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Development of New Archetypes for Building Code Analysis

Part 1: New Houses

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Executive Summary

The Pan-Canadian Framework on Clean Growth and Climate Change mandates development of model Net-Zero Energy Ready (NZE-R) codes for new construction, and alterations codes for existing buildings over the next 10 years. The framework requires that development of these new codes should consider the regional differences in building markets across Canada.

NRCan is supporting the National Research Council's (NRC) development the new model codes, and local authorities as they prepare to adopt these codes. To aid in the design and assessment of the NZE-R code for new construction, NRCan developed 240 new housing archetypes for eight major Canadian markets across Canada.

These archetypes were created using statistical methods, and reflect the best-available data on the energy characteristics of contemporary Canadian housing. These archetypes have unique features that recommend their use in building code design:

- **They represent contemporary housing:** Each archetype was selected from a database of actual houses built between 2016 and 2018, across Canada.
- **They exhibit regional variation:** NRCan developed separate archetypes are provided for eight Canadian regions: Atlantic, Quebec, Greater Toronto, North and East Ontario, Prairie Provinces, BC– Lower Mainland, BC–Interior, and Northern Territories.
- **They include emerging and alternative housing forms**: The greater number of archetypes used in the set allows them to represent different forms of housing, including very large and very small homes, homes with very large glazing ratios, and homes designed to achieve very low energy use.
- **They include a variety common construction types** (such as attic, cathedral, and scissor ceilings; basement, slab, and walk-out configurations) from each region is represented by the archetypes.
- **They include weighting factors for scaling results to stock-level:** These factors enable researchers to estimate nation-wide impacts for building codes, based on construction activity in each region.
- **They are designed for use with HTAP:** The archetypes are designed for compatibility with Housing Technology Assessment Platform (HTAP), which expedites code design and impact analysis.

The current release of the new archetypes are for single detached and double/row houses. Future work will add other Part 9 buildings such as MURBs. The systematic approach used for the development of the new archetypes provides the required tools to update archetypes in future as new data and new housing forms are needed.

1. Introduction

The Pan-Canadian Framework on Clean Growth and Climate Change [1] is the collective approach of federal, provincial, and territorial governments towards climate change mitigation. Key activities under the framework include development of a) Net-Zero Energy Ready (NZE-R) model building codes for new buildings and b) separate codes for alterations of existing buildings. Conventional approaches for code renewal that focus on incremental improvements of new construction requirements may not satisfy these ambitious new goals.

A typical NZE-R building incorporates a combination of energy saving measures, high efficiency energy technologies, and renewable energy generation. Advances in renewable/alternative energy technologies, and innovations in building envelope design, provide a large number of options for design and operation of net zero energy buildings. As such, the design of an affordable NZE-R building is a complicated problem.

For these reasons, local authorities and industry scrutinize the cost effectiveness of future codes. As codes are renewed to deliver greater energy savings, they may impose greater capital investment and greater risk that the energy benefits will not be realized.

These risks impede effective renewal of the codes. Authorities are reluctant to adopt future codes that may impose unintended consequences on homeowners or the construction industry. Furthermore, future codes that increase capital costs while not delivering the promised changes erodes public trust in the building code and enforcement authorities.

2. Background

Archetypes are a necessary component for a bottom-up building stock analysis. Prior researchers has developed various archetypes for use in academic research, program and code analysis in Canada. The methods employed to develop of those archetypes are relevant to this work. Two such archetype sets are described below:

- The **NRCan 11 Archetypes:** A set of 11 synthetic housing archetypes developed to support code and program analysis

- The **Canadian single detached, double and row database (CSDDRD):** A set of over 16,000 archetypes chosen from existing homes across Canada.

A key motivation for this work was to take advantage of new cloud computing and automation capabilities afforded by NRCan's Housing Technology Assessment Platform (HTAP). The features of HTAP are also introduced in this section.

2.1. **NRCan 11 Archetypes**

In 2008, NRCan led a project to develop new archetypes to support design and assessment of the next generation of Energy Star for New Homes program (ESNH). This project developed a set of synthetic archetypes using an "averaging technique" [2].

The averaging technique consist of analysing statistical data of building stock and the development of an average building which possesses characteristics of a mean statistical building. The average building may be a real building or an abstract building. While standard building performance simulation can be used for the energy analysis of an average archetype using a standard computer, the resolution of results are more limited compared with the results of an analysis using the archetypes generated based on a comprehensive sampling technique.

In this project, NRCan reviewed nearly 6000 records from the EnerGuide for Housing Database (EGHD), covering new construction between 2002 and 2007. From these data, NRCan developed average characteristics for the development the synthetic archetypes. NRCan initially indented to develop two archetypes, a single family home and a low-rise detached building. However, the 6000 house records exhibited a wide diversity of house characteristics such as shape, number of storeys, floor area, and foundation. This variation led NRCan to develop nine additional archetypes. The resulting set is generally known as the "NRCan 11 archetypes".

The principal characteristics of the NRCan 11 archetypes are shown in Table 1.

Table 1. Characteristics of NRCan 11 archetypes

No.	House type	Floor area (sqft)	Storeys	Foundation type
1	Single detached	1000	1	Basement
2	Single detached	1900	1	Crawl space
3	Single detached	1300	2	Basement
4	Single detached	2100	2	Basement
5	Single detached	3500	2	Basement
6	Single detached*	3500	2	Basement
7	Single detached	2100	2	Slab on grade
8	Single detached	2100	2	Basement
9	Single detached	3000	2	Basement
10	Row-end unit	1500	2	Basement
11	Row-middle unit	1500	2	Basement

**15% more glazing area compared with No.5*

NRCan developed a set of HOT2000 files to represent the thermal characteristics of each of the 11 archetypes. Separately, NRCan hired a consultant to develop plausible house plans and architectural drawings based on the characteristics of each archetype.

Elevations for ten of the archetypes are depicted in Figure 1. Archetype #6 has 15% more glazing area compared with Archetype #5. Archetype #11 represents a 'middle' unit variant of the row house depicted for archetype #10.

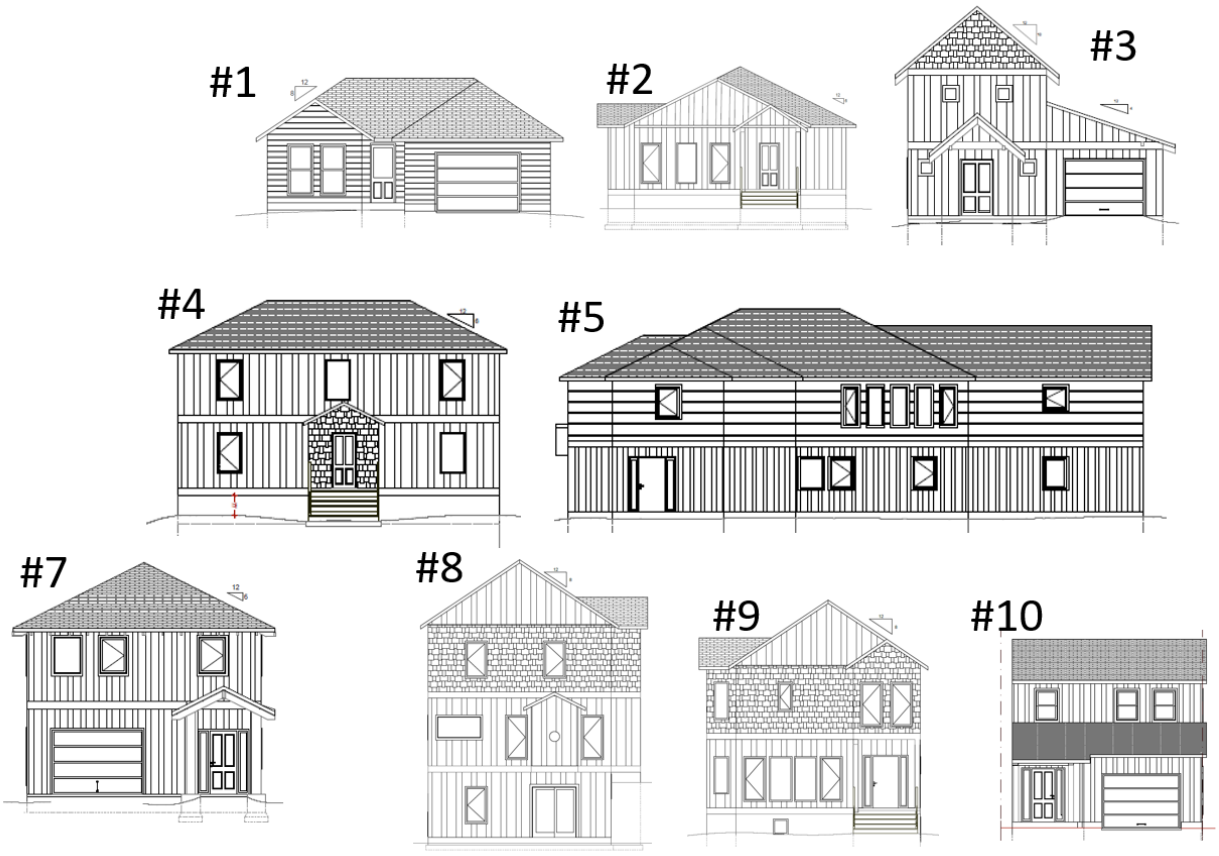

Figure 1: Elevations of the NRCan 11 archetypes (Archetype 6 and archetype 11 are the variants of archetype 5 and archetype 10, respectively.)

To verify the suitability of the 11 archetypes, a series of simulations were carried out to estimate the energy use of those archetypes in various regions of Canada. The results indicated that the energy consumption of those archetypes was within the range of energy consumption of new houses in the EnerGuide for housing database — supporting NRCan's assessment that the archetypes reflected the characteristics of new construction within the broader database.

The NRCan 11 archetypes were first used between 2008 to 2012 to support design and management of the Energy Star for New Homes program. Those studies showed that the energy consumption of archetype #4 was close to an average of energy consumption of all 11 archetypes. In subsequent work, archetype #4 was exclusively used for analysis of ESNH and costing of various options during the development of next generation of the ESNH and R-2000 Standards.

During development of the 2012 NBC 9.36 energy requirements, the code committee adopted the NRCan 11 archetypes for the development of prescriptive requirements. To expedite the cost and benefit analysis, the Canada Codes Commission elected to base the analysis on a single archetype (archetype #4) and using blended, average rates for energy costs. In the final report [3], the lead researcher on that study noted the limitations of the approach, and recommended more thorough approaches for future work:

> "*This cost benefit analysis was completed as an exercise to obtain an indication of the energy impact of the proposed changes on a national base. Although specific locations were used in the analysis, this cost-benefit study cannot be taken as a true reflection of the cost or energy savings for those locations."*
>
> *"In order to achieve a true representation of the impact of the proposed requirements in a specific region, it would be paramount that the analysis be performed using the respective regional context of current construction baseline, cost of construction materials and utility rates as well as common housing archetypes. The energy target data could then be used to calculate the benefits for an actual region."*

2.2. **Canadian Single Detached, Double and Row Database (CSDDRD)**

In 2009, Swan et al. [4] developed a housing database that was representative of existing Canadian houses using the Energuide for Houses Database and Survey of Household Energy Use (SHEU). Whereas the NRCan 11 archetypes are synthetic home designs constructed using the "averaging approach", CSDDRD contains real homes selected using statistical sampling methods.

The sampling technique consists of sample selection of real buildings. Depending on data availability and data resolution, a sampling technique can result in a simple building stock model with limited archetypes or a complex building stock model with several archetypes that cover a variety of building types. For example, a sampling method was used for previous studies in Belgium, Cyprus, Austria, England, Greece, and Canada [4,5].

Swan et al. [4] had access to the energy audit data of over 200,000 homes across Canada. The energy audit data provides the required information for building performance simulation such as

location and orientation, house type, geometry, number of storeys, foundation type, presence of an attic, construction materials including windows and doors, air-tightness, and domestic hot water (DHW) and space heating system information. Because participation in energy audit programs is voluntarily, the EGHD is not representative of the Canadian housing stock and a random sample selected from the EGHD is likely unrepresentative of the Canadian housing stock.

To address the inherent bias in the EGHD, Swan et al. used the Survey of Household Energy Use data. SHEU is a housing survey that Statistics Canada administers to determine the energy use of the Canadian housing stock [6]. Statistics Canada randomly selects houses based on the regional population. While Statistics Canada's selection methods are unbiased, the level of detail contained within the SHEU database is not sufficient to generate energy models.

Swan et al. [4] developed a methodology to selectively extract data from the EGHD based on the statistical representation of key parameters of the Canadian housing stock that was obtained from SHEU. SHEU divided the Canadian housing stock into the five regions (i.e. Atlantic, Quebec, Ontario, Prairies, and British Columbia). They selected the samples using the following selection parameters distribution:

- House type (Single Detached or Double/Row)
- Region (Atlantic, Quebec, Ontario, Prairies, British Columbia)
- Vintage (1900–1945, 1946–1969, 1970–1979, 1980–1989, 1990–2003)
- Storeys (1 through 3 including half storeys)
- Living space floor area (25–56 m^2, 57–93 m^2, 94–139 m^2, 140–186 m^2, 187–232 m^2, 232–300 m^2; excluding basement or crawl space)
- Space heating energy source (electricity, natural gas, oil, wood, propane)
- DHW energy source (electricity, natural gas, oil)

The resulting database, Canadian single-detached, double and row database (CSDDRD), consists of about 17000 entries. The number of samples for each element of the selection parameters was defined based on the distribution of those elements in SHEU. For example, according to the SHEU data, about 81% of the existing Canadian houses are single detached. Therefore, 81% of samples in the CSDDRD are single detached houses. Main features of the CSDDRD are:

- Statistically representative of existing Canadian houses based on the selection parameters,
- Each sample contains required information for building performance simulation,
- Each sample is of equal weight and represent 525 houses of the Canadian housing stock.

2.3. **Cloud Computing and NRCan's Housing Technology Assessment Platform (HTAP)**

Another key motivation for developing the new archetypes was to make greater use of high-performance computing resources in code and program analysis. As Proskiw [3] noted, national impact analysis should reflect regional weather, regional housing characteristics, costs and energy prices. In prior code and program development, the effort required to use traditional tools and the — such as HOT2000 [7] — has prevented researchers from undertaking such comprehensive analysis.

Since then, advances in automation and cloud have made it easier to undertake large residential energy analysis tasks. NRCan has developed HTAP, to expedite the sort of studies needed by code committees.

HTAP can explore and identify affordable approaches for low-energy housing design. HTAP brings together building performance simulation (BPS) software, building stock data, energy conservation measures, rulesets[1] and energy targets, economic data, and cloud computing to analyze numerous technology combinations and identify optimized design scenarios.

HTAP incorporates a house-as-a-system approach where every design scenario is modeled as a complete house in an annual energy analysis. HTAP uses HOT2000 (version 11 or later) [7] and ESP-r [8] as its building simulation engines.

HTAP allows the user to apply energy conservation measures to each archetype, and evaluate the cumulative impact of several upgrades in each location. A unique feature of HTAP is the built-in ruleset and energy targets. This feature automatically applies the requirements of codes and energy

[1] A ruleset is an script which applies the requirements of a prescriptive path, including envelope, airtightness, mechanical systems, domestic hot water heating, and operating conditions, to the archetypes

conservation programs on each archetype according to the local climate, house type and heating fuel.

HTAP also incorporates cost data from the Local Energy Efficiency Partnerships (LEEP) program [9] to estimate the cost of energy upgrades. Local energy prices are used to estimate the operating cost of each resulting house. In addition, HTAP provides tools to conduct sensitivity analyses on energy prices and cost analyses of conservation measures.

HTAP generates techno-economic data such as energy savings, GHG emissions, investment costs, and operating cost savings for each measure as well as combination of measures. Results can be analyzed to identify the maximum possible energy savings and GHG emissions reduction for a given investment cost.

3. Available Data Sources

To develop archetypes for new construction, researchers require information about:

- The type, size and shape of homes being built across Canada,
- The energy-related characteristics of those homes (including window area, ceiling types, foundation configurations),
- The representation of those homes in Canadian construction activity.

While no single database provides all of this information, the relevant data can be consolidated from multiple sources.

3.1. **EnerGuide for Housing Database**

The Energuide for Houses Database is maintained by NRCan's Office of Energy Efficiency (OEE). The EGHD contains housing audit data and HOT2000 analysis collected by OEE's various housing programs over the last 20 years. Currently, the EGHD contains over 2,000,000 audit records (including pre- and post-retrofit audit data), representing approximately 1,000,000 unique dwellings in Canada. Each audit record contains over 200 data points, describing the location, physical measurements and HOT2000 analysis estimates for the home. Audit data is collected when homeowners and homebuilders participate in one of OEE's voluntary programs:

- The EnerGuide for houses (EGH) program provides independent expert advice regarding the energy efficiency level of homes to the homeowners. EGH is a voluntary program and interested participants contact local program representatives to arrange an energy audit [10,11]. The EnergGuide for Houses program provides pre- and post-retrofit audits, allowing homeowners who undertake upgrades to quantify energy-related benefits
- R-2000 [12] is a voluntary housing standard, is designed and maintained by the OEE to promote a high level of energy efficiency in the Canadian housing stock. Typically, an R-2000 certified home is at least 50% more energy efficient than a code built house. The R-2000 program was originally launched in 1982, and the standard has been updated continuously.
- The ENERGY STAR program was originally developed by the U.S. Environmental Protection Agency in 1992. OEE adopted the ENERGY STAR program and promoted it in Canada since 2001. As a part of that program, the ENERGY STAR for new homes was introduced to enhance energy efficiency of new houses across Canada. An ENERGY STAR certified home is built to use about 20% less energy than a typical home built based on the latest building energy code.

Participation in any these programs requires physical measurements of the home, HOT2000 analysis, and submission of the data to OEE for inclusion in the EGHD. Since the participation is voluntary, the EGHD is not statistically representative of the Canadian housing stock.

3.2. **Housing Market Data**

The Canada Mortgage and Housing Corporation (CMHC) maintains the Housing Market Database [13] as a tool to assess Canadian construction activity. The database includes dwelling types, housing starts and completions, units under construction, units absorbed[1] and unabsorbed, existing housing stocks, ownership rates and prices for metropolitan centres over 10,000 population across Canada. This information is collected from the housing permits issued in each region. Therefore,

[1] An absorbed unit is a housing unit that has been sold and completed. A unit is considered sold when a binding contract is secured by a non-refundable deposit and has been signed by a qualified purchaser. The purpose of the Market Absorption Survey is to measure the rate at which units are sold after they are completed, as well as collect prices.

this database is representative of newly constructed houses across Canada. While the level of detail contained in the Housing Market Database is not sufficient for energy modeling purposes, its statistical distribution is a useful guide for the generation of scaling factors in each region.

3.3. **Survey of Household Energy Use (SHEU)**

Survey of Household Energy Use is a joint project between Statistics Canada and NRCan since 1993. The latest available SHEU [14], which provides the results of 2011 survey, was published on 2014 and the next SHEU will be published in 2019 based on the results of 2015 survey. The main purpose of SHEU was to collect data on energy use and the factors affecting energy use in the Canadian housing stock.

SHEU provides information on building basic characteristics such as dwelling type and floor area, type of appliances, lighting, and energy consumption. The results are statistical analysis are extrapolated to the Canadian housing stock and presented in tables by region and dwelling type. While the SHEU does not have necessary data for the development of building energy models, but the parameter distributions are helpful to understand the status of existing houses across Canada. Since the SHEU contain data on the entire Canadian housing stock it has limited utility for this work that is solely focused on new houses.

3.4. **Novoclimat**

Novoclimat [15] is the equivalent of ENERGY STAR for new housing program in the province of QC and manage the database of new houses in QC. Currently Transition énergétique Québec (TEQ), which was established as part of Quebec 2030 Energy Policy [16] to promote energy efficiency and coordinate the implementation of all the programs required to meet the energy targets set out by the Government of Quebec, manage the Novoclimat program.

Novoclimat manage the training and certification of trades, the homes inspection during their construction and the certification of conforming dwellings. While the Novoclimat program maintains a database of results, HOT2000 files are not available for participating homes. Therefore, the statistical data is useful for understanding the current practices of construction industry in QC.

4. Development of New Archetypes

4.1. Objectives and Guiding Principles

The main objectives of this report is to present the development of new archetypes that:

1. Reflect most recent housing data,
2. Account for regional differences,
3. Provide greater resolution into different types of housing,
4. Support new analysis methods using HTAP and cloud-computing techniques.

Even though this project seeks to develop a more comprehensive set of archetypes that better represent the variation in Canadian housing, the archetypes themselves must be an approximation of the actual homes being constructed in Canada. Where compromises were required, NRCan adhered to the following guiding principles:

- The archetypes would be drawn from real homes built in different regions across Canada. The sampling method developed by Swan et al. [4] would inspire this work; NRCan would adapt the method to reflect the data available for new housing.
- Each region would be represented by the same number of archetypes (15 detached, 15 attached), regardless of its significance in home construction activity. This approach ensures that provinces have a useful set of results to examine for their own NZE-R code development. Regional scaling factors would be provided to permit scaling energy impact results for nation-wide estimates.
- Archetypes would be chosen to ensure prevalent features (such as scissor ceilings, walk-out basements) are represented in as many regions as possible, even if this meant that homes with this feature would be statistically over-represented in a given region's archetypes.

4.2. Selection Parameters

Below is the list of selection parameters for sampling the new archetypes. These parameters represent the factors that affect the performance of houses in each region. These suitable range for

the selection parameters are identified based on the number of available house files in the EGHD, parameters of each house file, and the regional characteristics of new houses. The selection parameters was used to create a subset of HOT2000 files. The subset was used to randomly select the archetypes. Some rules were imposed on the selection criteria to ensure that underrepresented house types are included in the archetypes. The archetypes will be weighted against statistical data to account for the size of housing market.

Table 2. Selection parameters

No.	Parameter	Range
1	Housing market	Atlantic (AT), Quebec (QC), Greater Toronto Area (GTA), North and East Ontario (ON), Prairies (PR), British Columbia – Lower Mainland (BC-LM), British Columbia – Interior (BC-INT), Territories (North)
2	House type	Single detached (SD), Double and Row (DR), Multi Unit Residential Buildings including Duplex, Triplex and Apartments (MURB)
3	Construction year	2015 to 2018
4	Storeys	1, 2, and 3
5	Floor area	$50m^2$ to $450m^2$
6	Glazing ratio	0.05 to 0.35
7	Foundation type	Basement, crawl space, walkout, slab on grade
8	Ceiling type	Attic/hip, Attic/gable, Flat, Scissor, Cathedral

Other parameters such as energy source for space and domestic hot water (DHW) heating that can affect the performance of new houses are not used for selection archetypes because HTAP is capable of modifying mechanical systems. In addition, energy sources are not specified in the current building code. Lastly, adding energy sources to the selection parameters reduces the chance of developing enough archetypes especially in the housing markets that have a small number of house files in the EGH database.

4.3. **Available Records**

Without a statistically-representative distribution of new housing characteristics (e.g. stories, glazing ratio, foundation type) NRCan elected to use the distributions in the EGHD as an

approximation of new housing characteristics. While the EGHD is extensive (representing audits from over one million homes), three key requirements greatly limited the number of records that were available for this work:

1. The scope of the archetypes is new construction; which limited the available data to records from the R-2000, EnergyStar, and Energuide for New Houses programs.[1]
2. A key objective was to represent contemporary homes; for that reason only records for homes built after 2016 were used.
3. Another objective was to ensure compatibility with for HTAP, which only supports files from HOT2000 version 11.3 or later (Figure 2).

When the EGHD was filtered for records meeting these requirements, 6472 single detached and double/row records were found[2].

[1] The ENERGYSTAR for new houses program accepts either prescriptive or performance path for certification of new houses. The rate of adoption of performance path is not the same among all builders across the housing markets. Therefore, the number of house files in the EGNH database is not proportional with the size of a housing market (for example GTA and ON).

[2] Multi unit residential buildings including duplex, triplex and apartments are available in the EGH database. However, all house files were modeled with HOT2000v10 and earlier. Additionally, NRCan MURB archetypes were generated using a multi-unit building model in HOT2000v10. The multi-unit approach for modeling MURBs was discarded in newer releases of HOT2000 (i.e. v11.3 and v11.5). Therefore, conversion of NRCan MURB archetypes to an HTAP compatible format is not possible. Currently no suitable records for the development of MURB archetypes are available in the EGH database.

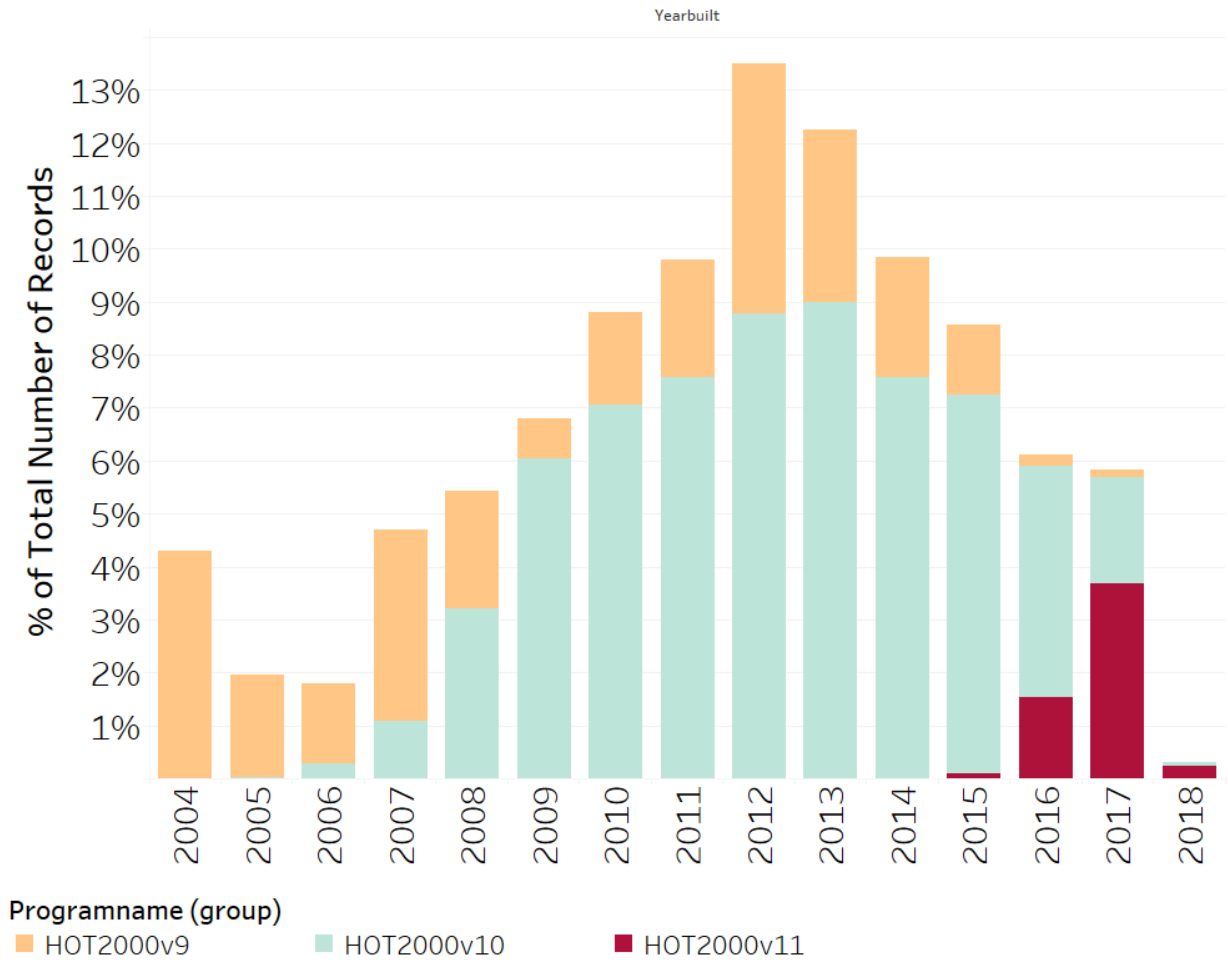

Figure 2. EGHD records by HOT2000 version

Since OEE staged the roll-out of HOT2000v11 by region, the 6472 files are not uniformly distributed in each region. Significant records are available for BC and the Prairie provinces, while only limited data is available Canada's largest home market in the Greater Toronto Area. While significant records are available in Ottawa, these are heavily biased by a single builder who uses the ENERGY STAR performance path for all of their products. Most notably, no data is available for Quebec – where builders commonly participate in the Novoclimat program instead of OEE programs.

Figure 3 depicts the available records according to housing market and house type. The coloured bars indicate the records available in April of 2018; the red lines indicate the change in records by August of the same year.

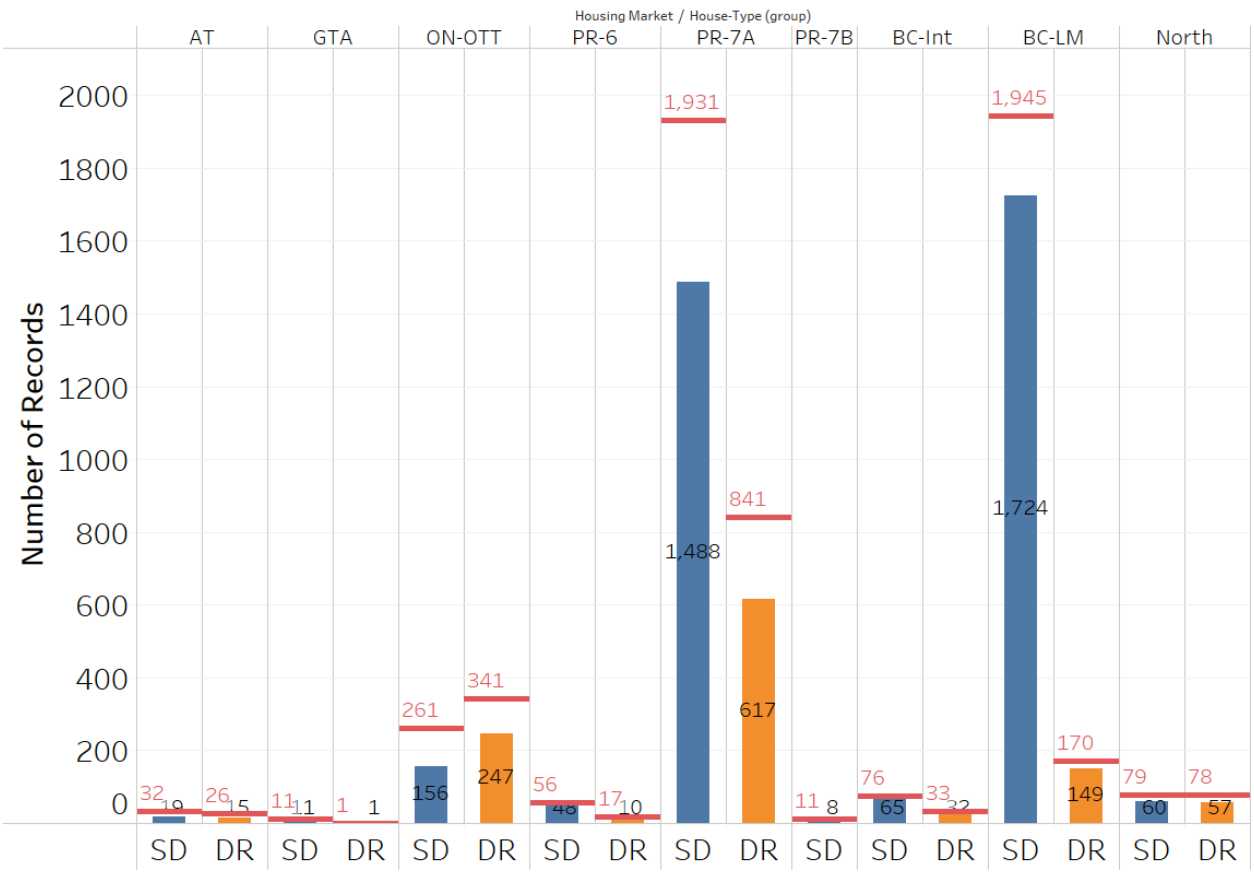

Figure 3: Distribution of available EGHD files by Housing Market and housing type; coloured bars indicate records as of April 2018; red lines indicate records as of August 2018.

Most of the records are concentrated in the BC and Prairies; representation elsewhere is more limited. To address this data gap, NRCan developed a "proxy-house" selection strategy, which allows a home from another region to be used in lieu of homes from Ontario and Quebec. This approach is discussed in Section 4.5.

Figure 3 also highlights that the number of available records is growing as more builders participate in the program; for this reason, NRCan is optimistic that future releases of the archetypes will have more regional homes.

4.4. **Sampling Method**

NRCan adapted the sampling approach developed by Swan et al. [4] to reflect the available data. The methodology was as follows:

1. NRCan randomly sorted the 6472 suitable EGHD records
2. NRCan examined each of these records in turn and selected them for inclusion in the archetype according to the following requirements:
    a. Each region must have 15 single attached homes and 15 double/row homes
    b. Each region must include at least one home exhibiting each of the following criteria:
        - One, two and three stories
        - Basement, crawl space, walkout, slab on grade foundation types
        - Attic/hip, Attic/Gable, Flat, Scissor and Cathedral types.
    c. Each home must be constructed in 2015 or later; have a floor area between 50m² and 450m², and a window-to-wall ratio between 0.05 to 0.35.

The random sort and sample procedure was repeated several times to ensure the results were consistent.

4.5. **Proxy Houses**

The number of existing house files in the EGHD is currently not sufficient for the development of new archetypes in GTA, ON, and QC. As an interim measure, NRCan developed a methodology to identify proxy archetypes from other markets that can be used until more data is available.

The proxy house methodology is as follows:

1. For homes constructed in the GTA, NRCan selected all of the available records (11 detached and 1 double/row) with associated HOT2000 v11 files.
2. For the remaining homes, NRCan examined the broader EGHD, including records with HOT2000 v10 files. NRCan used the same sampling procedure described in section 4.4 to identify additional 4 detached and 14 double/row homes.
3. NRCan examined these additional v10 files to identify key characteristics – floor area, glazing ratio, ceiling type, foundation type and number of stories.
4. NRCan then searched through the available version 11 files to find homes with similar characteristics. These homes are the “proxy houses”

NRCan repeated the proxy-home approach for the North and Eastern Ontario market, where a single builder's enthusiastic participation in the ENERGY STAR program significantly biases the available records. For Quebec, NRCan used the same approach with one exception – instead of the EGHD, the Novaclimat database was used as the basis for identifying key characteristics.

While the proxy-house approach is imperfect, it is a reasonable approach to ensure that key housing characteristics (size, glazing ratio, foundation type, ceiling type) from a given region are faithfully represented. While proxy-house approach does introduce significant error for efforts to understand as-built construction trends (for instance, wall assemblies and heating equipment used in Alberta cannot be expected to represent practices in Quebec), this uncertainty is less important for the intended scope – assessment of proposed code changes. In that analysis the as-built construction trends are commonly replaced with minimums from a reference baseline, and the archetypes geometry and configuration are predominately important.

NRCan is also optimistic that increased use of HOT2000v11 will increase the number of suitable records available for archetype development, and that future versions of the archetypes will replace the proxy-houses with regional examples.

4.6. **Scaling Factors**

The number of archetypes for all house types and housing markets are the same in this work. To take the size of housing markets into the account scaling factors are developed using the CMHC housing market data. Scaling factor is the number of actual new houses that each archetype represent.

To develop scaling factors for each archetypes the total number of houses completed by house type and housing market was estimated using the CMHC's housing market data between 2015 and 2017. Regional scaling factors are determined by dividing the total number of each house type in each region by the number of archetypes, as shown in Equation 1.

$$SF_{type,region} = \frac{Dwelling_{type,region}}{N_{Arch,type,region}}$$

The available data from the CMHC database does not provide the breakdown of houses by size, glazing ratio, foundation type, and ceiling type, the scaling factors are determined by house shape in each region. If the number of houses by other parameters can be estimated, the scaling factors will be refined to increase the accuracy by giving higher weight to the archetypes that are representative of more common houses in each region. In addition, the total number of houses in the North is not given in the CMHC database, and the scaling factors are not estimated for northern archetypes in this edition. Scaling factors (average between 2015 and 2017) are presented in Table 3.

Table 3. Scaling factors for new archetypes

Housing market	SD	DR
Atlantic (AT)	187	60
Quebec (QC)	426	261
Greater Toronto Area (GTA)	1215	618
Ontario (ON)	376	201
Prairies (PR)	1132	630
British Columbia-Interior (BC-Int)	220	89
British Columbia-Lower Mainland (BC-LM)	367	240
North	—	—

5. Results and Discussion

Eight main housing markets (shown in Table 2) were identified for the purpose of this work. In each housing market, 30 archetypes are developed. The list of archetypes and main characteristics are provided in Appendix A. HTAP was used to examine the new archetypes and to ensure the accuracy and quality of HOT2000 models. The selected results of simulations are provided in this section.

The range of glazing ratio of new archetypes by housing market and floor area are shown in Figure 4. Results indicate that the glazing ratio of the new archetypes is between 0.05 and 0.33 and the national average glazing ratio for new archetypes is about 0.14. As discussed earlier, a motivation for the development of new archetypes is to consider the regional differences in the code analysis. For example, the average glazing ratio of archetypes in British Columbia–lower mainland (BC-LM) is about 40 percent higher than the national average.

The colour of the dots in Figure 4 indicates the floor area of each archetype. Results indicate that various sizes (between 60 and 400 m^2) and forms of housing (e.g. a small house (green dot) with large glazing ratio and a large house (red dot) with small glazing ratio) are present in the new archetypes set. The archetypes that represent special forms of construction are tagged, for instance walk-out basement, highly-glazed house (large glazing ratio in a small house), etc. A user can select those archetypes and apply different energy efficiency measures in several locations using HTAP. Therefore, the new archetypes can help to further investigate the impact of energy efficiency measures on specific housing forms across Canada.

Figure 4. Glazing ratio of new archetypes by housing market and floor area

Each archetype was modeled for the original location. The original locations for the proxy archetypes are set to the largest municipality within the housing market. The thermal energy demand intensity (TEDI) of the new archetypes is shown in Figure 5. TEDI represents the annual space heating auxiliary energy required of the space heating system divided by the heated floor area of the archetype. This space heating auxiliary energy is the total heating load for the house minus the internal gains and the passive solar heat gains. The TEDI varies between 9.5 kWh/m^2 and 140 kWh/m^2.

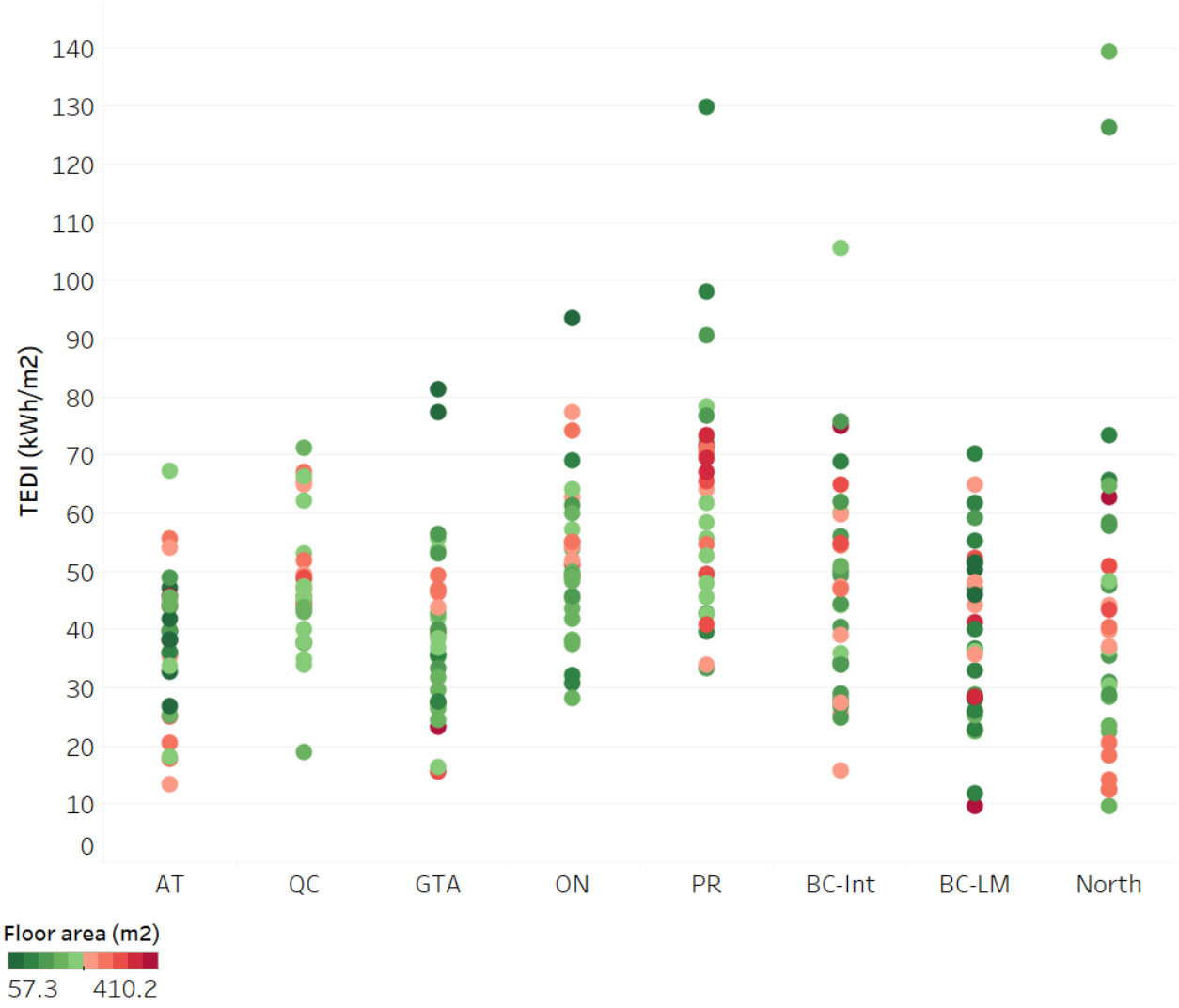

Figure 5. TEDI for new archetypes with the original design and location

As discussed earlier, the new archetypes were selected from the EGHD. The houses in that database were designed to perform better than a code built house. HTAP has built in rulesets to apply the requirements of NBC 9.36 to the archetypes.

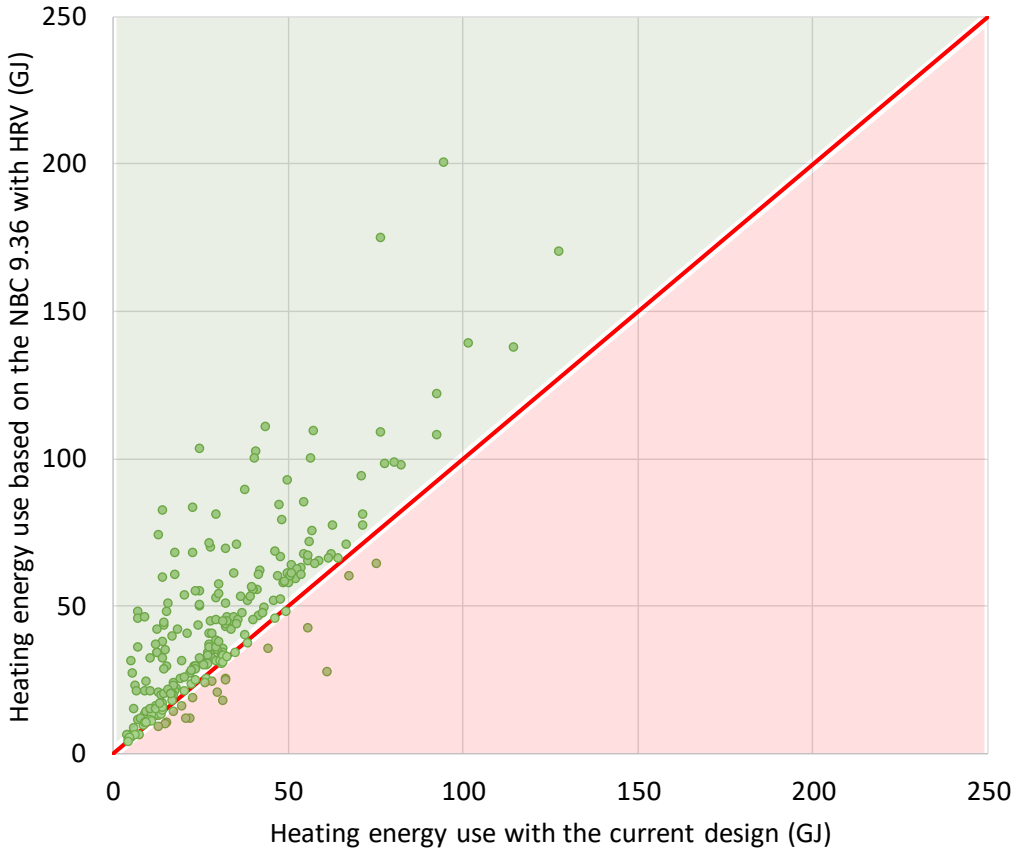

Figure 6. Annual heating energy use of archetypes based on the current design vs. the NBC 9.36 requirements

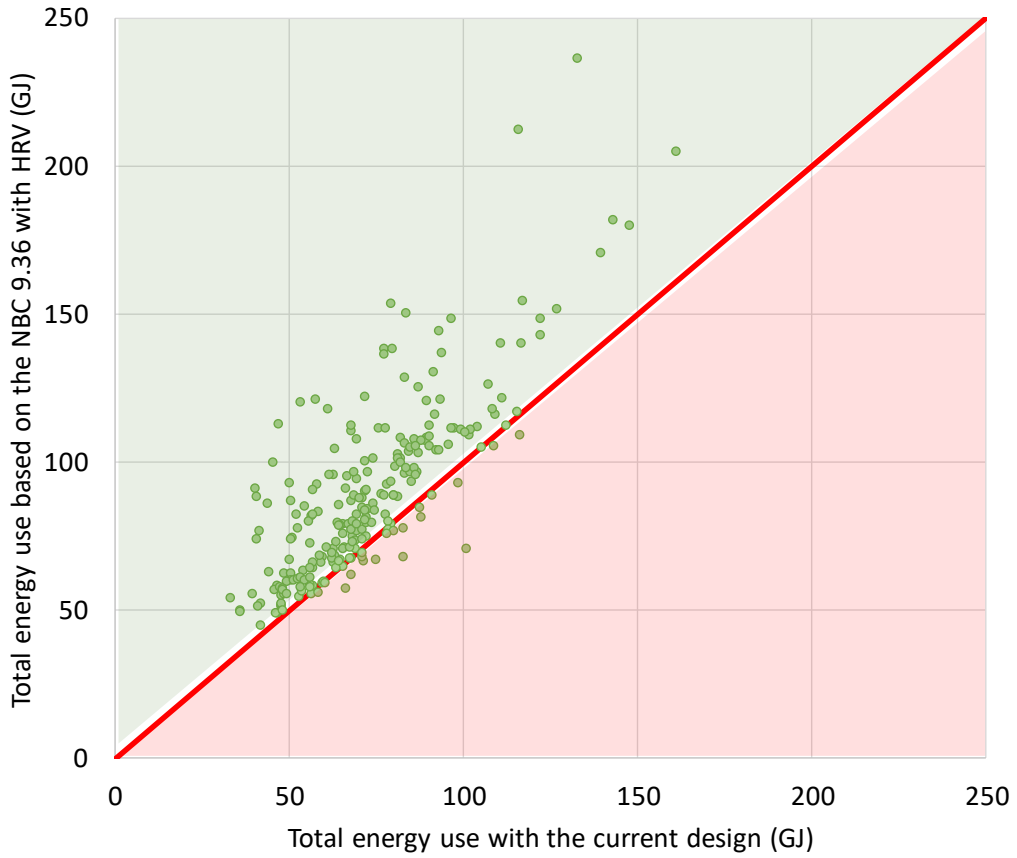

Figure 7. Total annual energy use of archetypes based on the current design vs. the NBC 9.36 requirements

Figure 6 and Figure 7 provide the heating energy and total energy use of archetypes for the current design and NBC 9.36 requirements. The red diagonal lines illustrate the code built house energy use. The dots in the green area indicate that the energy use of the archetype with the current design is less than its NBC 9.36 code reference house. Similarly, the dots in the red area indicate that the archetype use more energy than a code built house. It is expected that all archetypes fall in the green region. However, HTAP ruleset currently applies the requirements of national building code and neglect the regional differences in code requirements. Therefore, some archetypes fall in the red region due to differences in local codes compared to the NBC.

In prior analysis with the NRCan 11 archetypes, reviewers expressed concern that the homes were not designed to achieve low-energy performance. These reviewers concluded that cost impacts estimates obtained using the NRCan 11 archetypes were too high, and that lower cost impacts

would be achieved if the archetypes were redesigned according to passive-solar and energy efficiency principles.

The merits of this debate aside, these results shows the archetypes represent a wide range of as-built performance. The majority of the archetypes have as-built performance near, or slightly better than, the energy requirements of the NBC 9.36; the archetype set also contains homes with as-built performance approaching or exceeding Net-Zero Ready and Passive House levels. These characteristics suggest that they are suitable for use in designing next generation codes.

6. Conclusion

The Pan-Canadian Framework mandates Net-Zero Energy Ready performance for the next generation of building codes in Canada. This requires a significant shift from the way that people design, build, and operate residential buildings across Canada. The impact of many of the advanced technologies and construction practices on energy savings, GHG emissions reduction, and costs are not well understood within the building industry. Therefore, comprehensive analysis is required for the development of the new building codes. In addition, the Pan-Canadian Framework specified that the new building codes should consider the regional differences of building stocks into account. This aspect of the new building codes will further encourage the local authorities to adopt the new building codes.

To support these efforts, NRCan developed a new set of 240 housing archetypes, representing detached and double/row new construction in major Canadian markets. These archetypes were selected from actual homes built in Canada between 2015-2018, and their characteristics reflect regional variations between major Canadian housing markets.

Data sources for these archetypes include the EnerGuide for Housing Database, the CMHC Housing Market Database, and the Novoclimat database. In three regions (Quebec, Greater Toronto Area, and North/East Ontario), these data sources did not have sufficient records to develop the archetypes. NRCan proposed a “proxy-house” methodology that identified an archetype from anther region for use in these locations. While the proxy-house approach introduces significant uncertainty into the as-built characteristics (such as wall assemblies and

heating equipment) of the archetypes, this error will be of limited consequence in new-construction code analysis — where those parameters are reset to an NBC baseline.

NRCan's Housing Technology Assessment Platform (HTAP) was used for the analysis of the new archetypes. Results indicate that the new archetypes include a wider range of characteristics of housing stocks in different regions. Special forms of housing exists in the new archetypes, which enables the researchers to estimate the impact of energy efficiency measures in various house forms. For example, the thermal energy demand intensity (TEDI) of new archetypes show that some of those archetypes approach the TEDI requirement of a Passive House. Selection of archetypes from the actual built houses reduced the risk of adopting an archetype, which does not represent common construction practices across Canada.

Finally, the methodology that NRCan used for the development of the new archetypes provides the tools required to regularly update the new archetypes in future.

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Appendix A. Characteristics of Archetypes

Housing market	House type	Archetype	Foundation type	Floor area (m^2)	Ceiling type	Weather locale	No of storeys	Glazing ratio
AT	SD	ERS-1552	Basement	262	Attic/gable	MONCTON	2	0.08
		ERS-1553	Basement	213	Attic/gable	MONCTON	1	0.13
		ERS-1558	Basement	231	Attic/hip	MONCTON	2	0.15
		ERS-1575	Basement	410	Attic/gable	HALIFAX	2	0.20
		ERS-1576	Basement	275	Attic/gable	HALIFAX	1	0.15
		ERS-1586	Slab	187	Attic/gable	GREENWOOD	1	0.09
		ERS-1587	Basement	245	Cathedral	TRURO	1	0.19
		ERS-1599	Slab	155	Attic/gable	Greenwood	1	0.10
		ERS-1602	Slab	119	Attic/gable	GREENWOOD	1	0.08
		ERS-1603	Basement	145	Scissor	HALIFAX	1	0.16
		ERS-1607	Basement	255	Cathedral	HALIFAX	2	0.19
		ERS-1622	Basement	329	Attic/gable	GREENWOOD	2	0.11
		ERS-1623	Basement	236	Scissor	SYDNEY	1	0.19
		ERS-1654	Basement	212	Attic/gable	CHARLOTTETOWN	1	0.13
		ERS-1658	Crawl	100	Attic/gable	HALIFAX	1	0.12
	DR	ERS-1562	Basement	178	Attic/gable	MONCTON	2	0.14
		ERS-1563	Basement	178	Attic/gable	MONCTON	2	0.14
		ERS-1572	Slab	91	Attic/hip	GREENWOOD	1	0.12
		ERS-1573	Slab	91	Attic/hip	GREENWOOD	1	0.12
		ERS-1582	Slab	65	Attic/gable	TRURO	1	0.13
		ERS-1584	Slab	65	Attic/gable	TRURO	1	0.12
		ERS-1605	Slab	79	Attic/gable	SYDNEY	1	0.08
		ERS-1606	Slab	79	Attic/gable	SYDNEY	1	0.08
		ERS-1610	Slab	119	Attic/hip	GREENWOOD	1	0.14
		ERS-1611	Slab	119	Attic/hip	GREENWOOD	1	0.14
		ERS-1639	Slab	125	Attic/gable	GREENWOOD	1	0.11
		ERS-4764	Basement	280	Attic/gable	FREDERICTON	1	0.15
		ERS-4765	Basement	280	Attic/gable	FREDERICTON	1	0.15
		ERS-4766	Basement	289	Attic/gable	FREDERICTON	1	0.18
		ERS-4768	Basement	282	Attic/gable	FREDERICTON	1	0.14
QC	SD	ERS-1367	Basement	234	Attic/hip	MONTREAL	2	0.13
		ERS-1433	Basement	239	Attic/hip	MONTREAL	2	0.10
		ERS-2074	Basement	310	Attic/hip	MONTREAL	2	0.13
		ERS-2079	Basement	198	Attic/gable	MONTREAL	2	0.14
		ERS-2122	Basement	200	Attic/gable	MONTREAL	2	0.10
		ERS-2311	Basement	215	Attic/gable	MONTREAL	2	0.11
		ERS-2591	Basement	228	Attic/hip	MONTREAL	2	0.14

Housing market	House type	Archetype	Foundation type	Floor area (m^2)	Ceiling type	Weather locale	No of storeys	Glazing ratio
		ERS-3188	Basement	264	Attic/hip	MONTREAL	2	0.11
		ERS-3415	Basement	270	Attic/hip	MONTREAL	2	0.13
		ERS-3822	Basement	288	Attic/gable	MONTREAL	2	0.12
		ERS-6823	Basement	210	Attic/gable	MONTREAL	2	0.13
		ERS-7073	Basement	337	Attic/hip	MONTREAL	2	0.13
		ERS-7153	Basement	265	Attic/hip	MONTREAL	2	0.12
		ERS-7319	Basement	260	Attic/gable	MONTREAL	2	0.12
		ERS-7528	Basement	272	Attic/hip	MONTREAL	2	0.12
	DR	ERS-1312	Basement	212	Attic/gable	MONTREAL	2	0.13
		ERS-1337	Basement	202	Attic/hip	MONTREAL	2	0.09
		ERS-2512	Basement	217	Attic/hip	MONTREAL	2	0.13
		ERS-2548	Basement	194	Attic/hip	MONTREAL	2	0.11
		ERS-2704	Basement	192	Attic/hip	MONTREAL	2	0.22
		ERS-2827	Basement	190	Attic/hip	MONTREAL	2	0.17
		ERS-3137	Slab	187	Attic/gable	MONTREAL	2	0.16
		ERS-6637	Basement	227	Attic/hip	MONTREAL	2	0.16
		ERS-6711	Basement	198	Attic/gable	MONTREAL	2	0.10
		ERS-6758	Basement	199	Attic/hip	MONTREAL	2	0.10
		ERS-6791	Basement	203	Attic/gable	MONTREAL	2	0.14
		ERS-6857	Basement	195	Attic/hip	MONTREAL	2	0.11
		ERS-6910	Basement	224	Attic/gable	MONTREAL	2	0.14
		ERS-7023	Basement	193	Attic/hip	MONTREAL	2	0.11
		ERS-7032	Basement	192	Attic/hip	MONTREAL	2	0.14
GTA	SD	ERS-1407	Basement	247	Attic/gable	TORONTO	2	0.12
		ERS-3196	Basement	291	Attic/gable	TORONTO	2	0.14
		ERS-3248	Basement	287	Attic/gable	TORONTO	2	0.14
		ERS-3286	Basement	283	Attic/gable	TORONTO	2	0.13
		ERS-4040	Basement	211	Attic/hip	LONDON	1	0.09
		ERS-4041	Basement	308	Attic/gable	TORONTOMETRESSTN	2	0.16
		ERS-4042	Basement	387	Attic/gable	LONDON	2	0.13
		ERS-4043	Basement	82	Attic/gable	TORONTOMETRESSTN	1	0.13
		ERS-4044	Basement	82	Attic/gable	TORONTOMETRESSTN	1	0.13
		ERS-4046	Basement	320	Attic/hip	LONDON	1	0.15
		ERS-4047	Basement	122	Attic/hip	LONDON	1	0.12
		ERS-4386	Walkout	319	Attic/gable	TORONTO	1	0.19
		ERS-6494	Basement	199	Flat	TORONTOMETRESSTN	2	0.18
		ERS-6677	Basement	208	Attic/gable	TORONTO	2	0.09
		ERS-7134	Basement	227	Attic/gable	TORONTO	2	0.10
	DR	ERS-1344	Basement	180	Attic/hip	TORONTO	2	0.19

Housing market	House type	Archetype	Foundation type	Floor area (m^2)	Ceiling type	Weather locale	No of storeys	Glazing ratio
		ERS-1548	Basement	198	Attic/gable	TORONTO	2	0.12
		ERS-1660	Basement	220	Attic/gable	TORONTOMETRESSTN	2	0.15
		ERS-2066	Slab	119	Attic/hip	TORONTO	3	0.13
		ERS-2183	Basement	175	Attic/hip	TORONTO	2	0.17
		ERS-2925	Basement	135	Attic/hip	TORONTO	3	0.14
		ERS-3060	Basement	155	Attic/gable	TORONTO	2	0.12
		ERS-3082	Basement	208	Attic/hip	TORONTO	2	0.11
		ERS-3850	Basement	208	Attic/hip	TORONTO	2	0.12
		ERS-3908	Basement	181	Attic/hip	TORONTO	2	0.13
		ERS-3916	Basement	146	Attic/gable	TORONTO	2	0.18
		ERS-3967	Basement	181	Attic/hip	TORONTO	2	0.13
		ERS-3997	Basement	169	Attic/hip	TORONTO	2	0.12
		ERS-4001	Basement	161	Attic/hip	TORONTO	2	0.12
		ERS-8076	Basement	170	Attic/gable	TORONTO	2	0.24
ON	SD	ERS-1541	Basement	193	Attic/gable	OTTAWA	2	0.08
		ERS-1634	Slab	299	Attic/gable	OTTAWA	1	0.19
		ERS-2891	Basement	209	Attic/hip	OTTAWA	2	0.09
		ERS-3394	Basement	265	Attic/hip	OTTAWA	2	0.14
		ERS-3618	Basement	170	Attic/gable	OTTAWA	2	0.10
		ERS-4004	Basement	194	Attic/hip	OTTAWA	2	0.10
		ERS-4523	Walkout	299	Attic/gable	OTTAWA	2	0.11
		ERS-4540	Walkout	212	Attic/gable	OTTAWA	2	0.11
		ERS-6609	Basement	278	Attic/hip	OTTAWA	2	0.10
		ERS-6735	Basement	255	Attic/hip	OTTAWA	2	0.10
		ERS-7027	Basement	225	Attic/hip	OTTAWA	2	0.10
		ERS-7056	Basement	274	Attic/hip	OTTAWA	2	0.11
		ERS-7345	Basement	265	Attic/hip	OTTAWA	2	0.13
		ERS-7418	Basement	330	Attic/hip	OTTAWA	2	0.10
		ERS-7520	Basement	263	Attic/hip	OTTAWA	2	0.12
	DR	ERS-1210	Basement	186	Attic/gable	OTTAWA	2	0.11
		ERS-1211	Basement	186	Attic/gable	OTTAWA	2	0.11
		ERS-1261	Basement	193	Attic/gable	OTTAWA	2	0.11
		ERS-2133	Basement	182	Attic/hip	OTTAWA	2	0.14
		ERS-2213	Basement	182	Attic/hip	OTTAWA	2	0.12
		ERS-2638	Basement	162	Attic/hip	OTTAWA	2	0.12
		ERS-2880	Basement	155	Attic/hip	OTTAWA	2	0.11
		ERS-3049	Basement	68	Attic/hip	OTTAWA	1	0.10
		ERS-3389	Basement	189	Attic/hip	OTTAWA	2	0.09
		ERS-3745	Basement	164	Attic/gable	OTTAWA	2	0.12

Housing market	House type	Archetype	Foundation type	Floor area (m^2)	Ceiling type	Weather locale	No of storeys	Glazing ratio
		ERS-3829	Basement	131	Attic/hip	OTTAWA	3	0.16
		ERS-4111	Slab	116	Attic/gable	OTTAWA	3	0.18
		ERS-4121	Slab	116	Attic/gable	OTTAWA	3	0.12
		ERS-4176	Slab	105	Attic/gable	OTTAWA	3	0.19
		ERS-7481	Basement	192	Attic/gable	OTTAWA	2	0.11
PR	SD	ERS-1200	Basement	354	Cathedral	EDMONTON	3	0.12
		ERS-1363	Basement	273	Scissor	EDMONTON	2	0.13
		ERS-1631	Basement	329	Flat	CALGARY	2	0.28
		ERS-2185	Basement	373	Attic/hip	EDMONTON	2	0.23
		ERS-2721	Basement	308	Attic/hip	EDMONTON	2	0.11
		ERS-2852	Basement	271	Attic/hip	EDMONTON	2	0.11
		ERS-6771	Basement	230	Scissor	CALGARY	2	0.10
		ERS-7064	Slab	271	Attic/gable	CALGARY	2	0.11
		ERS-7237	Basement	364	Attic/gable	CALGARY	2	0.15
		ERS-7337	Basement	232	Scissor	CALGARY	1	0.19
		ERS-7490	Basement	407	Flat	CALGARY	2	0.21
		ERS-7496	Basement	219	Cathedral	CALGARY	3	0.07
		ERS-7497	Basement	219	Cathedral	CALGARY	3	0.07
		ERS-7529	Slab	331	Attic/gable	CALGARY	2	0.17
		ERS-8085	Slab	259	Attic/gable	CALGARY	2	0.12
	DR	ERS-1187	Slab	135	Cathedral	SASKATOON	3	0.15
		ERS-1409	Basement	205	Attic/hip	EDMONTON	2	0.14
		ERS-1470	Basement	205	Attic/hip	EDMONTON	2	0.14
		ERS-2272	Basement	239	Scissor	EDMONTON	1	0.21
		ERS-2921	Basement	132	Attic/gable	EDMONTON	2	0.11
		ERS-2996	Basement	201	Attic/hip	EDMONTON	2	0.12
		ERS-3142	Slab	204	Scissor	CALGARY	3	0.16
		ERS-3144	Slab	216	Attic/gable	CALGARY	3	0.18
		ERS-3152	Slab	133	Cathedral	CALGARY	3	0.20
		ERS-3154	Slab	204	Scissor	CALGARY	3	0.16
		ERS-3157	Slab	155	Cathedral	CALGARY	3	0.19
		ERS-3510	Slab	121	Flat	CALGARY	3	0.17
		ERS-3529	Slab	153	Flat	CALGARY	3	0.22
		ERS-3552	Slab	108	Flat	CALGARY	3	0.20
		ERS-7224	Slab	126	Attic/hip	CALGARY	3	0.15
BC-Int	SD	ERS-1690	Basement	324	Flat	KAMLOOPS	3	0.21
		ERS-1691	Slab	275	Attic/hip	KAMLOOPS	1	0.14
		ERS-1727	Walkout	294	Attic/hip	Kamloops	1	0.24
		ERS-1729	Walkout	242	Attic/hip	Kamloops	1	0.18

Housing market	House type	Archetype	Foundation type	Floor area (m^2)	Ceiling type	Weather locale	No of storeys	Glazing ratio
		ERS-1782	Basement	105	Scissor	CRANBROOK	1	0.16
		ERS-1785	Basement	172	Scissor	CRANBROOK	2	0.10
		ERS-1792	Basement	241	Scissor	CRANBROOK	1	0.17
		ERS-1795	Slab	147	Cathedral	CRANBROOK	2	0.20
		ERS-4849	Slab	236	Attic/hip	SUMMERLAND	2	0.15
		ERS-4892	Basement	245	Flat	Summerland	2	0.29
		ERS-6481	Basement	204	Cathedral	CRANBROOK	2	0.20
		ERS-6485	Walkout	222	Attic/hip	Comox	1	0.17
		ERS-7767	Crawl	394	Cathedral	WHISTLER	2	0.20
		ERS-7827	Basement	311	Flat	Whistler	1	0.29
		ERS-8020	Crawl	205	Attic/gable	COMOX	2	0.16
	DR	ERS-4863	Basement	159	Attic/gable	SUMMERLAND	2	0.30
		ERS-4865	Slab	158	Attic/gable	SUMMERLAND	3	0.20
		ERS-4867	Slab	156	Attic/gable	SUMMERLAND	3	0.15
		ERS-4874	Basement	155	Attic/hip	SUMMERLAND	2	0.22
		ERS-4875	Basement	156	Attic/hip	SUMMERLAND	2	0.33
		ERS-4876	Basement	156	Attic/hip	SUMMERLAND	2	0.33
		ERS-4877	Basement	155	Attic/hip	SUMMERLAND	2	0.22
		ERS-4879	Slab	158	Attic/gable	SUMMERLAND	3	0.19
		ERS-4894	Basement	230	Attic/hip	KAMLOOPS	1	0.16
		ERS-4903	Slab	145	Flat	Summerland	3	0.15
		ERS-4904	Slab	146	Flat	Summerland	3	0.19
		ERS-4906	Slab	145	Flat	Summerland	3	0.15
		ERS-4910	Slab	145	Flat	Summerland	3	0.19
		ERS-6480	Basement	252	Attic/gable	CRANBROOK	1	0.15
		ERS-6483	Basement	252	Attic/gable	CRANBROOK	1	0.15
BC-LM	SD	ERS-1734	Basement	348	Flat	VANCOUVER	2	0.28
		ERS-1885	Slab	99	Scissor	VANCOUVER	1	0.10
		ERS-1919	Slab	62	Flat	VANCOUVER	2	0.08
		ERS-1970	Crawl	268	Attic/hip	VICTORIA	2	0.14
		ERS-2001	Slab	238	Attic/gable	VICTORIA	2	0.11
		ERS-4943	Slab	98	Cathedral	VANCOUVER	1	0.09
		ERS-4998	Crawl	175	Scissor	VANCOUVER	2	0.13
		ERS-5099	Basement	356	Attic/gable	VANCOUVER	2	0.21
		ERS-5213	Basement	226	Attic/gable	VANCOUVER	2	0.18
		ERS-5856	Slab	57	Cathedral	Vancouver	1	0.09
		ERS-5947	Crawl	105	Attic/hip	VANCOUVER	2	0.09
		ERS-5976	Basement	252	Flat	VANCOUVER	2	0.29
		ERS-7668	Basement	66	Cathedral	Vancouver	2	0.09

Housing market	House type	Archetype	Foundation type	Floor area (m^2)	Ceiling type	Weather locale	No of storeys	Glazing ratio
		ERS-7856	Basement	247	Scissor	VANCOUVER	2	0.27
		ERS-7958	Crawl	307	Attic/hip	VICTORIA	2	0.21
	DR	ERS-2015	Crawl	119	Flat	VICTORIA	2	0.14
		ERS-4842	Basement	94	Cathedral	VANCOUVER	2	0.11
		ERS-5105	Slab	74	Attic/gable	VANCOUVER	2	0.11
		ERS-5107	Crawl	140	Attic/hip	VANCOUVER	2	0.11
		ERS-5999	Slab	104	Attic/gable	Vancouver	2	0.13
		ERS-6078	Crawl	106	Attic/gable	VANCOUVER	2	0.12
		ERS-6212	Slab	97	Flat	VANCOUVER	2	0.22
		ERS-7740	Slab	111	Cathedral	VANCOUVER	3	0.12
		ERS-7747	Slab	118	Flat	VANCOUVER	3	0.08
		ERS-7749	Slab	113	Attic/gable	VANCOUVER	3	0.09
		ERS-7787	Slab	121	Cathedral	VANCOUVER	2	0.15
		ERS-7804	Crawl	122	Attic/gable	VANCOUVER	2	0.14
		ERS-7934	Basement	149	Scissor	VANCOUVER	2	0.14
		ERS-7972	Basement	409	Scissor	Vancouver	2	0.11
		ERS-7973	Basement	165	Scissor	Vancouver	2	0.20
North	SD	ERS-1001	Basement	225	Scissor	WHITEHORSE	2	0.11
		ERS-1003	Crawl	187	Attic/gable	WHITEHORSE	2	0.19
		ERS-1022	Crawl	309	Attic/gable	WHITEHORSE	2	0.06
		ERS-1048	Basement	212	Attic/gable	WHITEHORSE	1	0.18
		ERS-1050	Basement	255	Scissor	WHITEHORSE	2	0.17
		ERS-1052	Basement	279	Attic/gable	WHITEHORSE	2	0.10
		ERS-1062	Basement	312	Attic/gable	WHITEHORSE	2	0.08
		ERS-1064	Crawl	132	Attic/gable	WHITEHORSE	1	0.14
		ERS-1073	Basement	246	Attic/gable	WHITEHORSE	2	0.09
		ERS-1083	Slab	140	Attic/gable	WHITEHORSE	1	0.10
		ERS-1127	Basement	95	Cathedral	WHITEHORSE	1	0.27
		ERS-1132	Basement	163	Cathedral	WHITEHORSE	1	0.11
		ERS-1134	Basement	381	Scissor	WHITEHORSE	2	0.20
		ERS-1146	Slab	137	Attic/gable	WHITEHORSE	2	0.16
		ERS-1626	Slab	176	Cathedral	YELLOWKNIFE	1	0.15
	DR	ERS-1014	Crawl	143	Attic/gable	WHITEHORSE	2	0.13
		ERS-1015	Crawl	144	Attic/gable	WHITEHORSE	2	0.13
		ERS-1016	Crawl	220	Attic/gable	WHITEHORSE	1	0.13
		ERS-1024	Basement	240	Attic/gable	WHITEHORSE	2	0.07
		ERS-1029	Basement	276	Attic/gable	WHITEHORSE	2	0.09
		ERS-1032	Basement	276	Attic/gable	WHITEHORSE	2	0.09
		ERS-1033	Basement	276	Attic/gable	WHITEHORSE	2	0.09

Housing market	House type	Archetype	Foundation type	Floor area (m^2)	Ceiling type	Weather locale	No of storeys	Glazing ratio
		ERS-1035	Basement	276	Attic/gable	WHITEHORSE	2	0.05
		ERS-1037	Basement	276	Attic/gable	WHITEHORSE	2	0.09
		ERS-1057	Basement	185	Attic/gable	WHITEHORSE	1	0.26
		ERS-1059	Basement	133	Attic/gable	WHITEHORSE	3	0.14
		ERS-1109	Basement	178	Attic/gable	WHITEHORSE	2	0.07
		ERS-1110	Basement	178	Attic/gable	WHITEHORSE	2	0.15
		ERS-1115	Basement	185	Scissor	WHITEHORSE	1	0.33
		ERS-1177	Basement	114	Attic/gable	WHITEHORSE	1	0.09