How to measure

ET

ERO

ENERGY

Event Venue: Virtual via Zoom
Event Date: April 10, 2024

REGISTER NOW >

Federal climate change policy and the National Building Code (NBC) are targeting Net Zero Energy Ready new homes and buildings by 2030. Local Ontario Green Building Standards are referencing the NBC 2020 step code Tier 4 and 5 or CHBA Net Zero. How does this relate to current OBC prescriptions for energy performance, Energy Star or higher? The long-awaited Super Semi Demonstration Project report sheds light on this topic and raises important questions. How do we measure zero energy carbon based on a standards approach. Do Net Zero energy houses actually perform as modelled and intended to? Where is the point of diminishing marginal returns for envelope improvements? Do solar arrays on homes make sense without battery storage? How do the existing OBC prescriptions like Package A1 stand up against the Paris Accord and COP28? Lastly, how will this effect Environmental Social Governance (ESG) for builders if they are building houses to the bare minimum? Join John, Paul and Christian for a thought-provoking session on April 10th 2024 via zoom https://us02web.zoom.us/j/86178431716

VIEW ALL ARTICLES >

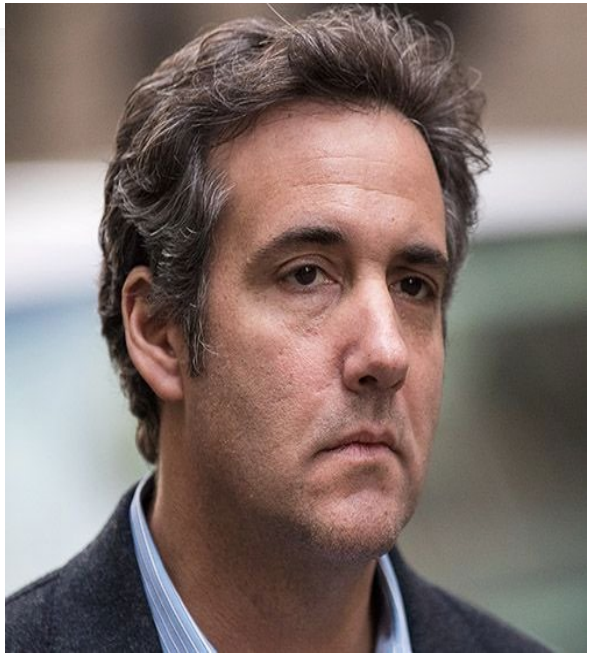
REGISTER NOW >

Introduction to our Speakers – these are not mugshots!

Rocco De Berardis the Influencer

Pretty Boy Rinomato

John the Profit



Mike the Fixer

The usual suspects!

ISSUE 48 | WINTER 2023

BETTER Builder

the builder's source

BACK TO THE FUTUREPROOFING

PUBLICATION NUMBER 42401014

TRCA's Archetype Houses
Bridging Research and Housing
When Policies Collide
Brush Up with BuildABILITY
Partners in High Performance
Advances in XPS Insulation

Code Harmonization, Green Building Standards and Fairness

Where does research end and attainable housing begin?

Colin Clive as Dr. Frankenstein and Dwight Frye as his assistant Fritz prepare to bring their monster to life in a scene from the 1931 movie version of Mary Shelley's *Frankenstein*.

When we think about green building standards, do we have a purpose looking for a process or do we have a process looking for a purpose? Do we have evidence-based policy or policy-based evidence?

"Net zero carbon" building doesn't actually exist and is a shell game of carbon offsets. When is a reasonable timeline to reach a necessary and realistic *low-carbon* building industry? In an era of historic housing shortages and an affordability crisis with skyrocketing costs for wages and materials, labour shortages, eye-watering red tape, egregious taxes, out-of-control inflation and financing costs, where does additional bureaucratic, experimental and theoretical research fit in? How do we achieve housing that is attainable for most people? Is this the time to experiment with housing?

After many years of cuts, scrapes and concussions in the homebuilding industry, I can still be floored and quite frankly disheartened by what I see and hear. It's like Mary Shelley's *Frankenstein*: a story where we try to create life and end up with an uncontrollable monster. The path to hell is paved with good intentions, it seems. Moreso, it's disturbing that many people (researchers, bureaucrats, policy makers, activists and others) who have never built a new home development project (outside of a few experimental discovery homes) can be so patronizing and condescending or just plain naïve when it comes to sustainable building practices for our industry. But I digress.

Our experience with sustainability programs, labels and research has been long and varied. It has also greatly deteriorated over time. We had voluntary EnerGuide labelling and incentivized Energy Star labelling in Vaughan, where the program was reasonable and incentives meaningful. Then, we had mandatory Energy Star labelling in Caledon, which were without incentives yet still had some rational requirements. Then, in Oakville, we fought to use the HERS scale to achieve equivalency to Energy Star. Recently, we had Energy Star version 17.1, which is expensive and problematic. Finally, today we have interested parties clamouring for "net zero-ready," carbon counting and "zero carbon" housing sooner rather than later. Well, there's one way to get to zero carbon – by not building anything, because no one can afford it.

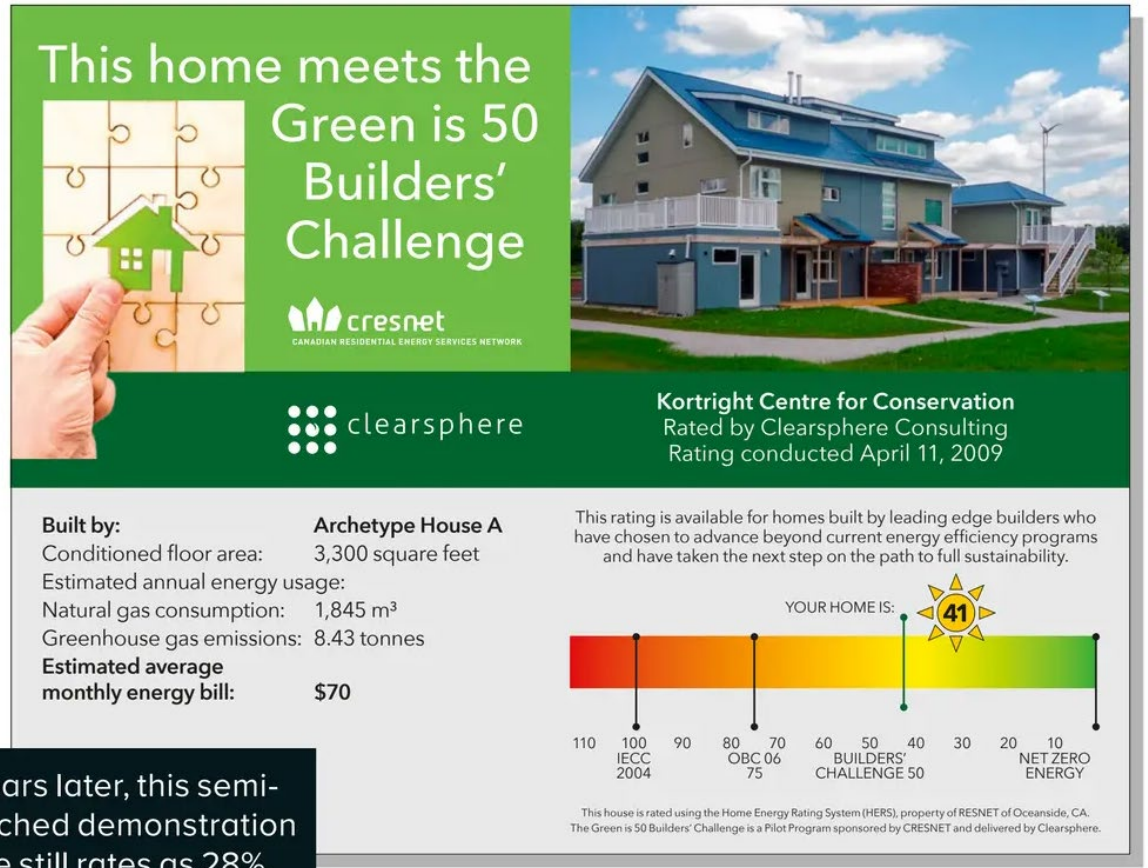
> In an era of historic housing shortages and an affordability crisis ... where does additional bureaucratic, experimental and theoretical research fit in?

BACK TO THE FUTURE

Nearly two decades later, the TRCA's Archetype Houses have mostly stood the test of time when it comes to futureproofing.

As we explore futureproofing, we'd be remiss not to highlight one of the most notable examples of prescient thinking in sustainable building, one with its roots nearly two decades old – a veritable eternity in this sector.

Imagine a semi-detached demonstration home conceived in 2006 that, upon completion in 2008, scored a HERS 41 – meaning that, 15 years later, it still rates as 28% better than Code.



15 years later, this semi-detached demonstration home still rates as 28% better than Code. It stood the test of time.

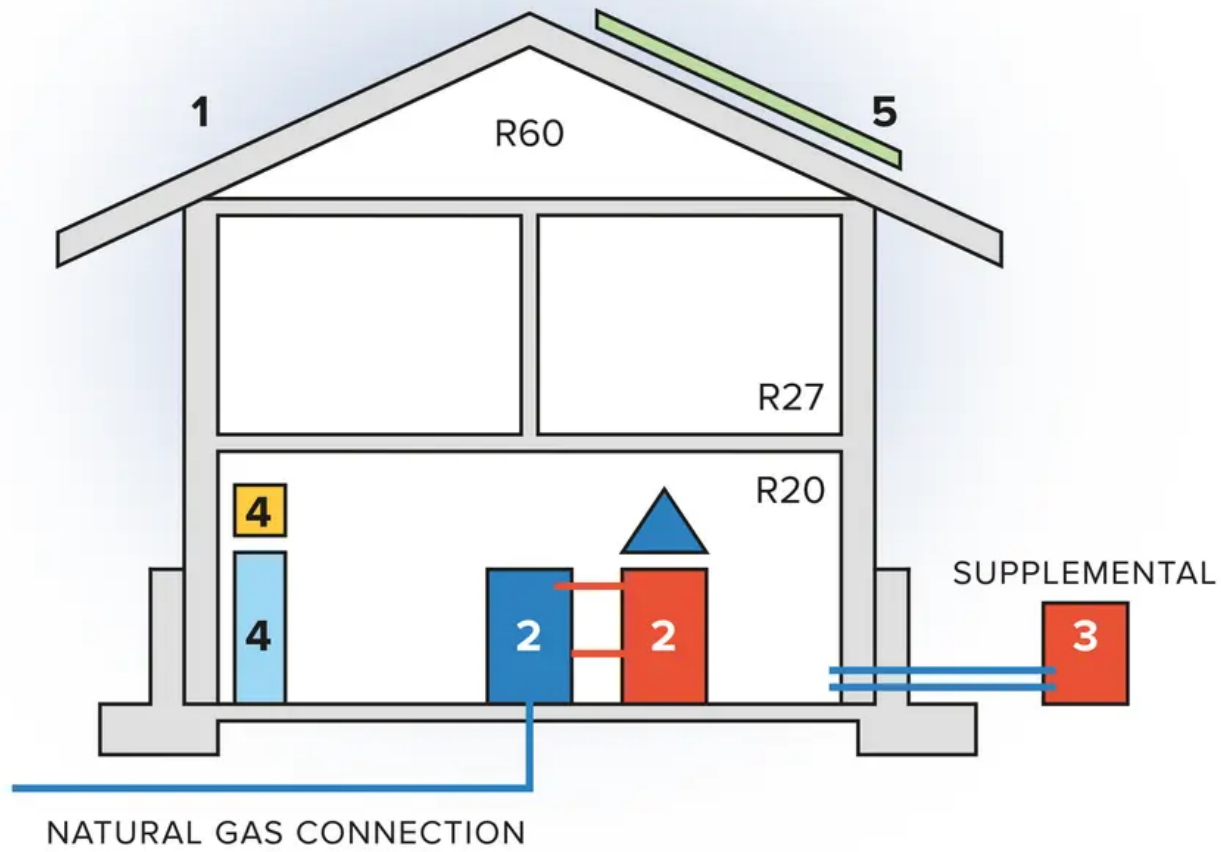


FIGURE 1: HYBRID HOUSE FORMULA

=

Thermal design 1 to HERS 46 (ASHRAE 90.2)

+

Combination heat 2 2 (20% reduction) (could be two-stage furnace)

+

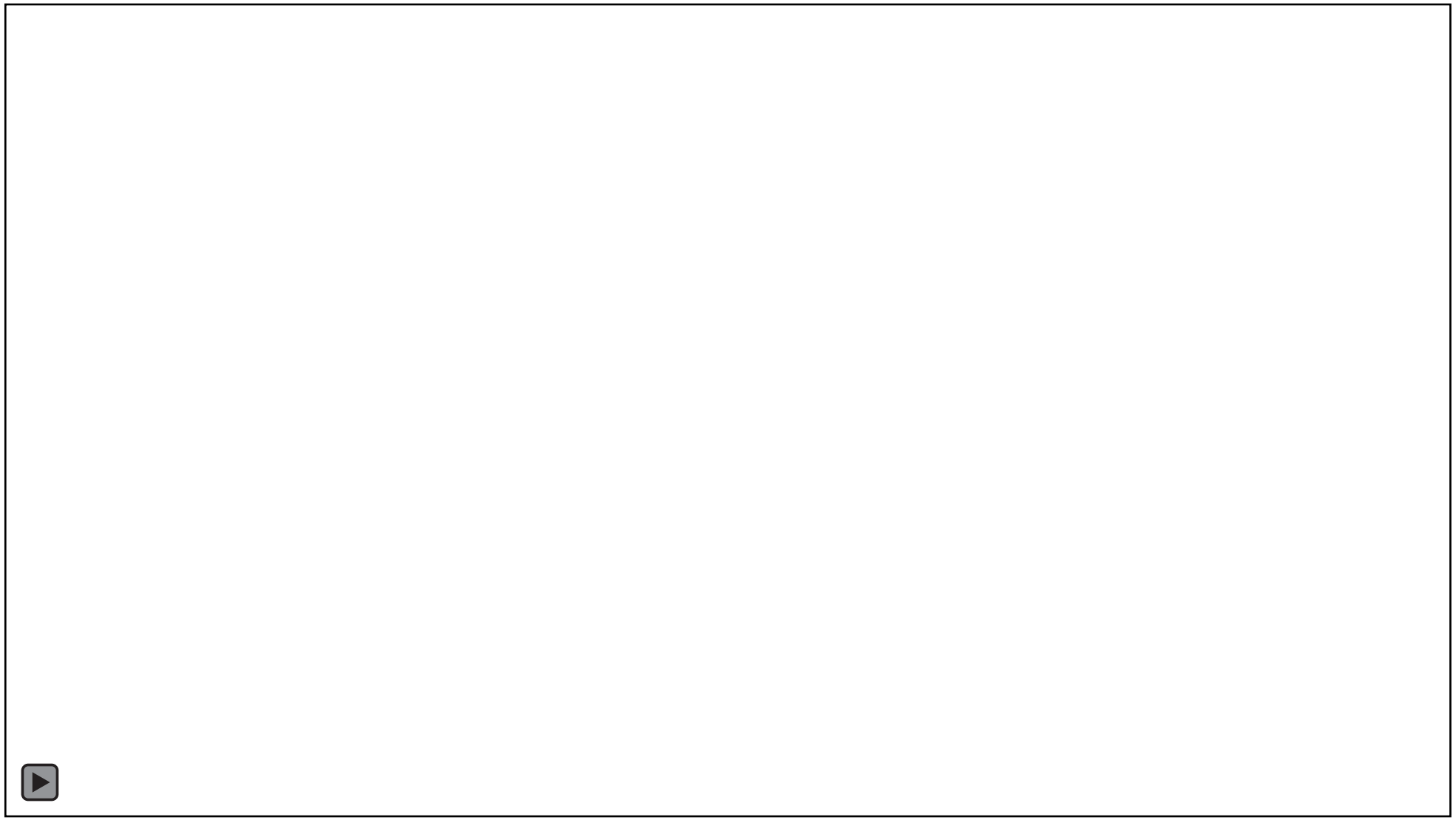
Three-season heat pump 3

+

Battery storage 4 with inverter 4 and critical circuits

+

Modest solar array 5 (5-7kW)



Q: How will Ontario meet its energy challenges?

a) Electrification with Nuclear
b) Wise use of Natural Gas
c) Renewables – Solar and Wind
d) Off-peak storage
e) All of the above – diversification of energy sources

ADDING CONSERVATION MEASURES DOESN'T ALWAYS JUSTIFY COST

Paul De Berardis
Director of Building Science & Innovation

The results of this study are important because the residential sector is facing a perfect storm of issues.

As regulatory requirements and policy objectives affecting construction standards evolve, it becomes critical to benchmark the real-world performance of new homes. Building codes and municipal green standards too often focus their policies on how new homes should perform, without measuring and responding to their actual performance. Certain supposed high-performance homes don't always deliver on anticipated outcomes once occupied.

RESCON, in collaboration with one of our members, Country Homes, commissioned a case-study analysis to compare two different approaches to what could represent the future of energy efficiency in new homes and help inform future building codes. The findings concluded that the added benefits associated with increasing energy-efficiency measures do not always justify the added costs for new home buyers.

The Super Semi Energy Efficiency Demonstration Project examined the construction costs versus occupant-realized energy savings of two high-performance homes. To better understand the relationship between annual energy use simulation software modelling versus real-world data, the study used analytical comparison methods to outline the energy performance of two nearly identical homes built in Milton. The homes were conceived as a demonstration to possibly represent the next step in energy conservation measures and help guide future regulatory policy decisions.

Together, Country Homes and RESCON wanted to compare the actual performance and annual energy-use modelling of various construction technologies as well as assess their costs.

The nearly identical homes were two halves of a semi-detached house identified as Lot120L and Lot120R. Lot120L was an all-electric home designed and built to the Canadian Home Builders' Association Net Zero energy program. Lot120R was a low-carbon home that allowed fuel-switching with an electric three-season heat pump and natural gas-combination hybrid heating system. This exercise allowed the builder to explore practices in advancing energy efficiency beyond code while evaluating real-life operating costs.

Through regulatory mandates, timelines are in place to transition to fully electrify all new buildings and homes to meet net-zero targets to combat climate change. However, empirical evidence from this demonstration project indicates there are concerns, as energy savings that result from these moves are limited and don't always justify the additional construction price tag for consumers, such as the home builder spending more than $50,000 in construction costs to save a homeowner $600 per year on his or her utilities.

The results of this study are important because the residential sector is facing a perfect storm of issues, and we are in an unprecedented housing crisis. As codes and standards are updated, we should not be adding more costs to housing without due consideration as to whether they really make sense, especially considering the looming electricity supply crunch to Ontario's grid.

Findings showed discrepancies between annual energy-use simulation software and the homes' actual performance, consuming more energy than predicted. The study also found that moving too far beyond the current building code requirements for energy-efficiency measures can result in a negative return on investment and unreasonable payback periods.

Since major policy decisions such as changes to building codes are based on assumptions derived from software models, there is growing concern that Canada's climate strategy with respect to homes and buildings may be misguided.

Given the ongoing housing affordability crisis, the limited energy savings homeowners realize from added conservation measures do not always justify the incremental construction costs imposed on new housing. This study showcases the discrepancy between computer models and real-world performance and highlights the need for more thorough and ongoing analysis.

Under the current Ontario Building Code, new home builders are already leaders and a decade ahead of other provinces when it comes to energy-efficient practices. Developers, builders and home buyers are facing crippling taxes, fees and levies that add as much as 31 per cent to the cost of a new home. Any steps to impose drastic energy-efficiency measures without a full cost-benefit analysis will just further exacerbate an already strained housing market.

Click here to read the full report.

PRESS RELEASE

COST OF ADDING UNDUE ENERGY CONSERVATION MEASURES REACH TIPPING POINT

Christian Rinomato and Corey McBurney at the opening of the Super-Semi project in 2021.

March 27, 2024, Vaughan, Ont. – A year-long case study found that the added benefits associated with increasing energy-efficiency measures do not always justify the added costs for new home buyers.

"Through regulatory mandates, there is a move to fully electrify all new buildings and homes to meet net-zero targets in order to combat climate change," says RESCON president Richard Lyall. "However, evidence from this demonstration project indicates there are concerns as energy savings that result from these moves are limited and don't always justify the additional construction price tag for consumers, such as spending over $50,000 to save a homeowner $600 per year on their utilities.

"The findings of this study are important because the residential construction industry is facing a perfect storm of issues, and we are in an unprecedented housing crisis. As codes and standards are updated, we should not be adding more costs to housing without due consideration as to whether they really make sense, especially considering the looming electricity supply crunch to Ontario's grid."

Christian Rinomato, director of sustainability with Country Homes, builder of the homes in the study, said, "We will continue to strive for a better-performing home, both from an environmental perspective, but also an economic perspective. We are in the midst of an affordability crisis and, as a builder, it is our responsibility to build better homes that perform efficiently and are affordable to operate."

The study prepared for the Residential Construction Council of Ontario (RESCON), titled the Super Semi Energy Efficiency Demonstration Project, corroborates a similar case study presented by NRCan in 2023. Analytical comparison methods were used to quantify, verify, and compare data on the real-world performance of occupied homes against their annual energy-use simulation computer models.

The nearly identical homes were two halves of a semi-detached house, allowing the builder to explore practices in advancing energy efficiency beyond code while evaluating real-life operating costs. One half of the semi was all-electric designed to achieve net-zero energy; the other was a low-carbon home that allowed fuel-switching with an electric heat pump and natural gas-combination hybrid heating system.

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Given the ongoing housing affordability crisis, the limited energy savings homeowners realize from added conservation measures do not always justify the incremental construction costs imposed on new housing. This study showcases the discrepancy between computer models and real-world performance and highlights the need for more thorough and ongoing analysis.

"Through our current provincial building code, new home builders are already leaders and a decade ahead of other provinces when it comes to energy-efficient practices," says Lyall.

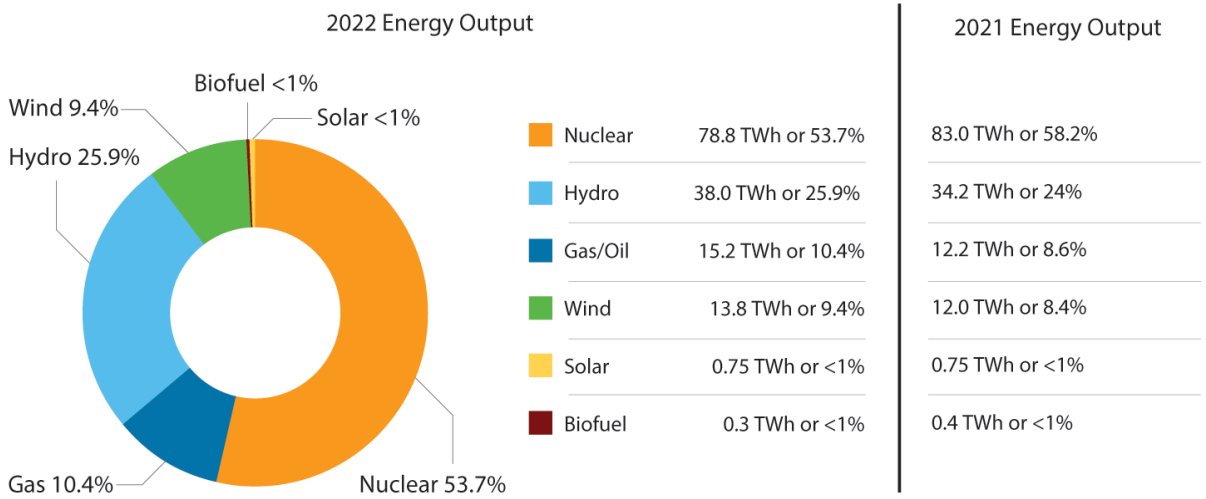
"Developers, builders and consumers are facing crippling taxes, fees and development charges that add as much as 31 per cent to the cost of a new home. Any steps to impose drastic energy-efficiency measures without a full cost-benefit analysis are a recipe for disaster."

Rinomato observed, "From the builder's perspective, we feel hand-tied when programs are forced upon us. We are currently striving for 20 per cent better than the building code and believe it should be up to us on how we get there."

Click here to read the study.

Recent Developments

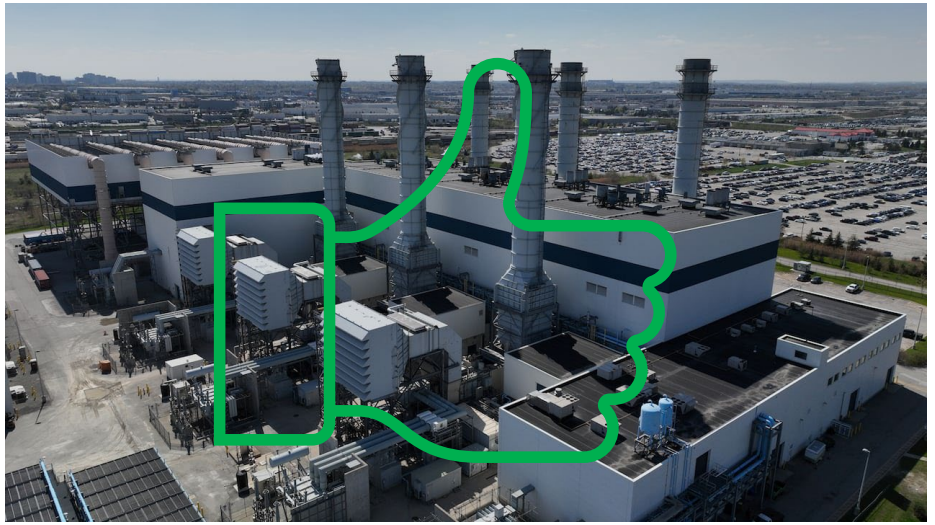
- Ontario Power Generation was slated to decommission the Pickering Nuclear Generation Station by 2026 but has now inked a new deal to refurbish Pickering to operate for an additional 30 years. Pickering provides 14 per cent of the province's electricity and the refurbishment is estimated to take 11 years.
- The Independent Electricity System Operator (IESO) has contracted the construction of three new gas plants, in St. Clair, Windsor, and Napanee, as well as scaling up generation at existing gas plants in Toronto, Brampton, Halton Hills, and Thorold.
- The Trudeau government has signaled it will walk back a key environmental pledge on power generation under the Clean Electricity Regulations. In response to objections by provinces and electrical grid operators, Ottawa is now proposing to allow natural gas power plants to keep burning beyond the promised deadline for net-zero power in 2035, extending the deadline to 2045.
- The Ontario Energy Board (OEB) issued a surprising Decision and Order on Enbridge Gas Inc.'s 2024-2028 Rates Proceeding. The ruling would ultimately require that new infrastructure supplying natural gas to new homes be paid for upfront by developers, rather than paid off gradually over 40 years by natural gas customers through their monthly charges.



ONTARIO ENERGY BOARD

ENBRIDGE

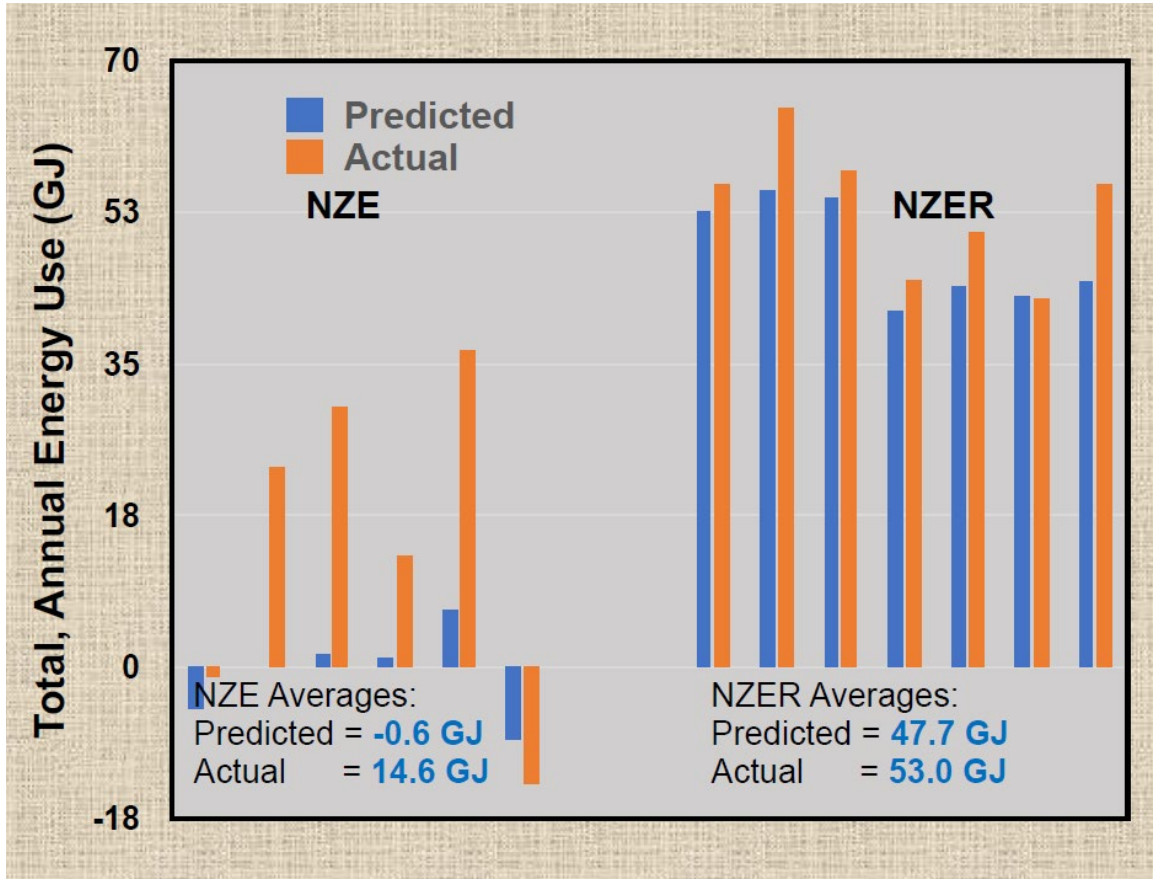
Impacts on Residential Building Industry



- The advancement of building codes, municipal green building standards, and now the OEB decision with Enbridge are all seeking to phase out the use of natural gas in new homes, yet burning natural gas for power generation will be a growing trend in Ontario over the next 20 years.
- The fundamental issues at play here are that the electrical grid is not up to this task without extensive infrastructure upgrades, plus we also do not have the electrical power generation capacity to meet the demand of electrified homes.
- As Ontario continues to experience a growing demand for housing, the residential construction industry faces numerous challenges in meeting the needs of a growing population, housing affordability, and access to energy to support new homes.

Real World Implications

- The CHBA Net Zero Energy Housing Council and National Resources Canada, published a case study which looked at the measured versus predicted energy performance of net zero energy and net zero energy ready homes.
- The data shed light on some glaring discrepancies between predicted and actual energy use, both in terms of energy use, natural gas consumption and solar photovoltaic power generation.
- Although it was only a small dataset of 13 homes, the results show that actual energy use greater than predicted, natural gas consumption was higher than predicted and solar generation achieved less than what was anticipated.



Real World Implications

- Some of the lessons learned and explanations of the notable discrepancies point to the fact that the air source heat pumps may not have been operating as predicted, potentially due to incorrect cut-off temperatures, excessive cycling, inadequate airflow or inadequate modelling by HOT2000.
- With respect to the less than predicted solar power generation, potential reasons for the shortfall point to solar systems not meeting their intended performance output, shading and inadequate modelling by HOT2000.
- These so-called high-performance homes are supposed to be guiding future code development, yet they are falling short on expected performance.

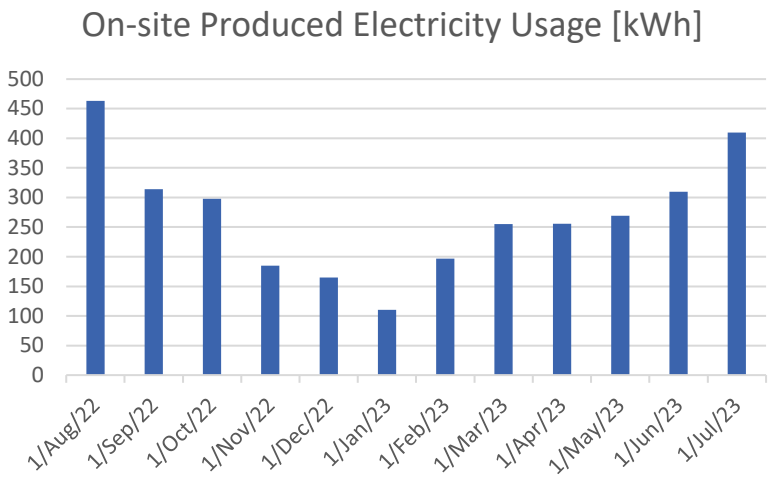
House	Climate Region	Gas Consumption (GJ)			DHW
		Predicted	Actual	Predicted-Actual	
2	7A	15.6	39.9	-24.3	Electric
3	6	1.9	7.5	-5.6	Electric
4	6	11.7	29.2	-17.5	Gas
7	6	11.5	10.1	1.4	Gas
8	5	11.4	23.8	-12.4	Gas
11	5	12.7	34.5	-21.8	Gas
12	5	11.6	44.3	-32.7	Gas
Mean (Predicted – Actual) Gas Use Gas heating, electric DHW				**-14.8**	
Mean (Predicted – Actual) Gas Use Gas heating, gas DHW				**-16.6**	

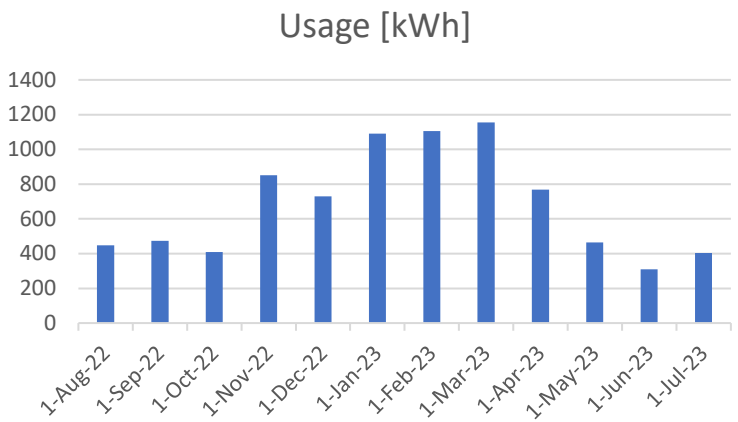
Super Semi Demonstration Project

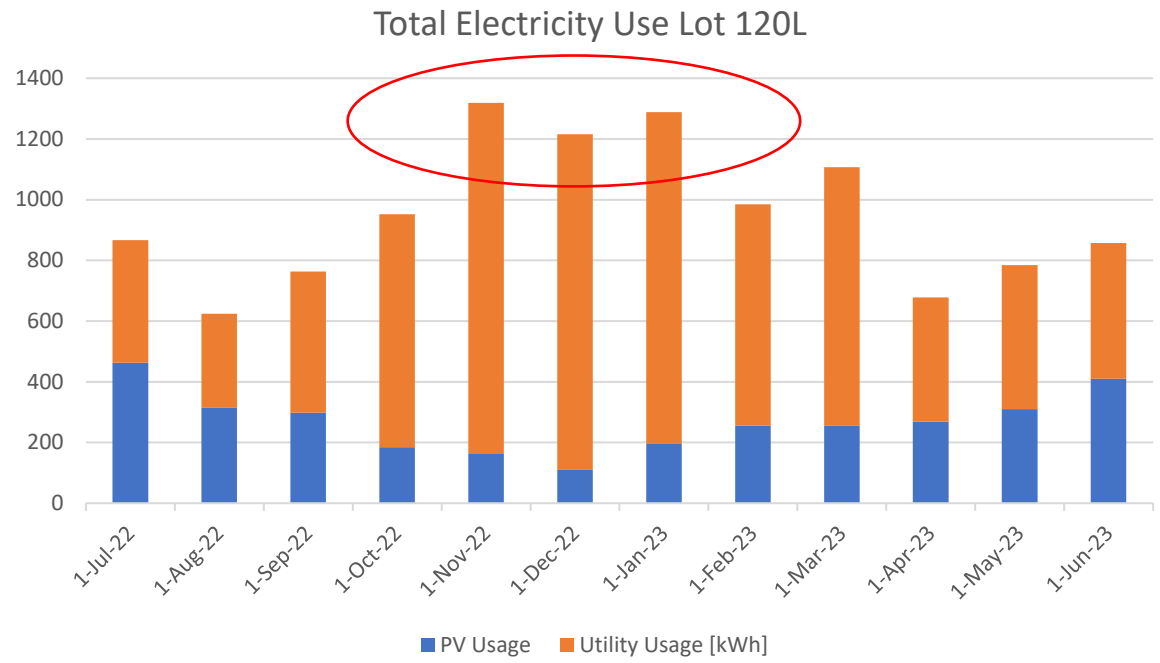
Country Homes

- Located in Milton, Ontario the super semi consisted of one home designed to CHBA Net Zero and the other a HERS 38
- The two homes were occupied for one year and the energy consumption was monitored and analyzed to gather real-world data and insights on the strengths of two different green building approaches.
- In collaboration with the builder, Country Homes, RESCON commissioned a research report to study the project.

Net Zero Energy - Seasonal Disparity of Loads







Season Disparity of loads

Definitions

So, what is a gigajoule? The prefix “giga” means “billion,” so a gigajoule (GJ) equals one billion joules. This may seem like an astronomical figure, but a single joule is actually a very small energy amount.

One GJ of natural gas has the same amount of energy as:

39 litres of propane.
27 litres of fuel oil.
26 litres of gasoline.
277 kilowatt-hours of electricity.

The equation for converting kWh to GJ is simple:

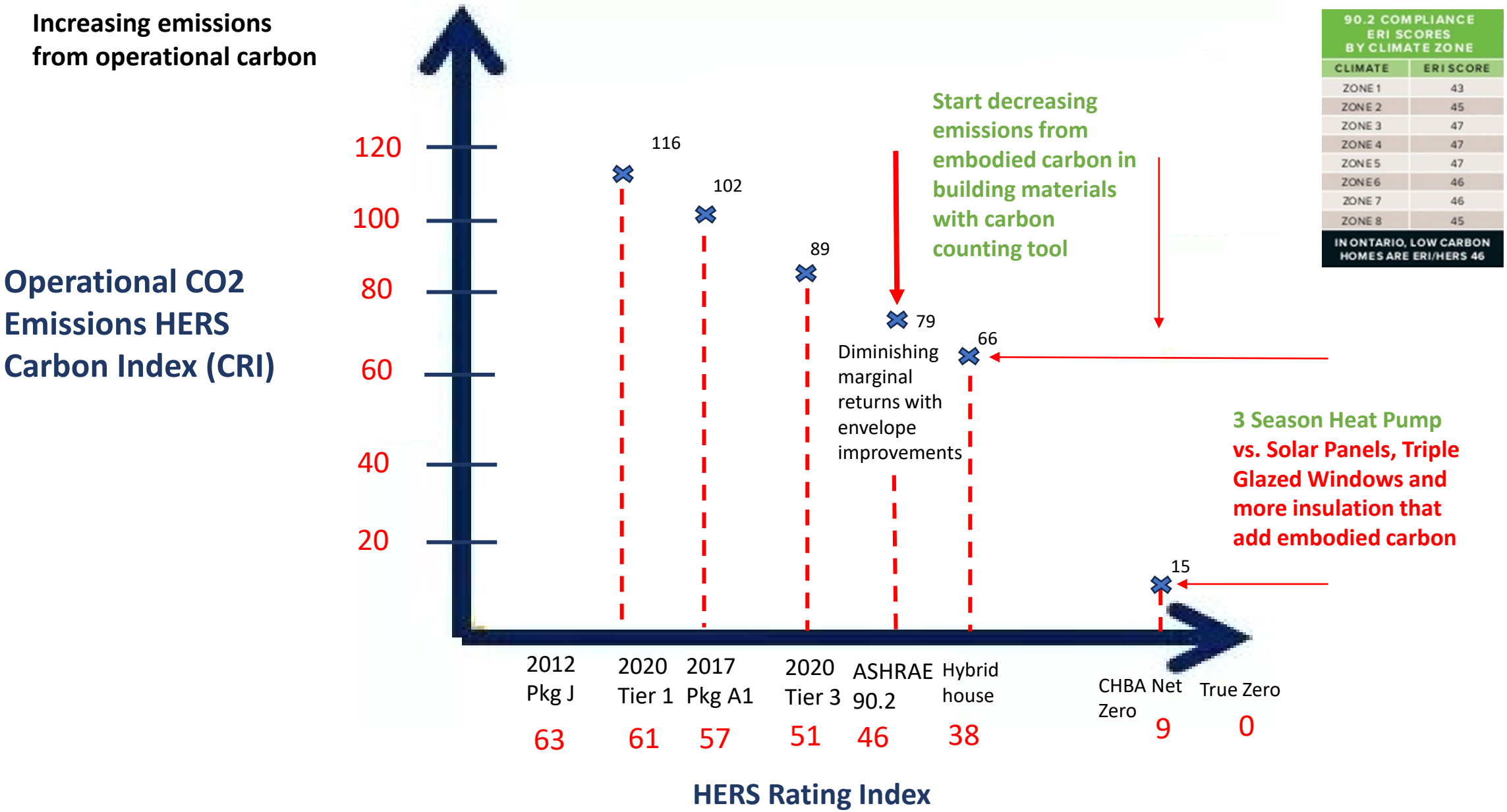
1 GJ = 0.0036 X kWh

What is a Giggle Joule

- A system that measures Primary & Secondary energy consumption and treats them exactly the same.

- “What the F is a Gigajoule?” – John Straube

The Law of Diminishing Marginal Returns with HERS Carbon Index



U.S. corn-based ethanol worse for the climate than gasoline, study finds

By Leah Douglas

February 14, 2022

REUTERS®

The research, which was funded in part by the National Wildlife Federation and U.S. Department of Energy, found that ethanol is likely at least 24% more carbon-intensive than gasoline due to emissions resulting from land use changes to grow corn, along with processing and combustion.

Takeaway: Adding ethanol to displace gasoline results in 24% higher CO2 emissions.

Time of use schedule in Ontario

Ultra-Low Overnight (ULO)

ULO Price Periods	All Year	ULO Prices (¢/kWh)
Ultra-Low Overnight	Every day 11 p.m. - 7 a.m.	**2.4**
Weekend Off-Peak	Weekends and holidays 7 a.m. – 11 p.m.	**7.4**
Mid-Peak	Weekdays 7 a.m. – 4 p.m. and 9 p.m. to 11 p.m.	**10.2**
On-Peak	Weekdays 4 p.m. – 9 p.m.	**24**

Unit Cost of Energy Per Gigajoule			
Source	**Energy Content/ GJ**	**Unit Cost ($)**	**Cost ($)/GJ**
Natural Gas (m3)	27	$0.275	7.42
Electricity (kWhrs)	278	$0.109	30.3
Notes (1)	Costs based on current NRCAN CBAT Tool		
Takeaway:	Electricity cost is 4x the cost of natural gas per GJ. Example of a heat pump with C.O.P of 3, still costs more at current rates of $30.30 per GJ of electricity compared to natural gas at 96% at $7.72		

Ultra-Low overnight rates can run heat pump in shoulder months and charge battery storage systems without solar PV

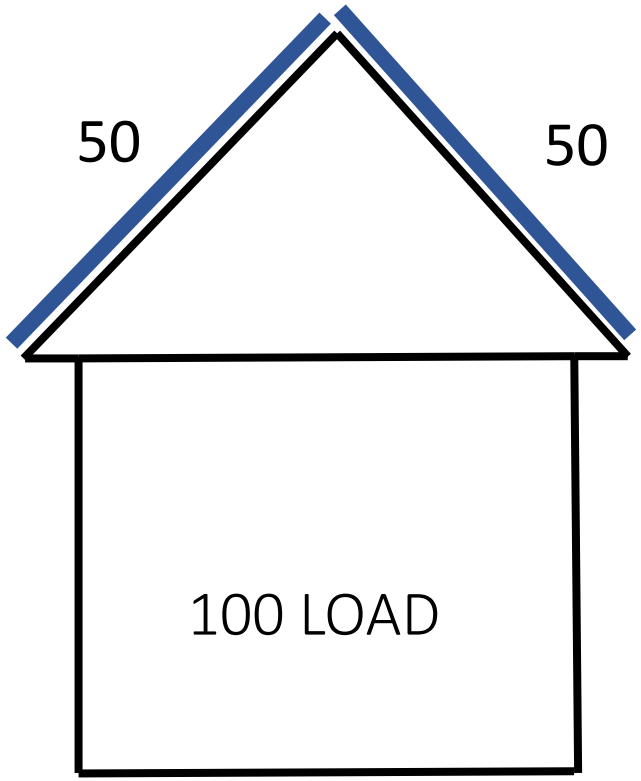
What is Net Zero?

1. An off-grid house
2. A grid connected house that OFFSETS its loads with onsite power generation sold to the grid
3. A CHBA program that uses modeled balanced energy consumption and has a electrical reference house (energy agnostic)

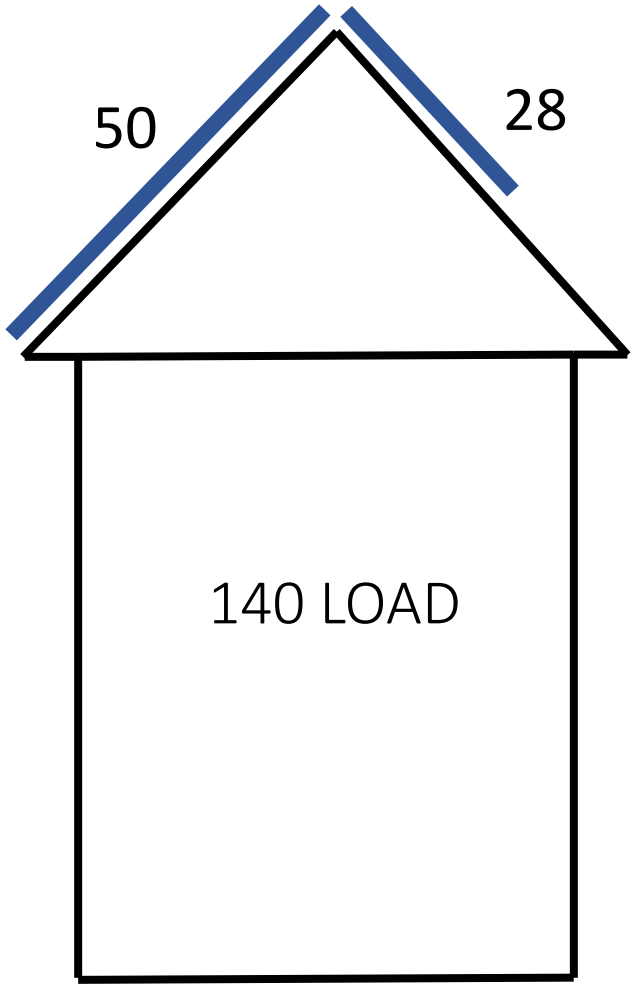
Note: Most people who refer to Net Zero Energy or Net Zero Carbon are referring to an offset and not an actual outcome.

Key Question: Can we Net out energy or carbon on any building?

CHBA Net Zero “Modelled Balanced Energy”



Modelled annual consumption



Onsite Solar Power

Actual annual consumption with occupants

Transportation

The first Tesla 'range inflation' lawsuit has been filed

Reuters reports, "That Tesla had inflated its range estimates, prompting owners to flood its service center over concerns that their vehicles needed service."

Kirsten Korosec @kirstenkorosec / 12:59 PM EDT • August 3, 2023

Comment

Image Credits: Tesla

Several Tesla owners have filed a lawsuit against the U.S. automaker over allegations of consumer fraud a week after a Reuters investigation found the company had exaggerated the range estimates of its EVs for years.

Last week, Reuters reported that Tesla had inflated its range estimates, prompting owners to flood its service center over concerns that their vehicles needed service. The investigation, citing anonymous sources and industry experts, found that the directive to use algorithms to give rosier range numbers came from CEO Elon Musk.

As sales exploded, service requests also grew. To thwart the influx of requests and help keep costs in check, Tesla created a special "diversion team" dedicated to handle so-called "range cases" — meaning owners complaining of lower ranges than expected, according to the Reuters report. Diversion team members were trained to tell owners that the EPA-approved range estimates were just a prediction. They would also provide tips to customers on how to extend range. The team's goal was to cancel as many of those appointments as possible,

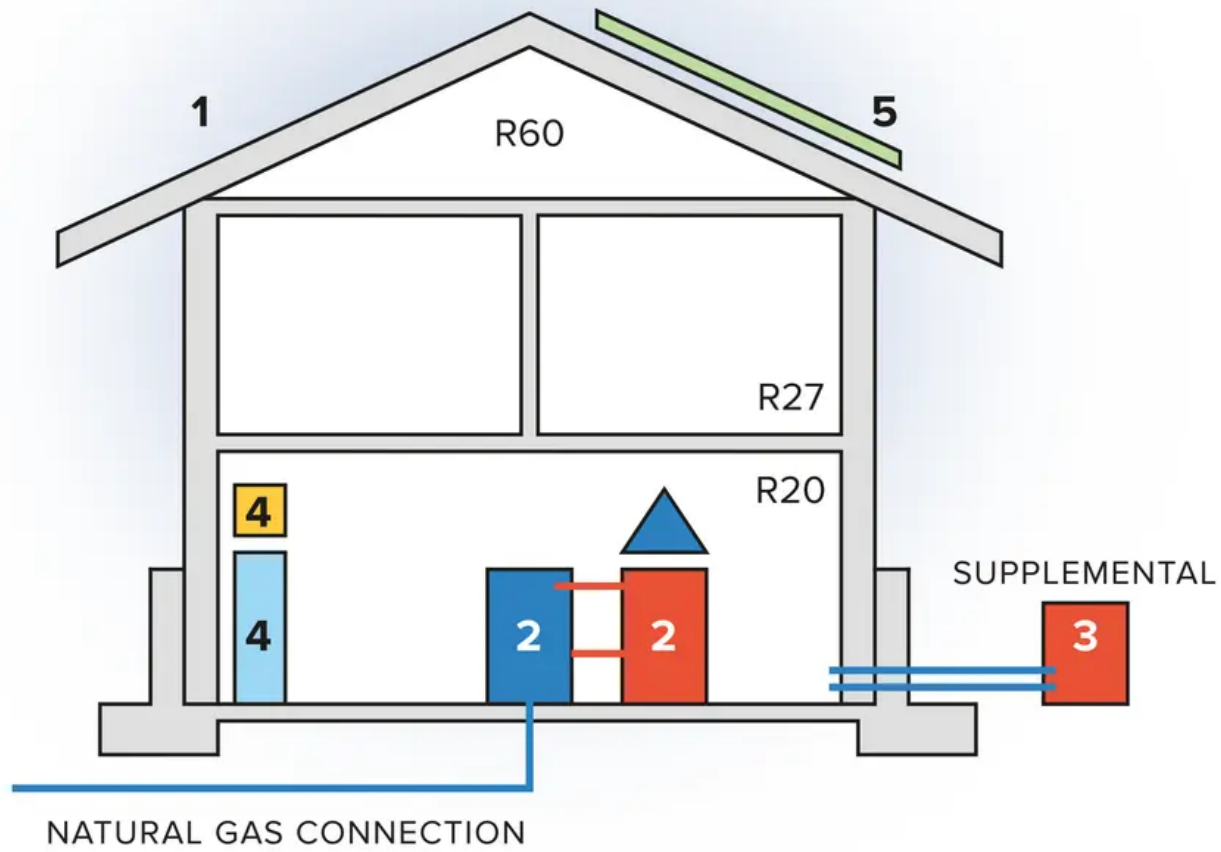


FIGURE 1: HYBRID HOUSE FORMULA

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Thermal design 1 to HERS 46 (ASHRAE 90.2)

+

Combination heat 2 2 (20% reduction) (could be two-stage furnace)

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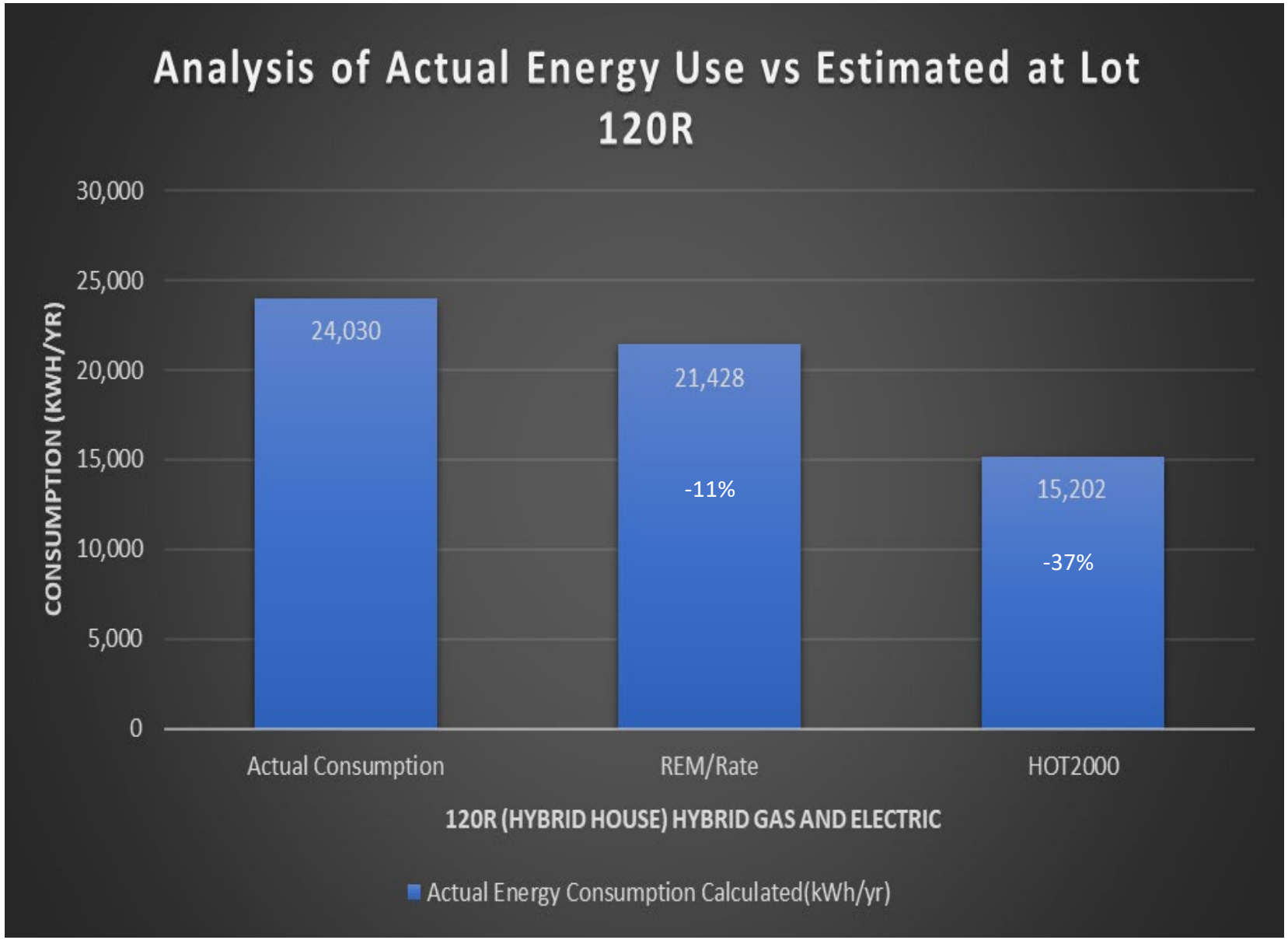
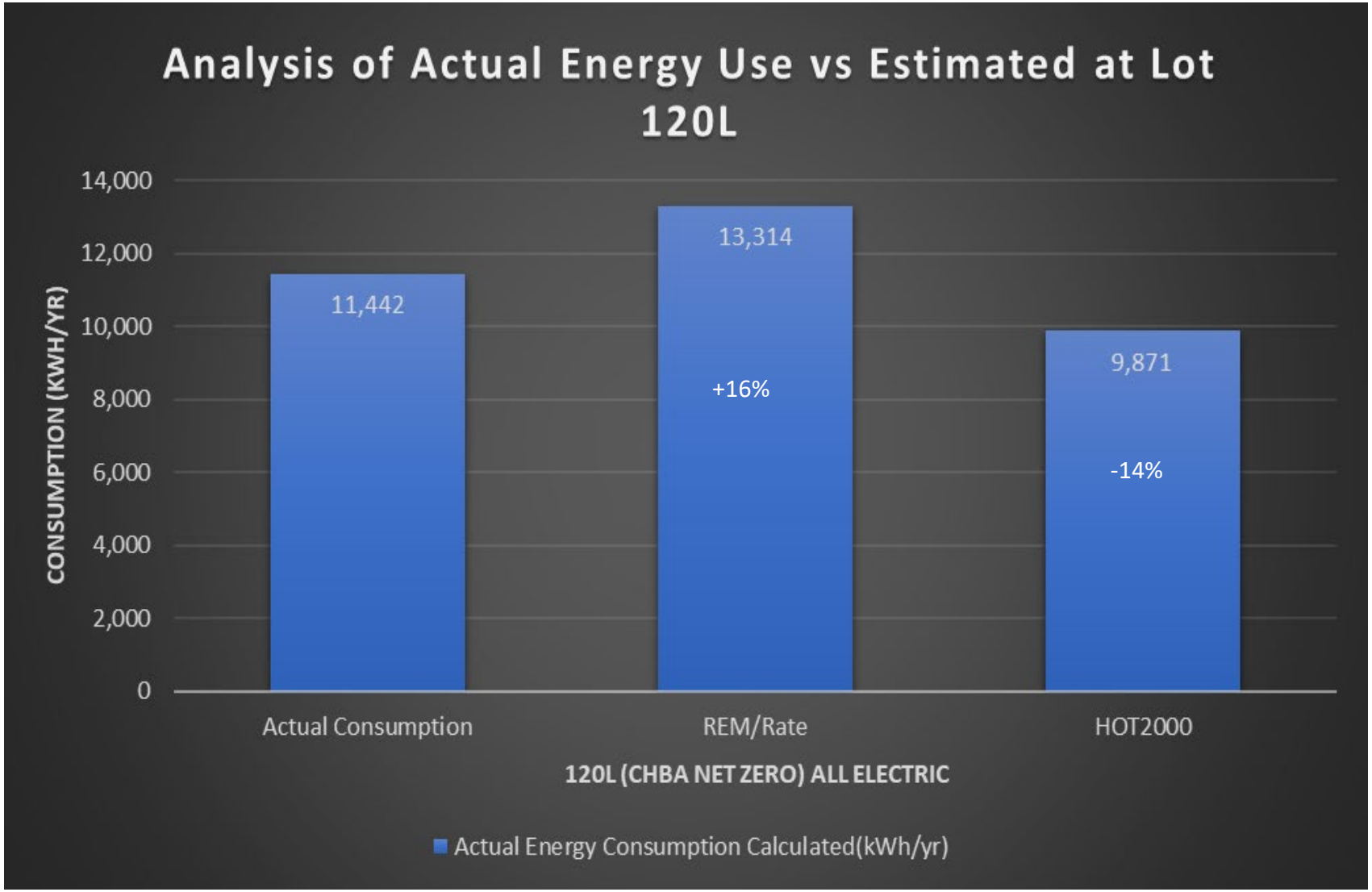


Takeaway: REMRate estimated actual energy at 11% less where HOT2000 estimated energy at 37% less.



Takeaway: Both REMRate and HOT2000 are not good at estimating cold climate heat pumps. There is a 30% divergence. Experts are in the process of figuring out how to do this.

Super Semi executive summary

Recognizing an opportunity to examine these two nearly identical units, the study had several objectives:

1. To provide insights as to the incremental costs and benefits of moving beyond the current tier of energy efficiency recognized/anticipated in the building code. (What does Tier 4 look like in Ontario?)

2. To compare two common software platforms used to make energy performance analyses in Ontario, namely HOT2000 and REM/Rate or code development.

3. To compare the accuracy of the results of the annual energy use models as they relate to actual occupied low energy houses in the field – energy efficient mortgages.

Takeaway: Both softwares work for code compliance as recognized in the Ontario Building Code

RESNET®
RESIDENTIAL ENERGY SERVICES NETWORK

Using RESNET® Data for ESG Reporting

Many home builders use the Sustainability Accounting Standards Board (SASB) Home Builder Sustainability Accounting Standard to guide their ESG reporting.

SASB is now part of the IFRS Foundation® which has consolidated the SASB standards and many other reporting frameworks to align with two new international standards.

Those standards are IFRS S1, General Requirements for Disclosure of Sustainability-related Financial Information and IFRS S2, Climate-related Disclosures and are built on and consolidate the TCFD recommendations, SASB Standards, CDSB Framework, Integrated Reporting Framework and World Economic Forum metrics to streamline sustainability disclosures.

As part of the alignment with these new standards, the SASB Home Builder Sustainability Accounting Standard was updated in June 2023.

Download the updated standard here:
https://sasb.org/standards/download/

Builders doing HERS® and HERS$_{H2O}$® Ratings can use data in the RESNET® National Buildings Registry to assist with reporting against the Design for Resource Efficiency and Climate Change Adaptation metrics in the SASB Standard.

The following data is available:

- Number of homes receiving a HERS® or HERS$_{H2O}$® Rating
- HERS® and HERS$_{H2O}$® Scores
- RESNET® Carbon Index Scores
- Estimated Energy and Water Savings
- CO2 Emissions
- ENERGY STAR Certification
- Zero Energy Ready Home Certification
- WaterSense Labeled Home Certification
- Use of WaterSense-labeled products (for homes receiving a WaterSense Certification)
- Use of renewable energy

For more information on accessing data in the RESNET® Registry, visit:
https://www.resnet.us/builders/resnet-builder-data-sharing/

RESNET®
RESIDENTIAL ENERGY SERVICES NETWORK
Leading the Path to Net Zero Energy Homes

MeritageHomes®

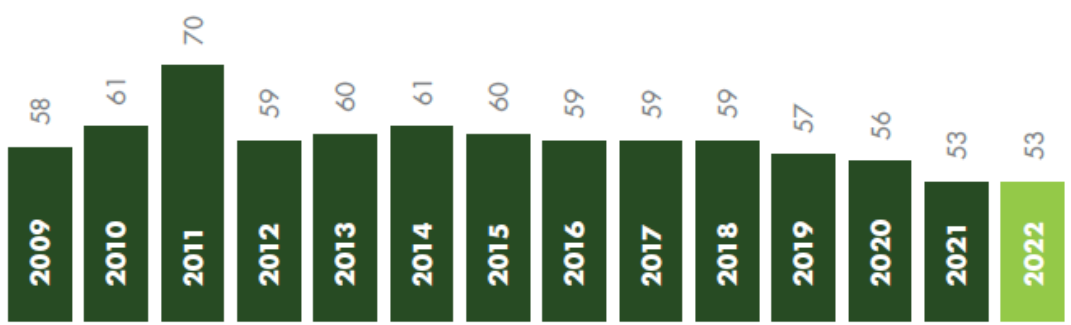
Setting the standard for energy-efficient homes®

2022 ESG REPORT

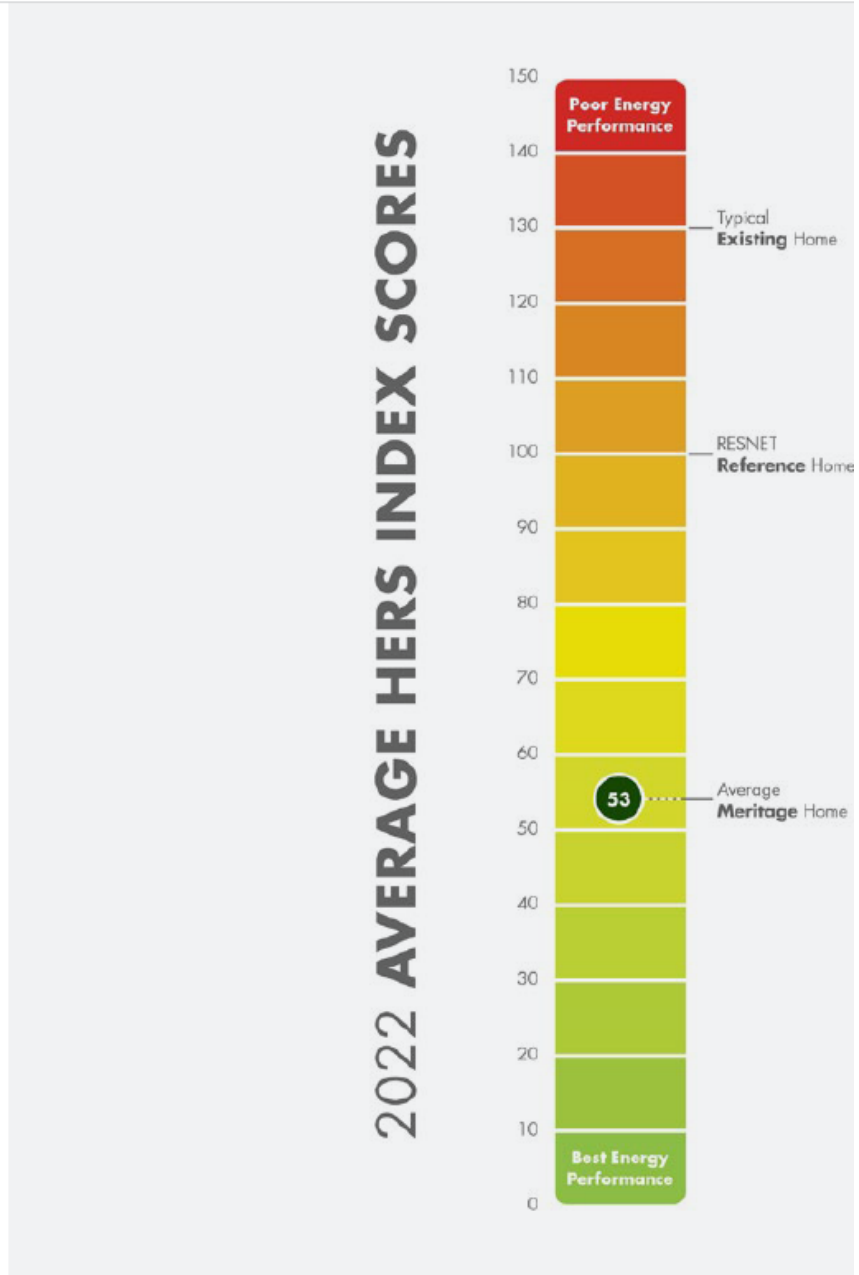
HERS INDEX CERTIFICATION[1]

Meritage's average HERS index score of 53 in 2022 implies our average home will consume 47% less energy than the RESNET Reference Home.

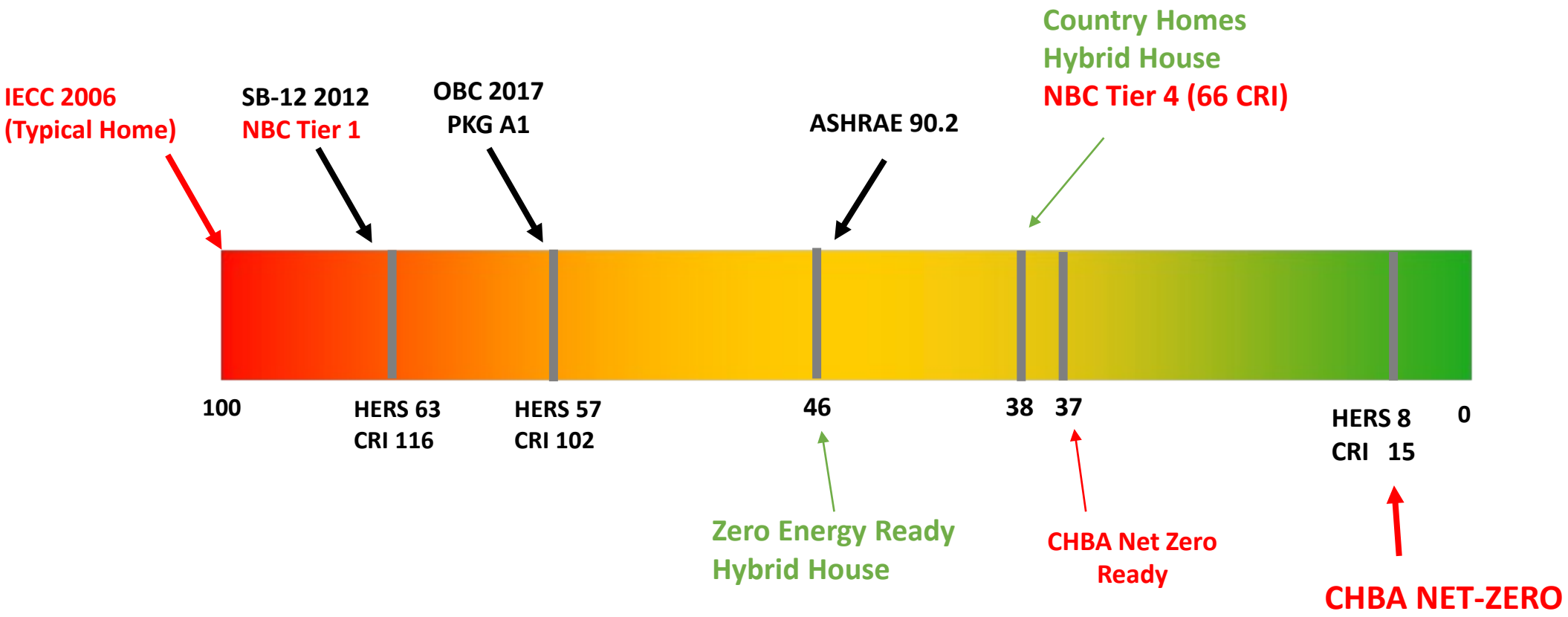
Meritage's Average HERS Index Score



[1]Source: RESNET.



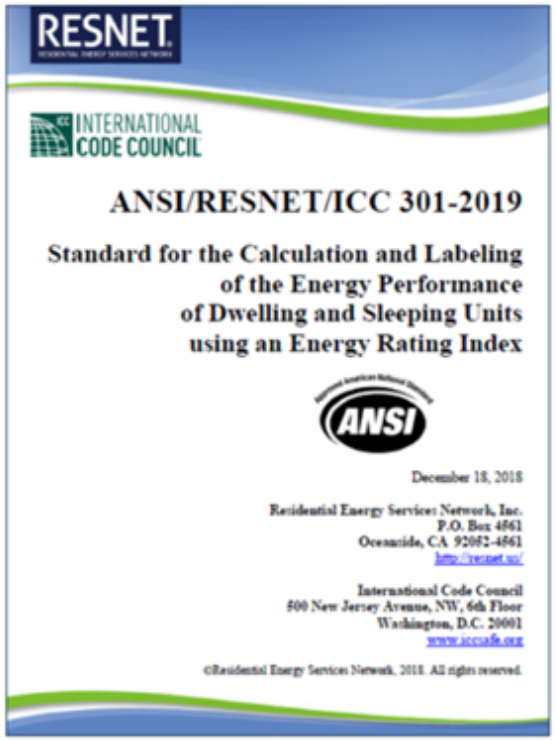
HERS RATINGS AT VARIOUS TIERS AND PROGRAMS FOR HYBRID HOUSE



Zero Energy Ready (Hybrid House): HERS (63-38) / 63 = 40% (Energy Efficiency)

Zero Energy Ready (Hybrid House): CRI (116-66) / 53 = 43% (Operational Carbon)

The Three Standards


RESNET

INTERNATIONAL CODE COUNCIL

ANSI/RESNET/ICC 301-2019

Standard for the Calculation and Labeling of the Energy Performance of Dwelling and Sleeping Units using an Energy Rating Index

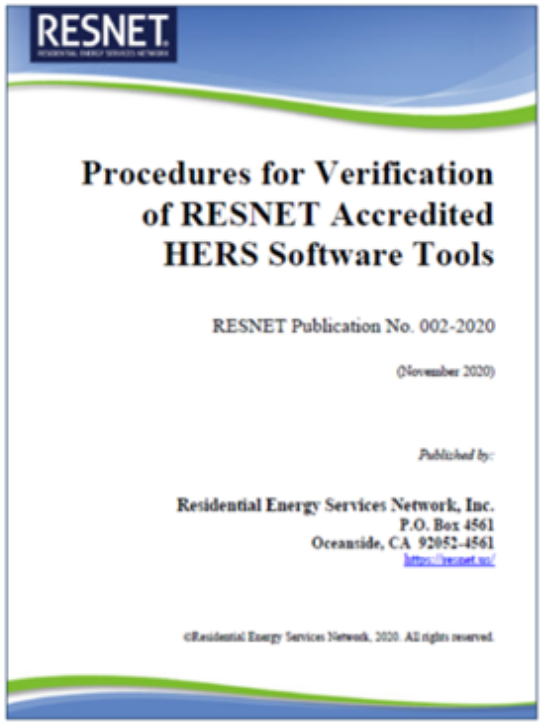
ANSI

December 18, 2018

Residential Energy Services Network, Inc.
P.O. Box 4561
Oceanside, CA 92052-4561
http://resnet.us/

International Code Council
500 New Jersey Avenue, NW, 6th Floor
Washington, D.C. 20001
www.iccsafe.org

Rules set definition and calculations for calculating energy consumption


RESNET

Procedures for Verification of RESNET Accredited HERS Software Tools

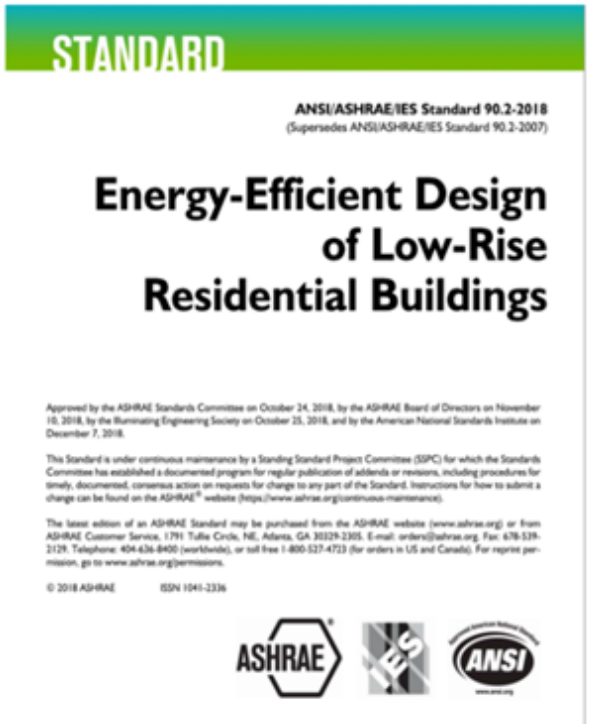
RESNET Publication No. 002-2020

(November 2020)

Published by:

Residential Energy Services Network, Inc.
P.O. Box 4561
Oceanside, CA 92052-4561
https://resnet.us/

Procedures used for consistency and verification of RESNET accredited HERS software tools


STANDARD

ANSI/ASHRAE/IES Standard 90.2-2018
(Supersedes ANSI/ASHRAE/IES Standard 90.2-2007)

Energy-Efficient Design of Low-Rise Residential Buildings

Approved by the ASHRAE Standards Committee on October 24, 2018, by the ASHRAE Board of Directors on November 10, 2018, by the Illuminating Engineering Society on October 25, 2018, and by the American National Standards Institute on December 7, 2018.

This Standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the Standard. Instructions for how to submit a change can be found on the ASHRAE® website (https://www.ashrae.org/continuous-maintenance).

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 ISSN 1041-2336

ASHRAE IES ANSI

Standard through rigorous cost benefit analysis defines the point of diminishing marginal returns for operational carbon

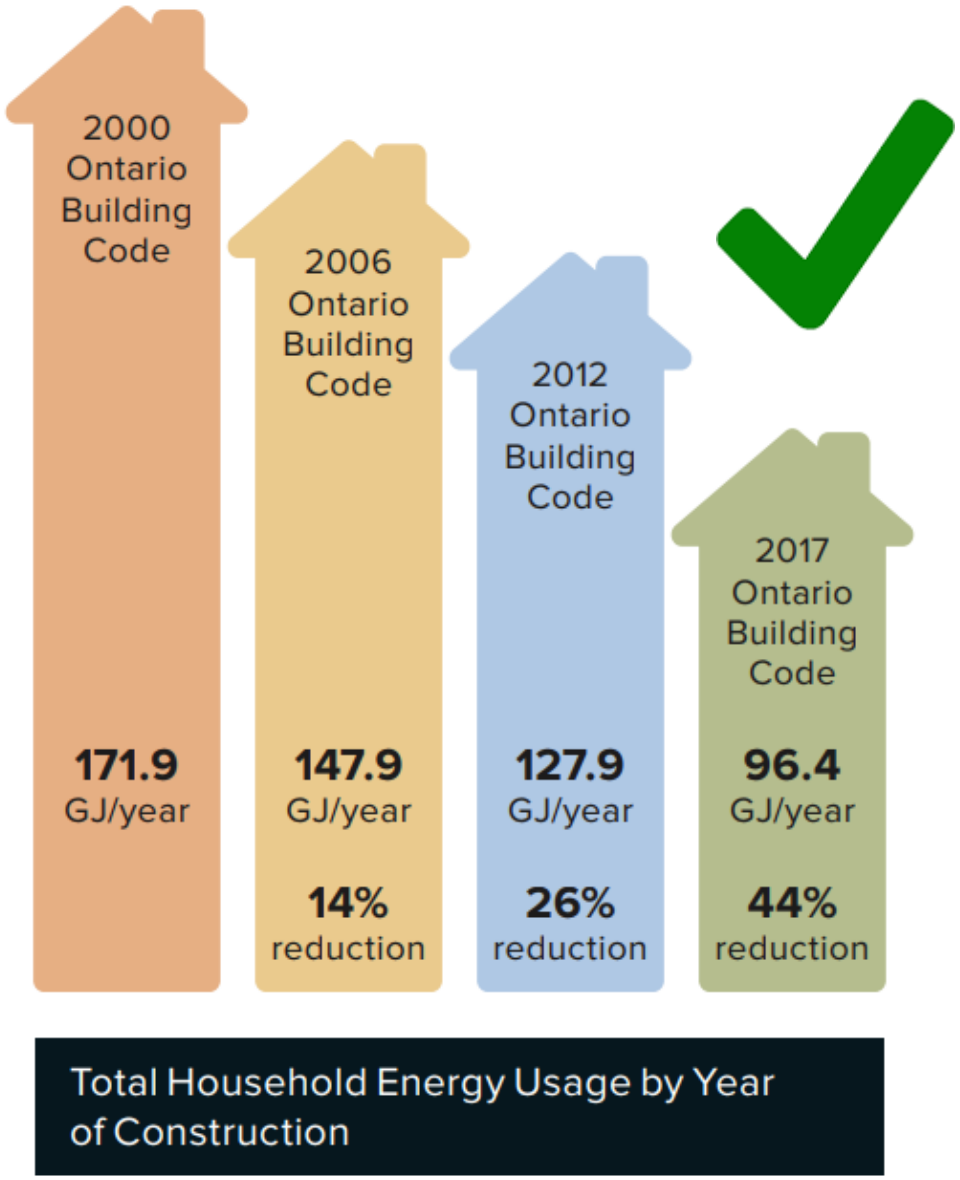
LESSONS LEARNED FROM CANADA'S RECORD ON CLIMATE CHANGE

Canada's commitments and actions on climate change

Exhibit 5.2—Canada's climate action and participation in major international climate agreements

Adopted		Canada's action
1988	Intergovernmental Panel on Climate Change	Canada hosts a major international climate event, the World Conference on the Changing Atmosphere, and later that year becomes an active member of the Intergovernmental Panel on Climate Change.
1992	United Nations Framework Convention on Climate Change	Canada ratifies the United Nations Framework Convention on Climate Change.
1997	Kyoto Protocol	Canada signs the Kyoto Protocol in 1998 and formally ratifies the agreement in 2002, committing to reducing its greenhouse gas emissions by 6% below 1990 levels between 2008 and 2012.
2009	Copenhagen Accord	Canada commits to this non-binding agreement and to reducing its greenhouse gas emissions by 17% below 2005 levels by 2020.
2011	Canada's withdrawal from the Kyoto Protocol	Canada abandons its commitment to emission reduction under the protocol.
2015	Paris Agreement	Canada signs the Paris Agreement in 2016 and commits to reducing its greenhouse gas emissions by 30% below 2005 levels by 2030.
2021	Canada's new greenhouse gas emission target	The Paris Agreement asked countries to enhance targets over time. Canada commits to a higher emission reduction target of 40% to 45% below 2005 levels by 2030, which equates to annual emissions of about 406 to 443 megatonnes of carbon dioxide equivalent.

OBC 2017 surpasses the PARIS ACCORD Targets (37% reduction below 1990 levels)



***Current Federal Targets are 40% reduction by 2030 based on 2005 levels. Target for 2050 is Net-Zero (80% reduction).**

Why are builders being singled out?

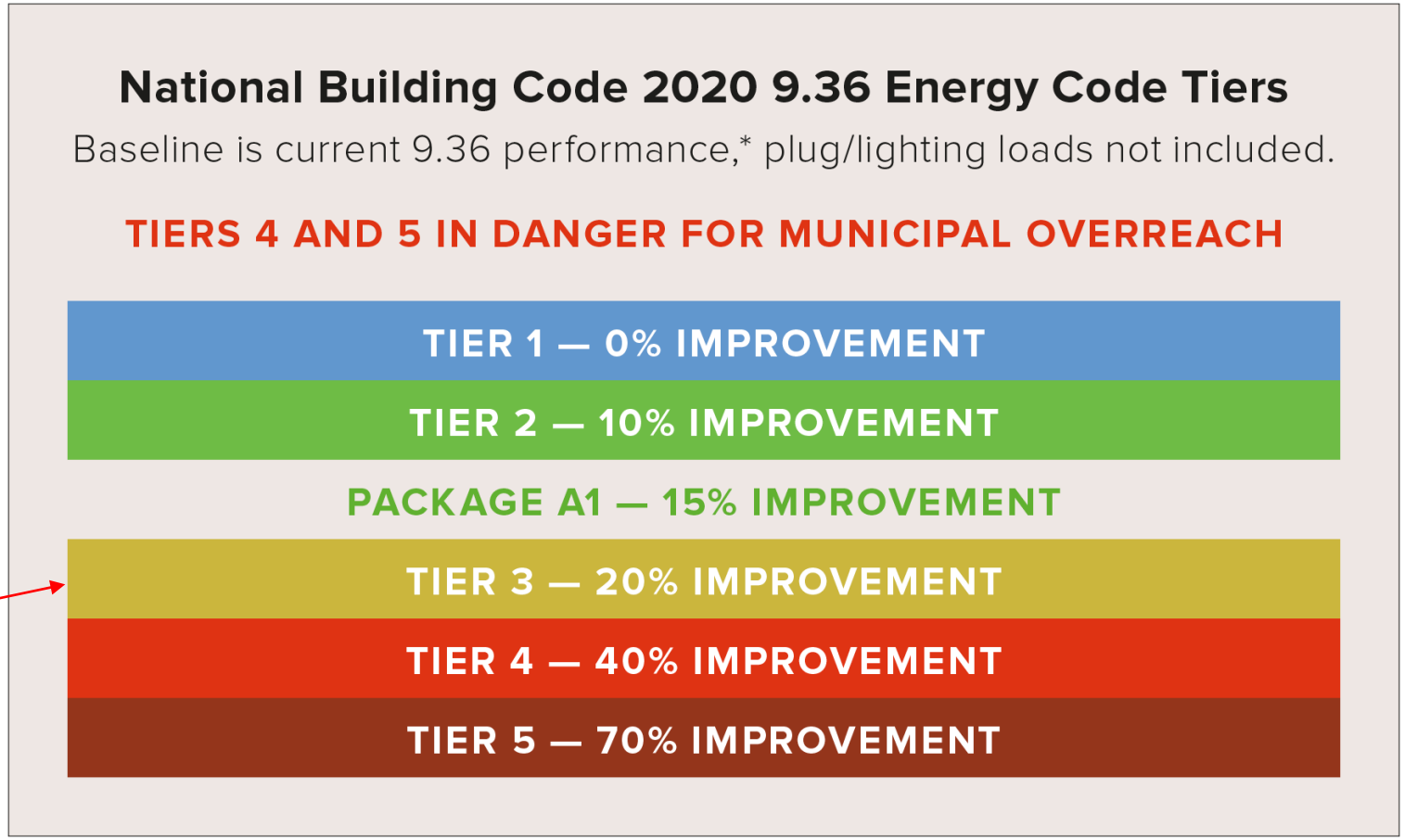
Low Carbon Home Builder Coalition (LCHC) started in 2019 with five members. CO2 emissions are banked on each house and expressed as cars off the road.

CARBON EMISSION SAVINGS FROM FIVE GTA BUILDERS				
BUILDER	CO_2 EMISSIONS REDUCTIONS (TONS)*	NUMBER OF HOUSES	CO_2 REDUCTIONS	CARS OFF THE ROAD
BROOKFIELD	1.303	196	255.38	151
EMPIRE	1.657	484	801.98	160.4
HEATHWOOD	1.658	168	278.54	55.7
STARLANE	1.520	261	409.77	82
ROSEHAVEN	1.516	414	627.62	125.5
TOTAL	–	**1523**	**2373.29**	**474.7**

Ontario Homes achieving a HERS 46 or less per builder 2019-2023						
Builder	2019	2020	2021	2022	2023	Total # of homes
Brookfield Residential	101	138	205	80	30	554
Campanale Homes	11	57	35	61	25	189
Dietrich Homes	0	0	6	24	11	41
Empire Communities	284	841	559	428	207	2319
Frontdoor	31	0	0	0	0	31
Habitat for Humanity	12	0	12	76	0	100
Heathwood Homes	0	18	63	76	46	203
Hunt Homes	12	14	7	17	5	55
Lindvest Communities	0	1	42	123	127	293
Liv Communities	169	0	0	0	0	169
Longwood Building Corp	0	0	0	0	35	35
Menkes	29	0	0	0	0	29
Regal Crest Homes	148	31	46	28	120	373
Rosehaven Homes	279	31	130	40	44	524
Royal Park Homes	8	45	0	0	18	71
Royal Pine Homes	0	2	2	66	58	128
Starlane Homes	260	1	20	0	50	331
Summitpines Estates	0	94	16	1	0	111
Treasure Hill	45	0	0	0	0	45
Tribute Communities	0	10	89	60	34	193
Upperview Homes	0	0	25	7	0	32
Vogue Homes	0	17	1	21	0	39
Custom Builder	69	14	56	37	17	193
3 Year Total (HERS <46)	-	1309	1297	1118	-	3724
5 Year Total (HERS <46)	1458	1314	1314	1145	827	6058
5 Year Total HERS Ratings in Ontario	**1707**	**1455**	**2028**	**2146**	**1793**	**9129**

Thresholds represent government programs

Tier 4 –Net Zero
Tier 5 – Passive House



- OBC 2024 to be released by April 10th, 2024
- January 1st 2025

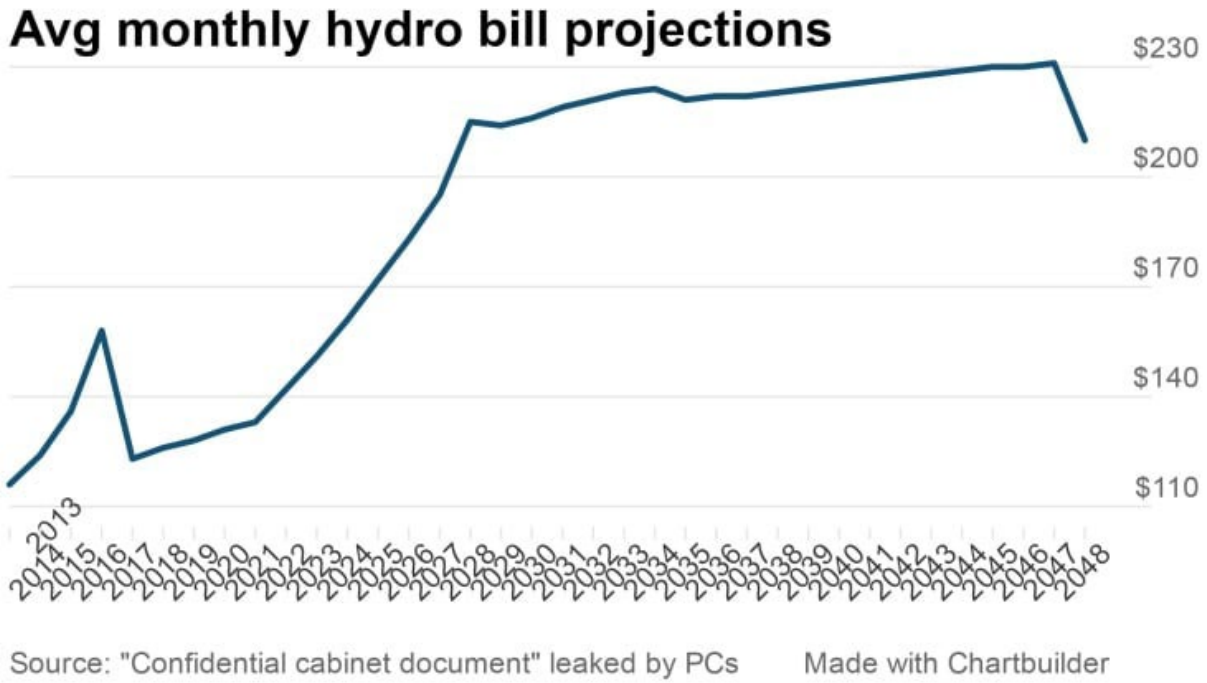
It looks like Ontario and BC have adopted a base level at Tier 3 for 20% better. Other provinces are adopting NBC 2015. (Tier 1)

Ontario has special needs

- Housing affordability and high development charges
- 45% of Canada’s people and cars and a peak load electricity challenge
- Nuclear power generation and stranded off-peak capacity, battery storage and a smart grid is the answer
- Provincial building code already **exceeds** the Paris Accord and meets COP 28 for CO2 reductions
- Local Green Building Standards are referencing Net Zero Ready or Tier 4 and builders need equivalencies such as demonstrated by Hybrid House.

How your hydro bill will rise over the next decade from leaked government document

Mike Crawley · CBC News · Posted: May 11, 2017 2:31 PM EDT | Last Updated: May 11, 2017



2022	$142
2023	$151
2024	$161
2025	$172

The document shows the average household monthly electricity bill in Ontario rising from $123 in 2017, to $195 in 2027, then $222 in 2037 and $231 in 2047.

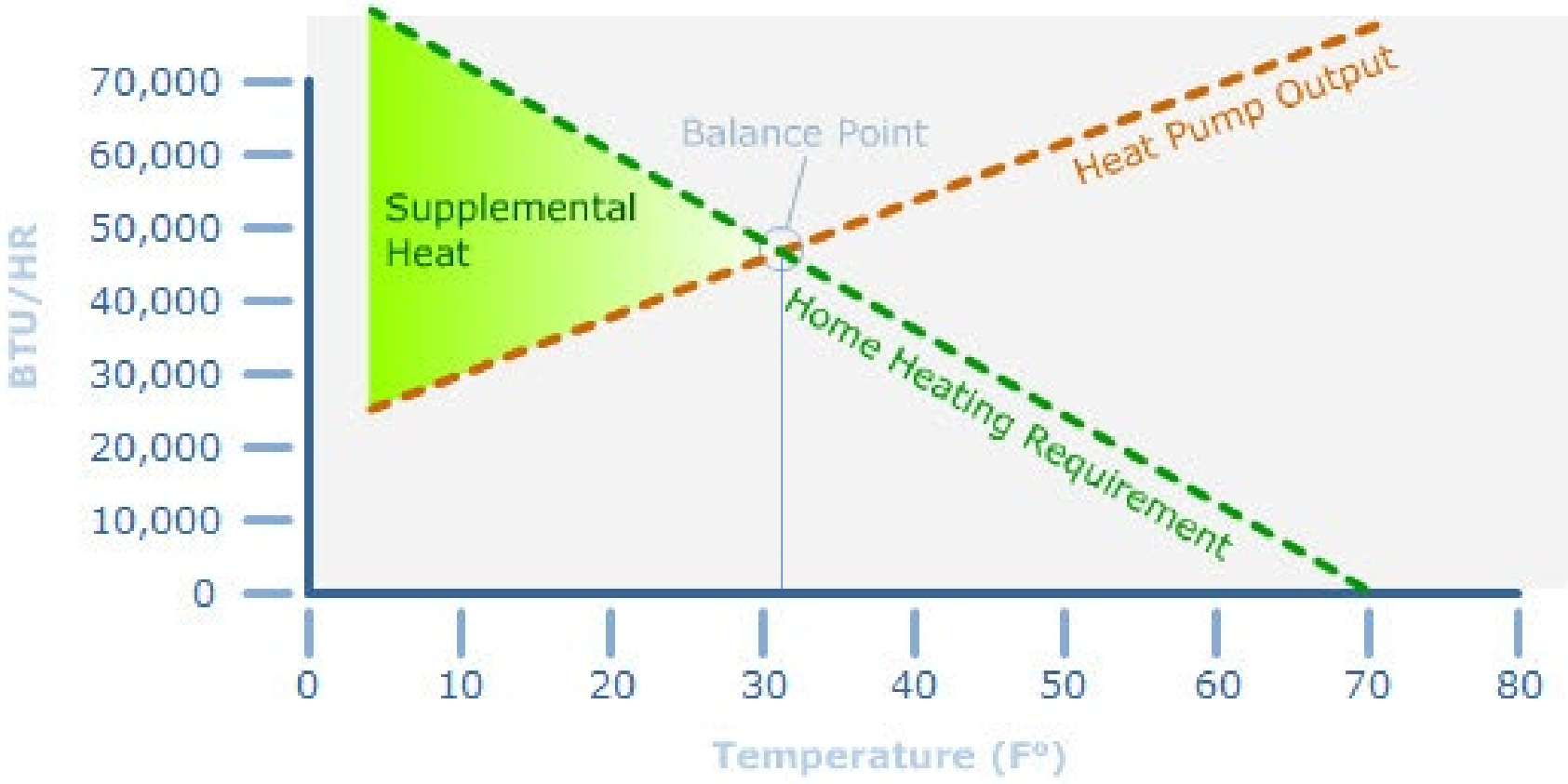
Takeaway: Analysis shows increase from 2022 – 2025 of 18%. This translates into $30/month or $360/year + $39 (delivery charges) for a total of $2064 + $468 (delivery charges) plus taxes. Total = **$2861.16/12 = $238**

3 Season Heat Pumps

As the outdoor temperature drops, the heating requirement of the house increases and the output of the heat pump decreases. At some point, the temperature of the home's heating requirement and the heat pump output match. This temperature is called the **balance point** and usually falls between 30-45 degrees Fahrenheit.

For any temperatures below the balance point, supplemental heat will be required. To locate the balance point, the heating requirement (BTUs/h) of the house and the heat pump output (BTUs/h) are plotted against the changes in outside temperature.

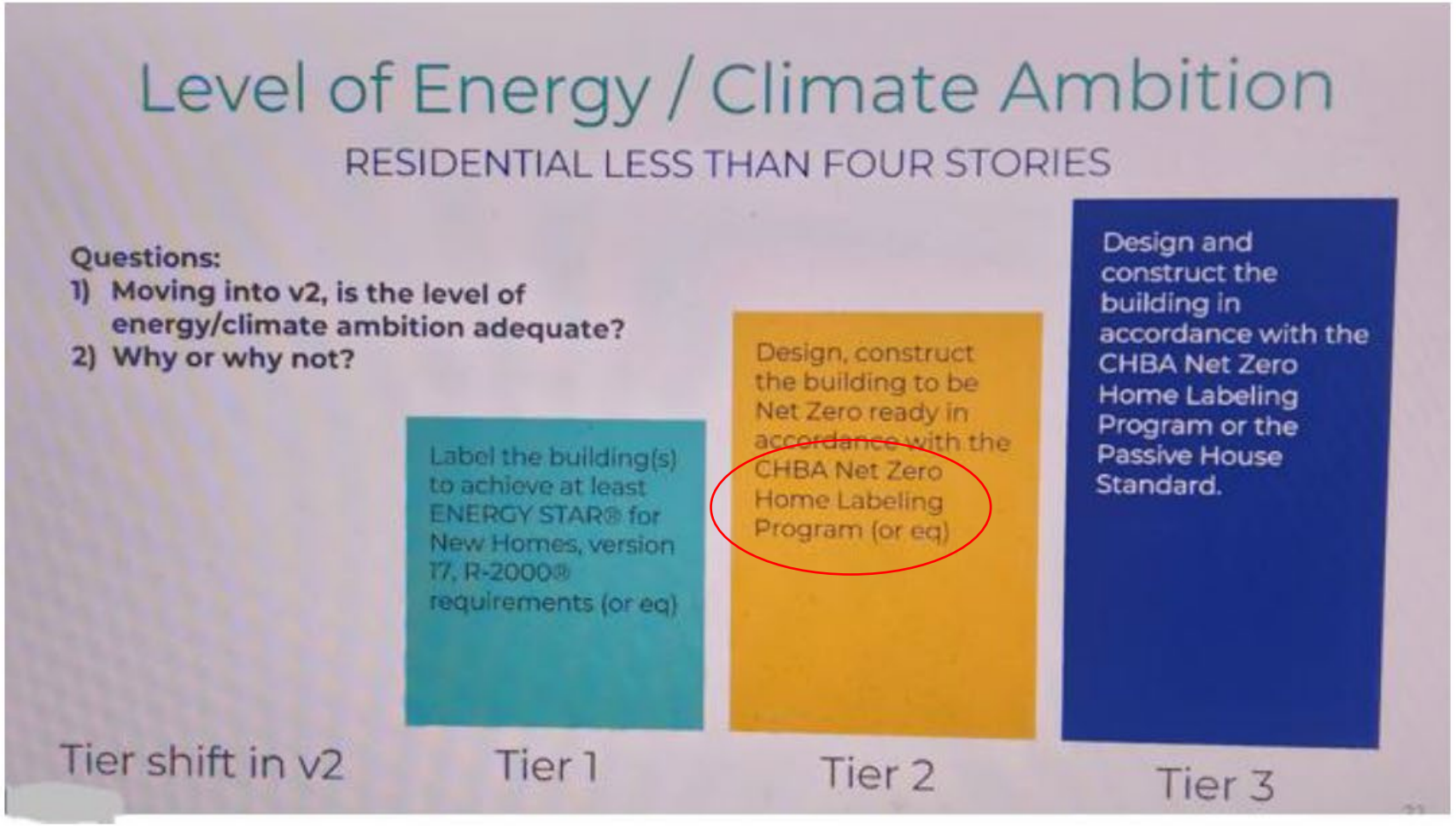
The place where the home heating requirement and heat pump output lines cross is the balance point.



How did we get here?

Local Green Building Standards (GBS) adopted by East Gwillumbury in 2006
OBC 2009 started transition towards energy performance in its prescriptions
OBC SB-12 2012 recognized energy performance requirements (ERS 80)
OBC SB-12 2017 removed rating system and prescriptions A1 to A6 15% better than ERS 80
OBC SB-12 2022 put on hold by Ford Government to wait for harmonization
OBC 2024 proposed adoption of Tier 3 equivalency to NBC 2020
GTA municipalities Caledon, Whitby, Markham referencing NBC 2020 Tier 4 (undetermined what this is)

Durham Green Building Standard



Local Green Building Standard CHBA Net Zero Ready when Ontario adopts Tier 3

Pickering Integrated Sustainable Design Standards

Low-Rise Residential

Performance Measures		Performance Criteria			For Submission		
Number	Development Feature	Tier 1 Mandatory	Met	Tier 2 Optional	Met	Documentation	Comments
ER2	**Building Energy Performance and Emissions**	Design and construct all buildings to achieve or exceed the **Energy Star®** for New Homes, latest version, or demonstrated modeled equivalent (e.g., Better Than Code ® using **Home Energy Rating System (HERS)**). **or** Design and construct all buildings to meet or exceed the **Energy Performance Emissions' Total Energy Use Intensity (TEUI)**, **Thermal Energy Demand Intensity (TEDI)** and **GHG Emission Intensity (GHGI)** targets.	☑	Design and construct all buildings to achieve a minimum energy performance level of 25% or better than the **Ontario Building Code** requirements in force at the time of application. **or** Design and construct all buildings to meet or exceed the **Energy Performance Emissions' Total Energy Use Intensity (TEUI)**, **Thermal Energy Demand Intensity (TEDI)** and **GHG Emission Intensity (GHGI)** targets.	☐	☑ Energy Modelling Report or other documentation demonstrating compliance with the target standard.	
ER3	**Renewable Energy**	Design and construct all buildings to be **solar ready**. **or** Incorporate web-based **Home Energy Management Systems (HEMS)**.	☐	Incorporate on-site **renewable energy** sources of power generation to meet 5% or more of the building energy needs. **or** Incorporate **peak shaving** devices like battery storage.	☐	☐ Drawings, plans, or other documentation demonstrating compliance.	

Table 5.1 Comparison of Actual Energy Consumption to Computer Modelled Consumption by end use for Lot120R

Item	Actual Consumption	REM/Rate	%diff	HOT2000	%diff
Annual Energy Consumption Calculated (kWh/yr)	24,030	21,428	-11%	15,202	-37%
Annual Energy Costs Calculated for Energy Only Note 1	$1,871.71	$1,423.09	-24%	$1,190.25	-36%
Actual Energy Costs from Utility Bills Note 2	$2,805.66				
Space Heating-Heat Pump (kWh/yr)	3,370	3,360	0%	2,665	-21%
Space Heating-Combo (kWh/yr)	7,322	7,922	8%	2,619	-64%
Ventilation Power Consumption (kWh/yr)				307	
Space Cooling (kWh/yr)	1,035	492	-52%	770	-26%
Water Heating (kWh/yr)	4,984	3,079	-38%	2,896	-42%
Lights and Appliances (kWh/yr)	10,688	6,575	-38%	5,832	-45%

Consistent with NRCan study

ANALYSIS OF THE MEASURED vs PREDICTED ENERGY PERFORMANCE OF NET ZERO ENERGY AND NET ZERO ENERGY READY HOUSES – SOME LESSONS LEARNED

House

Gas Usage – Why Was It So High?

- 2 Houses used gas for space heating with electric DHW
- 5 Houses used gas for space and DHW heating

House	Climate Region	Gas Consumption (GJ)			DHW
		Predicted	Actual	Predicted-Actual	
2	7A	15.6	39.9	-24.3	Electric
3	6	1.9	7.5	-5.6	Electric
4	6	11.7	29.2	-17.5	Gas
7	6	11.5	10.1	1.4	Gas
8	5	11.4	23.8	-12.4	Gas
11	5	12.7	34.5	-21.8	Gas
12	5	11.6	44.3	-32.7	Gas
Mean (Predicted – Actual) Gas Use Gas heating, electric DHW				-14.8	
Mean (Predicted – Actual) Gas Use Gas heating, gas DHW				-16.6	

For the 13 Houses:
Mean predicted energy use:
25.4 GJ/yr

Mean measured energy use:
35.3 GJ/yr

Actual average electrical and natural gas consumption 9.9/25.4 = 40% over predicted on Net Zero and Net Zero Ready Houses

Solar PV

PV System Performance

House	HOT2000-Predicted PV Generation (kWh/yr)	Measured PV Generation (kWh/yr)	Percent Achieved
2	14,174	9,710	69%
12	9,875	8.875	90%
13	12,975	9,570	74%
		Average	**78%**

On Net Zero Houses, photovoltaic powered generation is 22% less energy predicted by software.

Table 6.1-Summary of Results (Continued)

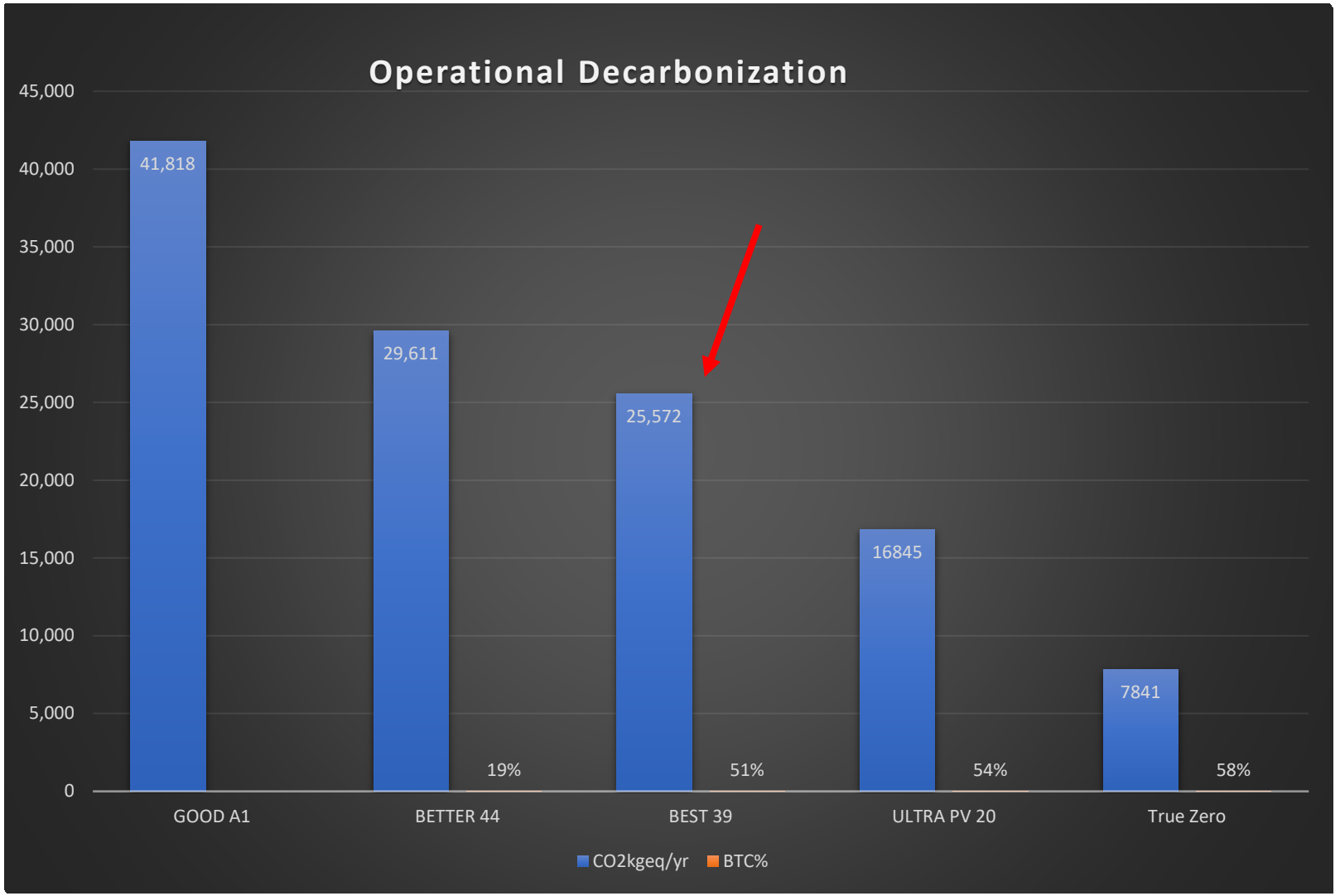
Component	1	2	3	4
	NBC Tier 1 2020	**OBC Package A1 2017**	**Hybrid House-Lot 120 R**	**CHBA Net-Zero-Lot 120 L**
Design Heat Loss (Btu/hr)	**34,700**	**32,300**	**22,900**	**19,200**
HERS Index (Figure #)	**63**	**57**	**38** (1)	**9** (2)
Carbon Index	**116**	**102** (3)	**66** (4)	**15**
Annual Modeled Energy Consumption (kWh/yr)	39,487.0	35,576.0	21,428.0	2,910.0
Consumption Difference to Tier 1 (%)		**9.9%**	**45.7%**	**92.6%** (5)
Estimated Annual Energy Costs $	$ 2,047.63	$ 1,978.38	$ 1,423.09	$ 317.19
Actual Energy Cost From Bills-$	N/A	N/A	$ 1,816.40	$ 1,214.48
Cost of Upgrades ($)			$ 4,214.90	$ 51,253.41
Simple Payback ($)			7.6 Years (6)	46.2 Years (6)
Est. Ann. Energy Saving ($)	N/A	N/A	$ 555.29	$ 1,105.18
Annual Mortgage Cost ($)	N/A	N/A	$ 318.84	$ 3776.88
Annual Cash Flow ($)	N/A	N/A	$ 236.45 (7)	**-$2,671.70** (8)

Discovery House OBC 2020 Comparison **14-Mar-23**
Low Carb - 38-4

Component	GOOD Package A1	BETTER	BEST	ULTRA	TRUE 0	Comments
Ceiling w/ Attic	R-60					
Ceiling w/o Attic	R-31					
Exposed Floor	R-31	R-40 G I				
Below Grade Walls	R-20	R-20	R-22+5ci			Finished ready Bsmt
Above Grade Walls	R-22	R-22+4.42ci			R-10 Under slab	
Slab < 600 mm	R-10 Under	N/A	N/A	R5 Dricore	R-10 Under slab	Secondary suite
Windows	1.6	U= 1.53 SHGC = 0.20	U=1.4, SHGC=0.3		U= 1.08 SHGC = 0.38	
Space Heating Combo	96% AFUE	96% AFUE w/ ECM Combo Navien-240				NPE-240 with iFLOW values P9-11
Space Cooling	13 SEER	16 SEER	21 SEER			
Heat Pump			21 SEER 10 HSPF			
Domestic Hot Water	0.80 EF	0.95 EF Navien-240				
ERV (Sensible Efficiency)	75% ERV	77% ERV Panasonic 100	83% ERV Panasonic FV-20VEC1			Exhaust ducted ERV
Insulation Grade	III	II			I	
Lighting (LED's)	N/A	100% LED				
Drain Water Heat Recovery	R3-42 (2 showers)	R3-60 (2 showers)				
Air Tightness (ACH)	3	2.0		1.5		Aerobarrier
Home Energy Monitoring System	N/A	Yes				
Appliances	N/A	yes				See attached table
PV (Solar)	N/A	N/A	N/A	7 kW and battery	17 kW (46 Panels)	East-West
HERS	58	39	39	20	0	Solar Battery Storage
Annual Energy Consumption (kWh/yr)	42,181.0	**29,611.0**	**25,572.0**	**16,845.0**	**7,519.0**	
Consumption Difference (%)		**33%**	**41%**	**61%**	**83%**	
Design Heat Loss (kBtu/hr)	42300	**32,700**	**32,100**	**30,300**	**27,400**	
Annual GHG Emission (kg) *	**5295**	**4312**	**2578**	**2422**	**2212**	
GHG Emission Saving over OBC	-	**19%**	**51%**	**54%**	**58%**	1

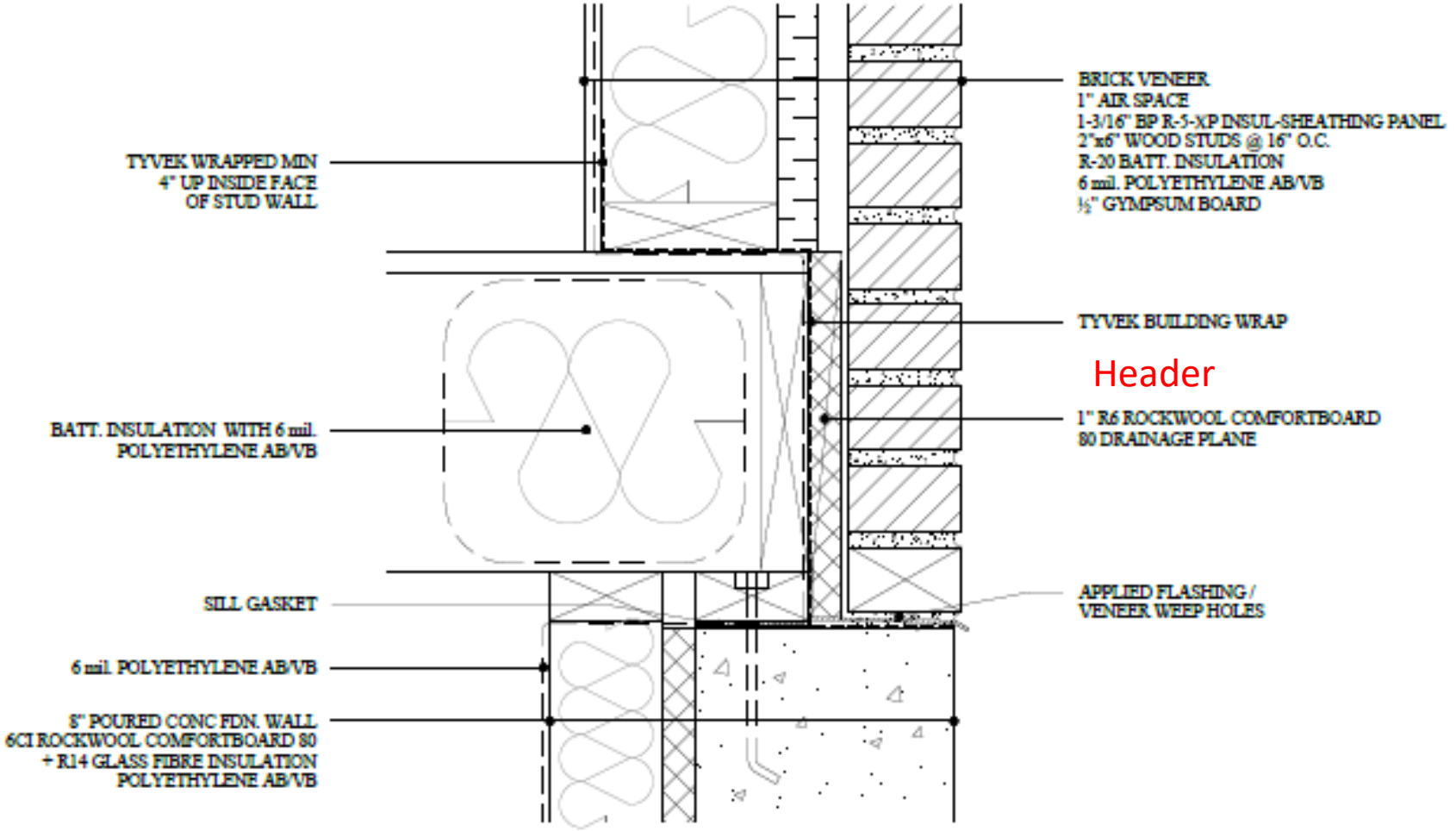
Proposed 2 and 3 A1 Reference all runs -365 kWh HEMS	43375.00

Green house gas emission factor based on SB-10 Table 1.1.2.2
* Nat gas @ 1.9 kg/m3 or 5.37 kg/CCF



GOOD A1	BETTER 44	BEST 39	ULTRA PV 20	True Zero
41,818	29,611	25,572	16845	7841
	19%	51%	54%	58%

Low Carbon foundation wall detail



8" FOUNDATION WALL SECTION
AT FIRST FLOOR WITH BRICK VENEER

1
A1.1

3" = 1'-0"

Christian Rinomato and Corey McBurney at the opening of the “Super-Semi” project November 19, 2021

Builder Perspective and Lessons Learned

I want to start by thanking all those who have been involved in this Discovery Home study. We intended to create two archetype homes that would further our understanding of low-carbon construction in low-rise development. Understanding these two models, both electrification and the hybrid approach has been incredibly helpful for us here at Country Homes, as well as the construction industry. Based on the study we have done here, it has come to our conclusion that we prefer the HERS rating modeling over the HOT2000 modeling as we found it much more accurate, especially as it pertains to the occupancy loads. It is important for us to show and market Energy scores that we are confident in and are the most accurate so that we do not mislead our customers.

We were also excited to explore how a system installed on our home would perform, both through an efficiency lens, but also a financial lens. We concluded that installing a single solar system for our homeowners does not make sense economically and is better off purchasing power solely from the local grid. We are exploring options for the future such as micro-grids and virtual net metering to further help the business case for solar energy.

Reviewing the Hybrid house performance, cost, and constructability (Lot 120R), Country Homes found that this was the best-suited approach as the next step to decarbonization. We will leverage the ITC tax credit to assist us with the cost of the air source heat pump, but we appreciate the low cost of operation, as well as the reduced use of natural gas. Currently, the grid cannot support the full electrification of communities so to bridge the gap we will be building the “hybrid” home as our new standard for the foreseeable future.

When we look at the idea of the Net Zero Programs, we do not support this concept. The reason is we found that the embodied carbon required to build a “Net Zero” home would put us back significantly for overall carbon. Currently, Ontario’s electricity grid is quite clean, and feel it is best suited to put our efforts towards a material selection that can reduce the carbon in our homes. From the builder's perspective, we feel hand-tied when programs are forced upon us. We are currently striving for 20% better than code and believe it should be up to us on how we get there.

We will continue to strive for a better-performing home, both from an environmental perspective, but also an economic perspective. We are in the midst of an affordability crisis and as a builder, it is our responsibility to build better homes that perform efficiently and are affordable to operate.

Christian Rinomato

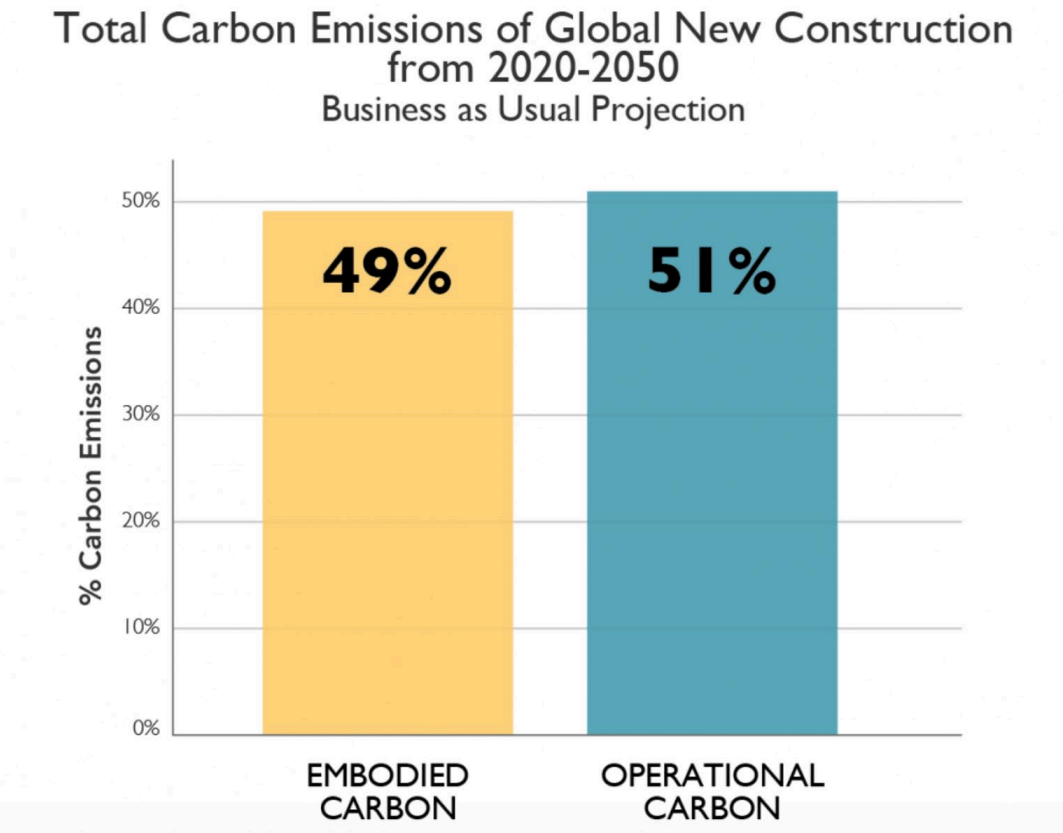
Associate Project Manager, Country Homes

Ontario's not so clean Grid

Emissions in Ontario's grid rose by 28% in 2021

- "The increasing use of natural gas-powered generating plants, which increase carbon intensity of the Ontario"- The Atmospheric Fund
- Over the next two decades, greenhouse gas (GHG) emissions from Ontario's energy grid are set to skyrocket more than 400 percent as the province cranks up the dial on its underused fleet of natural gas plants.
- A 100% clean grid is a prerequisite for decarbonizing the rest of the economy, which will need massive amounts of green electricity in the future

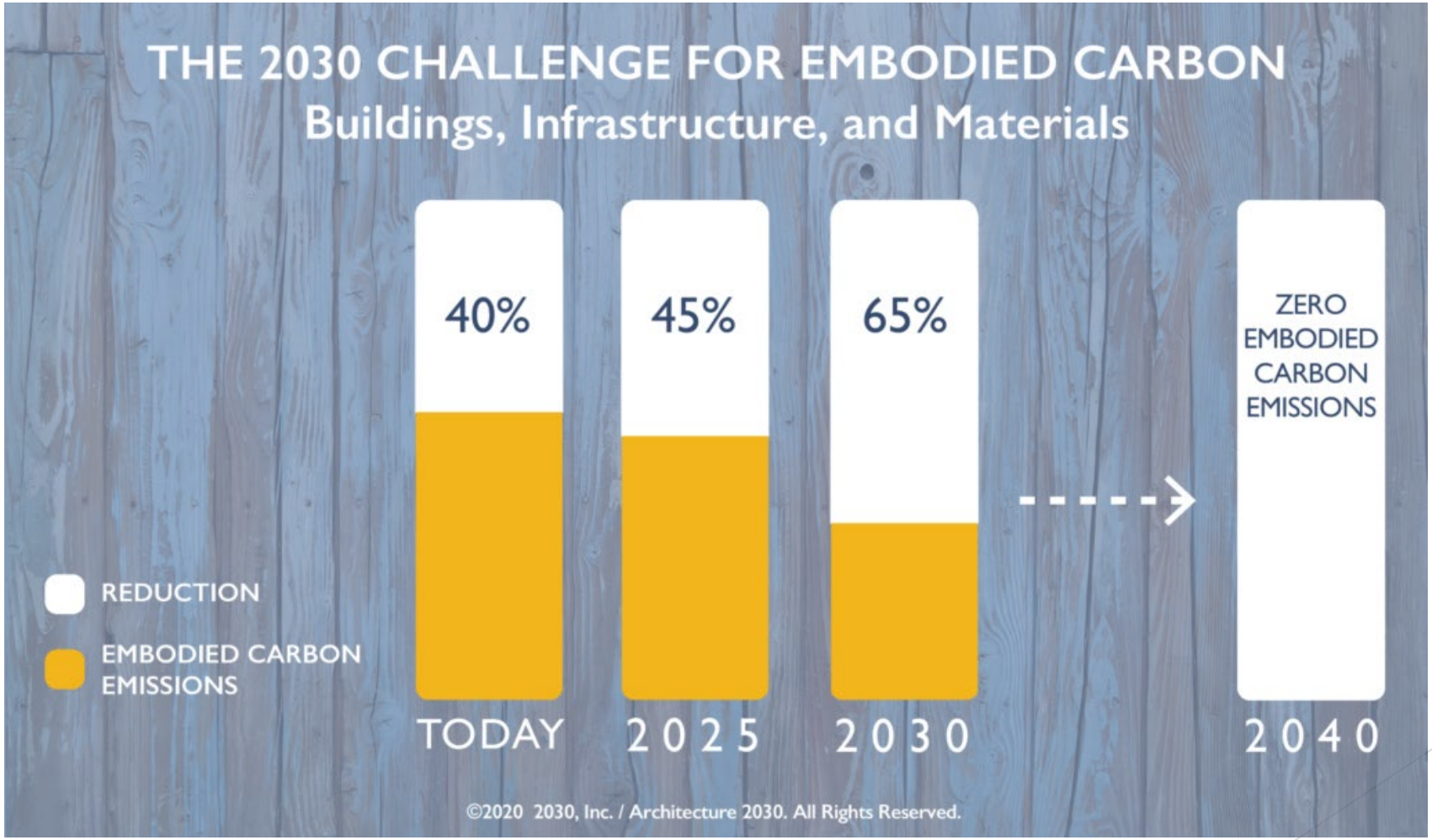
Operation vs. Embodied Carbon over 30 years



- Unlike operational carbon emissions, which can be reduced over time with building energy efficiency renovations and the use of renewable energy, **embodied carbon** emissions are locked in place as soon as a building is built.
- It is critical that we get a handle on embodied carbon now if we hope to phase out fossil fuel emissions by the year 2050.

Takeaway: HERS 46 is the threshold for decreasing operational carbon which is 51% of a house.

THE 2030 CHALLENGE FOR EMBODIED CARBON



Who Is RGC Energy Inc.?

BUILD WITH CLEAN, AFFORDABLE SOLAR ENERGY

We provide energy solutions to homeowners and homebuilders across Ontario. Our team will provide a solar solution to meet the energy needs of the homes and community you are building. We design, install and maintain the residential solar systems. By offering competitive pricing structures and excellent customer service, we help homeowners save money on their energy bills to reduce our environmental impact.

TURN SOLAR ENERGY INTO YOUR COMPETITIVE ADVANTAGE

Residential Solar

You can offer your customers three different pricing structures to best suit their needs:

1. PAY FOR ELECTRICITY AND NOT THE SOLAR PANELS

- Through a power purchase agreement, the homeowner will pay for the electricity that is generated from the solar system, similar to how they purchase electricity from the utility.

2. RENTAL OF EQUIPMENT

- Your homeowner can opt-in to a rental agreement for the equipment, which includes the use of solar energy and all maintenance required for the system. They are billed a fixed monthly fee.

3. PURCHASE OF EQUIPMENT

- Your homeowner can purchase the solar system from RGC Energy and include it in the final purchase price of their home.

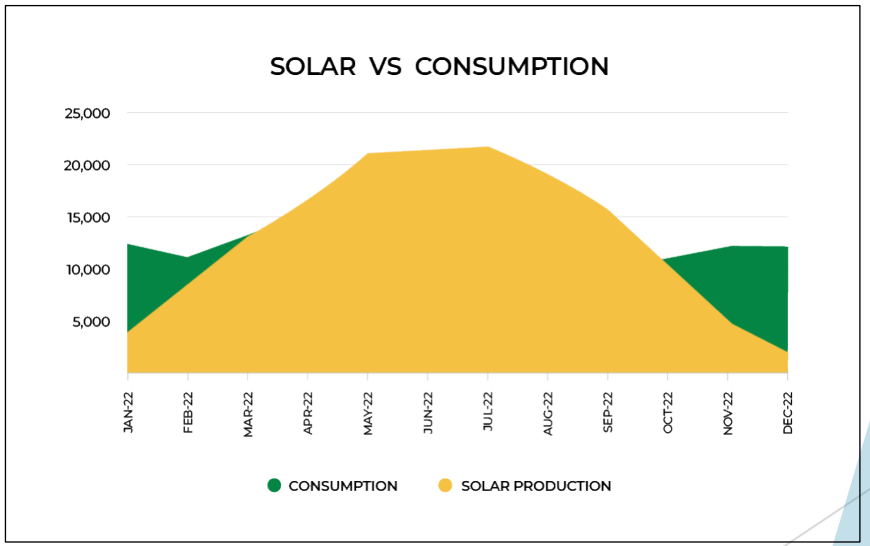
What is Solar Net Metering?

ONTARIO'S REGULATION

When the solar panels generate more electricity than you need, the excess energy is distributed to the utility company and you receive a credit on your energy bill for the energy sold. These credits can be used over 12 months.

Challenges:

- Our grid cannot handle twice the capacity at this moment for large-scale solar development
- We are currently struggling to deal with capacity for expansion



KB Homes: Connected Community – Nanogrid + Microgrid + Grid

- Virtual Net metering = Ontario's answer for solar power
- Micro Grids allow for economies of scale for solar developers to make clean electricity work
- We are 5-10 years away from this becoming a reality

Microgrid

=

Community PV

+

Battery Storage

"The experience opened our eyes to the need for offering builders a turnkey solution to on-site renewable energy development."

Nanogrid

Solar Solutions for Builders

Christian Rinomato, head of sustainability at Country Homes, a division of Rinomato Group of Companies, is an enthusiastic proponent of low-carbon building. In 2022, his company was the proud recipient of the Canadian Net Zero Builder award in the RESNET Cross-Border Builder Challenge for its discovery homes in a Milton development. With a net zero goal, the project set out to explore the inclusion of renewable energy by pushing the capabilities of the buildings, the built environments and the new technologies involved in all-electric homes.

"The experience opened our eyes to the need for offering builders a turnkey solution to on-site renewable energy development, so we opened RGC Energy, a renewable division of our company," says Rinomato. The formation of RGC, established two years ago, was the result of considerable planning and coordination with the Ontario Energy Board (OEB), different levels of government and utilities.

Under licence with the OEB, RGC offers a unique and sustainable solution to meet the energy needs of homebuilders, homeowners, community builders and businesses across Ontario. The company designs, installs, owns and operates residential and commercial solar systems, selling the electricity generated through net metering directly to the occupants.

Rinomato describes RGC as a third-party ownership model that is unique in Ontario. "Partnering with Country Homes, it allows for an integrated approach, working closely with builders and local utilities in the planning and development phase of projects," he says. "By offering competitive pricing structures that protect against rising energy costs, combined with excellent customer service, we help homeowners and businesses save money on their energy bills and reduce their environmental impact."

> "The experience opened our eyes to the need for offering builders a turnkey solution to on-site renewable energy development."

Conclusions of Super Semi Study

Ultimately, after studying the energy-use data from the occupied homes over the course of a full year, the following observations and conclusions were made:

1. Both houses consumed more energy than predicted by software modelling. The REM/Rate software appeared to predict total energy use better than HOT2000; the REM/Rate prediction of total energy use was 11% lower than actual use on Lot 120R; the HOT2000 prediction was 37% lower.

2. The largest variation in energy use was observed in base loads (lights, appliances and domestic water heating).

3. Both software packages substantially under-predicted cooling loads. This could have partly been a result of the fact that the cooling loads were higher than predicted.

Takeaway: Both softwares work for code compliance as recognized in the Ontario Building Code

4. Combination hybrid heat (CHH) is an emerging strategy for the wise use of natural gas in a transition period of increasing housing demand which reduces CO2 by 20%.

5. In Lot120L, even with the maximum solar PV generation (10.7kWh) determined by the CHBA NetZero program requirements, the all-electric house fell far short of its net zero energy target.

6. In terms of costs versus energy savings, it appears that the package of features used to achieve NBC Tier 4 performance (i.e. Lot120R – Hybrid House) had a simple payback of 7.6 years as opposed to going to Tier 5 and beyond which has simple payback of 45 years.

Summary

- Occupancy a big load? How big is it actually?
- The Discovery Home – road testing new technologies and building practices
- As a Low Carbon Builder, how do I market our products and ourselves – Net Zero?
- Cost Benefit and execution with our subtrades and our team
- The viability of Solar PV or Battery Storage
- Lesson learned – the wise use of natural gas as a bridging fuel and understanding the impacts of electrification
- Embodied carbon analysis in new builds to find the sweet spot

Special thanks to all of the sponsors of the Super Semi demonstration project!

- Airmax and Glow
- Aerobarrier
- Aria HVAC
- Carrier
- Clearsphere Consulting
- Panasonic
- Renewability
- RESCON
- Rockwool
- Schneider Electric
- VanEE
- Country homes owners and staff

Paul “The Brain” Duffy

2024 SHF Green Builder Challenge Golf Tournament

June 19th 2024

June 19, 2024 12 Noon to 5 PM

Flemingdon Golf Course, Toronto

The annual Green Builder Challenge Golf Tournament, hosted by the Sustainable Housing Foundation's President John Godden, is happening on Wednesday June 19th in the afternoon and you are invited to attend. Lunch and beverages will be provided before the first T-off time at 1 PM so come early and enjoy a relaxing lunch on the patio and great networking opportunity with your colleagues from the sustainable building industry in Toronto.

The price to play is $150 with all proceeds going toward supporting the educational training that the Foundation undertakes every year. You can book for just yourself and we will place you in a foursome, or book your own foursome and reward your staff or clients to a great afternoon of golf and comradery. Space is limited to 40 golfers so please book early. Please note that the game played will be best ball with T-offs scheduled every 10 minutes or so starting at 1 PM. The course is a nine hole course so only takes a couple of hours to play. No mechanical carts are allowed but you will be provided with a pull handle. Golf clubs can be rented directly from the golf course if pre-arranged with them. Registration details to come. Hope to see you there!