

Integrating CHBA Net Zero & PHIUS 2018+

By

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Passive Design Solutions

www.passivedesign.ca

Who are we?

- Passive Design Solutions is a Canadian design firm specializing in Passive House. Operating since 2009, we have designed or consulted on over 80 near-PH projects, built and certified 9 Passive Houses, and 6 Net Zero homes.

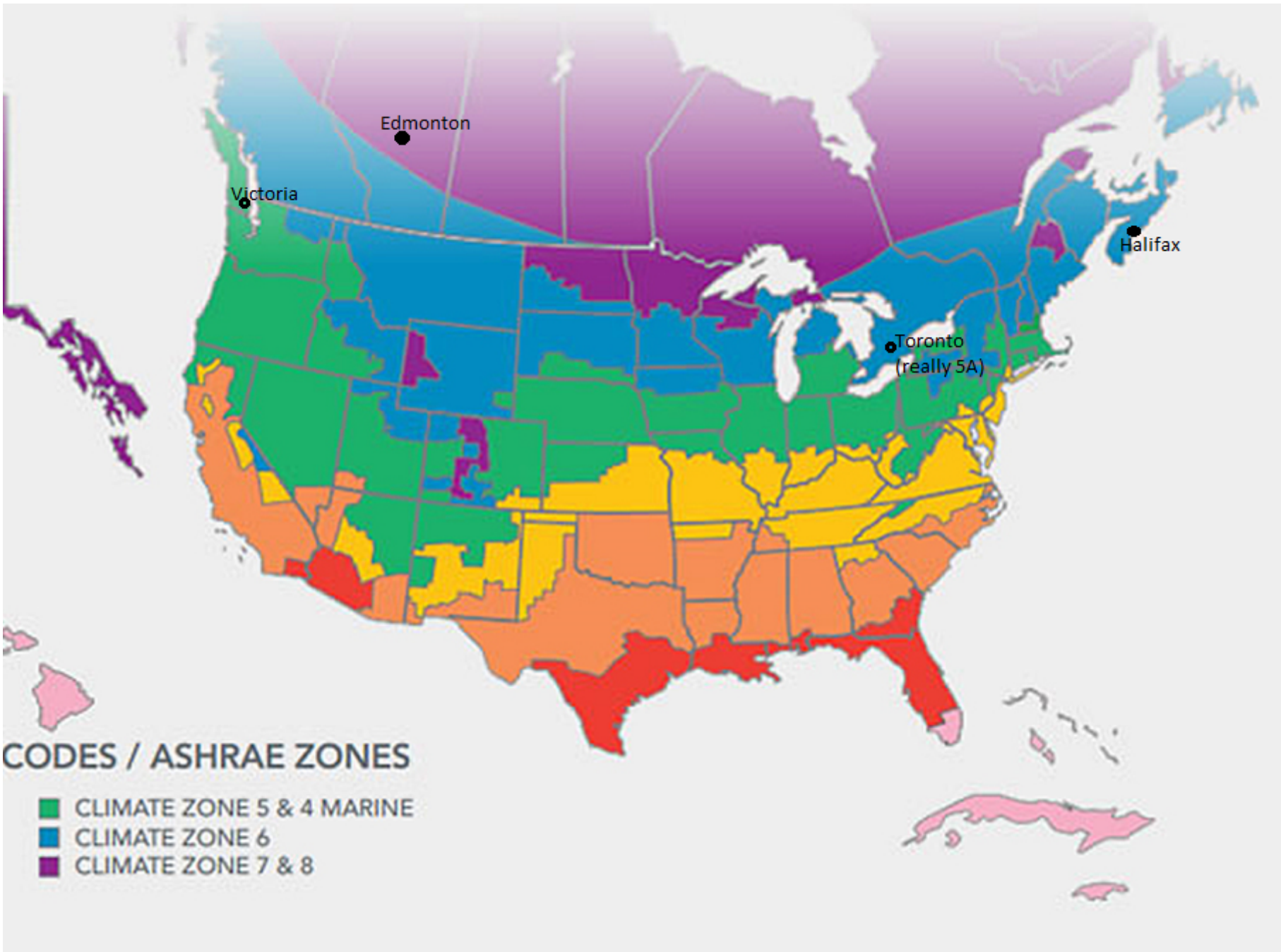


Abstract

- Canadian Government has identified building energy efficiency as a key strategy to the transition to a low carbon economy
- CHBA (Canadian Home Builder's Association) represents over 8500 residential construction companies. In 2017, it introduced its Net Zero Home labelling program.
- The new Passive House standard, PHIUS+ 2018, emphasizes a decrease in total site energy use with a “view towards zero”
- Understanding the similarities and differences between these building programs will be important to the continued growth of PHIUS+ (and by proxy, Passive House) in Canada

Methods

- Review each standard to identify program requirements, similarities and differences.
 - Requirements for certification
 - Overall energy use performance
 - Climate specific assembly details
 - Cost
- Test a “typical” plan in representative climate zones (IECC climate zones 4,5,6,7 – Victoria, Toronto, Halifax, Edmonton)



Assumptions for “default” Passive House

- TJI Wall (2x6, batt, 9.5” truss w/ dense pack cellulose) (R-55)
- 26” Cellulose Attic (R-97)
- 9.5” EPS Type 3 sub-slab insulation w/ 2’ EPS skirt (R-42)
- R-5.45 windows (U-0.188)
- 0.05 CFM / ft² air tightness
- Default appliance loads for both energy modelling software
- Panels are 250W Kyocera (calculations done in PVWatts using tilt = latitude) (apx. 18 sqft / panel)

Canadian Building Culture: our experience

- Majority of single family detached homes are between 1000 sqft – 2500 sqft (icfa)
- In Canada, we have a lot of space. Outside cities, land is relatively cheap. People are aging and want sprawling 1-story homes
- We operate mostly in Nova Scotia and Ontario

2017

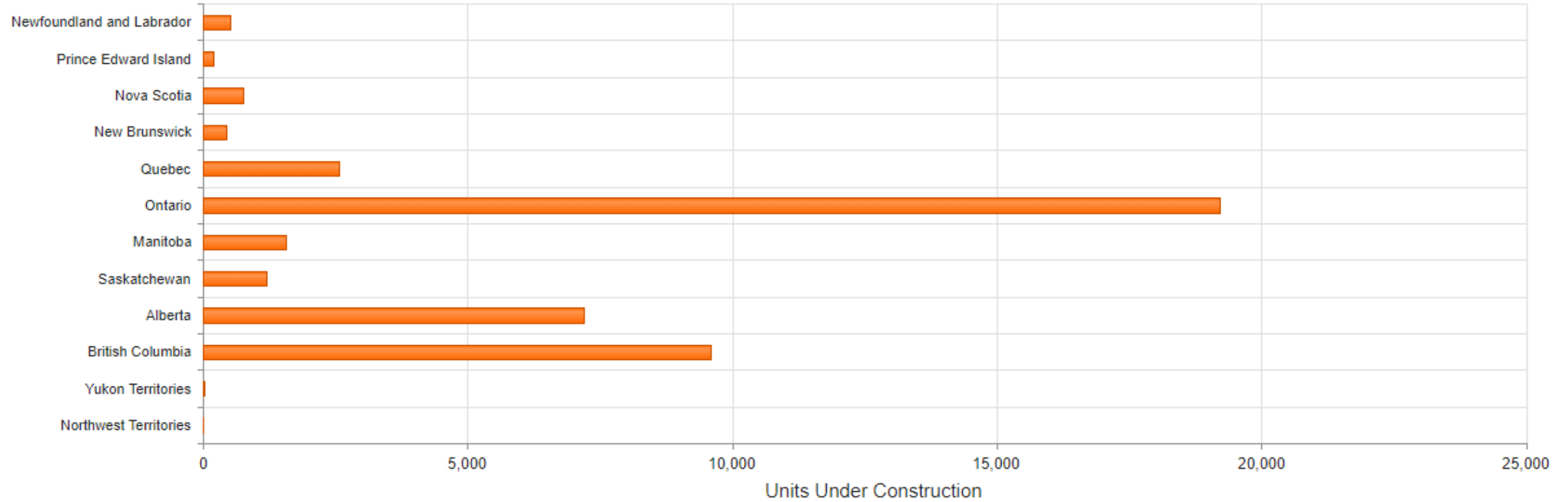
Intended Markets - All

Single

[TABLE](#)

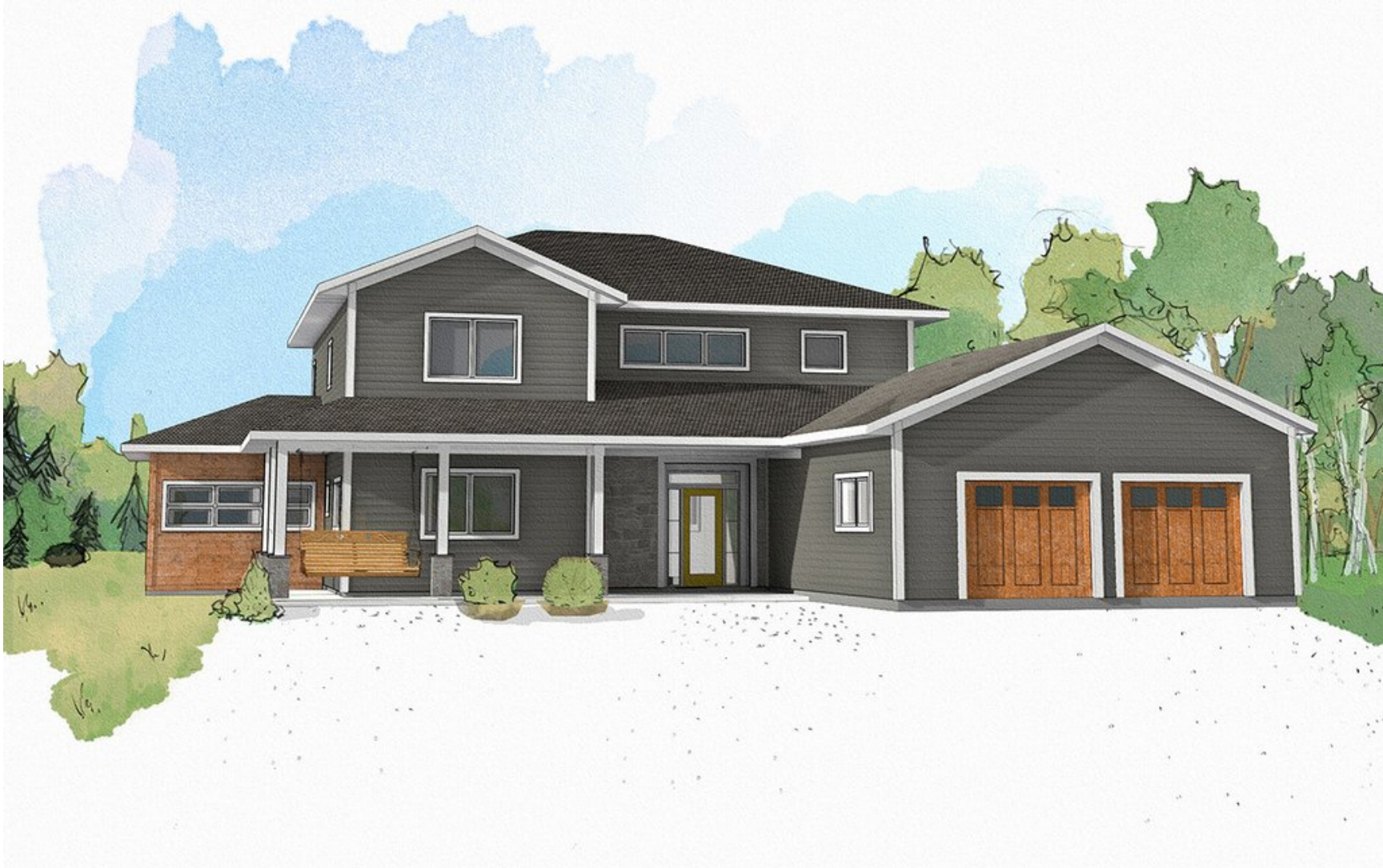
[CHART](#)

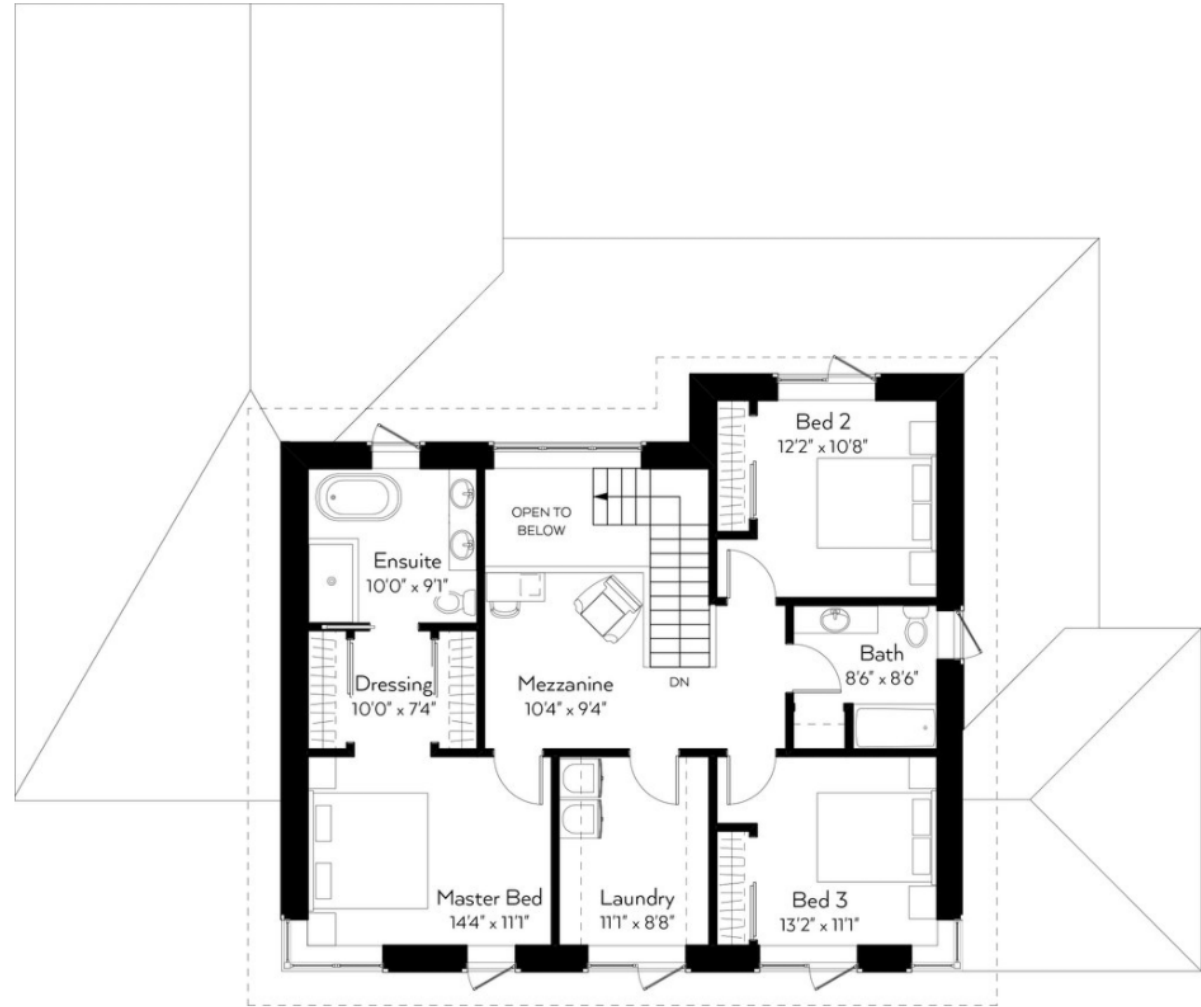
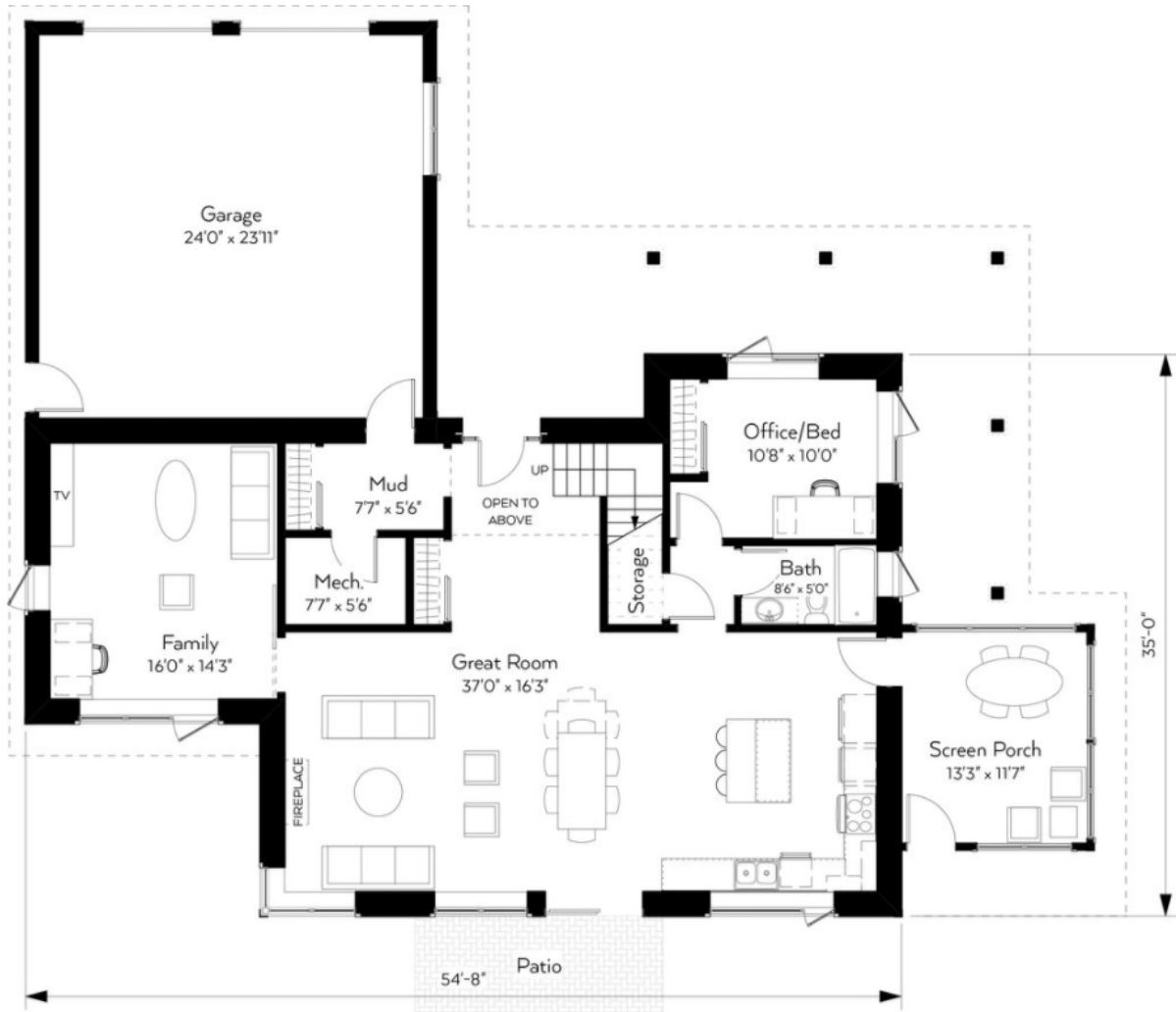
[MAP](#)



Source: CHMC Starts & Completions Survey

Skye Glen





Skye Glen stats

- 2411 ft² ICFA
- 4 Bed
- 3 Bath
- Back faces South
- 2 Story

	glazing ratios	total sqft	glazed sqft	ratio
south		1019.15	276.3	0.271
north		749.82	98.76	0.132
west		649.71	45.21	0.070
east		733.55	75.42	0.103
total		3152.23	495.69	0.157



PHIUS+ 2018

NEW

- Emphasis on “getting to zero”
 - Important: allows off-site renewable
- Less-granular climate based space-conditioning targets
- Rewards density
- Intended to serve as a guide for optimization based on upgrade costs vs savings

SAME

- Still pass / fail
- Overall energy limit based on source as it is a better proxy for resource consumption and emissions

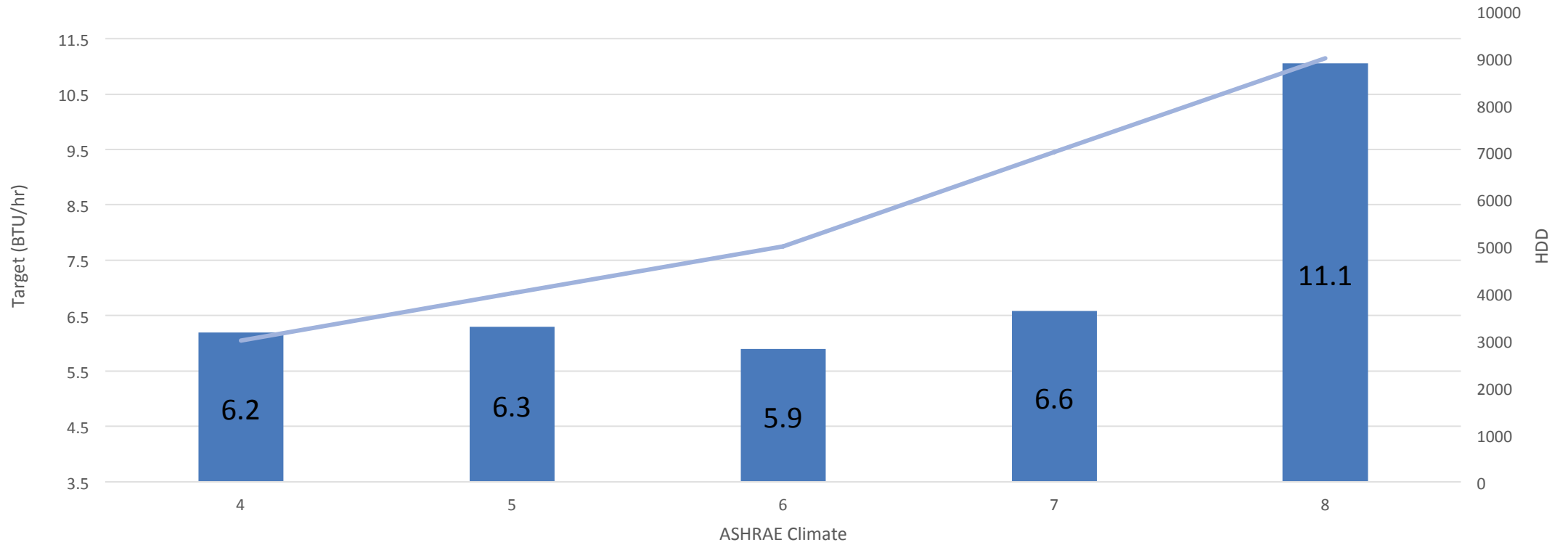
Changing targets for PHIUS+ 2018

- No longer city specific
- Each climate has it's own heat demand / heat load targets (cooling load / demand are generally not relevant for us, although over-heating is)
- Reduction of Canadian source energy factor (from 3.16 to 2.05) and limit of 3840 kwh / person (down from 6200 kwh) basically wash each other out

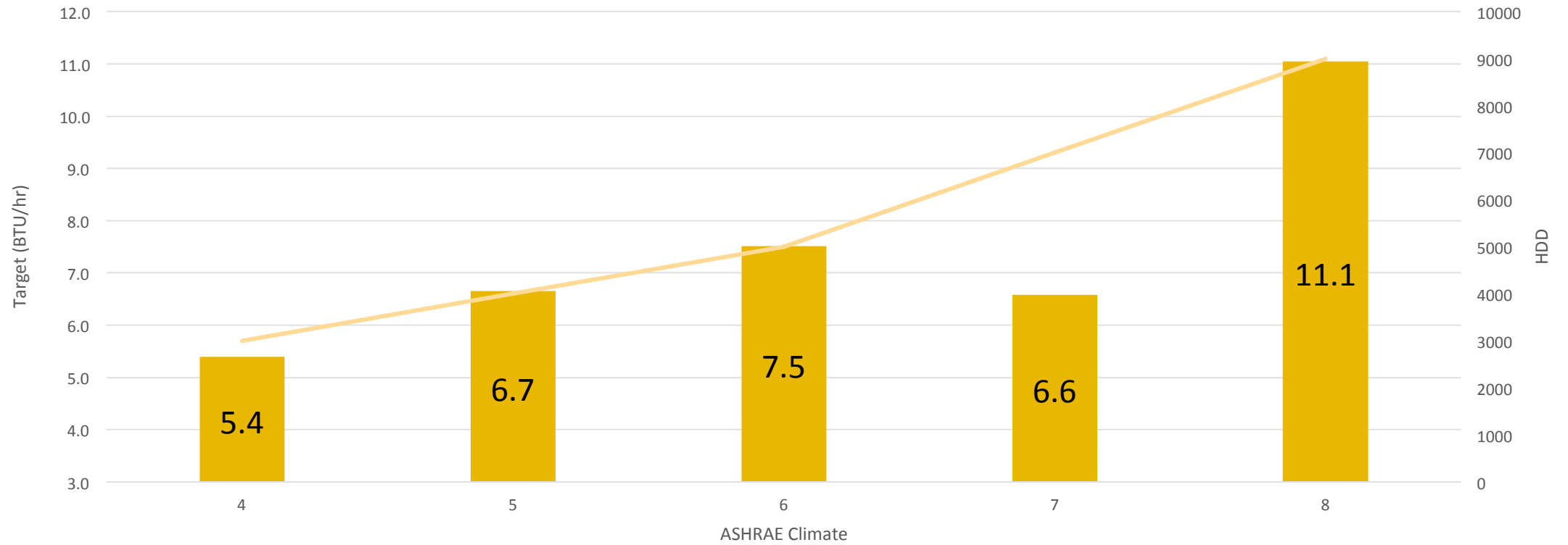
Kudos

Heat Load Targets

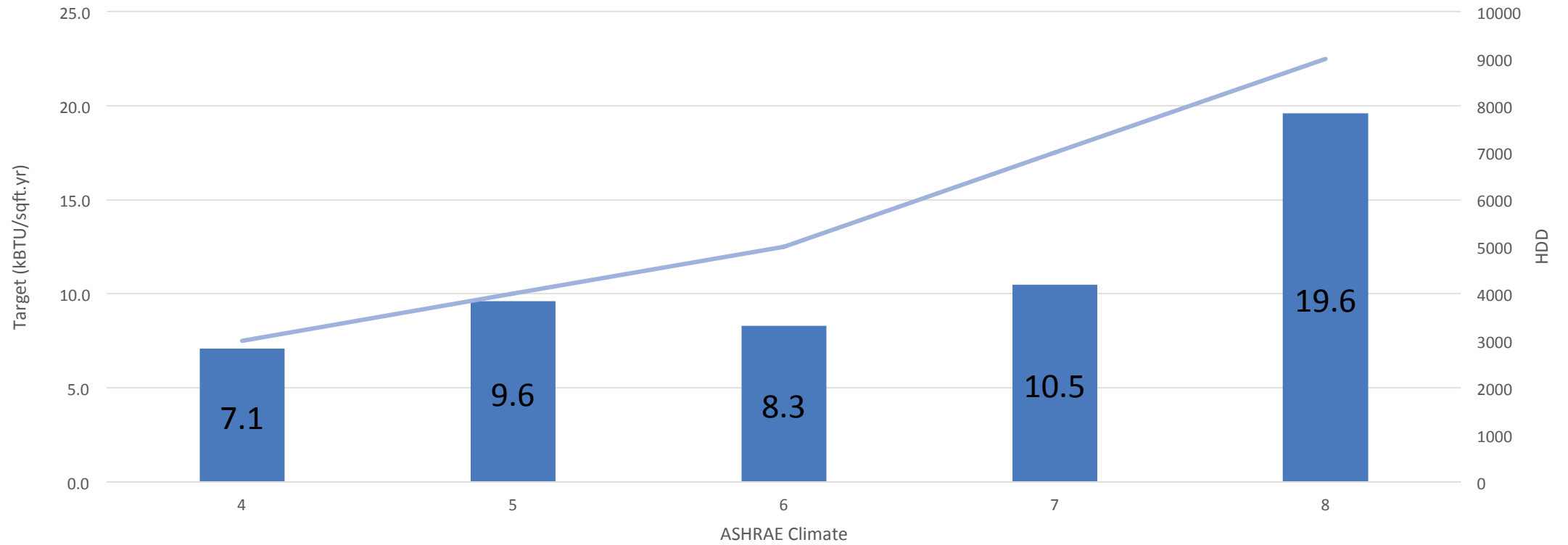
Climate Type A



Heat Load Targets Climate Type B

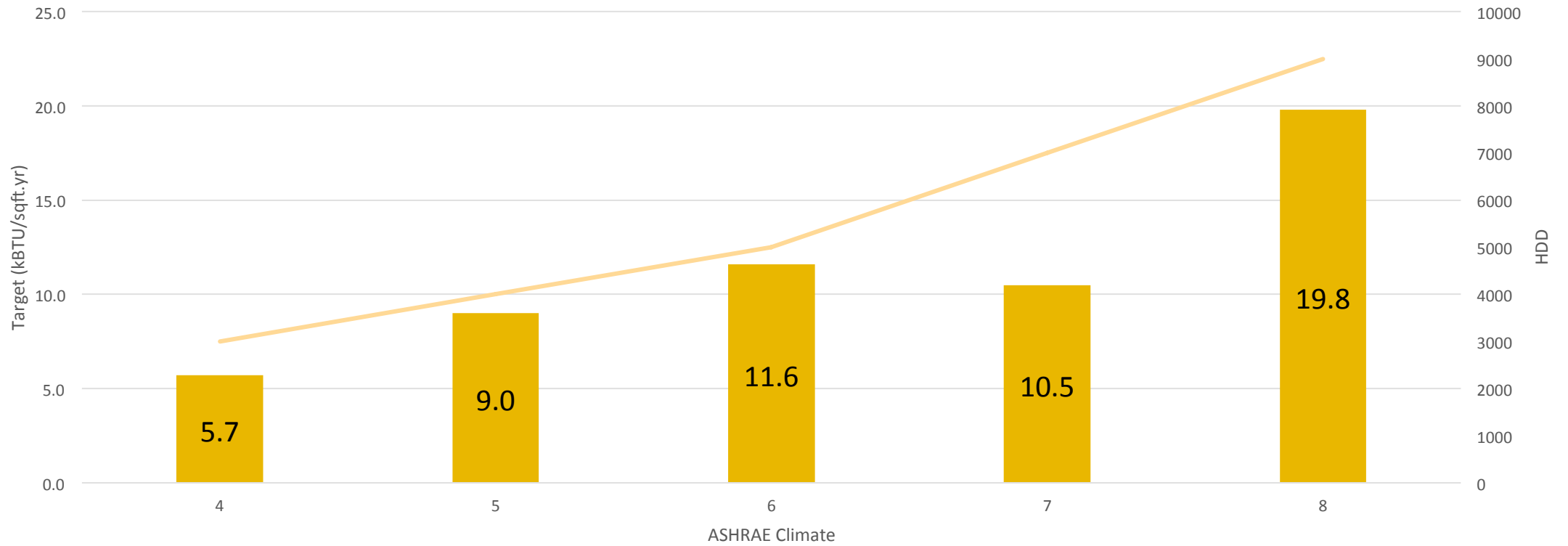


Heat DemandTargets Climate Type A

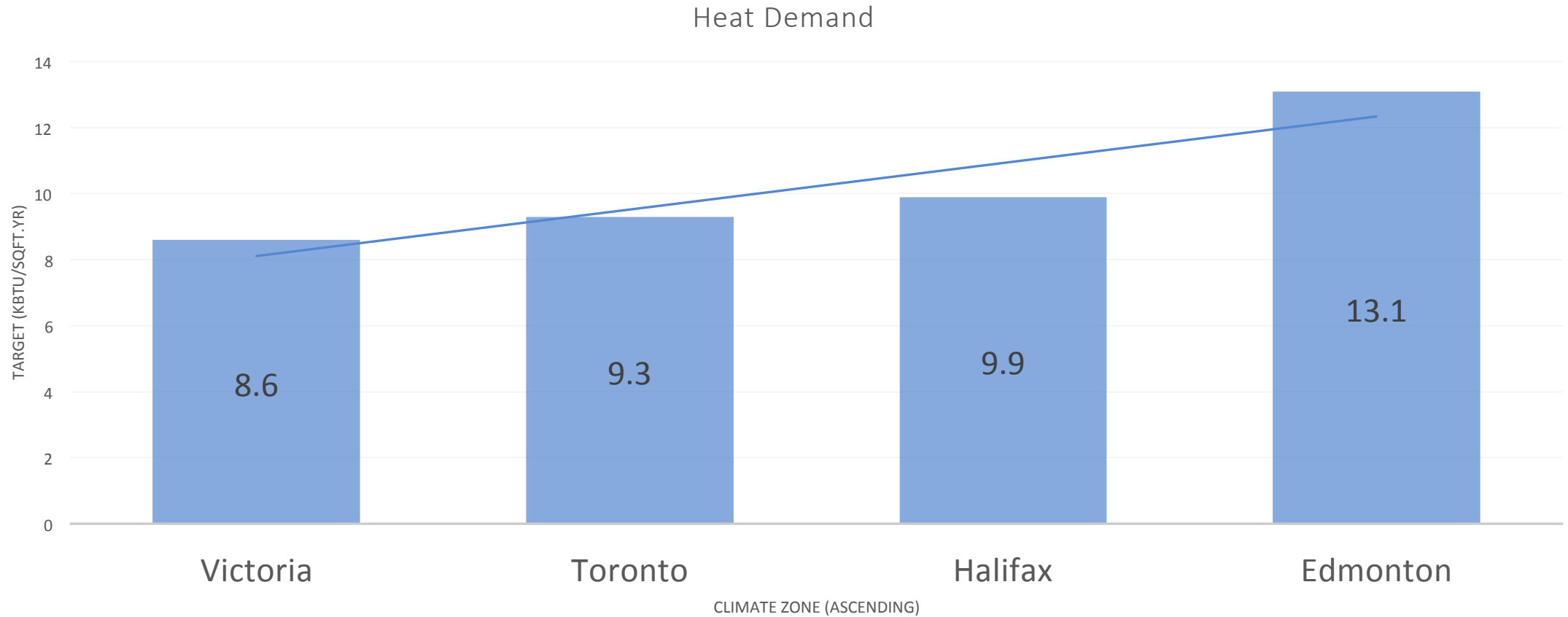


Heat DemandTargets

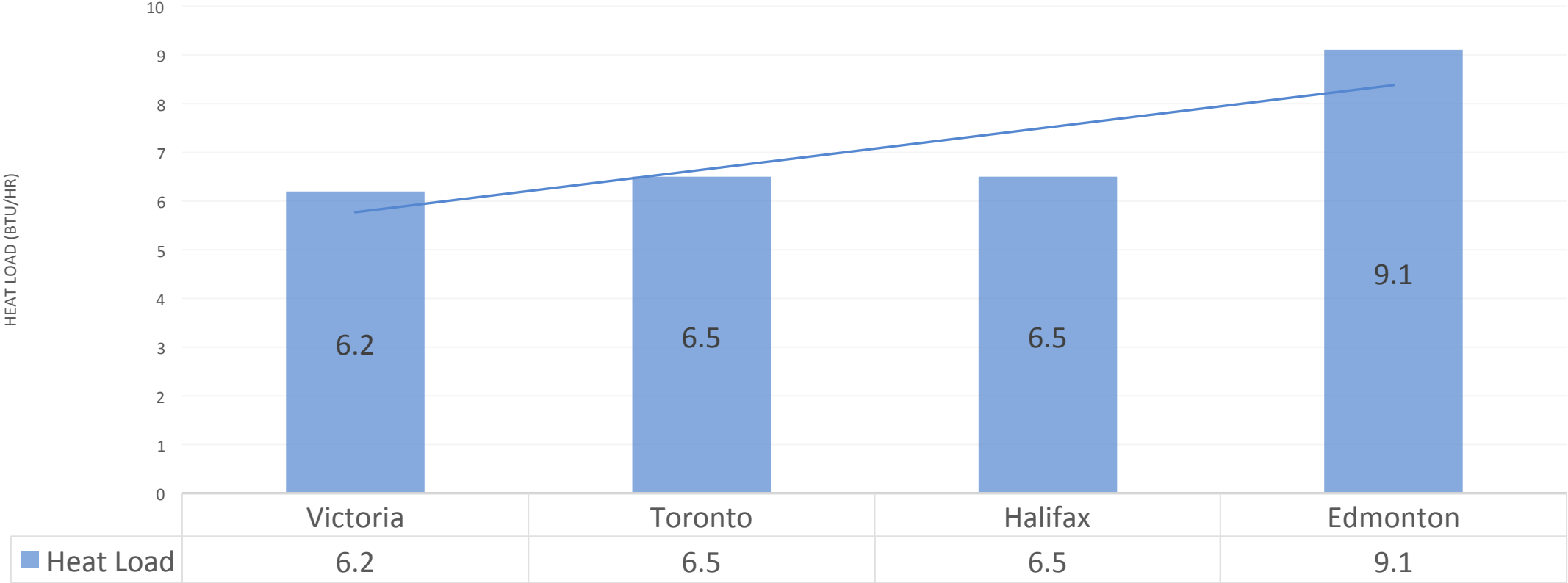
Climate Type B



Updated targets



Heat Load



WUFI Results (as designed – Halifax)

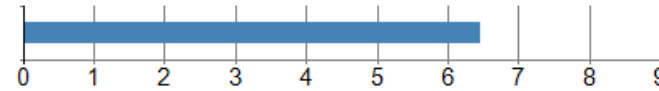
Certificate criteria: PHIUS+ 2015 Standard

Heating demand

specific: **6.46** kBtu/ft²yr

target: **9.9** kBtu/ft²yr

total: 15,563.67 kBtu/yr



Cooling demand

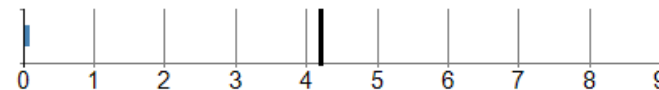
sensible: **0.1** kBtu/ft²yr

latent: **0.02** kBtu/ft²yr

specific: **0.11** kBtu/ft²yr

target: **4.2** kBtu/ft²yr

total: 274.36 kBtu/yr

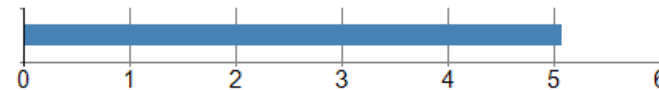


Heating load

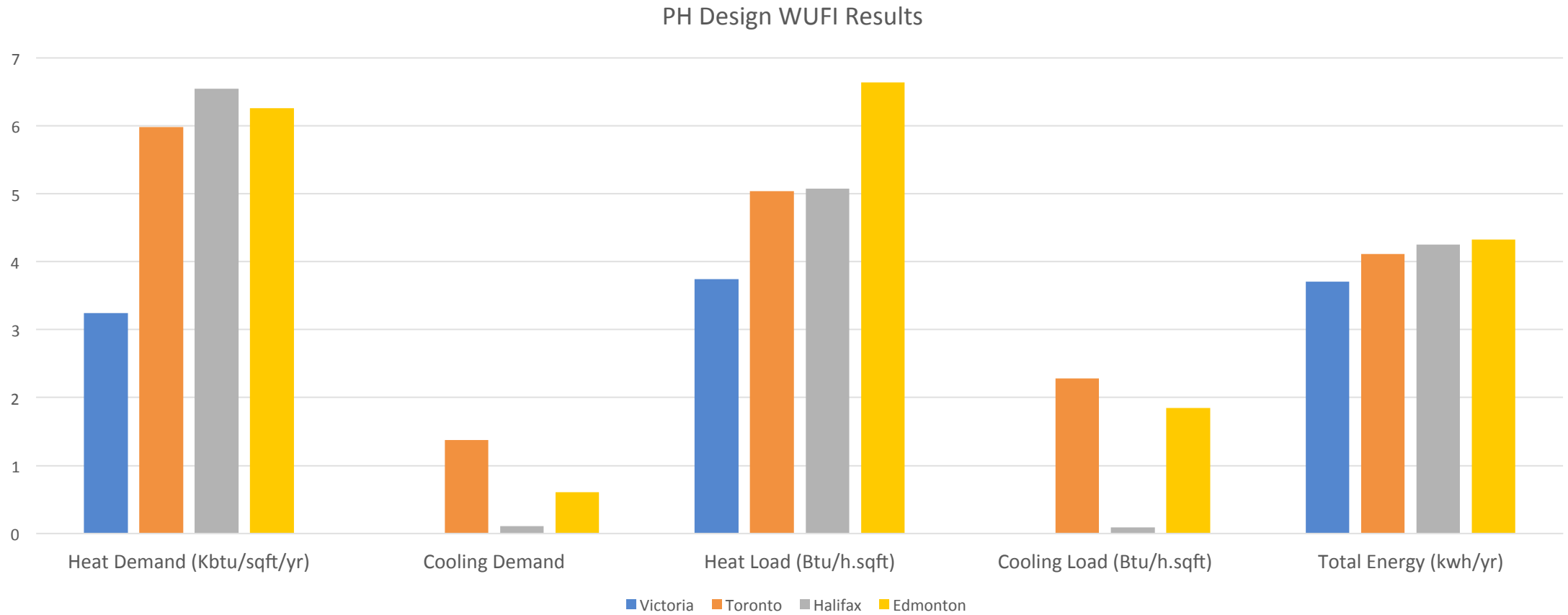
specific: **5.07** Btu/hr ft²

target: **6.5** Btu/hr ft²

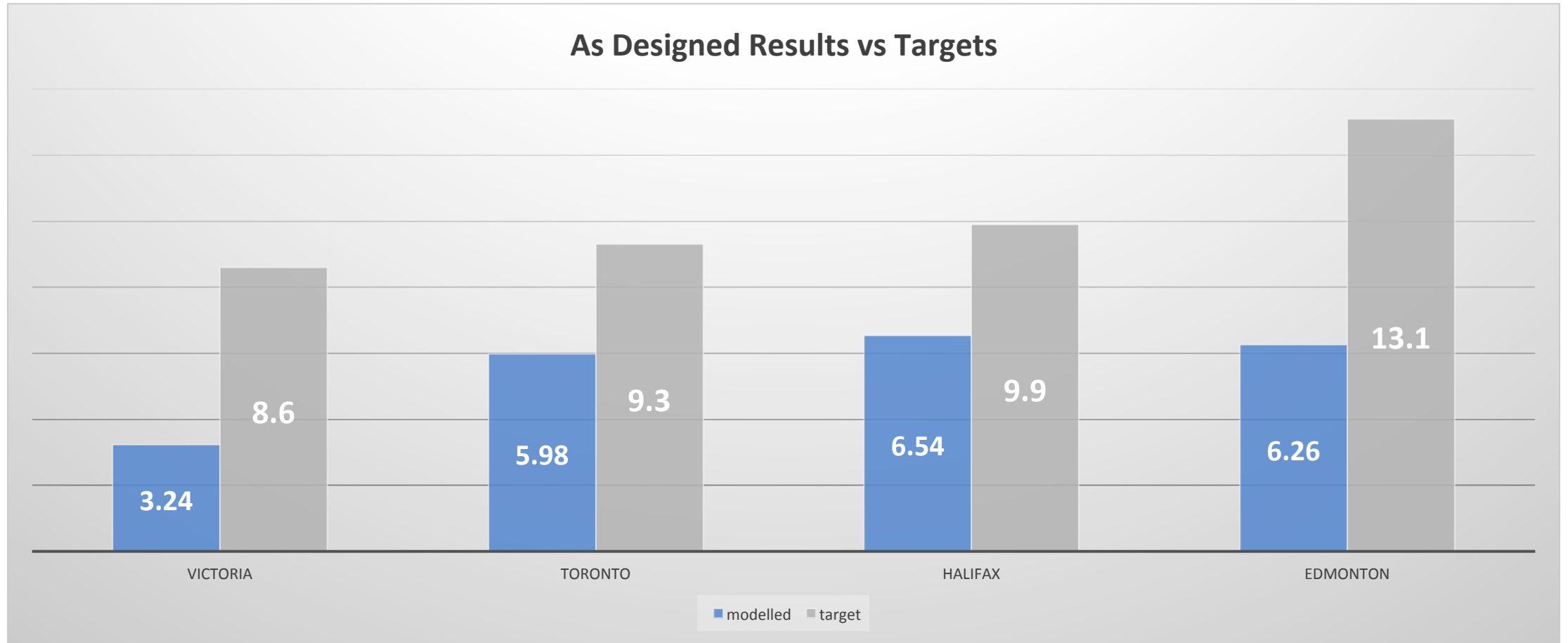
total: 12,228.88 Btu/hr



WUFI Results (as designed)



Results vs Targets



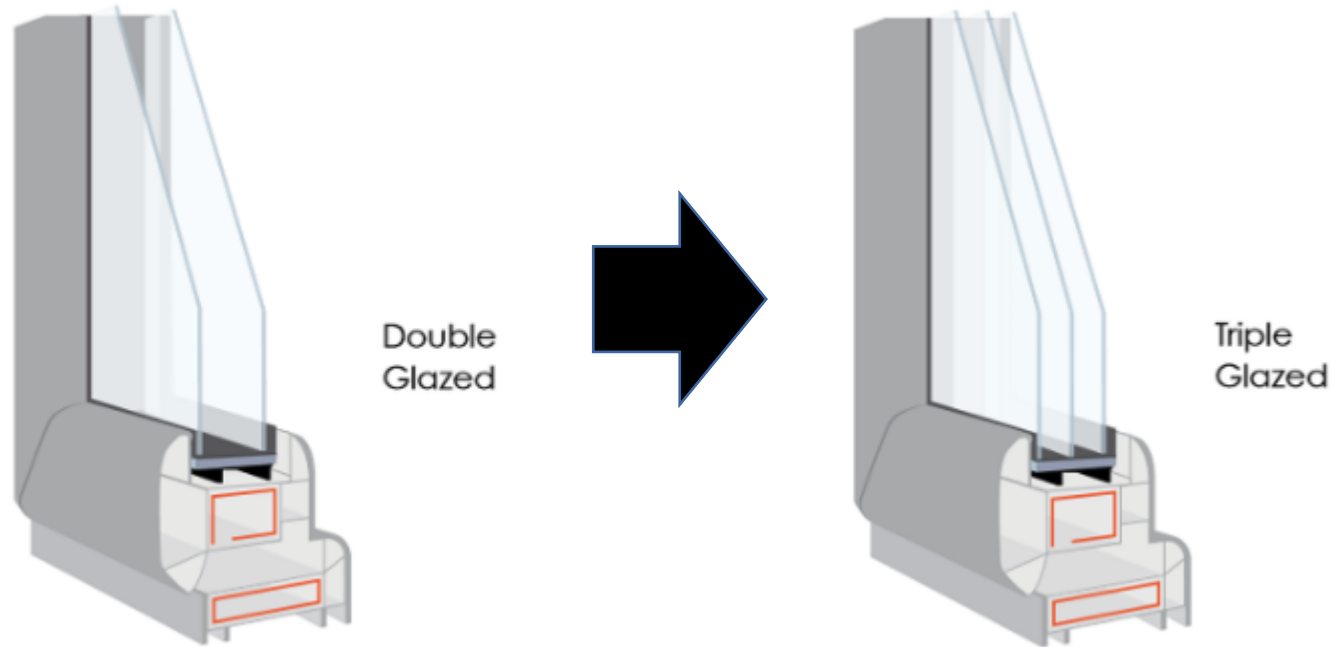
Let's look at the required assemblies.

Informed through R-value calculator

Walls	Envelope area	3000R-value increase	1.5			
	Insulation type	R/in	Cost/sqft.in	cost/sqft.R	Total cost	Total inches
	EPS foam	4	0.5	0.125	562.5	0.375
	Polyiso foam	6	0.75	0.125	562.5	0.25
	Cellulose	3.7	0.06	0.016216216	72.97297	0.40540541
	Fiberglass batt	3.7	0.12	0.032432432	145.9459	0.40540541

Note on windows...

- All climates required a window upgrade (from Code -> Triple Glazed, Low-E, Argon Filled)



Theoretical Assemblies for all climates

Climate	Walls	Roof	Slab
Victoria	24	40	10
Toronto	28.7	98	20
Halifax	31	98	20
Edmonton	24	98	13

CHBA Net Zero Home Labelling Program



**Net Zero Home Label to Recognize
Homes that Produce as Much Energy as
They Consume**

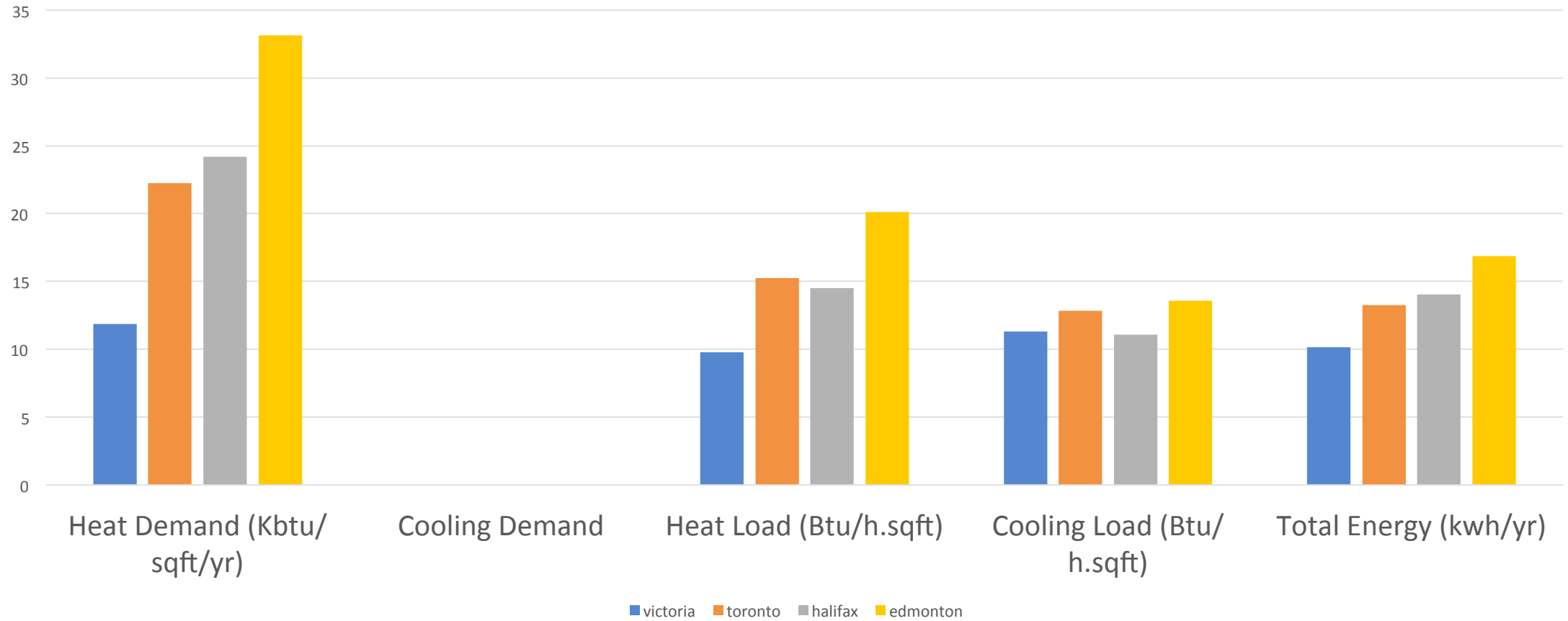
Key Differences

- Lower ventilation rates (less energy overall, but fans are default worse so energy ends up roughly the same)
- Substantially higher plug loads
- Must first be modelled to prescriptive minimums (essentially building code, but in some areas actually worse)
- All-electric heat / dhw (we used a DMS to equal the playing field) / crappy hrv (60% SRE with high w/cfm fan)
- 1.5ACH airtightness for all buildings, regardless of size (2.0 for attached buildings)
- Modelled in HOT2000

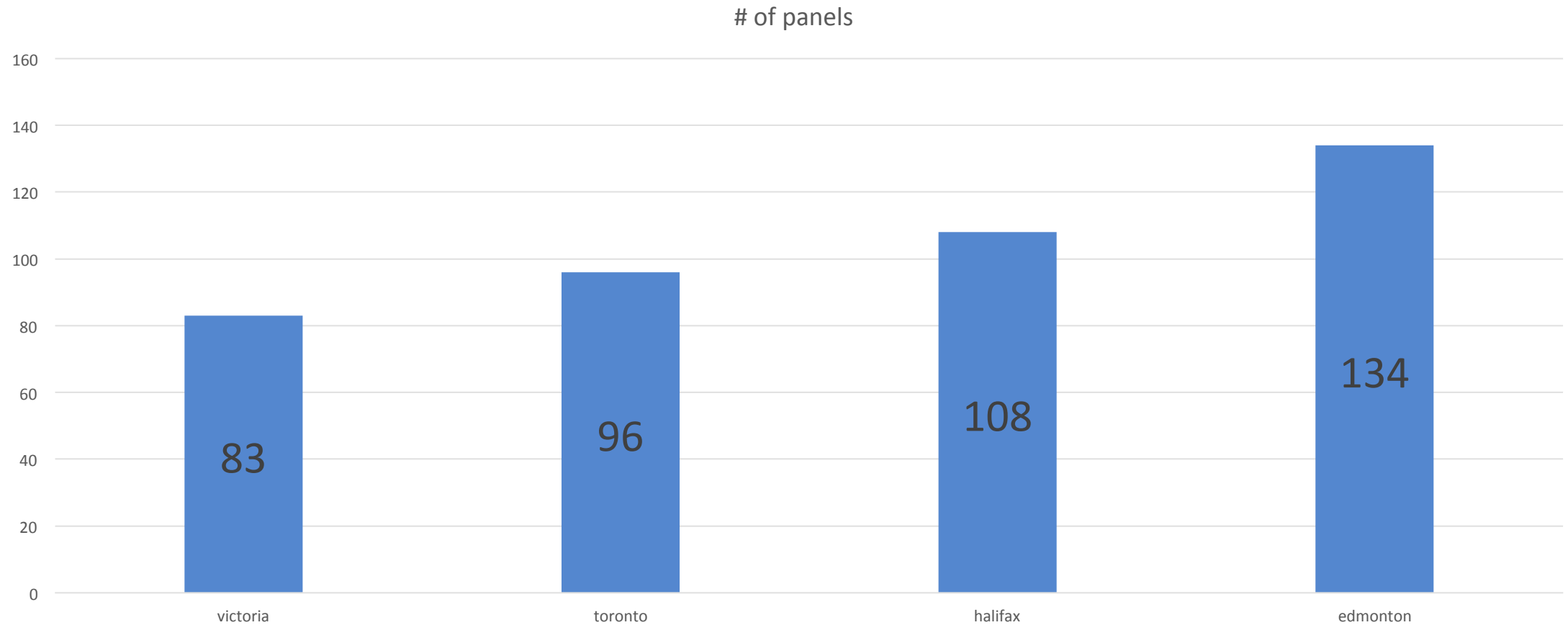
Criteria for “certification”

- <3 storeys
- <6500sqft
- 33% reduction of heat demand (called estimated space heating energy consumption) from the base model
- Only allows on-site renewables
- Modelled energy consumption of 0 GJ / year
- Energy monitoring required (real time and aggregate)

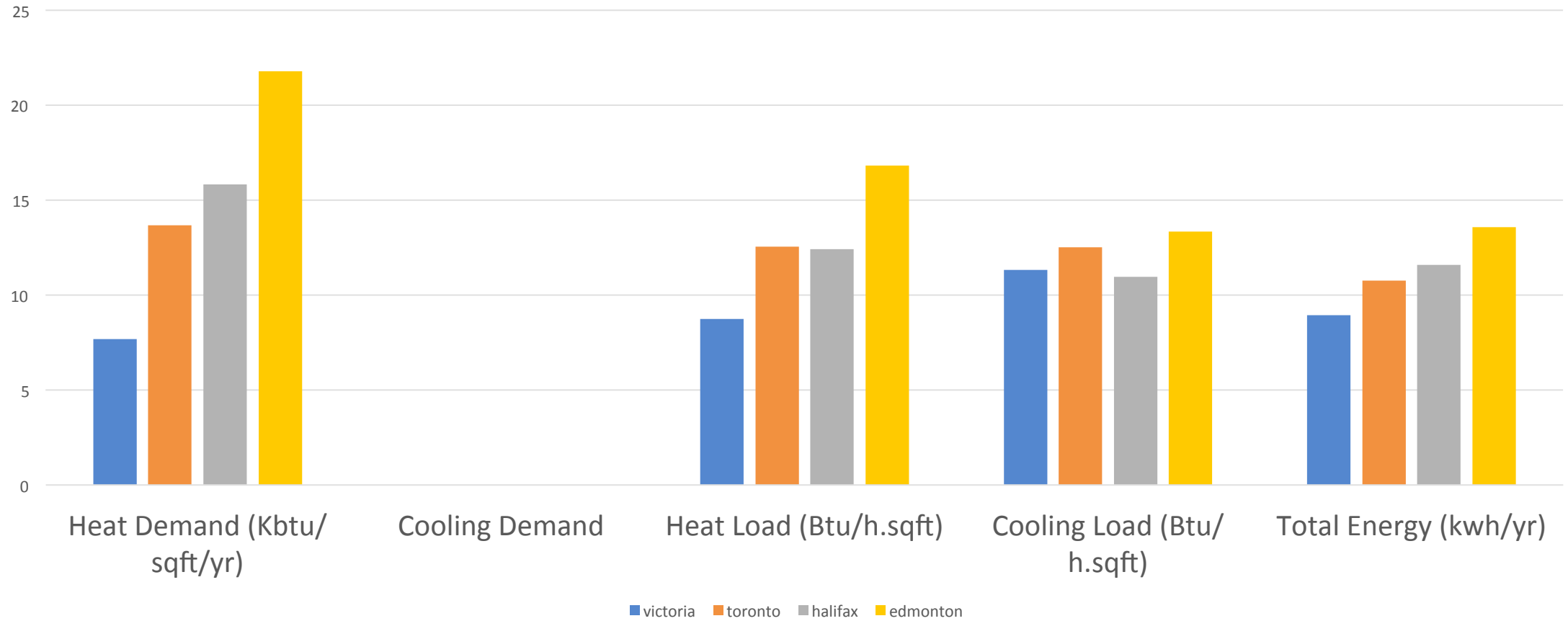
Results: Base Case



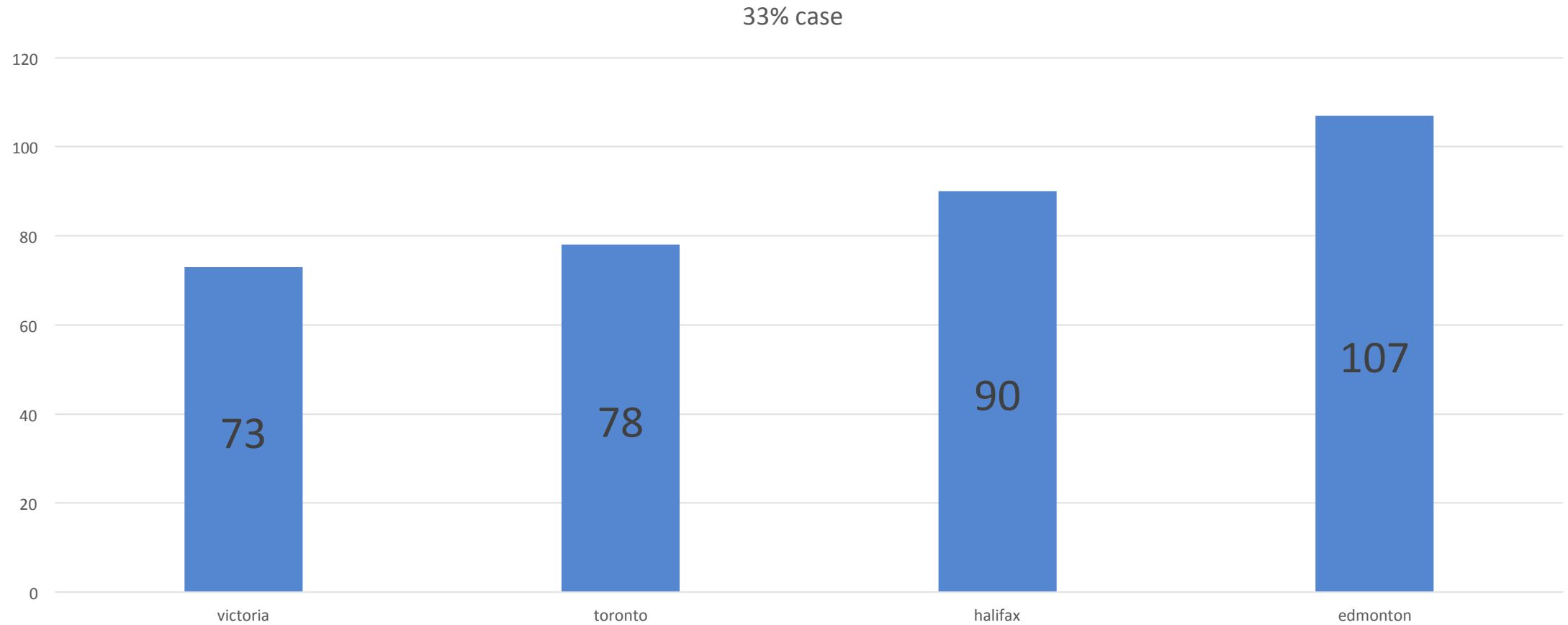
Required panels to hit 0 GJ / yr



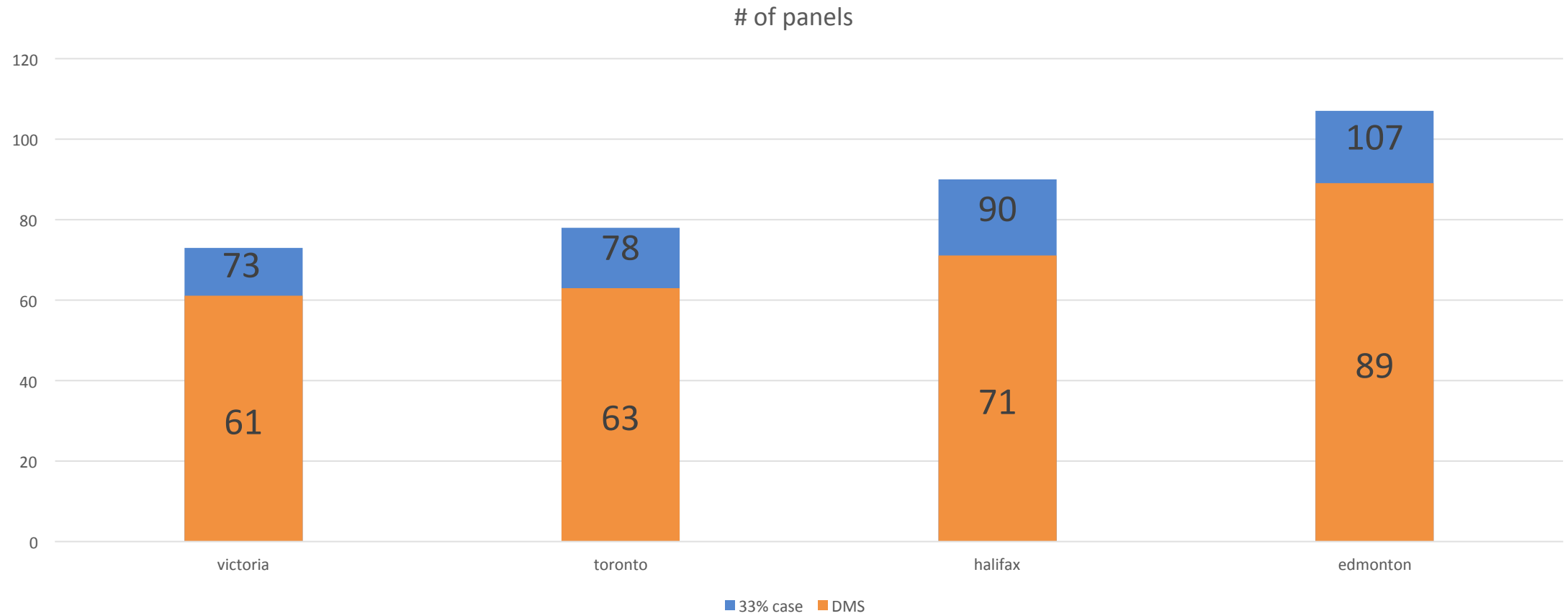
33% improved case



33% improved case #of panels

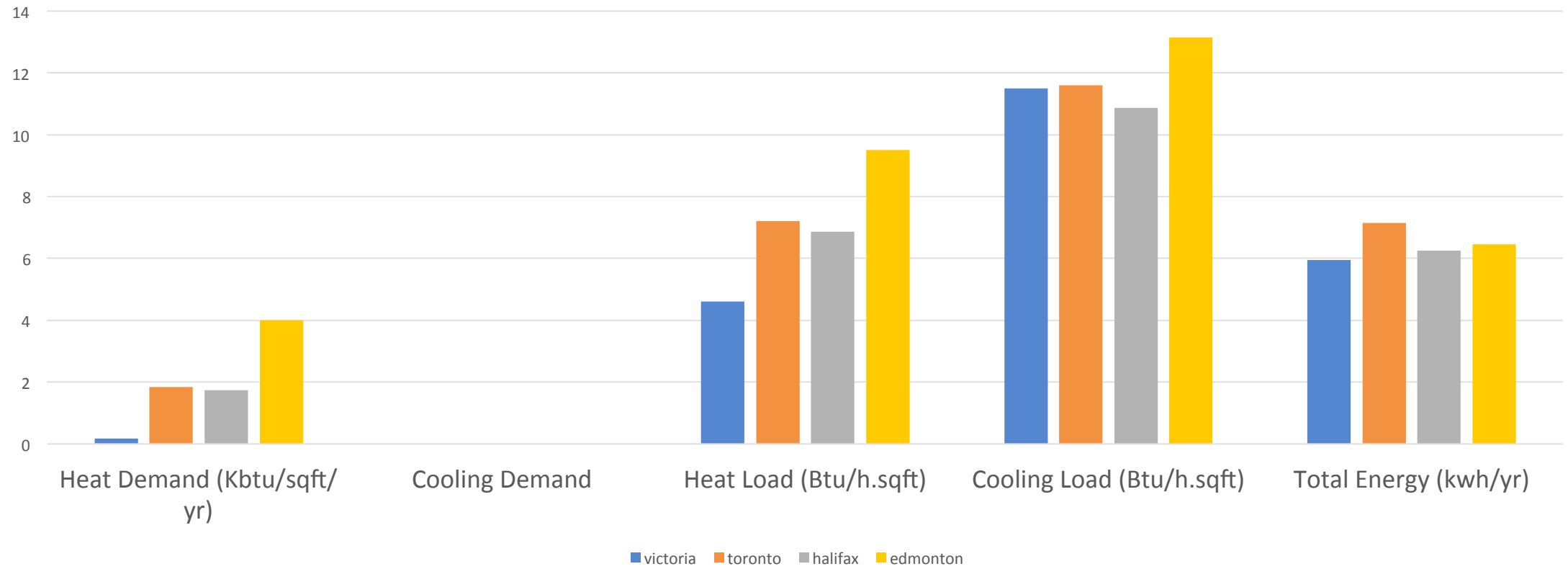


Reduction with DMS

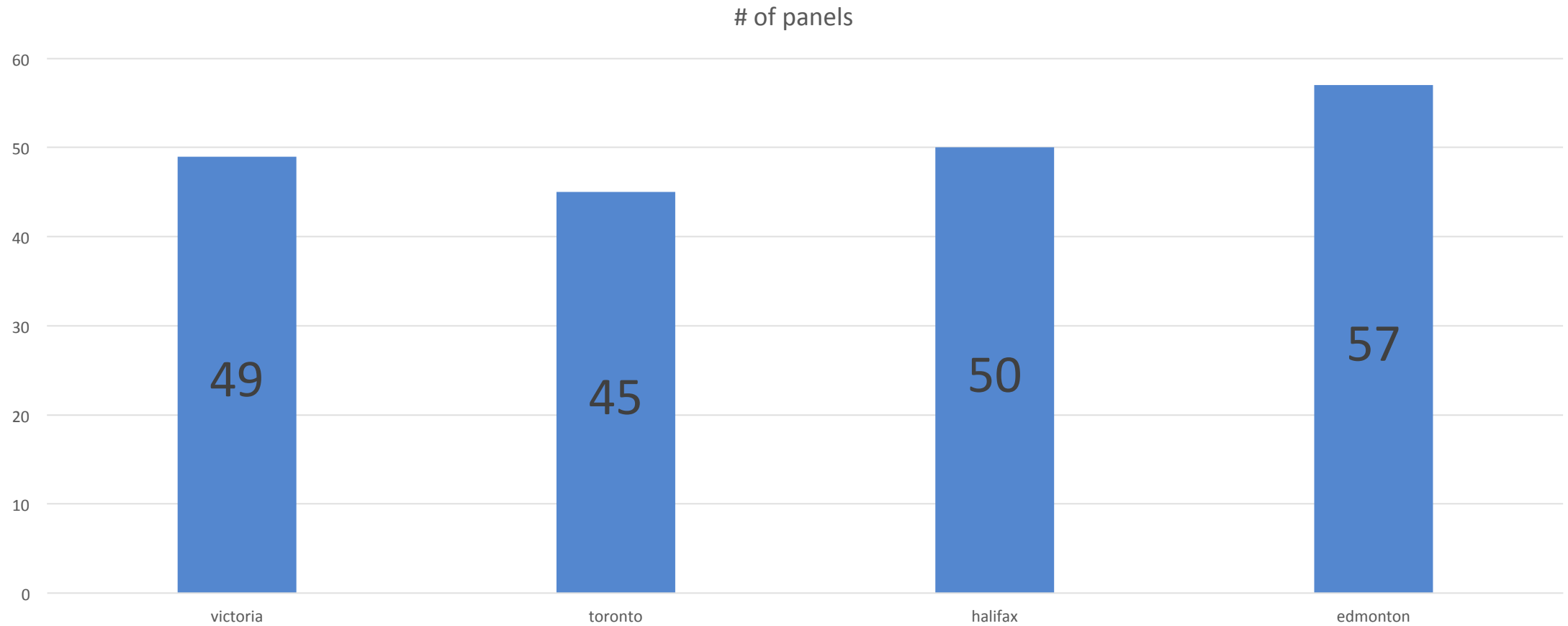


PH Case

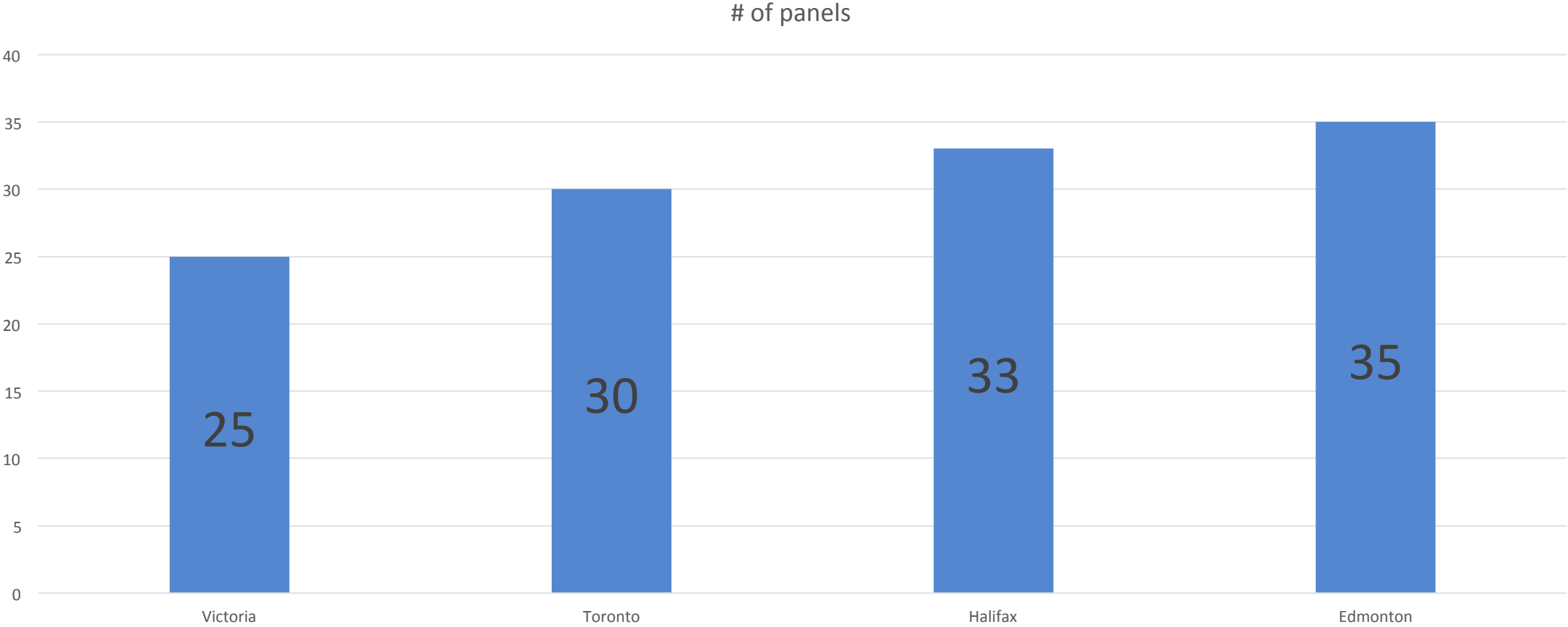
PH Design Case



PH Designed #of panels

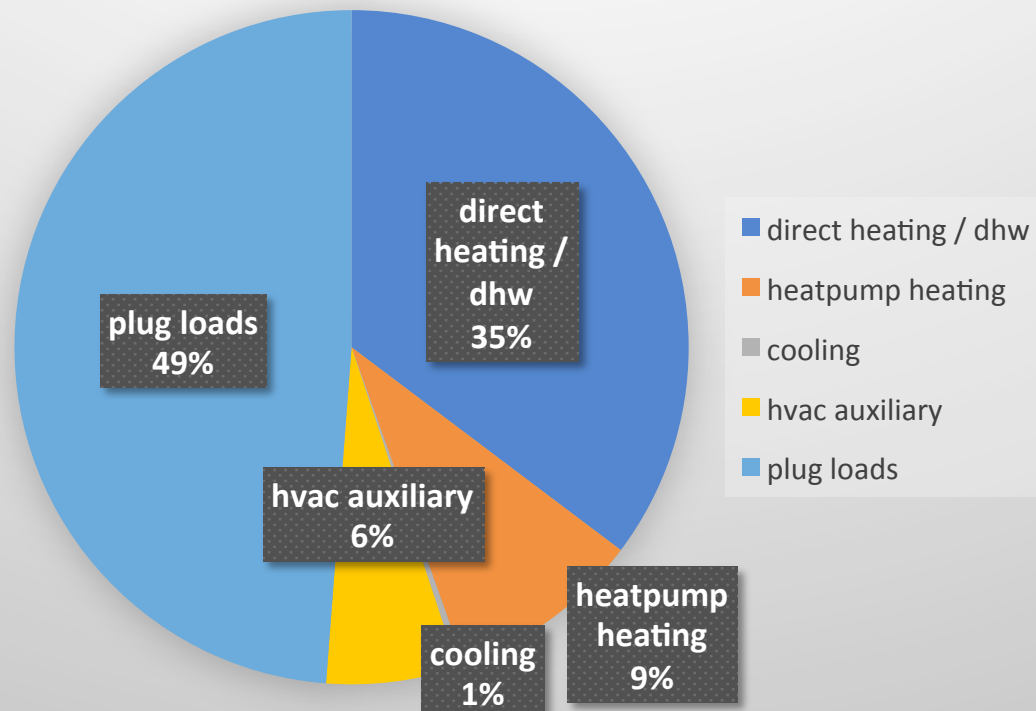


PH Designed # of Panels... using WUFI Assumptions

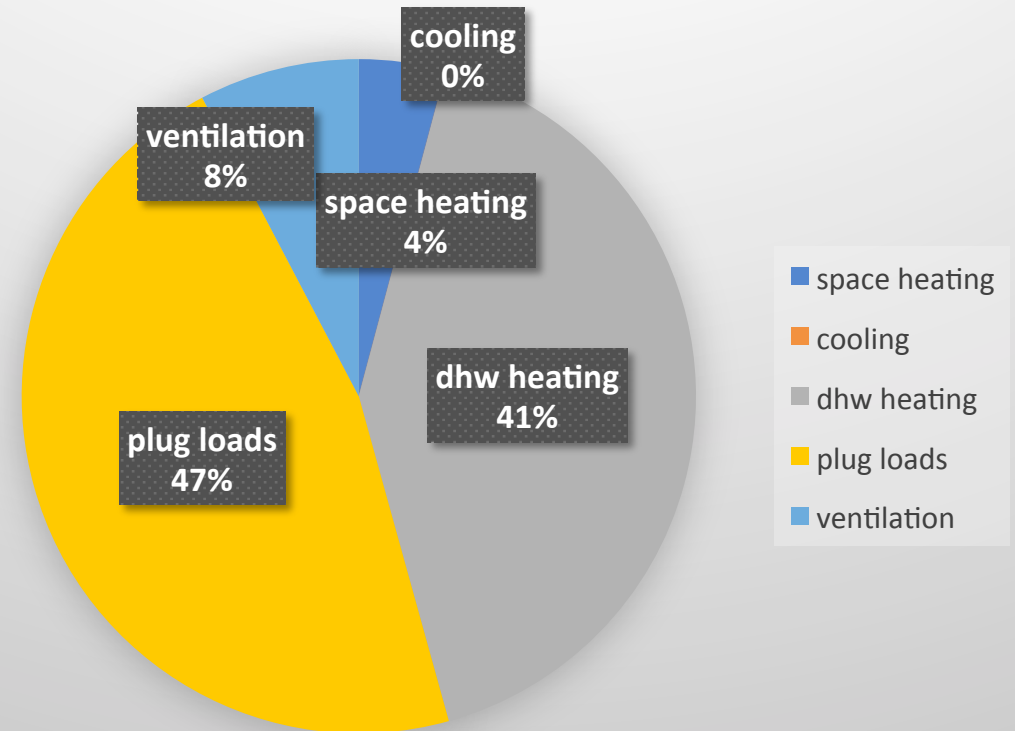


WUFI vs H2K Breakdown Total Energy Comparison

Halifax WUFI Total Energy Breakdown



Halifax H2K Total Energy Breakdown

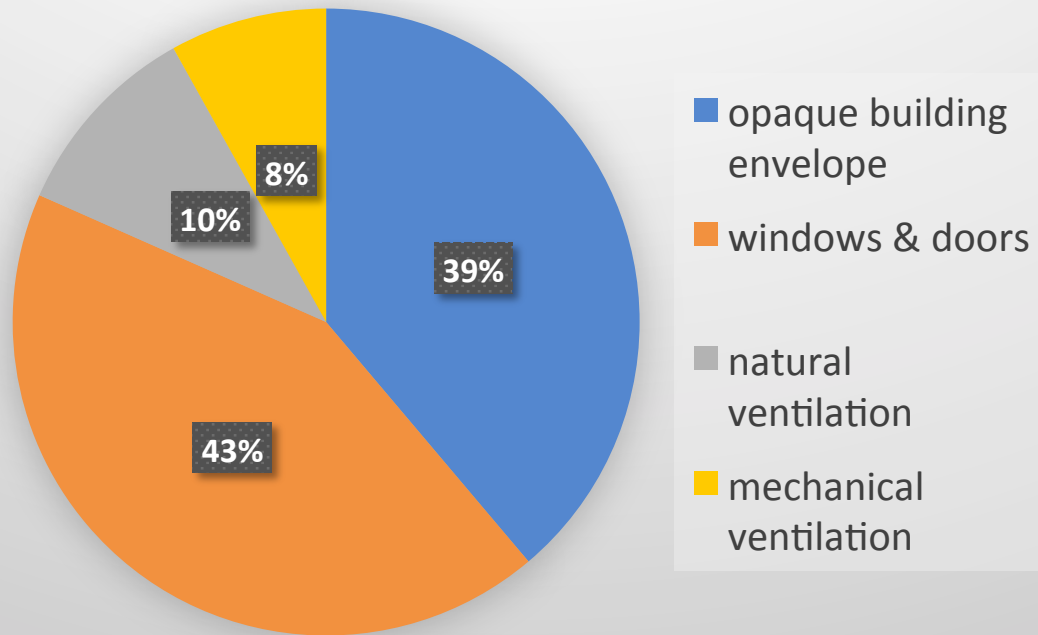


WUFI	kwh/yr
direct heating / dhw	3680
heatpump heating	969
cooling	35
hvac auxiliary	658
plug loads	5090
total	10432

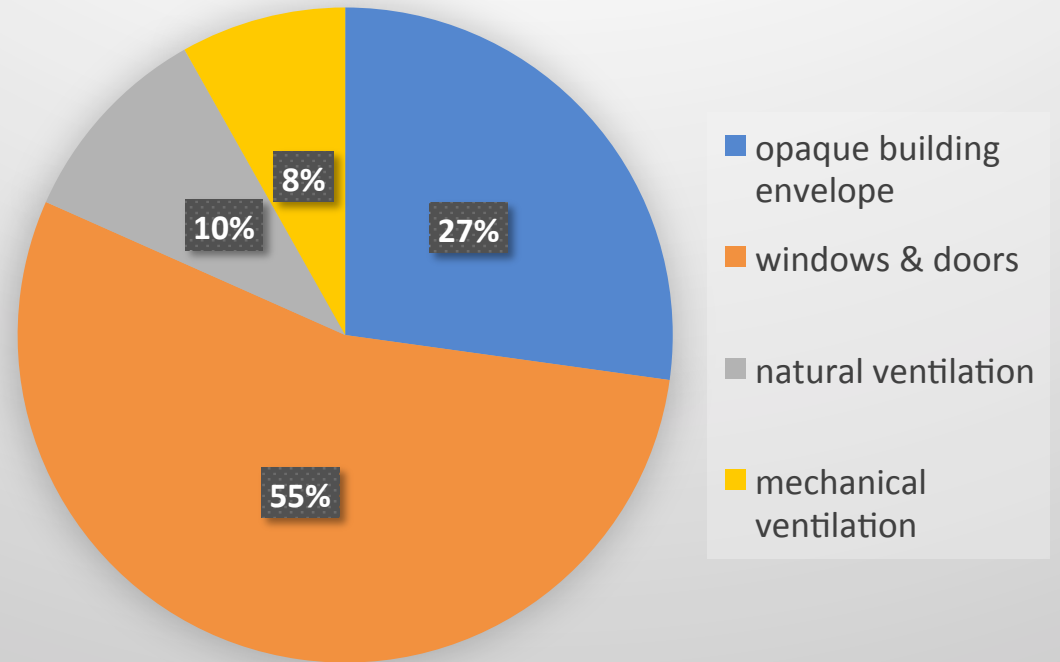
H2K	kwh/yr
space heating	646.8
cooling	0
dhw heating	6459.1
plug loads	7249.4
ventilation	1195.7
total	15551

Heat Loss Breakdown

Halifax WUFI Heat Loss Breakdown



Halifax H2K Heat Loss Breakdown



WUFI	kBtu/yr
opaque building envelope	18115
windows & doors	19966
natural ventilation	4791
mechanical ventilation	3778
total	46650

H2K	kBtu/yr
opaque building envelope	12588
windows & doors	25210
natural ventilation	4712
mechanical ventilation	3778
total	46288

33% Assemblies

Climate	Walls	Roof	Slab
Victoria	18.5	60	11.1
Edmonton	25.5	60	11.1
Toronto	23.5	60	11.1
Halifax	23	60	11.1

Required windows to go from R-2 to R-2.5

Assembly Comparison to hit standard

WUFI

NZH

Climate	Walls	Roof	Slab
Victoria	24	40	10.4
Edmonton	24	98	13
Toronto	28.7	98	20
Halifax	31	98	20

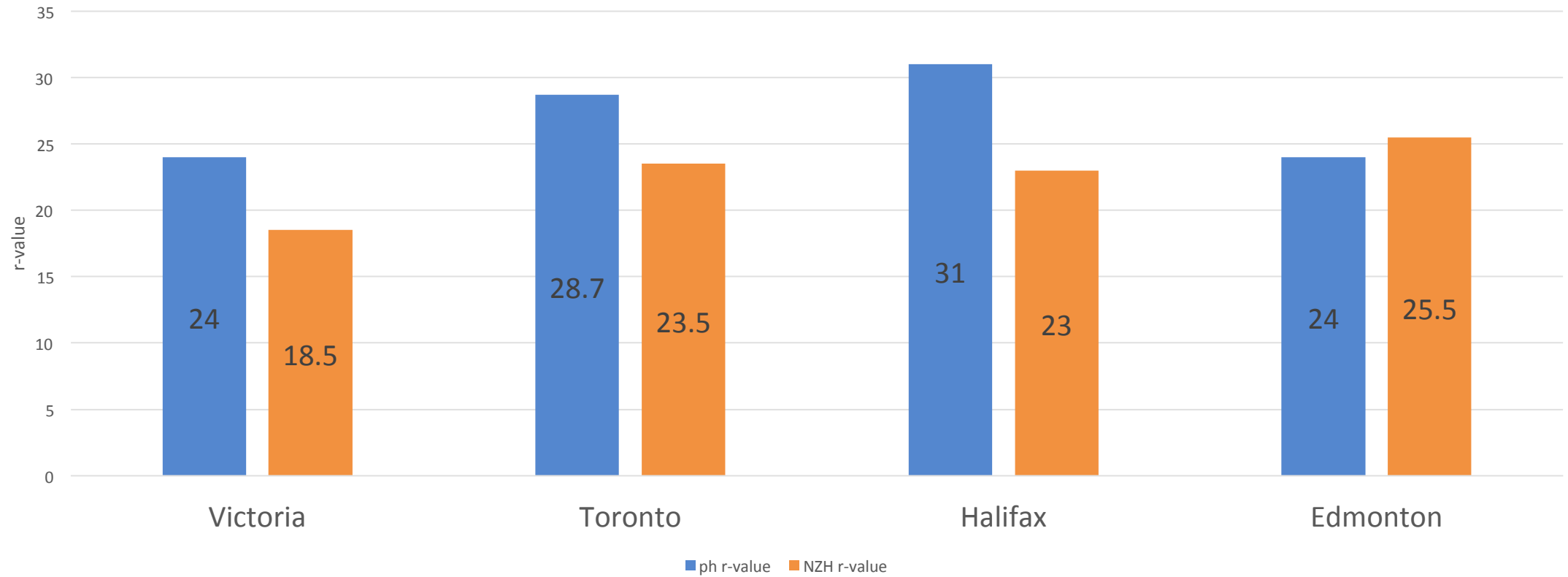
Triple glazed windows

Climate	Walls	Roof	Slab
Victoria	18.5	60	11.1
Edmonton	25.5	60	11.1
Toronto	23.5	60	11.1
Halifax	23	60	11.1

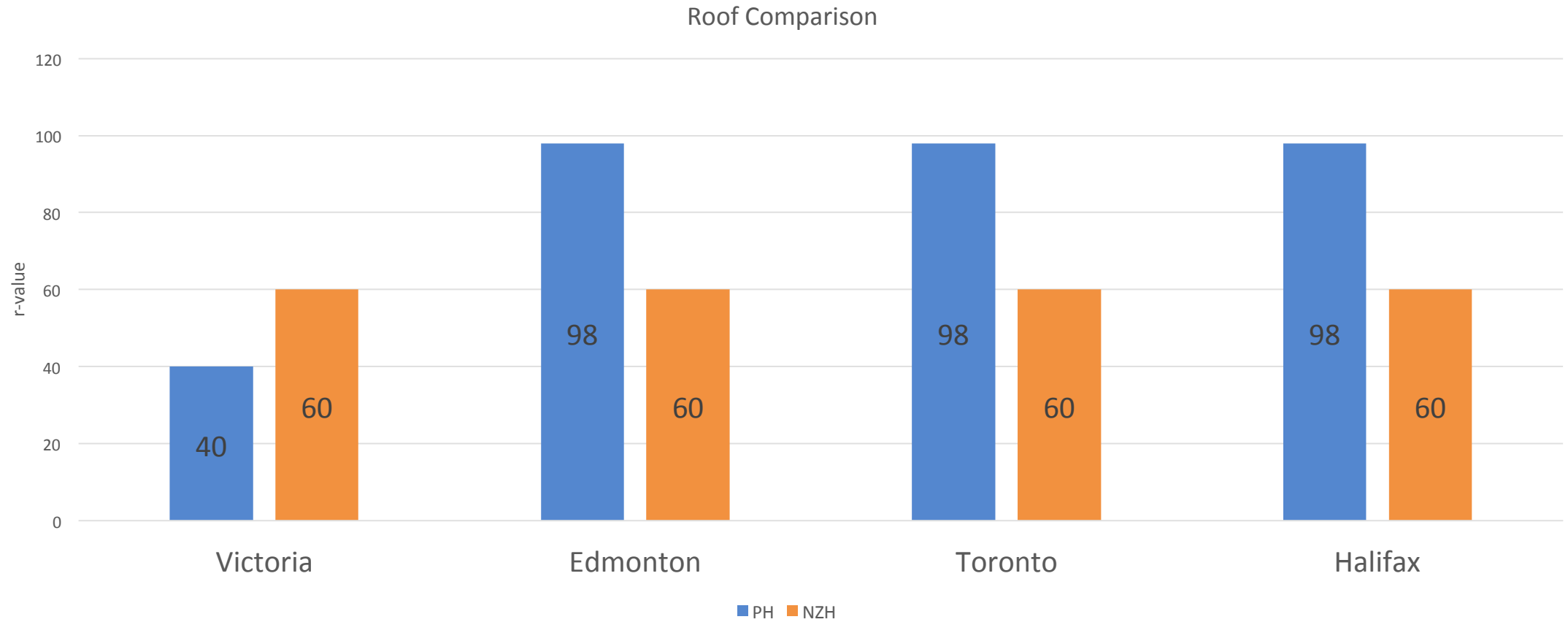
Slightly better than code windows

PH vs NZH R-Value Comparison Walls

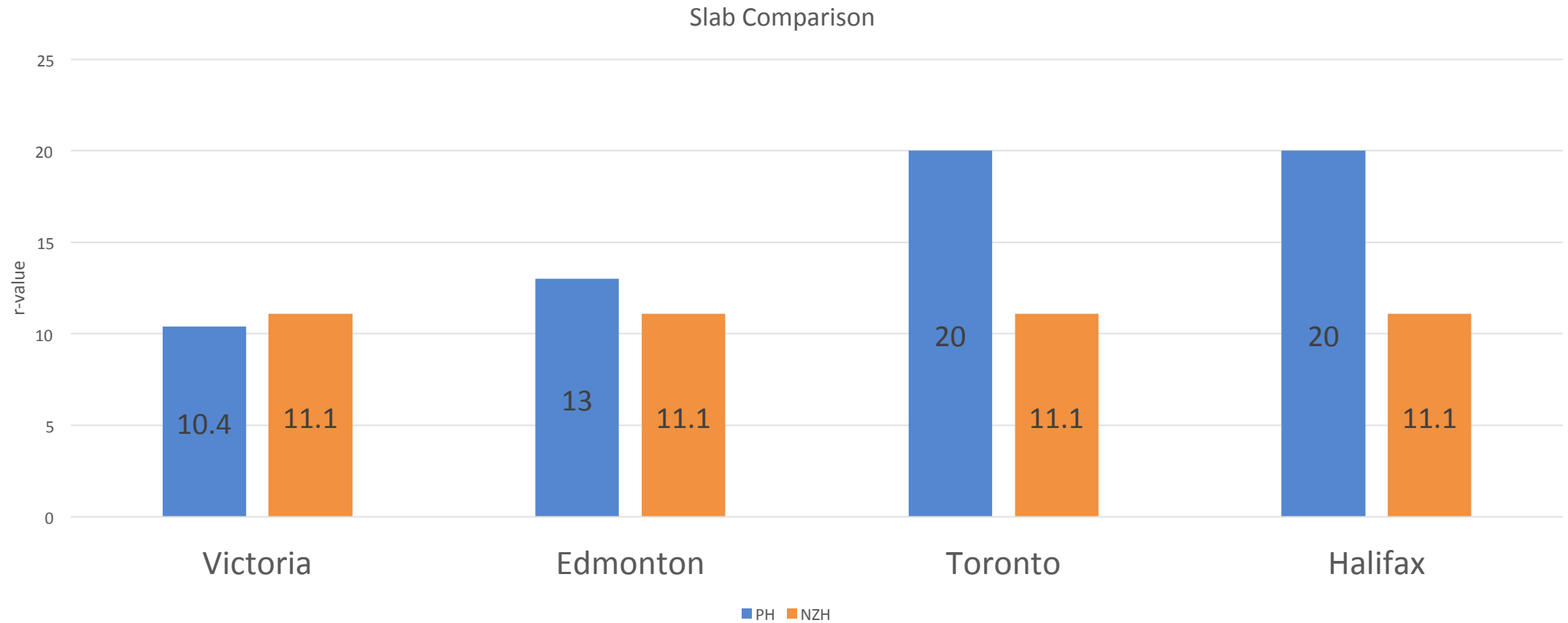
Wall Comparison



PH vs NZH R-Value Comparison Roof

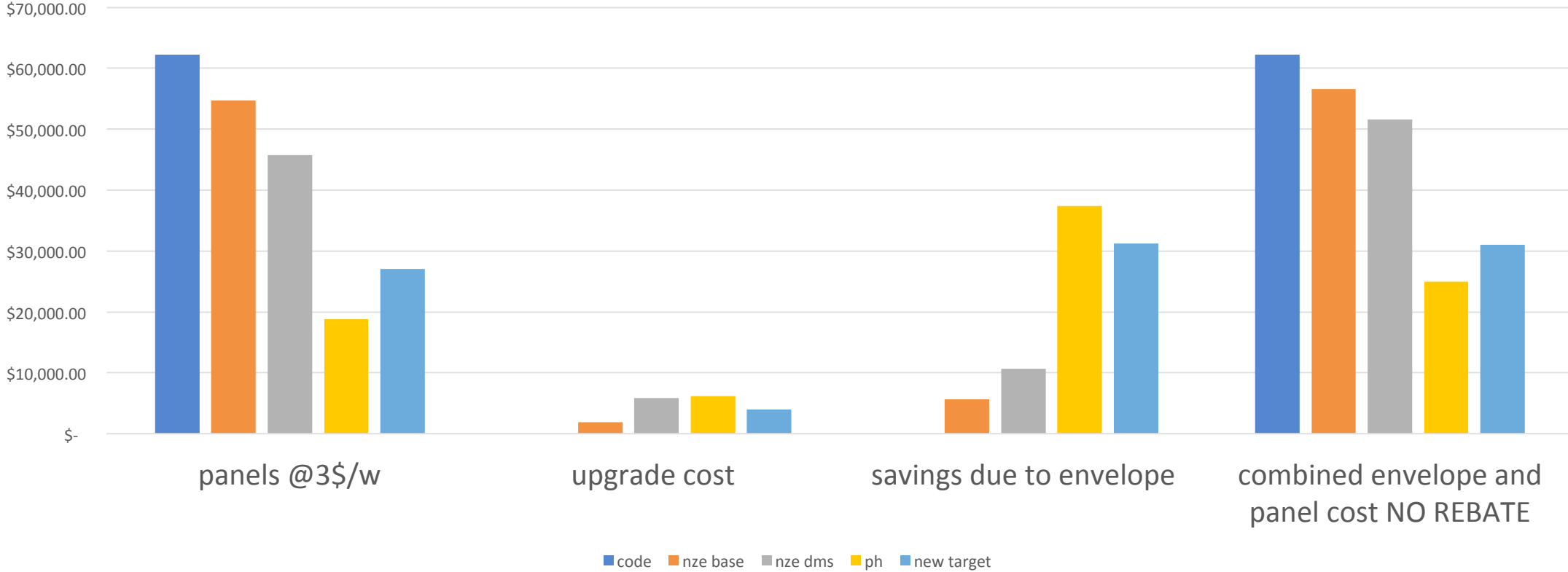


PH vs NZH R-Value Comparison Slab

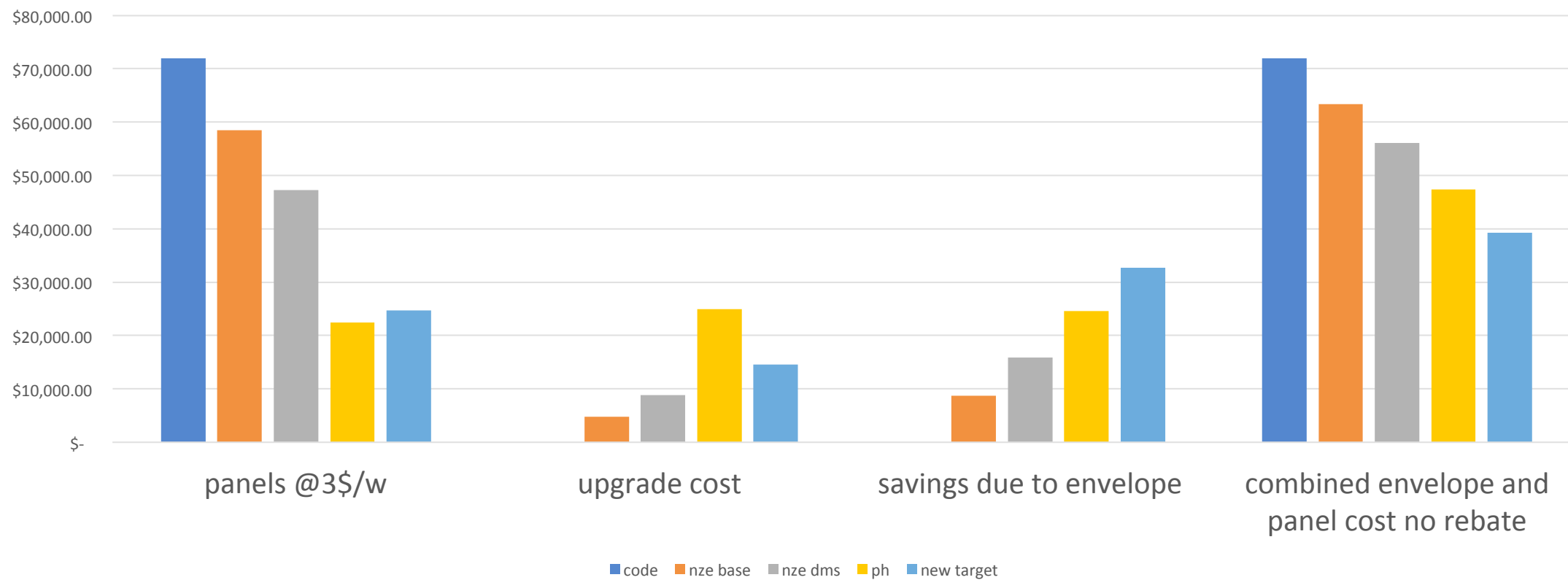


Value of PH / NZH

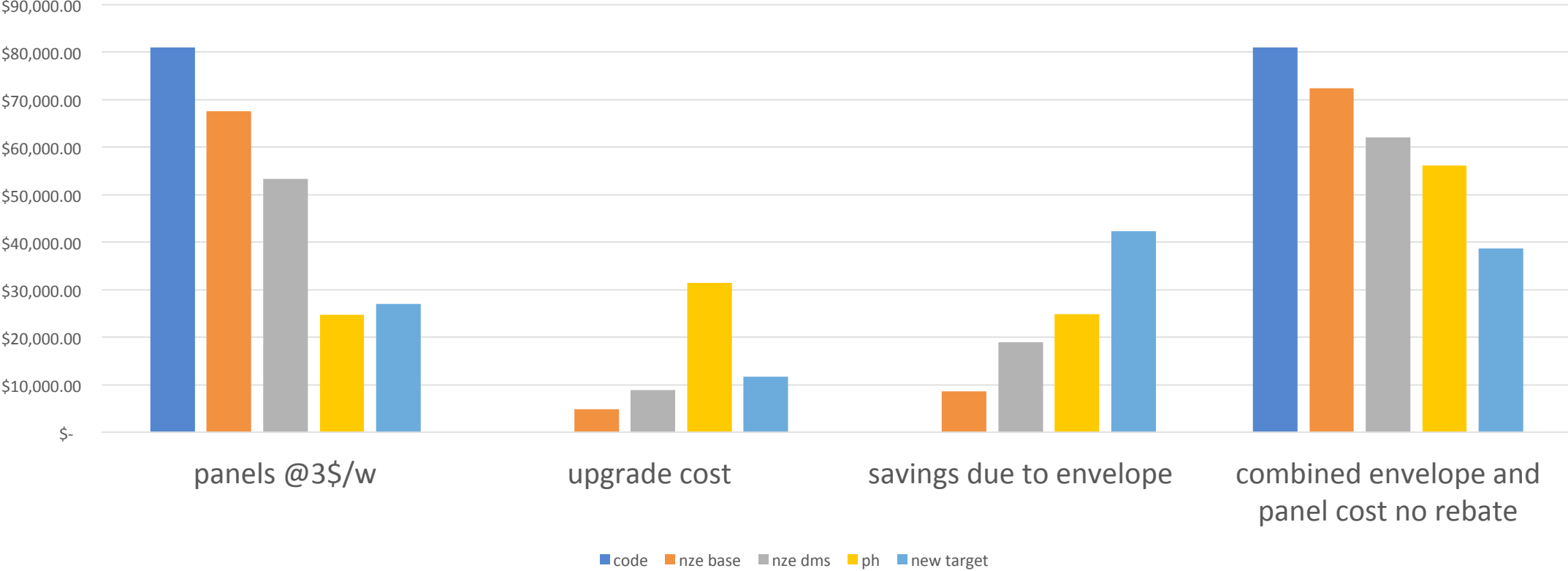
VICTORIA



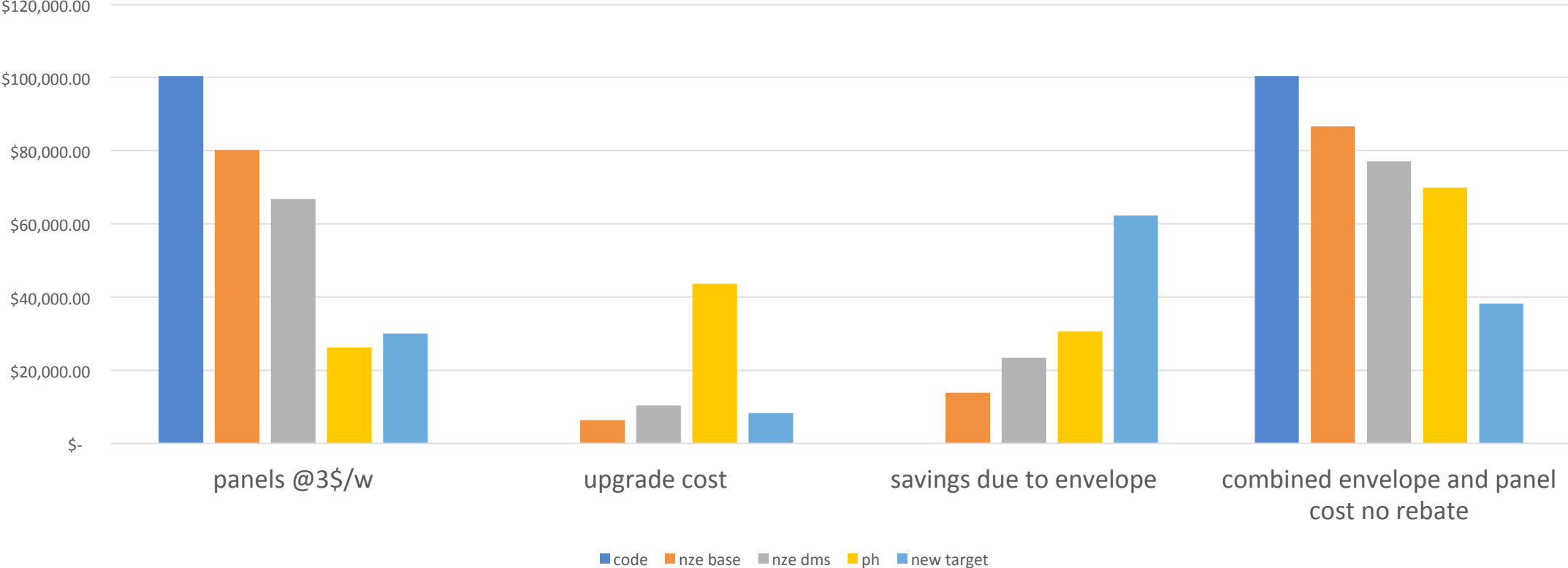
TORONTO



HALIFAX



EDMONTON



So, what do we think? A few considerations:

- Reality of upgrading electric service (cost about \$3000CAD to go from 200A -> 400A)
- Cost of lumber / materials rising, cost of solar decreasing
- Occupant comfort
- Bad design not addressed in NZH
- Currently there is a \$10k rebate in NS for PH – soon to be NZ (government weight)
- Currently, before this new rebate kicks in, there is no reason to go NZH. Quality assurance is more rigorous in PH and allows off-site renewables.

- Certified passive house
- *needed* panels to be on roof
- huge battery system
- needed substantial building envelope improvements / Zehnder HRV to hit targets



New client story

- Chose substantially higher priced bid because the TJI wall allowed her to fit NZ panels on roof (otherwise would need ground mount)

Discussion