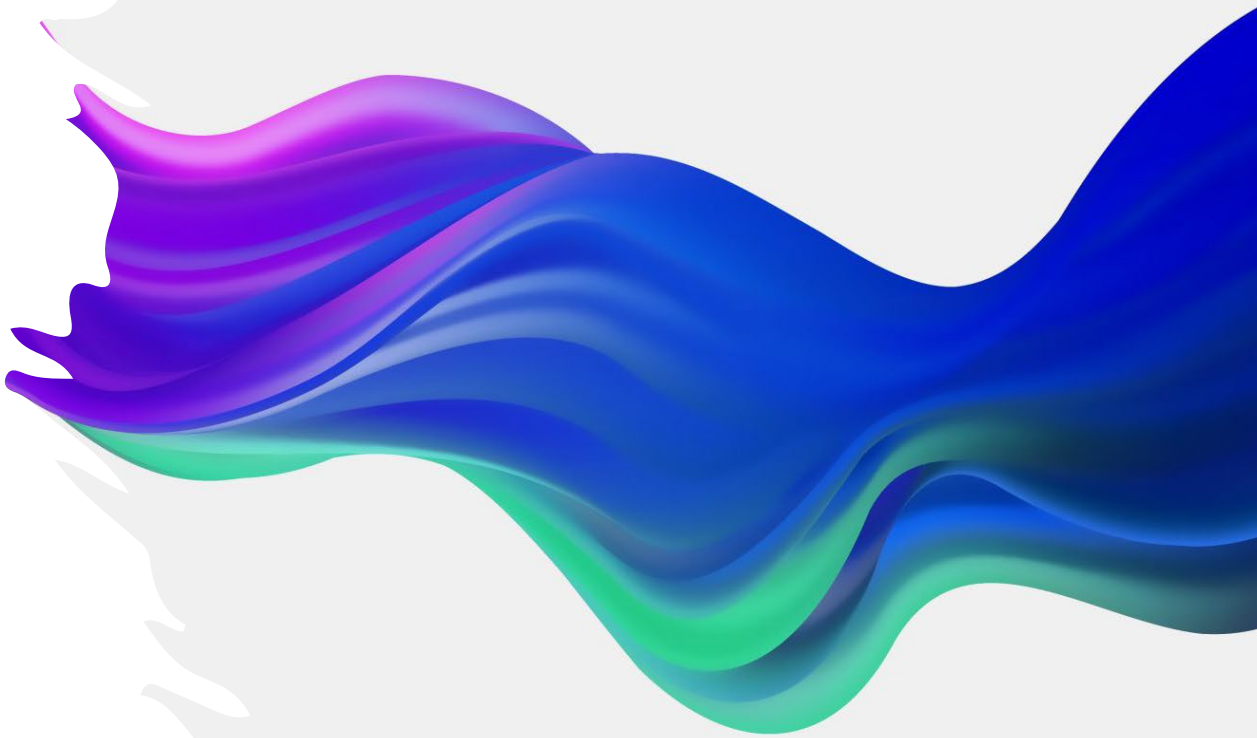
Diminishing Marginal Returns and Measuring Sustainability

By: John Godden

March 22nd 2023



SUSTAINABLE HOUSING FOUNDATION

In-person event on December 5th 2022

- How to create reasonable targets for carbon reduction
- Home energy management systems
- Future fuels- including hydrogen
- Embodied carbon – what it means for builders
- Connected buildings and neighbourhood grids
- Structural design efficiencies for sustainability and resiliency
- Finding the skilled trades needed
- Global warming products for the construction industry

Which gap can you personally fill? Which gap can we collectively fill?

Frank Buck
Frank Buck
Partner, The Davis Buck Agency

Frank Buck has over 30 years of experience in the North American construction industry. He has served in a variety of sales and marketing roles for major building material manufacturers, including as vice president, marketing for Moen Inc., an industry leader in stylish, highly reliable water conserving products for residential and ICI applications. In addition, Frank spent 11 years in the masonry sector, working for major Canadian clay brick producers Canada Brick/Hanson and Brampton Brick as vice president, sales and marketing and senior vice president, strategic planning, respectively.

Frank now owns and operates his own sales and marketing consulting agency called The Davis Buck Agency, specializing in environmentally appropriate hydronic HVAC products for the residential construction industry. He is proud to represent locally manufactured AIRMAX hydronic air handlers and Glow Brand a Canadian made heating and hot water product line.

For more information on the products that Frank represents:
http://www.airmaxtechnologies.com/index.html
http://www.glowbrand.ca/

“The law of diminishing returns means that even the most beneficial principle will become harmful if carried far enough.”

— Thomas Sowell

Who is this?

Rick’s rules. 1) Think before you act

2) Go for the low hanging fruit

What's the definition of net zero

- Does Zero actually exist?
- What is meant by Net Zero?
- What do we mean by modelled balanced energy?
- Is it reasonable to offset fossil fuels with electricity?
- Should the definition balance operational carbon with embodied carbon (LDMR)?
- With M.O.R.E requirements, one definition of Net Zero is being referenced. Is that prudent?

Sustainability

Doing more with Less

Less concrete, less brick, less glass, less steel, less solar panels, less foam, less embodied carbon

More carbon smart wood fiber from sustainable forestry practices locally produced

Project Profile – Lot 25 – Model 40-1

Newmarket 2009
34 LEED Platinum Homes

Breaking News!

RESNET CO2 RATING INDEX

ANSI/RESNET/IECC 301-2019 Addendum D-2022

- RESNET recently released an ANSI standard on how to calculate the carbon impacts of an individual house or building.

- The standard is one of the first of its kind in the world to estimate emissions accurately by

- accounting for the hour of the day/month/year at which electricity is consumed

- accounting usable renewable energy (solar,wind) against fossil fuel emissions. Hourly calculations are critical for impact on electrical grid.

- The standard allows calculation of electrification anywhere in United States (North America)

- Other benefits – local jurisdictions can target a maximum carbon savings, utilities can target goals and homeowners can reduce their carbon footprint

ANSI/RESNET/ICC 301-2019 Addendum D-2022
CO_2 Rating Index

Modify Section 1 as follows:

1. Scope. This standard is applicable to Dwelling Units and Sleeping Units in Residential or Commercial Buildings, except hotels and motels.[1] Energy Ratings determined in accordance with this Standard are for individual Dwelling Units or Sleeping Units only. This Standard does not provide procedures for determining Energy Ratings for whole buildings containing more than one unit.

This standard identifies the metrics, tolerances, procedures, calculations and the required documentation to: (1) calculate the standard energy use of Dwelling Units and Sleeping Units, (2) determine the Energy Rating Index of Dwelling Units and Sleeping Units, (3) determine the CO_2 Index of Dwelling Units and Sleeping Units, (4) define the minimum rated features of Dwelling Units and Sleeping Units, (5) calculate the retrofit savings for existing Dwelling Units and Sleeping Units, (6) calculate the cost effectiveness of energy saving improvements to Dwelling Units and Sleeping Units and (7) label the certified energy and CO_2 performance of Dwelling Units and Sleeping Units.

Modify Section 5 as follows:

5.1.2.2. ~~Pollution~~ Emissions ~~Savings.~~ ~~Where determined, t~~The ~~pollution~~ emissions ~~savings~~ for the Rated Home shall be calculated in accordance with Sections 5.1.2.2.2.1 and 5.1.2.2.2.2.

5.1.2.3. ~~Pollution~~ Emissions. ~~Pollution e~~Emissions for all homes shall be calculated in accordance with Sections 5.1.2.2.1.1 and 5.1.2.2.1.2.

5.1.2.3.1.1.1. For electricity use, data for the sub-region annual total output emission rates published by Environmental Protection Agency's ~~2012~~ 2019 eGrid database[2] for electricity generation shall be used to calculate emissions~~.~~[3] except CO_2 emissions, which shall be calculated using the Cambium database[4,5] for the most recent year's Mid-case, average hourly CO_2 generation rate (*co2_rate_avg_load_enduse*: $kgCO_2$ per MWh_{enduse}) for the local ZIP Code.

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1 (Normative Note) The terms "Dwelling Unit" and "Sleeping Unit" are interchangeable with the term "home" throughout this Standard, except where specifically noted.
2 (Informative Reference) http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html
3 (Informative Note) RESNET will compile and publish annual total output ~~pollution~~ emission rate data for NOx, SO_2 and CO_2 in accordance with the provisions of this section that can be used by Approved Software Rating Tools for the calculation of emissions.
4 https://cambium.nrel.gov/
5 Gagnon, Pieter, Will Frazier, Elaine Hale, and Wesley Cole, 2020. "Cambium Documentation: Version 2020." Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-78239. https://www.nrel.gov/docs/fy21osti/78239.pdf

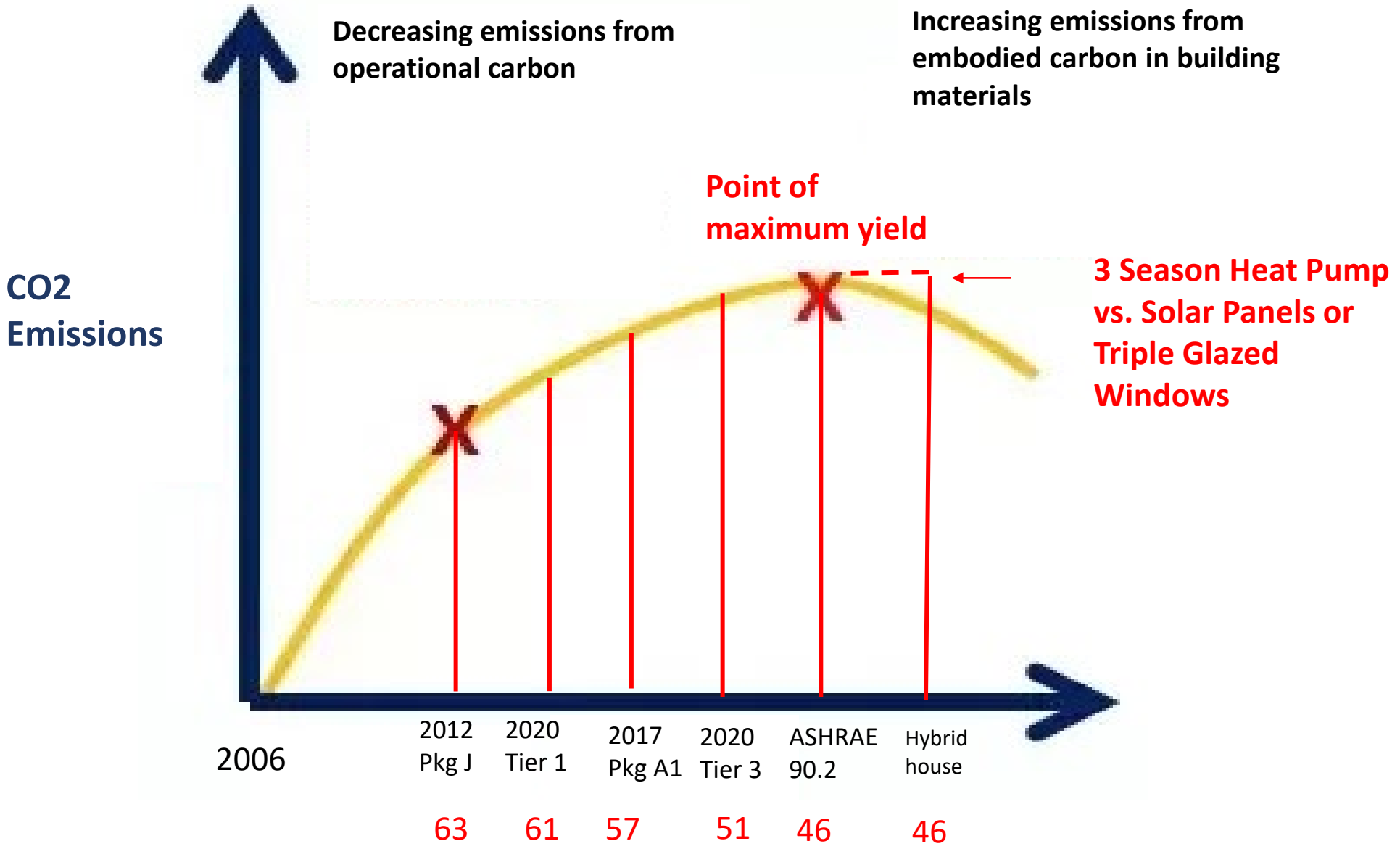
NBC Tier 1 Comparison

Low Carbon Builders Estimated CO2 Reductions and Savings for Homeowners compared to Tier 1

Builder	AVG % BTC	*ESTIMATE COST SAVINGS FOR HOMEOWNER ($)	# OF HOUSES	TOTAL ENERGY SAVINGS PER YEAR ($)	TOTAL CO2 REDUCED Tonnes	CARS OFF THE ROAD
Brookfield	32%	836.88	195	163192	163.2	55
Campanale	35%	915.34	62	56751	93.7	19
Country	31%	810.73	27	21890	36.1	7
Empire	35%	915.34	751	701167	1157.4	231
Dietrich	42%	1098.41	22	24165	39.9	8
Heathwood	35%	915.34	145	132724	219.0	44
Icon	31%	810.73	32	21079	34.8	7
Lindvest	37%	967.64	117	113214	227.0	45
Minto	29%	758.42	18	13652	22.5	8
Rosehaven	32%	836.88	136	113816	187.9	38
Royal Pine	39%	1019.95	75	76496	126.3	25
Regal Crest	37%	967.64	27	26126	43.1	9
Starlane	24%	627.66	7	4394	7.3	1
Tribute	36%	941.49	65	61197	101.0	20
Tobey	42%	1098.41	26	28559	47.1	9
Total for 2022			**1705**	**$1,558,420**	**2506.3**	**527**

*** Based on a comparison to NBC Tier 1 using the OBC SB-12 2017 reference house calculating with REMRate v.16.0.2**

The Law of Diminishing Marginal Returns with Carbon



Low Carbon Net Zero Cost

A package A1 home has a similar annual CO2 footprint as a small 4 cylinder car!

clearsphere
training & educating | sustainability consulting | energy rating
building on sustainable opportunities

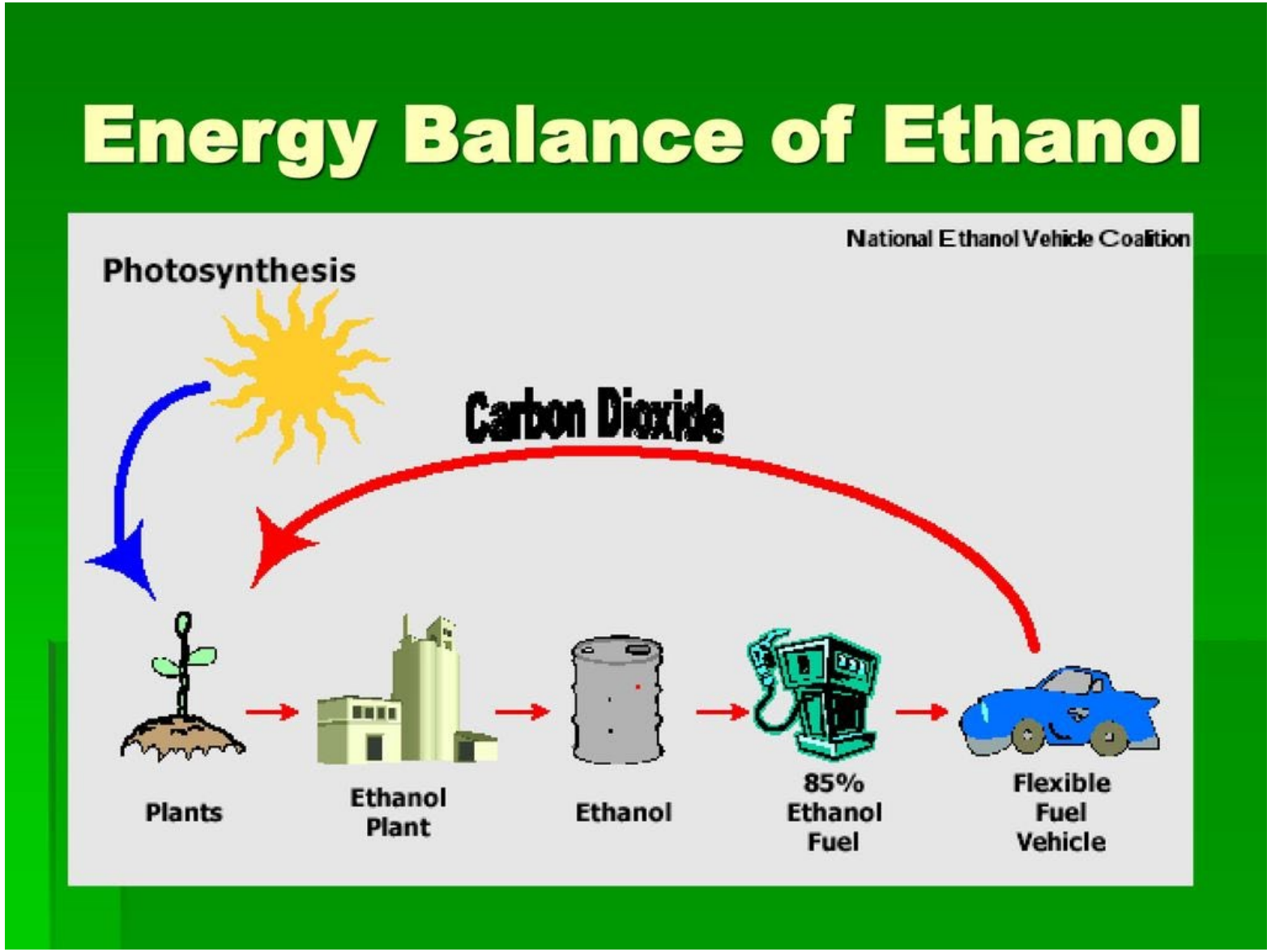
U.S. corn-based ethanol worse for the climate than gasoline, study finds

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.



Q: What's missing from this equation in terms of CO2 emissions?

A: O.Mc.T.

Life Cycle Analysis on 33kW at the University of Michigan (2018)

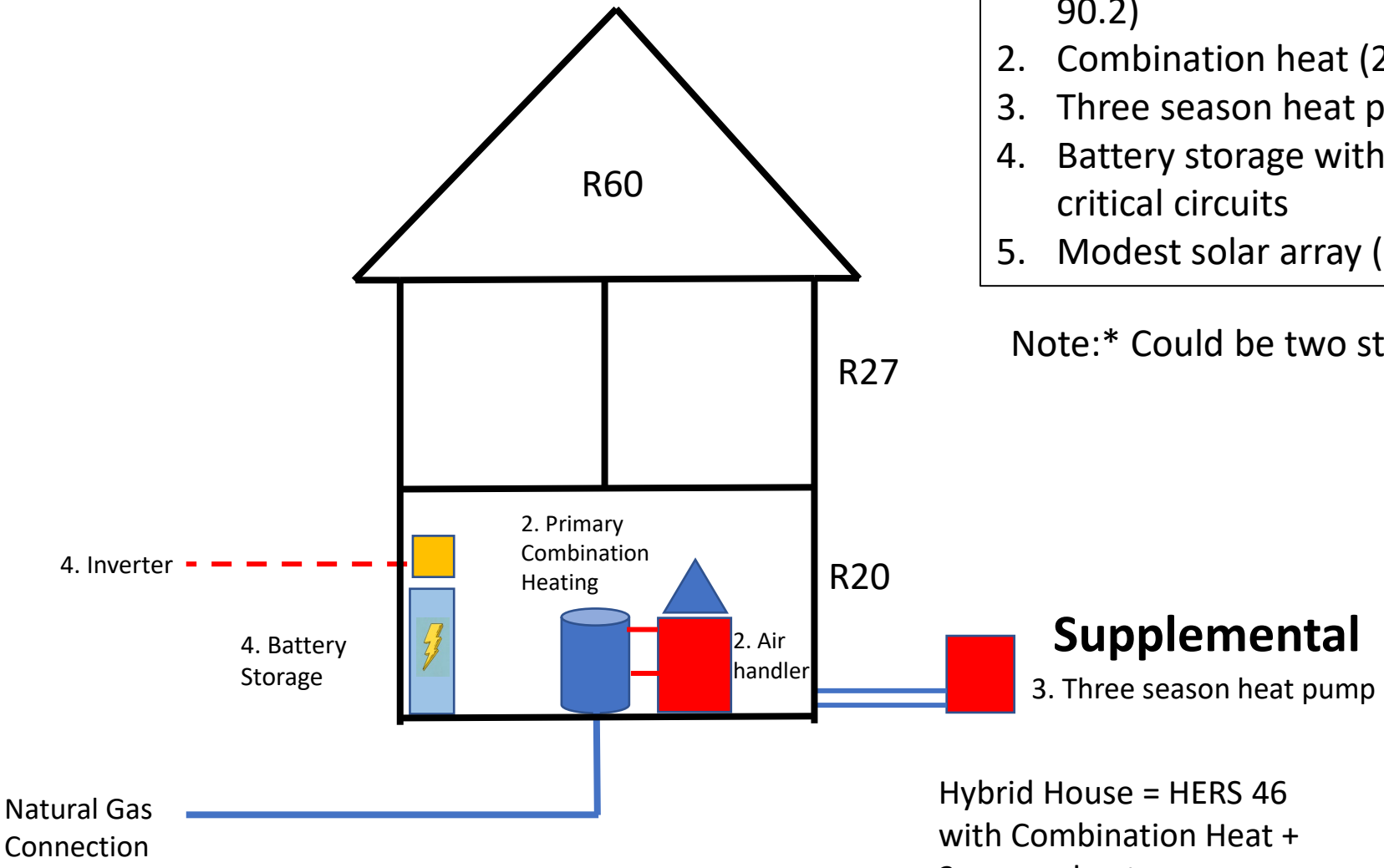
- 44,794 kW of electricity generated per year
- Emissions of panels 0.072 kg of CO_2/kWh (over 20 years)
- 44,794 kWh x 0.072 Kg of CO2/kWh = 3225 kg of CO2 per year
- Adjust for 10kW required for Net Zero (small house) 10/33 = 0.303
- 3225 kg of CO2 per year x 0.303 = 977 kg of CO2 per year

- Takeaway: through lifecycle analysis the carbon debt of solar PV is almost 1 tonne of CO2 per year over 20 years or 19.5 tonnes.

Paul Duffy checks the system air flow at Brookfield Homes.

Based on computer modelling, this system offers up to 29% reduction in gas usage and thereby GHG emissions.

HYBRID HOUSE FORMULA



1. Thermal design to HERS 46 (ASHRAE 90.2)
2. Combination heat (20% reduction)*
3. Three season heat pump
4. Battery storage with inverter and critical circuits
5. Modest solar array (5-7kw)

Note:* Could be two stage furnace

Supplemental

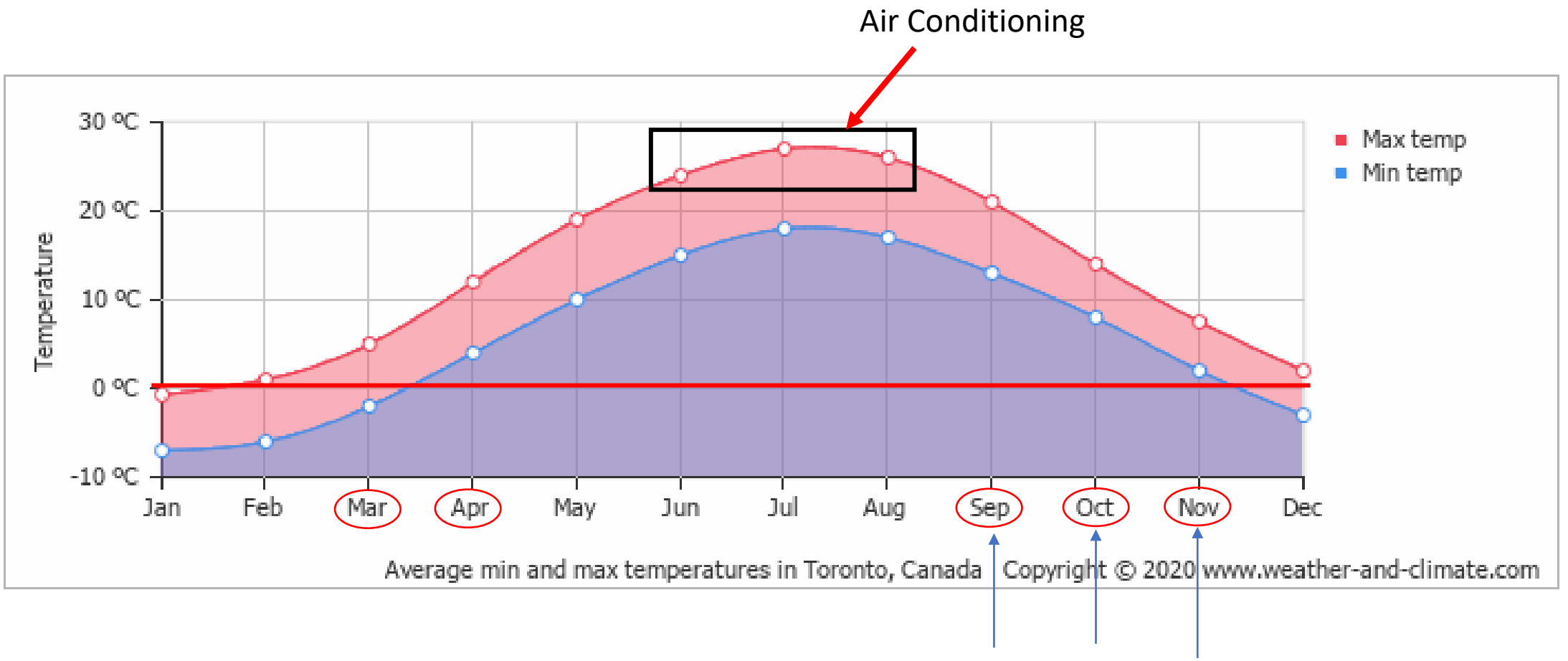
3. Three season heat pump

Hybrid House = HERS 46 with Combination Heat + 3 season heat pump + battery storage and critical circuits

ENV 5065 performs in 2500 sqft house built to the 1997 building code. Enough space heating and hot water for a family of four during a very cold 2022 winter.

Low velocity air handler

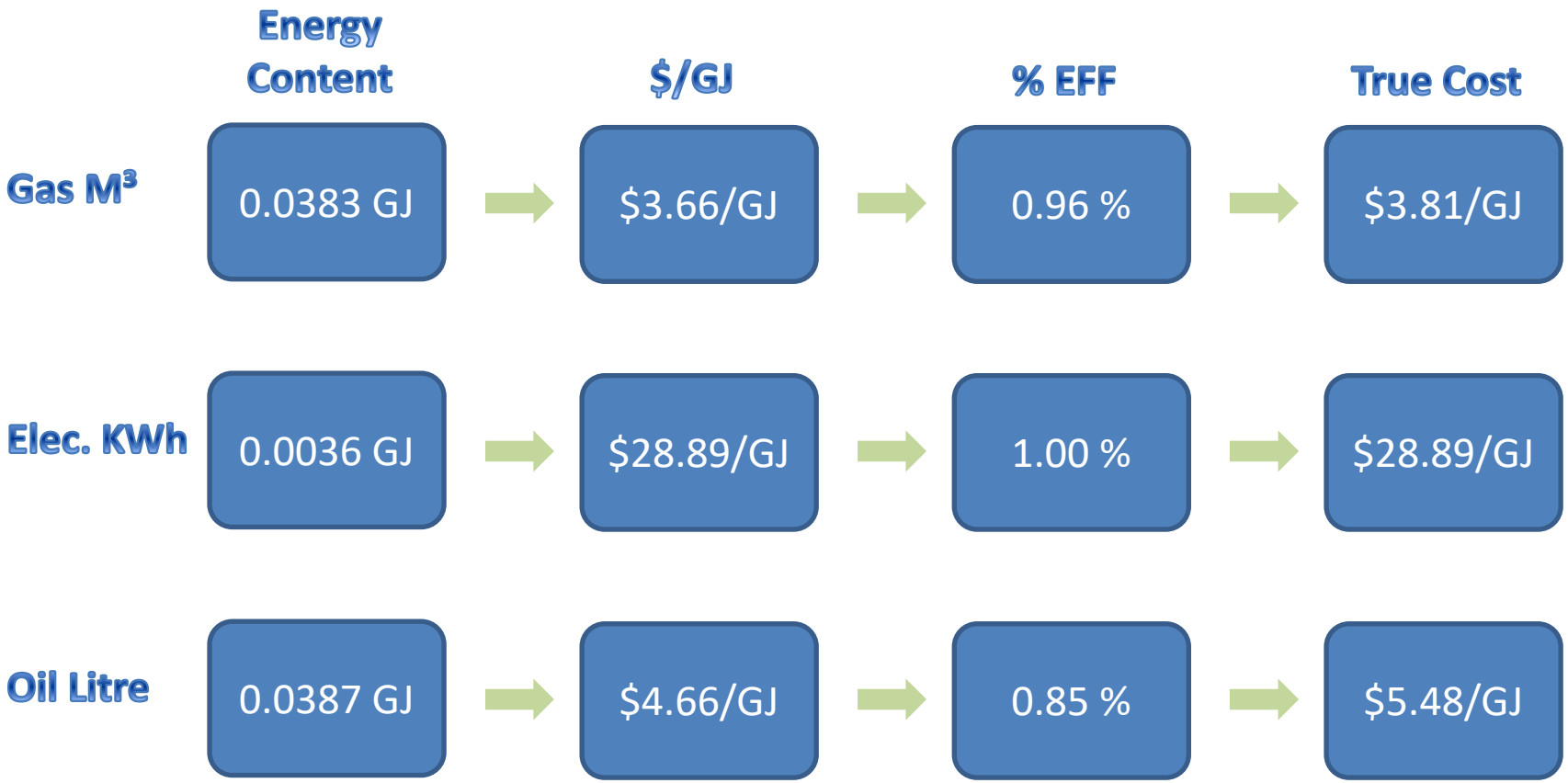
Supplemental heat from air source heat pumps can be up to **40%** of heating season



Key Question: Will these houses be electrically heated or can we use natural gas wisely with combination hybrid heat?

Problem: Ontario’s growing population has a peak electrical demand problem. We need to use off peak electricity to run heat pumps, charge batteries and cars, not heat houses.

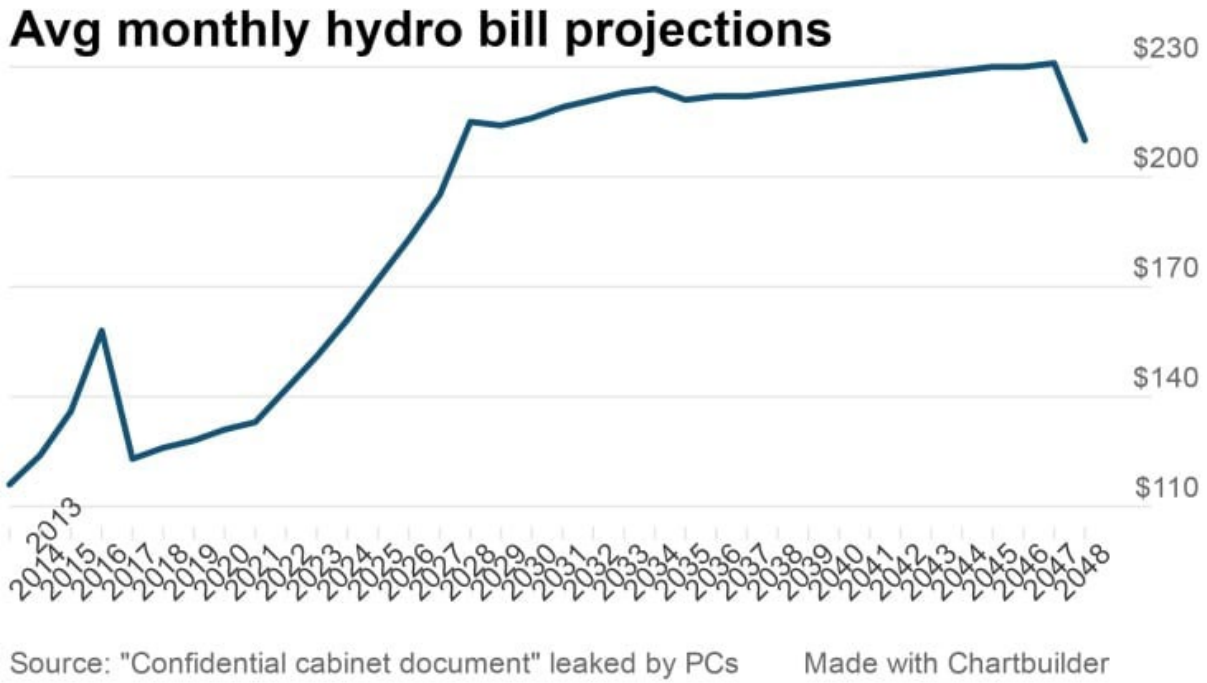
True Cost of Energy - Ontario



Electricity is 8 times that cost of natural gas per energy unit

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**

Example: Town of Whitby Performance Standard has already incorporated NBC's Step Code

Energy & Climate Change: Making buildings and manufacturing energy efficient and supplying all energy with renewables.

Development Feature	Tier 1 Criteria	Tier 2 Core Performance Criteria	Tier 3 Core Performance Criteria	Tier 4 Core Performance Criteria
District Energy Systems	Explore options to connect to existing on-site energy			
Renewable Energy	Determine the feasibility of energy generation from renewable	Ensure that buildings are designed to accommodate		
Passive Solar Orientation	Where feasible, 50% (or more) of the development blocks			
Building Commissioning		Commission the building using best practice commissioning.		
Energy Efficient Appliances		Provide Energy Star or equivalent labeled appliances.		
Building Energy Performance	Design the building to achieve 15%	Design the building to achieve Tier 2 TEUI, TEDI and GHGI	Design the building to achieve Tier 3 TEUI, TEDI and GHGI	Design the building to achieve Tier 4 TEUI, TEDI and GHGI
Building Energy Performance For low-rise residential development	Design the building(s) to achieve at least ENERGY STAR® for New Homes, version 17, R-2000® requirements or equivalent	Design, construct and label the building(s) to achieve at least ENERGY STAR® for New Homes, version 17, R-2000® requirements, or equivalent.	Design, construct the building to be Net Zero ready in accordance with the CHBA Net Zero Home Labeling Program or equivalent.	Design and construct the building in accordance with the CHBA Net Zero Home Labeling Program or the Passive House Standard.

Voluntary design to ESTAR or equivalent

(NBC Tier 3)

Label to ESTAR or equivalent

(NBC Tier 3)

Design to Net-Zero or equivalent

(NBC Tier 4)

Label to Net-Zero or Passive House

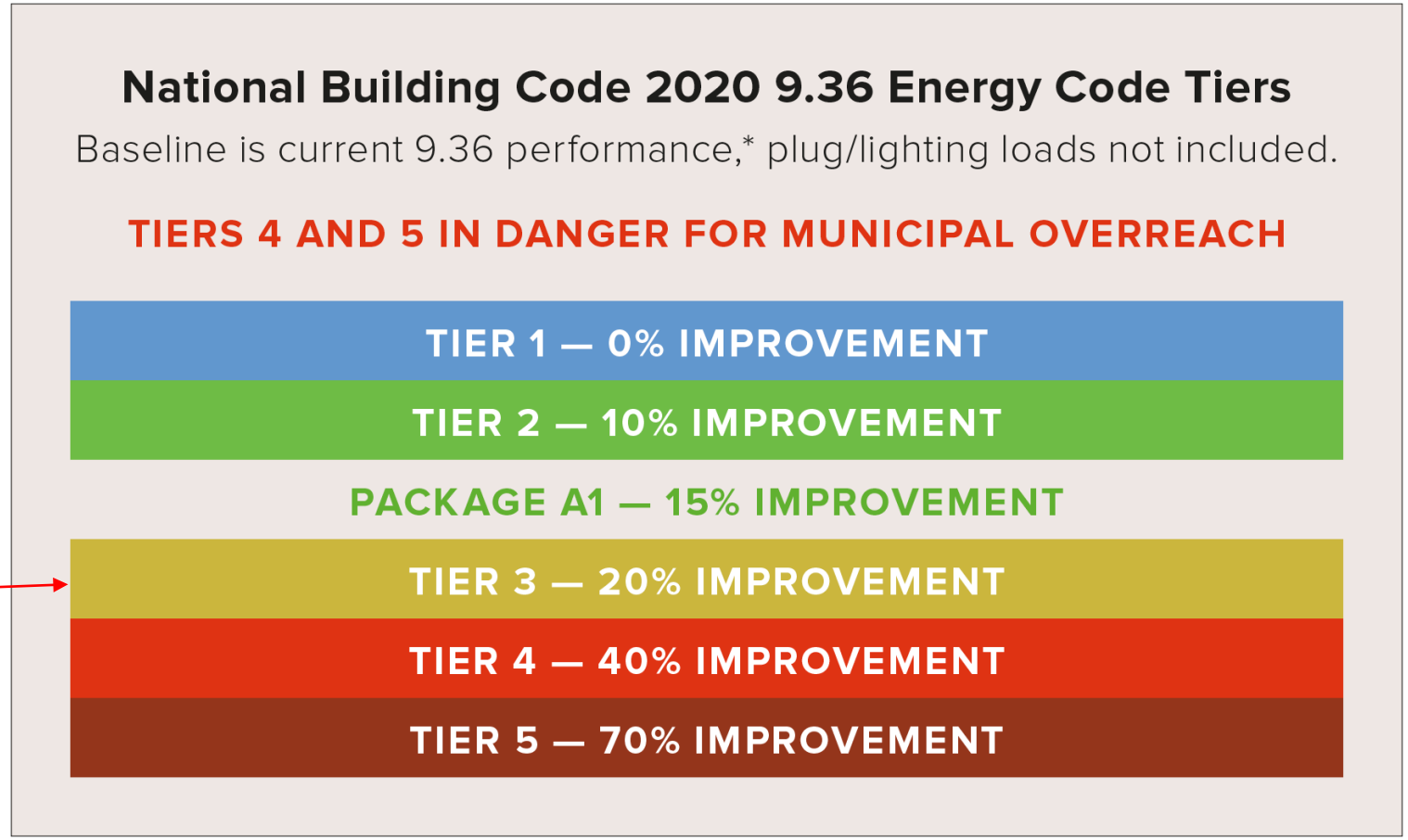
(NBC Tier 5)

NO EQUIVALENCY

Takeaway: Energy tiers in Whitby will be confused with code harmonization

Thresholds represent government programs

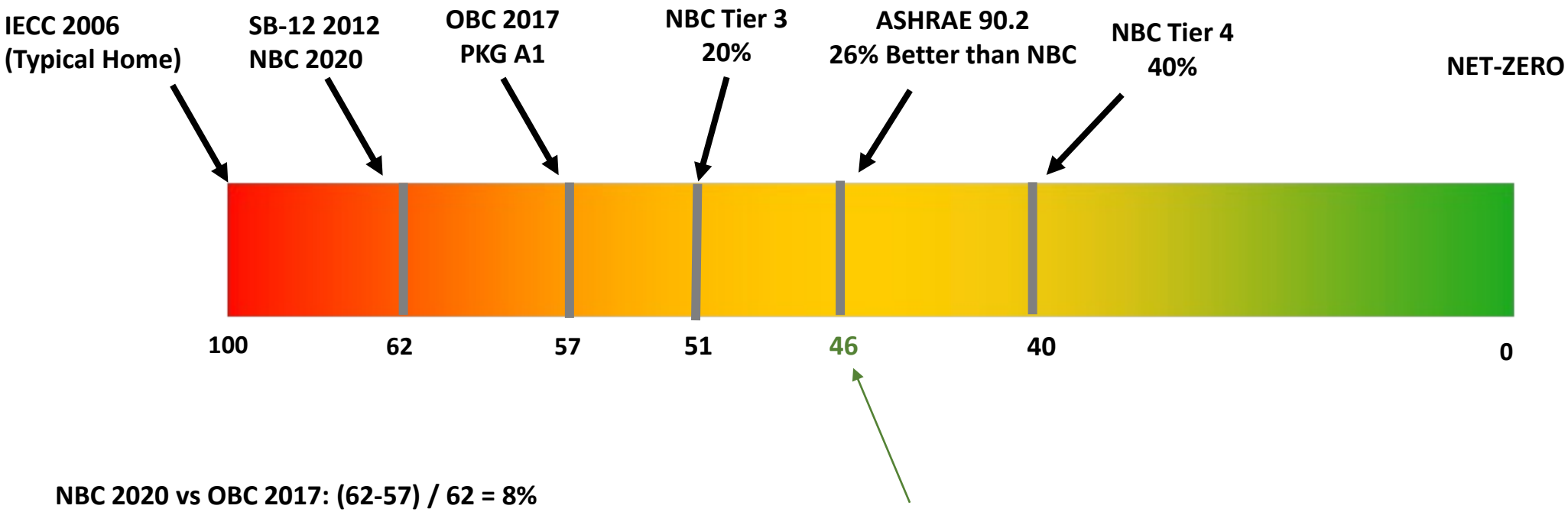
Tier 4 –Net Zero Ready
Tier 5 – Net Zero



Proposed OBC 2024 by municipal affairs and housing

Savings by Design would be a 35% improvement over Tier 1, not far to Tier 4

HERS RATINGS FOR ONTARIO REFERENCE HOME 2017 AT VARIOUS TIERS



NBC 2020 vs OBC 2017: (62-57) / 62 = 8%

Tier 3: (62-51) / 62 = 18%

Zero Energy Ready (DOE): (62-46) / 62 = 26%

Net-Zero Ready (CHBA): Varies by House

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.	

Performance Measures		Performance Criteria				For Submission	
Number	Development Feature	Tier 1 Mandatory	Met	Tier 2 Optional	Met	Documentation	Comments
W2	Water Efficiency	Implement two of the following: • Use **WaterSense®** labeled water fixtures. • Use a non-potable watering system for irrigation purposes. • Install a drain water heater recovery unit. • Install a hot water recirculation pump with an integrated adjustable timer or auto-adaptive controls to shut off during periods of low/no hot water use. • Use **Energy Recovery Ventilation** in lieu of conventional humidifier.	☑	Implement three of the following: • Use **WaterSense®** water fixtures that obtain a minimum 30% better than the **Ontario Building Code** baseline. • Use a non-potable watering system for irrigation purposes. • Design 25% of the dwelling units/buildings to be **"greywater ready"** (i.e., plumbing and infrastructure roughed in, adequate utility room space). • Install a hot water recirculation pump with an integrated adjustable timer or auto-adaptive controls to shut off during periods of low/no hot water use. • Use Energy Recovery Ventilation in lieu of conventional humidifier.	☐	☐ Plan(s), drawing(s), or other documentation demonstrating implementation of target elements(s). ☐ Plumbing fixtures specifications or other documentation demonstrating **WaterSense®** labelling and flush/flow rates. **or** ☑ Third party verification of water reductions with systems e.g., **Home Energy Rating System H2O** or **WaterSense®** labeling.	

Operational vs Embodied Carbon

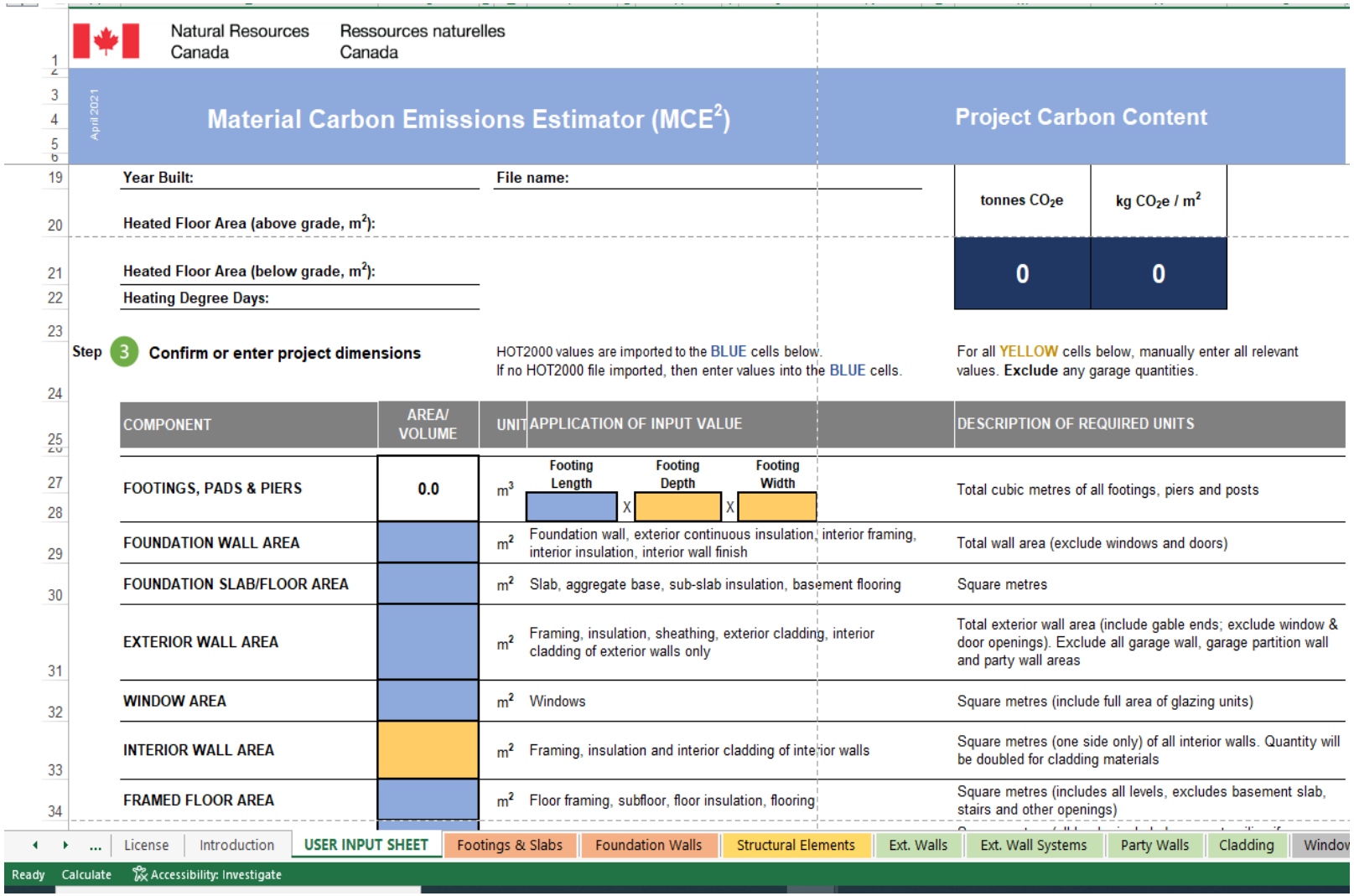
- **Operational Carbon** – calculated using energy performance software to estimate annual consumption on buildings and convert to co2 emissions based on source of energy.

- **Embodied Carbon** refers to the greenhouse gas emissions arising from the manufacturing, transportation, installation, maintenance, and disposal of building materials.

Definitions

- **Carbon sequestration** is the long-term storage of carbon in plants, soils, geologic formations, and the ocean.
- **Life cycle analysis (LCA**) is a method used to evaluate the environmental impact of a product through its life cycle encompassing extraction and processing of the raw materials, manufacturing, distribution, use, recycling, and final disposal.
- An **EPD (Environmental Product Declaration)** is a verified and registered document that communicates transparent and comparable information about the life-cycle environmental impact of products.
- **Global warming potential (GWP)** is defined as the cumulative radiative forcing, both direct and indirect effects, over a specified time horizon resulting from the emission of a unit mass of gas related to some reference gas. Carbon dioxide (CO2) was chosen as the reference gas to be consistent with the guidelines of the Intergovernmental Panel on Climate Change
- **The law of Diminishing marginal returns (DMR)** is a theory in economics that predicts that after some optimal level of capacity is reached, adding an additional factor of production will actually result in smaller increases in output.
- **Supplementary Cementitious Materials (SCMs)** are materials that, when used in conjunction with portland cement, portland limestone cement or blended cements, contribute to the properties of hardened concrete through hydraulic and/or pozzolanic activity.

Material Carbon Emissions Estimator



Natural Resources Canada | Ressources naturelles Canada

April 2021

Material Carbon Emissions Estimator (MCE²)

Project Carbon Content

tonnes CO_2e	kg CO_2e / m^2
0	0

Year Built:

File name:

Heated Floor Area (above grade, m^2):

Heated Floor Area (below grade, m^2):

Heating Degree Days:

Step 3 Confirm or enter project dimensions

HOT2000 values are imported to the BLUE cells below.
If no HOT2000 file imported, then enter values into the BLUE cells.

For all YELLOW cells below, manually enter all relevant values. **Exclude** any garage quantities.

COMPONENT	AREA/ VOLUME	UNIT	APPLICATION OF INPUT VALUE	DESCRIPTION OF REQUIRED UNITS
FOOTINGS, PADS & PIERS	0.0	m^3	Footing Length X Footing Depth X Footing Width	Total cubic metres of all footings, piers and posts
FOUNDATION WALL AREA		m^2	Foundation wall, exterior continuous insulation, interior framing, interior insulation, interior wall finish	Total wall area (exclude windows and doors)
FOUNDATION SLAB/FLOOR AREA		m^2	Slab, aggregate base, sub-slab insulation, basement flooring	Square metres
EXTERIOR WALL AREA		m^2	Framing, insulation, sheathing, exterior cladding, interior cladding of exterior walls only	Total exterior wall area (include gable ends; exclude window & door openings). Exclude all garage wall, garage partition wall and party wall areas
WINDOW AREA		m^2	Windows	Square metres (include full area of glazing units)
INTERIOR WALL AREA		m^2	Framing, insulation and interior cladding of interior walls	Square metres (one side only) of all interior walls. Quantity will be doubled for cladding materials
FRAMED FLOOR AREA		m^2	Floor framing, subfloor, floor insulation, flooring	Square metres (includes all levels, excludes basement slab, stairs and other openings)

License | Introduction | USER INPUT SHEET | Footings & Slabs | Foundation Walls | Structural Elements | Ext. Walls | Ext. Wall Systems | Party Walls | Cladding | Windov

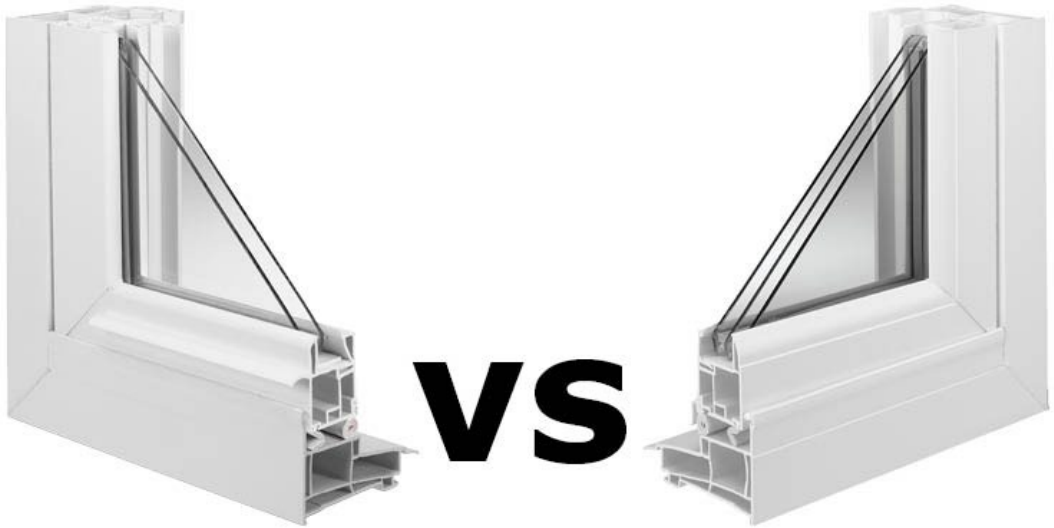
Ready Calculate Accessibility: Investigate

Battery Storage vs Solar Panels

Takeaway: Battery storage uses off-peak electricity for solar panels produce electricity for credit on billing.

CO_2 emissions considerations of doubles vs triples pane windows

- Manufacturing triple glazed windows generates more CO_2 than manufacturing double glazed windows due to the CO_2 embodied in an extra sheet of glass and a heavier frame.
- Since triple glazed windows are generally heavier than double glazed ones, the transport of triple glazed windows generates more CO_2



Analysis: replace high performance double glazed U=1.4 with triple glazed windows U=1.0 on reference house, savings of 76 m3 of natural gas or $26 annually.

10 carbon smart techniques checklist

1.Reuse buildings (especially the foundations and structure where most of the embodied carbon is). Always consider reuse and retrofit before designing a new building. Reuse and renovation with system upgrades typically generates 50% to 75% less embodied carbon emissions than new construction.

2.Concrete, specifically the production of cement for concrete, is responsible for more GHG emissions than any other material. **Specify low carbon concrete mixes** – replace cement with fly ash, ground blast furnace slag, calcined clays, and other substitute materials, reducing the cement content of concrete as much as possible.

3.Use high recycled content materials – especially metals. Steel is second only to concrete in embodied carbon impact. Virgin steel can have an embodied carbon foot print that is 5 times higher than high recycled content steel. Virgin aluminum can be more than 6 times higher than recycled aluminum.

4.Limit carbon intensive materials – aluminum, plastics, certain foam insulations, etc.
Use these materials sparingly and only when there are no alternatives.

5.Choose lower carbon alternatives for structure and finishes, such as wood structure over steel and concrete, wood siding over vinyl siding. Compare EPDs.

6.Choose carbon sequestering materials whenever possible. Wood is usually a lower carbon choice than steel or concrete, but it is important to note that the carbon footprint of wood is determined by forestry practices. (One study showed that wood from FSC certified forests sequestered 20% to 60% more carbon than wood from traditionally managed forests.) Consider the use of other agricultural products such as straw, hemp, cork, and cellulose.

7.Choose materials – brick, metals, broken concrete, wood. Salvaged materials typically have a much lower embodied carbon footprint than newly manufactured materials.

8.Maximize structural efficiency. Use the most efficient structural solutions to save on quantities of materials used. For example, “advanced framing” reduces wood use in wood framed structures.

9.Use structural materials as finishes and use fewer finish materials. Exposed concrete floors and ceilings and exposed wood structure look good and save carbon.

10.Minimize waste. Design in material size modules to minimize waste, taking advantage of standard size sheets for common materials such as 4×8 plywood and gypsum board.

AIA CALIFORNIA

6.1 Staying on 8 inch pours or SCM concrete

6.2 Carbon Smart engineered wood structures

6.3 Woodfiber sheathing with low GWP EPS insulation

6.4 No brick on exterior finish – EIFS stucco system or wood siding

6.5 Cellulose attic insulation

6.6 Advanced framing

6.7 SFI engineered hardwood floors

6.8 Factory or Panelized housing

Low hanging Fruit

	Building Component	Saving (KgCO2e)	% Reduction
1	Cellulose (attic and walls)	3695	8.3
2	8" Pour SCM Concrete	1385	3.12
3	Brick to Stucco (facebrick)	7328	16.5
4	Carpet to SFI Hardwood	2752	6.2
	Total	**15160**	**34.12**

20% reduction

Summary:

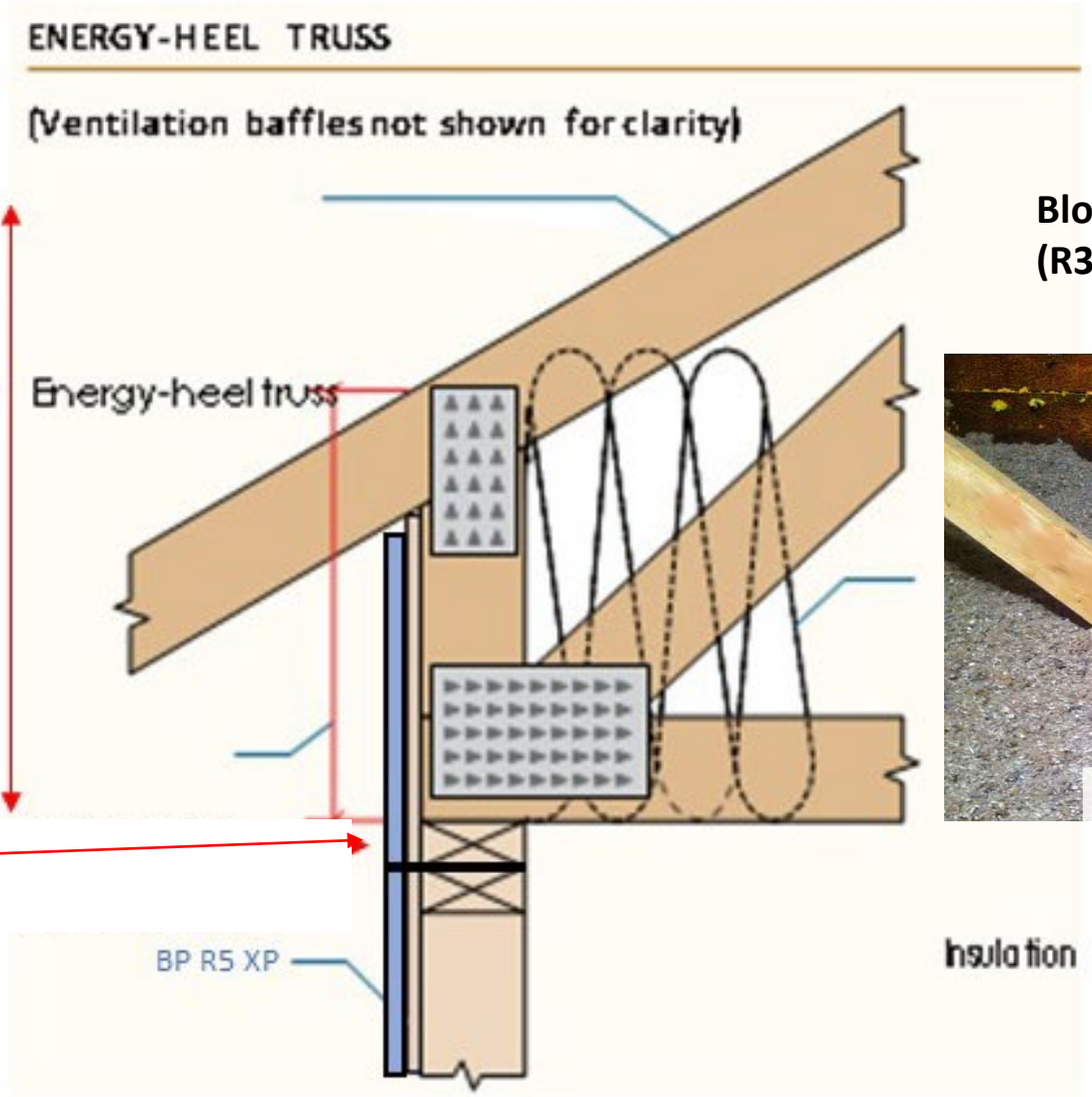
Typical Home	44 tonnes CO2
Hybrid house reduction	2 tonnes CO2
GWP materials reduction	15 tonnes CO2
Low Carbon footprint	27 tonnes CO2

Anchoring Raised Heel Trusses

Glass Fibre R60 (22”)

Blown Cellulose R60 (17”)

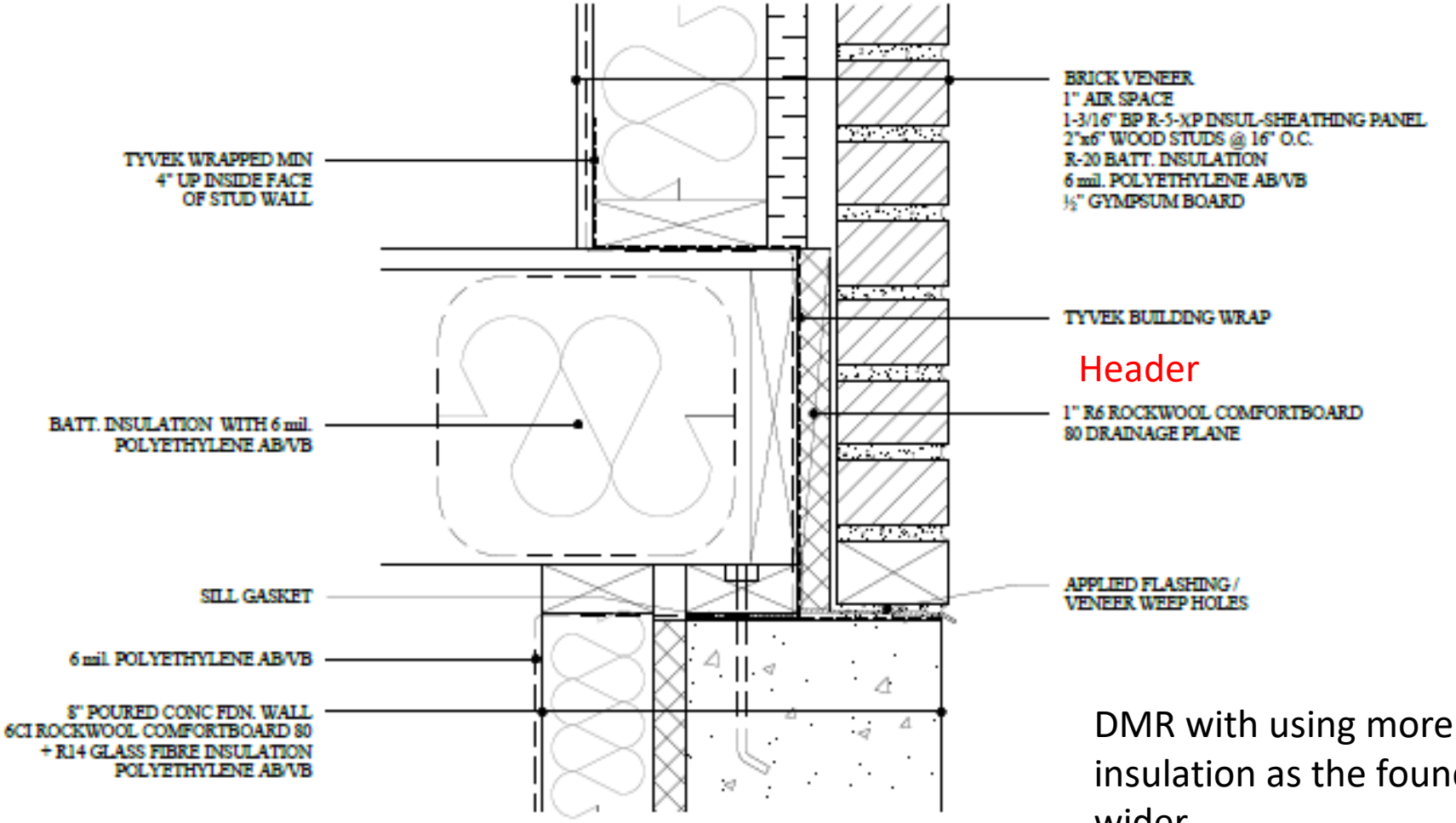
Nail sheathing to top plate and truss heels



Blown cellulose R-60 = 17” (R3.5/inch)

Checklist 6.1

Low Carbon foundation wall detail (Oxymoron)



DMR with using more outboard insulation as the foundation gets wider

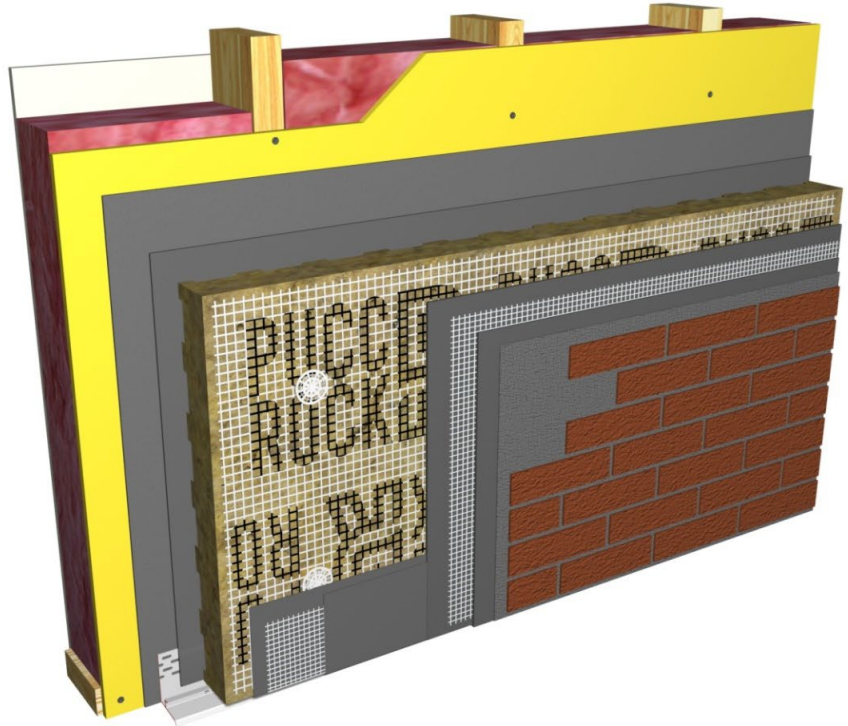
8" FOUNDATION WALL SECTION
AT FIRST FLOOR WITH BRICK VENEER
3" = 1'-0"

Checklist 6.4

Panelization Plant – Facebrick Veneer

Control joint

EIFS system – Facebrick Veneer



2x4’s with EIFS can easily go on an 8” foundation

Checklist 6.8

Factory or Panelized housing

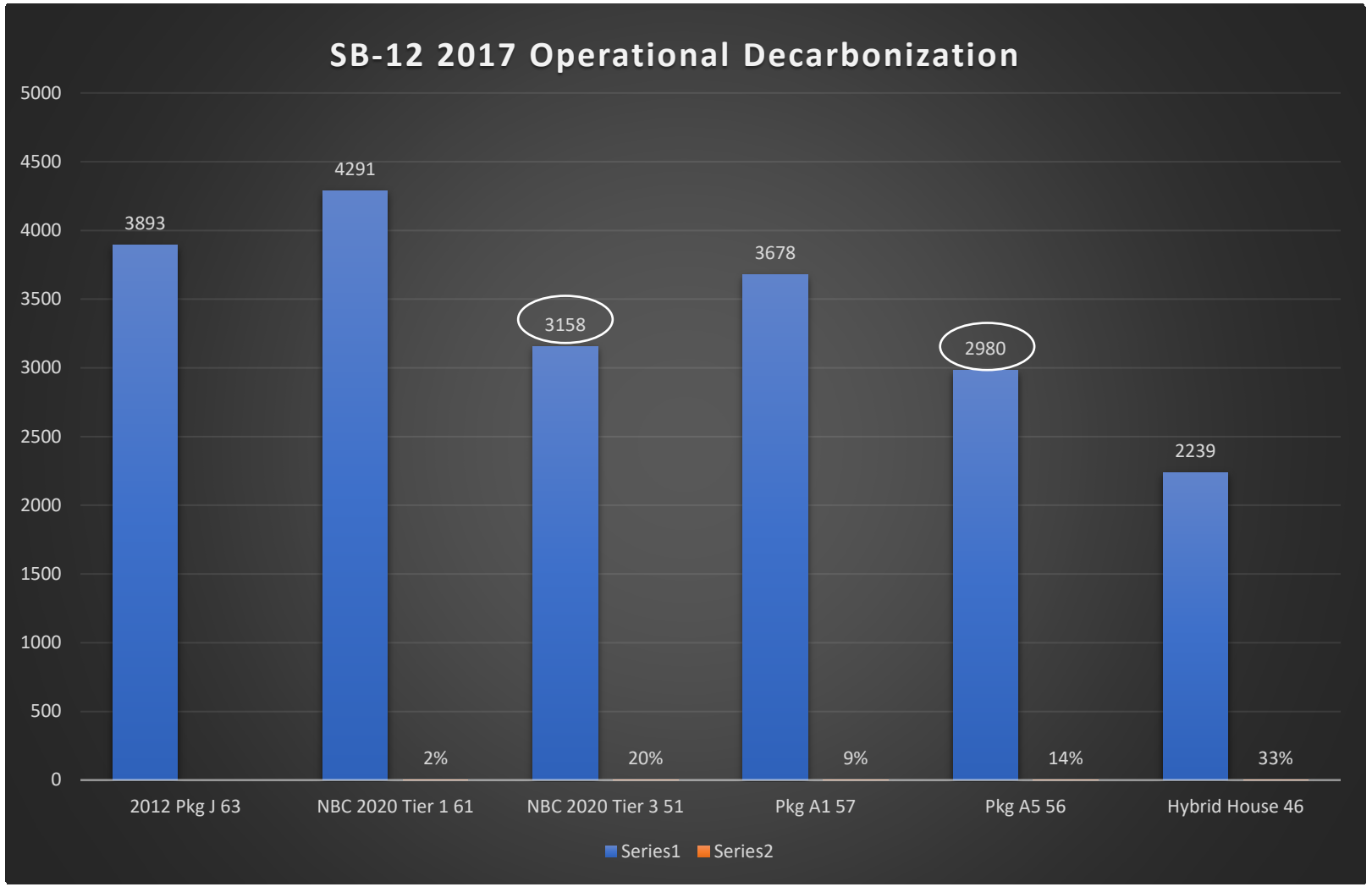
Checklist 6.7

Sustainable Forestry Institute Certified – Engineered Hardwood

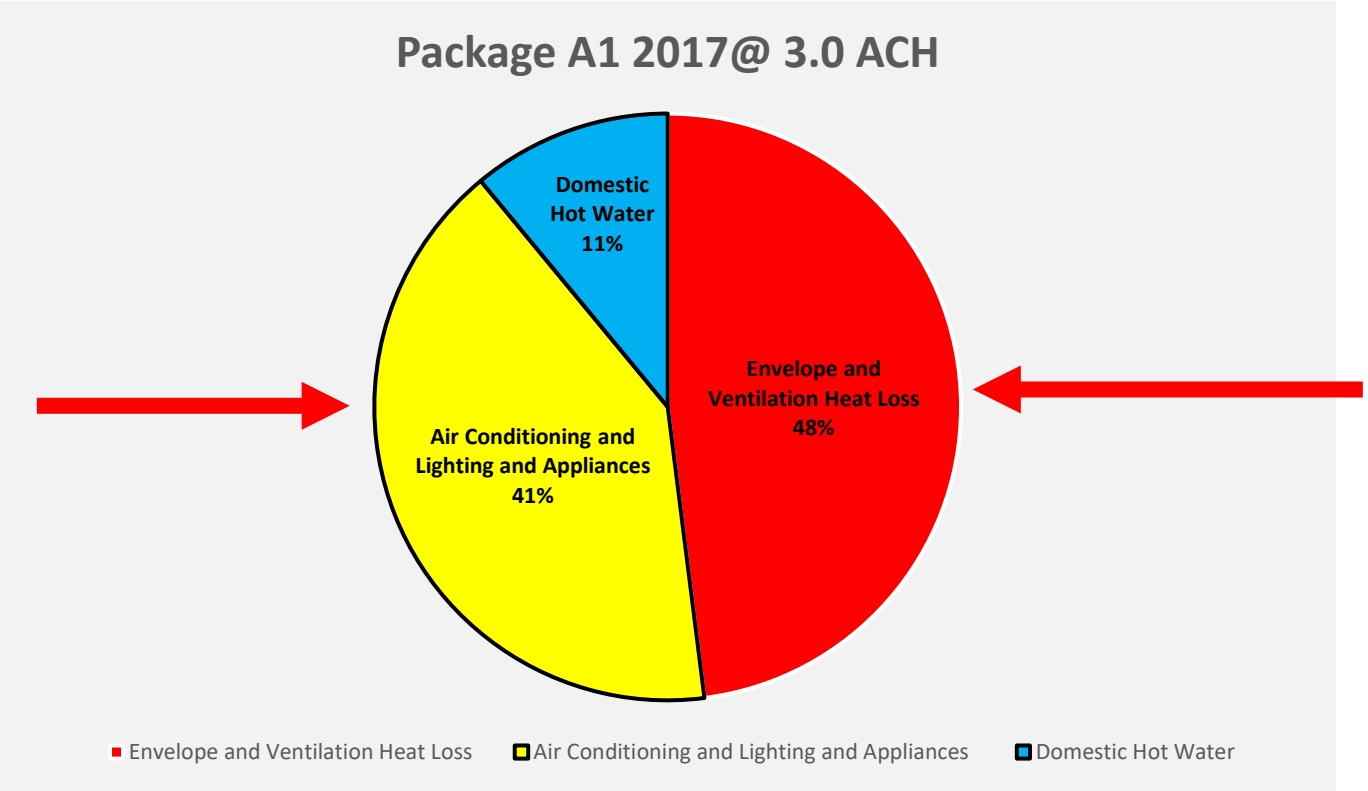
Chart #1 Table 3.1.1.2.A (IP): Reference House 3 Bedrooms

Zone 1-Compliance Package for Space Heating Equipment with AFUE ≥ 92%

Component	Complance Package					
	2012 Package J	NBC 2020 Tier 1	NBC 2020 Tier 3	A1	A5	Hybrid House
Ceiling with Attic Space	R50	R40 (eff.39.2)	R60	R60	R50	R60
Ceiling without Attic Space	R31	R31 (eff.26.5)	R31	R31	R31	R31
Exposed Floor	R31	R-31 (eff.26.5)	R-31	R31	R35	R-31
Walls Above Grade	R22	R-22 (eff.16.8)	***R-22+1.5ci***	R22	R19+5ci	***R-22+1.5ci***
Insulation Grade	III	III	III	III	III	III
Basement Walls	R12	R-12+10ci (eff.16.9)	III	R20ci	R12+5ci	III
Below Grade Slab > 600 mm	-	Uninsulated	Uninsulated	-	-	Uninsulated
Heated Slab or Slab ≤ 600 mm	10	R-10	R-10	10	10	R-10
Edge of Slab ≤ 600 mm	10	Uninsulated		10	10	
Windows and Sliding Glass Doors	1.8	U=1.8	U=1.6	1.6	1.6	U=1.6
Skylights	0.49	U=2.9 (SHGC=0.26)	U=2.8	0.49	0.49	U=2.8
Space Heating	94% AFUE	95% AFUE, Constant Torque	***97% AFUE***	96% AFUE	94% AFUE	***97% AFUE***
Space Cooling	-	14 SEER	***15 SEER***	13 SEER	13 SEER	***16 SEER***
Heat Pump						***8.5 HSPF***
HRV/ERV (Sensible Efficiency @ 0C)	60%	HRV 60% (SRE)	***HRV 80% (SRE)***	75%	70%	***HRV 80% (SRE)***
Domestic Hot Water Heater	0.67	0.65	***0.9 EF (94% TE)***	0.8	0.8	***0.9 EF (94% TE)***
Drain Water Heat Recovery (on all or min. two showers)	-	None	***47%***	42%	42%	***47%***
LED Lighting	None	None	None	None	None	***100%***
Air Change Per Hour	3	3	***2.5***	3	3	***2.5***
Modelling Results in REMRATE 16.02						
HERS	**63**	**61**	**51**	**57**	**56**	**46**
Ann. Ene. Consumption (MJ)	**129,359**	**127,340**	**104,060**	**117,407**	**111,960**	**86,726**
% Better than Package J	**-**	**1.6%**	**19.6%**	**9.2%**	**13.5%**	**33.0%**
Annual GHGE (kG)	**3893.25**	**4290.63**	**3157.56**	**3678.45**	**2980.35**	**2239.29**
Modeled Feb 28, 2022						
Modelling Results in Hot2000 V.11.11						
Ann. Ene. Consumption (MJ) ****	**115,848**			**104,654**	**103,922**	
% Better than Package J	**-**			**9.7%**	**10.3%**	

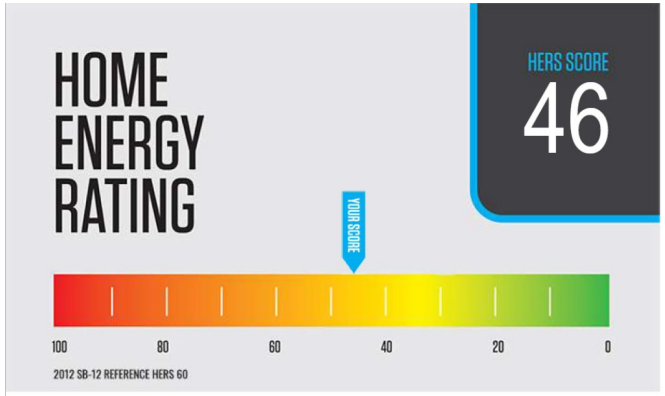

SB-12 2017 Operational Decarbonization
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
3893
4291
3158
3678
2980
2239
2%
20%
9%
14%
33%
2012 Pkg J 63
NBC 2020 Tier 1 61
NBC 2020 Tier 3 51
Pkg A1 57
Pkg A5 56
Hybrid House 46
Series1
Series2

52% of energy use is occupant loads



Diminishing marginal returns from adding more insulation

	Section 1: HIGH PERFORMANCE ENVELOPE	INCLUDED	QUESTIONS
1.1	Third party performance based energy rating and testing with 20% Better Than Code (HERS 46)	☑	☐
1.2	Tested air leakage @ 50Pa < 2.0 ACH detached (Aerobarrier required)	☑	☐
1.3	R5 XP Building Products of Canada sheathing and air barrier with all penetrations sealed, including window flashing. Cavity insulation R22 Rockwool. (New addition above grade walls)	☑	☐
1.4	Existing above grade walls Comfortboard 80 2x4 stand off wall w/R22 Rockwool batts	☑	☐
1.5	Air seal all HVAC boots, bath exhaust fan housings, pot lights and penetrations	☑	☐
1.6	Upgraded "better basement" R4 comfortboard 80 + R14 Rockwool for moisture management in new and existing	☑	☐
1.7	High performance windows with low U-Value=1.4 and low Solar Heat Gain Coefficient (SHGC)<0.30	☑	☐
	Section 2: HIGH PERFORMANCE HVAC	**INCLUDED**	**QUESTIONS**
2.1	Right sized 96% AFUE heating plant min. 2 Stage burner w/ECM	☐	☐
2.2	Condensing combination heating system with existing boiler @ 95% AFUE and 3 zoned hi-velocity air distribution system	☑	☐
2.3	Programmable web-based thermostat (3 zones)	☑	☐
2.4	Indirect hot water storage tank (EF=0.9) for use with radiant floor	☑	☐
2.5	Drain water heat recovery on two shower drains, R3-42 (R3-60 on one drain)	☑	☐
2.6	Hybrid Heat with heat pump Air conditioner	☐	☐
	Section 3: INDOOR AIR QUALITY	**INCLUDED**	**QUESTIONS**
3.1	Min. efficiency HRV 75% SRE	☐	☐
3.1(b)	Best ventilation: Energy recovery ventilation (ERV) SRE of 75% c/w ECM, exhaust ducted to 2-peice bath and basement bath	☑	☐
3.2	Flow rate verified by third party	☑	☐
3.3	2 High Static Bathroom fans verified at OBC capacities c/w best soffit vents	☑	☐
3.4	MERV 8 air filtration	☐	☐
3.4(b)	Best filter: 4 inches pleated MERV 12 for maximum air filtration	☐	☐
3.5	Better air conditioner: Right sized, 16 SEER, two-stage air conditioner	☐	☐
3.6	Containment control during construction	☑	☐
3.7	Pre-occupancy flush (48hrs before)	☑	☐
	Section 4: REDUCE WATER USAGE	**INCLUDED**	**QUESTIONS**
4.1	Toilets 4.00 LPF	☐	☐
4.2	Moen WaterSense fixtures and faucets	☐	☐
4.3	Greywater recycling system (Total Water Solution) with Flow monitoring device	☑	☐
4.4	Moen WaterSense Showerheads	☐	☐
4.5	Hot Water Circulation Pump w/ HERS H2O label	☑	☐
	Section 5: EFFICIENT ELECTRICAL AND MATERIAL MANAGEMENT	**INCLUDED**	**QUESTIONS**
5.1	100% LED lighting	☑	☐
5.2	Attic Insulation low CFC blown foam	☑	☐
5.3	Thermal insulated sheathing 90% recycled content	☑	☐
5.4	Rockwool Stonewool insulation throughout house, Greenguard Gold + certified	☑	☐
5.5	ENERGY STAR appliances (clothes washer, dishwasher and refridgerator)	☐	☐
5.6	Sustainable Forestry Initiative (SFI) approved engineered hardwood floor	☐	☐
5.7	Battery storage with critical circuits for backup	☑	☐



(Insert builder logo here)

THIS HOME IS 23% BETTER THAN CODE

123 Anywhere Street, King City, ON

RATING DATE

April 23, 2021

BETTER THAN CODE®

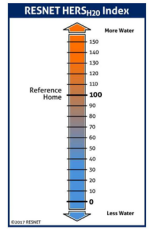
BETTERTHANCODE.CA

HERS$_{H2O}$

HERS$_{H2O}$® Water Efficiency Rating Certificate

Property
Address: N/A
City/Pr./PC: N/A
Builder: N/A

Rating Information
HERS$_{H2O}$ Index: 78
Rating Date: 11/20/2020
Rating Provider: Better Than Code



HERS$_{H2O}$ Index: 78

This home, compared to the reference home:

22 %

more water efficient

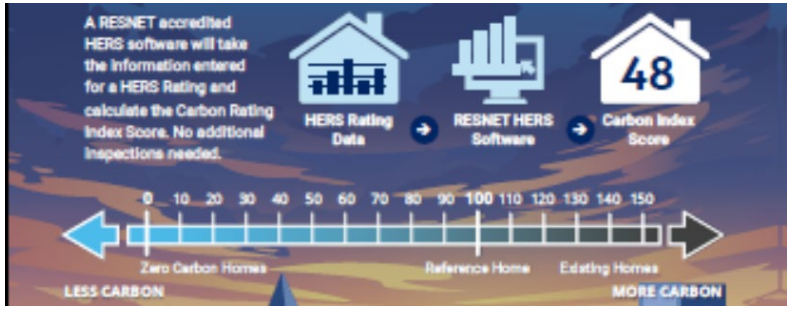
59,552

Litres, annual water savings

BETTER THAN CODE

CANADIAN PILOT

cresnet
CANADIAN RESIDENTIAL ENERGY SERVICES NETWORK



Resources for your use

1. Homeowner Awareness
https://www.youtube.com/watch?v=ayxbkaaa06A&t=56s

2. HERS index
https://www.youtube.com/watch?v=lV9tbHEKV44&t=76s

3. Why Future Proof your home
https://www.youtube.com/watch?v=iJZFGrCAIwo

4. Panasonic Storage

https://www.youtube.com/watch?v=2usVvnlNTlw

5. Sustainable Housing Foundation
https://sustainablehousingfoundation.org/

6. The Carbon Difference
https://www.youtube.com/watch?v=RSstTiuuj-Y

Future Fuels - Fueling Industry Change

Presenter: Frank Buck

Which fuels are we talking about?

- Wind Power
- Hydropower
- Hydroelectricity
- Nuclear Power
- Biomass / Biodiesel
- Solar / Photovoltaics / Concentrators
- Geothermal
- Hydrogen / Ammonia
- Photosynthesis
- Ethanol
- Tidal Bore / Waves

Definition of Clean Energy

- Energy generated in ways that do not deplete natural resources or harm the environment
- especially by avoiding or banning the use of fossil fuels and nuclear power.

Global Procrastination

- Global warming research ironically started with research conducted by Swedish scientists in the 1880"s who were researching the causes of the last ice age.

No single solution

- There is not a single low cost clean energy alternative that will completely replace fossil fuels in the short term.
- A potent cocktail of clean energy combinations will be the first wave of change.

Everything old is new again

- With the exception of photosynthesis all clean energy options have been well known for decades.

Unprecedented Green Growth

- Necessity is the mother of invention - more clean energy tech development in the coming twenty years than in the last hundred years.

Global Corporations embrace new profit opportunities

- Major gas and oil mutli-national corporations are distancing themselves from gas and oil in their branding in favour of identifying as global energy providers.
- Many of these companies are major investors in energy alternatives.
- Green energy capitalism will be the major investment driver behind clean energy development.

The Green Wrap

- Future fuels will change everything including the operation of the residential housing industry and the way homeowners consume energy.
- Just as fossil fuels were a game changer clean energy will be even moreso.

Questions

- How will we design shelter space and communities in the clean energy age?
- How will building codes change? Witness The Netherlands, The City of Vancouver, The State of California etc.
- Will the permitting process require the use of clean energy in the short term?
- European heating system manufacturers have already retooled for hydrogen.
- What will energy distribution look like over the next twenty years?
- Will the entire exterior cladding systems of buildings become photovoltaic?
- Is the next iteration of net zero - net net zero?

In conclusion, We are living in an unprecedented age of rapid corrective acceleration driven by a sense of urgency based on survival.

2023 SHF Green Builder Tournament

Event Venue: Flemingdon Park Golf Club
Event Date: June 22, 2023

REGISTER NOW >

June 22, 2023 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 Thursday June 22nd 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.

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BETTER Builder

the builder's source

BEST PRACTICES

FINDING THE PATH

PUBLICATION NUMBER 43408014