



A Proposal for a New RESNET Standard on Embodied Carbon


with the Northeast Home Energy Rating System Alliance Embodied Carbon Committee

Our Team

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The Northeast Home Energy Rating System Alliance Embodied Carbon Committee:

- ❖ **Betsy Ames** - NEHERS Executive Director
- ❖ **Andy Buccino** of Stephens and Co. - NEHERS Embodied Carbon Committee Chair
- ❖ **Mike Browne** of Advanced Building Analysis - NEHERS Board President
- ❖ **Chris Mazzola** of Home Energy Raters - NEHERS Board Vice President
- ❖ **Sara DeVico** of the BER - NEHERS Standards and QAD Committee Chair

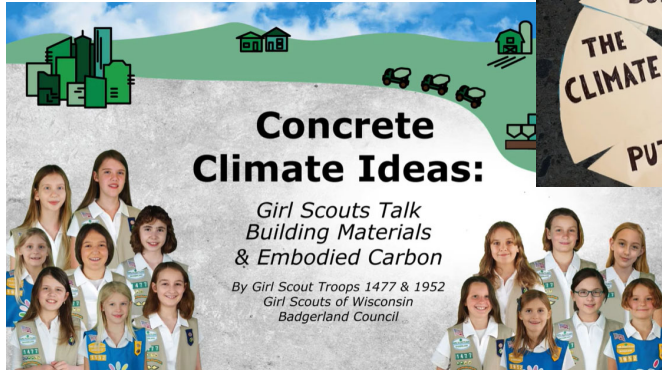


2

Hat Tip

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<https://www.youtube.com/watch?v=V4OZMNg5Ao>



<https://www.youtube.com/watch?v=tzL79SUBzgg>



Be The Change In The World...

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- ❖ Embodied Carbon Network
- ❖ Carbon Leadership Forum
- ❖ NESEA
- ❖ EnerCan
- ❖ New Buildings Institute
- ❖ Builders for Climate Action
- ❖ Architecture 2030
- ❖ Green Home Institute
- ❖ Mass CEC Triple Decker Challenge
- ❖ Rocky Mountain Institute
- ❖ The NMR Group
- ❖ PHIUS
- ❖ Project Drawdown
- ❖ Young Professionals in Energy Boston
- ❖ The One Tree Pledge
- ❖ Rachel White
- ❖ Allison Nash
- ❖ Jonathan Von Ranson
- ❖ MA Climate Action Network
- ❖ NEEP
- ❖ Endeavour Center
- ❖ Mike Duclos
- ❖ International Living Future Institute
- ❖ "Zero Carbon" Certification
- ❖ Powerhouse Certification



Perspective

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“Everything you do in life will be insignificant, but it’s very important that you do it anyway.”
- Ghandi



Special Thanks

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- ❖ **Chris Magwood** – RMI and Builders for Climate Action (the BEAM Tool)
- ❖ **Jacob Deva Racusin** – New Frameworks
- ❖ **Andrew Frederick** – Croft House
- ❖ **Stacy Smedley** – Building Transparency (the EC3 Tool)
- ❖ **Erik Bowden** – Builders for Climate Action
- ❖ **Jacob Kamen** – Ekotrope
- ❖ **David Goldstein** – NRDC and RESNET Standards Management Board
- ❖ **Bill Spohn** – TruTech Tools and RESTalk Podcast Host



Agenda

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- ❖ **Betsy Ames** – Overview
- ❖ **Andy Buccino** – Software Integration
- ❖ **Mike Browne** – Baseline, Evaluation and Indexing
- ❖ **Sara DeVico** – Standards
- ❖ **Chris Mazzola** – Market and Incentives



Our Living Biosphere

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Heat

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Temperature Distribution in 2021

The following map shows how local temperatures in 2021 have increased relative to the average temperature in 1951-1980.

2021

Relative to 1951-1980 Averages

www.BerkeleyEarth.org

Temperature Anomaly (°C)

-6 -4 -2 -1 -0.5 0 0.5 1 2 4 6

9

Humidity

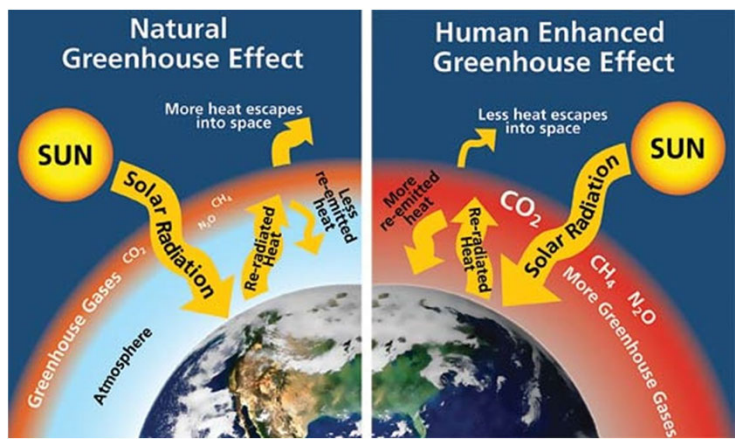
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https://en.wikipedia.org/wiki/2021_Atlantic_hurricane_season

10

Greenhouse Effect

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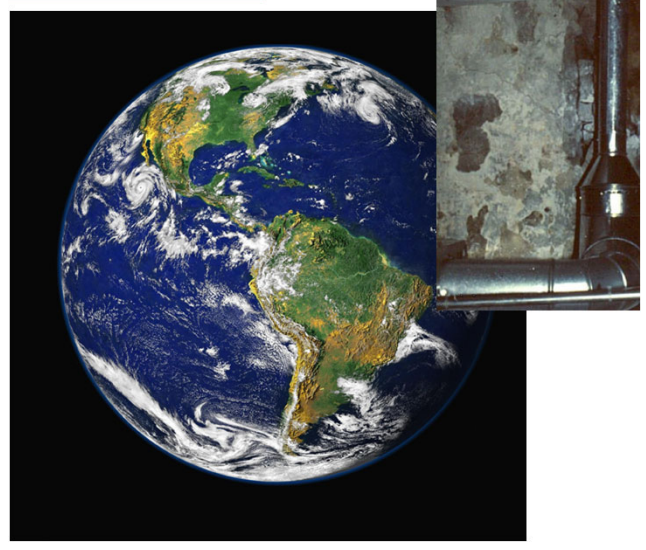
<https://climatechange.lta.org/get-started/learn/co2-methane-greenhouse-effect>



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Ventilation Needed

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Building Systems

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Social Systems

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Photo by
Nelson
Treehouse
and Supply

© NELSON TREEHOUSE



Download from
© iStockphoto.com



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Technology

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The image contains three separate photographs. On the left is a large wind farm with many white turbines against a blue sky and mountains in the background. In the center is a single white smart light bulb with the 'EcoLight Electric' logo. On the right is a small white and blue electric car (a Smart car) parked on a brick street, with a yellow charging cable plugged into its rear.




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NORTHEAST HOME ENERGY RATING SYSTEM ALLIANCE 15

The Law of Thermodynamics

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HIGH		LOW
HOT		COLD
WET		DRY



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Energy Added


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Global Economy

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Economic System

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RESOURCES

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Where Does Value Lie?

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TANGIBLE

Wampum

Gold

Shells

INTANGIBLE

Debt/ Credit

20

There Is No Planet B




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Extraction

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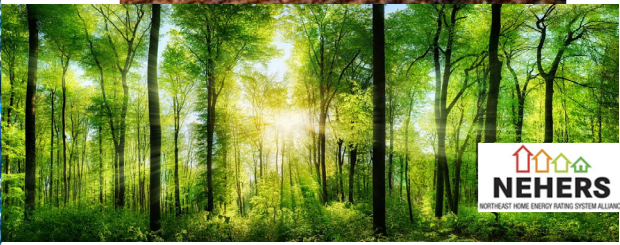
RAW MATERIALS → PRODUCTS → WASTE



22

Abundance

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23

Depletion and Waste

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PIT MINE



LANDFILL



24

Global Economy

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RESOURCES

POLLUTION

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Who Is Responsible?

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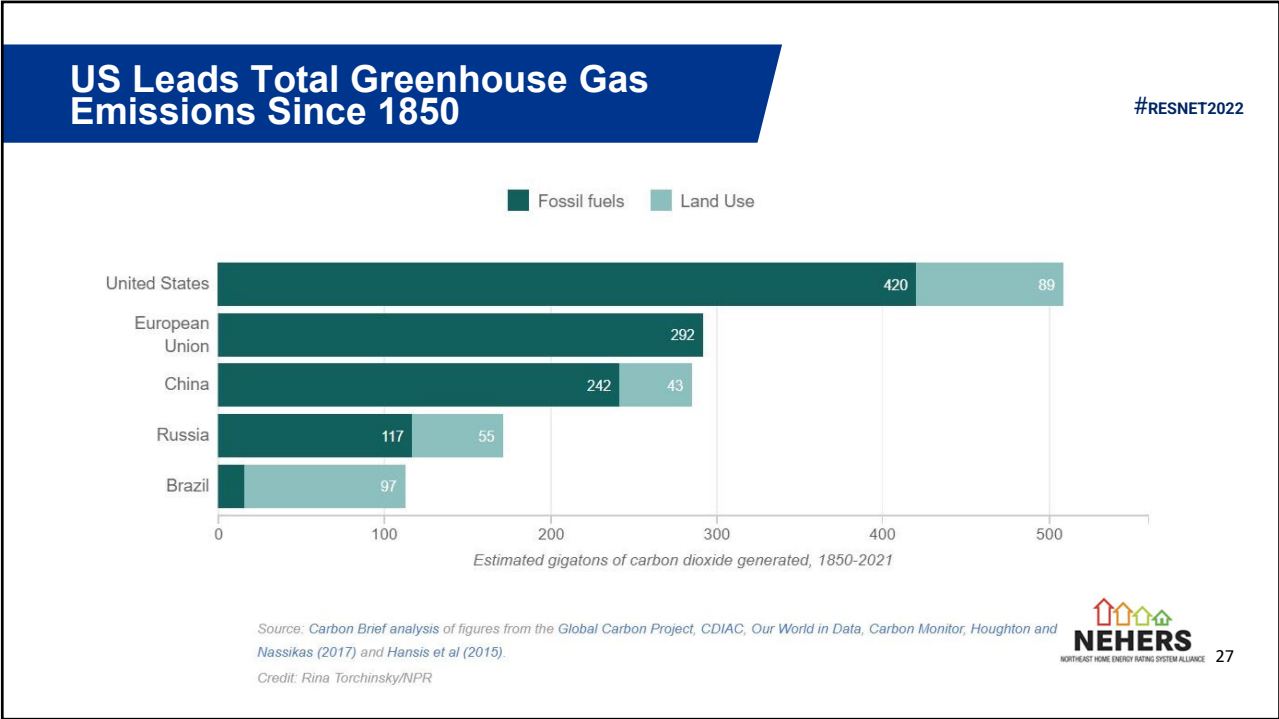
CO2 emissions per capita

emitted tons of CO2 per capita

0 1 10 20+ no data

Source: Global Carbon Project 2020, latest data as of 2019

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Indigenous Knowledge

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“5% of world’s population exist of indigenous people, and that their way of life has preserved 80% of the world’s biodiversity.”
– Raki of West Papua

<https://sustainingalllife.org/resources/frontline-voices-video/>



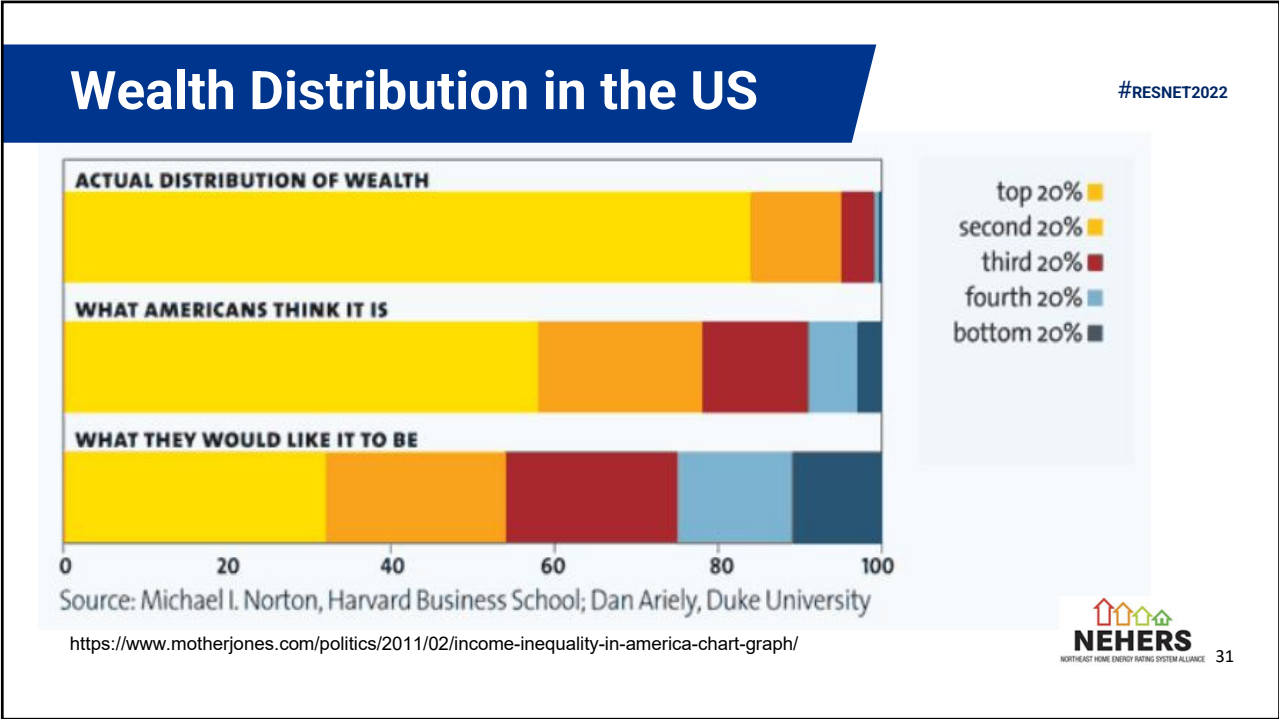
A Call for Action

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<https://sustainingalllife.org/resources/frontline-voices-video/>





Logical Outcomes of Extraction

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“The world’s eight richest billionaires control the same wealth between them as the poorest half of the globe’s population...”

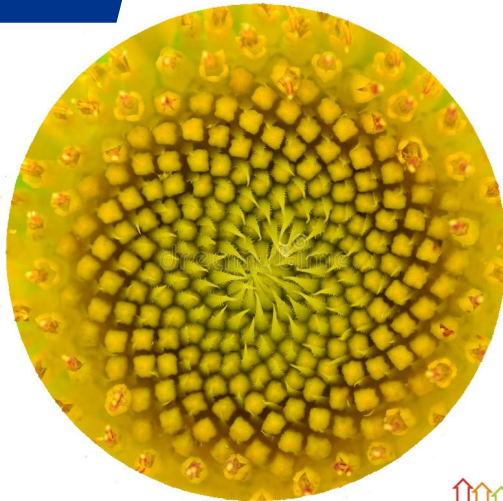
8 Men
\$426 Billion = The Wealth of
3.6 Billion People

<https://www.theguardian.com/global-development/2017/jan/16/worlds-eight-richest-people-have-same-wealth-as-poorest-50>

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Extraction vs Regeneration

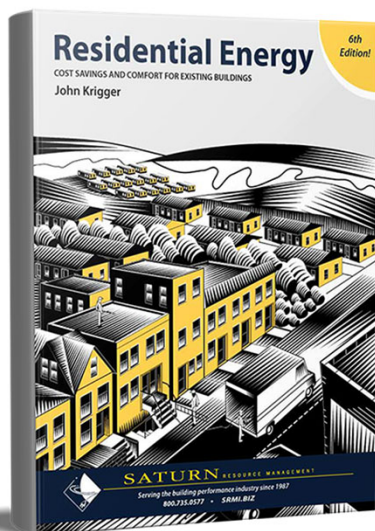
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Rating Industry Opportunity

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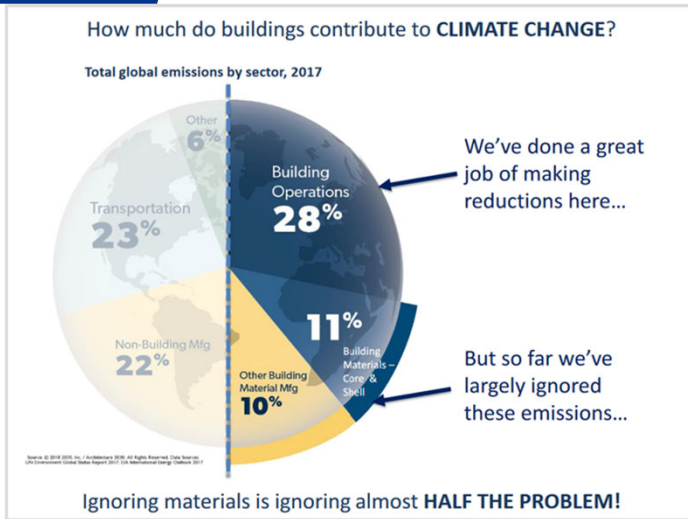
“The United States represents about 5% of the world’s population. Yet it consumes 25% of the world’s energy supplies... Buildings use about 40% of our total annual energy consumption.” (Page 13)


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Materials = 21%

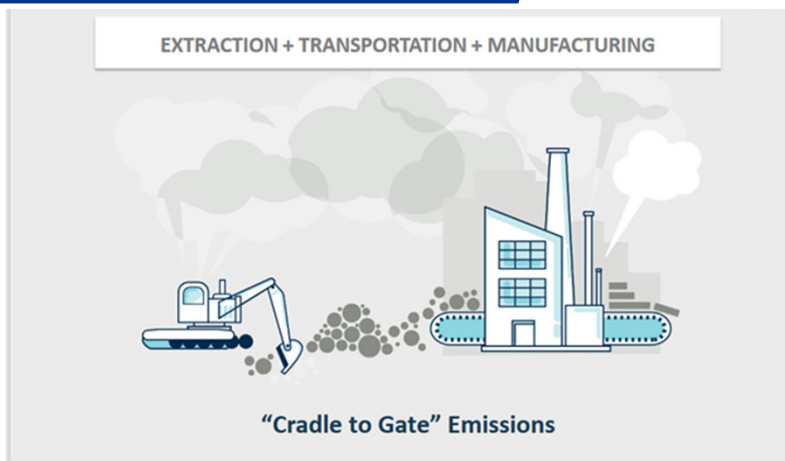
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Beyond Energy Efficiency: Why Embodied Carbon in Buildings Matters NOW - June 10, 2020 - Chris Magwood and Jacob Deva Racusin



Material Embodied Carbon

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Beyond Energy Efficiency: Why Embodied Carbon in Buildings Matters NOW - June 10, 2020 - Chris Magwood and Jacob Deva Racusin

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Full Life-Cycle Analysis

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Beyond Energy Efficiency: Why Embodied Carbon in Buildings Matters NOW - June 10, 2020 – Chris Magwood and Jacob Deva Racusin



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Operational Carbon


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The HERS Index is the Gold Standard for Tracking “Operational Use of Buildings”

Improved Performance Drivers

- Cold Climate Heat pump technology
- Dramatic Reductions in Air Leakage
- Heat Pump Hot Water
- Electrification of Buildings

Beyond Energy Efficiency: Why Embodied Carbon in Buildings Matters NOW - June 10, 2020 – Chris Magwood and Jacob Deva Racusin



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Low Hanging Fruit

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Raw Material Extraction,
Transportation
+ Manufacturing of
Building Materials =

60-90%

of a Building's Full Life
Cycle Emissions.

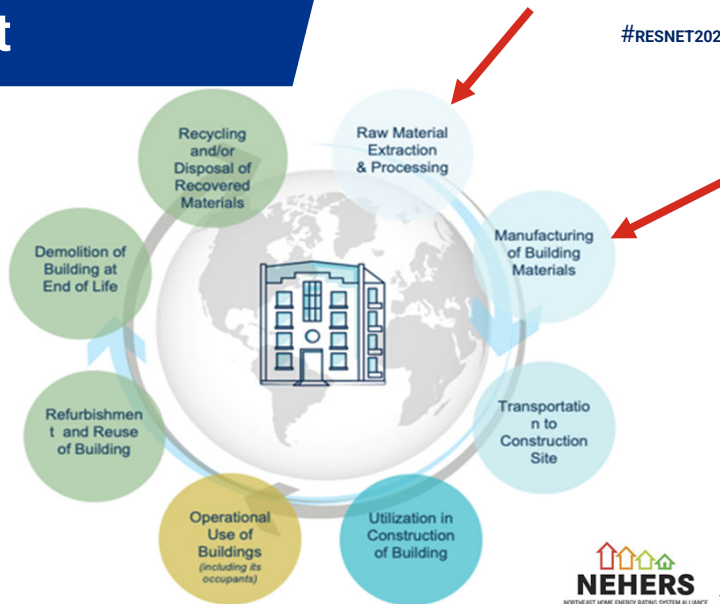
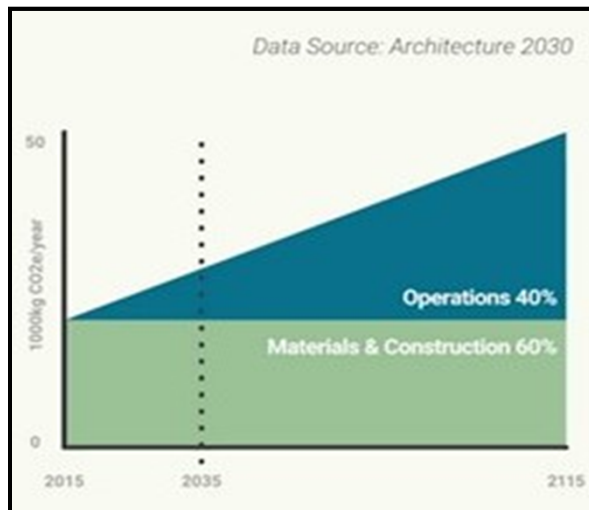


Image courtesy of: Jacob Deva Racusin, New Frameworks;
Chris Magwood, Builders for Climate Action

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Embodied Carbon Baseline

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1 Paris Every Week

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“Over the next 40 years, the world is expected to build **230 billion square metres** in new construction – adding the equivalent of Paris to the planet every single week.”

- Fatih Birol,
Executive Director of
the International
Energy Agency




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Uh Oh!

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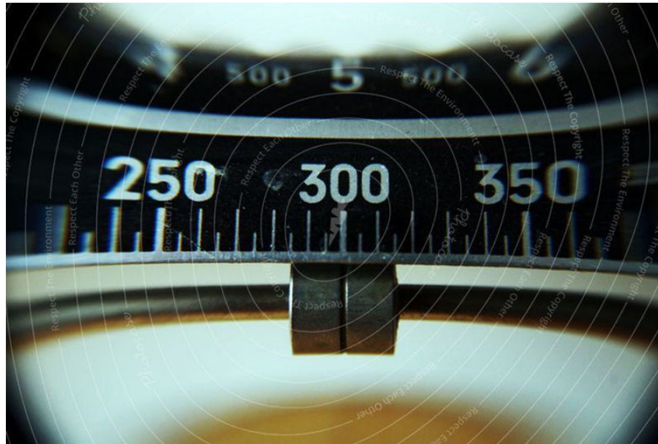



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350? 400? Now 419 Parts Per Million!!!

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POUNDS



PARTS
PER
MILLION
CO2

Photocase
Good for your eyes

prokop
photocase.com/106164


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IPCC: Remaining Carbon Budget

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To limit global warming to 1.5°C above pre-industrial levels with either a:

Two-in-Three (67%) Chance

One-in-Two (50%) Chance

400 GtCo2

500 GtCo2

as of 1/1/2020

as of 1/1/2020

Human activities emit around 40 billion tonnes of CO2
into the atmosphere in a single year.

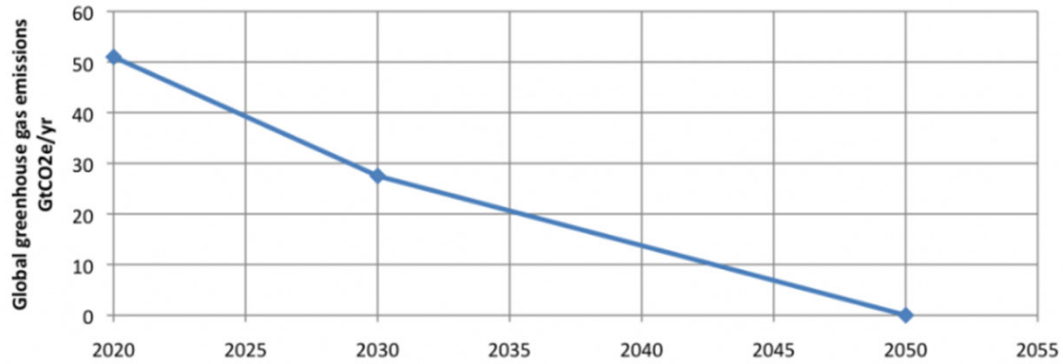
https://www.ipcc.ch/report/ar6/wg1/downloads/faqs/IPCC_AR6_WGL_FAQs.pdf Page 36 of 96


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Recommended

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IPCC Targets to Limit Global Warming to 1.5°C



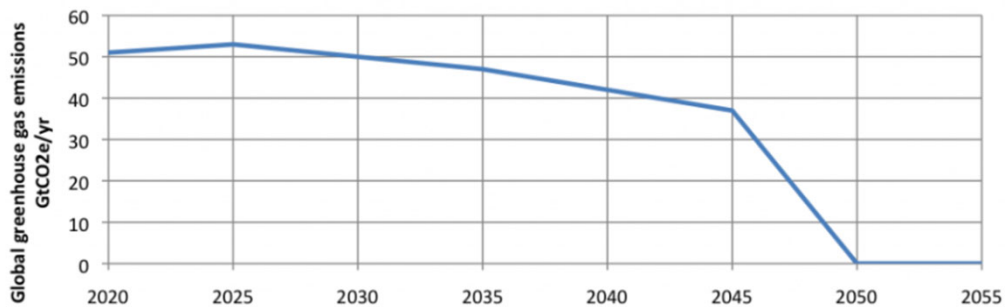
<https://www.russvernonjones.org/problems-with-net-zero-by-2050/>



Projected

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Current Policies w/ Carbon Removal Technology in the Future - Possible Trajectory If Cuts Are Delayed

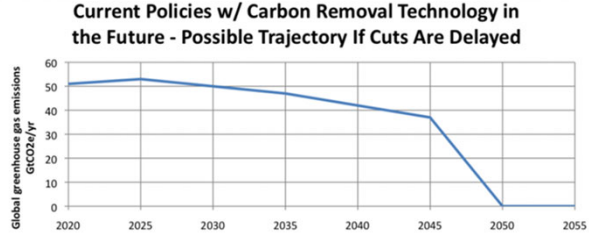
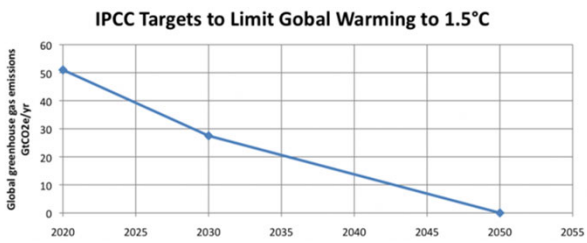


<https://www.russvernonjones.org/problems-with-net-zero-by-2050/>



Exceeded

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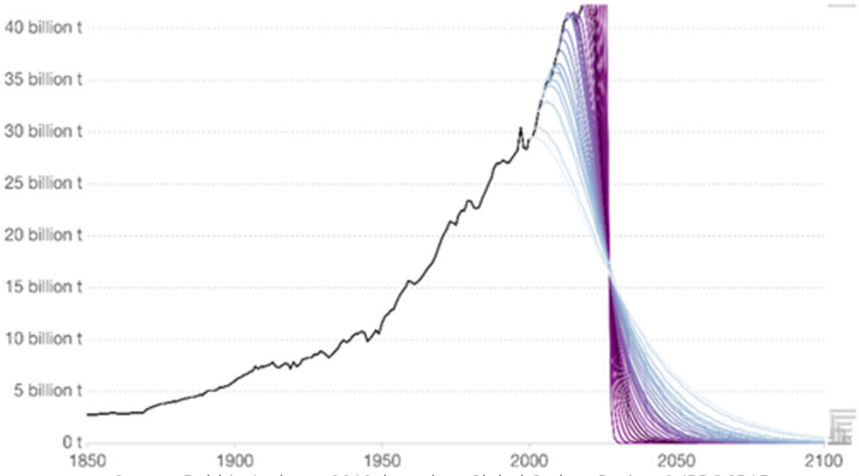
<https://www.russvernonjones.org/problems-with-net-zero-by-2050/>



Emissions Cliff

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Annual emissions of carbon dioxide under various mitigation scenarios to keep global average temperature rise below 1.5°C. Scenarios are based on the CO₂ reductions necessary if mitigation had started – with global emissions peaking and quickly reducing – in the given year.



Source: Robbie Andrews 2019; based on Global Carbon Project & IPCC SR15



NESEA Keynote 2019

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Category	Value (tonnes)	Total Net
Carbon Emissions (Initial)	+200	+212
Carbon Emissions (Reduced)	+100	+68
Carbon Storage (Initial)	-100	-15
Carbon Storage (Increased)	-100	-117

Material embodied carbon comparison

- Roof: Trusses + FSC cedar shake
- Ceiling: Straw insulation + ReWall
- Floors: 2x12 + FSC plank + linoleum + FSC softwood
- Windows: Double pane + wood frame
- Int. walls: Compressed straw panels + ReWall
- Cladding: FSC softwood
- Walls: Double stud + straw + fiberboard
- Slab: Adobe + expanded glass aggregate
- Fdn: Iso-span ICF with fiberboard

With Chris Magwood, Ace McArleton, and Jacob Racusin

<https://nesea.org/buildingenery-boston-2019-keynote-session>

Restoring Balance

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Connection to Nature

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Lake Mattawa, MA 2020

Betsy Tapping 100+ Year Old Maple-
Upstate New York 1984



Our Home

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Three Areas of Action Needed

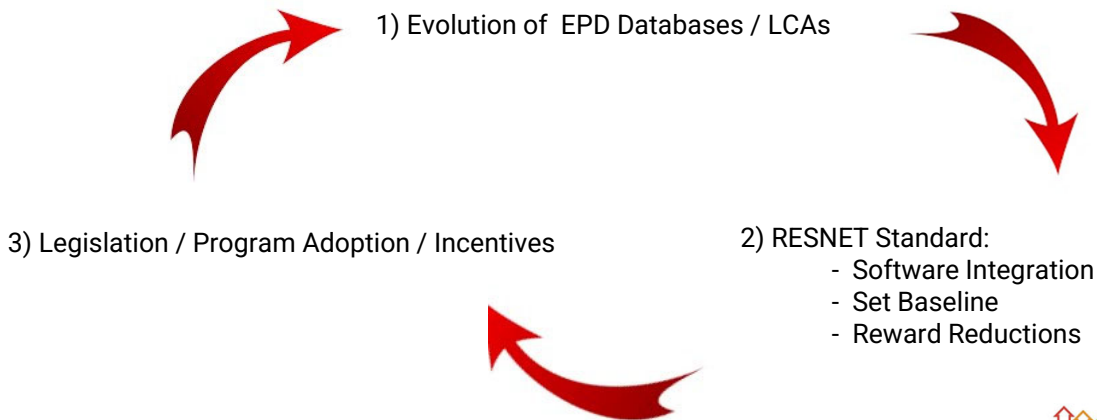
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- 1) Evolution of Environmental Product Declarations (EPDs)
Databases
 - Allow Whole Building Life Cycle Assessments (LCAs)
- 2) RESNET Standard:
 - Software Integration with EC Tools
 - Set EC Baseline to Recognize and Reward EC Reductions
 - Reward both OC and EC Reductions in Design
- 3) Legislation / Program Adoption / Incentives



Three Areas of Action Needed

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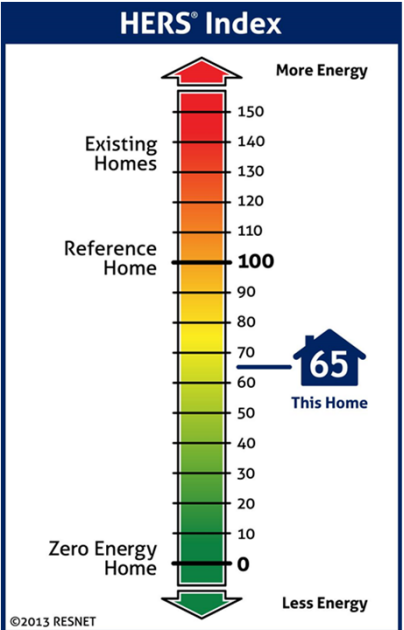
Our Pitch

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Gold Standard

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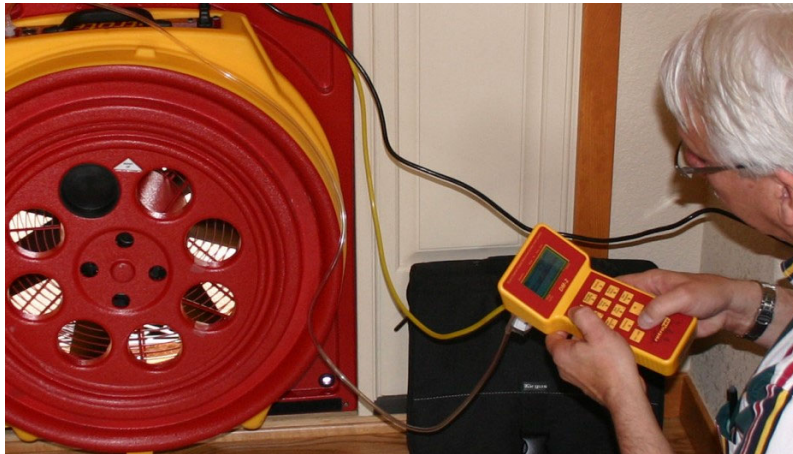


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HERS Raters

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We Already Collect LOTS of Data

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Above Grade Wall Help

Name: R19 Batt 16 OC gr 3 Verified Description

Assembly Properties

R 14.353
U 0.070

Layer Edit

Name: Fiberglass
Description:
 Continuous Stud/Cavity

Material

Fiberglass Ba
Depth in. 5.5
Insulation Grade III
Per Inch Total
R 17.6

Stud/Cavity

Stud Type: Wood
Depth in. 5.5
Width in. 1.5
Spacing in. 16
Framing Fraction 0.23005
Override Framing Fraction

Exterior
Interior

Cancel Save

A screenshot of a software interface for editing a wall assembly. The title is "Above Grade Wall" with a "Help" button. The "Name" field contains "R19 Batt 16 OC gr 3" and is marked as "Verified". The "Description" field is empty. Under "Assembly Properties", the R-value is 14.353 and the U-value is 0.070. The "Layer Edit" section shows a "Fiberglass" layer selected, with options for "Continuous" or "Stud/Cavity" (selected). Material properties include "Fiberglass Ba", "Depth in. 5.5", "Insulation Grade III", and "R 17.6". Stud/Cavity properties include "Stud Type: Wood", "Depth in. 5.5", "Width in. 1.5", "Spacing in. 16", "Framing Fraction 0.23005", and an "Override Framing Fraction" checkbox. A diagram shows a cross-section of the wall assembly with "Exterior" and "Interior" labels and plus signs. "Cancel" and "Save" buttons are at the bottom.

65 Data Points Overlap



Category / Data Point	x = Materials Embodied Carbon Impact
General Info	
Square footage	X
Volume	X
Envelope / Structural	
Slab - on or below grade	X
Framed Floor - including finish material	X
Foundation Walls	X
Above Grade Walls - Framing factors account total volume of lumber	X
Rim Joist per floor: height of framed floor plus insulation depth	X
Roof	X
Thermal envelope Insulation in all walls including foundations, slabs, above grade walls and roof	X
Note 1: Structural Steel Embodied Carbon is unaccounted for and is a building shell / structural component outlier	
Note 2: Framing components by framing factor and wall depth	
Fenestration	
Window Type #1	X
Window #2	X
Window #3	X
Door #1	X
Door #2	X
Door #3	X
Skylight	X

Mechanical Systems	
DHW	X
Hot Water Storage	X
Furnace w/ model energy guide	X
Air Handler	X
AC Coils	X
Condensers with energy guide	X
ERV/HRV or Bath Fan documentation	X
Associated Ductwork related to the above may or may not be accounted for in their entirety	X
Water	
Pipe insulation - Yes or NO	X
Circulation Pumps	X
Lighting and Appliances	
Lighting LED %	X
Refrigerator	X
Washer	X
Dryer	X
Dishwasher	X
Range/Oven	X
Other:	X
Onsite Generation	
PV Array Size kWh dc:	X 59
Other Generation	X

Complete Checklist

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nehers.org/Data/Sites/1/media/embodied-carbon/embodied-carbon-built-environment-checklist-from-nehers.pdf



- Home
- About
- Membership
- Store
- Become a Rater

Embodied Carbon

NEHERS Embodied Carbon One-Pager

NEHERS Embodied Carbon Built Environment Checklist



Letter of Support



Exports into Embodied Carbon Tools

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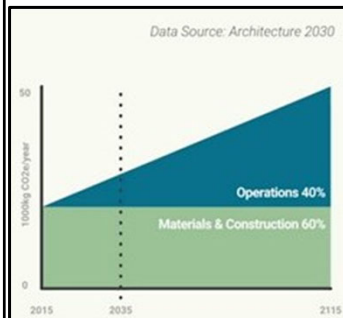
- Volume of Insulation
- Siding Material Sq. Ft.
- Roof Material Sq. Ft.
- Total Volume Plywood / Building Shell
- Volume of Framing Material / Shell
- Concrete in Slab - Assumed Thickness
- Concrete in Foundation Walls
- Windows and Doors



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Operational and Embodied Emissions

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Massachusetts Home Energy Scorecard

This scorecard compares the home's energy use and carbon footprint to an average home in Massachusetts.

Home Energy Use
24

Year Built
2021

Sq. Footage
1,009 ft²

Number of Bedrooms
1

Assessment Date
December 23, 2021

Primary Heating Fuel
Electric

Energy Specialist
Andrew Buccino

Home Energy Use

This shows the estimated total energy use (electricity and heating fuel) of your home for one year. The lower the energy use, the better.

mmBtu/yr

Worse
300

125.0
Avg. home in MA

0
Better

24

Home Carbon Footprint

This shows the estimated annual carbon emissions associated with your home and is based on your home's estimated total annual energy use. The lower the score, the less carbon pollution is released into the atmosphere.

ton/yr

Worse
25

9.7
Avg. home in MA

0
Better

1.5

Yearly Energy Use

Electric: 6,387 kWh Propane: 26 Gallons

Yearly Energy Costs*

Total: \$1,772

Electric: \$0.24/kWh, Propane: \$3.48/Gallon

HERS® Index **58**

RESNET's HERS® Index assesses the energy efficiency of a home. A HERS-100 home is as energy efficient as a home built to 2006 code. A HERS-0 home uses zero net energy in a typical year. Learn more at hersindex.com

*These are estimated costs. Actual energy costs may vary and are based on many factors such as occupant behavior, weather and utility rates.

Please see the next page for more information on how the Home Energy Use and Home Carbon Footprint are calculated.

January 31, 2022 | 3.2.3.2020 | RESNET Registry ID: 431137056

Brought to you by



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And Ultimately...

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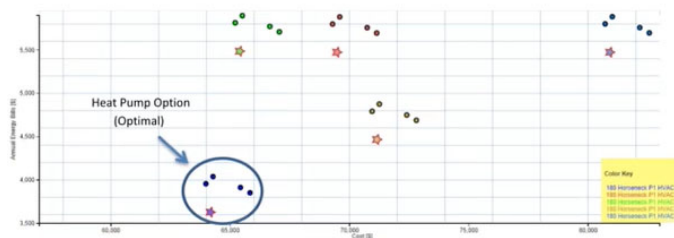


Optimizer Scatter Plot

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Mechanical Equipment Optimization

The optimized mechanical equipment is shown to be a High Efficiency Air Source Heat Pump for heating and cooling (Modeled after the Lennox Green Speed Heat Pump) and a Hybrid heat pump hot water heater (Modeled after a GE GeoSpring Heat Pump.)



The HVAC options considered included both propane and electric forced air and radiant systems. Some options included fully conditioned basements. These HVAC packages are outlined below in Table 1. The optimized heating and cooling package is toward the lower end of cost and lower end of energy consumption in the lower left corner of the scatter plot.



Software Integration

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HERS Accredited Software:



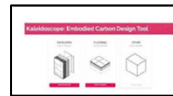
EPD/LCA Software:



BUILDING EMISSIONS ACCOUNTING FOR MATERIALS



+



Environmental Product Declarations (EPDs)

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EPDs are third party-verified documents based on LCA models, written in conformance with the same international standards



Material Labels for Health

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Nutrition Facts
Serving Size 1/2 cup (115g)
Servings Per Container About 4

Amount Per Serving		Calories from Fat 130	
		% Daily Value*	
Total Fat	14g		22%
Saturated Fat	9g		45%
Cholesterol	55mg		18%
Sodium	75mg		3%
Total Carbohydrate	26g		9%
Dietary Fiber	0g		0%
Sugars	26g		
Protein	4g		
Vitamin A	10%	Vitamin C	0%
Calcium	10%	Iron	0%

* Percent Daily Values are based on a 2,000 calorie diet.

EPD "Nutrition" Label
Your Building Product

Amount per Unit	
LCA MEASURES	TOTAL
Primary Energy (MJ)	12.4
Global Warming Potential (kg CO ² eq)	0.96
Ozone Depletion (kg CFC-11 eq)	1.80E-08
Acidification Potential (mol H+eq)	0.93
Eutrophication Potential (kg N-eq)	6.43E-04
Photo-Oxidant Creation Potential (kg O ₃ eq)	0.121

Your Product's Ingredients: Listed Here

kgCO₂e/m²



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EPDs Allow for Comparison

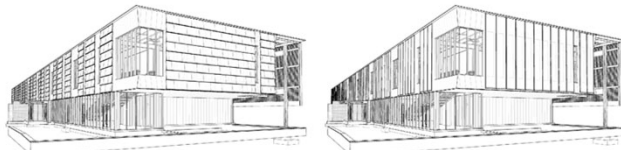
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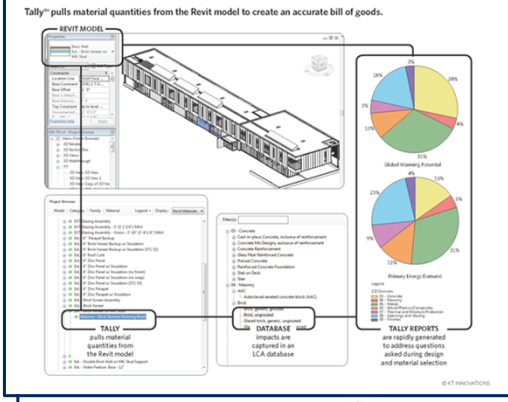
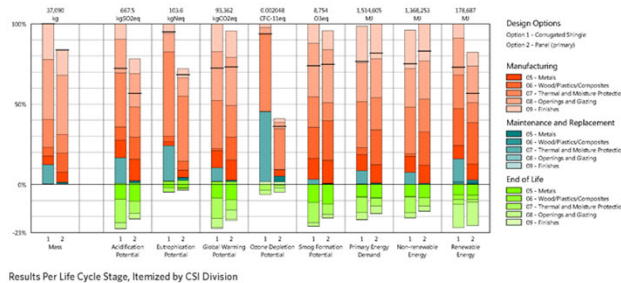
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Tally LCA Tool

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Option 1 - Corrugated Shingle Cladding Option 2 - Translucent Panel Cladding (Selected)



Embodied Carbon Calculator

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An Open Access EPD database started in Quarter 4, 2019



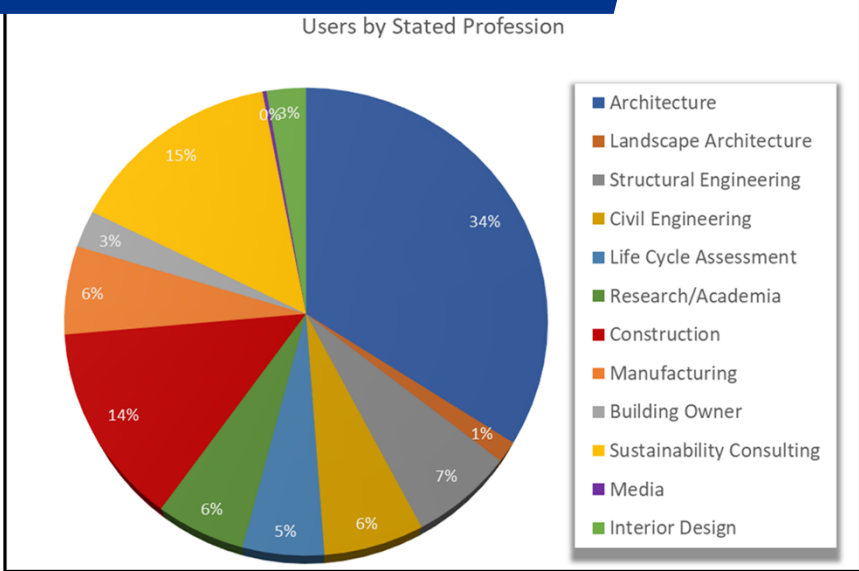
As of 2/1/2022 EC3 has:

- More than 85,000 product specific EPDs
 - 64,000 of which are ready mix concrete EPDs
- Over 600 industry average EPDs
- Over 300 digitized PCRs
- Over 22,000 users in over 70 countries



EC3 Types of Users

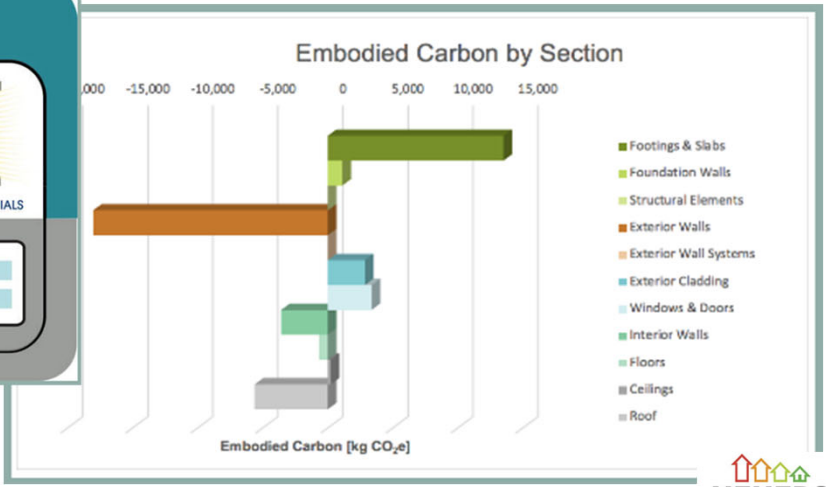
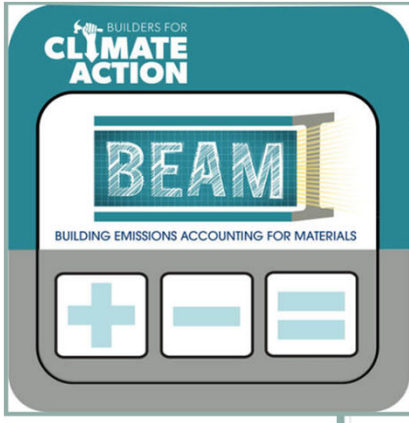
#RESNET2022



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BEAM Introduction

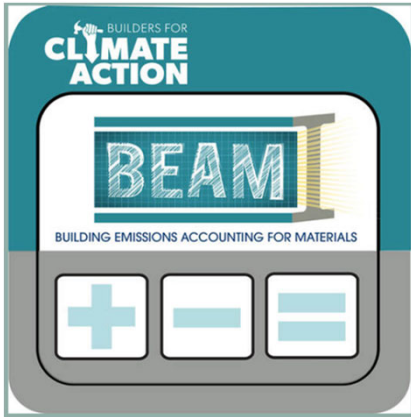
#RESNET2022



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BEAM Is Currently Used By:

#RESNET2022

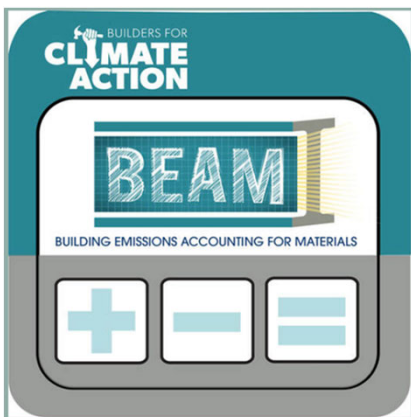


- Rocky Mountain Institute (RMI)
- HOT2000
- MassCEC Triple Decker Challenge
- CLF
- EC3
- the cities of Toronto, Vancouver and Nelson, British Columbia
- Building Transparency
- EEBA
- the Atmospheric fund



Happy Camper

#RESNET2022

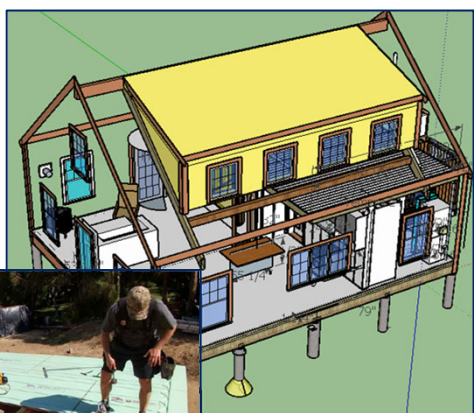


- Intuitive
- Easy to Use
- Perfect for Mid-Size Projects
- Runs Most of the Data Raters Already Collect



SIP House - Nantucket, MA 02554

#RESNET2022



Home Energy Rating Certificate		Rating Date: 2020-12-04
Final Report		Registry ID: 100897597
		Ektrope ID: 6LAMS5VVL
HERS® Index Score:	Annual Savings	
-28	\$3,174	
<small>Your home's HERS score is a relative performance score. The lower the number, the more energy efficient the home. To learn more visit www.hersindex.com</small>		<small>*Relative to an average U.S. home</small>



Structural Elements

#RESNET2022



BEAM Takeoff Data Interface



#RESNET2022

Project Dimensions						
COMPONENT	QUANTITY	UNIT	CALCULATION INCLUDES THESE COMPONENTS			DESCRIPTION OF REQUIRED UNITS
FOOTINGS, PADS & PIERS	16.05	m3	Length (m)	Depth (m)	Width (m)	Total volume of all footings, piers and posts
			47.88	0.30	0.91	
FOUNDATION WALL AREA	0.0	m2	Foundation wall, exterior continuous insulation, interior framing, interior insulation, interior wall finish			Total wall surface area (centerline times wall height) (exclude windows and doors)
FOUNDATION SLAB/FLOOR AREA	107.3	m2	Slab, aggregate base, sub-slab insulation, basement flooring			Total slab surface area
EXTERIOR WALL AREA	122.6	m2	Framing, insulation, sheathing, exterior cladding, interior cladding of exterior walls only			Square metres (include gable ends; exclude window & door rough openings). Exclude all garage wall, garage partition wall and party wall areas
WINDOW AREA	21.3	m2	Windows			Square metres (include full area of glazing units)
INTERIOR WALL AREA	0.0	m2	Framing, insulation and interior cladding of interior walls			Square metres (calculate one side only) of all interior walls. Quantity will be doubled for cladding materials
FRAMED FLOOR AREA	107.3	m2	Floor framing, subfloor, floor insulation, flooring			Square metres (all levels; exclude basement slab, stairs and other openings)
CEILING AREA		m2	Total finished ceiling area for entire project, except garage			Square metres (all levels; include basement ceiling; exclude garage ceiling)
ROOFING SURFACE AREA	94.6	m2	Roof framing, decking, roofing, and insulation parallel to roof deck			Square metres (include sloped and flat roofs; exclude overhangs and gable ends)
ROOF INSULATION SURFACE AREA	94.6	m2	Roof insulation parallel to ceiling in the roof cavity			Area of top roof bottom (typically this is equal to the attic base or top floor ceiling area)
MASS TIMBER ELEMENTS	2.9	m3	All large timber posts and beams			Total volume of wood in posts & beams. Heavy steel members input separately in Structural Elements tab
PARTY WALL AREA	0.0	m2	Party wall framing, insulation, sheathing, interior cladding.			Wall area that partitions one dwelling from another. Used for row housing units, apartment units, etc.

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Structural Elements

#RESNET2022

STRUCTURAL ELEMENTS									
INSTRUCTIONS: (double-click)									
CATEGORY	MATERIAL	QUANTITY	%	SELECT	NET CARBON EMISSIONS (kgCO2e)	CARBON OF SELECTED MATERIAL (kgCO2e)	CARBON EMISSIONS (kgCO2e)	CARBON STORAGE (kgCO2)	kgCO2e SUBTOTAL FOR STRUCTURAL ELEMENTS
									575
MASS TIMBER FRAMING									
TIMBER POSTS & BEAMS									
	Heavy Timber Framing - AVERAGE	2.9 m3	100%	1	575	575	575	0	
	Wood framing & siding - SPF / American Wood Council & Canadian Wood Council / /	2.9 m3	100%		184		184	0	
	Laminated strand lumber / American Wood Council & Canadian Wood Council / /	2.9 m3	100%		903		903	0	
	Laminated veneer lumber / American Wood Council & Canadian Wood Council / /	2.9 m3	100%		1,052		1,052	0	
	Glued laminated timber / American Wood Council & Canadian Wood Council / /	2.9 m3	100%		399		399	0	
	Glued laminated timber / Structurlam / Glulam Plus / 3-1/2" (90mm) thick	2.9 m3	100%		336		336	0	
HEAVY STEEL FRAMING									
STEEL POSTS & BEAMS									
	Steel beam / W150x22 (W6x15) / American Institute of Steel Construction		100%		0		0	0	
	Steel beam / W260x39 (W10x26) / American Institute of Steel Construction		100%		0		0	0	
	Steel beam / W260x58 (W10x38) / American Institute of Steel Construction		100%		0		0	0	
	Steel beam / W310x79 (W12x53) / American Institute of Steel Construction		100%		0		0	0	

PROJECT - Footings & Slabs - Foundation Walls - Structural Elements - Ext. Walls - Ext. Wall Systems - Party Walls - Cladding - Windows - Ceilings - Int. W. >

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Additional Data Points

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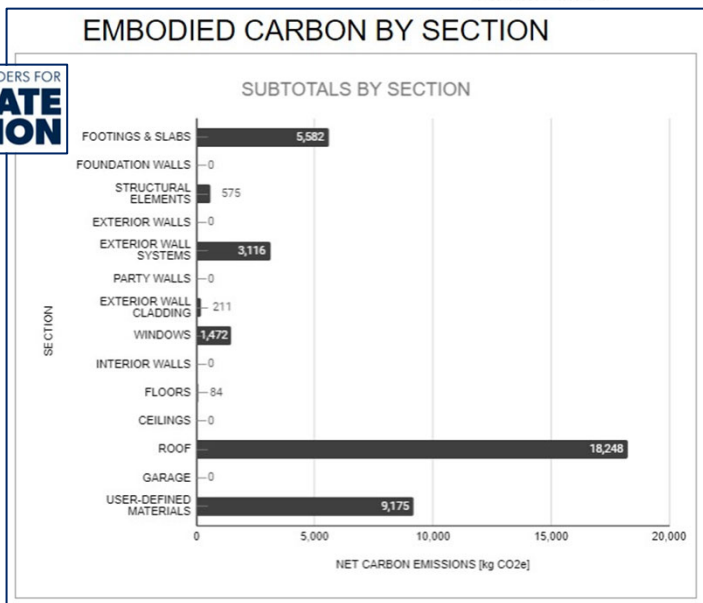
Not Included in HERS Software Tool	Relevant Components	Kitchen Components	
Concrete outside the Thermal Envelope			Countertops
			Tile
Framing	Transportation Structural steel		Cabinets
			Paint
			Other
Shell / Skin Components	Paper siding type		
Decks	All material		Countertops
Porches	All material		Tile
			Cabinets
			Paint
			Other
Exterior Trim	Doors Trim Components		glass doors
Flooring			
Interior partitions	Wall finish Cavity Insulation Framing Factor Paint Other Trim		Specialty
			Window Treatments
			Other
HVAC	GWP of refrigerant Ductwork materials	Upfront Embodied Carbon = X Operational Carbon Impact = Y X + Y = Carbon intensity of the building per square foot	kg-CO ₂ e/sf



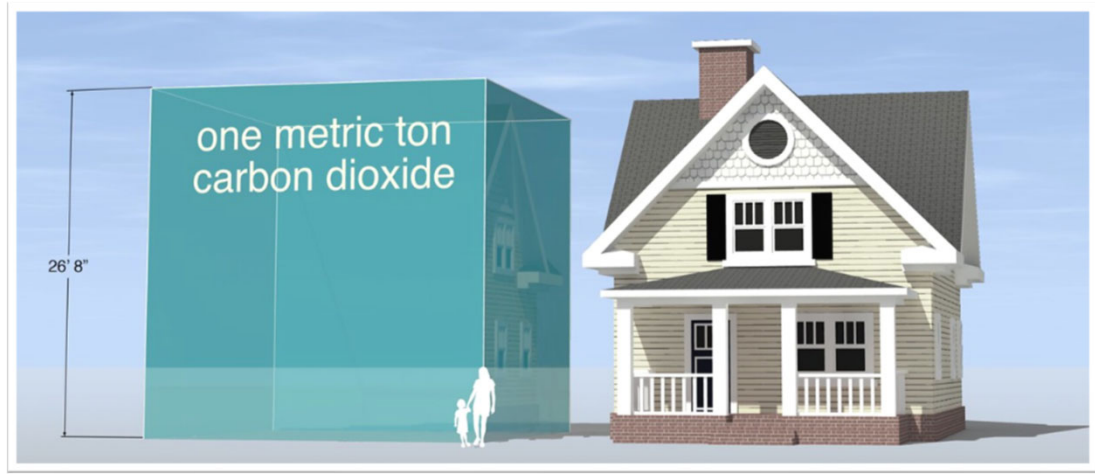
As-Built Materials Embodied Carbon BEAM Output



SECTION	NET CARBON EMISSIONS [kg CO ₂ e]
FOOTINGS & SLABS	5,582
FOUNDATION WALLS	0
STRUCTURAL ELEMENTS	575
EXTERIOR WALLS	0
EXTERIOR WALL SYSTEMS	3,116
PARTY WALLS	0
EXTERIOR WALL CLADDING	211
WINDOWS	1,472
INTERIOR WALLS	0
FLOORS	84
CEILINGS	0
ROOF	18,248
GARAGE	0
USER-DEFINED MATERIALS	9,175
NET TOTAL	38,463
NET TOTAL PER SQ. METRE	358



What Does a Metric Ton of CO2 Look Like?

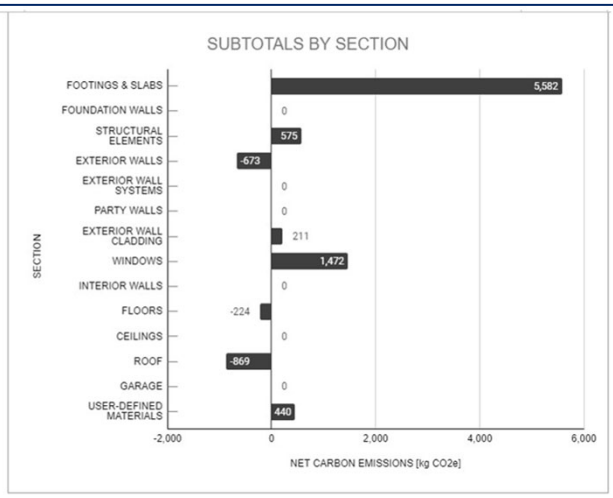


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Cellulose Walls and Roof Replacing SIP

#RESNET2022

SECTION	NET CARBON EMISSIONS [kg CO2e]
FOOTINGS & SLABS	5,582
FOUNDATION WALLS	0
STRUCTURAL ELEMENTS	575
EXTERIOR WALLS	-673
EXTERIOR WALL SYSTEMS	0
PARTY WALLS	0
EXTERIOR WALL CLADDING	211
WINDOWS	1,472
INTERIOR WALLS	0
FLOORS	-224
CEILING	0
ROOF	-869
GARAGE	0
USER-DEFINED MATERIALS	440
NET TOTAL	6,515
NET TOTAL PER SQ. METRE	61



NOTES:
 Cellulose Walls and Roof with equivalent R-Value as SIP model
 Eliminated XPS under Floor system / increased Cellulose volume to match RValue the increase/grew TJI's to 14"
 Andersen Windows in the BEAM database - used for all 3 models



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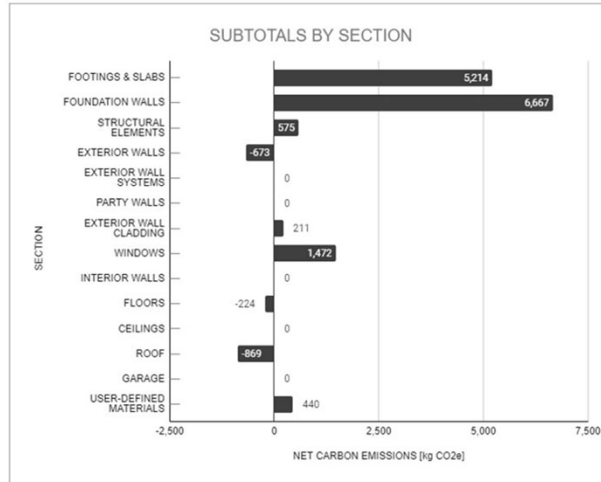
Same Cellulose House with an 8' Foundation - 2'x1' Footer

#RESNET2022

SECTION SUBTOTALS

SECTION	NET CARBON EMISSIONS [kg CO2e]
FOOTINGS & SLABS	5,214
FOUNDATION WALLS	6,667
STRUCTURAL ELEMENTS	575
EXTERIOR WALLS	-673
EXTERIOR WALL SYSTEMS	0
PARTY WALLS	0
EXTERIOR WALL CLADDING	211
WINDOWS	1,472
INTERIOR WALLS	0
FLOORS	-224
CEILINGS	0
ROOF	-869
GARAGE	0
USER-DEFINED MATERIALS	440
NET TOTAL	12,812
NET TOTAL PER SQ. METRE	119

EMBODIED CARBON BY SECTION



NOTES:

- 8" uninsulated walls
- 2'x1'x116 linear ft footer
- 4" reinforced slab
- 1st floor system same insulation value



BEAM'S Top 10 by Highest Impact Output

#RESNET2022

TOP 10 HIGHEST IMPACT MATERIALS

SECTION	kg CO2e	MATERIAL
Footings & Slabs	5,545	Concrete - 2501-3000 psi, Standard mix / NRMCA / N.A. Avg. /
Floors	1,545	Hardwood flooring - AVERAGE
Windows	1,472	Window - double pane / Andersen / Fibrex / PVC & Wood composite / USA
Structural Elements	575	Heavy Timber Framing - AVERAGE
Roof	482	Asphalt Shingles / Includes: Atlas, BP, CertainTeed, GAF, IKO, Malarkey, Owens Co
Floors	448	Plywood / American Wood Council & Canadian Wood Council / / 3/4"
User-Defined	440	Drywall 1/2" / CertainTeed / M2Tech moisture resistant / 1/2" (12.7 mm)
Ext. Walls	341	Plywood / American Wood Council & Canadian Wood Council / / 1/2"
Ext. Walls	314	Wood fram
Cladding	211	Cedar Sidi

SECTION	kg CO2e	MATERIAL
Roof	17,401	SIP panel - Roof - AVERAGE
User-Defined	8,735	XPS foam board / Dow Chemical Company / Styrofoam SM / R 5/inch
Footings & Slabs	5,545	Concrete - 2501-3000 psi, Standard mix / NRMCA / N.A. Avg. /
Ext. Wall Systems	3,116	SIP PANEL - R30 8.25" - EPS 7.25" @ R4/in. core, 2 sheets 1/2" OSB
Floors	1,545	Hardwood flooring - AVERAGE
Windows	1,472	Window - double pane / Andersen / Fibrex / PVC & Wood composite / USA
Structural Elements	575	Heavy Timber Framing - AVERAGE
Roof	482	Asphalt Shingles / Includes: Atlas, BP, CertainTeed, GAF, IKO, Malarkey, Owens Co
Floors	448	Plywood / American Wood Council & Canadian Wood Council / / 3/4"
User-Defined	440	Drywall 1/2" / CertainTeed / M2Tech moisture resistant / 1/2" (12.7 mm)

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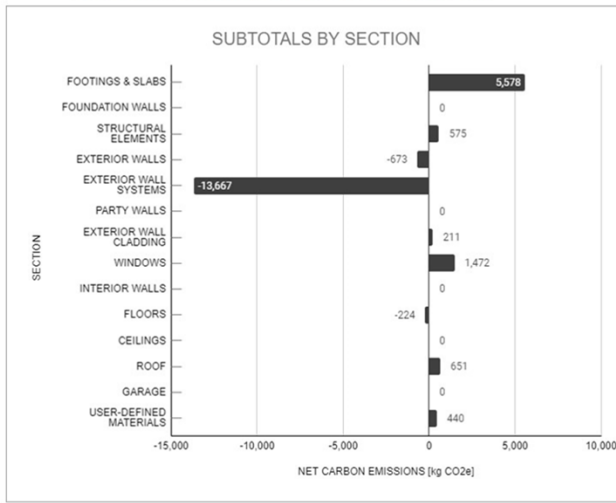
Straw Bale Panels Flip the Building to a Carbon Sink

#RESNET2022

SECTION SUBTOTALS

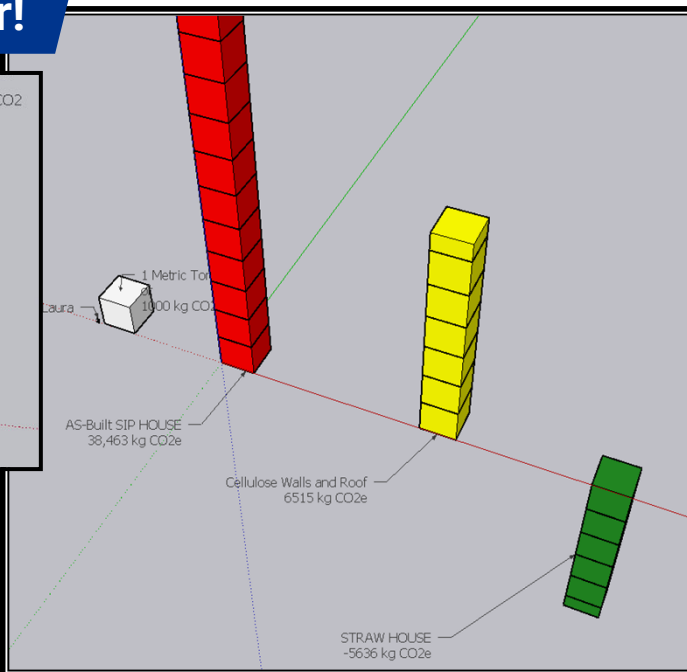
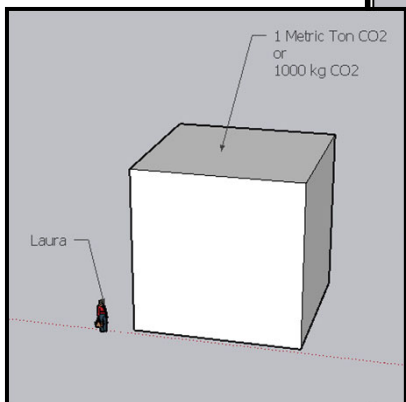
SECTION	NET CARBON EMISSIONS [kg CO ₂ e]
FOOTINGS & SLABS	5,578
FOUNDATION WALLS	0
STRUCTURAL ELEMENTS	575
EXTERIOR WALLS	-673
EXTERIOR WALL SYSTEMS	-13,667
PARTY WALLS	0
EXTERIOR WALL CLADDING	211
WINDOWS	1,472
INTERIOR WALLS	0
FLOORS	-224
CEILING	0
ROOF	651
GARAGE	0
USER-DEFINED MATERIALS	440
NET TOTAL	-5,636
NET TOTAL PER SQ. METRE	-53

EMBODIED CARBON BY SECTION



Materials Matter!

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Materials Matter!

one metric ton carbon dioxide

26' 8"

#RESNET2022

1 Metric Ton CO2
or
1000 kg CO2

Laura

1 Metric Ton CO2
1000 kg CO2

AS-Built SIP HOUSE
38,463 kg CO2e

Cellulose Walls and Roof
6515 kg CO2e

STRAW HOUSE
-5636 kg CO2e

Laura

NEHERS
NORTHEAST HOME ENERGY RATING SYSTEM ALLIANCE

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Accredited Software

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NEHERS
NORTHEAST HOME ENERGY RATING SYSTEM ALLIANCE

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What Is A Baseline?

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A baseline is a static reference against which to compare progress towards a goal. Baseline data enables the tracking of changes or improvements over time.

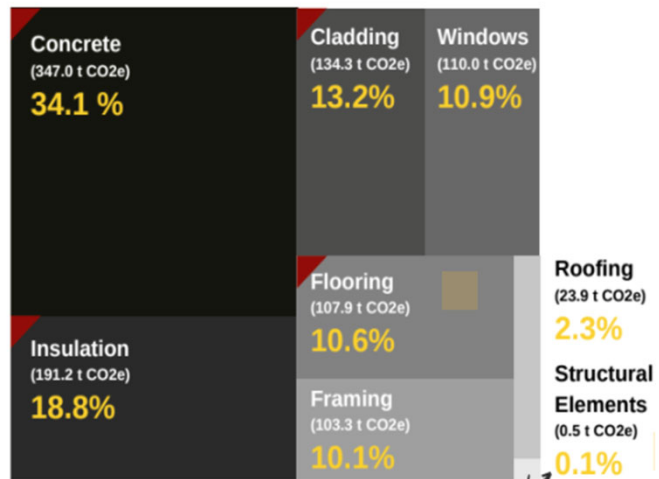


Examples of Baseline Studies



#RESNET2022

Category	Total MCE plans x built	% of Total
Concrete	6,727,412	32.9%
Insulation	5,381,890	26.3%
Cladding	2,727,050	13.3%
Interior Surfaces (flooring, walls, ceilings)	2,064,988	10.1%
Framing	1,398,194	6.8%
Windows	1,034,026	5.1%
Structural Elements	645,445	3.2%
Roofing	450,686	2.2%
TOTAL	20,429,689	100%



What Does a Comparison Look Like



#RESNET2022

Category / Data Point	x = Materials Embodied Carbon Impact
General Info	
Square footage	X
Volume	X
Envelope / Structural	
Slab - on or below grade	X
Framed Floor - including finish material	X
Foundation Walls	X
Above Grade Walls - Framing factors account total volume of lumber	X
Rim Joist per floor: height of framed floor plus insulation depth	X
Roof	X
Thermal envelope Insulation in all walls including foundations, slabs, above grade walls and roof	X
Note 1: Structural Steel Embodied Carbon is unaccounted for and is a building shell / structural component outlier	
Note 2: Framing components by framing factor and wall depth	
Fenestration	
Window Type #1	X
Window #2	X
Window #3	X
Door #1	X
Door #2	X
Door #3	X
Skylight	X

These are tracked by Raters TODAY and makeup over 85% of the embodied carbon in new construction

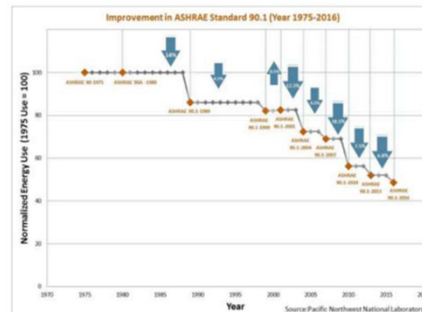
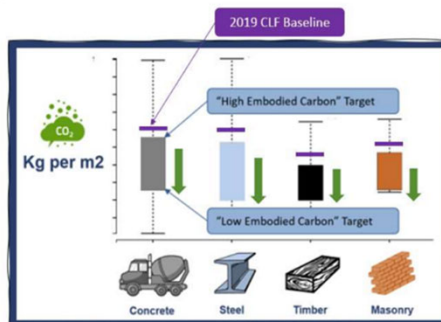
- Volume of Insulation
- Volume of Insulation
- Siding Material Sq. Ft.
- Roof Material Sq. Ft.
- Total Volume Plywood / Building Shell
- Volume of Framing Material / Shell
- Windows and Doors
- Concrete in Slab - Assumed Thickness
- Concrete in Foundation Walls Based on Industry Average Thickness

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Baselines Change, But The RESNET Reference Home Doesn't Have To!

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Baselines and targets can be optimized/lowered over time as more EPD data is available and lower carbon options come to market.



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Net Zero Emissions

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Achieving Real Net-Zero Emission Homes:

Embodied carbon scenario analysis of the upper tiers of performance in the 2020 Canadian National Building Code



Reference Home and Design Home

#RESNET2022

$$\text{Annual Carbon Index} = \frac{\text{Rated Home AC}}{\text{Reference Home EC}}$$

$$\text{Embodied Carbon Index} = \frac{\text{Rate Home EC}}{\text{Reference Home EC}}$$

$$\text{Combined Carbon Damage} = \text{EC} * (\text{years} + 1) + \frac{1}{2} \text{AC} * (\text{years})^2$$

$$\text{Total Carbon Index} = \frac{\text{Rated Home CCD}}{\text{Reference Home CCD}}$$



Damage from Emissions – 75 Years

#RESNET2022

Damage from Emissions over time
shown as embodied emissions, operation emissions
and total emissions

Reference Home

Damage from Emissions over time
shown as embodied emissions, operation emissions
and total emissions

Ref home with 1/2 AC

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Damage from Emissions – 20 Years

#RESNET2022

Damage from Emissions over time
shown as embodied emissions, operation emissions
and total emissions

Ref home with 1/2 AC

Damage from Emissions over time
shown as embodied emissions, operation emissions
and total emissions

Ref home with 1/2 AC

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Reference Home and Design Home

#RESNET2022

$$\text{Annual Carbon Index} = \frac{\text{Rated Home AC}}{\text{Reference Home EC}}$$

$$\text{Embodied Carbon Index} = \frac{\text{Rate Home EC}}{\text{Reference Home EC}}$$

$$\text{Combined Carbon Damage} = EC * (\text{years} + 1) + \frac{1}{2} AC * (\text{years})^2$$

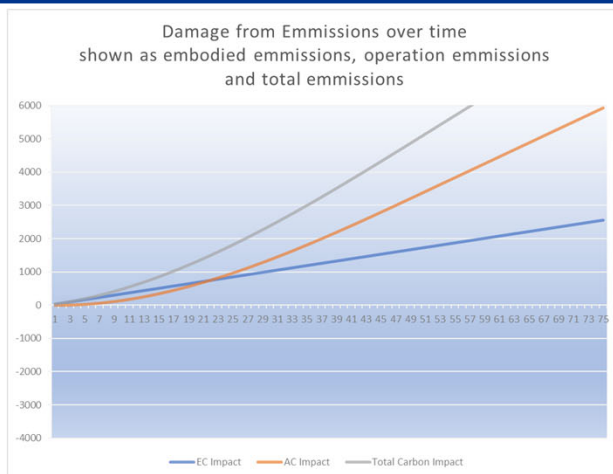
$$\text{Total Carbon Index} = \frac{\text{Rated Home CCD}}{\text{Reference Home CCD}}$$



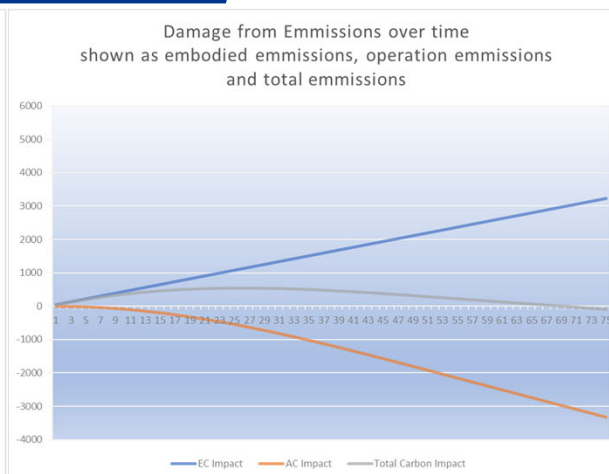
Damage from Emissions Over Time



#RESNET2022




Example with code minimum and no PV: HERS 62 TC(15): 80

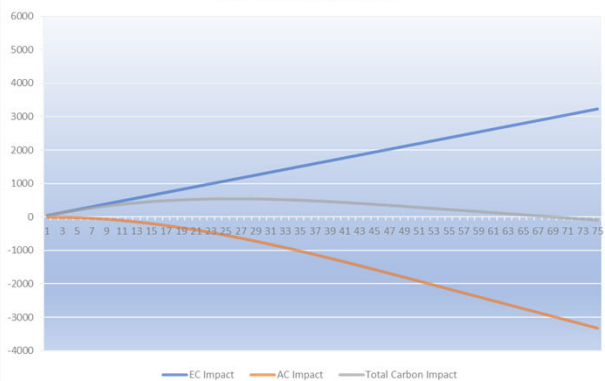


Example with SIPs and PV: HERS -28 TC(15): 37 98

Damage from Emissions Over Time

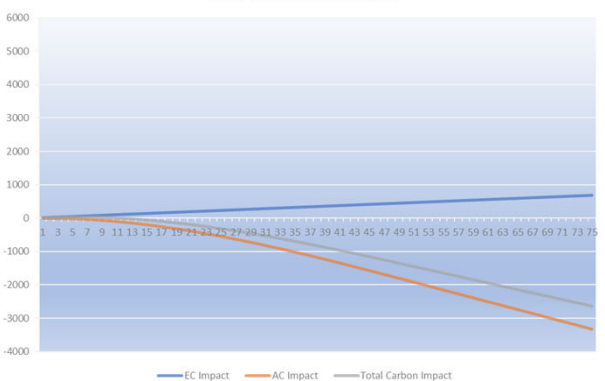

#RESNET2022

Damage from Emissions over time shown as embodied emissions, operation emissions and total emissions




Example with SIPs and PV: HERS -28 TC(15): 37

Damage from Emissions over time shown as embodied emissions, operation emissions and total emissions

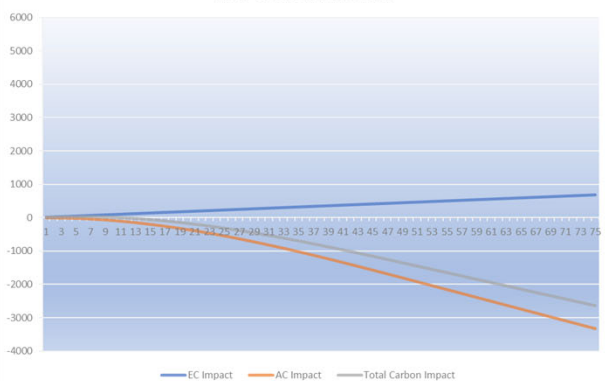


Example with CE and PV: HERS -28 TC(15): -9 99

Reference Home and Design Home

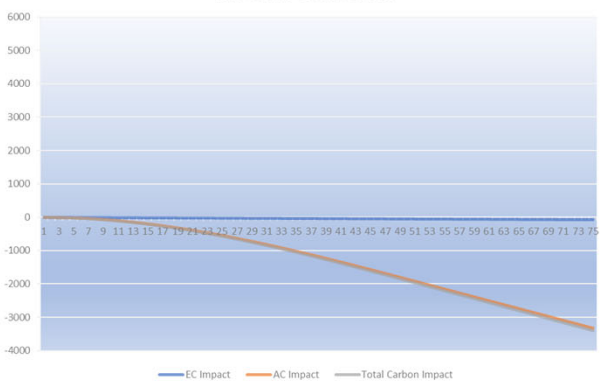

#RESNET2022

Damage from Emissions over time shown as embodied emissions, operation emissions and total emissions



Example with CE and PV: HERS -28 TC(15): -9

Damage from Emissions over time shown as embodied emissions, operation emissions and total emissions



Example with negative embodied carbon: HERS -28 TC(15): -23 100

Comprehensive Standard Needed

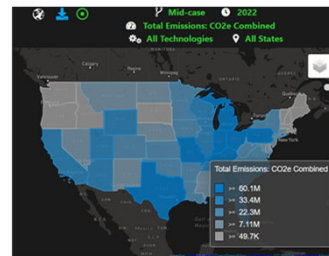
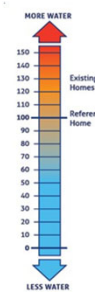
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- Accreditation of rating providers, rater training providers, and rating software tools
- Quality Assurance oversight of Home Energy Ratings
- Verification of energy savings and performance for a variety of programs from energy efficient mortgages (EEMs) to the EPA's ENERGY STAR Homes Program
- Code compliance by the International Energy Conservation Code
- Performance option for compliance with energy codes adopted
- Verification of energy performance in state utility benefit program funded residential energy efficiency programs



Recent RESNET Standards Developments

#RESNET2022

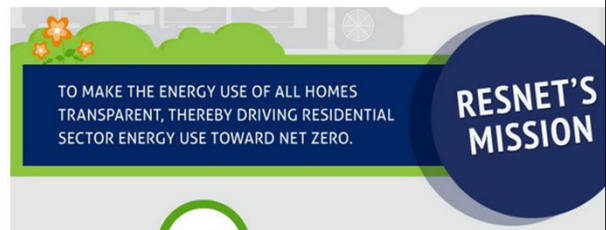


Standards

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This Standard for Embodied Carbon is perfectly aligned with the RESNET Mission

- speaks to the partners that they have vision
- Shows that they are constantly responding to the market pressures of the construction industry, government policy
- RESNET is a leader with adaptive strength



Standards

#RESNET2022



Standards

#RESNET2022



Standards

#RESNET2022

Adapt the software



Establish a baseline



Incentivize Evaluation of OC and EC



Standards

#RESNET2022

PROPOSAL submitted online to RESNET Standards Management Board (SMB)

SMB decides:
Proposal fits within RESNET policies

If so SMB:
A. Assigns addendum to SDC right away
B. Defers project to next update of the effected standard

The diagram shows a flow from a proposal submitted online to the RESNET Standards Management Board (SMB). The SMB then decides if the proposal fits within RESNET policies. If it does, the SMB either assigns an addendum to the SDC immediately or defers the project to the next update of the standard. The RESNET logo is shown as a computer monitor with a checklist, and the NEHERS logo is at the bottom right.

Standards

#RESNET2022

SDC reviews and accepts or rejects proposal.

If accepted SDC:
• Develops a consensus draft
• Submits consensus draft to public comment
• Approves or rejects comments
• Responds to all commenters

Substantive changes required

No substantive changes required

The diagram illustrates the SDC review process. The SDC reviews and either accepts or rejects the proposal. If accepted, the SDC develops a consensus draft, submits it for public comment, approves or rejects comments, and responds to all commenters. Depending on the feedback, either substantive changes are required (looping back to the start) or no substantive changes are required. The RESNET logo is shown as a tablet with a document and a green checkmark, and the NEHERS logo is at the bottom right.

Leverage Our Strong Partnerships

#RESNET2022



- RESNET Standard 2022 -
Materials Embodied Carbon creates
the benchmark - the Gold Standard



The Market

#RESNET2022

RESNET
RESIDENTIAL ENERGY SERVICES NETWORK



Substantial Growth Anticipated

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- Today there are approximately 2000 HERS Raters in the US
- 550 in Texas alone!!
- 126 in Massachusetts



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Rater Flexibility and Versatility

#RESNET2022

The Rater development pipeline can scale and has shown versatility across new market opportunities:

- HERS H20
- HVAC Grading Standard
- Residential Renovations and Additions
- Commercial: Low-Energy/High-Rise
- Indoor Air Quality



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International Policies



PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

#RESNET2022

The Paris Agreement:

- is a **legally binding international treaty on climate change.**
- adopted by 196 Parties at COP 21 in 2015
- entered into full force on November 4, 2016

Most recent IPCC 2022 report:

“the dangers of global warming are mounting so rapidly that adapting to them could soon become impossible.”

1) <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>

2) <https://www.ipcc.ch/report/ar6/wg2/>



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National Policies



#RESNET2022

Biden Federal Sustainability Executive Order (Signed December 8, 2021)

- 100% carbon pollution-free electricity (CFE) by 2030
- 100% zero-emission vehicle (ZEV) acquisitions by 2035
- Net-zero emissions from federal procurement no later than 2050, including a **Buy Clean Policy to promote use of construction materials with lower embodied emissions**
- Net-zero emissions building portfolio by 2045
- Net-zero emissions from overall federal operations by 2050.

Infrastructure Investment and Jobs Act (Signed November 15, 2021)

- Electrification of schools, transit and a clean grid.

Build Back Better (2021)

- Passed by House but not by Senate



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State Policies in the Northeast

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VT – Statutory Goals – **75% by 2050**
CT – Proposal Goals – 80% by 2050
ME – Plan Goals – 80% by 2050
NH – Plan Goal – 80% by 2050.
RI – Plan Goals – 80% by 2050
NY – Rule Goals – 85% by 2050
MA – Statutory Goals – **100% by 2050**

Source: Appalachian Mountain Club: <https://www.outdoors.org/resources/amc-outdoors/conservation-and-climate/a-state-by-state-guide-to-climate-change-plans-in-the-northeast-and-mid-atlantic/2r4vuvb3>

Slide and Data Courtesy of Mike Duclos [https://nehers.org/_members/webinars#MediaViewer\[video\]/8/](https://nehers.org/_members/webinars#MediaViewer[video]/8/)



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State Legislation in MA

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MA Global Warming Solutions Act (MA GWSA)
+
Clean Energy and Climate Plan (2030 CECP)
+
MA State Climate Bill S. 9 Municipal (AKA Climate Bill 2021)
=

Slide and Data Courtesy of Mike Duclos
[https://nehers.org/_members/webinars#MediaViewer\[video\]/8/](https://nehers.org/_members/webinars#MediaViewer[video]/8/)



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State Legislation in MA

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Combined: MA GWSA / 2030 CECP / Climate Bill S.9 Require:

- **50% MA GHG Emission Reduction by 2030**
 - Includes both existing and new homes
 - Retrofit 1,000,000 homes to '2050 Compatibility' by 2030
 - means reducing heat load and all electric
 - 400 homes retrofit per weekday for 10 years!

Slide and Data Courtesy of Mike Duclos
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2030 CECP Strategy

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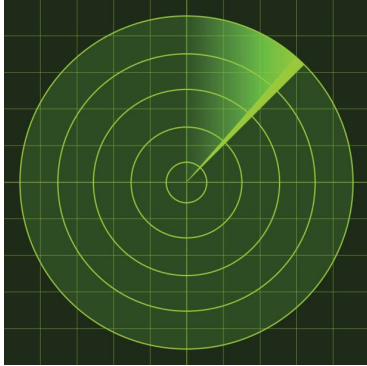
- Reduce Space Heating Load of the 'Thermal Enclosure'
- Use Only Electricity – *Including* for Space Heating & Hot Water
- Use *Clean* Electricity to Drive Heat Pumps

Slide and Data Courtesy of Mike Duclos
[https://nehers.org/_members/webinars#MediaViewer\[video\]/8/](https://nehers.org/_members/webinars#MediaViewer[video]/8/)



EC Not On the Radar

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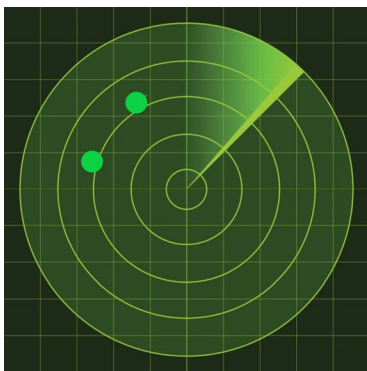


Neither the Global Warming Solutions Act or the Climate Act of 2021 for Massachusetts include Embodied Carbon.



On the Radar in CA and CO

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Both CA and CO have passed Buy Clean procurement policies.

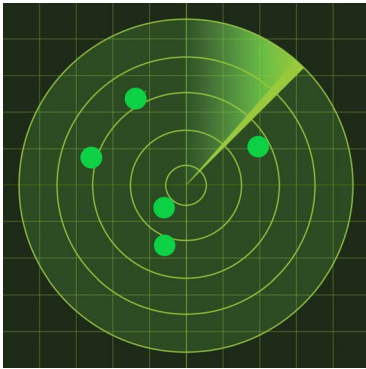


<https://newbuildings.org/embodied-carbon-bootcamp/>



Local

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- Climate Action Plans
- Building Codes
- City zoning, land use, building regulations and incentives
- Building and material reuse policies



<https://newbuildings.org/embodyed-carbon-bootcamp/>



How to Move the Needle?

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- Legislation?
- Codes?
- Standards?
- Program Incentives?
- Procurement Policies?
- Disclosure?
- EPDs/LCAs?
- Altruism?
- Profit?
- All of the Above?



What Is the Rater's Role?



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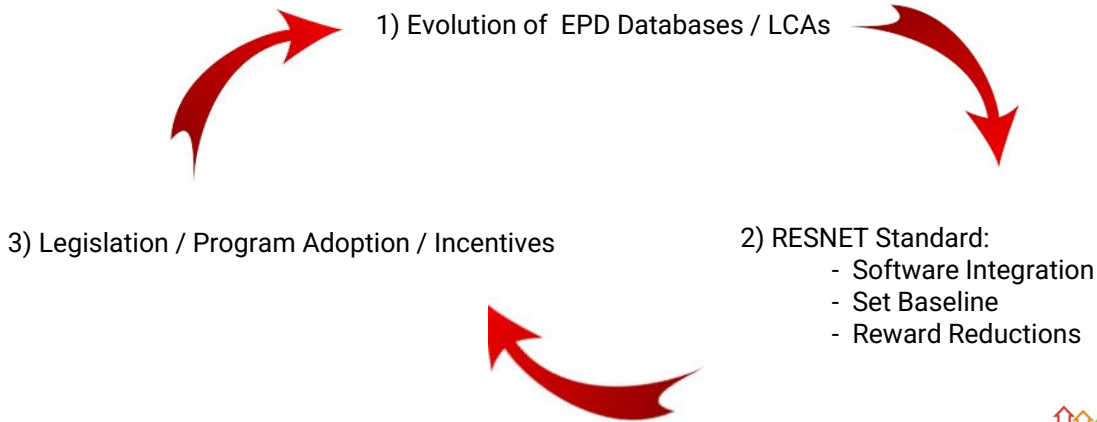
Disclosure	Standards	Incentives
<p>Buy Clean policies require measurement and disclosure of supply chain emissions in the form of environmental product declarations (EPDs), which are documents that contain information about a product's environmental impact. Requiring disclosure encourages the construction materials market to produce more and better data, which increases the quality and quantity of data available. This enables private and public purchasers to identify and select lower-carbon products based on demonstrated carbon reductions.</p> <p>Possible outcomes of using disclosure requirements:</p> <ul style="list-style-type: none"> • Increased availability of EPDs • Increased quality, consistency, and breadth of data to support future policies and research • Procurement teams can select products based on environmental impact data • Builds capacity of manufacturers to measure and track reductions in greenhouse gas emissions 	<p>Setting performance-based standards that set emissions (GWP) limits for eligible products allows for a technology-agnostic, market-based approach to industrial and building sector decarbonization. Emissions limits may be lowered or reviewed at regular intervals to align with climate goals.</p> <p>Possible outcomes of using standards:</p> <ul style="list-style-type: none"> • Encourages domestic clean manufacturing solutions and discourages emissions outsourcing (avoids the carbon loophole) • Encourages innovation and development of new decarbonization strategies • Levels the playing field and rewards companies that have already invested in reducing their carbon footprint • Supports tracking of emissions reductions (in contrast, prescriptive strategies may not necessarily result in emissions reductions) 	<p>Policies can use incentives to encourage voluntary participation, support broader implementation, or reward high performance. Examples of incentives include financial support (tax incentives or other), technical support and training, and preferential purchasing (i.e. bid incentives).</p> <p>Incentives can be provided early in the implementation of a new policy through a voluntary trial period or indefinitely.</p> <p>Possible outcomes of using incentives:</p> <ul style="list-style-type: none"> • Increased early, voluntary participation • Targeted support for small businesses • Rewards innovators and industry leaders to continue pushing low carbon solutions • Encourages market-driven solutions for reaching climate targets in the building and industrial sectors

Carbon Leadership Forum Buy Clean Policy Primer



Three Areas of Action Needed

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How to Value Regeneration?

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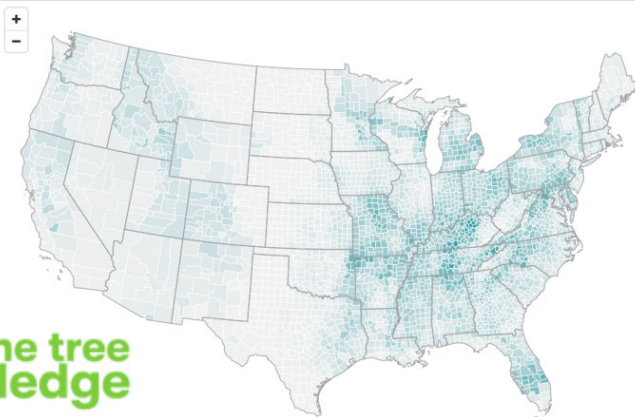
One Tree Pledge

<https://onetreepledge.org/resnet/>

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REFORESTATION HUB

About FAQ Select a state



There are up to 133 million acres of opportunity in the United States to restore forest cover for climate mitigation.

Reforesting these areas with approximately 68 billion trees could capture 333 million tonnes of CO₂ per year, equivalent to removing 72 million cars from the road.

Low High
Total Opportunity Acres
 Scale by county area

Slide courtesy of Austin Rempel, Forest Restoration Manager at American Forests

Reforestation opportunities are everywhere



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The Best Time To Plant A Tree...

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... was 7 years ago.

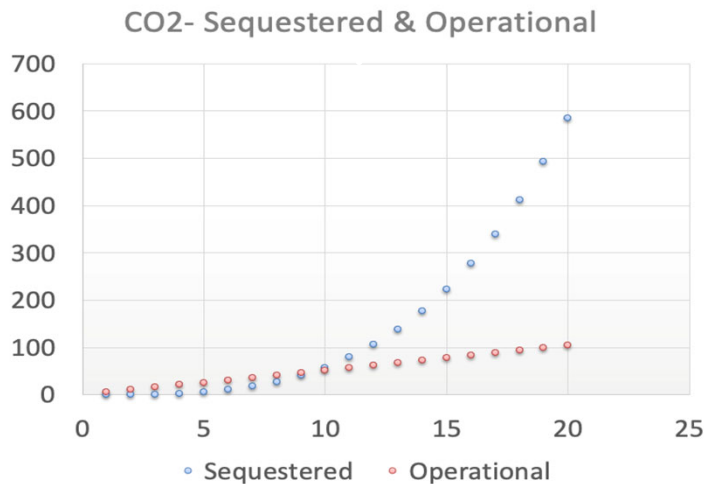
The NEXT best time
to plant a tree is
TODAY.



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Old Trees Sequester More Carbon

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Slide and Data
Courtesy of Mike
Duclos
[https://nehers.org/_members/webinars#MediaViewer\[video\]/8/](https://nehers.org/_members/webinars#MediaViewer[video]/8/)

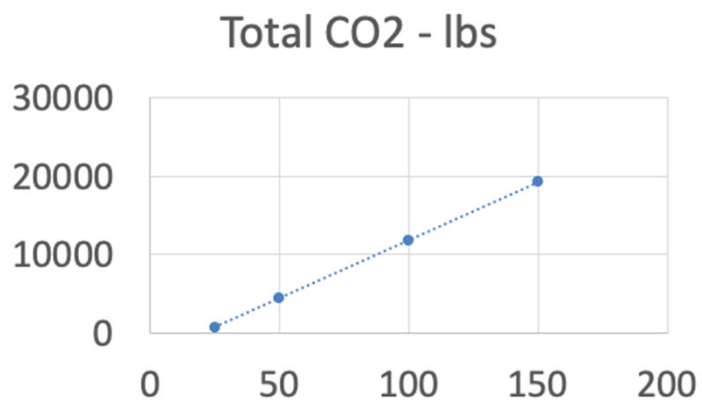
Carbon Storage in Large vs Small Trees - an Example by Robert T. Leverett



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Massive Sequestration After 25 Years

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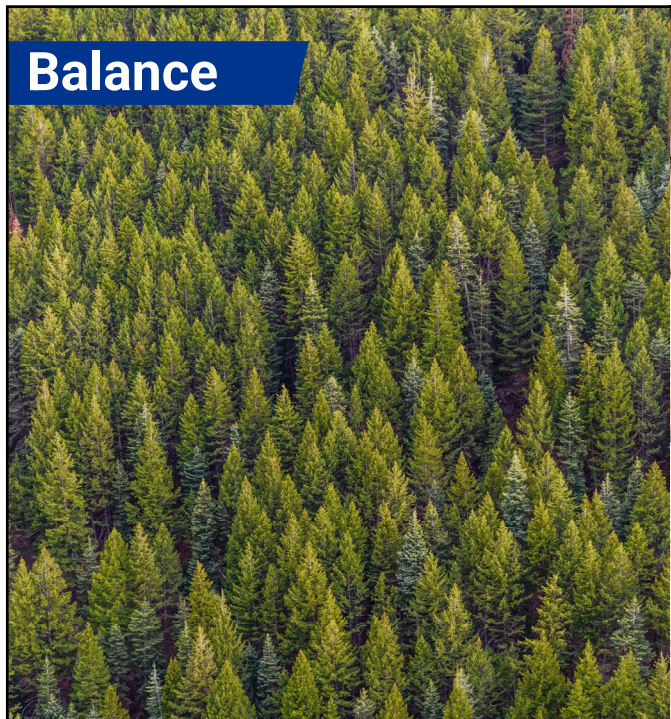
Slide and Data
Courtesy of Mike
Duclos
[https://nehers.org/_members/webinars#MediaViewer\[video\]/8/](https://nehers.org/_members/webinars#MediaViewer[video]/8/)

Photo by Betsy
Ames 100+ Year
Old Maple,
Northampton, MA

Eastern Old-Growth Forests Then and Now – Rewilding - Leverett



Balance



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Which Mindset?

Extraction / Growth

VISA



AMERICAN EXPRESS

Use Now, Pay Later!

Regeneration / Sequestration

Legend: DC - Debit Card • FT - Funds Transfer • SC - Service Charge • TD - Tax Deductible			
PAYMENT, FEE, WITHDRAWAL (-)	✓	DEPOSIT, CREDIT (+)	\$ BALANCE
			400 6x CO ₂

Lock in Savings, Pay It Forward



How Do I Make \$\$\$ At This?


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Let's be honest, we all want to make money at this, while potentially saving the planet.

A cool concept!



MA Net Zero Coalition


#RESNET2022

1-4 Unit All-Electric Homes Incentive


How do Builders and Designers and Homeowners get compensated for their work?

Component	Level 1	Level 2
Energy savings percentage or HERS Index Score	Savings ≥ 30% or HERS Index Score ≤ 45*	Savings ≥ 50% or HERS Index Score ≤ 35*
Heat pump for space heating**	Required	Required
Heat pump for water heating	Optional	Required
All-electric cookware	Required	Required
Average infiltration rate (ACH)	ACH50 ≤ 1.5	ACH50 ≤ 1.0
Balanced ventilation systems (HRVs & ERVs)	Required	Required
Continuous envelope insulation	Optional	Required
Electric vehicle-ready checklist	Required	Required

Home Type	Level 1	Level 2
Single family	\$15,000	\$25,000
Two units	\$17,500	\$30,000
Three units	\$20,000	\$35,000
Four units	\$22,250	\$40,000

- HERS Index Score before factoring onsite generation
- Air source heat pumps must be on the Mass Save Heat Pump Qualified Products List (HPQPL)
- Incentives are per building
- All units must achieve same eligibility level

WE ARE MASS SAVE™:




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Massachusetts

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MassSave:

- Offers up to \$10k for tested performance of a SF home
- Offers up to \$10K for shallow energy retrofits and renovations
- Offers \$15K for homes that achieve >1.5 ACH, no fossil-fuel burning appliances, balanced ventilation, EV and PV ready. HERS Under 45
- Offers \$25K if the same home has continuous insulation – entire thermal envelope. With HERS under 35.
- These amounts all increase with Multi family dwellings...




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Chris Mazzola's 7 Point Plan

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1. Value Engineer
2. Utility or State Funded Incentive Programs
3. Above Code Programs
4. Non-Profit Incentives
5. Volunteer!
6. Market Your Home
7. Educate Your Clients



Value Engineering

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NGBS Green
Certified Homes

COMcheck™

LEED

REScheck™

EnergyGauge®
Energy and Economic Analysis Software



REM/Rate™



Utility or State Funded Programs

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MA Net Zero Buildings Coalition - Net Zero Stretch Code Framework February 2022

NET ZERO DEFINITION
An energy-efficient, all-electric, low embodied carbon building building operations through the production and/or procurement

<p>CARBON NEUTRALITY GOAL <i>IMPORTANT NEW CODE PROVISION</i> Achieve statewide carbon neutrality per the Global Warming Solutions Act which calls for emissions reductions from 1990 levels of at least 50% by 2030 and at least 75% by 2040, leading to "net zero" by 2050. Support municipalities in meeting or exceeding these emission reduction goals.</p>	<p>EQUITY <i>IMPORTANT NEW CODE PROVISION</i> Prioritize net zero, affordable housing "No community left behind."</p>
<p>COMMERCIAL & RESIDENTIAL PRINCIPLE <i>IMPORTANT NEW CODE PROVISION</i> Transition all building types to 100% renewable energy. Ensure "No square foot left behind."</p>	<p>NEW CONSTRUCTION PRINCIPLE <i>IMPORTANT NEW CODE PROVISION</i> Electrify all build major renovation</p>
<p>ENERGY EFFICIENCY <i>IMPORTANT NEW CODE PROVISION</i> Set energy efficiency standards consistent with leading benchmarks to reduce greenhouse gas emissions, operational expenses, and grid load.</p>	<p>ELECTRIFICATION <i>IMPORTANT NEW CODE PROVISION</i> Require primary and other system loads of renewable and air-conditioning</p>

RENEWABLE ENERGY
IMPORTANT NEW CODE PROVISION
Require buildings to be powered by 100% renewable energy which can be on-site or off-site, generated and/or purchased from approved sources, so that building operations are carbon neutral.

EMBODIED CARBON
IMPORTANT NEW CODE PROVISION
Require Whole Building Life Cycle Assessment (WBLCA) to account for and minimize embodied carbon in the sourcing, production, and transportation of building materials.

BUILDING ENERGY REPORTING & COMMISSIONING
IMPORTANT NEW CODE PROVISION
Require building energy reporting and disclosure, together with initial and periodic commissioning, to ensure that building systems operate as designed.

REFRIGERANTS
IMPORTANT NEW CODE PROVISION
Require the selection of low-impact refrigerants and refrigerant recycling (prohibiting disposal) to limit ozone depletion and carbon emissions.

EXEMPTIONS & WAIVERS
IMPORTANT NEW CODE PROVISION
Exemptions should be narrowly defined, fully justified, and subject to review as technology changes. Exemptions only be available in limited instances through a clearly defined process. These might include emergency and process gases or other instances of technological infeasibility.

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For more information contact Northeast Energy Efficiency Partnerships - Darren Rothbart at darr@neep.org Kari Palmer-Dumina at kpdumina@neep.org

Which Lever to Pull

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Opportunities to reduce embodied carbon are widely available

STRATEGIES	<ul style="list-style-type: none"> Reusing materials/buildings Reduced floor area Design for Disassembly 	<ul style="list-style-type: none"> Design for efficiency Choose low carbon systems and assemblies Use alternate, low-carbon materials 	<ul style="list-style-type: none"> Select the lowest carbon version of the selected product Clean manufacturing (efficiency, fuel switching)
TOOLS	Calculators	Whole Building Life Cycle Assessment (WBLCA)	Environmental Product Declaration (EPDs)
POLICY LEVERS	Reuse/deconstruction policies		
	City zoning, land use, and building regulations		
	Building Codes / Climate Action Plans / Incentive Programs		
			Procurement Policy

Carbon Leadership Forum

<https://newbuildings.org/embodied-carbon-bootcamp/>

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Above Code Programs



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LEED and the USGBC:

- A force moving the decarbonized needle



Energy Star

- A rock of the industry



PHIUS or Passive House International

- Vital and growing part of the IECC building codes



Individual State "Stretch Energy Codes"

- Opt-in advanced building requirements forging a new way

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Non-Profit Incentives

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Example: The Massachusetts Clean Energy Center is offering webinars as part of a solicitation that will support Minority and Women Owned Business Enterprises (MWBEs) in climate critical fields. Grants between \$250,000 and \$1 million are available for organizations to support Massachusetts-based MWBEs in their entry, creation, and expansion into fields that are critical to meeting the Commonwealth's climate goals of reaching net zero emissions by 2050.

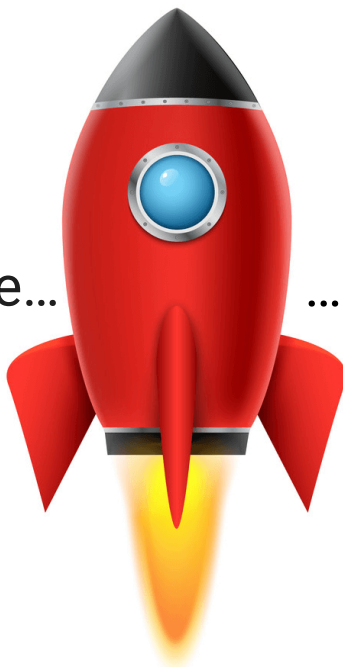


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Volunteer

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Not rocket science... ..get involved!



Market Your Home for What It Is!

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Its OK if your home cost more!

Because:

You and your client will get more out of it!

(Half Kidding) Be known for the house you build
not a price point.



Educate Your Clients



#RESNET2022

- Showcase the Efficiencies of the Home You Build.
- Make Sure Everyone Knows Your Home is Better and Why!
- Teach the Owner How to Maintain the Home You Built.
- This Reduces the Call Backs – Saves You Time and MONEY!



Who Are the Stakeholders?



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Federal Government should manage the EPD database:

- Department of Energy?
- office of EERE?
- EPA?
- ASHRAE?
- Private entity?

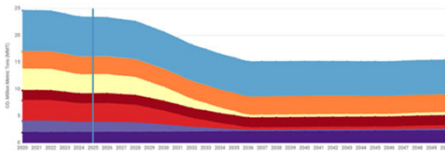
- contributing source or partners
 - ASHRAE, NYSERA, CalCEC, MassCEC, Energize VT

ENERGY.GOV
Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY
Geothermal Technologies Office

February 10, 2022

Scenario 1: 95% Grid Decarbonization by 2035

CO₂ Emissions - Wayne, Michigan



Data Filters

- Transportation Non-Electricity*
- Residential Non-Electricity*
- Commercial Non-Electricity*
- Industrial Electricity
- Transportation Electricity
- Residential Electricity
- Commercial Electricity
- Industrial Natural Gas

*Non-electric energy demand includes solid, liquid, and gaseous fuels and steam consumed within the buildings, industrial, and transportation sectors

You're Invited to the Launch Webinar for SLOPE's New 'Scenario Planner' Tool

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Conclusion

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- ❖ HERS Index Is the Gold Standard
- ❖ HERS Raters Already Track the Data
- ❖ The Software Can Be Integrated
- ❖ A Baseline Can Be Set
- ❖ A Standard Provides Consistency and a Platform for Program Incentives
- ❖ If We Don't Do It Someone Else Might (Who Don't Understand the Role of Raters)
- ❖ It's A Huge Opportunity for Rater Workforce Development
- ❖ We Get to Be Part of Figuring Out What Comes Next
- ❖ The Time Is Now
- ❖ Please Join Us!



Please Sign Our Letter of Support

#RESNET2022

<https://nehers.org/embodied-carbon>



Questions

#RESNET2022



NEHERS
NORTHEAST HOME ENERGY RATING SYSTEM ALLIANCE
info@nehers.org



Thank You!

#RESNET2022



www.nehers.org

