



# Embodied Carbon & Resilience: *Playing Nice Together*

Chris Magwood  
RMI Carbon Free Buildings  
Building Knowledge Webinar  
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## Chris Magwood

- Green design/build for 25 years
- Educator & author
- Accidental embodied carbon nerd



# HomebuildersCAN

## CARBON ACTION NETWORK



### 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 turn them into relatable stories
- 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
- Display commitments recognized and valued by investors and clients



### SECTOR ALIGNMENT

#### **Advocate for alignment across the residential building sector**

- Develop approaches for integrating embodied carbon into energy efficiency and green building rating 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 like green mortgages

# GHG emissions from homes: Operational

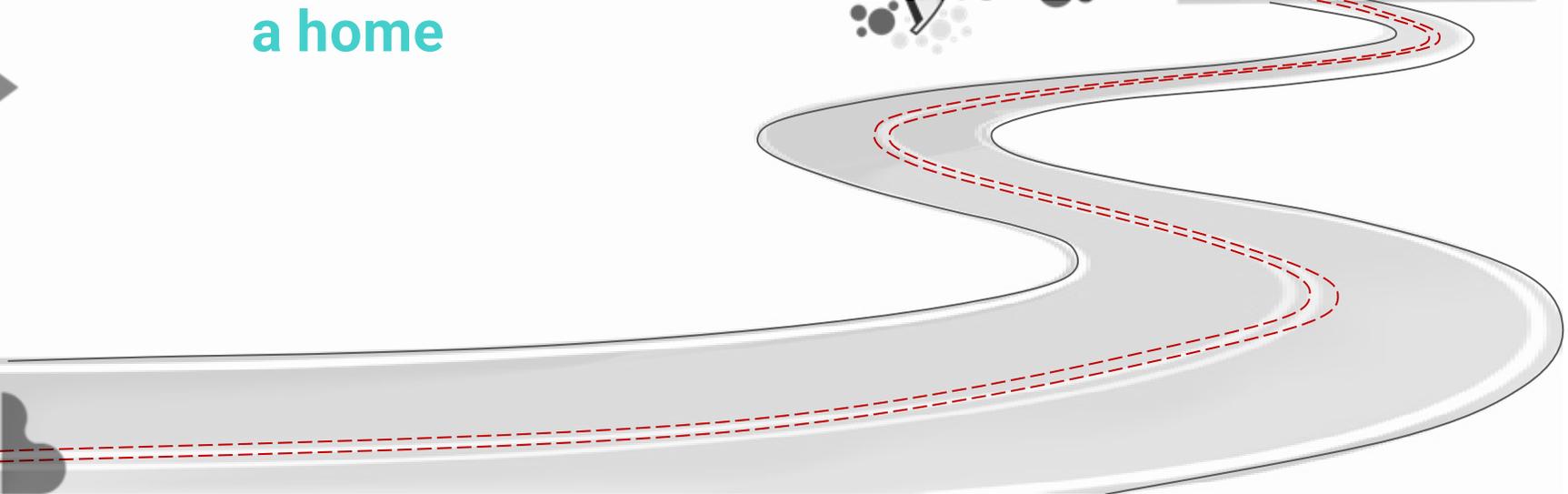


We've done a good job of reducing these emissions...

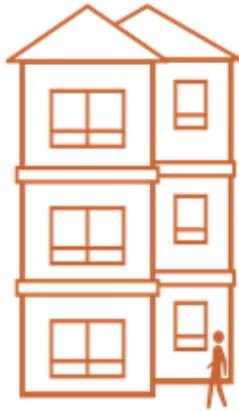
# GHG emissions from homes: Embodied



...but we've missed  
the emissions from  
products and  
processes that make  
a home



# Is embodied carbon important?



In 2021, Canada's new homes were responsible for

**14–20 million tonnes of embodied carbon emissions**

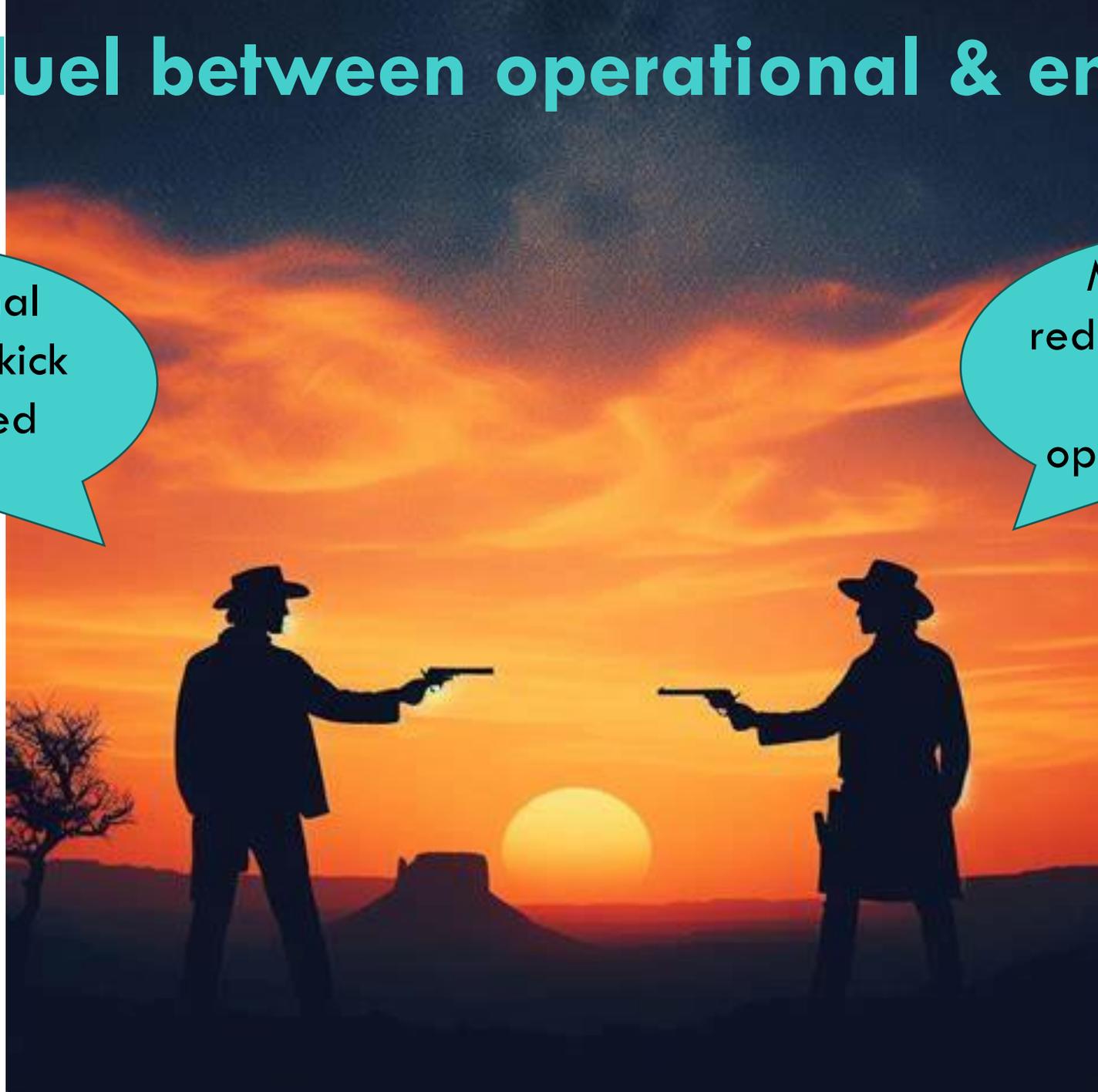
Homes built in 2030 will need to produce

**83% less embodied GHGe to avoid overshoot of Canada's goals\*\***

# It's not a duel between operational & embodied!

My operational reductions will kick your embodied butt!

My embodied reductions will put a bullet in your operational heart!

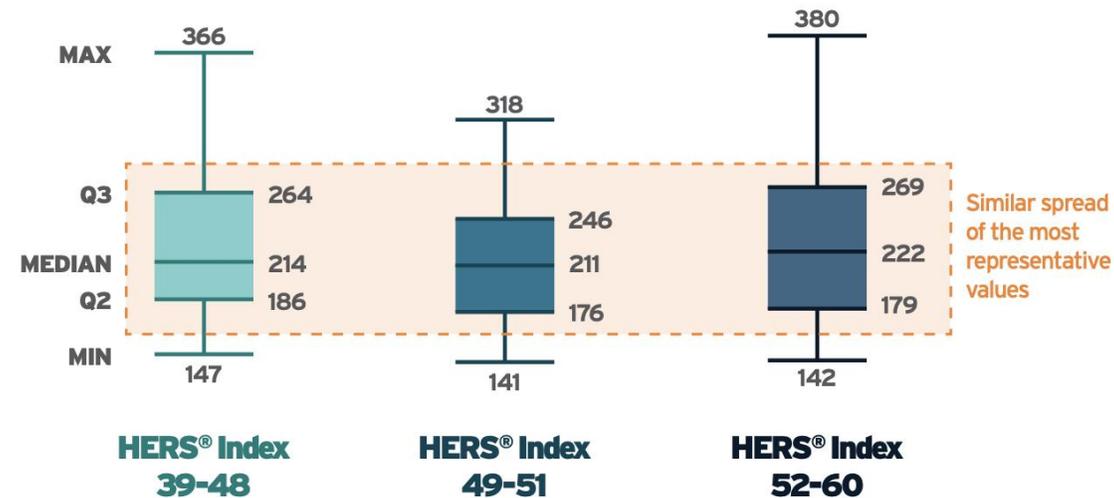


MASSACHUSETTS 100-HOME EMBODIED CARBON STUDY KEY FINDINGS

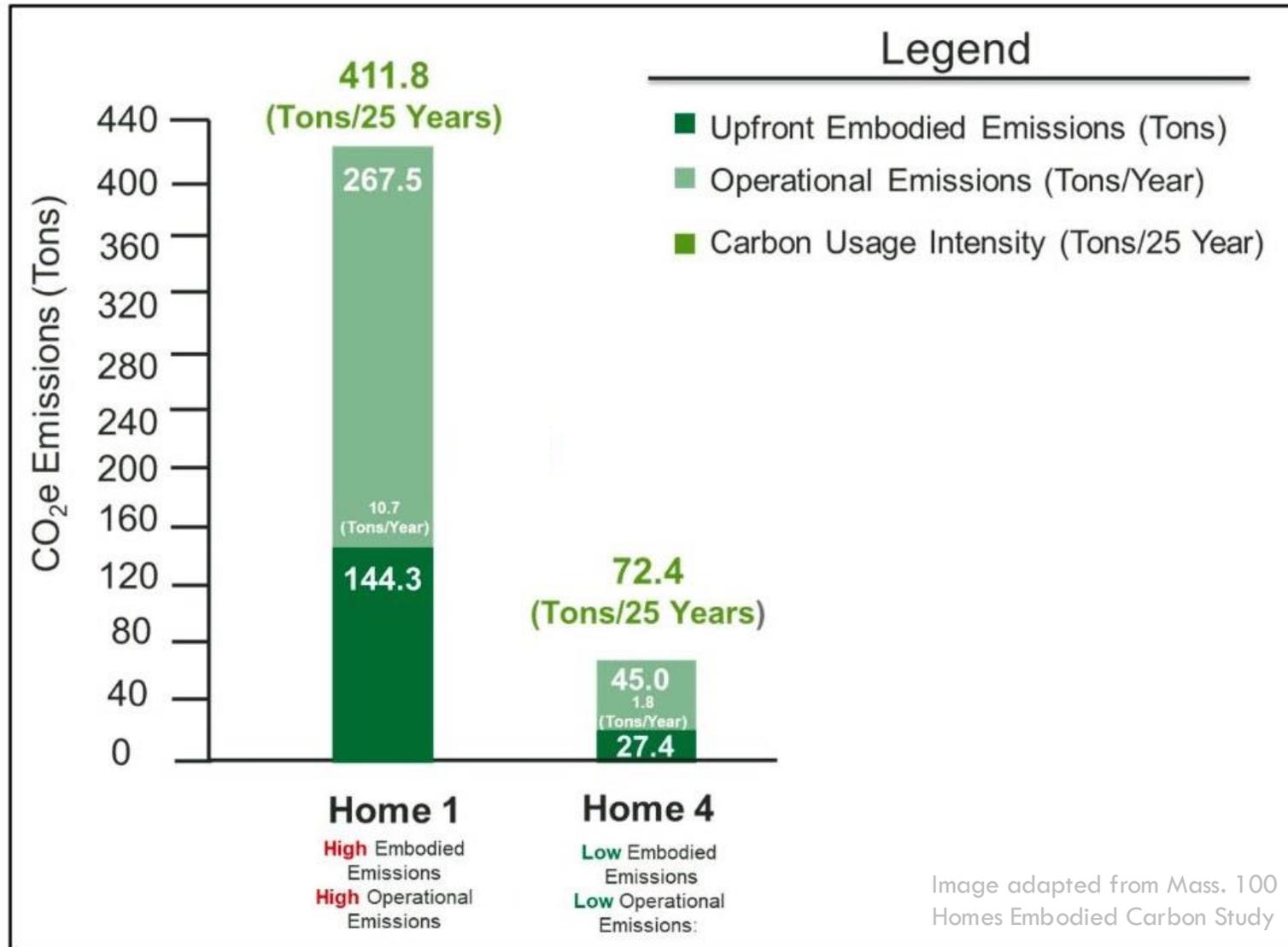
# The level of energy efficiency is not a predictor of embodied carbon performance.

The spread of embodied carbon intensities across different ranges of HERS® Scores mostly stays the same with similar medians and quartiles.

Net Embodied Carbon Intensities per Conditioned Floor Area by HERS® Index (kg CO<sub>2</sub>e/m<sup>2</sup>)



# We can achieve performance in both!



# Tackle Embodied & Operational Together

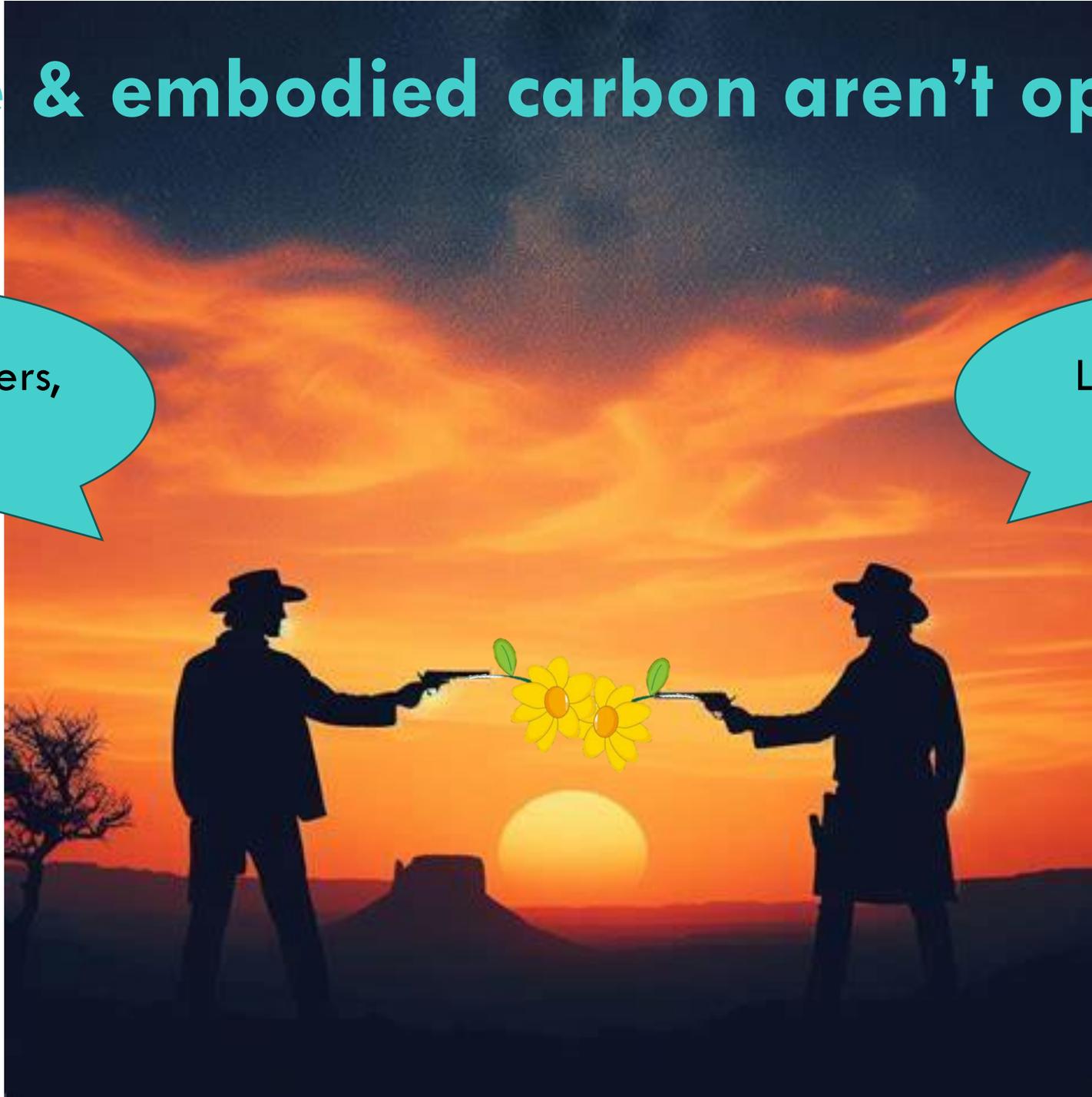
Operational Performance Improvement	Possible to Achieve with Equivalent or Reduced Embodied GHGe
Reduced building size and/or surface area	✓
Increased quantity of insulation	✓
High performance windows	✓
Improved air tightness	✓
Improved equipment efficiency	✓
Fuel switching	✓
Passive design	✓

**Many energy efficiency strategies can be applied without increasing embodied carbon**

# Resilience & embodied carbon aren't opposites!

Let's be partners,  
pardner!

Let's be resilient  
together!



# How to reduce embodied carbon:

use **less** stuff

use **better versions** of the same stuff

use **better stuff**

# How to increase performance for embodied carbon & resilience – HAIL:



Measures for All Homes	
ID	Measure
RC3	“Premium” Class 4 hail impact-resistant roofing products (e.g., recycled rubber, slate, concrete tile) installed.
S2	Fibre-cement, brick, stone, brick or stone veneer, steel siding, or products warranted for resistance to damaging hail size installed.

## Roofing Shingles:

Product category avg: **4.4 kg CO<sub>2</sub>e/m<sup>2</sup>**

Malarkey Vista: **3.0 kg CO<sub>2</sub>e/m<sup>2</sup>**

Owens Corning Duration: **3.5 kg CO<sub>2</sub>e/m<sup>2</sup>**

## Siding:

**X Vinyl average:** **4.7 kg CO<sub>2</sub>e/m<sup>2</sup>**

Hardie fibre-cement: **3.9-5.1 kg CO<sub>2</sub>e/m<sup>2</sup>**

# How to increase performance for embodied carbon & resilience – WIND:

Continuous Vertical Load Path	
ID	Measure
CLPB	Provide a continuous load path to transfer wind uplift forces from the roof to the foundation, which is compliant with Section 8 of CSA S520, which includes: Roof to wall connections, connections between upper and lower storey (where upper storeys are present), connections between lower storeys and the building foundation, and connections between the lower storey and sill plate.

## Hurricane clips & nails:

50 clips: **17.85 kg CO<sub>2</sub>e/m<sup>2</sup>**

400 nails: **38.86 kg CO<sub>2</sub>e/m<sup>2</sup>**

**Total:** **56.71 kg CO<sub>2</sub>e/m<sup>2</sup>**

—————> **Typical home:** **50,000 kg CO<sub>2</sub>e/m<sup>2</sup>**

**Addition of clips = 0.1% EC increase**

# How to increase performance for embodied carbon & resilience – FIRE:

## Roof decking & wall sheathing:

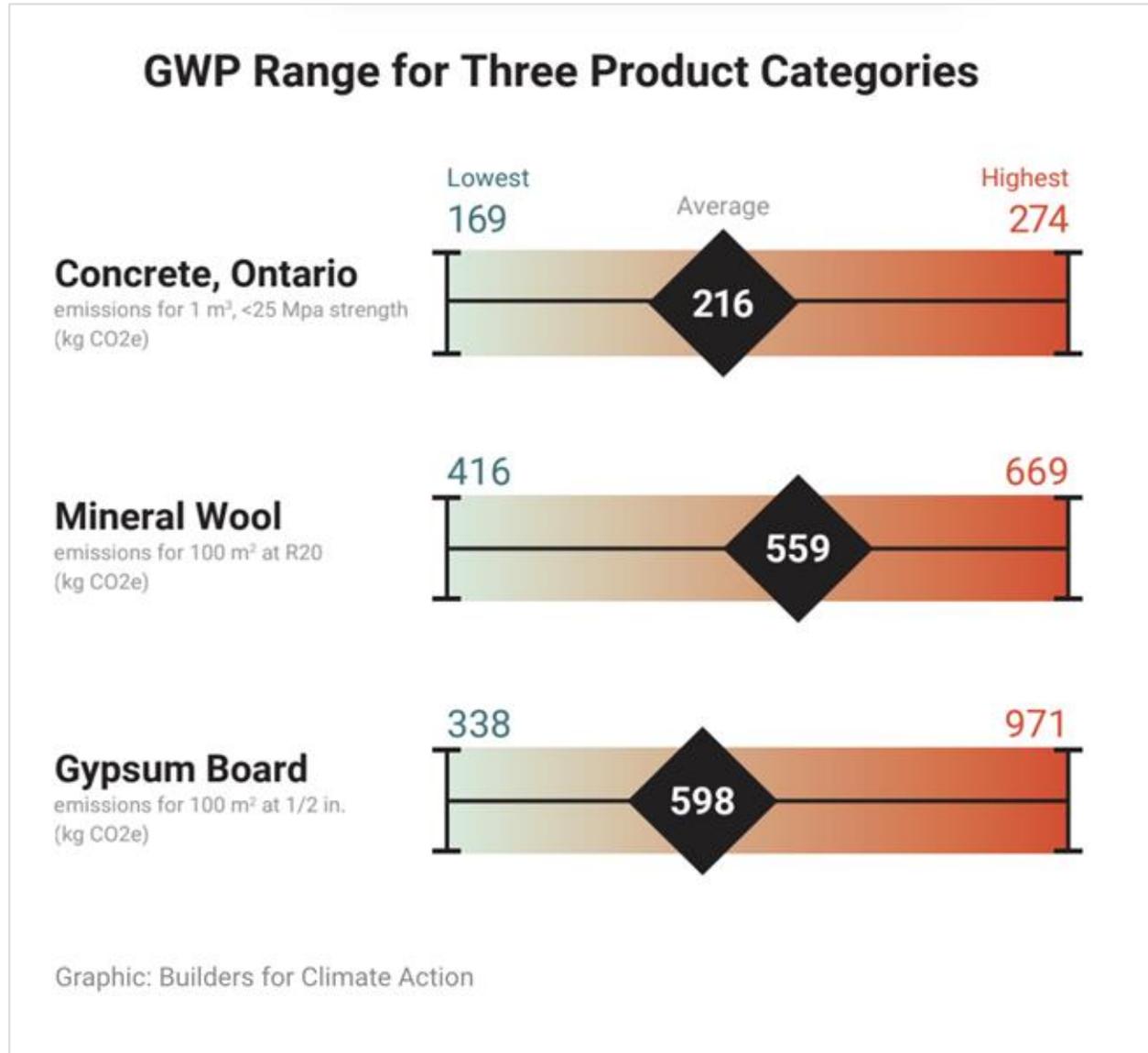
OSB avg: **3.85 kg CO<sub>2</sub>e/m<sup>2</sup>**

CertainTeed Glasroc: **3.34 kg CO<sub>2</sub>e/m<sup>2</sup>**

LP Flameblock: **4.55 kg CO<sub>2</sub>e/m<sup>2</sup>**

# How to increase performance for embodied carbon

If resilience measures **DO** drive up embodied carbon, reductions to balance or offset exist elsewhere in the building



# Resources



**RM**

## The Hidden Climate Impact of Residential Construction

Zeroing In on Embodied Carbon Emissions for Low-Rise Residential Buildings in the United States



Report / March 2023

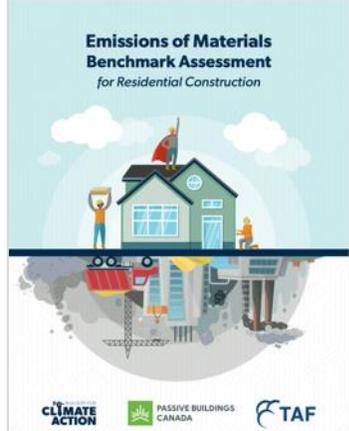
<https://rmi.org/insight/hidden-climate-impact-of-residential-construction/>



**Achieving Real Net-Zero Emission Homes:**  
Embodied carbon scenario analysis of the upper tiers of performance in the 2020 Canadian National Building Code

Natural Resources Canada

BUILDERS FOR CLIMATE ACTION



**Emissions of Materials Benchmark Assessment**  
for Residential Construction

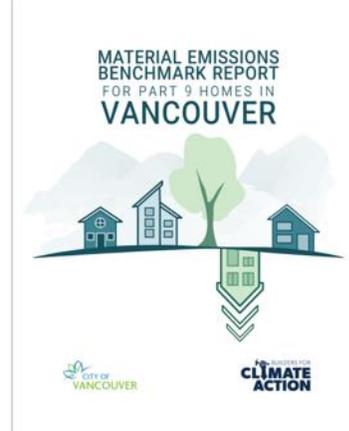


CLIMATE ACTION

PASSIVE BUILDINGS CANADA

TAF

<https://www.buildersforclimateaction.org/our-work.html>



**MATERIAL EMISSIONS BENCHMARK REPORT**  
FOR PART 9 HOMES IN VANCOUVER



CITY OF VANCOUVER

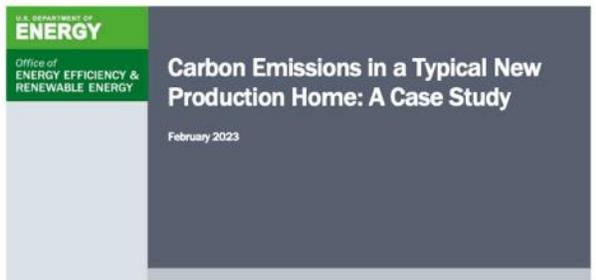
CLIMATE ACTION

*Benchmarking Report*

### Establishing the Average Upfront Material Carbon Emissions in New Low-Rise Residential Home Construction in the City of Nelson & the City of Castlegar

Prepared for  
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U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

### Carbon Emissions in a Typical New Production Home: A Case Study

February 2023

<https://www.nrel.gov/docs/fy23osti/84227.pdf>



**BEAM**

**BUILDING EMISSIONS ACCOUNTING FOR MATERIALS**