

# Carbon & Insulation

A Life-Cycle Carbon Analysis of Embodied and Operational Carbon related to Insulation in New Construction

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FIBRE GLASS, ROCK WOOL AND SLAG WOOL INSULATION

# What is happening in the industry?

- **CBHCC** proposes **embodied carbon accounting using a Tiered approach** similar to that being used for operational carbon
- **UL** Changes to the **Product Category Rule** for Building Envelope Thermal Insulation EPD requirements (life of building)
- **NAIMA Canada** – insulation should be treated as critical infrastructure – insulation is unique – operational carbon savings over the life of the building

STRATEGIC SHADING AND  
EXTERNAL FINISHES WITH LIGHT  
COLORS TO REDUCE SUMMER  
HEATING LOAD

# An Alternative Approach

RAISED HEEL TRUSSES  
SUPER INSULATED ATTIC SPACE  
TO R-60 OR BETTER

What is the cost in \$ to convert a piece of raw land to a move-in ready house?

- The selling price of the house.

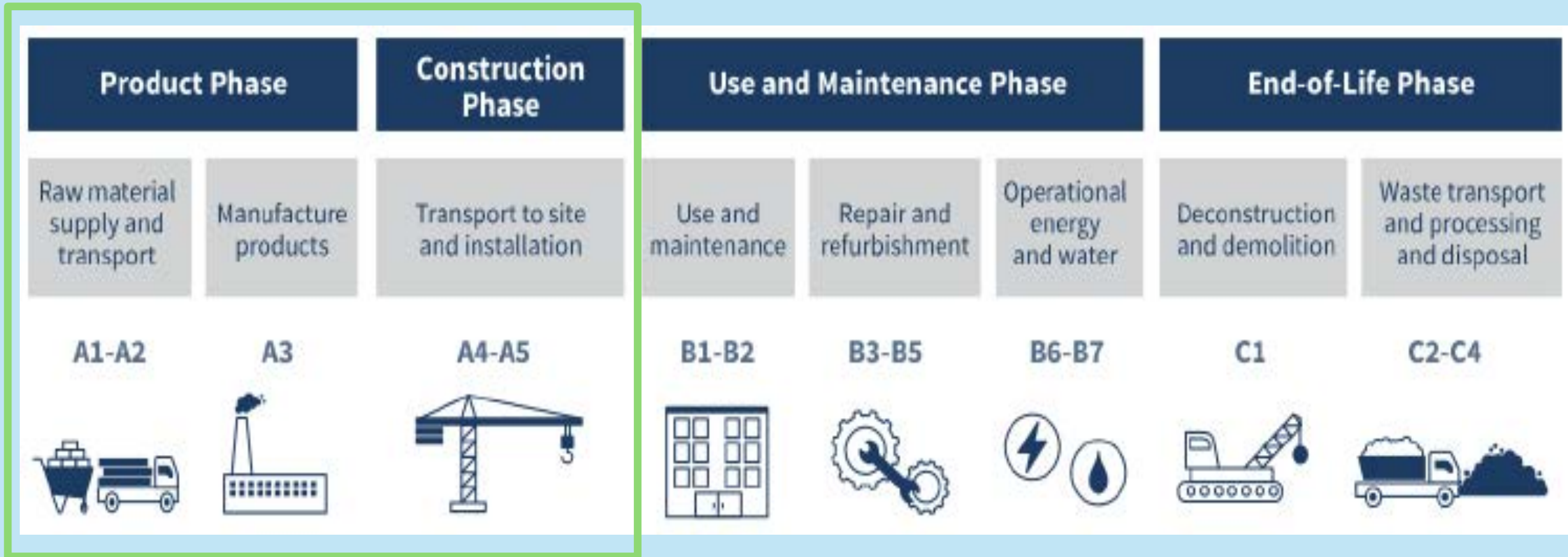
What is the cost in Carbon to convert a piece of raw land into a move-in ready house.

- A1 – A5 The Carbon Emissions of Construction
- Operational Carbon for Space Conditioning Until Closing

ENERGY EFFICIENT APPLIANCES  
AND HOT WATER EQUIPMENT

CONSTANT MECHANICAL VENTILATION FOR FRESH AIR AND  
EXHAUST WITH AN HRV OR ERV

# Life-Cycle Assessment Phases



# CARBON DEBT OF CONSTRUCTION

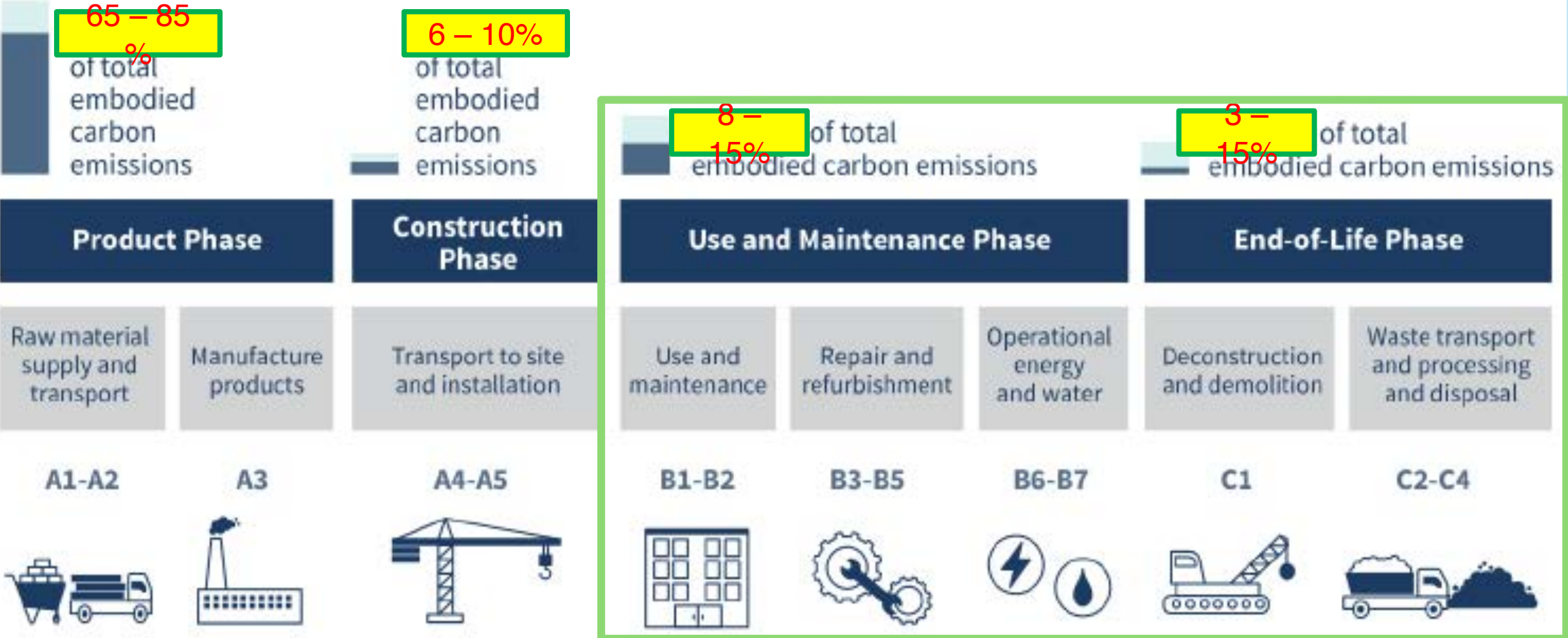


# Why is “Move-In” Important?

- **Building Code**
  - From the time construction starts until occupancy the house falls under the jurisdiction of the Building Code.
  - After the Occupancy Permit is issued the house is no longer “under construction”
  - The house becomes a “used house”
- **Carbon Debt**
  - Majority of Embodied Carbon is in place
  - Operational Carbon is used to condition the house while under construction (need to account for winter works)



# Embodied Carbon is Added After Occupancy



# EMBODIED CARBON DEBT OVER TIME



# BKC Study for NAIMA Canada

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- **5 Architypes**
  - End Unit Stacked Townhouse
  - Mid Unit Stacked Townhouse
  - End Unit Townhouse
  - Mid Unit Townhouse
  - Single Detached Home
- **2 Climate Zones**
  - Ottawa
  - Edmonton



# Analysis

- Embodied Carbon & Operational Carbon
  - Tier 1
  - Tier 5
  - Tier 1 – No insulation
  - Tier 1 – With Tier 5 Insulation & Airtightness
  - Tier 1 – With Tier 5 Insulation



# RESULTS:

## Detached House in Edmonton & Ottawa

**EDMONTON**

**OTTAWA**

Operational Carbon 100 years		Embodied Carbon		Carbon Savings & Target	
Tonnes CO <sub>2</sub> Tier 1 No Insulation	Tonnes CO <sub>2</sub> Tier 1 with Tier 5 Insulation & Airtight	Tonnes CO <sub>2</sub> Tier 1 No Insulation	Tonnes CO <sub>2</sub> Tier 1 with Tier 5 Insulation & Airtight	Tonnes CO <sub>2</sub> Tier 1 No Insulation	Tonnes CO <sub>2</sub> Tier 1 with Tier 5 Insulation & Airtight
1856	659	70.51	78.64	1188.87	737.64
1179	290	62.26	69.37	881.89	359.37

# RESULTS: 5 Architypes in Edmonton

	Operational Carbon 100 years		Embodied Carbon		Carbon Savings & Target		
	Tonnes CO <sub>2</sub>	Tonnes CO <sub>2</sub>	Tonnes CO <sub>2</sub>	Tonnes CO <sub>2</sub>	Tonnes CO <sub>2</sub>	Tonnes CO <sub>2</sub>	
	Tier 1 No Insulation	Tier 1 with Tier 5 Insulation & Airtight	Tier 1 No Insulation	Tier 1 with Tier 5 Insulation & Airtight	Tier 1 No Insulation	Tier 1 with Tier 5 Insulation & Airtight	
END TOWN	2823	938			1876.13	1019.25	PASS
MID STACK	1047	654	72.38	81.25	389.17	701.84	FAIL
TOWN END	1321	714	44.01	47.84	602.08	766.91	FAIL
STACK TOWN	1418	587	47.99	52.91	824.94	659.75	PASS
MID TOWN	1856	659	66.69	72.75	1188.87	737.64	PASS
SING. DET.			70.51	78.64			

# RESULTS:

## Reduced Embodied Carbon by 50%

		Carbon Savings Over 100 Years		
		Tonnes CO <sub>2</sub>	Tonnes CO <sub>2</sub>	Tonnes CO <sub>2</sub>
		T1 No Insul vs T1 with T5 I&AT	T1 No Insul vs T1 with T5 I&AT	Improvement With Reduced
		50% Reduced EC	100% EC	EC
<b>Edmonton</b>	End Unit Townhome	1880.57	1876.13	4.44
	Mid Unit Stacked Townhome	391.09	389.17	1.92
	End Unit Stacked Townhome	604.54	602.08	2.46
	Mid Unit Townhome	827.96	824.94	3.02
	Single Detached Home	1192.94	1188.87	4.07
<b>Ottawa</b>	End Unit Townhome	1361.19	1357.39	3.80
	Mid Unit Stacked Townhome	299.42	297.85	1.57
	End Unit Stacked Townhome	457.81	455.55	2.26
	Mid Unit Townhome	621.54	619.08	2.46
	Single Detached Home	885.45	881.89	3.56

# RESULTS: Increase Life Span of the House by 20%

		Carbon Savings Over 100 Years			
		Tonnes CO <sub>2</sub>	Tonnes CO <sub>2</sub>	Tonnes CO <sub>2</sub>	%
		T1 No Insul vs	T1 No Insul vs	Improvement	Improvemnet
		T1 with T5 I&AT	T1 with T5 I&AT	With Longer	120 vs 100 years
		120 years	100 years	Life Cycle	
<b>Edmonton</b>	End Unit Townhome	2253.13	1876.13	377.00	20.09
	Mid Unit Stacked Townhome	467.17	389.17	78.00	20.04
	End Unit Stacked Townhome	723.08	602.08	121.00	20.10
	Mid Unit Townhome	991.94	824.94	167.00	20.24
	Single Detached Home	1427.87	1188.87	239.00	20.10
<b>Ottawa</b>	End Unit Townhome	1630.39	1357.39	273.00	20.11
	Mid Unit Stacked Townhome	357.85	297.85	60.00	20.14
	End Unit Stacked Townhome	547.55	455.55	92.00	20.20
	Mid Unit Townhome	744.08	619.08	125.00	20.19
	Single Detached Home	1059.89	881.89	178.00	20.18

# Next Steps?

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- Industry and government working to **reduce/eliminate fossil fuel use** in housing
- Moving towards a **clean electricity** approach
- Once electricity is clean, do we care how much energy the house uses? No operational carbon cost. Only embodied carbon cost to payback.
- Once electricity is clean there will still be a charge to use it. Insulation will still have a place.
- When will fossil fuel not be used? What will the \$ cost of clean electricity be?



# Conclusions

- **Insulation is critical infrastructure.** The more energy/carbon we save, the faster we can move to clean electricity. We need low-load housing first.
- We must move to **Whole Building life-cycle analysis.** UL has recognized this and brought changes to the Product Category Rule for Building Envelope Thermal Insulation EPD requirements (75 year life of building).
- **Reducing Embodied Carbon is important, especially as we get to a clean electricity world** – this is the target we should be working towards on Embodied Carbon reduction. Not 5-10 years as per CBHCC draft policy.



# Conclusions – cont'd.

- Extending the life of high-performance housing offers large additional carbon savings at reduced cost.
- Deep Energy Retrofits are not being done at the scale we need.
- Additional insulation and improved airtightness is not being done **after** the house is occupied - difficult to retrofit.
- It's time to use Tier 5 levels of insulation and airtightness at construction and allow the mechanicals and windows to catch up at replacement times.



# Thank you! Questions?

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