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Archetype development for existing houses

Review of methodology and preliminary results

March 26, 2020

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Key Points

- CE-O has developed 240 archetypes that reflect both contemporary housing trends and regional variation
  - Actual house from eight housing markets used for the development of new archetypes

- Vintage Archetypes for residential buildings (Part9)
  - Alteration of existing building code
  - Impact analysis of technologies for retrofit
  - Assessment of pathways for fuel switch and GHG reductions

Background

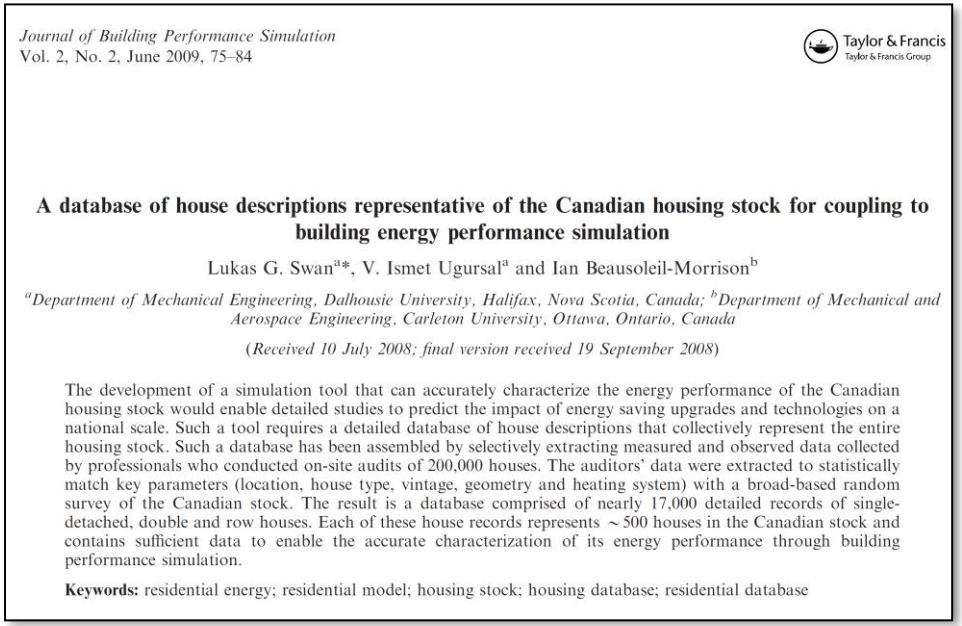
Prior Works

EnerGuide for Houses Database

- Over 200,000 requested home energy audits that were conducted from 1997 through 2006.
- The database is biased and unrepresentative of the CHS

Survey of Household Energy Use

- A housing survey which was designed to quantify the energy use characteristics of the CHS
- Limited parameters



Journal of Building Performance Simulation
Vol. 2, No. 2, June 2009, 75–84

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A database of house descriptions representative of the Canadian housing stock for coupling to building energy performance simulation

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(*Received 10 July 2008; final version received 19 September 2008*)

The development of a simulation tool that can accurately characterize the energy performance of the Canadian housing stock would enable detailed studies to predict the impact of energy saving upgrades and technologies on a national scale. Such a tool requires a detailed database of house descriptions that collectively represent the entire housing stock. Such a database has been assembled by selectively extracting measured and observed data collected by professionals who conducted on-site audits of 200,000 houses. The auditors' data were extracted to statistically match key parameters (location, house type, vintage, geometry and heating system) with a broad-based random survey of the Canadian stock. The result is a database comprised of nearly 17,000 detailed records of single-detached, double and row houses. Each of these house records represents ~500 houses in the Canadian stock and contains sufficient data to enable the accurate characterization of its energy performance through building performance simulation.

Keywords: residential energy; residential model; housing stock; housing database; residential database

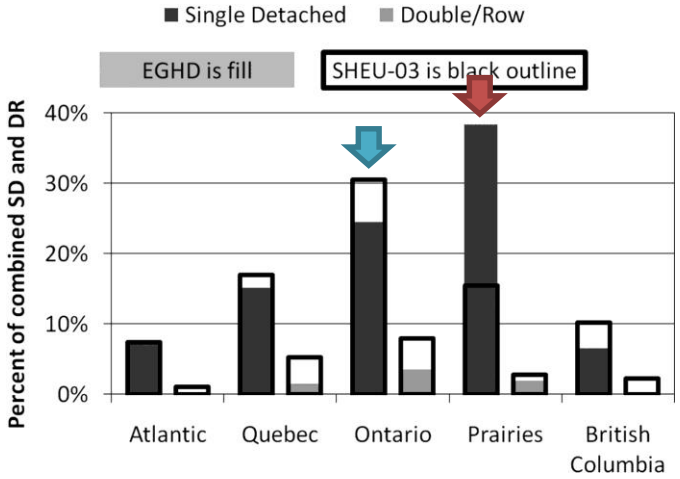
- Dalhousie University proposed an innovative approach to create a housing database based on the EGH which statistically represent the Canadian housing stock

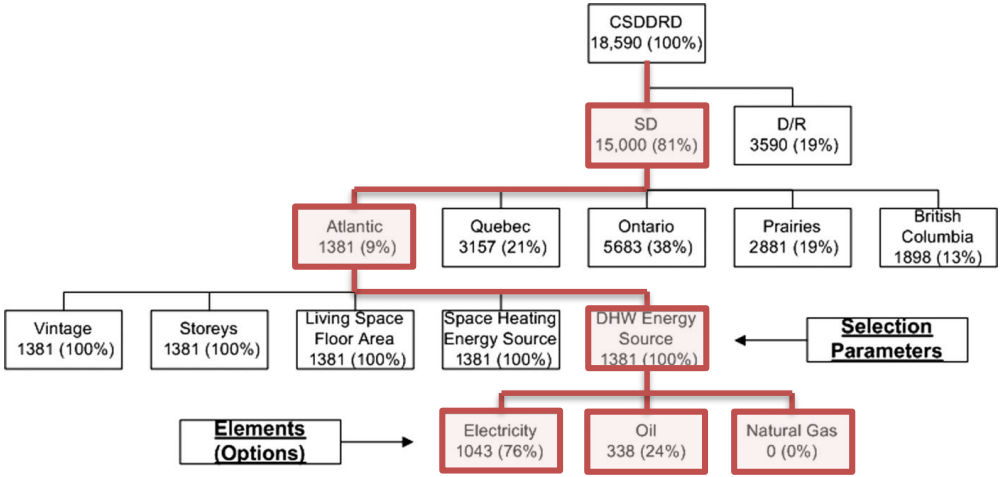
Canadian Single-Detached and Double/Row Housing Database (CSDDRD)

Prior Works

Why CSDDRD?

How CSDDRD was created?





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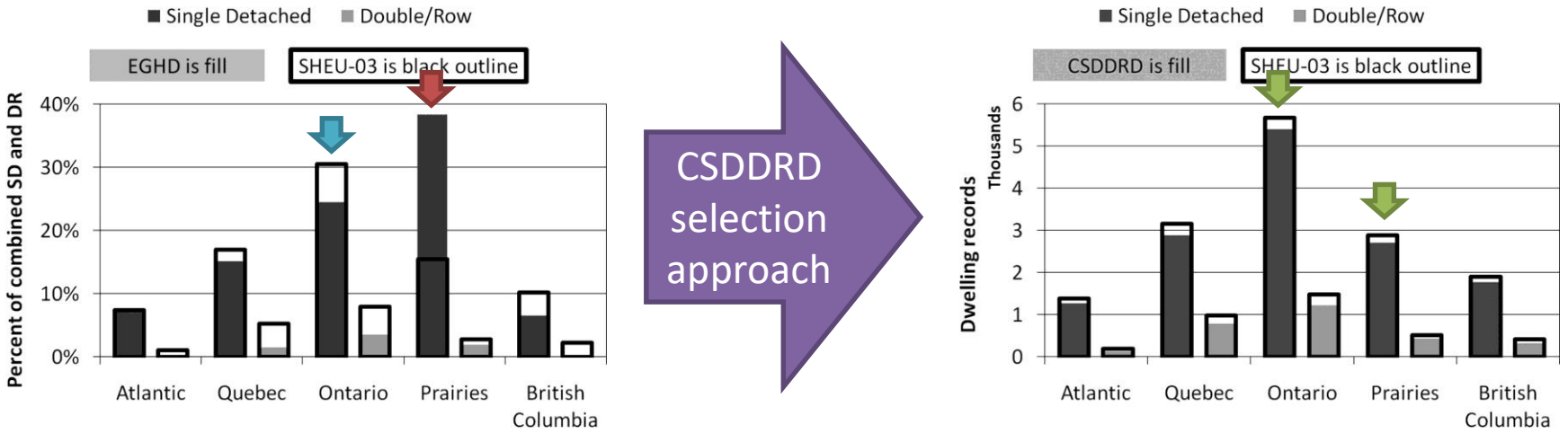
Prior Works

CSDDRD impact



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Vintage Archetypes for AEB Code

Key Questions

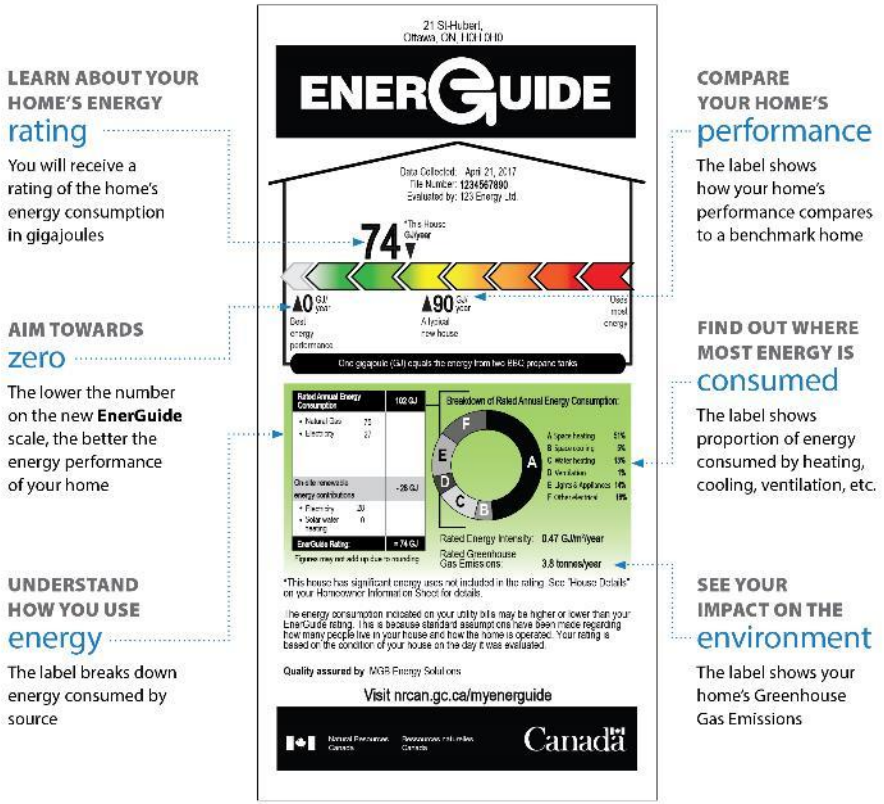
1. Can we use the CSDDRD method to select data for vintage housing archetypes?
2. Is the resulting set representative enough to give us enough confident in results?
3. What data gaps would we encounter and how we can address that?

Guiding Principles

- Selection parameters
  - House type
    - Detached
    - Attached
    - MURB
    - Mobile
  - Region
  - Vintage
  - Floor area
  - Storeys
  - Space heating fuel
  - DHW heating fuel

Guiding Principles

- Data sources
  - EnerGuide for housing database
  - SHEU2015
  - National Energy Use Database (NEUD)
  - Census2016
  - Statistics Canada. Table 25-10-0060-01 Household energy consumption, Canada and provinces



Guiding Principles

- Number of Archetypes
  - Simulation time
  - Scaling factor ~ 2000 for all regions except North
  - 100 Archetypes for the North

Data Availability

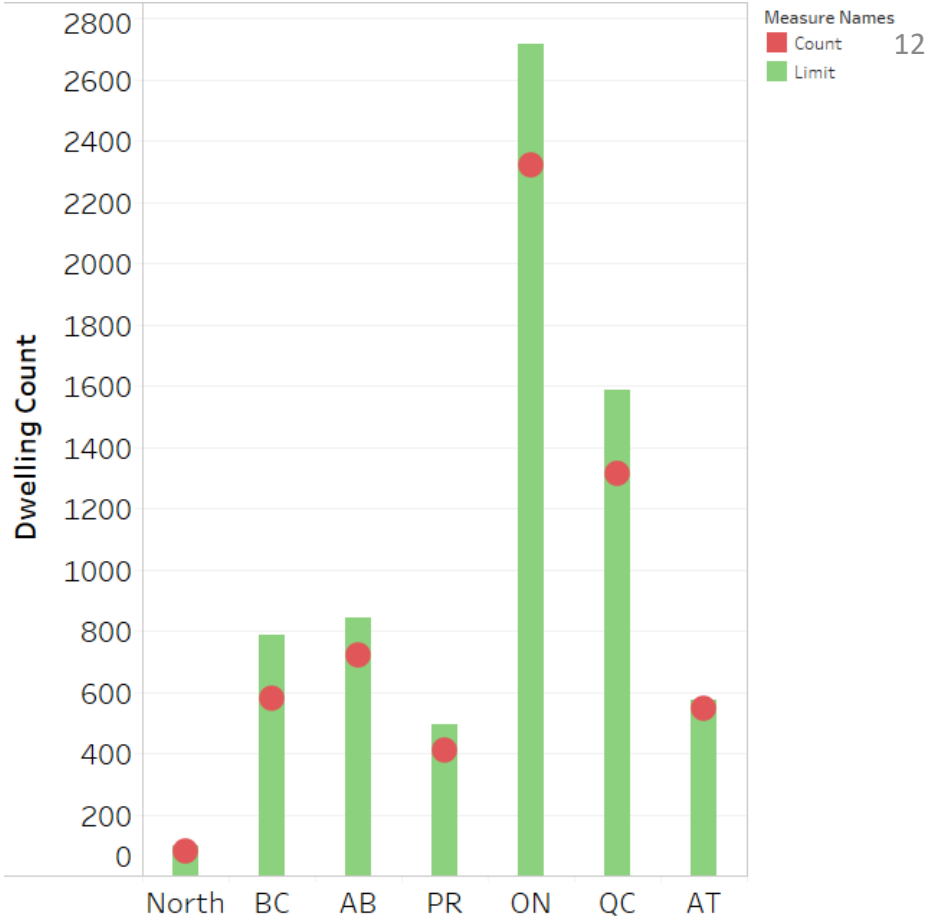
1.Green columns:

Number of required dwellings based on the SHEU2015

- SHEU has no data for Territories,
- NEUD was used for the North.

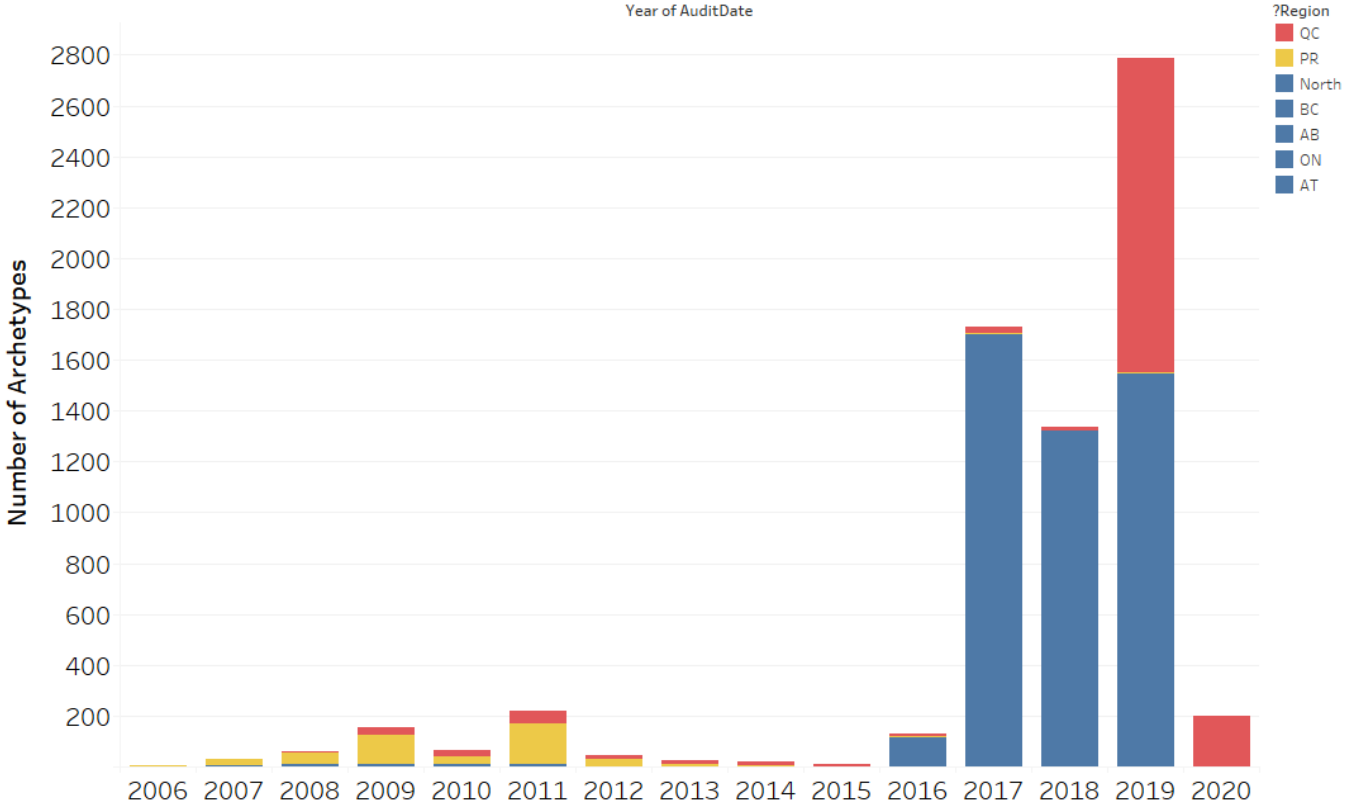
2.Red dots:

Number of selected archetypes.



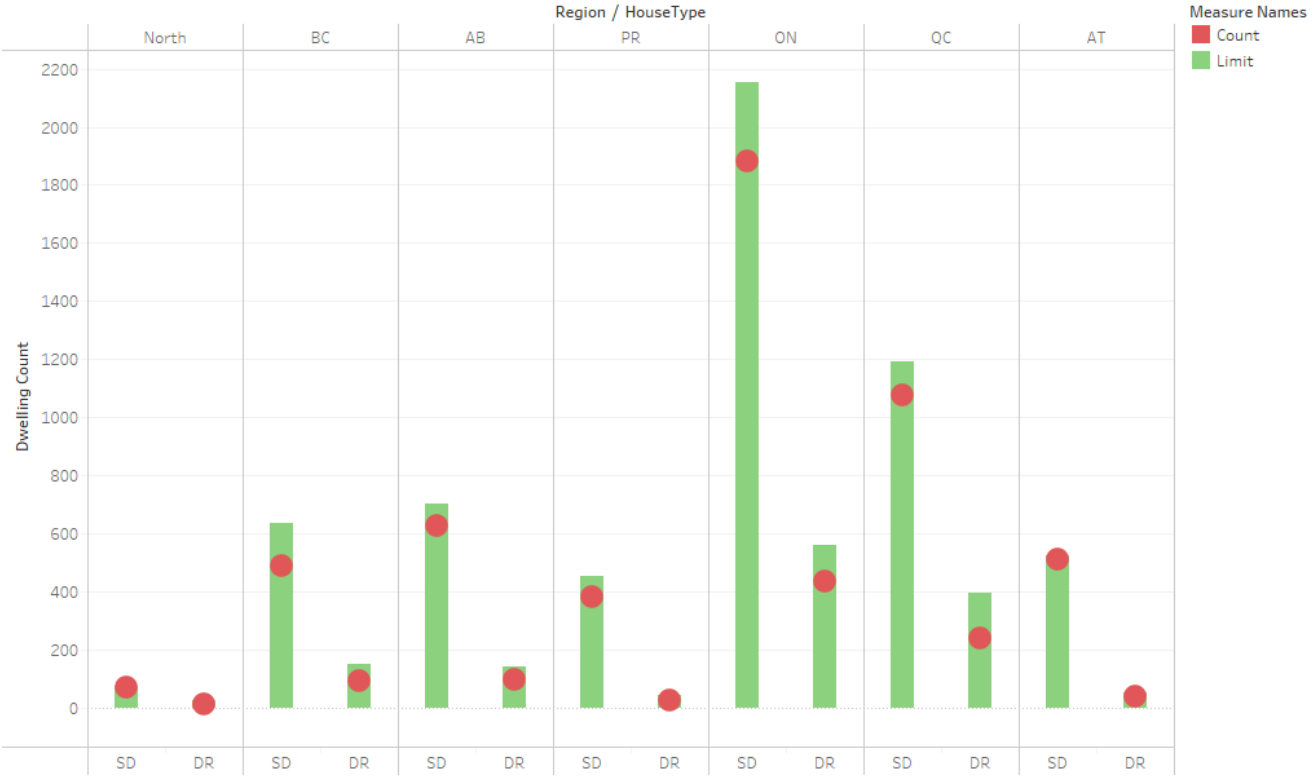
Data Availability

- Majority of archetypes were selected from recent audits



Results of Selection Algorithm

- House Type
  - SD: 5036
  - DR: 934
  - MURB: 367
  - Mobile: 472
- Need to revisit scaling factors

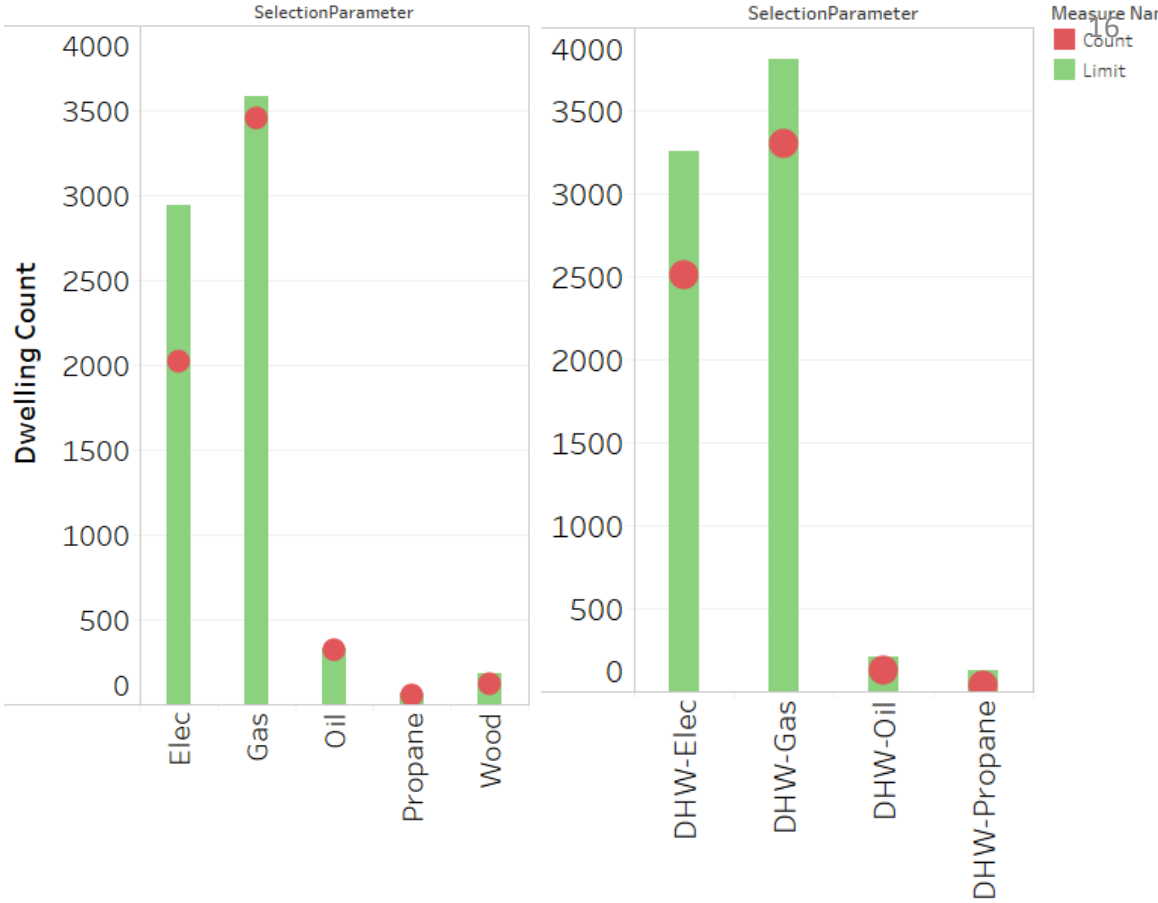


Results of Selection Algorithm

- Vintage
  - Reached the targets for most vintages
  - Lack of data for most recent constructions

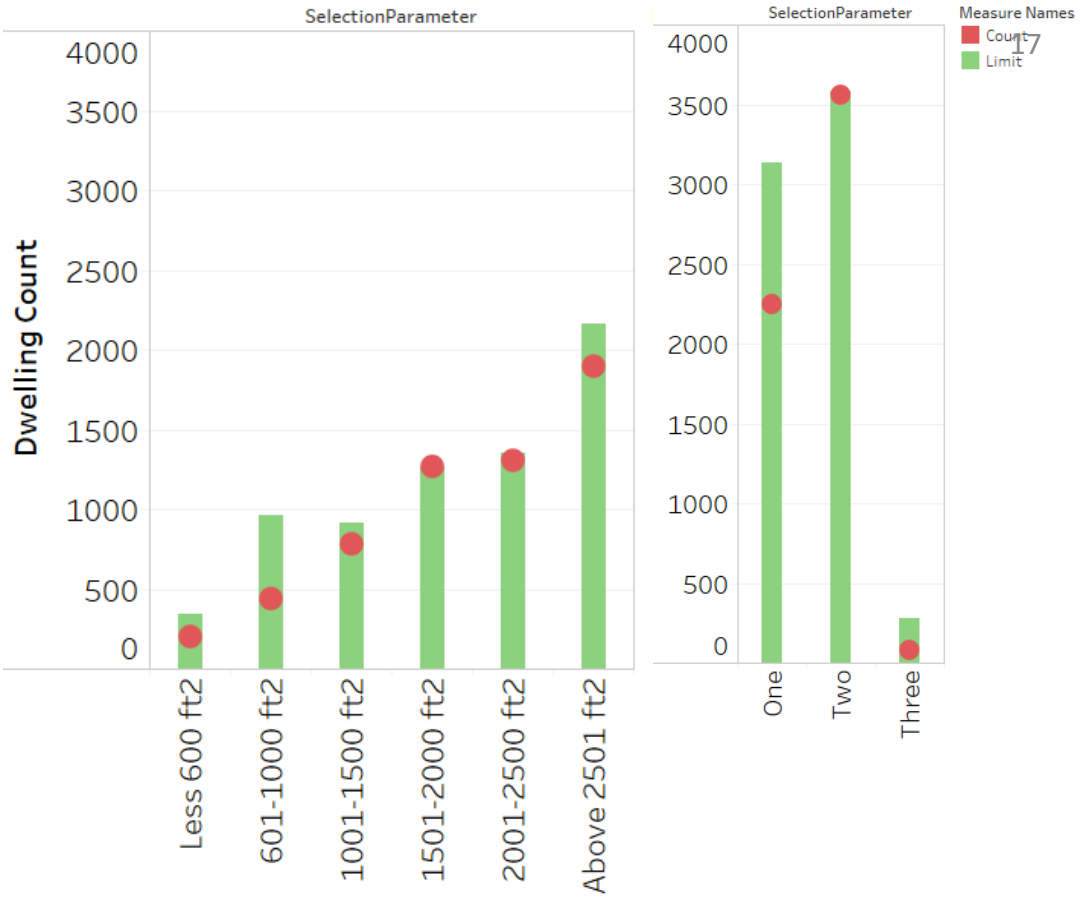
Results of Selection Algorithm

- Fuel source
  - Sufficient representation of less dominant fuel sources
  - Hybrid systems
  - Opportunity to investigate fuel switch



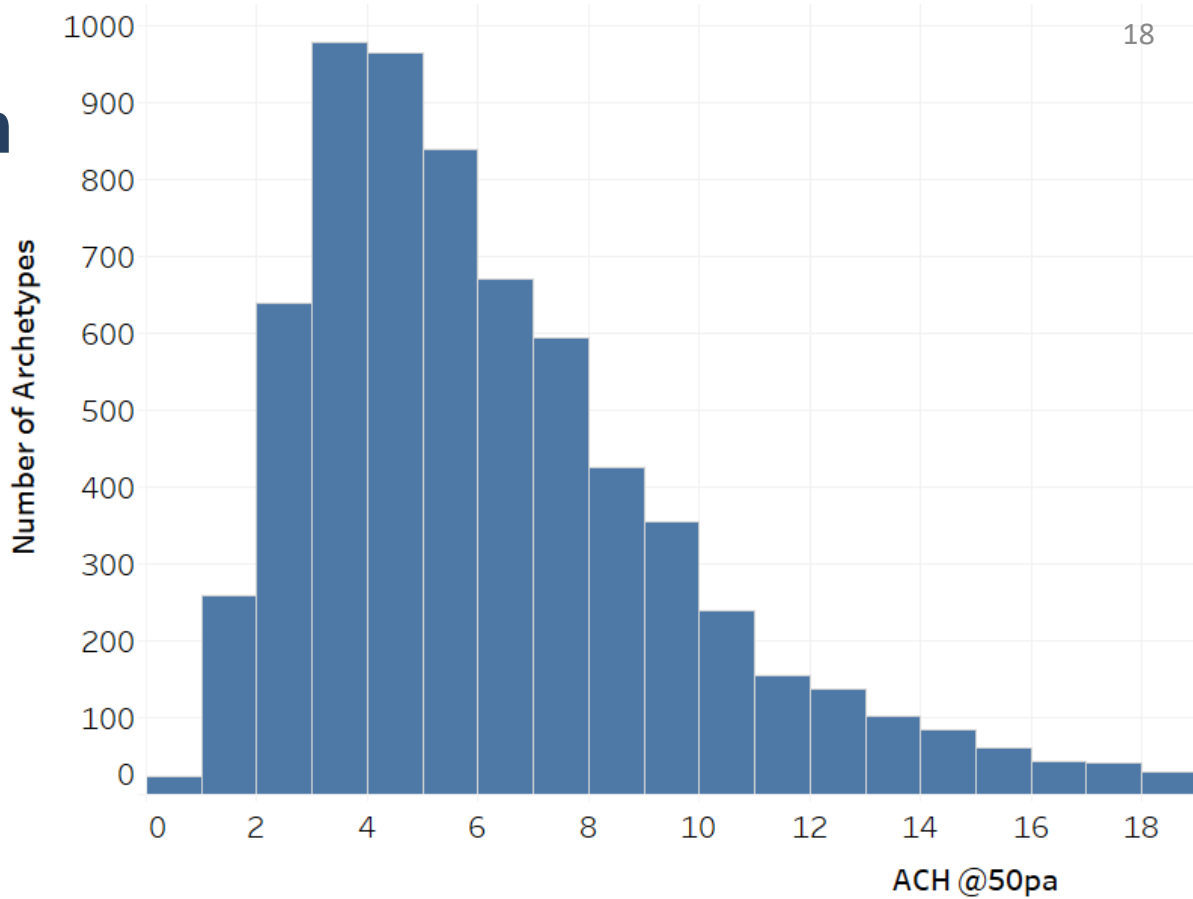
Results of Selection Algorithm

- Area
  - Bin sizes are selected based on the SHEU2015
- Storeys
  - Three storeys are the least common



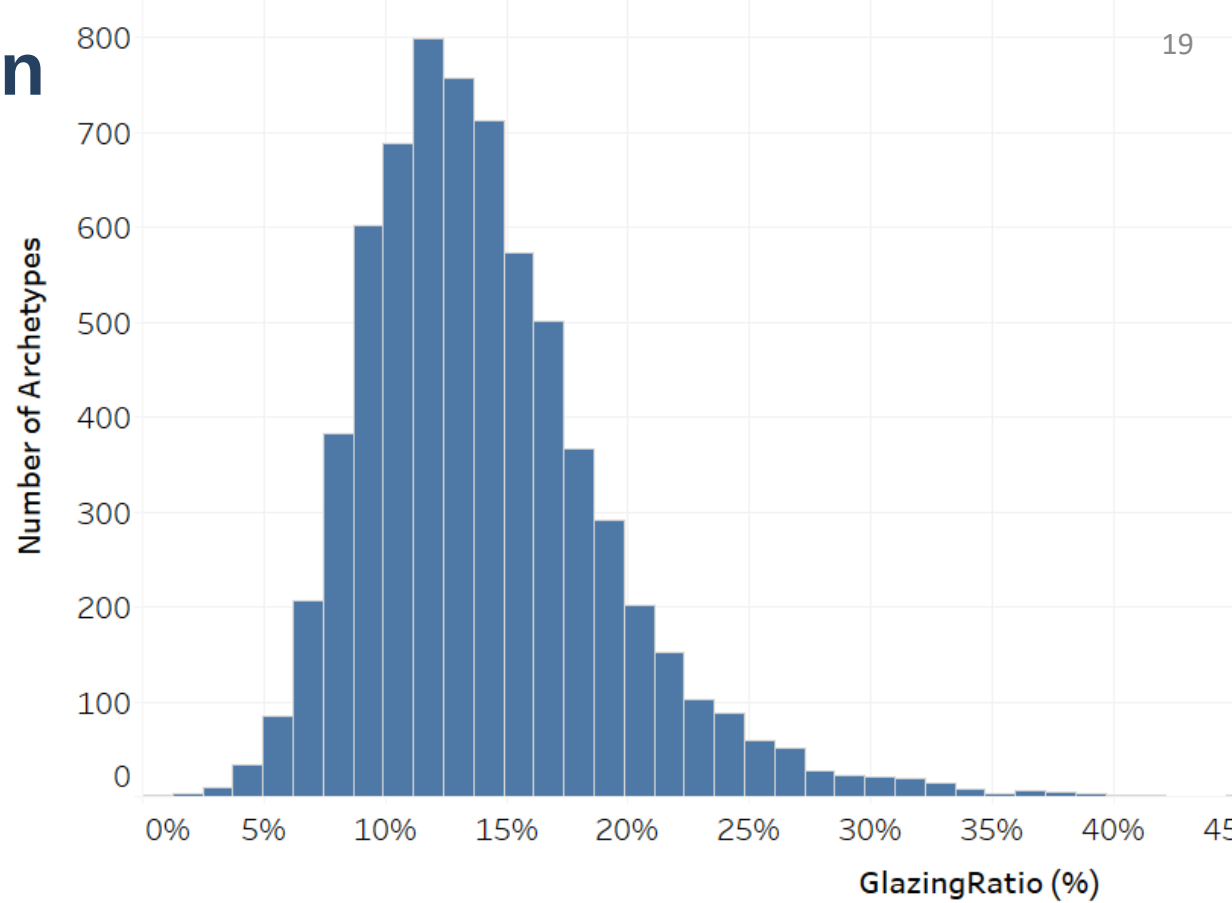
Results of Selection Algorithm

- Majority of archetypes are in the range of 2-10 ACH@50Pa
- Very leaky and very tight envelopes



Results of Selection Algorithm

- Wide range of glazing ratio
- Majority of houses have less glazing ratio than the reference house



Results of Selection Algorithm

- Summary of archetypes characteristics
- Parameters that were not part of selection process

	Region							Vintage								Type			
	North	BC	AB	PR	QC	ON	AT	Before 1946	1946-1960	1961-1977	1978-1983	1984-1995	1996-2000	2001-2010	After 2011	SD	DR	MURB	Mobile Home
Basement Presence (%)	46%	48%	95%	95%	95%	92%	52%	90%	89%	79%	79%	83%	85%	82%	68%	89%	90%	92%	4%
Crawl Presence (%)	34%	33%	6%	5%	5%	12%	41%	20%	12%	18%	15%	14%	12%	12%	21%	12%	5%	8%	80%
Slab Presence (%)	3%	29%	4%	3%	3%	3%	7%	6%	6%	6%	8%	6%	5%	5%	12%	6%	6%	6%	0%
Average Heated Floor Area (m^2)	175	206	221	198	205	214	156	214	183	172	186	236	221	222	180	210	178	307	87
Average Window Area (m^2)	18	29	22	16	24	21	17	22	20	19	20	24	24	24	23	23	17	33	12
Rural (%)	29%	13%	4%	29%	18%	13%	31%	22%	12%	20%	20%	13%	13%	15%	31%	18%	5%	6%	43%
Urban (%)	71%	87%	96%	71%	82%	87%	69%	78%	88%	80%	80%	87%	87%	85%	69%	82%	95%	94%	57%
Glazing Ratio (%)	13%	16%	14%	12%	17%	13%	13%	13%	15%	15%	14%	14%	14%	14%	15%	14%	15%	18%	11%
Average ACH @50pa	5.3	7.5	4.2	4.8	5.7	7.9	8.3	10.7	8.3	7.7	6.4	5.4	4.8	3.9	3	6.3	7.2	7.8	10.3

Validation

$$\omega_i = \frac{N_{arch,prov}}{N_{dwelling,prov}}$$

$$Ratio\ of\ Total\ Energy\ Use = \frac{\sum_i \omega_i E_{tot,i}}{Stat\ data}$$

- $N_{arch,prov}$→Number of archetypes in each province
- $N_{dwelling,prov}$→Number of dwellings in each province according to Census 2016
- ω_i→Weighting factor
- $E_{tot,i}$→Total energy use

	SHEU	STATCAN	NEUD
Canada	1.20	1.06	0.91
Newfoundland and Labrador	0.80		
Nova Scotia		1.14	0.87
Prince Edward Island		1.36	1.36
New Brunswick		1.27	0.88
Quebec	1.04	0.98	0.71
Ontario	1.27	1.14	1.00
Manitoba	7.06	1.27	1.23
Saskatchewan		1.43	1.38
Alberta	1.24	1.03	0.97
British Columbia	1.16	0.81	0.85
Territories		0.00	1.43

Answer to Key Questions

1. Can we use the CSDDRD method to select data for new housing archetypes?
2. Is the resulting set representative enough to give us enough confident in results?
3. What data gaps would we encounter and how we can address that?

Answer to Key Questions

1. Can we use the CSDDRD method to select data for new housing archetypes?
   - Yes, EnerGuide for housing database is available for selection of archetypes. SHEU2015 and Census2016 data is available for comparison of archetypes and to develop regional weighting factors.

Answer to Key Questions

2. Is the resulting set representative enough to give us enough confident in results?
   - Archetypes are selected based on an approved scientific approach. The resolution of archetypes are acceptable for an accurate analysis. Results of stock modeling show a reasonable agreement with other estimations of residential energy use.

Answer to Key Questions

3. What data gaps would we encounter and how we can address that?
   - Limited data availability in QC and PR region was addressed by converting older files to HTAP compatible format. Less data is available for MURBs and Mobile archetypes, but selected archetypes provide a range of designs that can be used in impact analysis of AEB code.

Discussion