



# HomebuildersCAN: Official Launch

April 3, 2024

# Today's Speakers



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**ANDREW  
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Empire Communities,  
VP Sustainability &  
Innovation

# Why focus on embodied carbon?

Emissions from materials for new homes in the United States is equivalent to the total emissions from entire countries.



# Decarbonization of buildings a national priority:

Department of Energy

## DOE Releases First Ever Federal Blueprint to Decarbonize America's Buildings Sector

APRIL 2, 2024



### Increase building energy efficiency

Reduce on-site energy use intensity in buildings 35% by 2035 and 50% by 2050 vs. 2005



### Accelerate on-site emissions reductions

Reduce on-site GHG emissions in buildings 25% by 2035 and 75% by 2050 vs. 2005



### Transform the grid edge

Reduce electrical infrastructure costs by tripling demand flexibility potential by 2050 vs. 2020



### Minimize embodied life cycle emissions

Reduce embodied emissions from building materials and construction 90% by 2050 vs. 2005

## **Solution:**

**Homebuilders take the lead in**  
*understanding, measuring, reporting*  
*& acting strategically*  
**to adopt and scale profitable,**  
**low-embodied carbon building practices**

# HomebuildersCAN will support homebuilders to:



## INCREASE PERFORMANCE

### Increase embodied carbon performance and share your successes

- Learn how to measure embodied carbon using standards and tools
- Identify and analyze embodied carbon hotspots and reduction opportunities
- Develop reporting strategies that demonstrate embodied carbon improvements
- Highlight your commitments and let buyers know about high-value features



## PROFITABLE PRACTICES

### Adopt and scale profitable low-carbon building practices

- Discover emerging low-carbon materials and advanced construction techniques
- Access leading building decarbonization research and resources
- Consult with experts for prototypes and demonstration projects
- Create data and reports suitable for sustainability reporting



## SECTOR ALIGNMENT

### Advocate for alignment across the residential building sector

- Develop approaches for integrating embodied carbon into energy efficiency & green building programs
- Standardize approaches and reporting for integrating embodied carbon into incentive programs, regulator needs, and sustainability reporting
- Advocate for the inclusion of embodied carbon performance in financing mechanisms

# HomebuildersCAN Events Calendar

April 3, 2024	HomebuildersCAN Launch <b>(Public)</b>
April 24, 2024	Featured Case Studies
May 8, 2024	Climate Disclosure for Homebuilders <b>(Public)</b>
May 29, 2024	How to Measure Embodied Carbon: BEAM training
June 5, 2024	ABC Collective Manufacturers Showcase
June 10, 2024	Valley of the Sun Deconstruction & Reuse Panel <b>(Public)</b>
June 19, 2024	How to Benchmark for Embodied Carbon
July 3, 2024	Embodied Carbon Market Incentives
August 7, 2024	All About Concrete
September 4, 2024	Materials Showcase <b>(Public)</b>
October 1, 2024	HomebuildersCAN Summit at EEBA <b>(In-Person)</b>
October 16, 2024	The RESNET/ANSI 1550 Standard <b>(Public)</b>
November 6, 2024	Embodied Carbon in Energy Efficiency Programs
December 4, 2024	Featured Case Studies <b>(Public)</b>
December 11, 2024	Making Commitments: First Cohort of Commitment Program

# HomebuildersCAN Resources

Custom Consultation

Case Studies

Training

Templates (Reporting, Requesting EPDs)

Reports, and more!

**ARMI | HomebuildersCAN**  
**Case Study: Cross Cabin**

Inspired by Michael Pollan's Food Rules, the Cross Cabin is a project that was inspired by a mission to build a home with as many plants as possible. The project is a 1,000SF two-bed, two-bath home with a structural frame made from plant-based materials: cross-laminated timber, insulating cork cladding, and hemp batt insulation. The project improved the home's carbon impact, and, beyond that, it's a different, and simply feels different than a conventional home. No drywall, no fiber cement siding or stucco.

**ARMI | HomebuildersCAN**  
**Case Study: Blue Dot Farm**

The Blue Dot Farm Farmworker Unit is a prototype for flexible, low carbon, and energy efficient farmworker housing. Farmworkers often do not have access to adequate and affordable housing yet they are essential workers, growing food and caring for livestock. This house was built for the agricultural community, made with agricultural materials: namely straw bale and sheep's wool. Carbon storing materials are key to the project: strawbale insulation, strawboard interior paneling, and cork rigid insulation. It utilizes a hybrid straw bale system in which straw bales are placed upright between 2x4 studs. This allows for the many benefits of bale walls - R30 insulation, excellent acoustics, carbon sequestration - within the framework of plywood shear walls and the option for a wide range of exterior finishes.

**Embodied Carbon**  
 Cradle-to-gate, kg CO<sub>2</sub>e/m<sup>2</sup>

110  
 200 average\*

\*Average based on report from 2022.

**Reduction Strategies**

- Biobased insulation (strawbale, cork board)
- Lime plaster & salvaged Redwood siding
- Low carbon concrete foundation
- Strawboard interior paneling
- Earth masonry unit foundation stem wall

**Carbon Storage**

- Strawbale insulation
- Cork board insulation
- Strawboard paneling

**-7 tons of CO<sub>2</sub> stored**

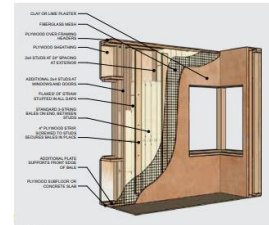
**“** We aimed to bring the values of land stewardship to farmworker housing, caring for people and planet using agriculturally based materials. **”**

Owner: Blue Dot Farm

**ARMI | HomebuildersCAN**

**Operational Carbon** | The roof overhangs block direct summer sun and the high-up operable windows provide ideal stack-effect ventilation to stay cool as well as letting in winter sun. The interior plaster on the highly insulating strawbale walls provides thermal mass to slowly absorb heat from the day and release it during the night. These passive strategies result in the residence only requiring a small electric heat pump to provide additional heat in the cold months.

Electric heat pump | Highly insulating strawbale walls | Stack-effect ventilation



**Bales on End Between Studs Wall System**

In addition to balancing the hard to avoid high emitting materials with sequestering materials like straw and cork, strategies to reduce the project's carbon footprint included careful selection of windows (where glass has a high embodied carbon footprint) and designing mechanical systems for efficient performance while meeting a range of personal temperature preferences. Notably, the overall construction was designed with a modest scale meeting a total embodied carbon intensity of only 3,179 kg per occupant.

- Lessons Learned**
1. Balance the hard to avoid high emitting materials (metal roofing, glass) with sequestering materials (straw, cork).
  2. Work with concrete batch plants to push for mixes with lower cement content for greater reductions in embodied carbon.
  3. Specific site conditions (e.g. pouring a concrete "rat slab" under the crawlspace) can have high embodied carbon impacts.

**Project Information**

Project Name: Blue Dot Farm Farmworker Housing Unit  
 Location: Nicasio, CA  
 Builder: Hoyt Dingwall, Faultline Builders  
 Architect: Arkin Tilt Architects  
 Year Built: 2022  
 Typology: Farmworker housing, residential  
 Size: 1,275 SF GFA  
 Cost: \$500,000 - \$750,000

**“** Natural, plant based materials reduce the carbon impact and sensory experience of a home. Carbon-smart homes smell great! **”**

Greg Esparza, Homeowner or Founder, Cross Cabin Build & Supply






# Early supporters of HomebuildersCAN




# Airtightness Study

# Efficiency & embodied carbon: **NOT** in opposition

Win-Win scenarios address both issues



Improvements in  
energy efficiency and  
operational emissions



Improvements in  
embodied carbon  
performance

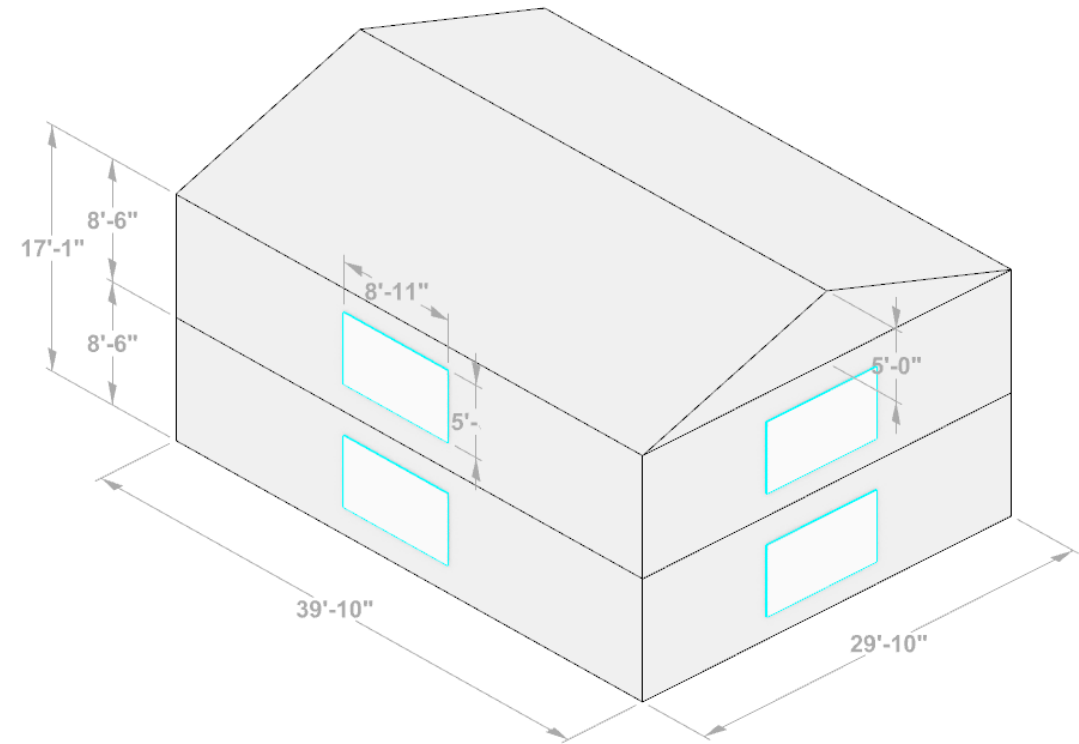
# Airtightness Improvements: A Win-Win Solution

Airtight construction is an effective strategy for both **improved energy efficiency** with relatively **low embodied carbon impacts**.

# DOE Study: Building Model Overview

## Key Specifications:

- 2-story single-family home
- Gross floor area: 2,376 sq-ft
- 8 windows (U-factor: 0.35, SHGC: 0.25)
- Gable roof
- Wood stud framing
- Gas furnace heating
- R20 wall cavity insulation
- R49 roof cavity insulation



DOE Energy Code Models: <https://www.energycodes.gov/prototype-building-models#Residential>

*Report:* Kunwar, Niraj, Shrestha, Som, Desjarlais, Andre Omer, Accawi, Gina, Ng, Lisa, and Dalglish, Laverne. Online Calculator to Evaluate the Impact of Airtightness on Residential Building Energy Consumption and Moisture Transfer. United States: N. p., 2022. Web.

# DOE Study: Energy Model Results

<b>Climate Zone 3A (Dallas, TX)</b>			
	<b>No air barrier (13 ACH50)</b>	<b>IECC min. (5 ACH50)</b>	<b>Passive House (0.6 ACH50)</b>
Air tightness			
Electricity (kWh)	4,164	3,906	3,763
		<b>6.2% reduction from no barrier</b>	<b>3.7% reduction from IECC min.</b>
Natural Gas (kBtu)	42,839	29,630	22,069
		<b>31% reduction from no barrier</b>	<b>26% reduction from IECC min.</b>

*Note: % reductions shown are based on annual energy consumption, not operational carbon*

# DOE Study: Energy Model Results

Climate Zone <b>5B (Pittsfield, MA)</b>			
Air tightness	No air barrier (13 ACH50)	IECC min. (5 ACH50)	Passive House (0.6 ACH50)
Electricity (kWh)	4,025	3,944	3,919
		<b>2.0% reduction</b> from no barrier	<b>0.6% reduction</b> from IECC min.
Natural Gas (kBtu)	66,077	48,037	37,178
		<b>27% reduction</b> from no barrier	<b>23% reduction</b> from IECC min.

*Note: % reductions shown are based on annual energy consumption, not operational carbon*

# DOE Study: Cradle-to-Gate Embodied Emissions

Total Embodied Emissions:  
**32,171 kg CO<sub>2</sub>e**

Emissions Intensity:  
**146 kg CO<sub>2</sub>e/m<sup>2</sup>**

MATERIAL CARBON EMISSIONS BY SECTION		
Footings & Slabs	10,772 kg CO <sub>2</sub> e	
Foundation Walls	0 kg CO <sub>2</sub> e	
Structural Elements	0 kg CO <sub>2</sub> e	
Exterior Walls	1,581 kg CO <sub>2</sub> e	
Party Walls	0 kg CO <sub>2</sub> e	
Exterior Wall Cladding	9,328 kg CO <sub>2</sub> e	
Windows	2,844 kg CO <sub>2</sub> e	
Interior Walls	1,274 kg CO <sub>2</sub> e	
Floors	3,624 kg CO <sub>2</sub> e	
Ceilings	269 kg CO <sub>2</sub> e	
Roof	2,477 kg CO <sub>2</sub> e	
Garage	0 kg CO <sub>2</sub> e	

Assuming typical construction materials, like industry average concrete, fiberglass batt cavity insulation, brick cladding, double-glazed windows, carpet, light wood I-joist floor framing, and asphalt roof shingles.



# DOE Study: EC Impact of Interventions

No air barrier  
(13 ACH)

**27-31%**  
energy usage reduction

IECC minimum  
(5ACH)



Adding a membrane:

**+2.3% of cradle-to-gate EC**

Total EC added: +738 kgCO<sub>2</sub>e

# DOE Study: EC Impact of Interventions

IECC minimum  
(5ACH)

**23-26%**  
energy usage reduction

Passive house  
(0.6ACH)



Tighter construction:

**+~0% of cradle-to-gate EC**

Negligible additional material  
Primarily onsite installation interventions

# HERS Models: Summary of Models

6 energy models of homes in Massachusetts (Climate Zone 5)



Model	Area (sq-ft)	Typology	HERS Score	Embodied Carbon*	Operational Carbon
01	1,003	Apartment	43	130 kgCO <sub>2</sub> /m <sup>2</sup>	Heating: 0.41 tons/yr Cooling: 0.0 tons/yr
02	1,156	Single family	-28	358 kgCO <sub>2</sub> /m <sup>2</sup>	Heating: 0.42 tons/yr Cooling: 0.0 tons/yr
03	2,017	Single family	48	222 kgCO <sub>2</sub> /m <sup>2</sup>	Heating: 2.41 tons/yr Cooling: 0.10 tons/yr
04	1,508	Single family	48	403 kgCO <sub>2</sub> /m <sup>2</sup>	Heating: 2.81 tons/yr Cooling: 0.03 tons/yr
05	1,000	Single family	45	207 kgCO <sub>2</sub> /m <sup>2</sup>	Heating: 0.52 tons/yr Cooling: 0.0 tons/yr
06	710	Townhouse	53	214 kgCO <sub>2</sub> /m <sup>2</sup>	Heating: 0.70 tons/yr Cooling: 0.01 tons/yr

# HERS Models: Operational Carbon Scenario Modelling



IECC code min.  
for Climate  
Zones 1 and 2

IECC code min.  
for Climate  
Zones 3 thru 8

Keeping the climate variables constant and varying the airtightness performance from 5 ACH to Passive House (0.6 ACH), **notable savings in Annual Heating Operational Carbon are observed.**

**5ACH to 3ACH**

**13%**

Avg. % Reduction in Annual Operational Carbon (6%-22%)

**5ACH to 1ACH**

**25%**

Avg. % Reduction in Annual Operational Carbon (10%-43%)

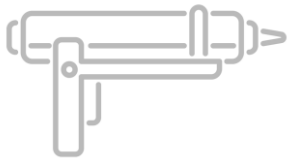
**5ACH to PH (0.6ACH)**

**27%**

Avg. % Reduction in Annual Operational Carbon (10%-47%)

A special thank you to **Andy Buccino** (Stephens & Company, Inc.), **Patrick Nachlas** (Ekotrope), and **Jacob Bodah** (Energy Code Help) for their analysis support and expertise!

# HERS Models: Operational Savings Compared



**Strategy**

More airtight construction (5ACH to 3ACH)

Much more airtight construction (5ACH to 1ACH)

Upgrade from double- to triple-paned windows

Doubling exterior wall insulation thickness

**% Reduction in Annual Operational Carbon**

**13%**

**25%**

**~10%**

**~8%**

**Embodied Carbon Impact**

**Negligible.**

**Negligible.**

**+2-8%**  
in A1-A3  
Embodied Carbon

**+6-30%**  
in A1-A3  
Embodied Carbon

# Summary: A Win-Win for Embodied & Operational Carbon

Improving air tightness is the **best improvement in operating emissions** for the **least increase in embodied emissions**

**ADDED  
AIR BARRIER  
(13ACH to 5ACH)**



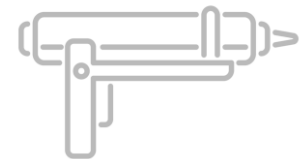
**+31%**

Building energy performance improvement

**+2%**

Added embodied carbon

**TIGHTER  
CONSTRUCTION  
(5ACH to 0.6ACH)**



**+27%**

Building energy performance improvement

**+0%**

Added embodied carbon

# Panel Discussion



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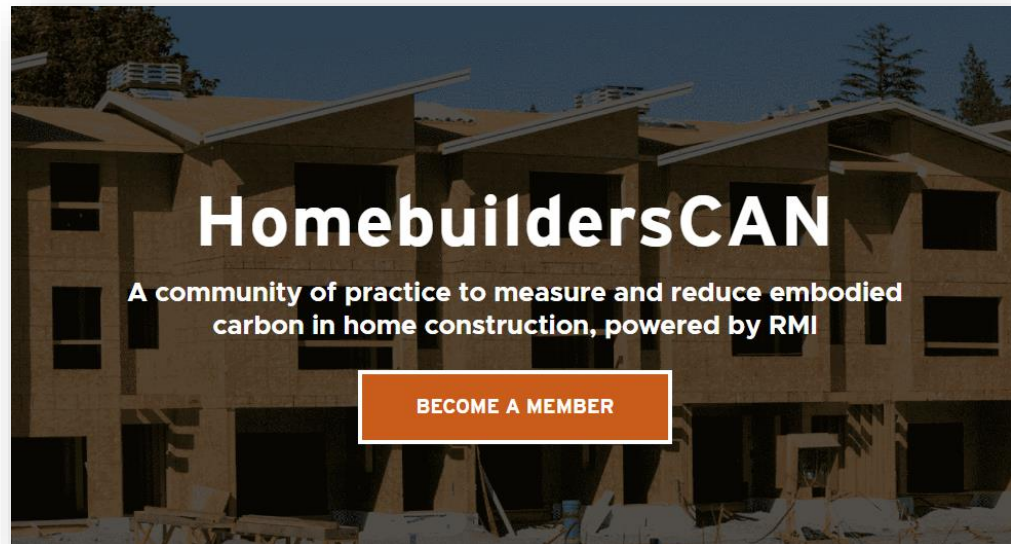
# Thank You

The recording will be available on the **event page** within 24 hours.



Sign up as a member or subscribe:

[rmi.org/HomebuildersCAN](https://rmi.org/HomebuildersCAN) 





# HomebuildersCAN

## CARBON ACTION NETWORK

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