



## CHBA NET ZERO HOME LABELLING PROGRAM Summary Report – 2020

This report details the assemblies and technologies used in the homes qualifying under the Net Zero Home Labelling Program from the Pilot to December 31, 2020, and the resulting performance metrics they achieved.

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# CONTENTS

LIST OF TABLES .....	ii
LIST OF FIGURES .....	iii
1.0 INTRODUCTION .....	1
1.1 Executive Summary .....	2
2.0 DEFINITIONS.....	3
3.0 PROGRAM TO-DATE .....	4
3.1 Uptake and Capacity.....	4
3.2 Number of Homes .....	5
4.0 ENVELOPE .....	7
4.1 Above-Grade Wall Assemblies.....	8
4.2 Ceiling Assemblies .....	10
5.0 MECHANICALS.....	12
5.1 Space Heating & Cooling .....	12
5.2 Water Heating .....	13
6.0 FUEL SOURCE .....	14
7.0 PERFORMANCE .....	15
7.1 Annual Energy Consumption .....	16
7.2 Whole Home Heat Loss .....	18
7.3 Airtightness.....	20
7.4 Total Energy Use Intensity (TEUI) .....	21
7.5 Percent Better than Reference House – Annual Energy Consumption (“Ref. AEC”) .....	22
7.6 Percent Better than Reference House – Building Envelope (“Ref. Env.”) .....	23

## LIST OF TABLES

Table 1: Number of Newly Trained Participants by Year.....	4
Table 2: Number of Qualified Net Zero and Net Zero Ready Homes by Year .....	5
Table 3: Number of Homes by Province .....	5
Table 4: Distribution of Homes by Type and by Climate Zone .....	6
Table 5: Building Envelope Performance Summary by Project Type and Climate Zone .....	7
Table 6: Detached Homes - Building Envelope Performance by Climate Zone .....	7
Table 7: Attached Homes - Building Envelope Performance by Climate Zone .....	8
Table 8: Space Heating Configuration of Homes .....	12
Table 9: Heating System Configuration of Homes by Province .....	12
Table 10: Performance Metrics Summary by Project Type .....	15

## LIST OF FIGURES

Figure 1: Climate Zone Map of Canada (source: Natural Resource Council of Canada, colour coding by NAIMA Canada) .....	6
Figure 2: Distribution of Homes by Climate Zone.....	6
Figure 3: Detached Homes - Distribution of Above-Grade Wall $RSI^{eff}$ in Climate Zone 4 .....	8
Figure 4: Detached Homes - Distribution of Above-Grade Wall $RSI^{eff}$ in Climate Zone 5 .....	8
Figure 5: Detached Homes - Distribution of Above-Grade Wall $RSI^{eff}$ in Climate Zone 6 .....	8
Figure 6: Detached Homes - Distribution of Above-Grade Wall $RSI^{eff}$ in Climate Zone 7a .....	8
Figure 7: Attached Homes - Distribution of Above-Grade Wall $RSI^{eff}$ in Climate Zone 4 .....	9
Figure 8: Attached Homes - Distribution of Above-Grade Wall $RSI^{eff}$ in Climate Zone 5 .....	9
Figure 9: Attached Homes - Distribution of Above-Grade Wall $RSI^{eff}$ in Climate Zone 6 .....	9
Figure 10: Attached Homes - Distribution of Above-Grade Wall $RSI^{eff}$ in Climate Zone 7a .....	9
Figure 11: Detached Homes - Distribution of Ceiling $RSI^{eff}$ in Climate Zone 4 .....	10
Figure 12: Detached Homes - Distribution of Ceiling $RSI^{eff}$ in Climate Zone 5 .....	10
Figure 13: Detached Homes - Distribution of Ceiling $RSI^{eff}$ in Climate Zone 6 .....	10
Figure 14: Detached Homes - Distribution of Ceiling $RSI^{eff}$ in Climate Zone 7a .....	10
Figure 15: Attached Homes - Distribution of Ceiling $RSI^{eff}$ in Climate Zone 4 .....	11
Figure 16: Attached Homes - Distribution of Ceiling $RSI^{eff}$ in Climate Zone 5 .....	11
Figure 17: Attached Homes - Distribution of Ceiling $RSI^{eff}$ in Climate Zone 6 .....	11
Figure 18: Attached Homes - Distribution of Ceiling $RSI^{eff}$ in Climate Zone 7a .....	11
Figure 19: Water Heating Configuration of all Net Zero and Net Zero Ready Homes .....	13
Figure 20: Fuel Source Configuration of Homes by Province .....	14
Figure 21: Fuel Source of Net Zero and Net Zero Ready Homes.....	14
Figure 22: Average Load Distribution of Annual Energy Consumption by Floor Area .....	16
Figure 23: Annual Energy Consumption of Homes by Floor Area .....	16
Figure 24: Annual Energy Consumption Breakdown of Attached Homes.....	17
Figure 25: Annual Energy Consumption Breakdown of Detached Homes $<2600ft^2$ .....	17
Figure 26: Annual Energy Consumption Breakdown of Detached Homes $\geq 2600ft^2$ and $<4,000ft^2$ .....	17
Figure 27: Annual Energy Consumption Breakdown of Detached Homes $>4000ft^2$ .....	17
Figure 28: Whole Home Heat Loss of Homes by Floor Area .....	18
Figure 29: Whole Home Heat Loss of Homes by Assembly .....	18
Figure 30: Detached Homes – Whole Home Heat Loss Intensity by Climate Zone .....	19
Figure 31: Distribution of Airtightness by $ACH@50$ .....	20
Figure 32: Detached Homes – Total Energy Use Intensity by Floor Area.....	21
Figure 33: Detached Homes - Total Energy Use Intensity by Climate Zone.....	21
Figure 34: Distribution of Percent Better Than Reference House - Annual Energy Consumption .....	22
Figure 35: Detached Homes - Percent Better Than Reference House – Annual Energy Consumption by Climate Zone .....	22
Figure 36: Distribution of Percent Better Than Reference House - Building Envelope .....	23
Figure 37: Detached Homes - Percent Better Than Reference House - Building Envelope by Climate Zone .....	23
Figure 38: Detached Homes - Percent Better Than Reference House - Building Envelope by Year.....	24

## 1.0 INTRODUCTION

Founded in 1943, **the Canadian Home Builders' Association (CHBA) is the voice of Canada's residential construction industry.** The residential construction industry is a vital part of Canada's economy in every community across the country:

- Directly and indirectly supporting more than 1.2 million jobs
- Paying more than \$73.6 billion in wages
- Generating \$150.9 billion in annual economic activity

The CHBA is one association serving our members at three levels. Membership with a local Home Builders' Association (HBA) automatically provides membership at the provincial and national levels. The national office is in Ottawa, Ontario. Representing about 9,000 companies across Canada, CHBA members include home builders, renovators, land developers, trade contractors, product and material manufacturers, building product suppliers, lending institutions, warranty and insurance providers, service professionals, municipalities and more.

On April 3, 2014, the CHBA Board of Directors approved the motion to establish a Net Zero Energy Housing Council (NZC). The NZC supports innovation in the industry with the goal of creating a market advantage for builder and renovator members pursuing net zero energy performance on a voluntary basis. The Council's work will help the industry meet the housing aspirations of Canadians and renew Canadian leadership in high-performance housing. More information can be found at [www.chba.ca/nzc](http://www.chba.ca/nzc).

On September 29, 2015, CHBA launched a Pilot of the Association's Net Zero Energy (NZE) Labelling Program—continuing CHBA's long history in leading energy efficiency in residential construction. The pilot was used to validate both administrative and technical details prior to launching "version 1" of the Program on May 2, 2017. More information can be found at [www.chba.ca/nze](http://www.chba.ca/nze) and [www.netzerohome.com](http://www.netzerohome.com).

The CHBA Net Zero Home Labelling Program (the Program) recognizes builders and service professionals who commit to its Administrative Requirements and the houses that meet the Technical Requirements. Alongside marketing and communication, education and finance initiatives, the Program remains one of the four Net Zero Energy Housing Council key priorities established to address industry-identified barriers to Net Zero/Ready Home construction.

## 1.1 Executive Summary

The purpose of this report is to support CHBA members' voluntary adoption of Net Zero Energy Housing by building awareness and knowledge via the consolidation and sharing of information. The desired outcomes of this report are to communicate the activity of the CHBA Net Zero Home Labelling Program, share information about the construction assemblies, technologies, and performance of the homes, and support current and future research regarding Net Zero and Net Zero Ready construction.

This report includes information on the uptake of Net Zero and Net Zero Ready Homes labelled under the Program from September 29, 2015, until December 31, 2020, as well as participation in the Net Zero Training courses. The analysis of the homes is separated into four building types: detached homes, attached homes, single unit multi-unit residential buildings, and whole building multi-unit residential buildings. Within these building types, trends from the data are presented in the categories: energy efficiency, building envelope efficiency, mechanical systems installed, and fuel source configurations.

In addition, six performance metrics are also analyzed: annual energy consumption, whole home heat loss, airtightness, total energy use intensity, percent better than reference house – envelope, and percent better than reference house – annual energy consumption. These performance metrics are based on the modelled values determined by the Qualified Net Zero Energy Advisor using the HOT2000 modeling software. The performance metrics for the homes are reviewed against a variety of variables including: the province in which the home is located, the climate zone in which the home is located, the program year that the home was completed in, and the heated floor area of the home.

Here are some highlights of the report content:

- 30 Net Zero Homes and 208 Net Zero Ready Homes were labelled in 2020, bringing the total to 520 homes labelled under the Program as of December 31, 2020.
- Homes have been labelled in 9 provinces.
- There are 333 detached homes, 153 attached homes, and 34 units contained in 4 multi-unit residential buildings.
- The majority (62%, 303/486) of detached and attached homes used above-grade walls with an RSI between 4.4 and 5.3 (R25-R30).
- For detached and attached homes the most common (81%, 392/486) ceiling RSI was between 8.9 and 11.4 (R50-560).
- The most common space heating and cooling configuration for Net Zero Homes (65%, 117/179) was an air source heat pump as the primary heating and cooling source and an electric furnace as a secondary heating source. For Net Zero Ready Homes the most common configuration (90%, 306/341) was an air source heat pump as the primary heating and cooling source with a natural gas furnace as a secondary heating source.
- The majority of Net Zero Homes (80%, 144/179) used an all-electric fuel source configuration and the majority of Net Zero Ready Homes (96%, 329/341) used a dual fuel source configuration.
- Most of the detached homes (81%, 269/233) achieved a modelled annual energy consumption of between 40 and 60 GJ/yr.
- There was a strong correlation between the size of the homes and the percentage of annual energy consumption that is allocated to the occupant load. On average, as home size increases, the percentage of annual energy consumption that is allocated to the occupant load decreases.
- On average, both Net Zero and Net Zero Ready Homes have a whole home heat loss of 47.7 GJ/year, with the majority (31%) of heat being lost through the windows and doors.
- The average airtightness for detached homes was 0.98 ACH@50 and for attached homes was 1.46 ACH@50.
- The average calculated Total Energy Use Intensity (TEUI) for detached homes was 46.6 kWh/m<sup>2</sup>/year and for attached homes was 61.4 kWh/m<sup>2</sup>/year.
- The average percent better than reference – annual energy consumption was 70.4% for detached homes and 66.9% for attached homes.
- The average percent better than reference –envelope was 52.5% for detached homes and 61.4% for attached homes.

We release a detailed report of this nature annually, presenting the highlights at the annual CHBA Spring Meetings to share advancements in the program.

## 2.0 DEFINITIONS

The Program terminology is provided below.

### **Attached House**

One residential unit that shares a wall with one or more adjacent dwellings, each with a separate entrance. Alternate names are row house, townhouse, and semi-detached.

### **Building Envelope / Space Cooling (BE/SC) Evaluation Tool**

This CHBA spreadsheet tool calculates and tracks the elements of the home's design to document Program compliance.

### **CHBA Qualified Net Zero Home ("Net Zero Home")**

A CHBA Qualified Net Zero Home that is labelled under the Program is a home that is recognized by CHBA, on the basis of the attestations by the builder/renovator, its Qualified Net Zero Service Organization and a Qualified Net Zero Energy Advisor to have met the Technical Requirements, including the energy performance rating using Natural Resources Canada's (NRCAN's) EnerGuide Rating System (ERS) to be designed, modelled and constructed to produce as much energy (from on-site renewable energy sources) as it consumes, on an annual basis.

### **CHBA Qualified Net Zero Ready Home ("Net Zero Ready Home")**

A CHBA Qualified Net Zero Ready Home that is labelled under the Program is a home that is recognized by CHBA, on the basis of the attestations by the builder/renovator, its Qualified Net Zero Service Organization and a Qualified Net Zero Energy Advisor to have met the Technical Requirements, including the energy performance rating using NRCAN's EnerGuide Rating System (ERS), to be a Net Zero Home that has a renewable energy system designed for it that will allow it to achieve Net Zero Home performance, but the renewable energy system is not yet installed.

### **Detached House**

A dwelling unit with walls, floors, ceilings, and roof independent of any other building, as opposed to semi-detached or row houses sharing common walls. An alternate name is single-family detached house.

### **Heating Degree Days**

Heating Degree Days (HDD) are equal to the number of degrees Celsius that a given day's mean temperature is below 18 °C. For example, if the daily mean temperature is 12 °C, the HDD value for that day is equal to 6 °C. If the daily mean temperature is above 18 °C, the HDD value for that day is set to zero.

### **Single Unit – MURB**

These homes are multi-unit residential buildings (MURBs) that have been modelled in HOT2000 using a single unit approach. In this Program a MURB is defined as a purely residential occupancy buildings with a minimum of two vertically stacked units and a minimum of two storeys above finished grade in which each unit has a private entrance either outside the building or from a common hall, lobby, vestibule, or stairway.

### **Whole Building – MURB**

These homes are multi-unit residential buildings (MURBs) that have been modelled in HOT2000 using a whole building approach. In this Program a MURB is defined as a purely residential occupancy buildings with a minimum of two vertically stacked units and a minimum of two storeys above finished grade in which each unit has a private entrance either outside the building or from a common hall, lobby, vestibule, or stairway.

## 3.0 PROGRAM TO-DATE

This section provides an overall evaluation of Program activity and uptake as of December 31, 2020, which includes participants and homes in the Pilot through to the end of Year 4 of the Program.

<b>Pilot</b>	September 29, 2015 – December 2, 2016
<b>2017</b>	May 2, 2017 – December 31, 2017
<b>2018</b>	January 1, 2018 – December 31, 2018
<b>2019</b>	January 1, 2019 – December 31, 2019
<b>2020</b>	January 1, 2020 – December 31, 2020

Homes labelled in 2017, 2018, 2019 and 2020, were qualifying under Version 1. The Pilot homes and the Version 1 homes both used the same energy modelling software, HOT2000, but different versions (v10.51 and v11 respectively).

### 3.1 Uptake and Capacity

There are four CHBA Net Zero Qualifications for participants:

1. CHBA Qualified Net Zero Service Organization (“SO”)
2. CHBA Qualified Net Zero Energy Advisor (“EA”),
3. CHBA Qualified Net Zero Trainer (“Trainer”), and
4. CHBA Qualified Net Zero Builder/Renovator (“Builder/Renovator”).

The requirements for participants to become qualified under the Program can be found on the CHBA website at [www.chba.ca/nze](http://www.chba.ca/nze). The lists of Qualified Net Zero Service Organizations(SO), Energy Advisors (EA) and Trainers can be found on the CHBA website at [www.chba.ca/nze](http://www.chba.ca/nze) and Qualified Net Zero Builders and Renovators can be found at [www.netzerohome.com](http://www.netzerohome.com).

#### TRAINING

Builders/Renovators, Energy Advisors, and Trainers are required to successfully complete the CHBA Net Zero Builder Training offered through a Qualified Net Zero Service Organization and delivered by a Qualified Net Zero Trainer. Additionally, EAs and Trainers are required to successfully complete CHBA Net Zero Energy Advisor Training offered through a Qualified Net Zero Service Organizations and delivered by a Qualified Net Zero Trainer.

*Table 1: Number of Newly Trained Participants by Year*

Program Year	Pilot	2017	2018	2019	2020	Total
<b>Participants</b>	261	190	82	71	338	<b>942</b>

During the Pilot, NZC Sponsor Members Owens Corning, JELD-WEN and Dettson provided support to run a “blitz” of training sessions across Canada which resulted in excellent attendance by early adopters in the training during that timeframe. In 2020 the Net Zero Builder course and Net Zero Energy Advisor course were updated, and the new Net Zero Renovator Pilot course and Net Zero Sales & Marketing course were launched.

## 3.2 Number of Homes

Table 2: Number of Qualified Net Zero and Net Zero Ready Homes by Year

Label	Pilot	2017	2018	2019	2020	Total
Net Zero Home	26	9	8	106	30	179
Net Zero Ready Home	2	10	12	109	208	341
<b>Total</b>	<b>28</b>	<b>19</b>	<b>20</b>	<b>215</b>	<b>238</b>	<b>520</b>

Table 3: Number of Homes by Province

Province	Net Zero	Net Zero Ready	Total
Alberta	24	9	33
British Columbia	7	8	15
Manitoba	1	0	1
New Brunswick	2	11	13
Newfoundland & Labrador	0	2	2
Northwest Territories	0	0	0
Nova Scotia	10	1	11
Nunavut	0	0	0
Ontario	127	310	437
PEI	0	0	0
Quebec	6	0	6
Saskatchewan	2	0	2
Yukon	0	0	0



Figure 1: Climate Zone Map of Canada (source: Natural Resource Council of Canada, colour coding by NAIMA Canada).

Table 4: Distribution of Homes by Type and by Climate Zone

Type of House	Qty. per Climate Zone			
	4	5	6	7a
Detached Homes	4	163	141	25
Attached Homes	1	99	43	10
Unit by Unit - MURB	0	0	6	0
Whole Building - MURB	0	28	0	0
Subtotal	5	290	190	35
Total	520			

**Note:** The number 28 in Whole Building – MURBs row represents the total number of dwelling units within the 3 buildings

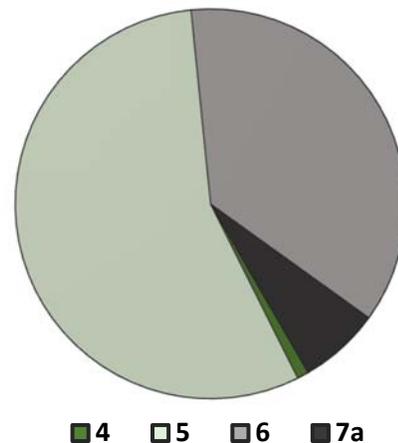


Figure 2: Distribution of Homes by Climate Zone

## ANALYSIS

There has been a significant amount of program uptake in the year 2020. In 2020, the Program saw growth of 111% over the number of Net Zero and Net Zero Ready Homes labelled in 2019. As a result of this program expansion, the data set of homes has strengthened and become more diverse allowing us to extrapolate trends in the data with a higher degree of certainty. These trends can be seen throughout this report.

## 4.0 ENVELOPE

This section explores the envelope assemblies used by the 520 homes labelled under the Program prior to December 31, 2020.

Table 5 summarizes the project types and their average thermal resistance values. The project types are:

- Detached homes less than 2,600 ft<sup>2</sup> in floor area,
- Detached homes greater than 2,600 ft<sup>2</sup> and less than 4,000 ft<sup>2</sup> in floor area,
- Detached homes greater than 4,000 ft<sup>2</sup> in floor area,
- Attached homes,
- Unit by unit – multi-unit residential buildings (MURB), and
- Whole building – multi-unit residential buildings (MURB)

**Note:** This report contains data from three projects under the home type Whole Building – MURB. It should be noted that each MURB was very different: one project had 3 units, one project had 10 units, and one project had 15 units.

Table 5: Building Envelope Performance Summary by Project Type and Climate Zone

Project Type	Climate Zone(s)	# of Labels	Avg. Area m <sup>2</sup>	Avg. Area ft <sup>2</sup>	Above Grade Wall Eff.			Ceiling Eff.			Basement Eff.		
					Avg. RSI [R]	Min. RSI [R]	Max. RSI [R]	Avg. RSI [R]	Min. RSI [R]	Max. RSI [R]	Avg. RSI [R]	Min. RSI [R]	Max. RSI [R]
Detached <2,600 ft <sup>2</sup>	5,6,7a	88	209	2,252	<b>5.03 [28.6]</b> 4.19 [23.8] 7.33 [41.6]	<b>10.69 [60.7]</b> 5.21 [29.6] 17.97 [102.0]	<b>4.34 [24.6]</b> 0.00 7.40 [42.0]						
Detached ≥2,600 ft <sup>2</sup> <4,000 ft <sup>2</sup>	4,5,6,7a	185	295	3,170	<b>4.85 [27.5]</b> 3.98 [22.6] 9.22 [52.4]	<b>10.43 [49.2]</b> 8.39 [47.6] 16.19 [91.9]	<b>4.22 [24.0]</b> 0.00 9.16 [52.0]						
Detached ≥4,000 ft <sup>2</sup>	4,5,6,7a	60	521	5,612	<b>5.34 [30.3]</b> 3.86 [21.9] 9.76 [55.4]	<b>10.91 [62.0]</b> 7.15 [40.6] 22.94 [130.3]	<b>4.46 [25.3]</b> 0.00 8.01 [45.5]						
Attached	4,5,6,7a	153	192	2,069	<b>4.94 [28.0]</b> 4.05 [23.0] 8.74 [49.6]	<b>9.99 [56.7]</b> 6.39 [36.3] 15.78 [89.6]	<b>3.5 [19.9]</b> 0.00 6.15 [34.9]						
Single Unit MURB	6	6	101	1,084	<b>4.80 [27.3]</b> 4.66 [26.5] 4.89 [27.8]	<b>8.22 [46.7]</b> 6.27 [35.6] 10.35 [58.8]	N/A						
Whole Building MURB	5	3	776	8,354	<b>5.24 [29.8]</b> 5.18 [29.4] 5.33 [30.3]	<b>8.90 [50.6]</b> 8.58 [48.7] 9.08 [51.6]	<b>3.85 [21.8]</b> 3.70 [21.0] 3.99 [22.7]						

Table 6: Detached Homes - Building Envelope Performance by Climate Zone

Climate Zone	# of homes	Above Grade Wall Efficiency		Ceiling Efficiency		Basement Efficiency	
		Avg. RSI [R]	Avg. RSI [R]	Avg. RSI [R]	Avg. RSI [R]	Avg. RSI [R]	Avg. RSI [R]
4	[4]	5.23 [29.7]	9.49 [53.9]	4.19 [23.8]			
5	[163]	4.50 [25.6]	10.34 [58.7]	4.18 [23.7]			
6	[141]	5.31 [30.2]	10.64 [60.4]	4.14 [23.5]			
7a	[25]	6.26 [35.6]	12.05 [68.4]	5.95 [33.8]			

Table 7: Attached Homes - Building Envelope Performance by Climate Zone

Climate Zone	# of homes	Above Grade Wall Efficiency Avg. RSI [R]	Ceiling Efficiency Avg. RSI [R]	Basement Efficiency Avg. RSI [R]
4	[1]	8.74 [49.6]	8.70 [49.4]	6.15 [34.9]
5	[99]	4.86 [27.6]	9.59 [54.5]	3.34 [19.0]
6	[43]	5.17 [29.4]	10.64 [60.4]	4.11 [23.3]
7a	[10]	4.44 [24.5]	11.29 [64.11]	2.20 [12.6]

## 4.1 Above-Grade Wall Assemblies

This section considers the effective thermal resistance of above-grade wall assemblies. The 333 detached homes as well as the 153 attached homes are evaluated by climate zone. The evaluation measures an assemblies’ resistance to heat flow using the metrics RSI and R-value, with a higher value being favourable. The CHBA Program has minimum requirements for the effective thermal resistance of above-grade wall assemblies outlined in the Technical Requirements.

### DETACHED HOMES

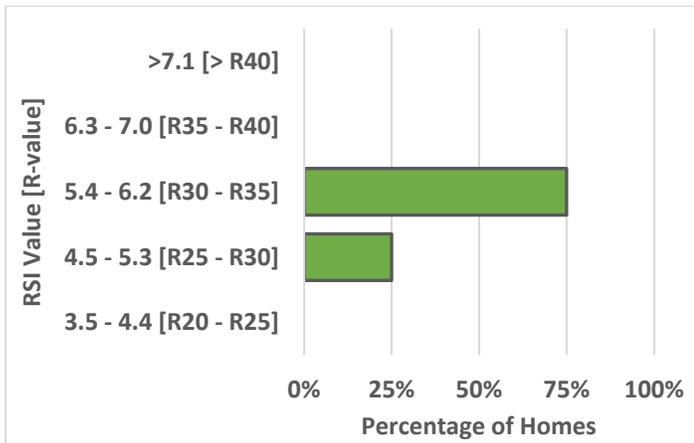


Figure 3: Detached Homes - Distribution of Above-Grade Wall  $RSI^{eff}$  in Climate Zone 4

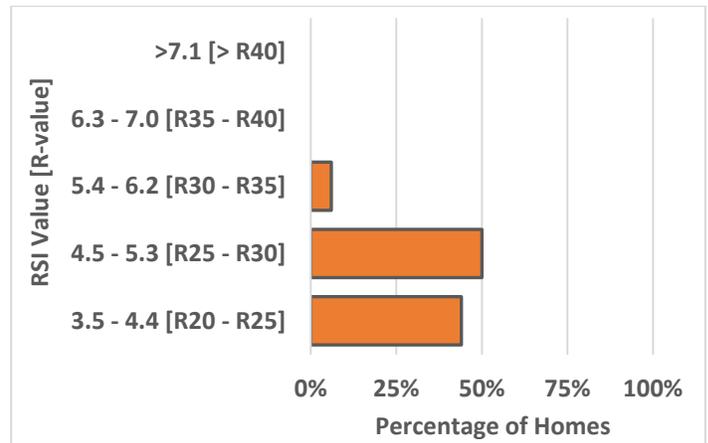


Figure 4: Detached Homes - Distribution of Above-Grade Wall  $RSI^{eff}$  in Climate Zone 5

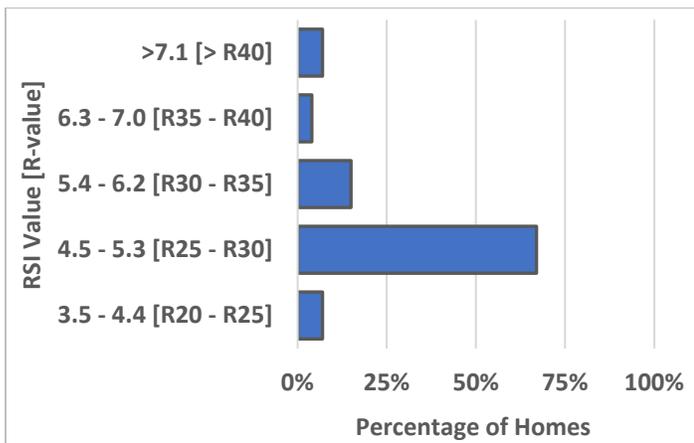


Figure 5: Detached Homes - Distribution of Above-Grade Wall  $RSI^{eff}$  in Climate Zone 6

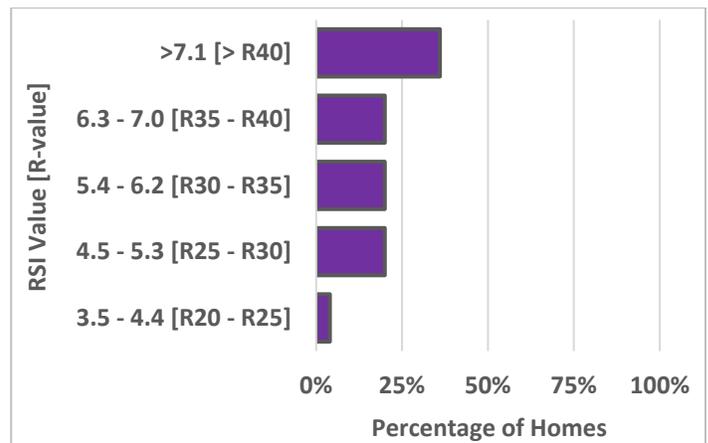


Figure 6: Detached Homes - Distribution of Above-Grade Wall  $RSI^{eff}$  in Climate Zone 7a

ATTACHED HOMES

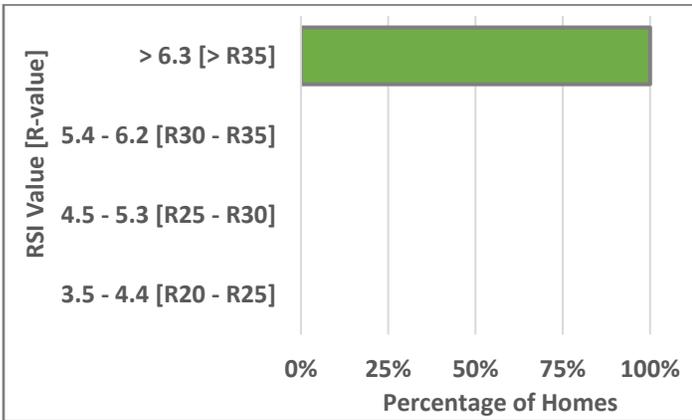


Figure 7: Attached Homes - Distribution of Above-Grade Wall RSI<sup>eff</sup> in Climate Zone 4

**Note:** There was only one attached home in climate zone 4.

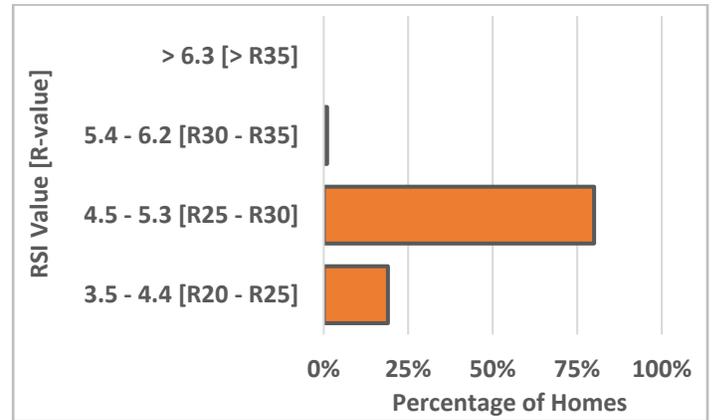


Figure 8: Attached Homes - Distribution of Above-Grade Wall RSI<sup>eff</sup> in Climate Zone 5

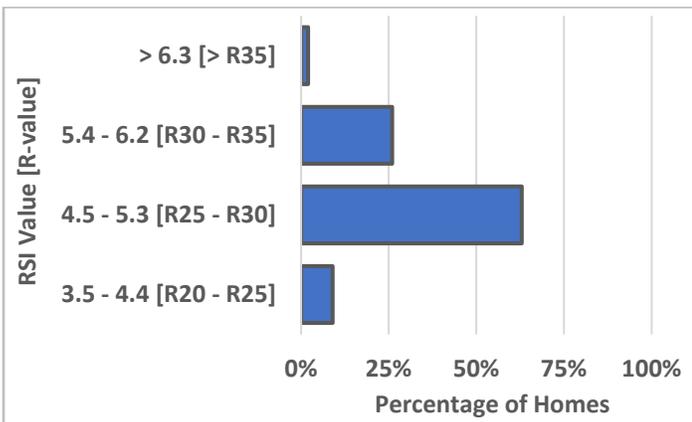


Figure 9: Attached Homes - Distribution of Above-Grade Wall RSI<sup>eff</sup> in Climate Zone 6

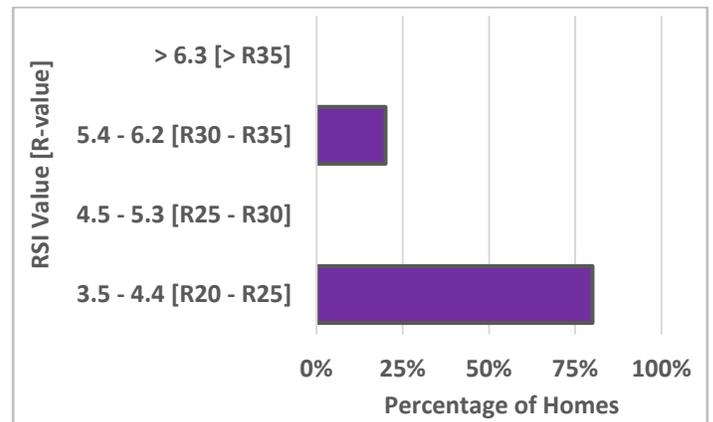


Figure 10: Attached Homes - Distribution of Above-Grade Wall RSI<sup>eff</sup> in Climate Zone 7a

## 4.2 Ceiling Assemblies

This section considers the effective thermal resistance of ceiling assemblies. The 333 detached homes as well as the 153 attached homes are evaluated by climate zone. The evaluation measures an assemblies' resistance to heat flow using the metrics RSI and R-value, with a higher value being favourable. The CHBA Program has minimum requirements for the effective thermal resistance of ceiling assemblies outlined in the Technical Requirements.

### DETACHED HOMES

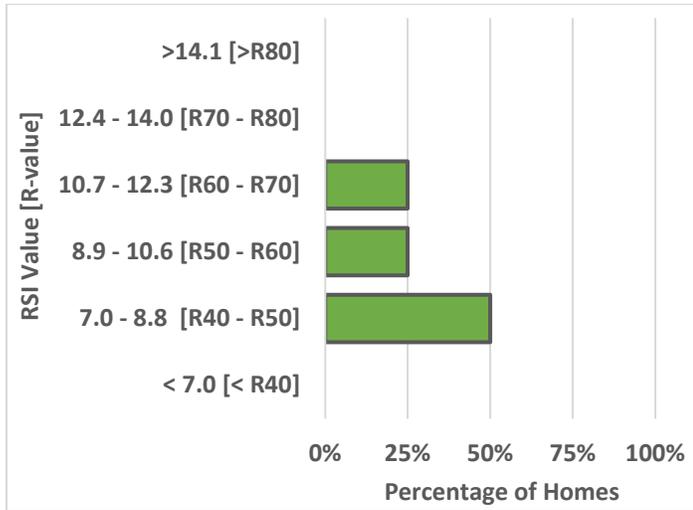


Figure 11: Detached Homes - Distribution of Ceiling  $RSI^{eff}$  in Climate Zone 4

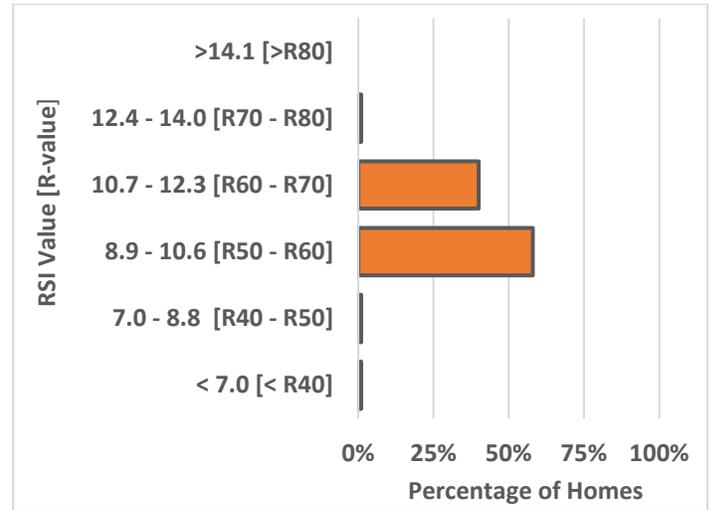


Figure 12: Detached Homes - Distribution of Ceiling  $RSI^{eff}$  in Climate Zone 5

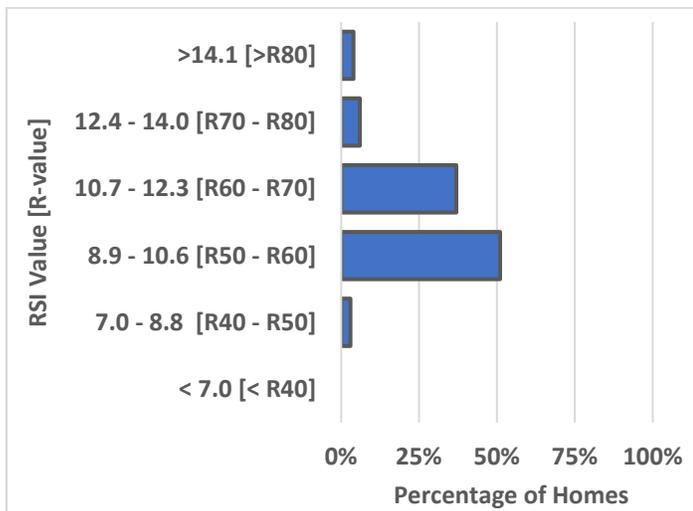


Figure 13: Detached Homes - Distribution of Ceiling  $RSI^{eff}$  in Climate Zone 6

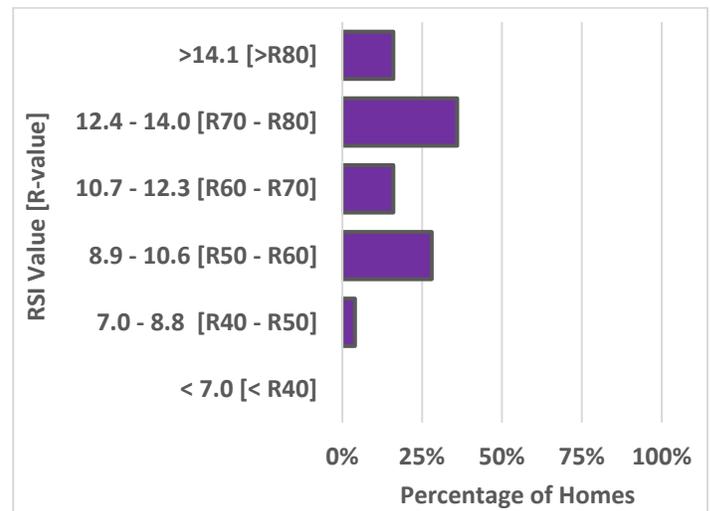


Figure 14: Detached Homes - Distribution of Ceiling  $RSI^{eff}$  in Climate Zone 7a

## ATTACHED HOMES

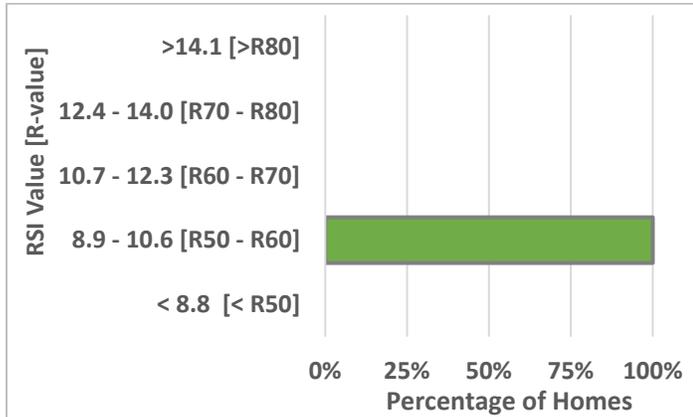


Figure 15: Attached Homes - Distribution of Ceiling  $RSI^{eff}$  in Climate Zone 4

**Note:** There is only one attached home in climate zone 4.

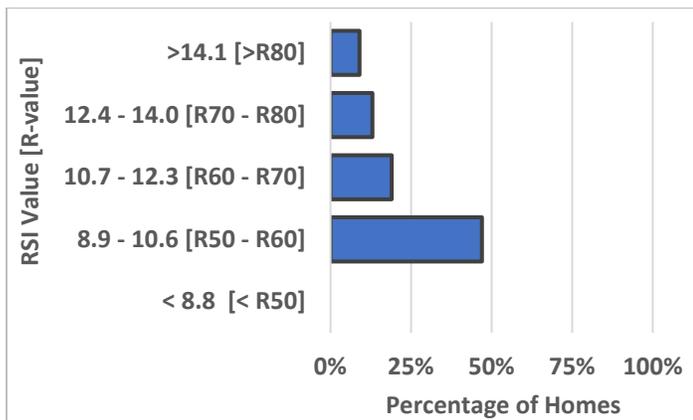


Figure 17: Attached Homes - Distribution of Ceiling  $RSI^{eff}$  in Climate Zone 6

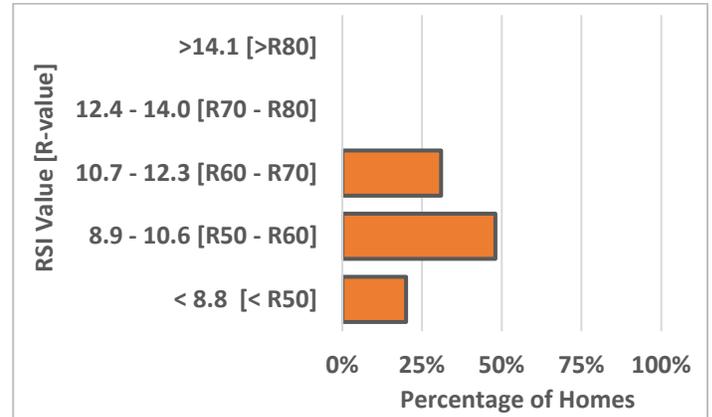


Figure 16: Attached Homes - Distribution of Ceiling  $RSI^{eff}$  in Climate Zone 5

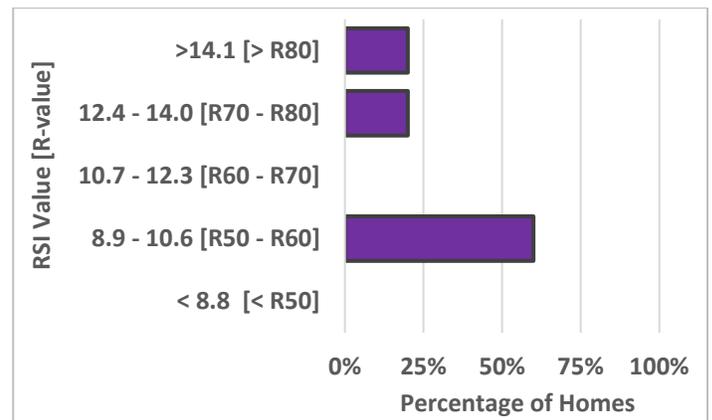


Figure 18: Attached Homes - Distribution of Ceiling  $RSI^{eff}$  in Climate Zone 7a

### Analysis

- 79% (263/333) of detached homes used effective thermal resistance of wall assemblies of  $\geq$  RSI 4.4 [R25].
- 80% (122/153) of attached homes used effective thermal resistance of wall assemblies of  $\geq$  RSI 4.4 [R25].
- 88% (292/333) of detached homes used effective thermal resistance of ceiling assemblies of  $\geq$  RSI 9.7 [R55].
- 82% (125/153) of attached homes used effective thermal resistance of ceiling assemblies of  $\geq$  RSI 8.9 [R50].

## 5.0 MECHANICALS

This section explores the mechanical systems in the homes relating to:

- space heating and cooling,
- water heating, and
- ventilation.

### 5.1 Space Heating & Cooling

This section looks at the space heating and cooling systems used in the 486 attached and detached homes labelled under the Program.

- **Only electric source:** 27% (129/486 homes)
- **Only gas source:** 1% (7/486 homes)
- **Dual source:** 72% (350/486 homes)

Only 12 homes in the program did not elect to install an air-source heat pump (ASHP) and therefore only those homes were required to perform the space cooling threshold calculation. ASHPs provide both space heating as well as space cooling so the homes that installed an ASHP would not have required a stand-alone space cooling system. 100% of homes installed an HRV or ERV for mechanical ventilation, per the Program Technical Requirements.

*Table 8: Heating System Configuration of Homes in 2020*

Heating System Configuration	2020	Total
ASHP + Electric Baseboard/Hydronic/Plenum(duct) heaters	13	30
ASHP + Electric Furnace	13	95
ASHP + Natural Gas Condensing Furnace	198	335
ASHP + Propane Condensing Furnace	0	1
Conventional Gas Furnace	0	4
Ground Source Heat Pump System	3	5
Combo/Domestic Hot Water	11	16
<b>Total</b>	<b>238</b>	<b>486</b>

*Table 9: Heating System Configuration of Homes by Province*

Heating System Configuration	AB	BC	MB	NB	NL	NS	ON	SK	Total
ASHP + Electric Baseboard	4	5	0	1	2	9	9	0	30
ASHP + Electric Furnace	20	5	1	2	0	2	65	0	95
ASHP + Natural Gas Condensing Furnace	0	0	0	9	0	0	324	2	335
ASHP + Propane Condensing Furnace	0	0	0	0	0	0	1	0	1
Conventional Gas Furnace	0	1	0	0	0	0	3	0	4
Ground Source Heat Pump System	1		0	1	0	0	3	0	5
Combo/Domestic Hot Water	8	4	0	0	0	0	4	0	16
<b>Total</b>	<b>33</b>	<b>15</b>	<b>1</b>	<b>13</b>	<b>2</b>	<b>11</b>	<b>409</b>	<b>2</b>	<b>486</b>

## 5.2 Water Heating

This section looks at the water heating systems used in homes labelled under the Program.

- **Electric water heating:** 31% (150/486 homes)
- **Natural gas water heating:** 68% (331/486 homes)
- **Solar water heating:** 1% (2/486 homes)
- **Propane water heating:** 1% (3/486 homes)

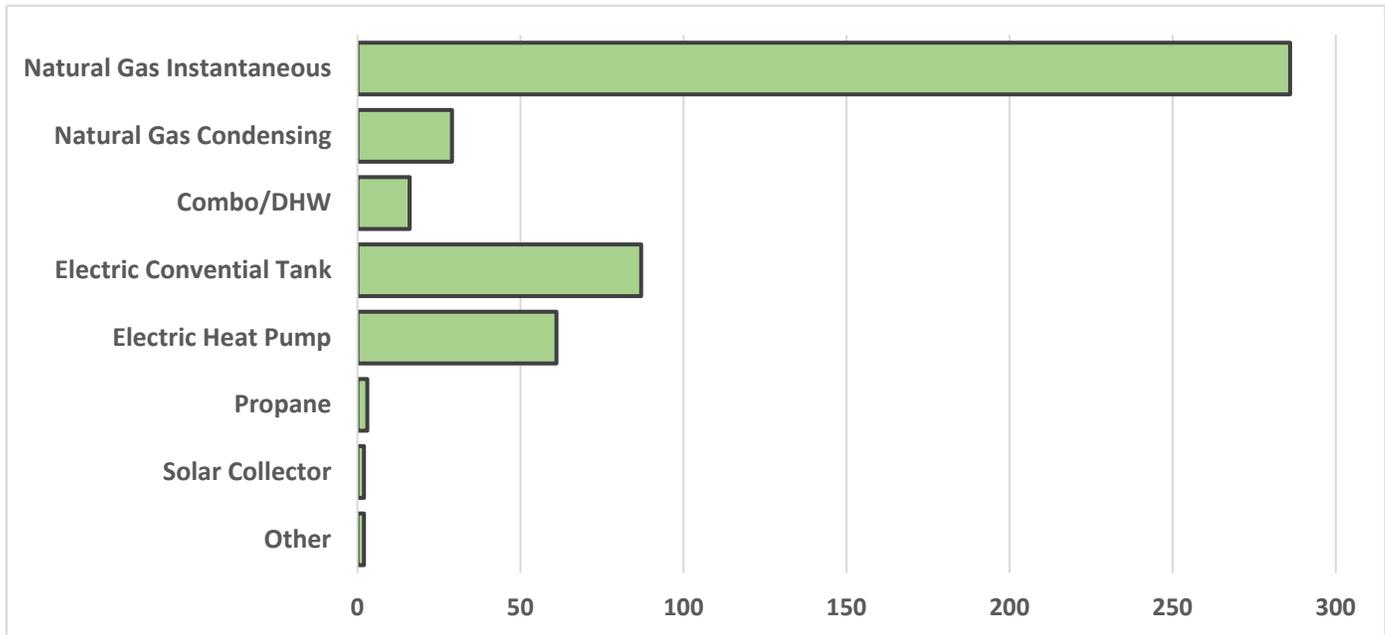


Figure 19: Water Heating Configuration of all Net Zero and Net Zero Ready Homes

### Analysis

The majority of Net Zero and Net Zero Ready homes install an Air Source Heat Pump in combination with a backup heating source such as an electric furnace or a natural gas condensing furnace, yet generally still use conventional water heating configurations. 100% of homes installed an HRV or ERV for mechanical ventilation, per the Program Technical Requirements.

## 6.0 FUEL SOURCE

This section looks at the fuel source configuration used in the 520 Net Zero and Net Zero Ready Homes. The fuel sources that are used in these homes include electricity, natural gas, propane, and solar thermal water heating. In the categories below, “all-electric” means that the home uses only electricity and “dual source” means that the home uses electricity and either natural gas or propane. The CHBA Program has no requirement for specific heating fuel sources – it is fuel agnostic. The only related requirement is that the total energy consumption is modelled to 0 GJ/year using onsite renewables.

- **Net Zero all-electric:** 28% (144/520 homes)
- **Net Zero dual source:** 7% (35/520 homes)
- **Net Zero Ready all-electric:** 2% (12/520 homes)
- **Net Zero Ready dual source:** 63% (329/520 homes)

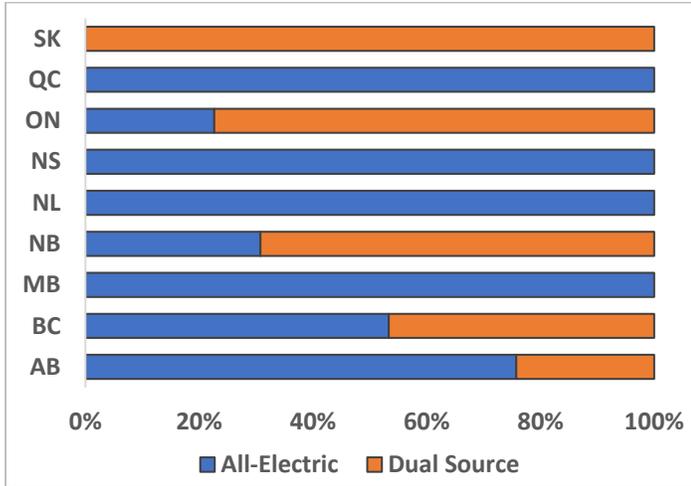


Figure 20: Fuel Source Configuration of Homes by Province

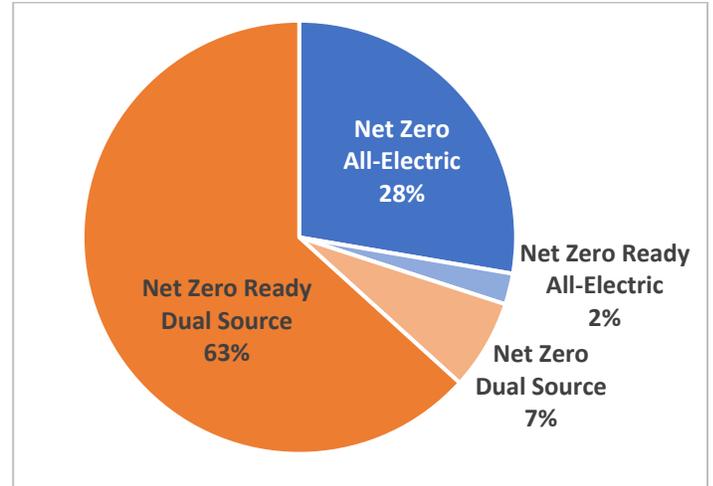


Figure 21: Fuel Source of Net Zero and Net Zero Ready Homes

### Analysis

The CHBA Net Zero Home Labelling Program is fuel agnostic. Builders have the choice to use whichever fuel source they like as long as the home can be modelled to offset the total estimated annual energy using renewable energy. There are a variety of reasons why builders choose the fuel sources that they do. Some examples are cost, availability, homeowner goals, etc. The majority of Net Zero Ready homes continue to use natural gas or even propane as a source of heating and are therefore “dual source”. The majority of Net Zero Homes use only electricity as a fuel source.

## 7.0 PERFORMANCE

This section looks at the performance metrics used to evaluate these homes. Each metric is explained in detail in their respective sections. The metrics are:

- Annual energy consumption, measured in in GJ/year (AEC),
  - Occupant load versus operational load in GJ/year
- Whole home heat loss, measured in GJ/year (WHHL),
- Airtightness, measured in air changes per hour at 50 pascals (ACH@50),
- Total energy use intensity, measured in kWh/m<sup>2</sup> per year (TEUI),
- Percent better than reference house—whole house annual energy consumption (Ref AEC), and
- Percent better than reference house—building envelope (Ref Env.).

Table 10: Performance Metrics Summary by Project Type

Project Type	Climate Zone(s)	# of Labels	Avg. Area m <sup>2</sup>	Avg. Area ft <sup>2</sup>	AEC		WHHL		ACH@50		TEUI		Ref AEC <sup>1</sup>		Ref Env	
					Avg. Min.	Avg. Max.	Avg. Min.	Avg. Max.	Avg. Min.	Avg. Max.	Avg. Min.	Avg. Max.	Avg. Min.	Avg. Max.		
Detached <2,600 ft <sup>2</sup>	5,6,7a	88	209	2,252	<b>42.4</b>	<b>46.9</b>	<b>0.98</b>	<b>58.4</b>	<b>69.9</b>	<b>55.7</b>						
					30.9	22.9	0.4	40.2	59.0	36.9						
					58.2	81.3	1.7	174.6	83.0	75.3						
Detached ≥2,600 ft <sup>2</sup> <4,000 ft <sup>2</sup>	4,5,6,7a	185	295	3,170	<b>47.5</b>	<b>60.1</b>	<b>0.97</b>	<b>45.2</b>	<b>69.8</b>	<b>51.4</b>						
					35.4	<b>38.8</b>	0.28	30.9	36.1	35.3						
					82.7	122.9	1.76	82.0	85.9	88.7						
Detached ≥4,000 ft <sup>2</sup>	4,5,6,7a	60	521	5,612	<b>62.0</b>	<b>106.1</b>	<b>1.00</b>	<b>33.6</b>	<b>71.6</b>	<b>51.0</b>						
					35.8	42.3	0.21	16.6	0.0	33.6						
					130.8	227.6	1.50	69.8	86.8	84.1						
Attached	4,5,6,7a	153	192	2,069	<b>39.8</b>	<b>36.5</b>	<b>1.46</b>	<b>61.3</b>	<b>66.9</b>	<b>61.4</b>						
					27.2	<b>18.9</b>	0.46	35.4	56.3	38.2						
					99.7	101.3	3.25	124.1	86.7	86.9						
Single Unit MURB	6	6	101	1,084	<b>20.9</b>	<b>24.4</b>	<b>1.47</b>	<b>20.7</b>	N/A	<b>85.3</b>						
					19.8	19	1.36	13.5	77.6							
					21.5	26.6	1.63	31	93.3							
Whole Building MURB	5	3	776	8,354	<b>229.5</b>	<b>257</b>	<b>2.52</b>	<b>66.3</b>	<b>63.6</b>	<b>52.3</b>						
					69.7	76.5	2.49	24.5	63	41						
					353.2	378.5	2.58	146.4	64	67.3						

<sup>1</sup> 19 Detached homes, 6 attached homes, and all 6 Single Unit - MURBs did not have this calculation ("Ref AEC").

## 7.1 Annual Energy Consumption

### DEFINITION

Annual energy consumption is defined as the amount of energy required to operate the home on an annual basis. This includes energy required for space heating, space cooling, water heating, ventilation, and occupant loads (lighting, appliances, and plug loads). Annual energy consumption is measured in GJ/year with a lower value being favourable. The CHBA Program has a modelled performance target of 0 GJ for the annual energy consumption, offset by the on-site renewable energy production.

**Note:** The GJ values below reflect the energy consumption of the homes—without the renewable energy generation.

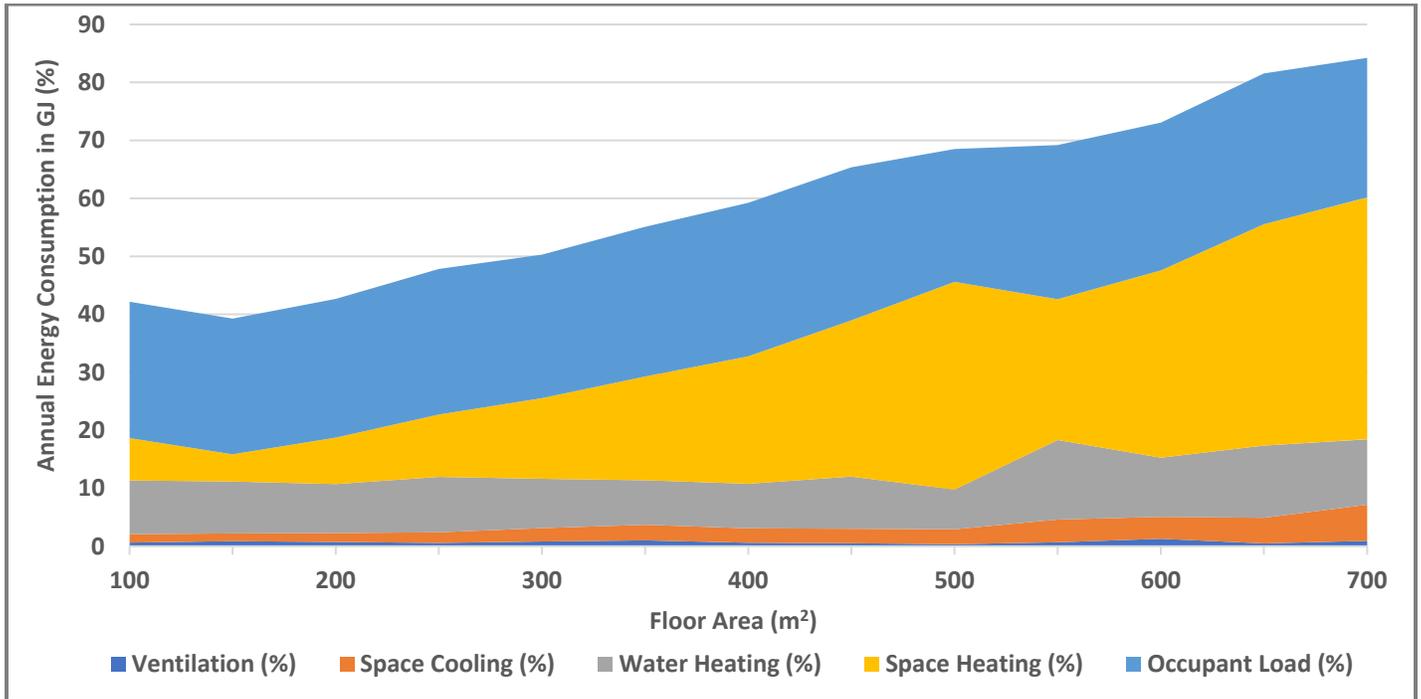


Figure 22: Average Load Distribution of Annual Energy Consumption by Floor Area

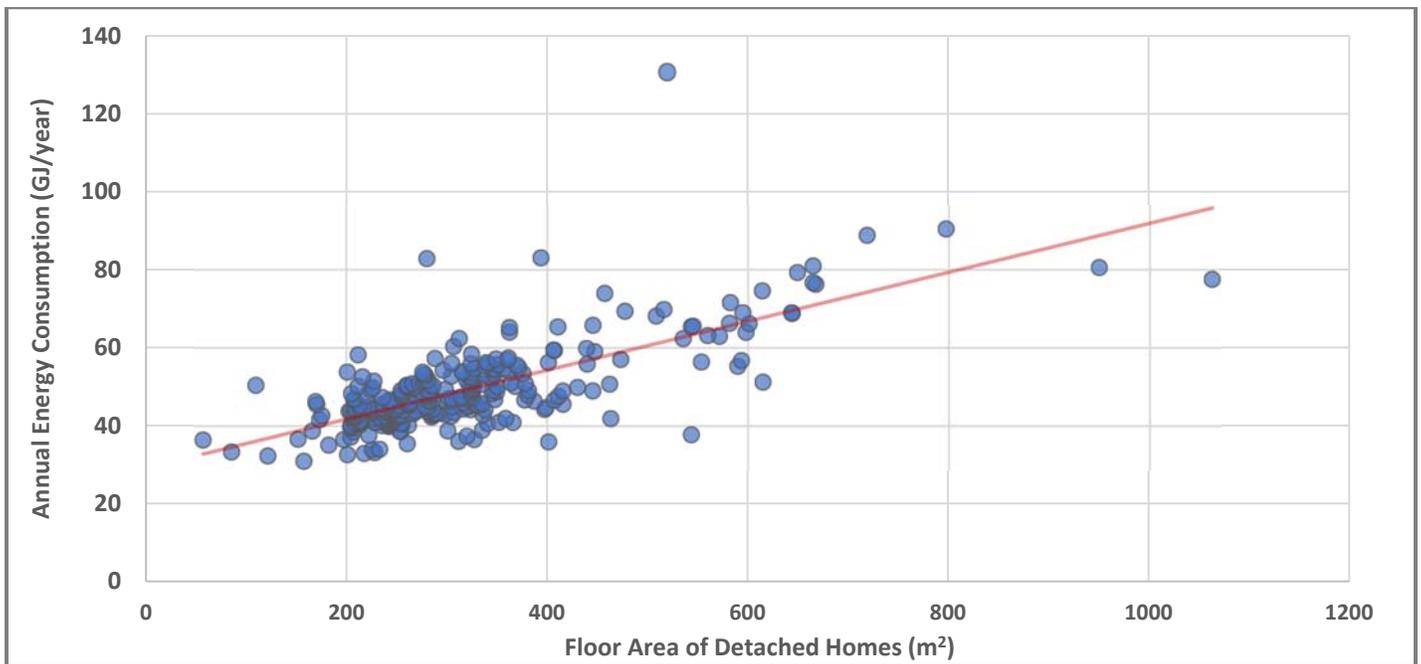


Figure 23: Annual Energy Consumption of Homes by Floor Area

## 7.1.1 Occupant and Operational Load Breakdown

### DEFINITION

In this section the annual energy consumption is considered by separating the amounts of energy required for individual load types. The energy required for space heating, space cooling, water heating and ventilation are considered the operational load. The operational load represents the amount of energy the home consumes annually to operate only essential equipment, regardless of occupancy. These energy requirements are modelled based on the energy performance of actual equipment used in the home. The occupant load (or baseload) is modelled using estimated energy consumption averages for lighting, appliances and plug loads. The occupant load estimates the average energy consumption of the occupants within the home. HOT2000 estimated the occupant load based on the assumed consumption of three occupants for detached homes and two occupants per unit for MURBs. The CHBA Program has a modelled performance target of 0 GJ for the total annual energy consumption and does not consider the individual load types.

### AVERAGE ATTACHED HOME

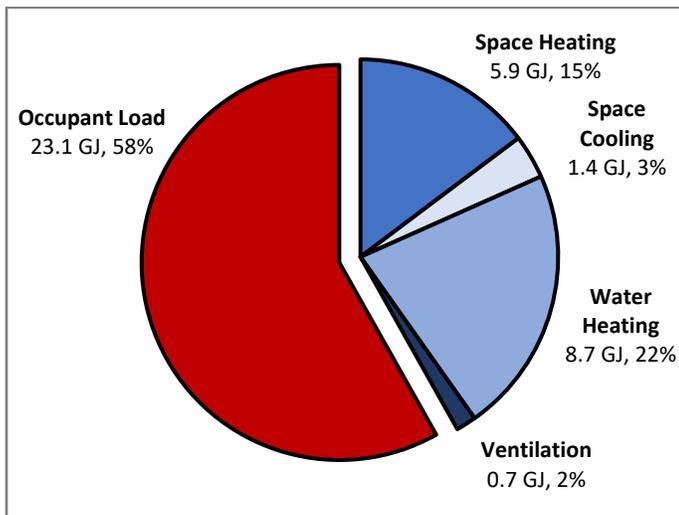


Figure 24: Annual Energy Consumption Breakdown of Attached Homes

### AVERAGE DETACHED HOMES < 2600ft<sup>2</sup>

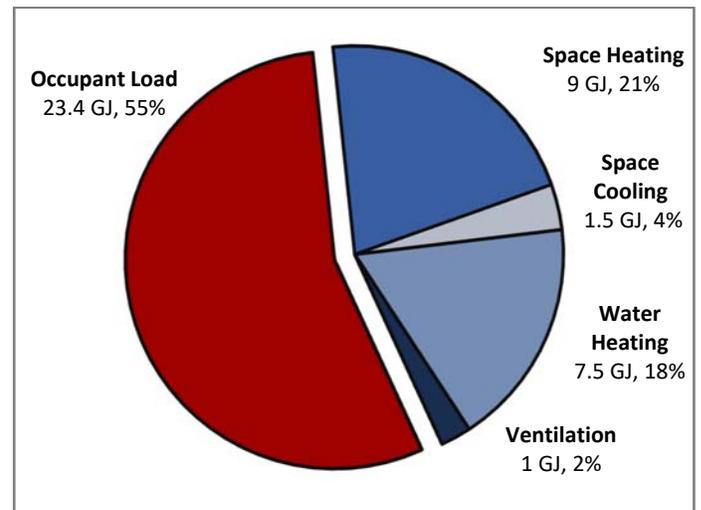


Figure 25: Annual Energy Consumption Breakdown of Detached Homes <2600ft<sup>2</sup>

### AVERAGE DETACHED HOMES ≥ 2600ft<sup>2</sup> and < 4,000ft<sup>2</sup>

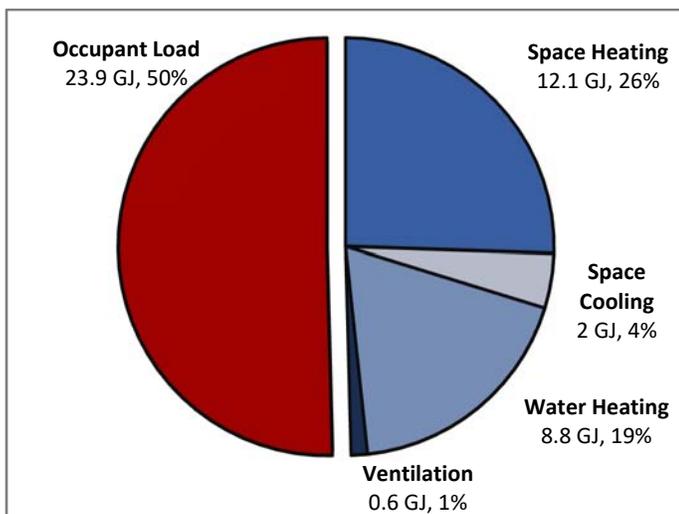


Figure 26: Annual Energy Consumption Breakdown of Detached Homes ≥2600ft<sup>2</sup> and <4,000ft<sup>2</sup>

### AVERAGE DETACHED HOME > 4000ft<sup>2</sup>

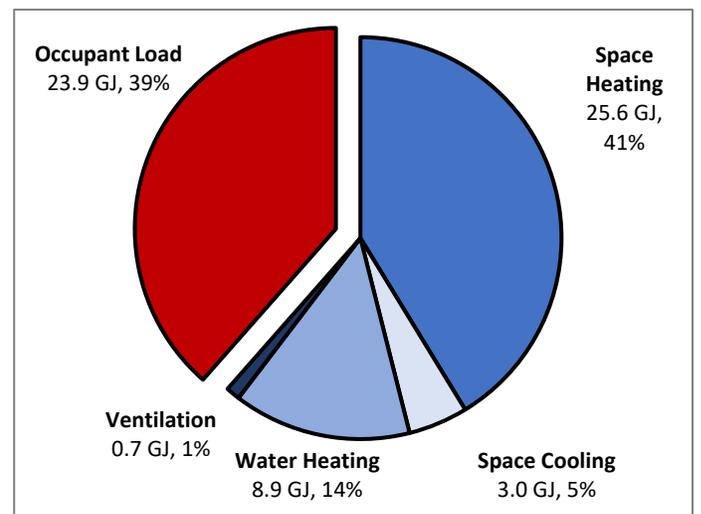


Figure 27: Annual Energy Consumption Breakdown of Detached Homes >4000ft<sup>2</sup>

## Analysis

- 68% (236/333) of detached homes modelled to consume less than 50 GJ/year.
- 71% (108/153) of attached homes modelled to consume less than 40 GJ/year.

There is clear trend between the floor area of the homes and the amount of space heating energy required to heat the home. The larger the home, the greater the heating energy required to meet the heating load. In addition, there is a clear trend between the estimated occupant and the floor area of the home. The smaller the home, the larger the percentage the occupant loads makes up of the total annual energy consumption.

## 7.2 Whole Home Heat Loss

### DEFINITION

Whole home heat loss is defined as the total amount of heat lost from the whole home on an annual basis. This includes heat lost from air leakage and heat lost through the foundation, ceilings, walls, and windows and doors. Whole home heat loss is measured in GJ/year with a lower value being favourable. The CHBA Program does not have a performance target for whole home heat loss.

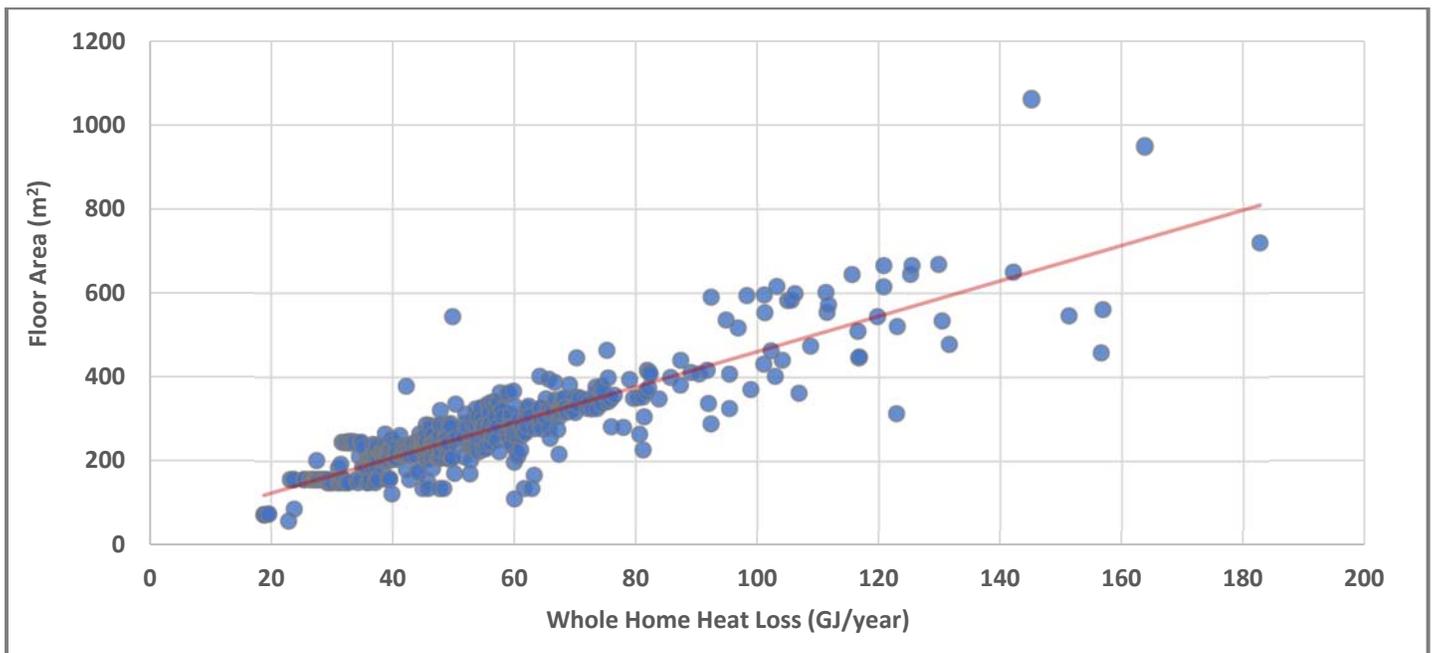


Figure 28: Whole Home Heat Loss of Homes by Floor Area

### WHOLE HOME HEAT LOSS BY ASSEMBLY

Total Heat Loss:	47.7 GJ/year
Foundation:	16.0 GJ/year
Ceiling:	5.7 GJ/year
Walls:	11.7 GJ/year
Windows & Doors:	15.3 GJ/year

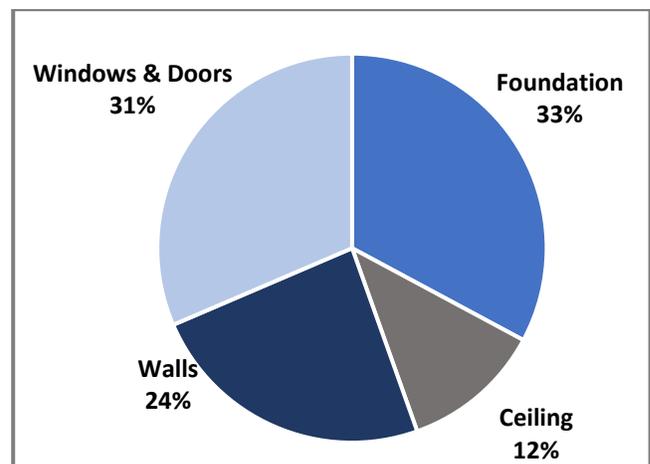


Figure 29: Whole Home Heat Loss of Homes by Assembly

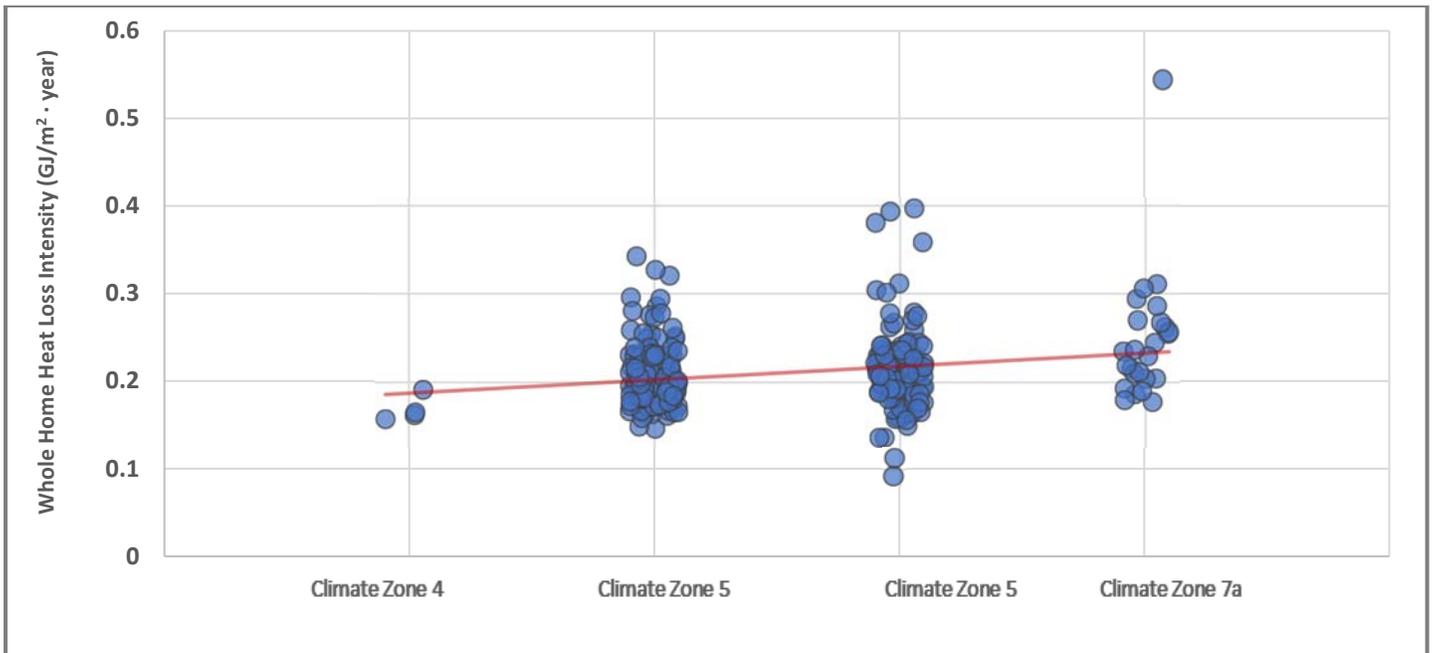


Figure 30: Detached Homes – Whole Home Heat Loss Intensity by Climate Zone

#### DETACHED HOMES - AVERAGE BY CLIMATE ZONE

- Climate Zone 4 = 0.17 GJ/m<sup>2</sup>/year
- Climate Zone 5 = 0.21 GJ/m<sup>2</sup>/year
- Climate Zone 6 = 0.21 GJ/m<sup>2</sup>/year
- Climate Zone 7a = 0.25 GJ/m<sup>2</sup>/year

#### Analysis

- 74% (246/333) of detached homes were modelled to have a whole home heat loss of less than 70 GJ annually.
- 81% (124/153) of attached homes were modelled to have a whole home heat loss of less than 40 GJ annually.
- 0.21 GJ/m<sup>2</sup>/year is the average whole home heat loss intensity of detached homes.

There is a strong relationship between the homes estimated whole home heat loss and the floor area of the homes. Larger homes lose more heat through their envelope. Whole home heat loss is also impacted by the local climate. Whole Home Heat Loss intensity, which is a measure of the homes heat loss annually per m<sup>2</sup> of floor area, on average increases slightly from warmer climate zones to colder climate zones.

## 7.3 Airtightness

### DEFINITION

Airtightness is a measurement of how resistant the dwelling unit is to inward and outward air leakage. Airtightness is measured in air changes per hour (ACH@50) with a lower value meaning better performance. The dwelling unit is depressurized (or pressurized) to 50 pascals with a fan typically positioned and enclosed in the front door frame. The volume of air passing through the fan at a constant pressure is recorded. This amount represents the amount of air escaping the dwelling unit. ACH measures the number of times the air is replaced in one hour compared to the volume of the dwelling unit, for example, an ACH@50 of 1, 2, and 0.5 means the amount of air replaced in one hour is the same, double and half (respectively) the volume of the unit being tested. The CHBA Program has a performance target of maximum 1.5 ACH@50 for detached homes and maximum 2.0 ACH@50 for attached homes. The Program also has airtightness targets using two additional recognized metrics: Normalized Leakage Area at 10 Pascals (NLA@10) and Normalized Leakage Rate at 50 Pascals (NLR@50). The Program requires that only one of these targets be met.

**Note:** 4 attached homes were excluded from figure 31 as outliers because they met the NLA@10 or NLR@50 targets and exceeded the scale of this graph.

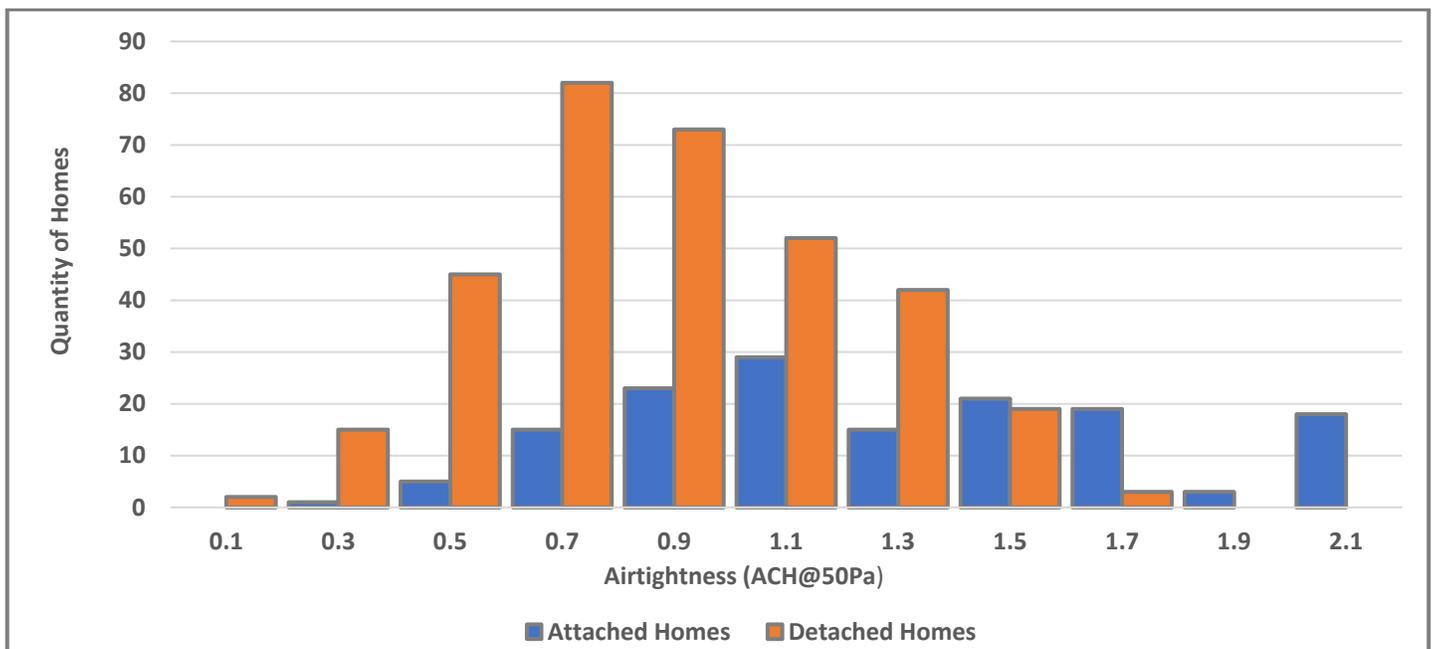


Figure 31: Distribution of Airtightness by ACH@50

### Analysis

- The average airtightness of all 333 detached homes is 0.98 ACH@50Pa.
- The average airtightness of all 153 attached homes is 1.46 ACH@50Pa.
- 57% (190/333) of the detached homes achieved airtightness of 1.0 ACH@50Pa or less.
- 44% (67/153) of the attached homes achieved airtightness of between 0.7 and 1.3 ACH@50Pa.

The airtightness of the detached homes shows a clear trend of builders aiming for 1.0 ACH@50pa or less. Attached homes don't trend as clearly as detached homes. Note that 25 attached homes achieved the CHBA airtightness requirements using one of the other available targets, NLA@10 Pa and NLR@50 Pa. The NLA@10Pa target for attached homes is 1.18 cm<sup>2</sup>/m<sup>2</sup> and the NLR@50Pa is 0.78 L/s/m<sup>2</sup>.

## 7.4 Total Energy Use Intensity (TEUI)

### DEFINITION

Total Energy Use Intensity is a normalized metric comparing the estimated annual energy consumption of the home to the size of the home's heated floor area. TEUI is measured in kWh/m<sup>2</sup>/year with a lower value indicating better performance. TEUI includes the energy required for space heating, space cooling, domestic water heating, ventilation, and occupant load and divides the total by the heated floor area. The CHBA Program does *not* have a performance target for TEUI.

**Note:** 3 homes were removed from figure 32 and 33 as outliers. The TEUI's of these homes were 108.3, 175.0, 127.8.

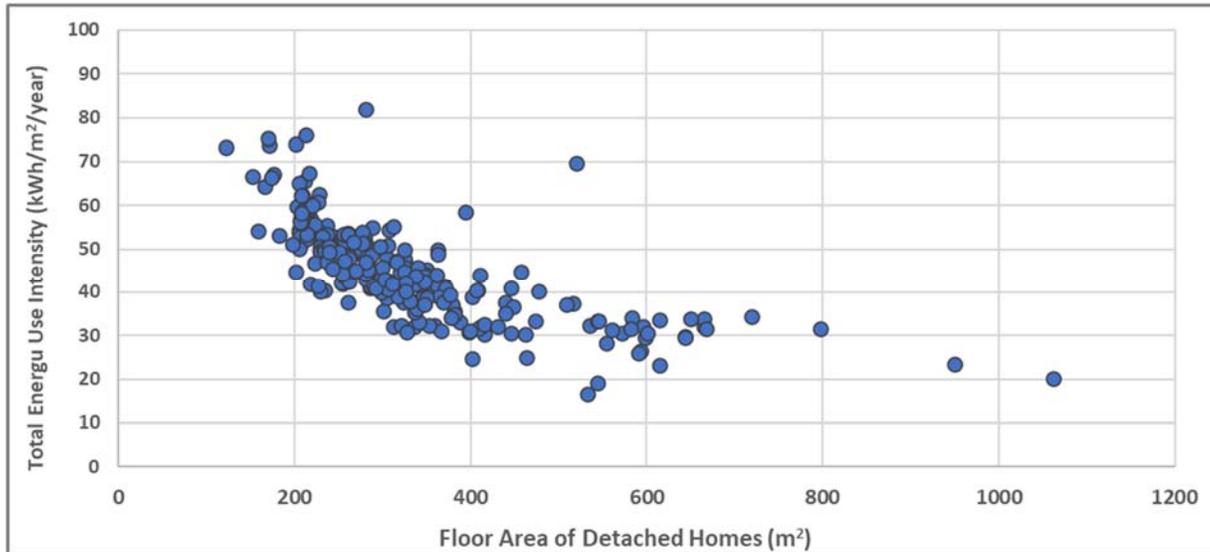


Figure 32: Detached Homes – Total Energy Use Intensity by Floor Area

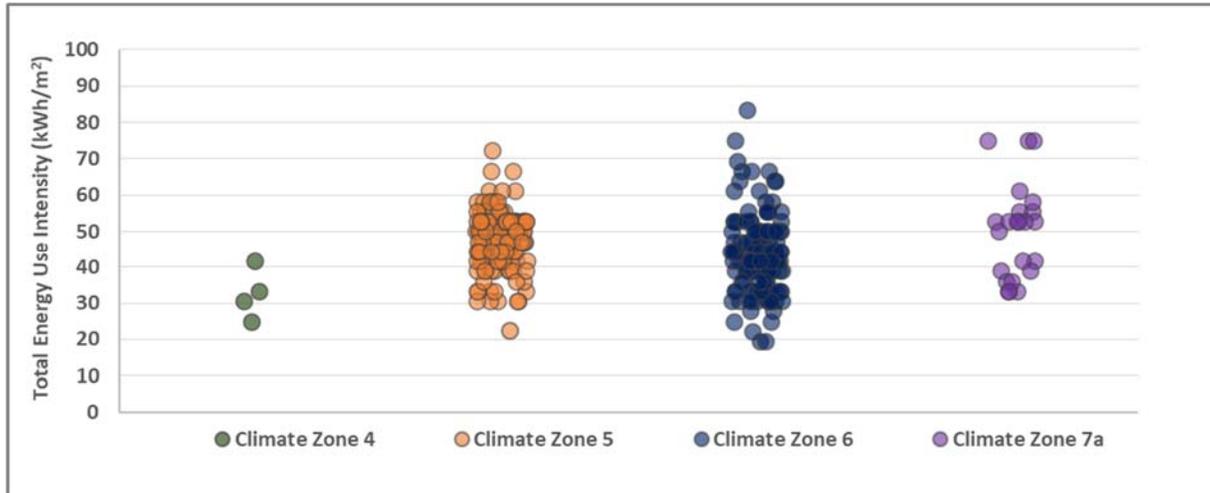


Figure 33: Detached Homes - Total Energy Use Intensity by Climate Zone

### DETACHED HOMES - AVERAGE BY CLIMATE ZONE

- Climate Zone 4 = 32.6 kWh/m<sup>2</sup>/year.
- Climate Zone 5 = 47.8 kWh/m<sup>2</sup>/year.
- Climate Zone 6 = 45.3 kWh/m<sup>2</sup>/year.
- Climate Zone 7a = 50.2 kWh/m<sup>2</sup>/year.

### Analysis

Colder climates and smaller heated floor area can impact the ability of a home to achieve a low TEUI. On average, TEUI increases marginally from warmer climate zones to colder climate zones. Smaller homes typically have a higher TEUI than larger homes.

## 7.5 Percent Better than Reference House – Annual Energy Consumption (“Ref. AEC”)

### DEFINITION

Percent Better than Reference House—Whole House Energy Consumption is a measure of how much better the proposed house is in the area of whole house energy consumption compared to its respective Reference House, which is a Code minimum version of the proposed house. “Ref. AEC” is measured as a percentage (%) with a higher value indicating better performance. The “Ref. AEC” calculation in this report follows the “Ref AEC” calculation as defined in the BC Energy Step Code. Ref AEC includes the energy consumption of the home’s space heating, space cooling, water heating, and ventilation and excludes the occupant baseloads (lights, appliances, plug loads) from both the proposed house and the Reference House. The CHBA Program does not have a performance target for “Ref. AEC”. The highest step in the BC Energy Step Code does not include a “Ref. AEC” target, however, the second highest step in the BC Energy Step Code includes a “Ref. AEC” target of 40% better as a compliance path.

**Note:** Only 463 detached and attached homes have this calculation because it was included in the updated version of HOT2000. 1 detached home was excluded from Figure 34 as an outlier.

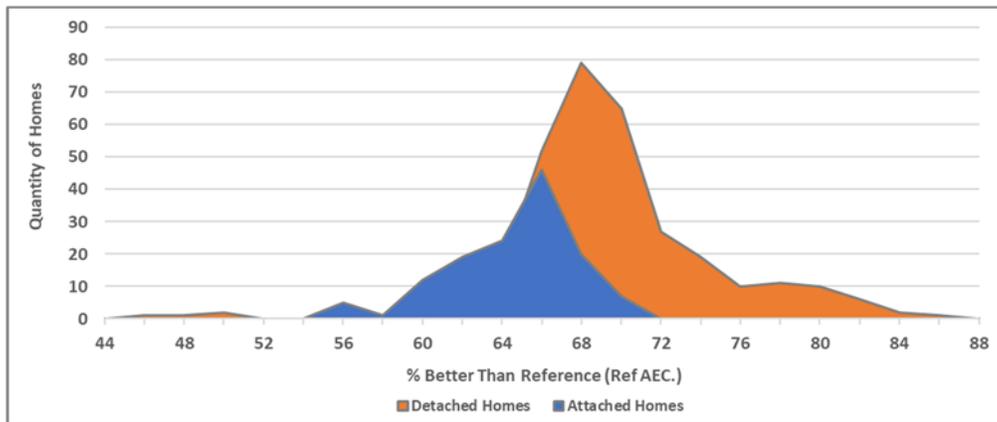


Figure 34: Distribution of Percent Better Than Reference House - Annual Energy Consumption

**Note:** 1 detached home was excluded from Figure 35 as an outlier because its Ref AEC was below the scale of this chart (36%).

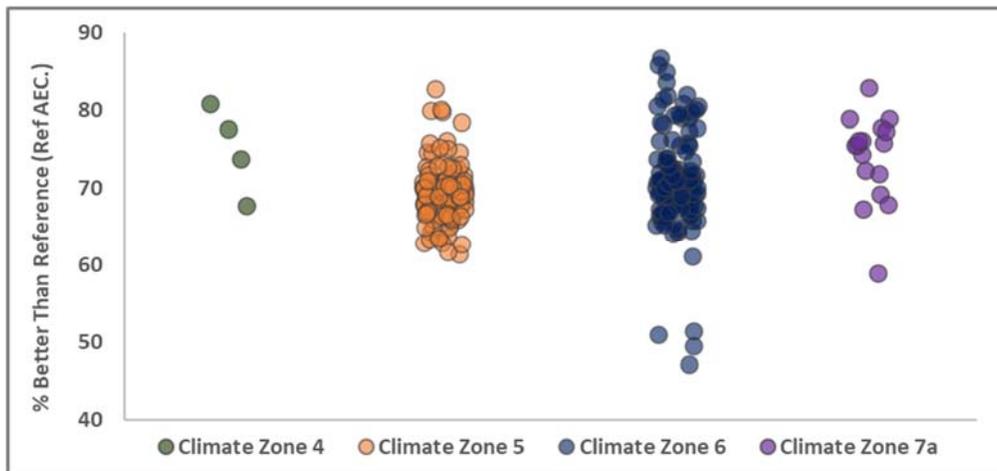


Figure 35: Detached Homes - Percent Better Than Reference House – Annual Energy Consumption by Climate Zone

### ANALYSIS

- The average for all 314 detached homes is 70.4% better than “Ref. AEC”.
- The average for all 147 attached homes is 66.9% better than “Ref. AEC”.
- 60% (277/461) of the attached and detached homes achieved between 60% and 70% better than “Ref. AEC”.
- 37% (171/461) of the attached and detached homes achieved greater than 70% better than “Ref. AEC”.

On average, most Net Zero and Net Zero Ready homes achieve between 60% and 75% better than the reference for annual energy consumption. The data does not show a relationship between the climate zone of the home and the achieved percentage improvement of annual energy consumption over the reference house.

## 7.6 Percent Better than Reference House – Building Envelope (“Ref. Env.”)

### DEFINITION

Percent Better than Reference House—Building Envelope is a measure of how much better the proposed house is in the area of building envelope compared to its respective Reference House, which is a Code minimum version of the proposed house. “Ref. Env.” is measured as a percentage (%) with a higher value indicating better performance. The “Ref. Env.” calculation compares the space heating energy requirements from the proposed house energy model and the Reference House energy model. The CHBA Program includes a performance target of minimum 33% better than its Reference House for building envelope.

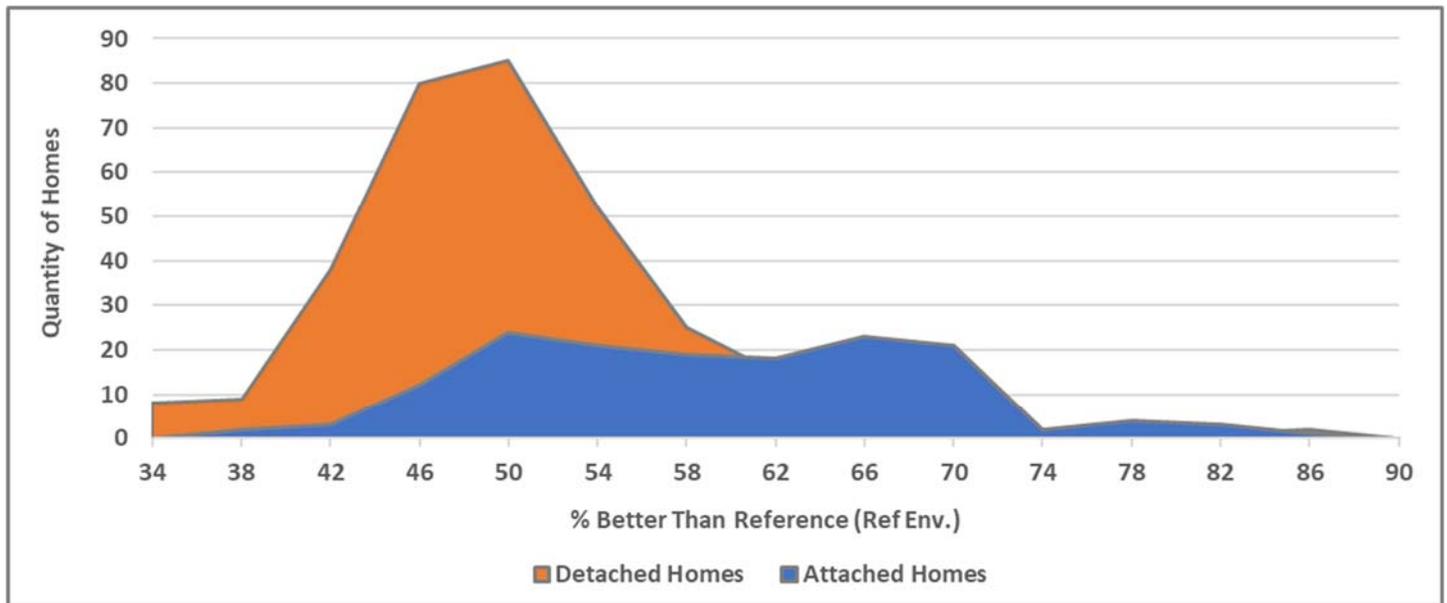


Figure 36: Distribution of Percent Better Than Reference House - Building Envelope

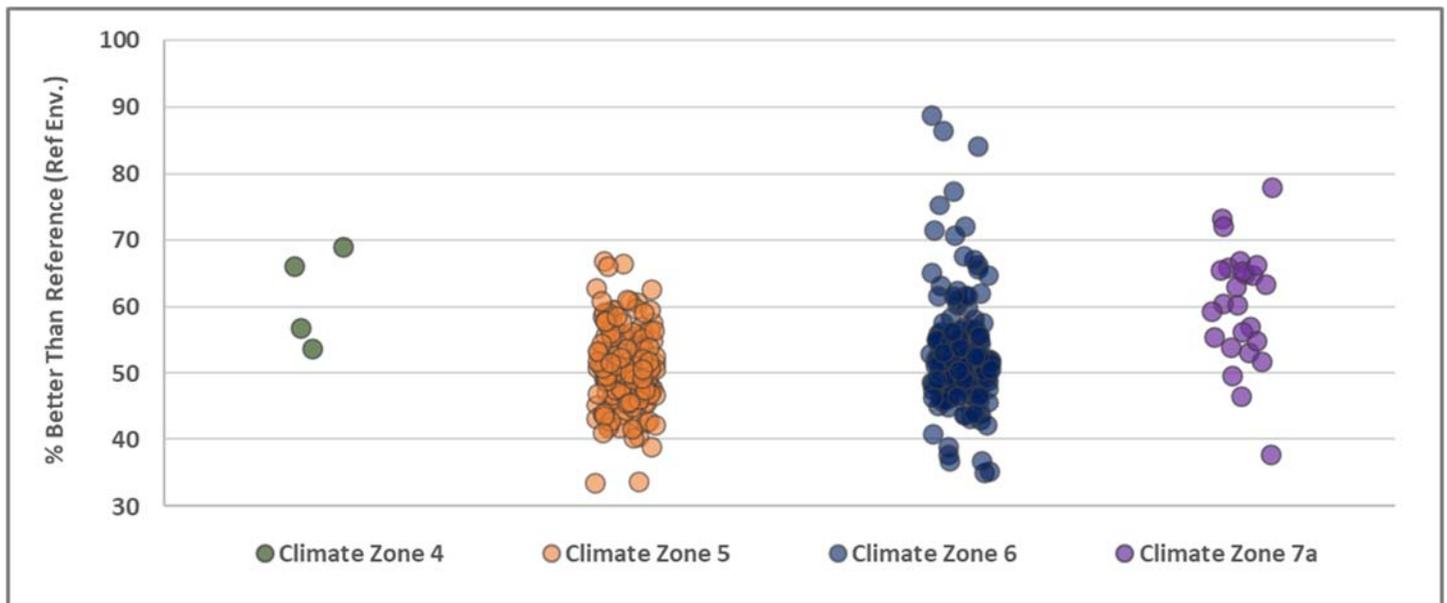


Figure 37: Detached Homes - Percent Better Than Reference House - Building Envelope by Climate Zone

### DETACHED HOMES - AVERAGE BY CLIMATE ZONE

- Climate Zone 4 = 61.4%
- Climate Zone 5 = 50.7%
- Climate Zone 6 = 53.0%
- Climate Zone 7a = 60.2%

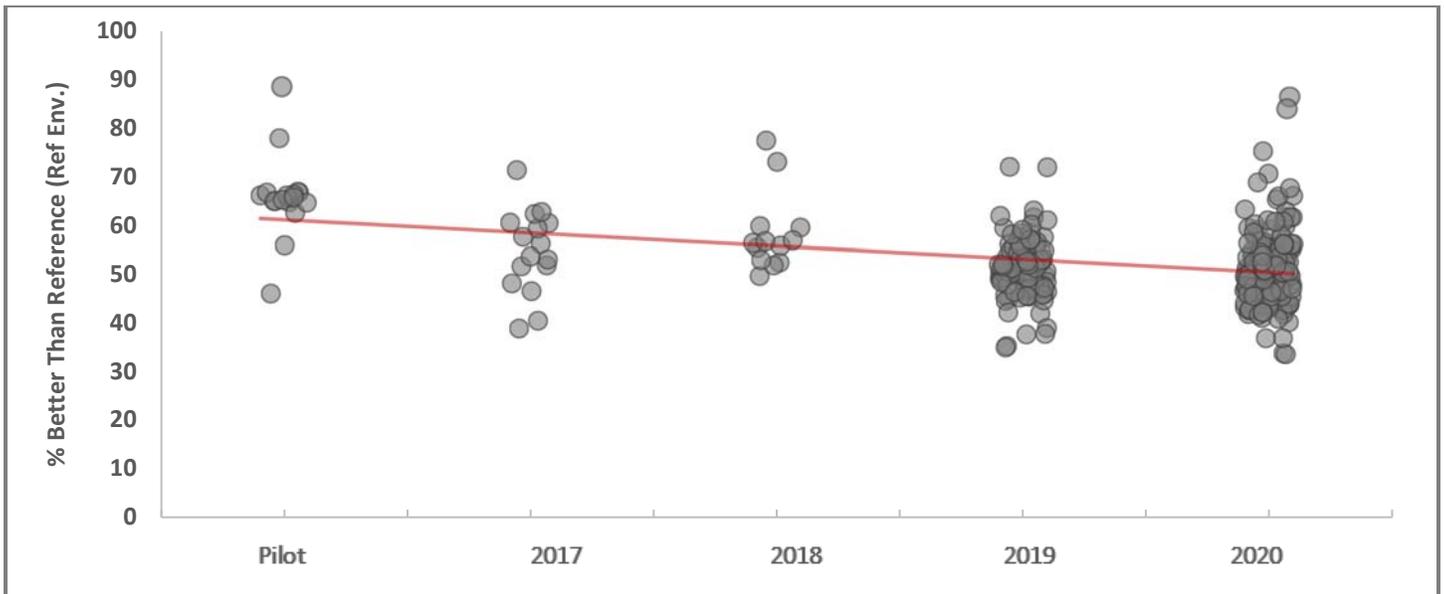


Figure 38: Detached Homes - Percent Better Than Reference House - Building Envelope by Year

#### DETACHED HOMES - AVERAGE BY YEAR

- Pilot = 66.0 %
- 2017 = 54.7 %
- 2018 = 58.4 %
- 2019 = 51.1 %
- 2020 = 51.3 %

#### ANALYSIS

- The average for all 333 detached homes is 52.5% better than “Ref. Env.”
- The average for all 153 attached homes is 61.4% better than “Ref. Env.”
- 65% (316/486) of the attached and detached homes achieved between 45% and 60% better than “Ref. Env.”

The distribution of building envelope percent improvement better than the reference house shows a tighter correlation for detached homes than attached homes. Climate zone has show to have little impact on the achieved building envelope efficiency. From the Pilot to 2020, the average percent better than reference house for building envelope has decreased marginally over the years. This may be a result of builders optimizing their building design in order to meet 0 GJ annual estimated energy consumption. This may also be as a result of the improving efficiencies of photovoltaic solar panels over time.