



**FINDING THE EMISSIONS  
SWEET SPOT. How much  
is too much?**



**Sonja Winkelmann**  
Senior  
Director, Net  
Zero Energy  
Housing, CHBA



**Andy Oding**  
Vice President,  
Director of  
Building Science,  
Building  
Knowledge  
Canada Inc.



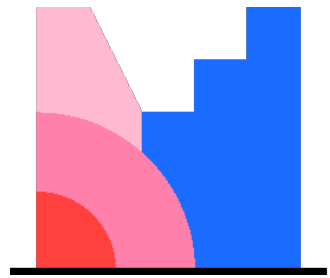
**Leigh St. Hilaire**  
Executive  
Director, Volta  
Research



**Lauren Chung**  
Senior Manager,  
Low Carbon  
Homes Task  
Force, NRCan



**Jay Wilson**  
Director, Net  
Zero and  
Electrification,  
Electricity  
Canada



# Mentimeter



**[www.menti.com](https://www.menti.com)**

**Poll # 23 21 62 5**



**Sonja Winkelmann,  
Senior Director, Net Zero Housing,  
CHBA**





# CHBA Net Zero Council

2024-2026 Strategic Plan

Canadian  
Home Builders'  
Association





## NZC Key Priorities

- 1. A Labelling Program** to distinguish and recognize Net Zero and Net Zero Ready Homes (detached, attached, and MURBs), Renovations, and Neighbourhoods, and the participating builders/renovators - focused on both energy efficiency and emissions reductions. To support industry adoption of this voluntary program, the following efforts will be delivered:
  - **Technical & Administrative Requirements** that support market preparedness for the implementation and compliance of the highest feasible tiered energy codes, and for operational and embodied emissions planned for the 2025 and 2030 codes.
  - **Marketing & Communications initiatives** to strengthen the Net Zero Home Labelling Program brand, build awareness and understanding of the value of CHBA Net Zero Homes, and stimulate market demand.
  - **Educational initiatives** to bridge the knowledge gap, support cost-optimization, and accelerate the industry's capacity to capitalize on Net Zero, such as training (which utilize the CHBA manuals), webinars, and the Net Zero Leadership Summit.
  - **Financing solutions** using program information/data to inform the development of innovative and effective financing mechanisms by key industry players to address the initial cost, helping accelerate voluntary adoption of Net Zero/Ready Homes.



## NZC Key Priorities

- 2. Applied Research, Development, and Demonstration (RD&D) initiatives** (including LEEP field trials) working with industry leaders to identify and prioritize barriers and seek innovative solutions for cost-effective Net Zero levels of performance **focused on both energy efficiency and emissions reductions** for all housing forms, including multi-family and renovations, and for neighbourhoods. Initiatives support energy efficient construction by enabling builders and renovators to reduce their time and risk identifying, exploring, and adopting innovations in the residential construction industry. Efforts contribute to and leverage CHBA RD&D work in **Climate Change Mitigation, Adaptation and Resilience guidelines and standards.**

# GOALS INFLUENCED BY:



## NET-ZERO EMISSIONS BY 2050 - GLOBAL EFFORTS

To keep global warming to no more than 1.5°C – as called for in the Paris Agreement – **emissions need to be reduced by 45% by 2030 and reach net zero by 2050.**

<https://www.un.org/en/climatechange/net-zero-coalition>



## NET-ZERO EMISSIONS BY 2050 - CANADA'S COMMITMENT

To avert the worst impacts of climate change, the Government of Canada is committed to achieving **net-zero emissions by 2050.**

<https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/net-zero-emissions-2050.html>



## NBC

**NBC 2020:** Tiered Energy Code

**NBC 2025:** Operational Emissions

**NBC 2030:** Embodied Emissions & Resilience







## NZC 3HAG:

### 3 Year Highly Achievable Goal (to end of 2026)

Expand the labelling program to include an option for **operational and embodied emissions** reductions.

- Develop a Net Zero Operational Emissions option by 2025.
- Develop a Net Zero Embodied Emissions option by 2028.

**RENOS:** A Net Zero Reno Roadmap including ROPs (Renovator Option Packages).

## NZC BHAG:

### 10 Year Big Hairy Audacious Goal (to end of 2033)

Qualified Net Zero Builders can build Net Zero/Ready **for zero additional total cost of ownership** compared to a Tier 1 2023 home.

**RENOS:** A network of Qualified Net Zero Renovators that are renovating homes to Net Zero/Ready levels of performance across the country.



## WAITING FOR MINISTERIAL ANNOUNCEMENT TO COMMUNICATE PROJECT

### Capacity Building & Training

- Net Zero Ready “Builder Option Packages” (exploring how to include opGHGs & emGHGs)
- Develop training on Section 9.36 for builders
- Offer Net Zero Home Labelling Program training courses at a discounted fee

### Emissions & Resilience Working Group (ERWG)

- To assess the feasibility of integrating emissions and resilience aspects into the CHBA Net Zero Home Labelling Program:
  - Develop a Net Zero Operational Emissions option by Dec 31/24
  - Develop a Net Zero Embodied Emissions option by Dec 31/26
  - Develop Resilience Best Practice Guidelines by Dec 31/26

# Looking Ahead

- **Net Zero Ready Case Study Houses in NB**
- **PCF 2004: Performance Requirements**
- **What about solar?**



# Typical NZr Home in NB

## SPECIFICATIONS

**Climate Zone:** 6 (Fredericton, NB)

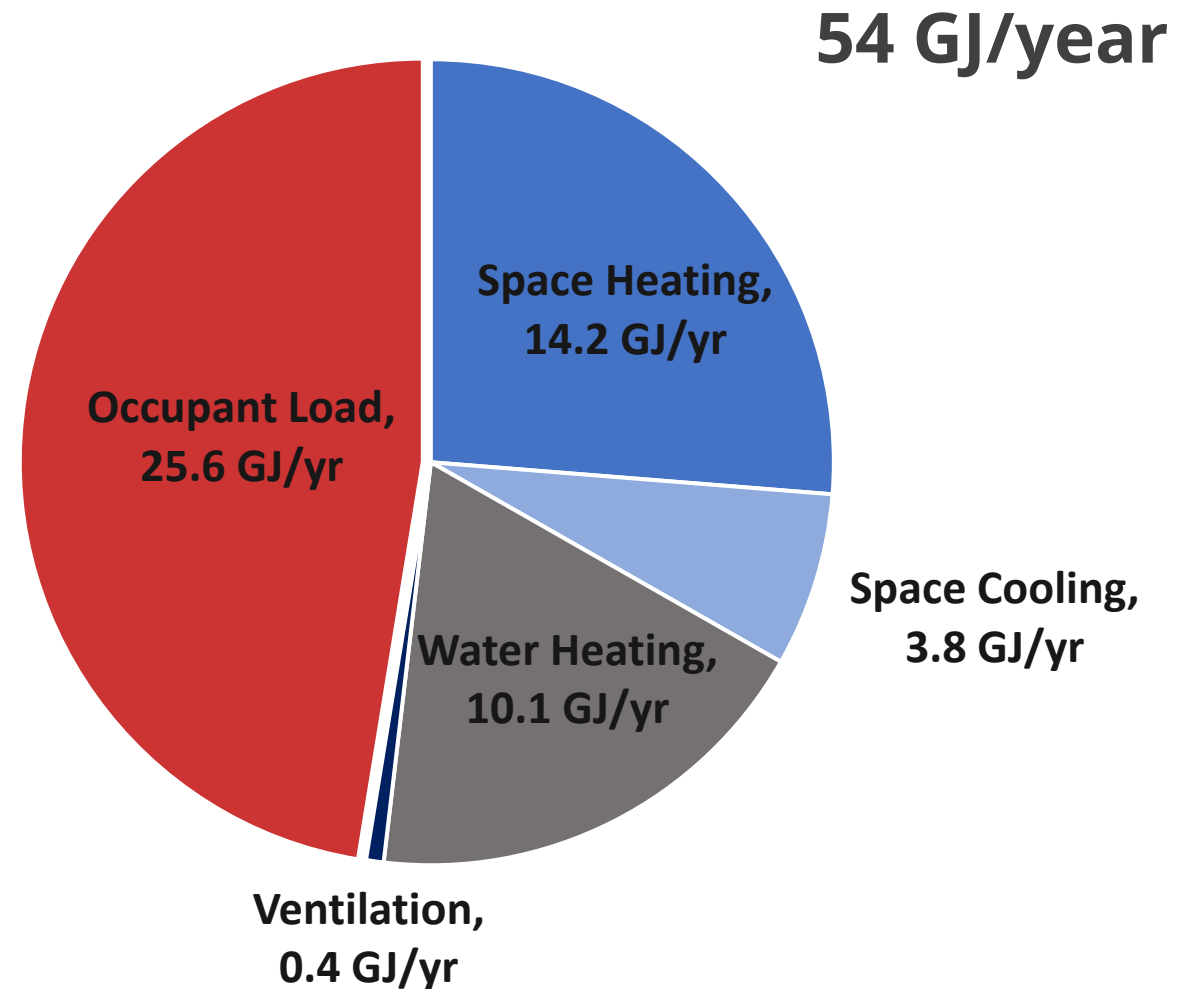
**Heated Floor Area:** 3,000 ft<sup>2</sup>

**Heating & Cooling:** ASHP + Gas Furnace

**Water Heating:** Gas Instantaneous

**Envelope:** 51% better than ref. house.

- R61 Ceiling
- R27 Above Grade Walls
- R25 Foundation (ICF)
- 0.78 ACH@50

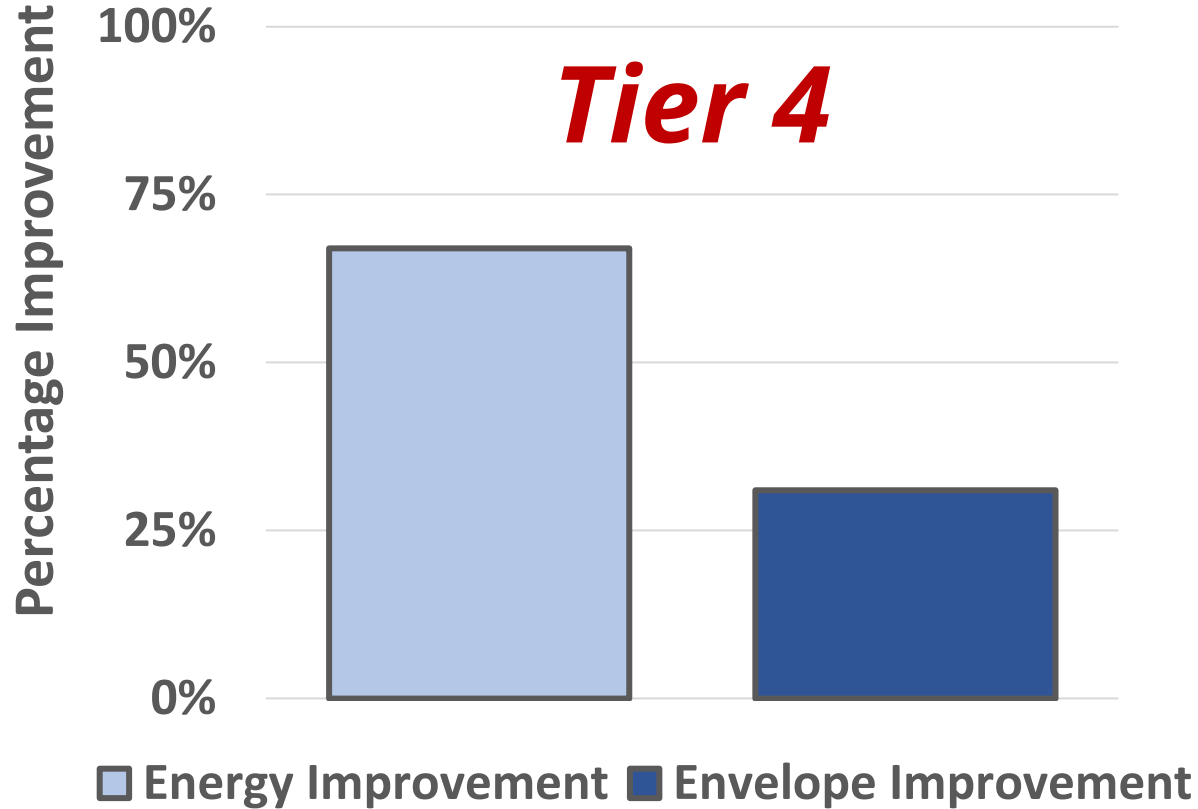




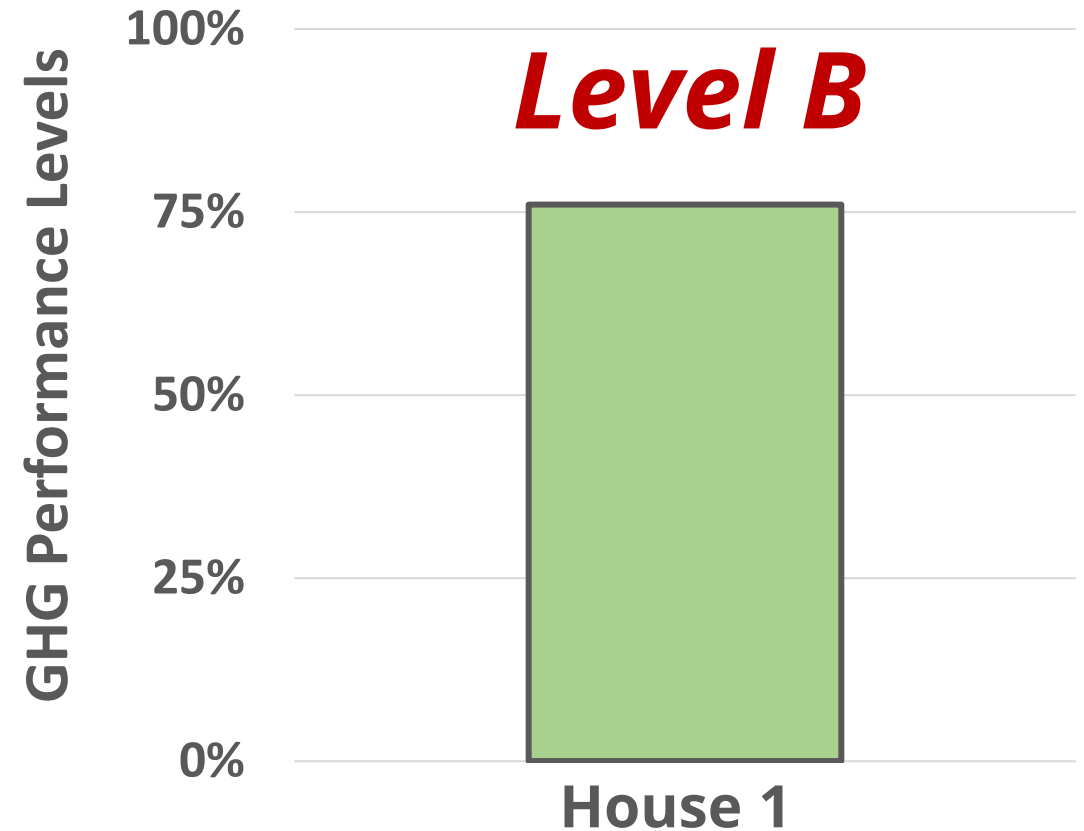
# CHBA NZr: NBC Comparison

New Brunswick Edition

### NBC 2020: Energy Performance Tiers



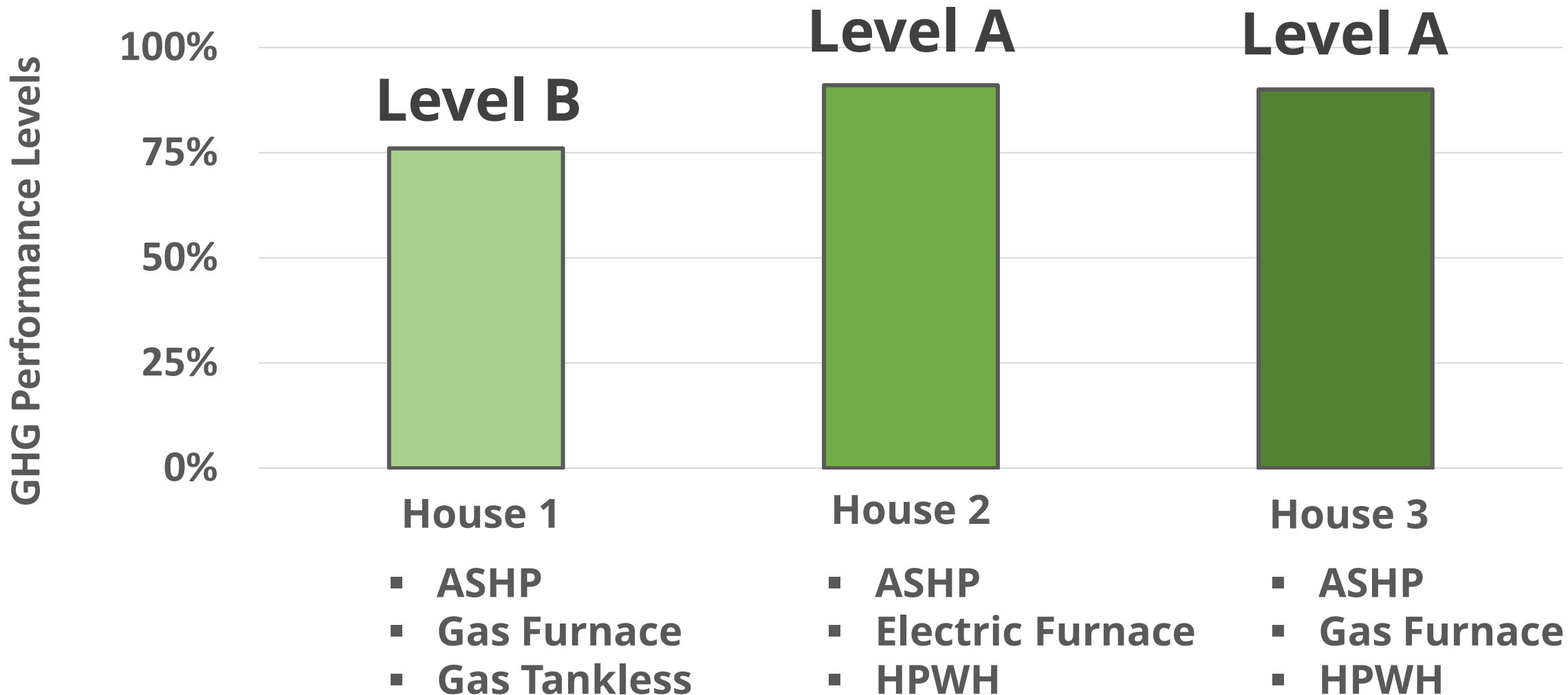
### NBC 2025: GHG Emissions Performance Levels - PCF 2004





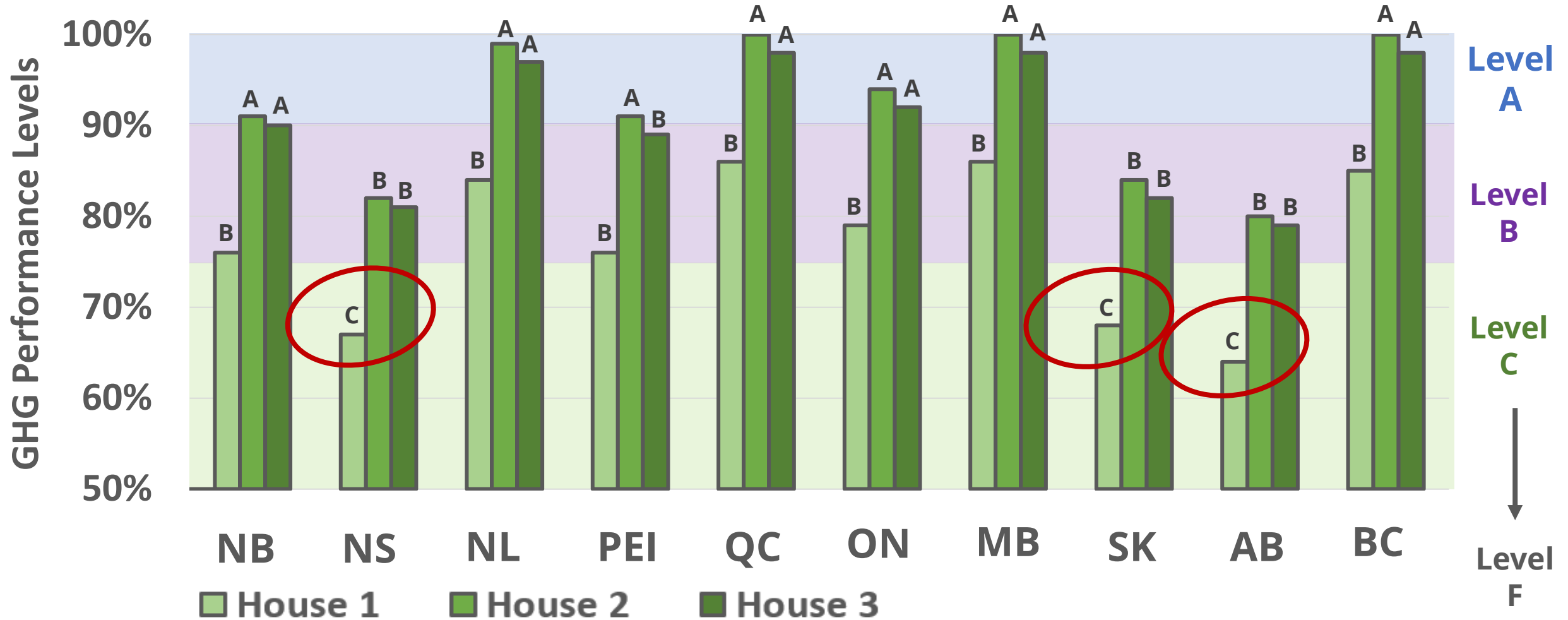
# GHG Emissions Performance Levels

PCF 2004 Review: New Brunswick Edition



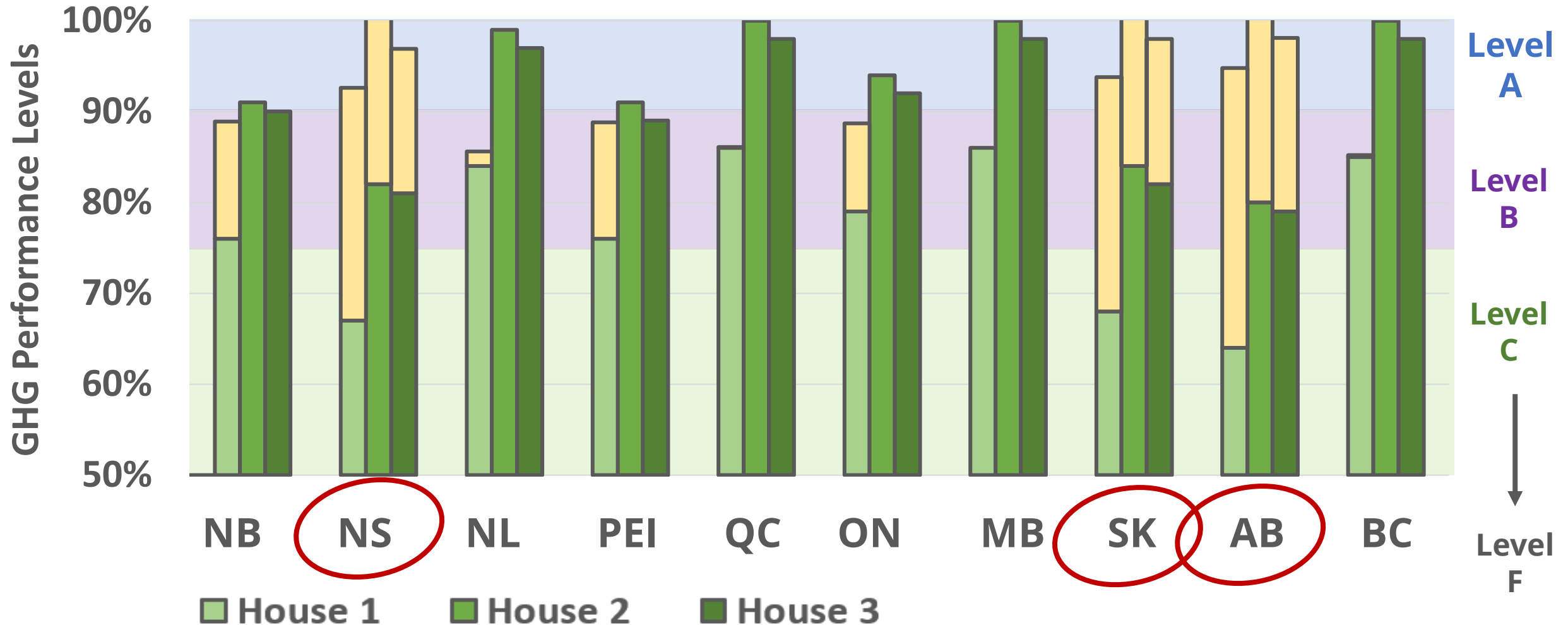
# GHG Emissions Performance Levels

PCF 2004 Review: Provincial Edition



# GHG Emissions Performance Levels

PCF 2004 Comment Review: 5kW Solar PV Offset







**Andy Oding,  
Vice President,  
Building Knowledge Canada**



THE HOME THAT SCIENCE BUILT

## **NBC 2025 & 2030**

### **Operational Emissions & Embodied Emissions**

*Looking for the sweet spot (with a complex grid  
and a challenging future)*

---

2024 CHBA Net Zero Summit



**Andrew Oding** MEA, NZQEA, LEED AP, BSSO  
**Vice President**



Since 1986, helping the Canadian home building industry, through building science, to design and construct homes that people LOVE to live in.



## Building Energy Performance Evaluation & Consulting Services

- Building Science Consulting and Engineering (Design and Forensics)
- Building Science Training: Course Development and Delivery
- HVAC Design, consulting and Forensics
- Professional IDP/Design Charette Facilitation Services: Residential
- Energy Modeling **Ontario Building Code SB12** and **National Building Code NBC 9.36**
- EnerGuide Rating System Evaluation Services
- ENERGY STAR® Evaluation & Compliance
- Net Zero Hometm Evaluation & Compliance
- Net Zero Renovation Evaluation and Compliance
- R-2000 Evaluation Services
- LEED® for Homes Project Management
- Industry Incentives Program Compliance
- Existing Home Energy Evaluation
- Air Tightness / Blower Door Testing & Building Diagnostic Services
- Large Building Air tightness testing
- Building Science Training & Facilitating
- Advanced Residential Quality Control Services
- Manufacturer & Utility Client Services

Proudly a  
member of:

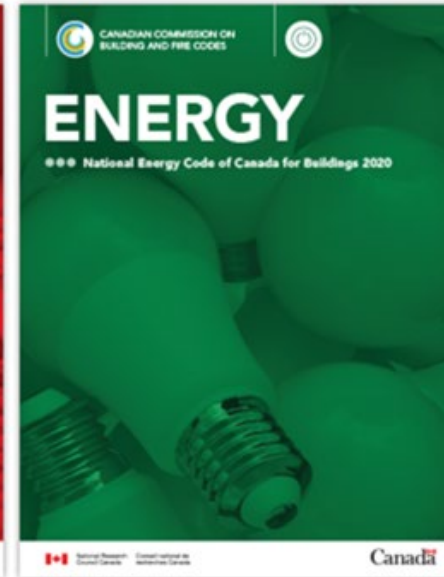
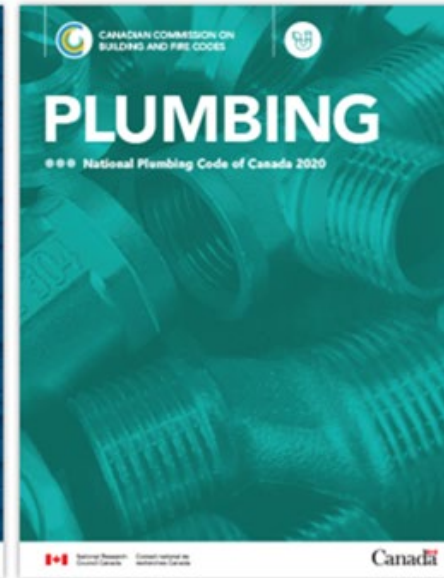


**Ontario**  
Home Builders'  
Association



# WHERE are the energy codes?

NBC 9.36 – Low Rise Residential, 3 story's >



NECB 3/10 large buildings, commercial

# THE 2020 TIERED ENERGY CODE PART 9.36

## ***OBSERVATIONS FROM A HOMEBUILDERS PERSPECTIVE***

### Tiered Performance Path 9.36.6

Table [9.36.6.2.]

Energy Performance Tiers for *Buildings* or Houses  
Forming Part of Sentence 9.36.6.2.(1)

Volume $V_T$	Target Metrics	Applicable Energy Performance Tier				
		1	2	3	4	5
> 300 m <sup>3</sup> and where volume is not determined	Percent Heat Loss Reduction (1)	n/a	≥ 5%	≥ 10%	≥ 20%	≥ 40%
	or Percent Improvement (2)	≥ 0%	≥ 10%	≥ 20%	≥ 40%	≥ 70%
	Percent House Energy Target (3)	≤ 100%	≤ 90%	≤ 80%	≤ 60%	≤ 30%
≤ 300 m <sup>3</sup>	Percent Heat Loss Reduction (1)	n/a	≥ 0%	≥ 5%	≥ 15%	≥ 25%
	or Percent Improvement (2)	≥ 0%	≥ 0%	≥ 10%	≥ 30%	≥ 60%
	Percent House Energy Target (3)	≤ 100%	≤ 100%	≤ 90%	≤ 70%	≤ 40%

ENVELOPE  
TARGET

TOTAL ENERGY  
TARGET

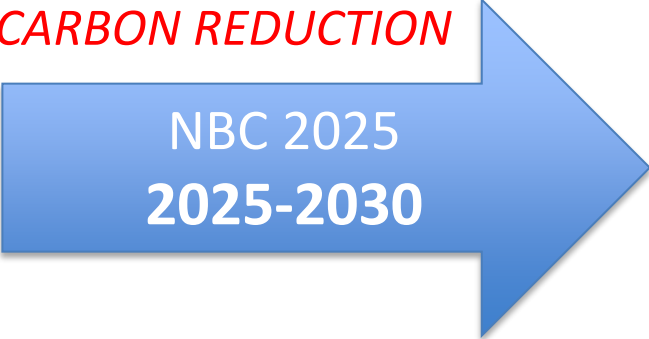
# WHERE ARE CANADIAN BUILDING CODES GOING IN THE FUTURE

*ENERGY  
REDUCTION  
ONLY*



*EXISTING HOMES &  
BUILDINGS ENERGY  
REDUCTION*

*AND  
OPERATIONAL  
CARBON REDUCTION*

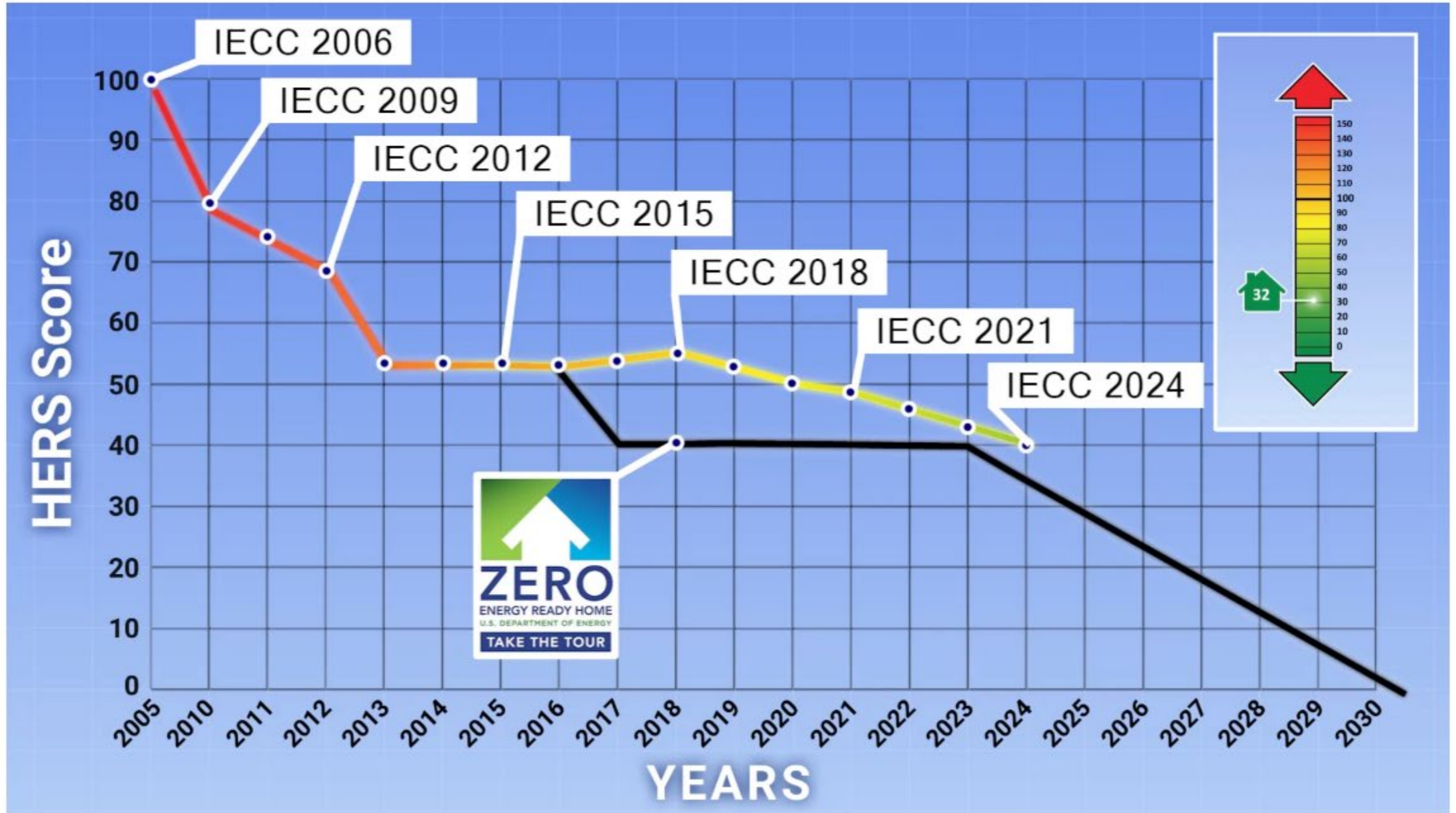


*RESILIENCY  
(EXTREME HEAT,  
WIND, FIRE, FLOOD)*

*EMBODIED CARBON  
REDUCTION*



# US Codes - IECC International Energy Conservation Code



# HOME LABELING PROGRAMS

## LEANING INTO CARBON




Natural Resources Canada / Ressources naturelles Canada | CanmetENERGY | LEEP LOCAL ENERGY EFFICIENCY PARTNERSHIP

### Material Carbon Emissions Estimator (MCE<sup>2</sup>)

Project Carbon Emissions Estimates

Save This Scenario

**PROJECT SUMMARY**



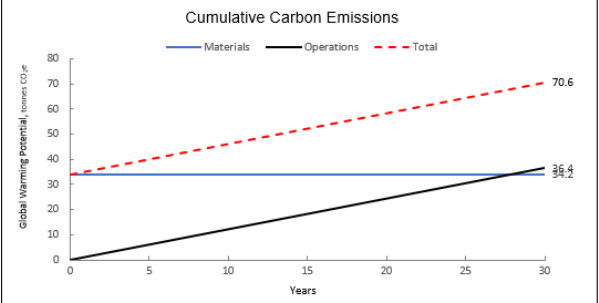
Project: Worked Example  
 Evaluator: Doug  
 Location: Ontario  
 Home description: 2-storey, single-detached, one-car, walkout  
 Building Size: 233.5 m<sup>2</sup>

Material Emissions		Operational Emissions	
tonnes CO <sub>2</sub> e	kg CO <sub>2</sub> e / m <sup>2</sup>	tonnes CO <sub>2</sub> e / yr	t CO <sub>2</sub> e / 30 yrs
34	146	1	36

Material Carbon Intensity, kg CO<sub>2</sub>e/m<sup>2</sup>

**Project Notes**  
Home is aiming to achieve XYZ level of performance...

**PROJECT EMISSIONS TIMELINE**

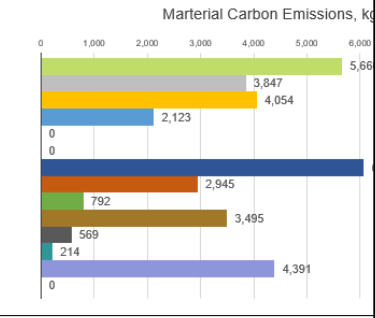


**Chart information**  
The Cumulative Carbon Emissions chart offers a simplified view of the climate impact of materials manufacturing and building operations for the initial 30 years. This chart should be used as a directional guidepost for where to focus carbon reduction efforts, rather than as a predictive model for future emissions. There are several unknowns which may cause deviations from this model, some of which are described below.

Natural Resources Canada / Ressources naturelles Canada | CanmetENERGY

### Project Carbon Emissions Results

**EMISSIONS BY ELEMENT OF THE HOME**



Element	Material Carbon Emissions (kg CO <sub>2</sub> e)
Cladding	5,660
Structural Elements	3,847
Footings & Slabs	4,054
Foundation Walls	2,123
Windows	792
Floors	2,945
Garage	569
Cladding	3,495
Garage	214
Cladding	4,391

**TOP 10 MOST IMPACTFUL MATERIALS**

Rank	kg CO <sub>2</sub> e	Section	Material
1	5,181	Cladding	Brick
2	3,949	Structural Elements	Heavy Timber
3	3,475	Footings & Slabs	Concrete - 0-25 MPa, Industry A
4	3,457	Foundation Walls	Concrete - 0-25 MPa, Industry A
5	2,945	Windows	Wood
6	2,042	Footings & Slabs	Concrete - 0-25 MPa, Industry A
7	1,809	Floors	Hardwood flooring - AVERAGE
8	1,491	Garage	Concrete - 0-25 MPa, Industry A
9	1,269	Garage	Concrete - 0-25 MPa, Industry A
10	885	Cladding	Vinyl Siding / Vinyl Siding Institute

# RESNET's New Carbon Rating Index

RESNET CARBON INDEX

The US energy system is changing

First-of-its-kind carbon rating index addresses critical issue of greenhouse gas emissions.

**The Standard:**  
Based on ANSI/RESNET/ICC 301-2019 Standard "CO<sub>2</sub>e Rating Index"

HERS RATING GUIDE | RESNET Registration No. 0000 | 5001 Main St, Cocoa, FL 32922

HERS INDEX SCORE | 50 | ANNUAL SAVINGS | \$646 | HERS CARBON INDEX SCORE | 62



HERS Index: 50 (This Home), Reference Home: 100, Zero Energy Home: 0

HERS Carbon Index: 62 (This Home), Reference Home: 100, Zero Carbon Home: 0

Annual Energy Cost: \$225 (This Home) vs \$870 (Reference Home) vs \$245 (Zero Energy Home)

Annual Savings: \$646

Annual Emissions: 1 (This Home), Reference Home: 36, Zero Carbon Home: 0

HERS Index Breakdown:

Category	This Home	Reference Home	Savings
Electricity	50	50	\$0
Natural Gas	50	50	\$0
LPG	50	50	\$0
Fuel Oil	50	50	\$0
On-Site Power	50	50	\$0
Annual Energy Use	7680	10800	\$646
Electricity (kWh)	0	0	0
Natural Gas (therms)	0	0	0
LPG (gallons)	0	0	0
Fuel Oil (gallons)	0	0	0
On-Site Power (kWh)	0	0	0

Annual Emissions Breakdown:

Category	This Home	Reference Home	Savings
CO <sub>2</sub> (tonnes)	1	36	35
SO <sub>2</sub> (lbs)	2.62	4.98	2.36
NO <sub>x</sub> (lbs)	5.74	9.95	4.21

HERS Index and Carbon Index are trademarks of RESNET. © 2019 RESNET. All rights reserved.

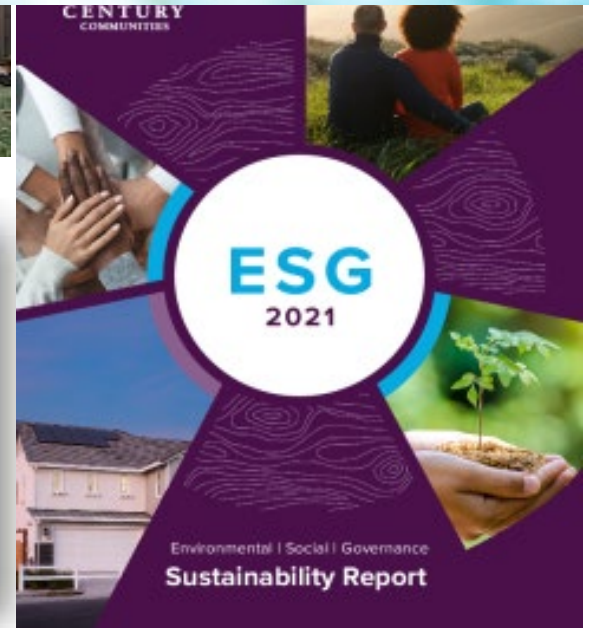
HERS Index and Carbon Index are trademarks of RESNET. © 2019 RESNET. All rights reserved.

HERS Index and Carbon Index are trademarks of RESNET. © 2019 RESNET. All rights reserved.



# Carbon Benchmarking, Reporting & Reduction

## Embodied Carbon + Operational Carbon



# CARBON EMISSIONS. THE NEW CODE TARGET

**November 2022\_CBHCC adopted the direction set by Canadian Commission on Building and Fire Codes, including:**

- developing **objective(s) to address GHG emissions for inclusion in the 2025 National Model Codes;**
- developing proposed technical requirements related to **operational GHG emissions for inclusion in the 2025 National Model Codes;**
- developing proposed technical requirements related to **embodied GHG emissions for inclusion in the 2030 National Model Codes;** and
- undertaking policy work, and objective and technical development in parallel.

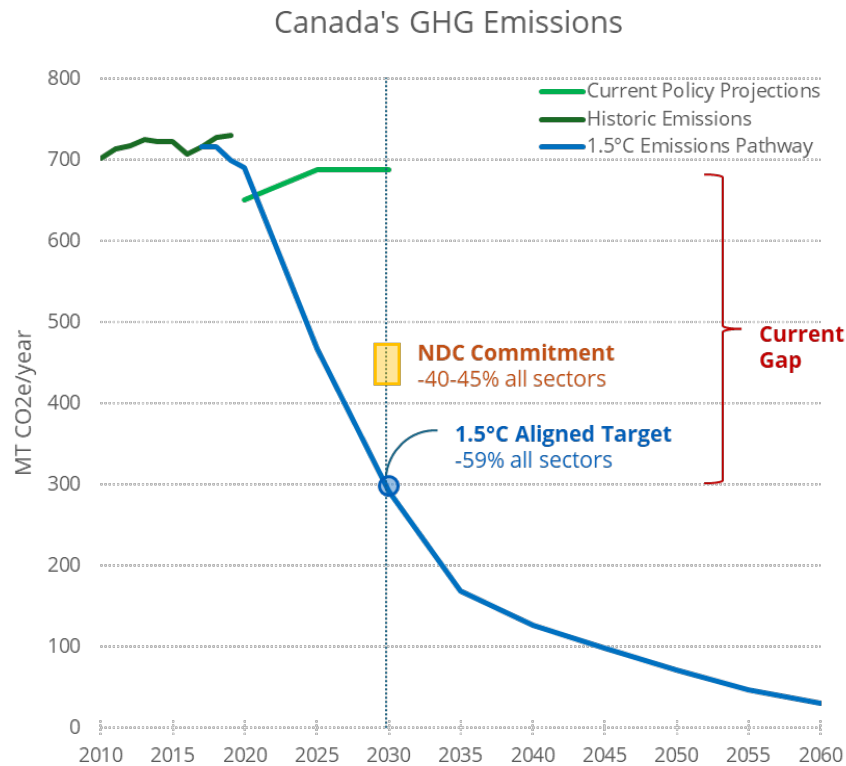


*Approximately 27% of Canada's GHG emissions are due to buildings and so addressing GHG emissions in the Codes is an important step to enable action towards climate goals.*

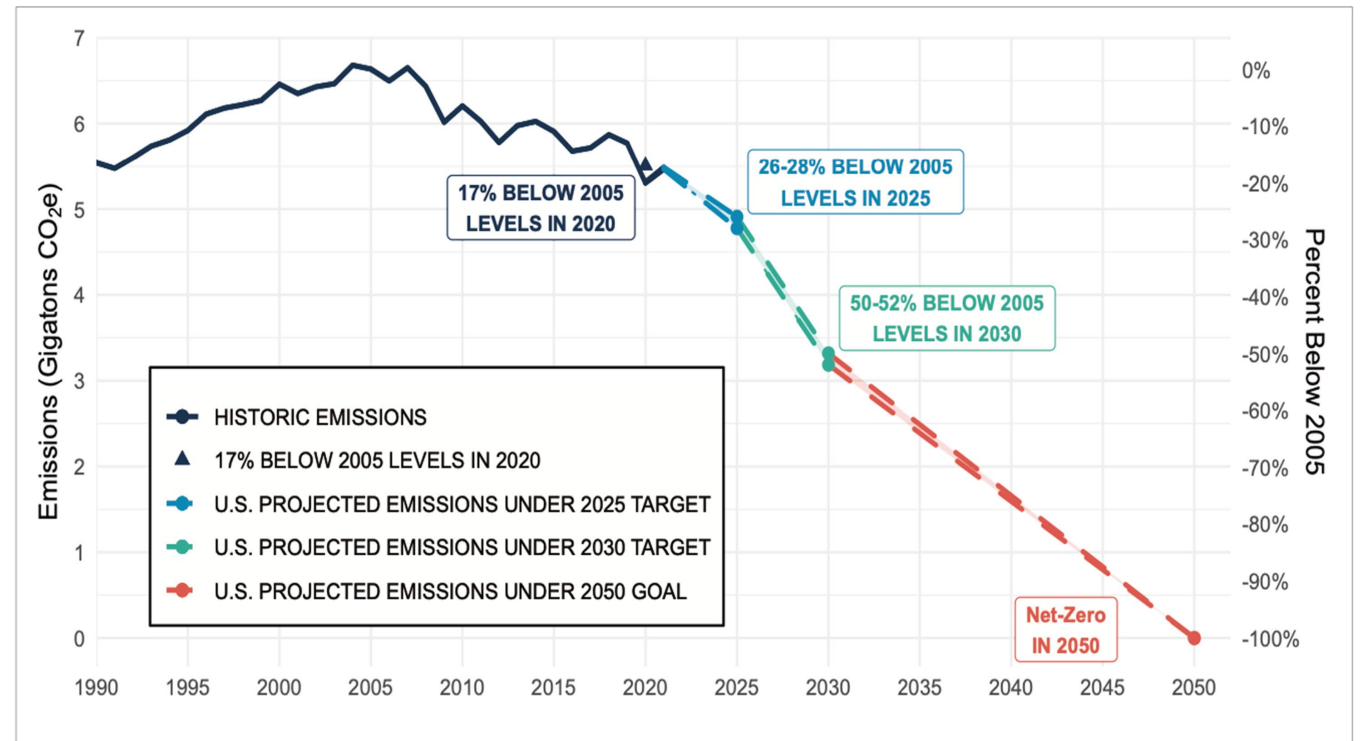
# Proposed NBC 2025 Tiered Operational Carbon Emissions Reduction

Canadian National targets:

- Emissions reduction target of 40 percent below 2005 levels by **2030**
- Zero or near zero operational GHG emissions across provinces and territories by **2050**



Climate Analytics, 2022. 1.5°C National Pathways Explorer., RWDI visualization



# Proposed NBC 2025 Tiered Operational Carbon Emissions Reduction

## Key 2025 NBC Proposed Changes

- **PCF 2004**
- **PCF 2026**
- Electric utilities are shifting away from coal power generation, while gas utilities are experimenting with new technologies to lower emissions through use of hydrogen and renewable biogas sources
- Some provincial utilities expect to reduce electric emissions by 60% or more by 2030.
- The **proposed emission requirements/targets are based on the best available future looking forecasts for utility emissions, averaged for the years 2031-2035**
- Natural gas utilities: Such projections are expected in future years, and could be incorporated into the code at a later date

*2020 GHG Emissions in the Residential and Building Sectors*

*Source: CBHCC*

# Proposed NBC 2025 Tiered Operational Carbon Emissions Reduction

## NBC 2025 **PCF 2004** Provides Operational Carbon Emission Reduction Tiers

- Canadian National targets: emissions reduction target of 40 percent below 2005 levels by **2030**
- Zero or near zero operational GHG emissions across provinces and territories by **2050**

GHG Emission Performance Level	% Building GHG Emissions Target	% Improvement
A	0%	≥ 100%
B	≤ 10%	≥ 90%
C	≤ 25%	≥ 75%
D	≤ 50%	≥ 50%
E	≤ 75%	≥ 25%
F	≤ 90%	≥ 10%
G	≤ 100%	≥ 0%

OPERATIONAL + EMBODIED EMISSIONS

BALANCING ACT  
&  
MYTH BUSTING

7 Critical Lessons Learned

# Point #1: OC + UEC – We Need To Address Both UPFRONT EMBODIED CARBON BECOMES MORE IMPORTANT WITH TIME (BUT OPERATIONAL STILL MATTERS)

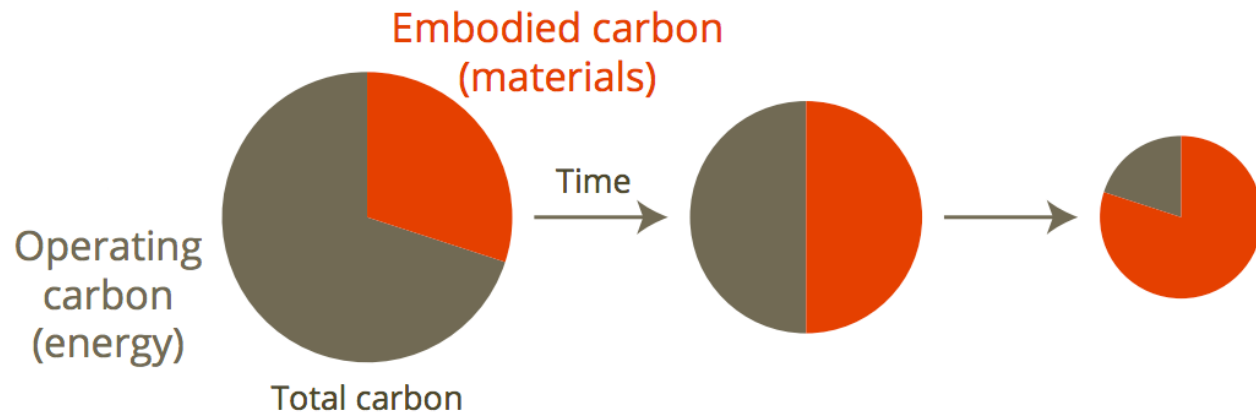
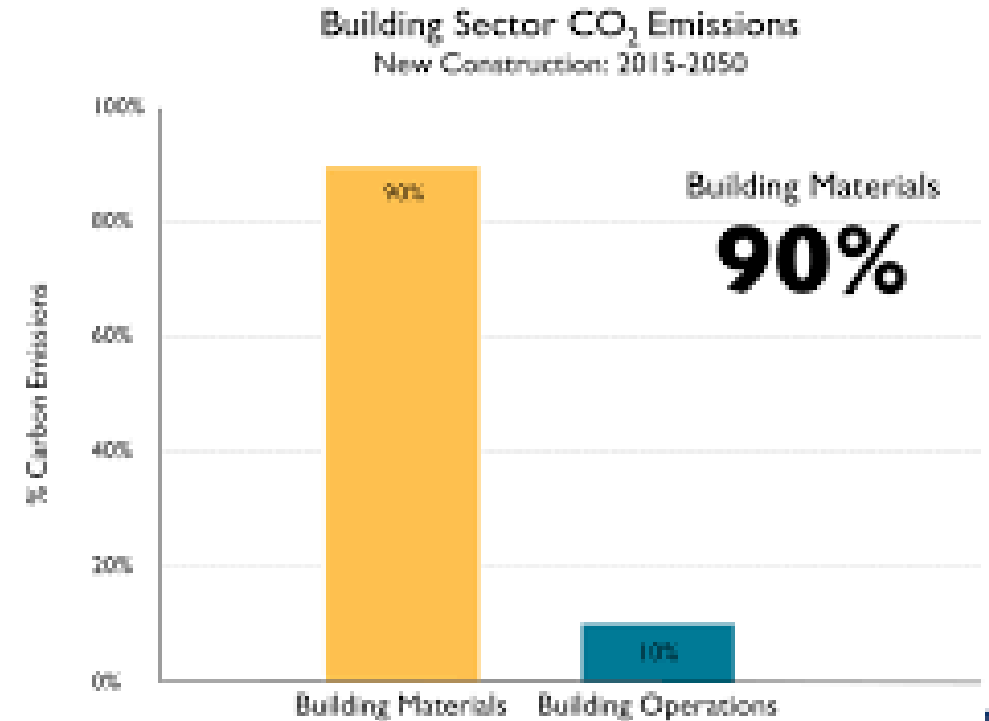


Figure 1. Growing importance of embodied carbon as building operational energy decarbonizes

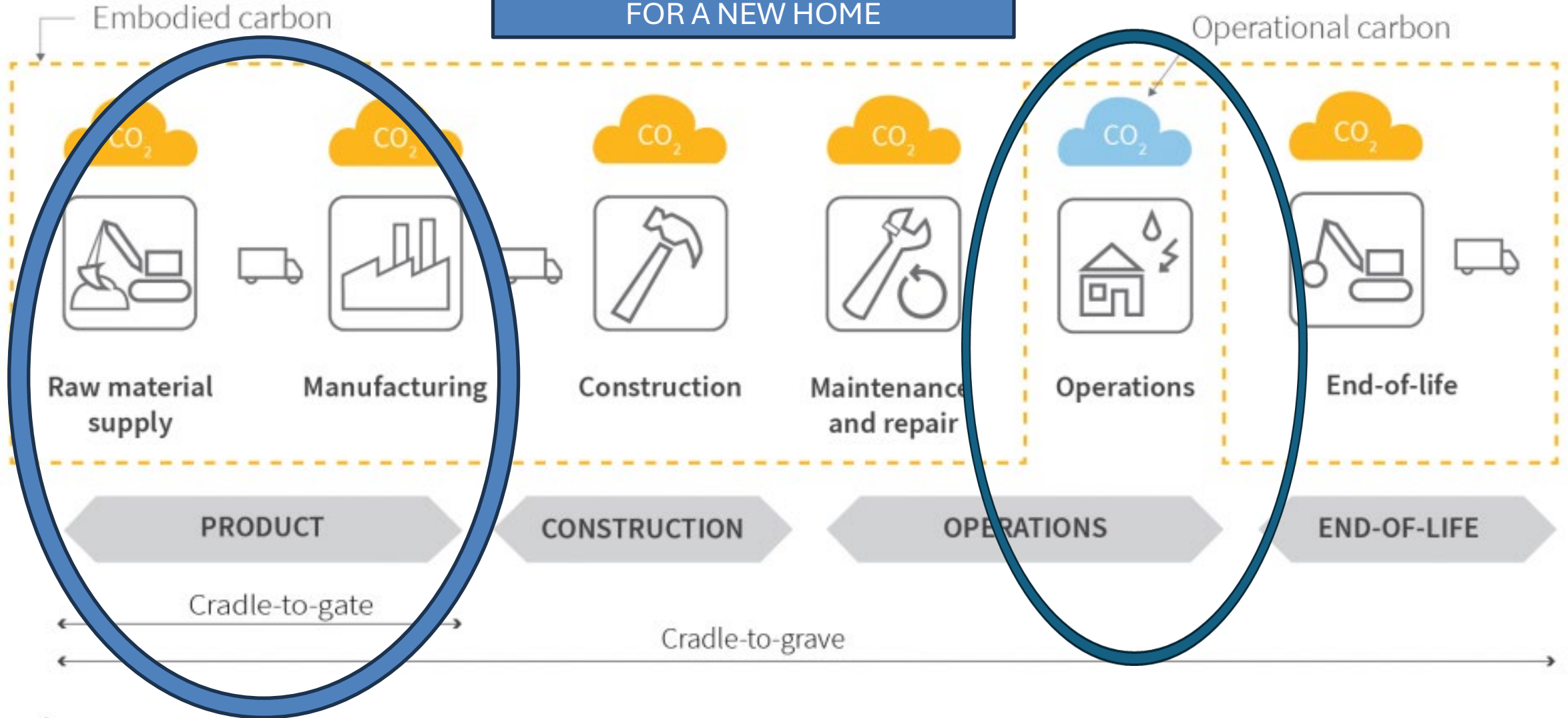


Source: ©2014 2050 Inc. / Architecture 2050. All Rights Reserved.  
Data Source: The (2014) National Grid, ENR (2014) McKinsey Global Institute



# Point #2: We Know Enough To Start Making A BIG Difference

80% < TOTAL CARBON EMISSIONS FOR A NEW HOME





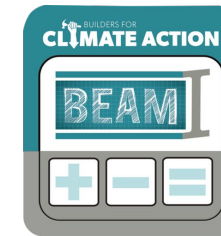
Point #2: We Know Enough To Start Making A BIG Difference

# Carbon Emission Estimate Tools: For Low Rise Residential Construction

NRCan MCE<sub>2</sub> TOOL<sup>tm</sup>

&

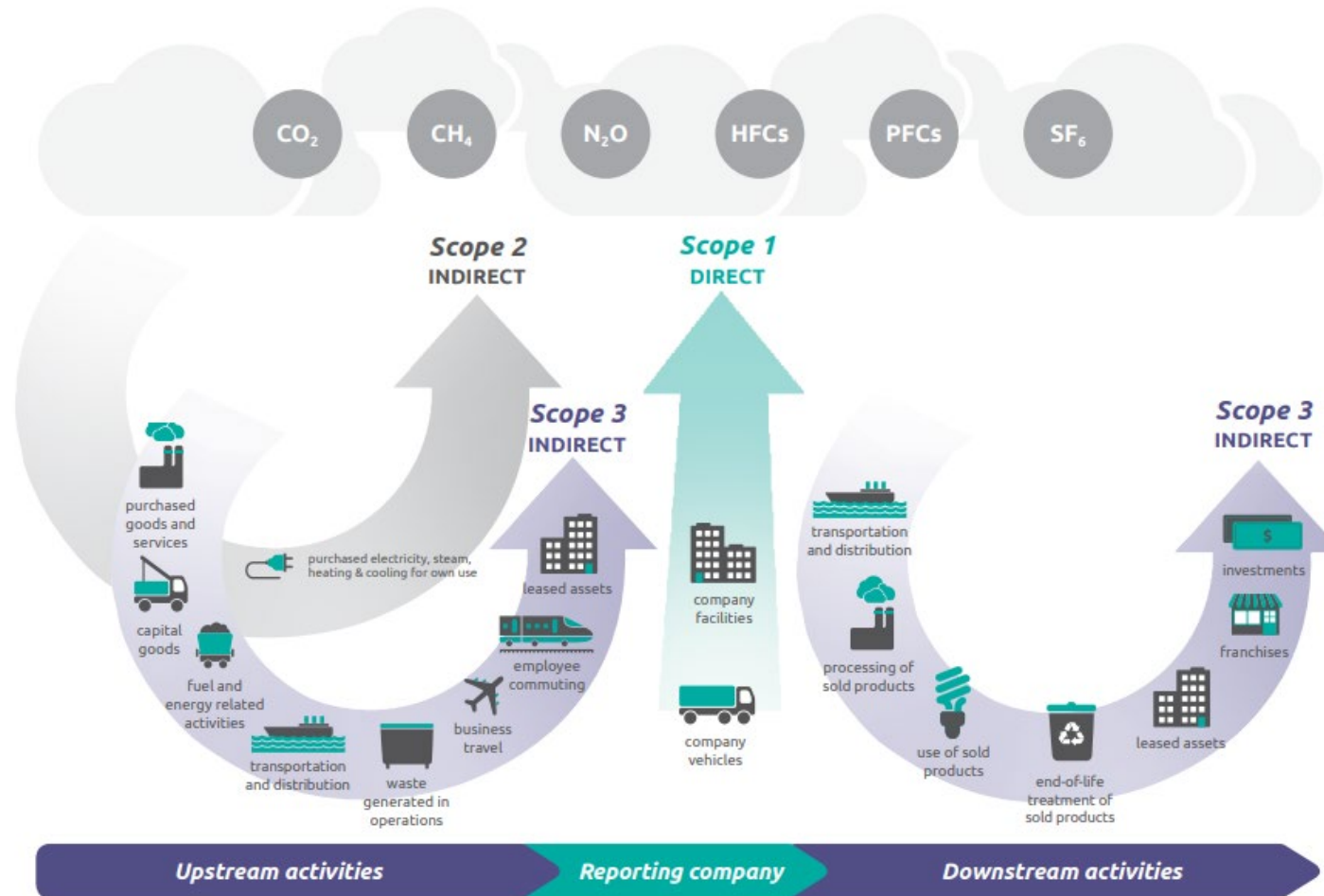
BEAM<sup>tm</sup> TOOL



# Point #3: Focus Efforts Where It Matters

## Emissions Scope 1,2,3 – Know Your Impact As a Homebuilder

Figure [5.2] Overview of GHG Protocol scopes and emissions across the value chain

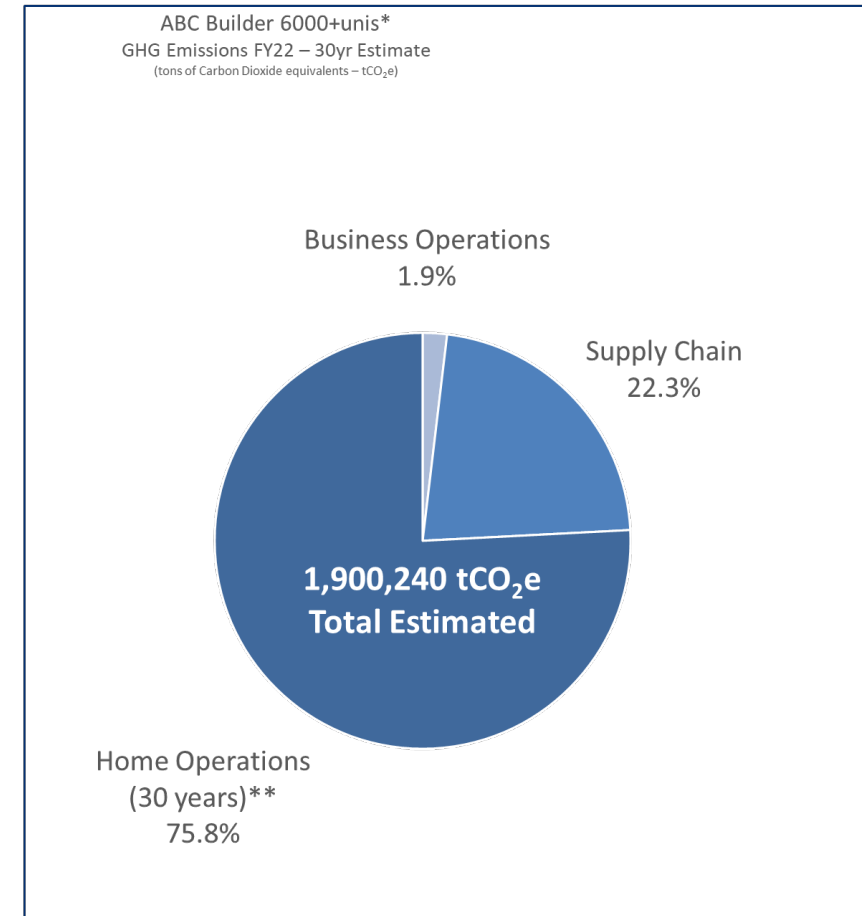


2021 World  
Economic  
Forum

# Point #3: Focus Efforts Where It Matters

Estimate for FY22 based on FY20 results and estimates for Supply Chain and Home Operations

		Business Operations	
Scope 1 - Direct Control	Scope 1	Natural Gas	
		Fleet Fuel	
Scope 2 - Indirect Control	Scope 2	Electricity	
		Steam (66 Wellington ONLY)	
Scope 3a	Scope 3a	Air Travel	
		Hotels	
		Car Rentals	
		Employee Commute	
		Supply Chain	
Scope 3 - All Other Emissions	Scope 3b	Purchased Goods & Services	
		Energy Related Activities	
		Transportation & Distribution	
		Waste & Recycling	
		Home Operations	
Scope 3c	Scope 3c	Natural Gas - Heating	
		Electricity - Heating/ Cooling/ Plug Loads	



Information provided courtesy of Mattamy Asset Management

# Archetype 1:

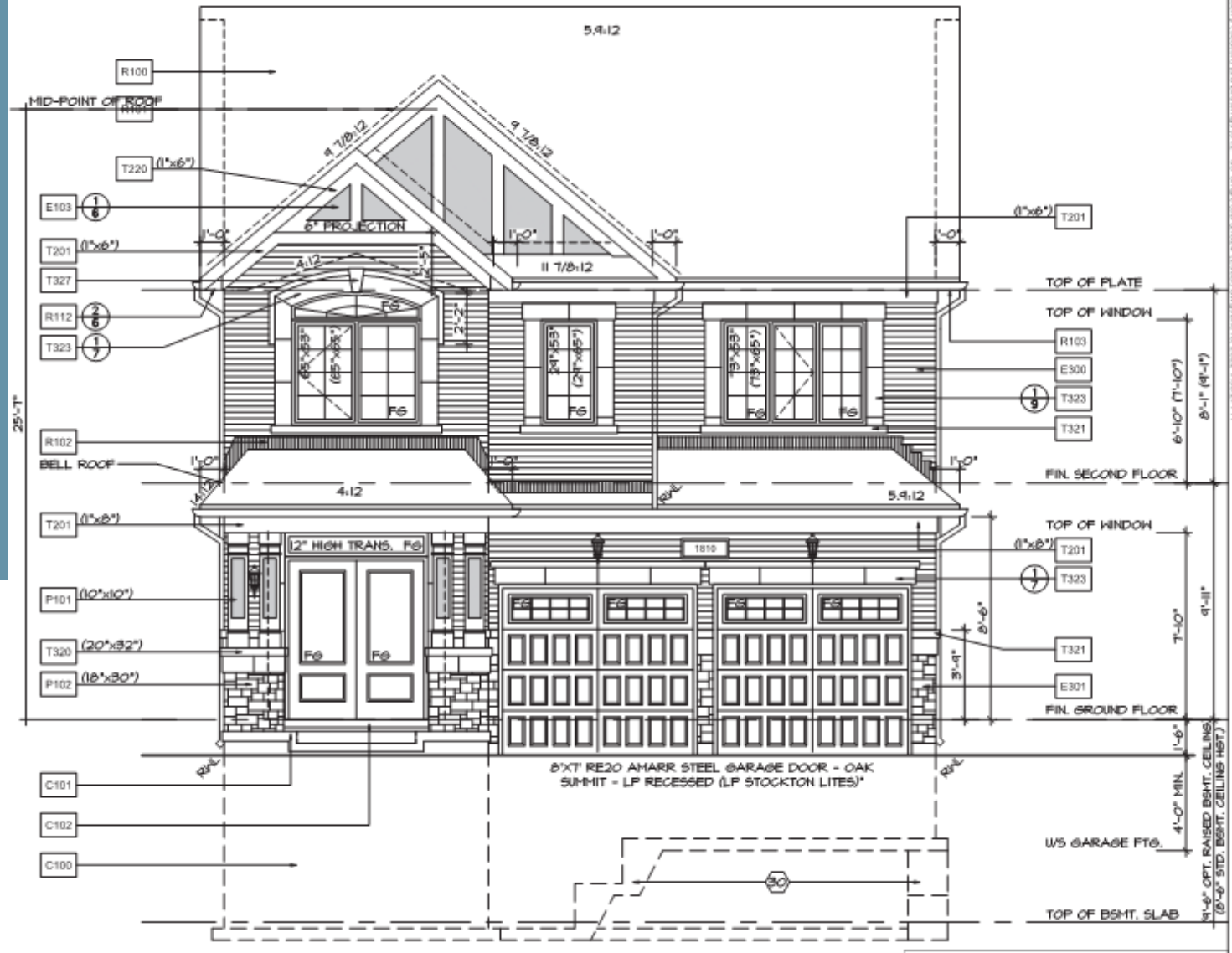
## 36' Single Detached

### Cladding

GTA: 95% Brick, 2% Fiber Cement, 2% Aluminum Panel

OTT: 84% Vinyl, 8% Fiber Cement, 8% Brick

ALB: 60% Vinyl, 20% Fiber Cement, 20% Brick



Information provided courtesy of Mattamy Asset Management

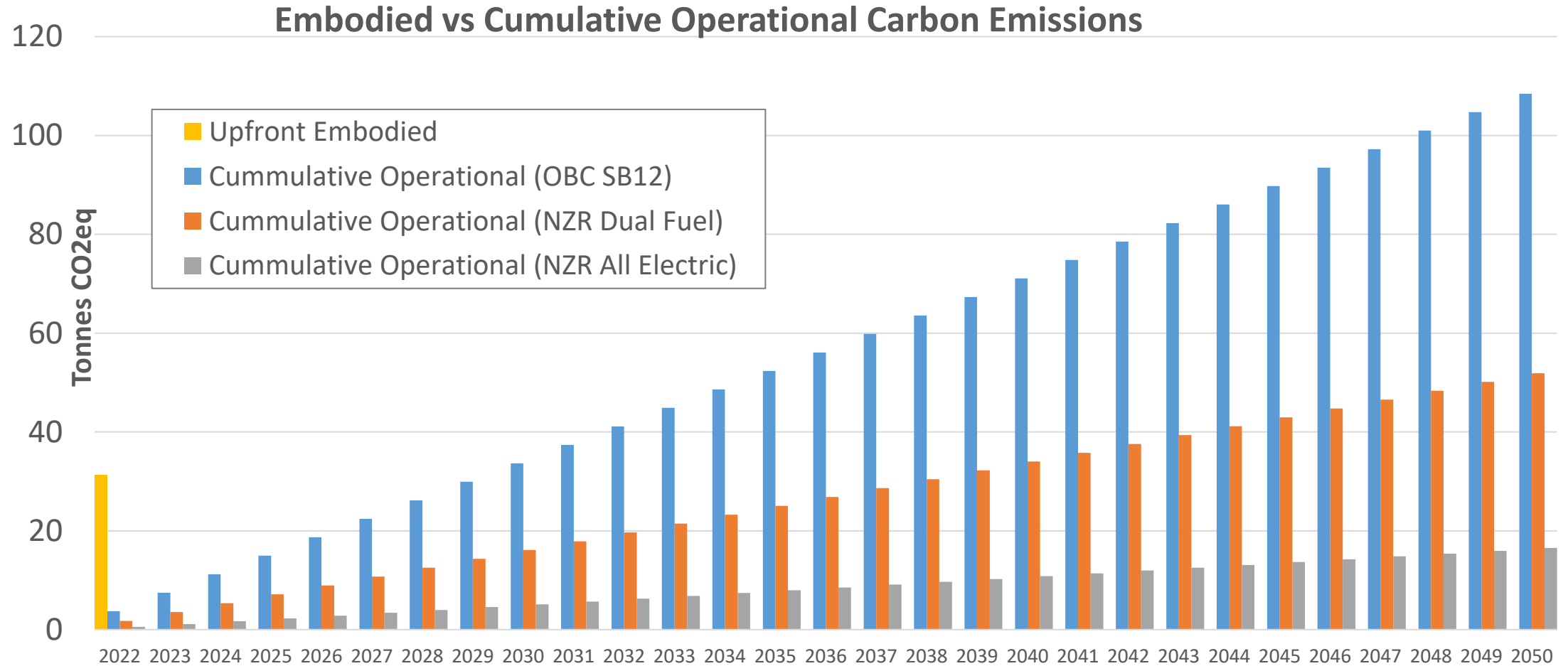
When it comes to Operational Grid Emissions...

Point #4: The Emissions (and peaks) of Tomorrows Grid Matters **Today**.

**...Can't stop thinking about tomorrow !**

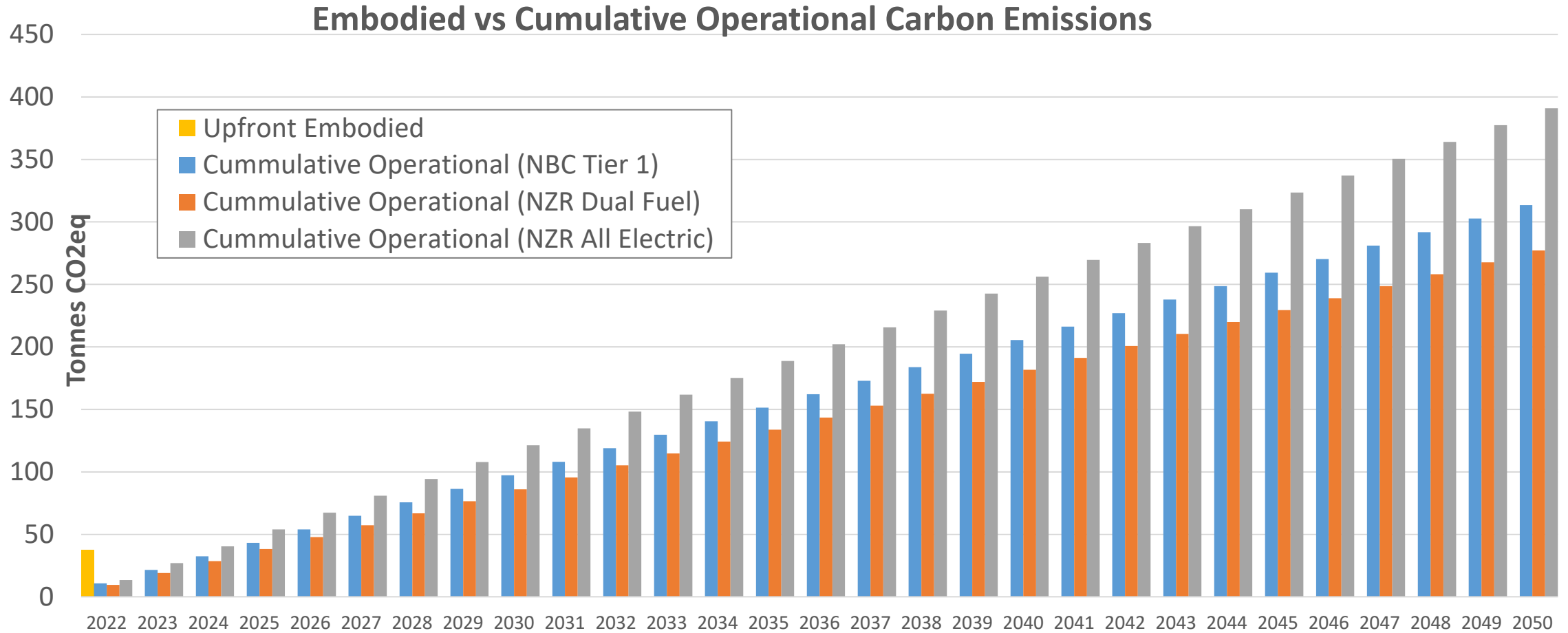
# Point #4: The Emissions (and peaks) of **Tomorrows** Grid Matters **Today**

## Ottawa – 36' Single Detached – **Today's** Grid Emissions...

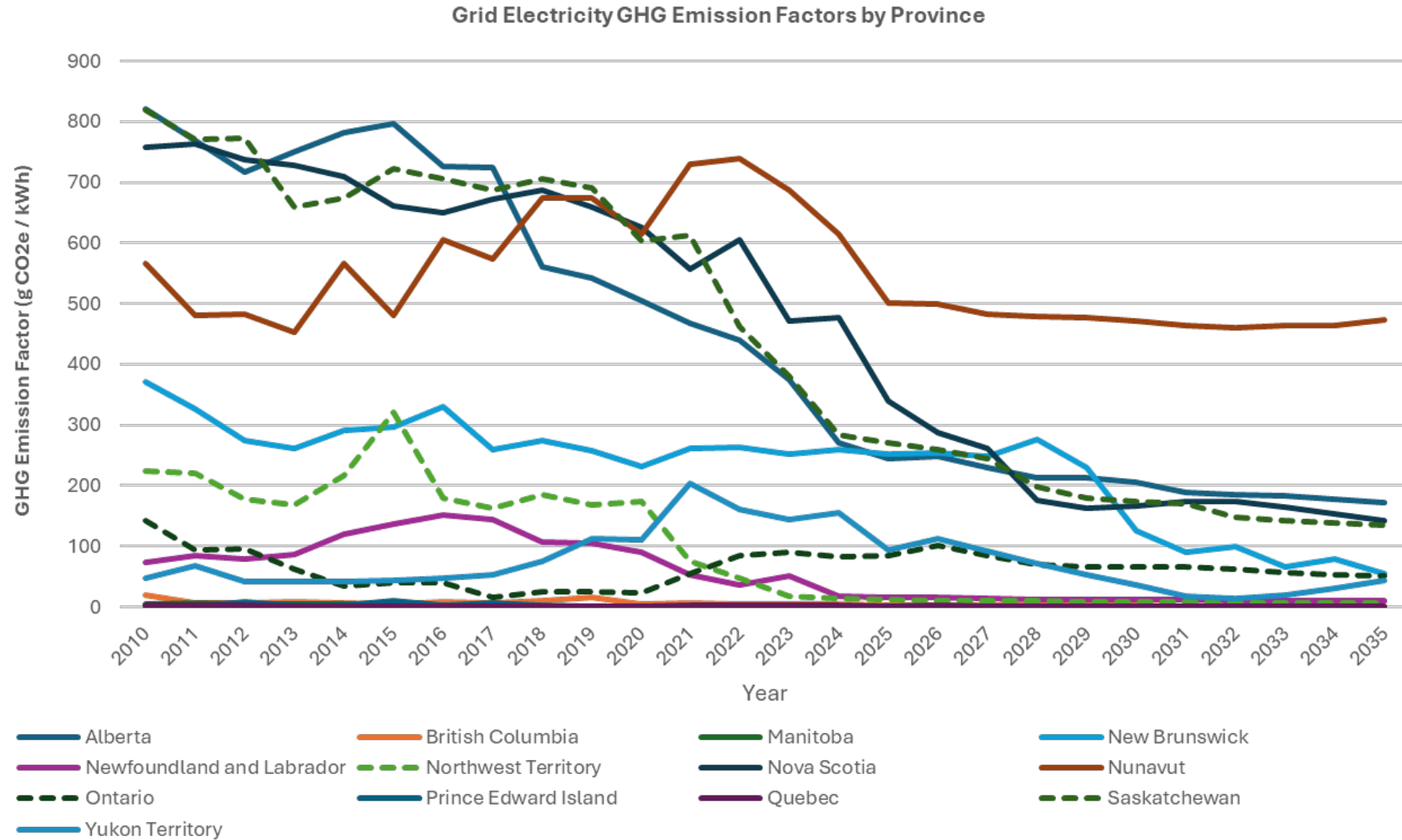


# Point #4: The Emissions (and peaks) of **Tomorrows** Grid Matters Today

Calgary – 36' Single Detached **Today's** Grid Emissions.....



# Point #4: The Emissions (and peaks) of **Tomorrows** Grid Matters Today



Data Natural Resources Canada, visualization by RWDI



# Point #4: The Emissions (and peaks) of **Tomorrows** Grid Matters Today

NBC 2025 **PCF 2026** GHG Emissions in the Residential and Building Sectors

- Provides projected electrical grid emission rates for Prov/Terri 2030-35

## Classification of provincial/territorial electric grids

- **High:** Emission factor more than or equal to 100 g CO<sub>2</sub>e/kWh
- **Moderate:** Emission factor more than 25 g CO<sub>2</sub>e/kWh and less than 100 g CO<sub>2</sub>e/kWh
- **Low:** Emission factor less than or equal to 25 g CO<sub>2</sub>e/kWh



Province/Territory	Grid GHG Emissions	2030<Grid GHG Emissions Factor (g CO <sub>2</sub> e/kWh)	Current Grid GHG Emissions Factor (gCO <sub>2</sub> e/kWh)
Alberta	High	181.86	800<
British Columbia	Low	1.32	10<
Manitoba	Low	0.00	3<
New Brunswick	Moderate	77.88	250<
Newfoundland and Labrador	Low	11.08	
Nova Scotia	High	161.64	700<
Northwestern Territory	Low	6.82	
Nunavut	High	465.16	
Ontario	Moderate	57.90	30>
Prince Edward Island	Moderate	80.42	
Quebec	Low	0.38	2>
Saskatchewan	High	146.60	700<
Yukon Territory	Low	25.00	

Source: CBHCC \_PCF 2026

# Point #5: Embodied Carbon; It's all about the BIG HITTERS

## Ottawa – 36' Single Detached

### TOP 10 MOST IMPACTFUL MATERIALS

Rank	tonnes CO2e	Section	Material
1	7.568	Foundation Walls	Concrete / 0-25 MPa
2	2.349	Windows	Window / Double Pane / Vinyl Frame
3	2.246	Footings & Slabs	Concrete / 0-25 MPa
4	1.882	Floors	Carpet / Average
5	1.730	Footings & Slabs	Concrete / 0-25 MPa
6	1.681	Garage	Concrete / 0-25 MPa
7	1.291	Cladding	Vinyl Siding / Vinyl Siding Institute
8	1.248	Garage	Concrete / 26-30 MPa
9	1.202	Cladding	Brick / US - Canada Industry Average
10	0.983	Structural Elements	Steel Post / Generic

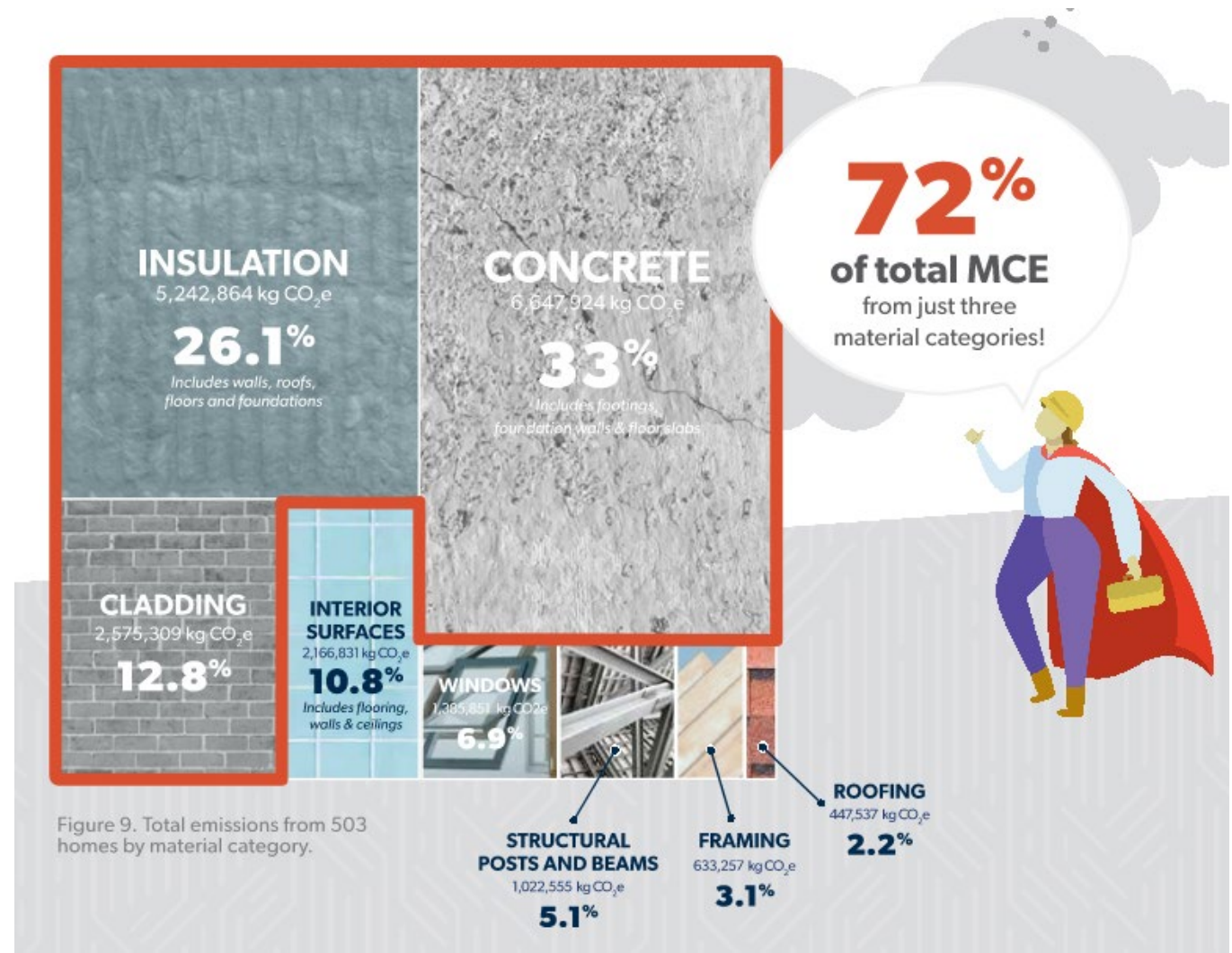
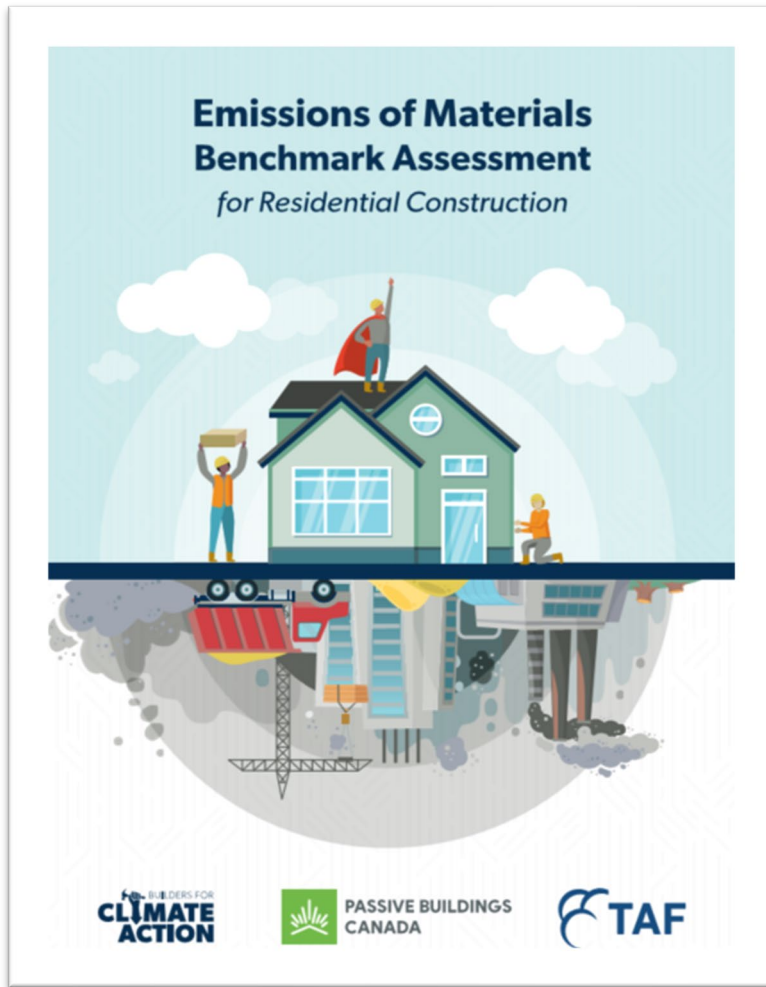
# Point #5: Embodied Carbon; It's all about the BIG HITTERS

## Calgary – 36' Single Detached

### TOP 10 MOST IMPACTFUL MATERIALS

Rank	tonnes CO2e	Section	Material
1	8.199	Foundation Walls	Concrete / 31-35 Mpa / 30-40% Fly Ash
2	3.007	Cladding	Brick / US - Canada Industry Average
3	2.349	Windows	Window / Double Pane / Vinyl Frame
4	2.133	Footings & Slabs	Concrete / 0-25 Mpa / 15-29% Fly Ash
5	1.874	Footings & Slabs	Concrete / 31-35 Mpa / 30-40% Fly Ash
6	1.578	Garage	Concrete / 26-30 Mpa / 30-40% Fly Ash
7	1.568	Floors	Carpet / Average
8	1.226	Ext. Walls	OSB Sheathing / Canadian Wood Council
9	1.211	Floors	Spray Polyurethane Foam / Closed Cell (HFC)
10	1.158	Garage	Concrete / 26-30 Mpa / 15-29% Fly Ash

# Point #5: Embodied Carbon; It's all about the BIG HITTERS



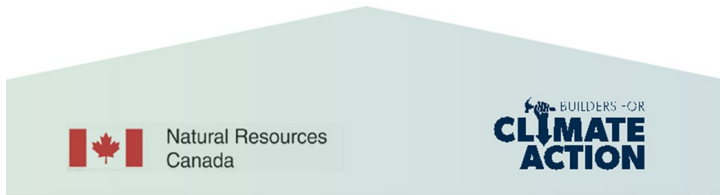
<https://www.buildersforclimateaction.org/report---embarc-report.html>

# Point #6: Know The Optimal Solution On Your Horizon: **Draw-Down Homes**



## Achieving Real Net-Zero Emission Homes:

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



## Canada-wide NRCAN Study

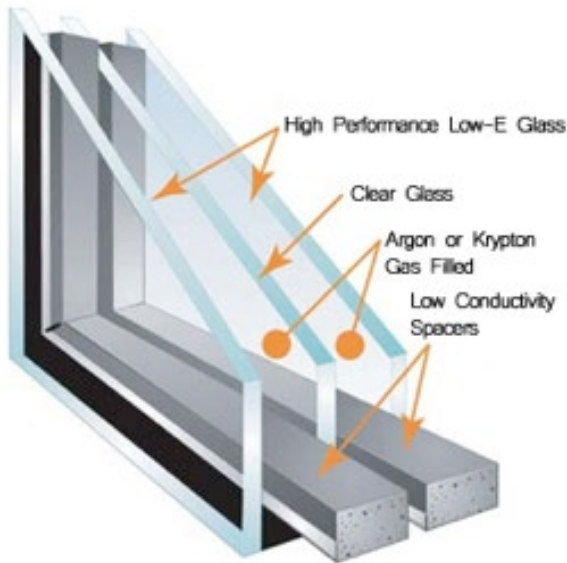
Canadian average of three archetypes and 190 models

- BUILDINGS CAN BE PART OF THE ANSWER
- “DRAW-DOWN” HOMES AND BUILDINGS
- NEW BIO-BASED PRODUCTS ARE BEING DEVELOPED



# Point #6: Know Myth From Science. Do The Math

## SAMPLE HOUSE + WINDOW UPGRADE w/ TRIPANE



- Moderate Emission Grid factor more than 25 g CO<sub>2</sub>e/kWh and less than 100 g CO<sub>2</sub>e/kWh
- Climate Zone 5

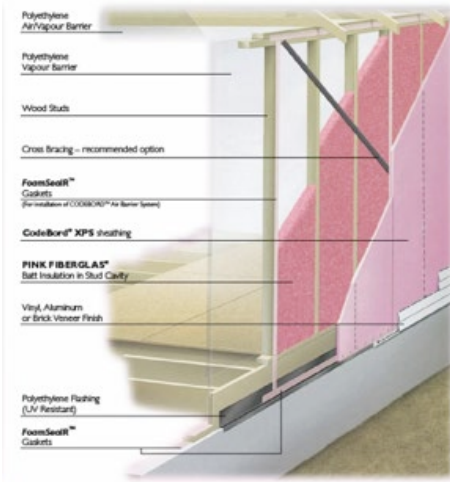
*A 2 year “return” on carbon investment*

Glazing	MMBTUs/yr	Operational CO <sub>2</sub> e Tonnes/yr	Embodied CO <sub>2</sub> e Tonnes
Double, Low E, Argon	108.1	7.82	71.2
Triple, 2 Coats Low E, Argon	103.9	7.55	71.7
Change		- 0.27 Tonnes/yr	+0.5 Tonnes

**30 year carbon reduction potential:**  
**8.1 Tonnes CO<sub>2</sub>E**

# Point #6: Know Myth From Science. Do The Math

## SAMPLE HOUSE + EXTERIOR INSULATION/LOW GWP XPS



Insulated Sheathing	MMBTUs/yr	Operational CO <sub>2</sub> e Tonnes/yr	Embodied CO <sub>2</sub> e Tonnes
None	108.1	7.82	71.2
R5	103.5	7.57	72.4
R10	100.5	7.41	73.6
Change		-0.41 Tonnes /yr	+2.4 Tonnes

- Moderate Emission Grid factor more than 25 g CO<sub>2</sub>e/kWh and less than 100 g CO<sub>2</sub>e/kWh
- Climate Zone 5

*A 6 year “return” on carbon investment*

**30+ year carbon reduction potential:**  
**-12.3 Tonnes CO<sub>2</sub>E**

# Point #6: Know Myth From Science. Do The Math

## AIR TIGHTNESS / AIR TIGHTNESS IMPROVEMENT



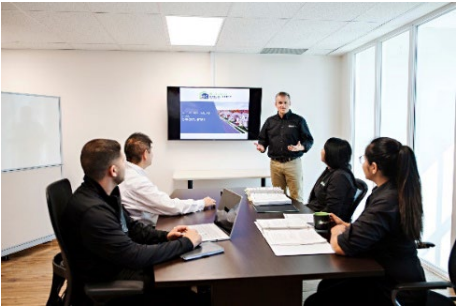
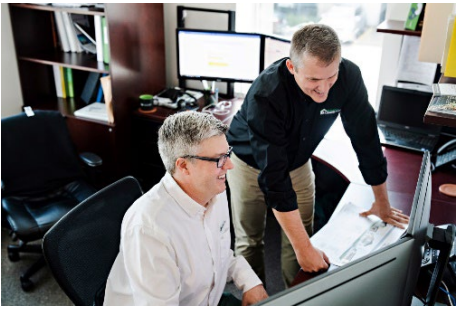
- Moderate Emission Grid factor more than 25 g CO<sub>2</sub>e/kWh and less than 100 g CO<sub>2</sub>e/kWh
- Climate Zone 5

*Less than 1 year “return” on carbon investment*

Tightness ACH50	MMBTUs/yr	Operational CO <sub>2</sub> e Tonnes/yr	Embodied CO <sub>2</sub> e Tonnes
3.0	108.1	7.82	71.2
2.0	103.2	7.56	Negligible
1.5	100.9	7.44	Negligible
Change		-0.38 Tonnes/yr	Negligible

**30 year carbon reduction potential:**  
**-11.4 Tonnes CO<sub>2</sub>E**

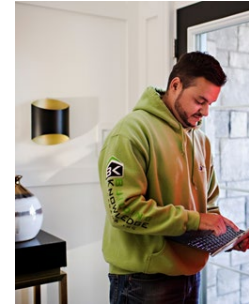
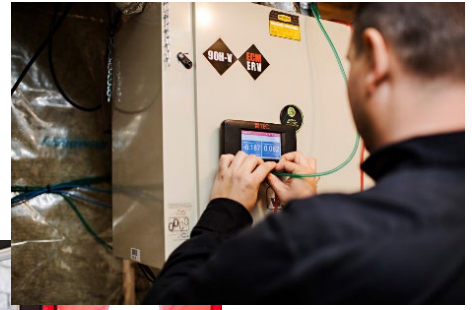




THANK YOU



THE HOME THAT SCIENCE BUILT





**Leigh St. Hilaire,  
Executive Director,  
Volta Research**



# Operational Emissions: Current and Future

**volta**  
RESEARCH



# Volta Research

## *A Brief History*

### OUR TEAM

- Founded as a not-for-profit in 2018 with a mission to reduce energy use and emissions in Canada
- Small team that supports and utilizes recent graduates and new entrepreneurs
- Stakeholder-driven with aim of building capacity to talk about and reduce energy use and emissions

### OUR IMPACT

- Research, development, analysis, and technical consulting on energy and emissions reduction processes, practices, and tools
- Focus on demographic, economic, and wider societal relationships with energy usage and emissions in Canada

# Operational Emissions

## *An Introduction*

### What are Operational Emissions?

- Emissions that result from the operation of the building (HVAC, DHW, lighting, loads, etc.)
- Now in the 2025 NBC & NEBC
- The emissions values per energy unit that we use for each energy type (electricity, gaseous fuel, liquid fuel, etc.) are standardized



# Operational Emissions

## *An Introduction*

### **Current Provincial Values:**

- [National Inventory Report: Greenhouse Gas Sources and Sinks in Canada](#)

### **Future Provincial Values:**

- [Proposed Change 2004 - Operational GHG Emissions: Tiered Performance Requirements in the NBC](#) and [Tiered Prescriptive Requirements in the NBC](#)

# Operational Emissions

## *Current and Future Values*

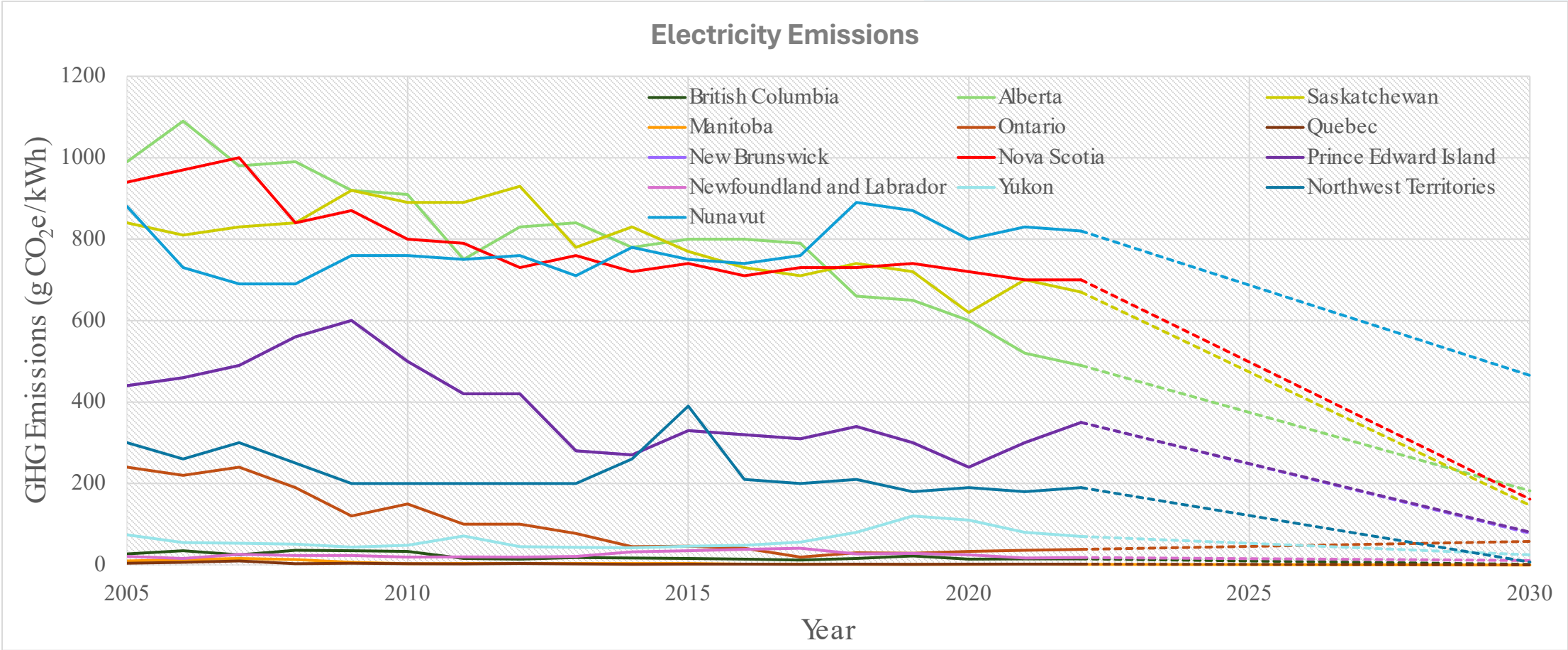
GHG Emissions Factor by Energy Source, g CO <sub>2</sub> e/kWh				
Province or Territory	Electricity		Utility Gas	
	2022	2030 (PCF)	2022	2030 (PCF)
British Columbia	15	1.32	190	190
Alberta	490	181.86	190	189
Saskatchewan	670	146.6	185	185
Manitoba	1.4	0	185	185
Ontario	38	57.9	186	185
Quebec	1.7	0.38	186	186
New Brunswick	350	77.88	185	185
Nova Scotia	700	161.64	185	190
Prince Edward Island	350	80.42	185	185
Newfoundland and Labrador	18	11.08	185	185
Northwest Territories	70	25	190	190
Yukon	190	6.82	190	185
Nunavut	820	465.16	190	190

### Classification of provincial/territorial electric grids:

- **High**: Emission factor more than or equal to 100 g CO<sub>2</sub>e/kWh
- **Moderate**: Emission factor more than 25 g CO<sub>2</sub>e /kWh and less than 100 g CO<sub>2</sub>e /kWh
- **Low**: Emission factor less than or equal to 25 g CO<sub>2</sub>e /kWh

# Operational Emissions

## *The Grid Getting Clean*

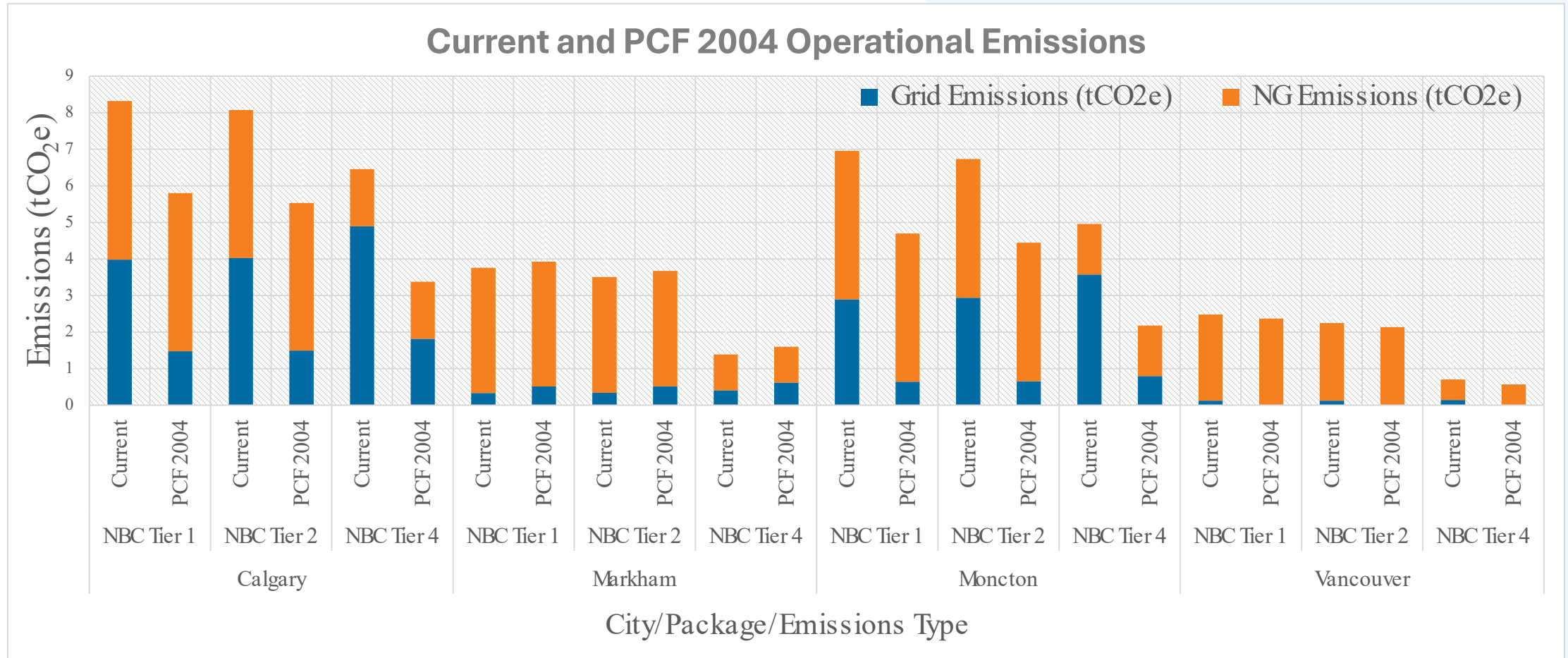






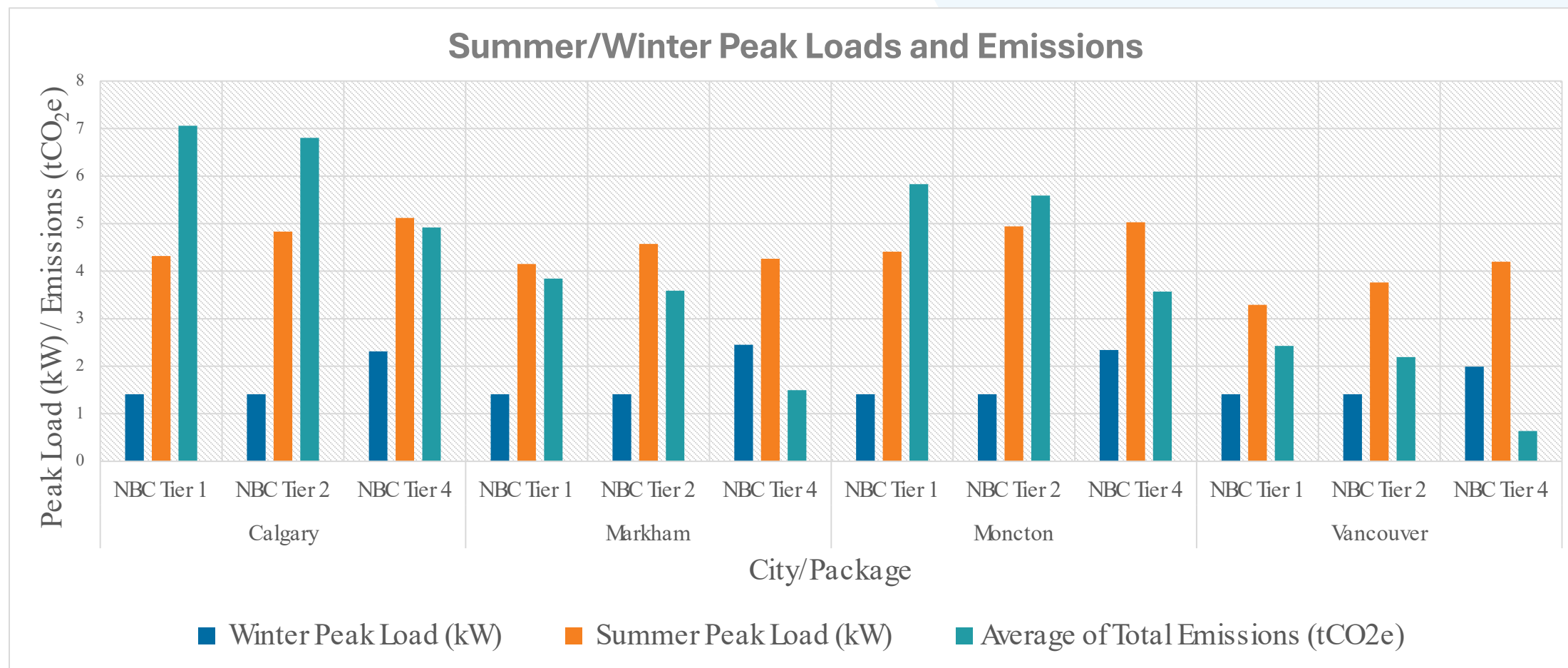
# Operational Emissions

## A Case Study



# Operational Emissions

## A Case Study



# Operational Emissions

## *A Case Study*

### PCF 2004 - Operational Emissions Performance Level

City	NBC Tier 1	NBC Tier 2	NBC Tier 4
Calgary	<b>F (4.0%)</b>	F (8.7%)	D (46.2%)
Markham	E (19.4%)	E (24.7%)	C (68.3%)
Moncton	E (16.2%)	E (20.9%)	C (62.5%)
Vancouver	D (32.3%)	D (39.2%)	<b>B (84.5%)</b>

# Operational Emissions

## *What's Next*

- Start to work with your consulting energy advisor on **operational emissions optimization** alongside compliance work
  - Tools coming (**Volta SNAP**) to help consultants more easily provide this to builders
- Providing **energy diversity** now (e.g. fuel switching) will help within the lifetime of current equipment



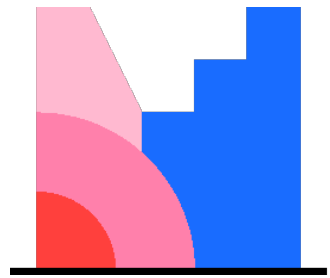
# Operational Emissions

## *What's Next*

There is more to emissions than just those from building operations:

- Addressing the emissions that come from the materials and equipment in the building, **embodied emissions**, can be much more impactful
- Important to reach a **“sweet spot”** that balances embodied and operational emissions to make the largest impact for dollars invested





# Mentimeter



[www.menti.com](https://www.menti.com)

Poll # 23 21 62 5



**Laureen Chung, Senior Manager,  
Low Carbon Homes Task Force,  
NRCan**





# THE VALUE PROPOSITION OF ELECTRIC HEAT PUMPS IN CANADIAN HOMES

**Presentation to CHBA Net Zero Home Leadership Summit  
June 11, 2024**






**Homes and Communities Division  
Office of Energy Efficiency, Natural Resources Canada**



# CONTEXT - SPACE HEATING IN CANADA'S HOMES

## KEY STATISTICS: EXISTING HOMES (CEUD, 2021)

### Current space heating stock in Canada's homes

				
Electric resistance	Heat pumps	Natural gas & propane	Heating oil	Wood
5.7 M	0.9M	7.7 M	1.1 M	0.9 M
		<b>23Mt</b>	<b>3Mt</b>	<b>2Mt</b>

~16M dwellings\*

37Mt from space (28Mt) and water heating (9Mt) annually

99% of homes' emissions are from space and water heating

~5% of Canada's total GHGs

\*includes single detached, semi-detached, row, low-rise and high-rise.



## WHAT ABOUT NEW HOMES?

**5.8 million:** new homes needed between now and 2030 to alleviate housing crisis.

**Potential for significant additional emissions** if those new homes are built following current trends, where ~50% use natural gas.

### KEY TAKE AWAY:

Decarbonization of home heating is **ESSENTIAL** to achieve net zero in the buildings sector, and to meet Canada's emission reductions targets

# A FEW NOTES ON OUR METHODOLOGY

**Capital cost** assumptions, includes: retail, materials, labour, electric upgrade for all-electric HP systems (\$500 in new homes / \$3,000 in existing), AC for non-HP systems:

**Natural gas furnace w/ AC:** ~\$10,000

**Hybrid, ASHP / Gas:** ~\$14,500

**Hybrid, ASHP / Electric:** ~\$8,500 / ~\$11,000

**ccASHP / Electric:** ~\$17,500 / ~\$20,000

**GSHP / Electric:** ~\$35,500 / ~\$38,000

**Electric resistance w/ AC:** ~\$5,500

## Energy use

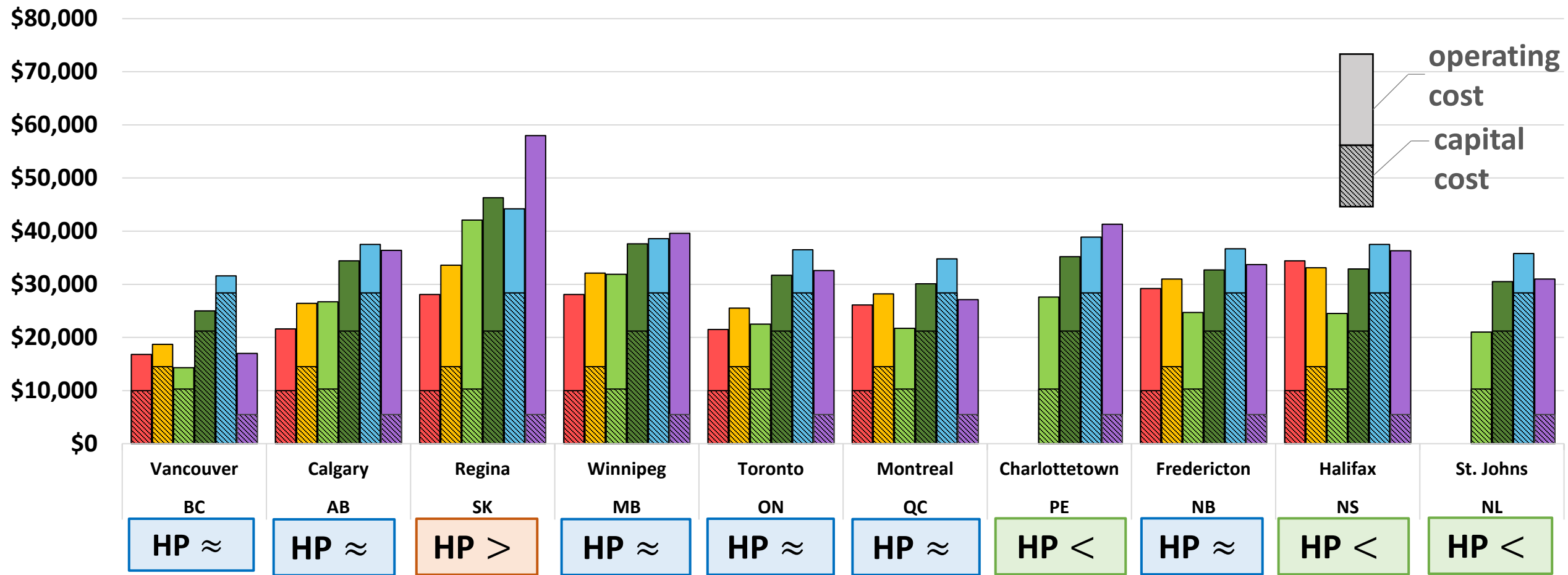
- HOT2000 software
- single-detached 2,200 ft<sup>2</sup> archetype
- by selected vintage
- across 10 Canadian cities

## Total ownership cost analysis:

- 20-year outlook includes capital and operating costs
- Net Present Value (NPV), using 3% discount rate.
- ASHPs and ccASHPs assumed to have 15-year working life (re-capitalize after 15 years.)
- GSHPs assumed to have a 25-year working life (capital cost discounted)
- Energy price projections:
  - Natural gas from Canada Energy Regulator's (CER) *Energy Futures Outlook 2023 Report*
  - Electricity from Canadian Climate Institute, factors in CER, StatsCan and other models
- 2023 base year (\$2023), rounded to nearest \$100
- **Does not** include grants/incentives for heat pumps
- **Does not** discount gas connection cost for all-electric systems

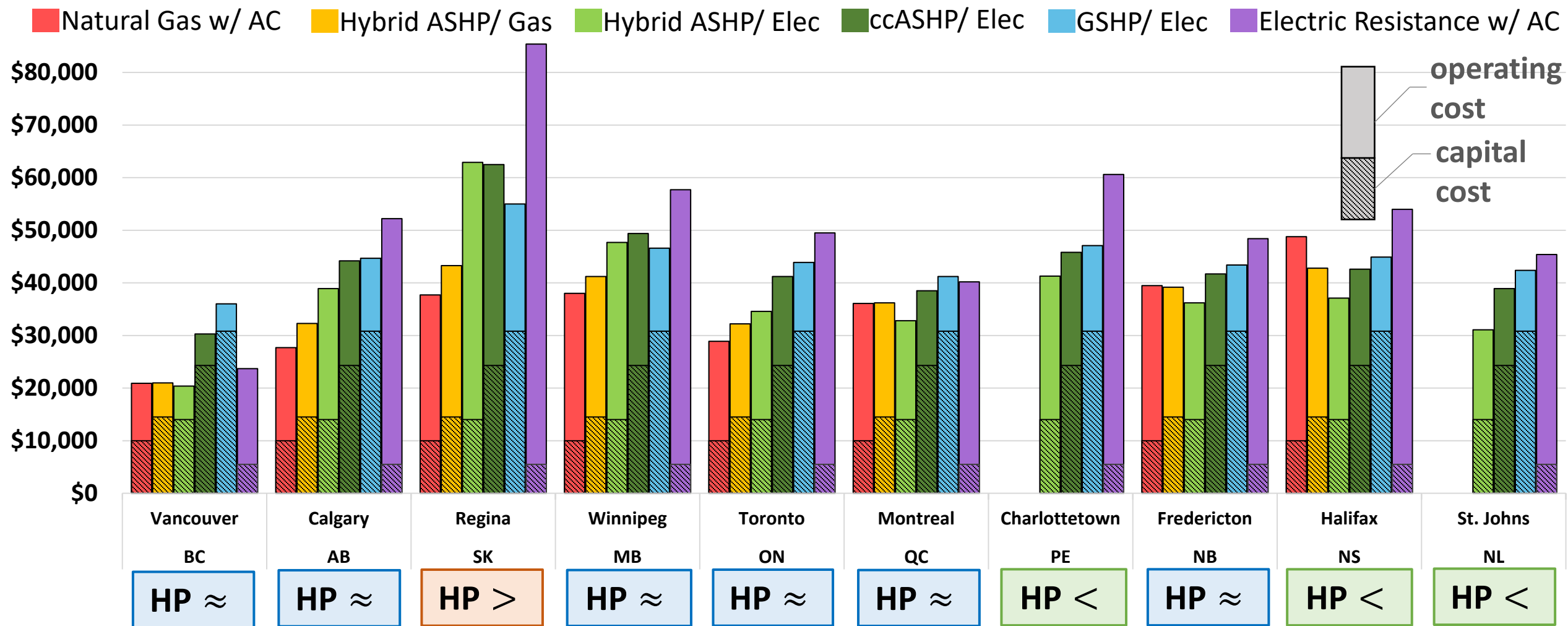
# FINDINGS: TOTAL 20 YEAR OWNERSHIP COST, NEW HOMES, STARTING IN 2024

■ Natural Gas w/ AC  
 ■ Hybrid ASHP/ Gas  
 ■ Hybrid ASHP/ Elec  
 ■ ccASHP/ Elec  
 ■ GSHP/ Elec  
 ■ Electric Resistance w/ AC



**KEY TAKE AWAY →** In 2024, over equipment life, HPs cost the **same** (within \$250/year) or **less** than natural gas in every province except **SK**

# FINDINGS: TOTAL 20 YEAR OWNERSHIP COST, EXISTING HOMES, STARTING IN 2024



**KEY TAKE AWAY →** Bigger heating loads in older homes mean higher costs for all system types. Comparative **HP business case is the same** as for new build homes across all cities.

# WHAT ABOUT HYBRIDS?

## REASONS WHY A HEAT PUMP – NATURAL GAS FURNACE HYBRID MAY BE A GOOD CHOICE



### Affordability

Cost-resilience in the face of unpredictable gas and electricity cost fluctuations



### Grid readiness

Help mitigate peak demand on the electricity grid before it builds out capacity



### Stepping stone

Existing homes may have ducting size constraints for full heat pump conversion



### Emissions impact

Offset emissions before furnaces come to end of life



### Access to cooling

Access to cooling while also offsetting some natural gas use for heating

# KEY MESSAGES FOR BUILDERS AND THEIR CLIENTS

## A WIN-WIN-WIN FOR THE HOMEOWNER

### Affordability



In most places in Canada, some form of heat pump system is at least on par with the cost of a natural gas furnace with AC system, over the 20-year equipment life.

### Decarbonisation



Deployment of heat pumps is our best pathway to decarbonise the biggest source of emissions in homes.

### Climate resilience

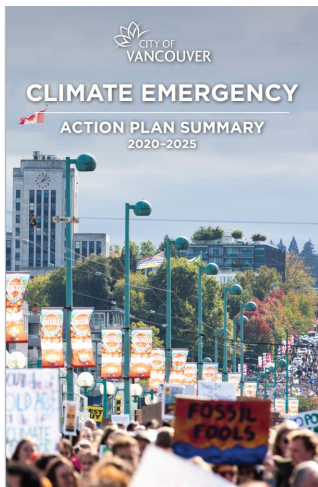
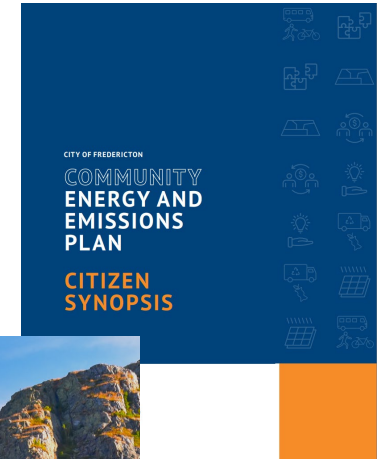
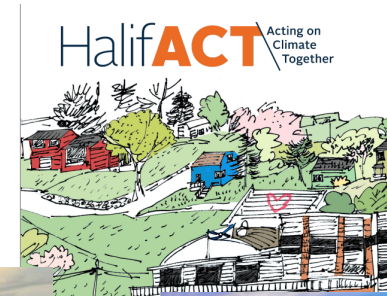
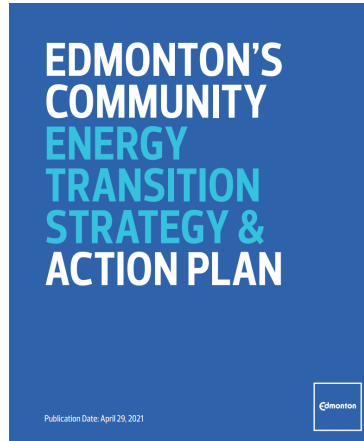


Every home with a heat pump has cooling, an essential service in Canada's increasingly hot summers.

**+** For the 16M existing homes, **complementary retrofit measures** can further reduce costs and emissions in existing homes

- Measures like improving insulation and air sealing can reduce peak demand by as much as **25%** in older homes.
- Deep energy retrofits, where a home is gutted or insulation is added on the exterior face, can reduce peak load demands by **50%** or more.

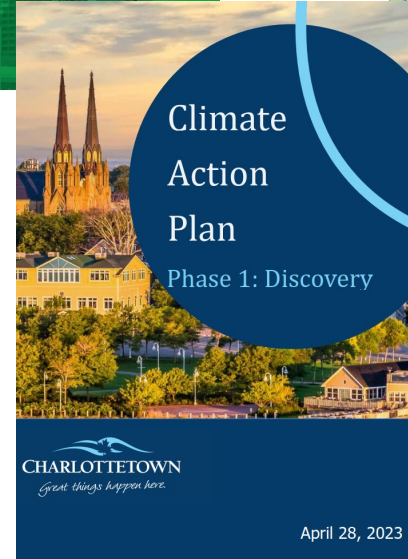
# KEY MESSAGES FOR BUILDERS AND THEIR CLIENTS



**BETTER BUILDINGS  
OTTAWA STRATEGY**  
City of Ottawa's Strategy for Accelerating Retrofits of Existing Industrial, Commercial, Institutional, and Multi-Unit Residential Buildings



SEPTEMBER 2021  
Climate Change and Resiliency Section, City of Ottawa



*"I am interested in installing a heat pump in my home in the future"*



■ Strongly Disagree  
 ■ Disagree  
 ■ Somewhat Disagree  
 ■ Neither Agree or Disagree  
 ■ Somewhat Agree  
 ■ Agree  
 ■ Strongly Agree



## Heat pumps

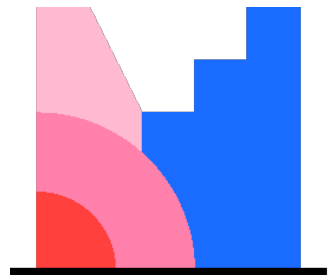


For NRCan's Heat Pump Videos and Pamphlets:  
[www.canada.ca/heatpumps](http://www.canada.ca/heatpumps)

Questions?

[Laureen.chung@nrcan-rncan.gc.ca](mailto:Laureen.chung@nrcan-rncan.gc.ca)

Manager, Homes and Communities Division  
Office of Energy Efficiency, Natural Resources Canada



# Mentimeter



[www.menti.com](https://www.menti.com)

Poll # 23 21 62 5

Poll 15-16



**Jay Wilson,  
Director, Net Zero and  
Electrification, Electricity Canada**

**Electricity  
Canada**

Our energy future



**Électricité  
Canada**

Notre avenir énergétique

# How will the grid help us get to Net Zero?

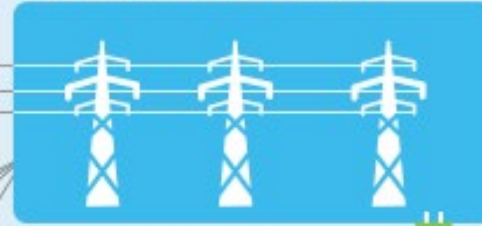
CHBA Net Zero Leadership Summit  
June 2024

## GENERATION



Managing electricity supply for today and tomorrow.

## TRANSMISSION



Managing the grid to ensure we have electricity where we need it, when we need it.

## DISTRIBUTION



Ensuring reliable service to local communities.

## SYSTEM OPERATORS

Policy Makers  
Energy Boards  
Regulators  
Technicians  
Scientists  
Engineers

## ELECTRICITY CONSUMERS



Consumer protection on service and pricing.



MODERN NECESSITIES

High-voltage Transmission Towers

Power Lines

# Grid Basics



# Affordable

# Reliable

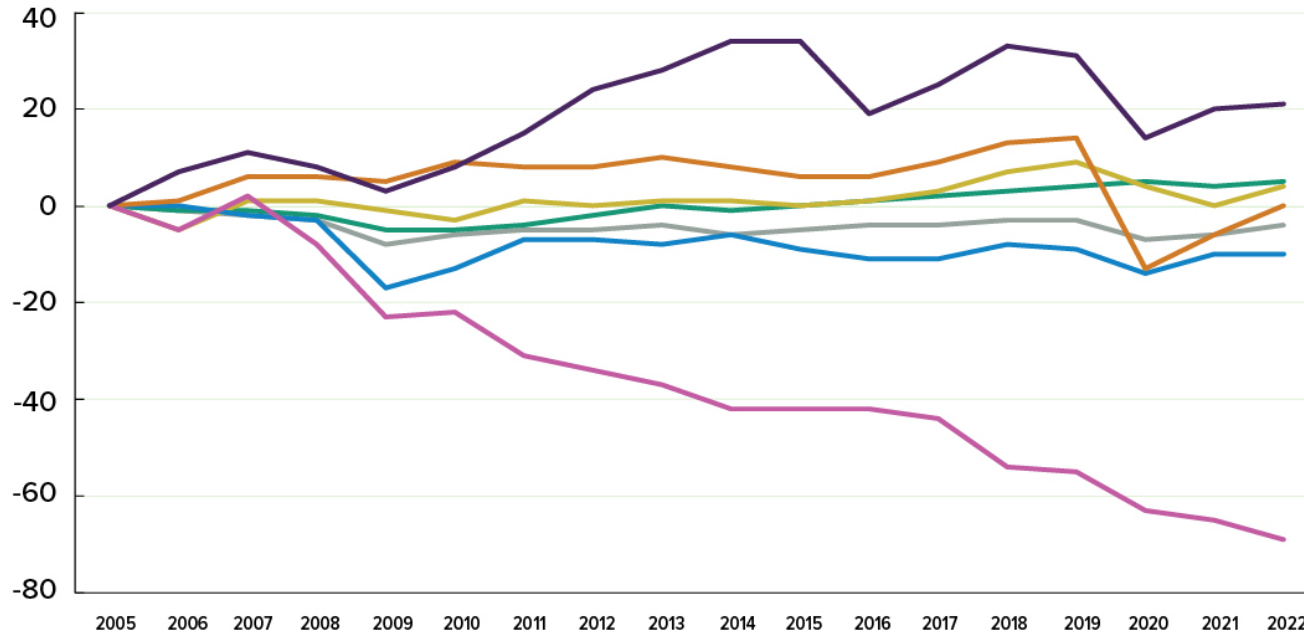
---

# Clean



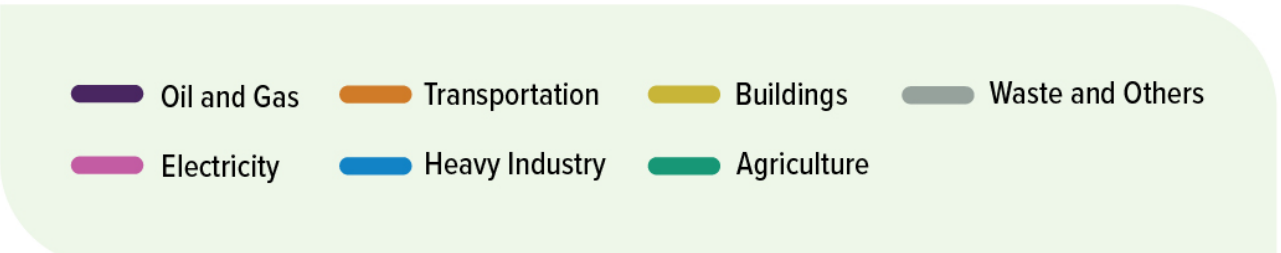
# Canada's 2024 National Inventory Report

Change in GHG Emissions  
from 2005 Level (Mt CO<sub>2</sub> eq)



Other sectors

Electricity sector CO<sub>2</sub> emissions



Source: [Environment and Climate Change Canada, 2024](#)



# Two Targets, Two Different Challenges



**Net Zero Electricity Grid:** Canada's goal of having the electricity sector achieve no emissions of greenhouse gases (GHG) by 2035, or emissions that are offset by other actions that remove carbon from the atmosphere. This includes direct emissions and does not include lifecycle or upstream emissions.



**Net Zero Economy:** Canada's stated goal of having the Canadian economy achieve either no emissions of greenhouse gases (GHG) by 2050, or that all emissions are completely compensated for by removing carbon from the atmosphere (negative emissions) through other actions.



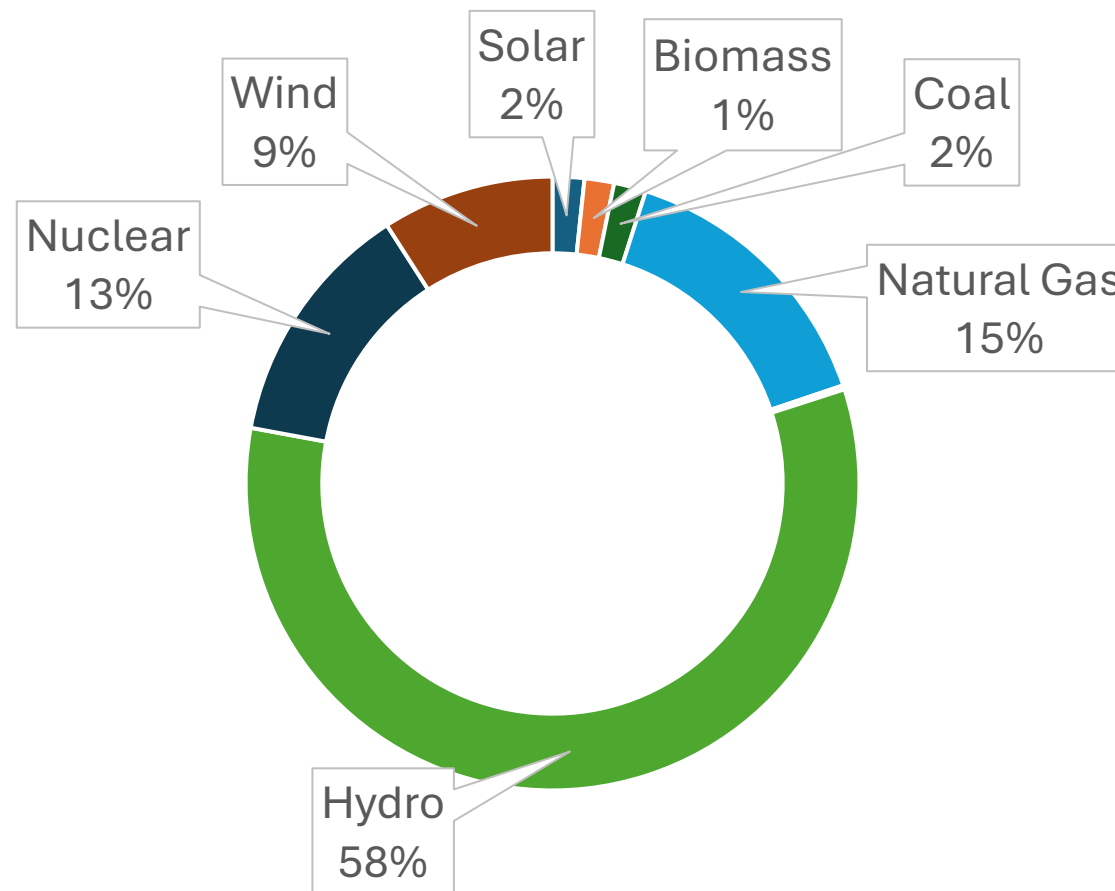
According to Government estimates, Canada will  
**need to produce up to 2-3x as  
much clean power as it does  
now to meet our Net Zero by  
2050 commitments.**



# Canada's Generation Fleet Today

**Total Generation:  
637 TWh**

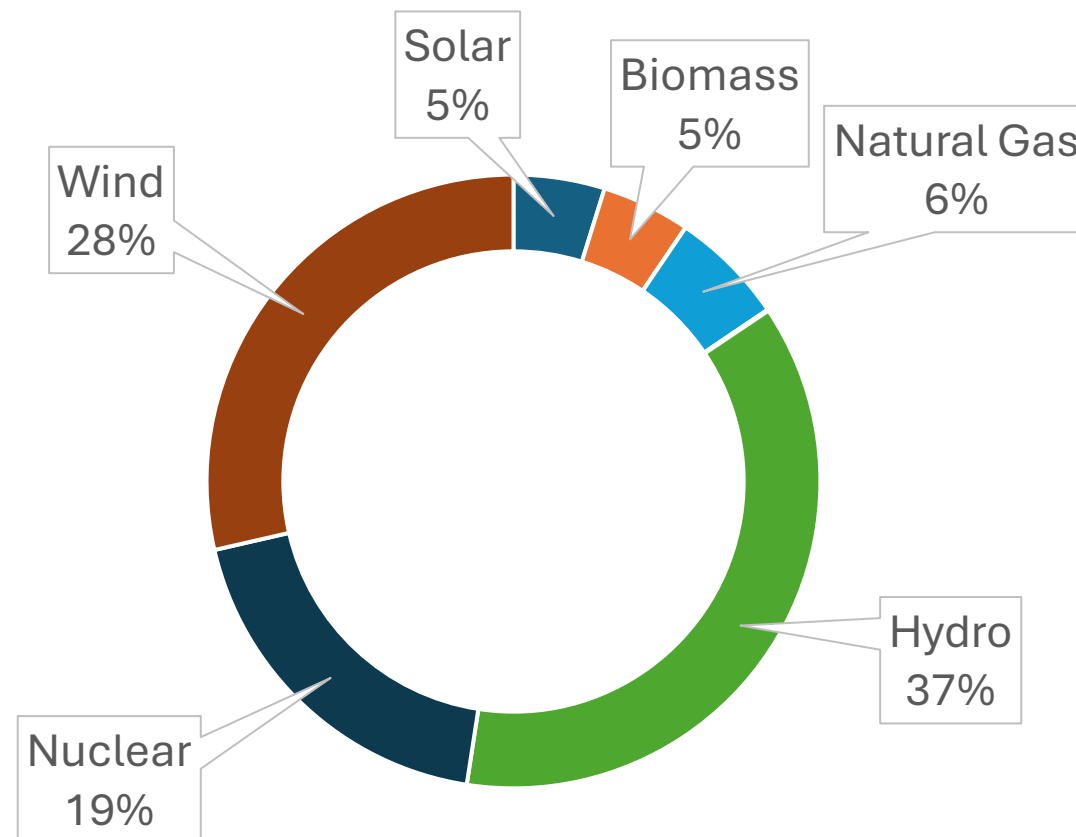
**Non-emitting  
generation:  
84%**



# Canada's Generation Fleet in 2050

**Total Generation  
(Projected):  
1 292 TWh**

**Net Zero GHG  
emissions**





**Connecting new  
generation to load**

**More transmission  
within and between  
provinces**

# Modernizing Distribution

- Demand Side Management
- Distributed Energy Resources
- Smart Grids
- Electrification



# The Affordability Challenge

**It's clear from our research that electricity bills will go up.**

**We need to mitigate the impact.**

What do  
we  
need?

Policy

Investment

Consistency



# Questions?

## Contact us at:

Electricity Canada  
275 Slater Street, Suite 1500  
Ottawa, Ontario, K1P 5H9  
613.230.9263  
[info@electricity.ca](mailto:info@electricity.ca)



*Questions?*





CANADIAN HOME BUILDERS' ASSOCIATION  
**netzero** home  
LEADERSHIP SUMMIT

# Lunch Break

**in the Demo Hub. (Whistler Ballroom)**

**Be back by 1:00 pm.**

