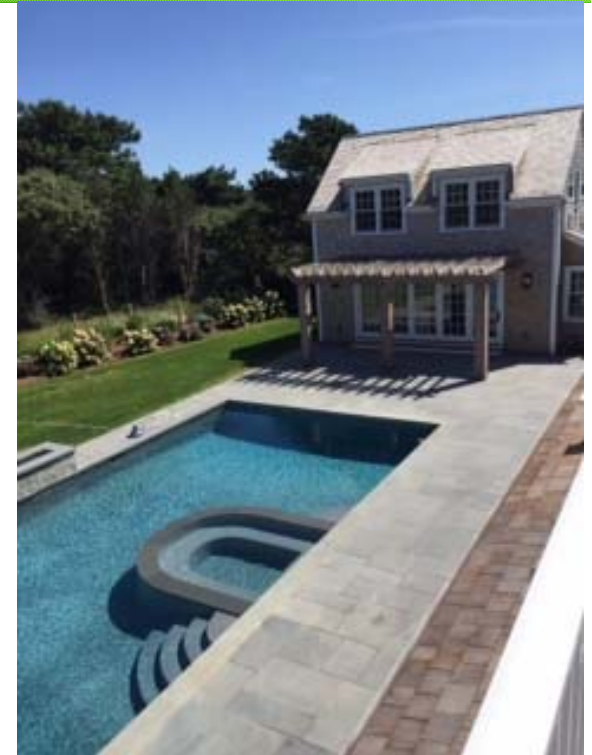


27 Monomoy Rd, Nantucket



Builder: Chip Stahl, KSM Design, Inc.

- Single Family project eligible for a **\$3,920** performance incentive
- 7,099 square feet
- Primary Heat: Propane
- 32% more efficient than the Baseline Home
- 1.28 ACH50 Total Leakage
- Received 180 Program LED's at no cost



27 Monomoy Rd, Nantucket



27 Monomoy Rd, Nantucket



27 Monomoy Rd, Nantucket



■ Heating and Cooling

- 95% Propane Hydro-Air System w/ 13 SEER Condenser

■ Hot Water

- Propane Storage Water Heater w/ .87 Energy Factor Provided by Boiler

■ Envelope

- R-21 Walls
- R-38 Spray Foam Roof
- R-10 Under Slab
- Conditioned Basement
- .31 U-Value Windows



34 Brewster Rd, Nantucket



Builder: Bessey Construction

- Project is eligible for a **\$3,984** incentive
- 6,984 square feet
- 31.2% more efficient than the Baseline Home
- 1.45 ACH50 Total Leakage
- Received 180 Program LED's at no cost



- **Heating and Cooling**
 - 95% Propane Hydro Air System w/ 13 SEER Condenser
- **Hot Water**
 - Propane Storage Water Heater w/ .87 Energy Factor Provided by Boiler
- **Envelope**
 - R-21 Walls (fiberglass)
 - R-38 Spray Foam Roof
 - Conditioned Basement w/ Insulated Slab
 - Avg .30 U-Value Windows



10 Monomoy Creek, Nantucket



Builder: Will Gorman

- Project is eligible for a **\$3,155** performance incentive
- 5,783 square feet
- 28% more efficient than the Baseline Home
- 1.74 ACH50 Total Leakage
- Received 235 Program LED's at no cost



10 Monomoy Creek, Nantucket



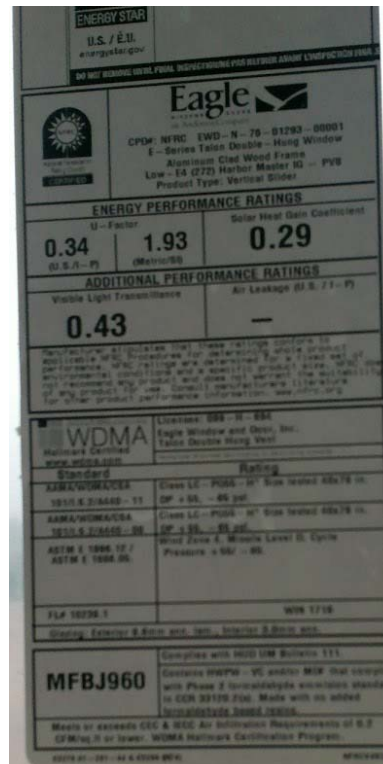
10 Monomoy Creek, Nantucket



10 Monomoy Creek, Nantucket



- **Heating and Cooling**
 - 94% Propane Boiler w/ 13 SEER Condenser
 - ERV
- **Hot Water**
 - Propane Storage Water Heater w/ .86 Energy Factor Provided by Boiler
- **Envelope**
 - R-20 Walls
 - Conditioned Basement
 - Foam used throughout for air sealing + tight shell



ENERGY STAR U.S. / E.U. energystar.gov		
DO NOT REMOVE LABEL FROM WINDOW/DOOR FOR ENERGY STAR PROGRAM		
Eagle Eagle Window and Door, Inc. CPDM: NFDG EWD-N-75-01293-00001 E-Series Tall Double-Hung Window Aluminum Clad Wood Frame Low-E4 (27) Harbor Master III - PV8 Product Type: Vertical Slider		
ENERGY PERFORMANCE RATINGS		
U-Factor 0.34 (U.S. & E.U.)	Solar Heat Gain Coefficient 1.93 (Metric)	0.29
ADDITIONAL PERFORMANCE RATINGS		
Visible Light Transmittance 0.43	Air Leakage (U.S. & E.U.) —	
New Product: All products that these ratings conform to must include the procedures for determining their product performance. All ratings are determined for a fixed set of environmental conditions and does not account for the actual environmental conditions and does not account for the actual performance of any product. See (www.energystar.gov) for details on the performance of any product. For complete performance information, see www.energystar.gov.		
WDMA National Certification www.wdma.com	Listing: 200-11-054 Eagle Window and Door, Inc. Tall Double Hung Win	Rating
AMA/WMA/CSA 1001 & 20440-11	Class LC - P020 - 67" Size Window 65x78 in.	U-F + SH - 85 U-F
AMA/WMA/CSA 1001 & 20440-11	Class LC - P020 - 67" Size Window 65x78 in.	U-F + SH - 85 U-F
ASTM F 1066 1077 ASTM F 1066 1077	Wind Zone 4, Middle Level 0, Cycle Pressure + 90 - 90	
FLP 10290.1	W19 1218	
Listing: Exterior 2.80 in. and 3.00 in. Interior 2.80 in. and 3.00 in.		
MFBJ960	Complies with 2009 UBC Section 111. Contains WDMA - VC window MFR that complies with Phase 2 Sustainability selection standard in ICCR 20120.204. Made with no added formaldehyde based resins.	
Made to exceed ICC & IRC Air Infiltration Requirements of 0.2 CFM/ft ² or lower. WDMA National Certification Program.		



19 Wapossett Circle



Builder: Housing Assistance Corporation

- Project is eligible for a **\$624** performance incentive
- 1,221 square feet
- 12.4% more efficient than the Baseline Home
- 2.38 ACH50 Total Leakage
- Received 68 Program LED's at no cost



19 Wapossett Circle



- **Heating and Cooling**

- 9 HSPF (Heating Season Performance Factor) 17 SEER Cooling

- **Hot Water**

- Heat Pump Water Heater with Energy Factor of 3.24

- **Envelope**

- R-43 Ceilings with low density foam
- Conditioned Basement
- .30 U-Value Windows



10 Eat Fire Springs Road



Adam Ross, Ross Builders



10 Eat Fire Springs Road



- Project is eligible for a **\$7,323** performance incentive
- 7,970 square feet
- 52.3% more efficient than the Baseline Home
- .51 ACH50 Total Leakage
- Received 129 Program LED's at no cost



10 Eat Fire Springs Road



Total Rooms: 16	Lot Size: 3.24 acres
Beds: 7 Baths: 6	Year Built: 2017

10 Eat Fire Springs Road



- **Heating and Cooling**

- Avg. 4.4 COP Geothermal Heating Avg. 29.5 EER Geothermal Cooling
- 8 vertical wells @ 125'
- 900' piping used
- ERV's @ main air handling units

- **Hot Water**

- Geothermal Pre-Heat with Energy Factor of 3.0
- 119 Gallon Storage

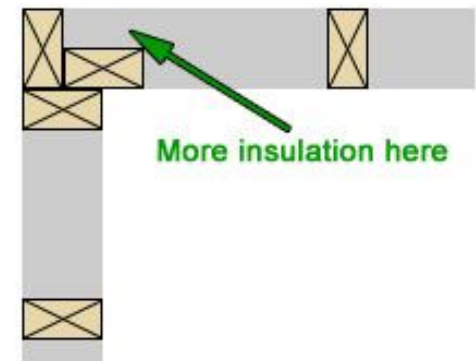
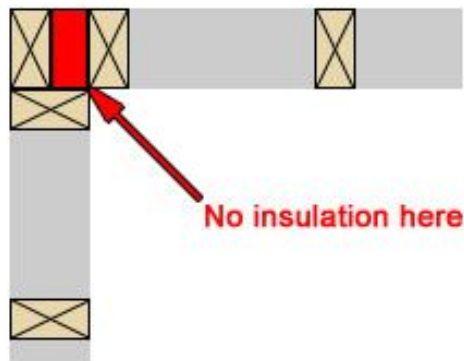


10 Eat Fire Springs Road



■ Envelope and Advanced Framing

- R-29 Walls w/ 24" on center framing
- R-48 Ceilings w/ 24" on center framing
- Insulated Slab
- 2" Offset Framing and Foam for Tight, Dry, Conditioned Basement
- .27 U-Value Windows



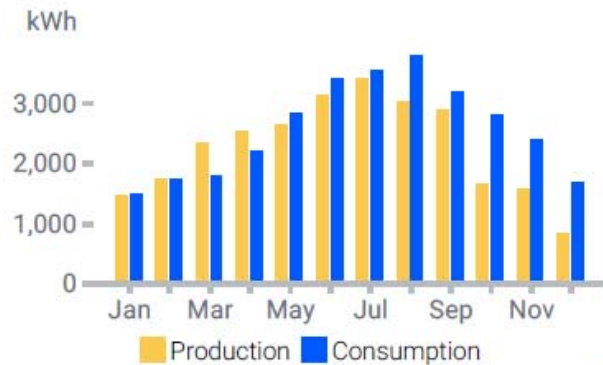
10 Eat Fire Springs Road



10 Eat Fire Springs Rd Solar Electric Summary

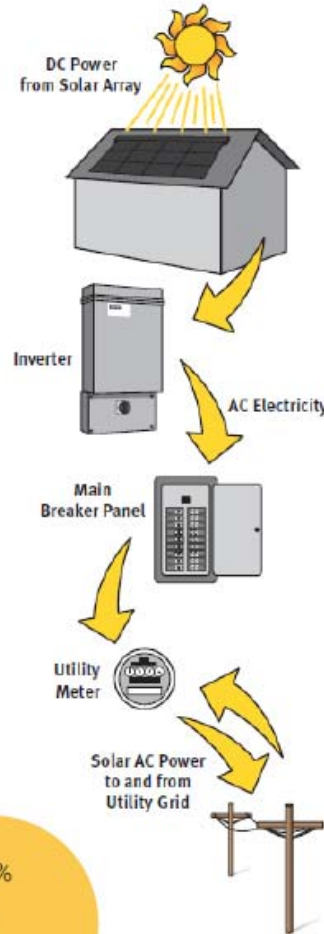
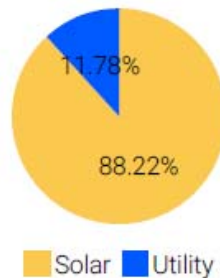
System Information

Size: 22.80 kW DC
 Project Life: 20 years
 1st Year AC Power: 27,305 kWhrs
 1st Year Utility Savings: \$5,297
 Average Yearly Power: 26,046 kWhrs
 Lifetime Power: 520,920 kWhrs
 Lifetime Utility Savings: \$77,595



Annual Environmental Benefits

6,696 Trees planted or
 280,490 Pounds of coal saved or
 621,754 Miles per year driven



Manufacturer	Model	Quantity
Silfab Solar	SLA285M	80
SMA Solar Technology AG	SB 6000TL-US-22 (240V)	2
SMA Solar Technology AG	SB-7700TL-US-22 (240V)	1



10 Eat Fire Springs Road



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To Get Started

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Thank you

