Natural Resources Canada
Ressources naturelles Canada

Building Envelope Thermal and Air Leakage Characteristics of Canadian Housing

CCBST 2017
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CanmetENERGY
Leadership in ecoInnovation

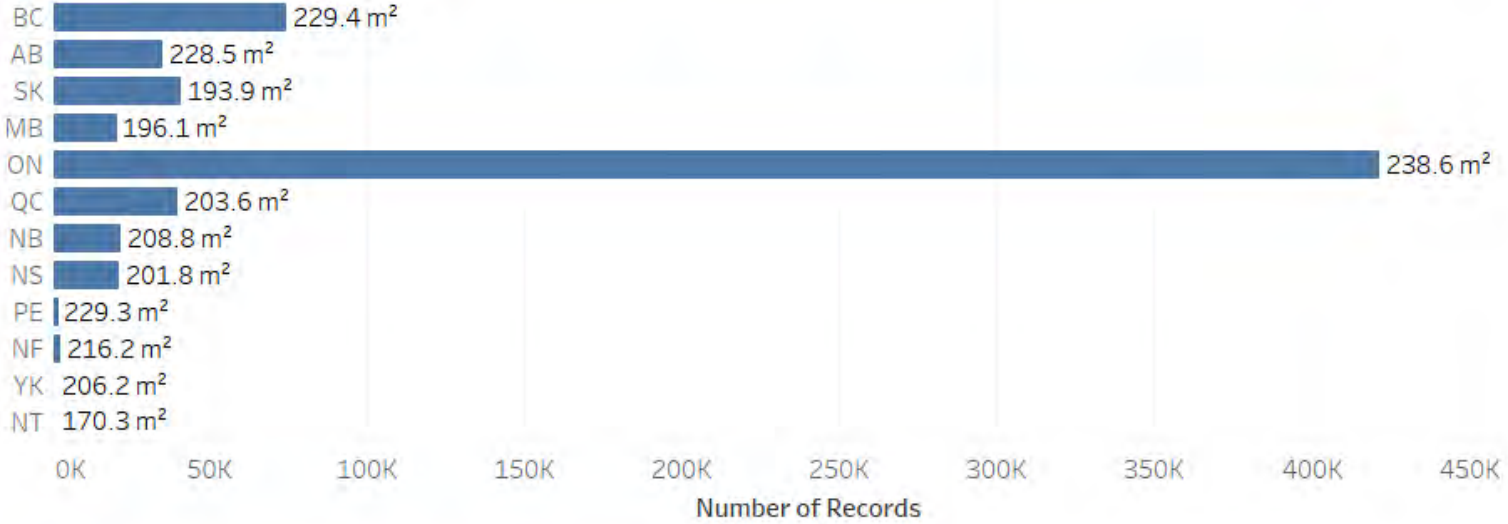
Canada

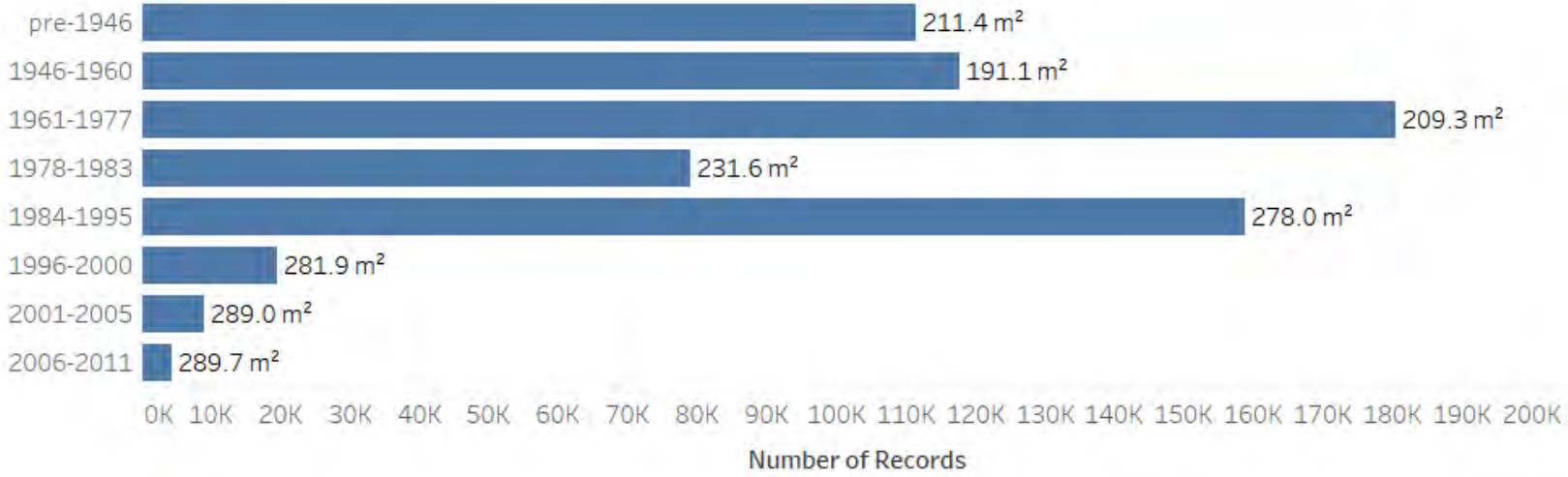
ecoENERGY Retrofit Programme

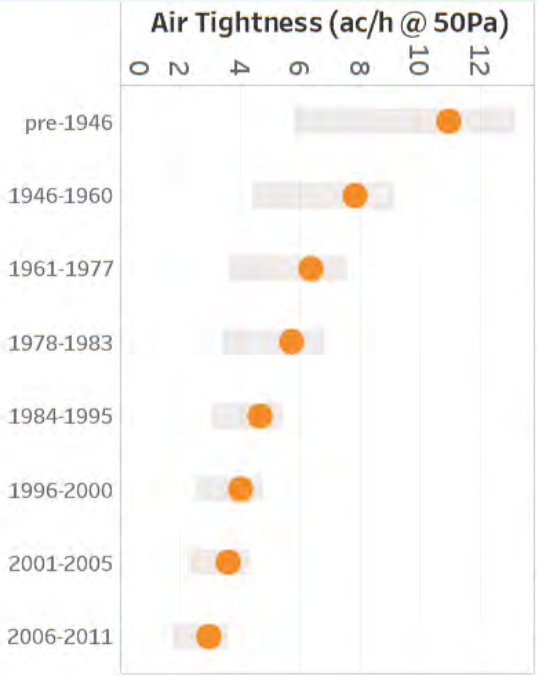
- Nation-wide program for energy efficiency retrofits of existing housing with financial incentives
- 2007-2013
- Energy efficiency evaluations to homeowners for pre- and post-retrofits
- 140 specific parameters related to house geometry, insulation levels
- Thermal, mechanical and energy consumption data

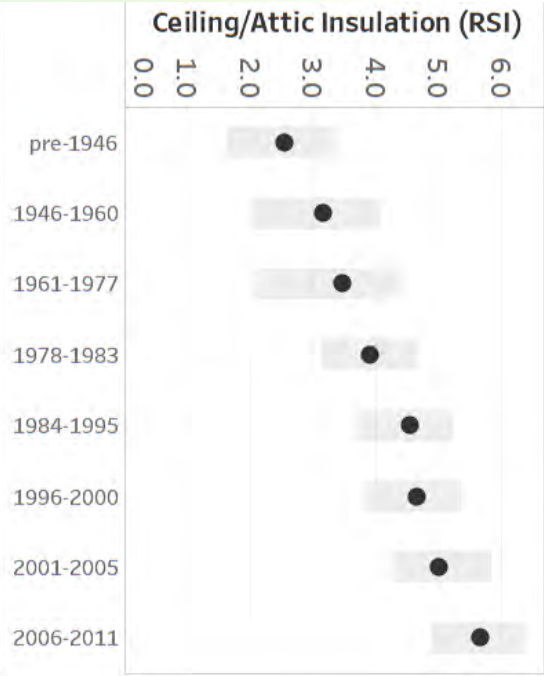
EnerGuide for Houses Database

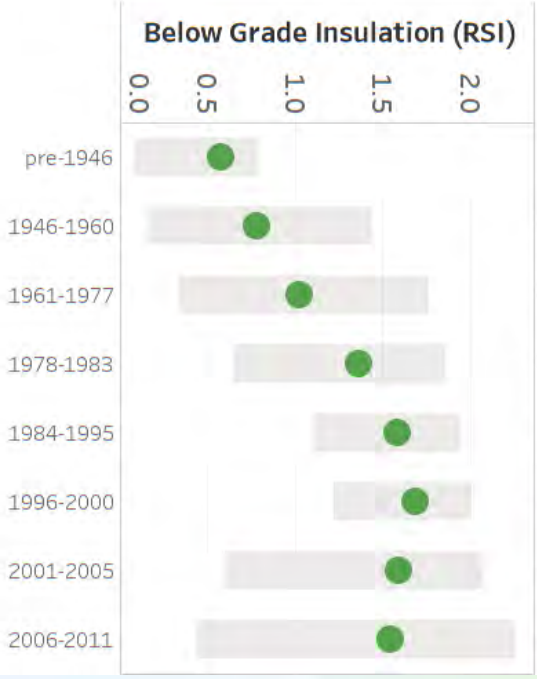
- House specific information gathered from field evaluations
  - Geometric configuration
  - Insulation levels
  - AirtightnessSpace heating, hot water and ventilation systems
- House-as-a-system Energy Analysis
  - Standard Operating Conditions (SOCs)
  - Heat losses for envelope components
  - Energy use:
    - space heating & cooling
    - domestic hot water
    - ventilation
    - base loads for lighting, appliances and miscellaneous electrical loads

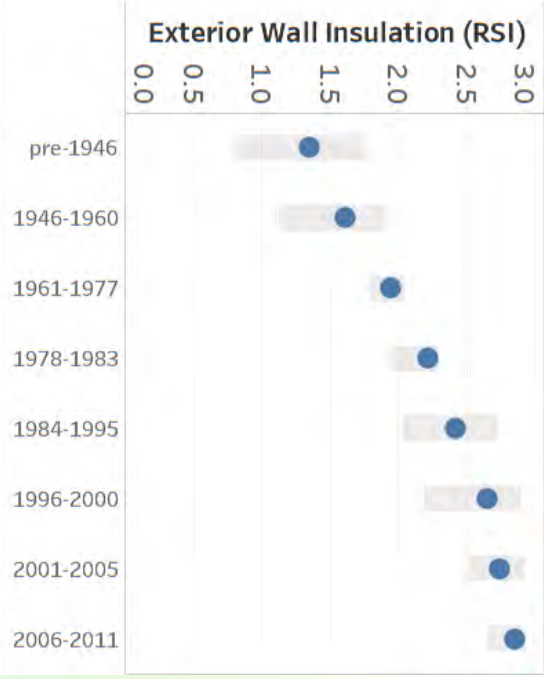

BC 229.4 m²
AB 228.5 m²
SK 193.9 m²
MB 196.1 m²
ON 238.6 m²
QC 203.6 m²
NB 208.8 m²
NS 201.8 m²
PE 229.3 m²
NF 216.2 m²
YK 206.2 m²
NT 170.3 m²
0K 50K 100K 150K 200K 250K 300K 350K 400K 450K
Number of Records

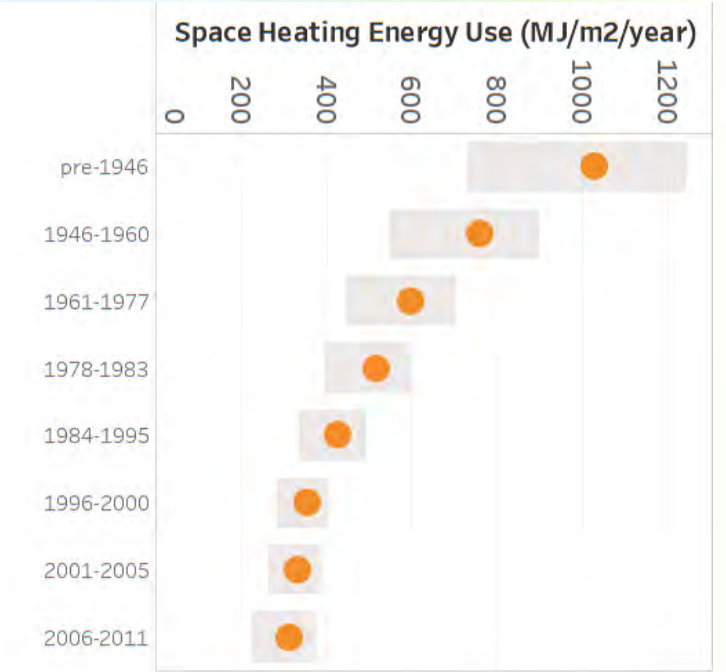

pre-1946 211.4 m²
1946-1960 191.1 m²
1961-1977 209.3 m²
1978-1983 231.6 m²
1984-1995 278.0 m²
1996-2000 281.9 m²
2001-2005 289.0 m²
2006-2011 289.7 m²
0K 10K 20K 30K 40K 50K 60K 70K 80K 90K 100K 110K 120K 130K 140K 150K 160K 170K 180K 190K 200K
Number of Records

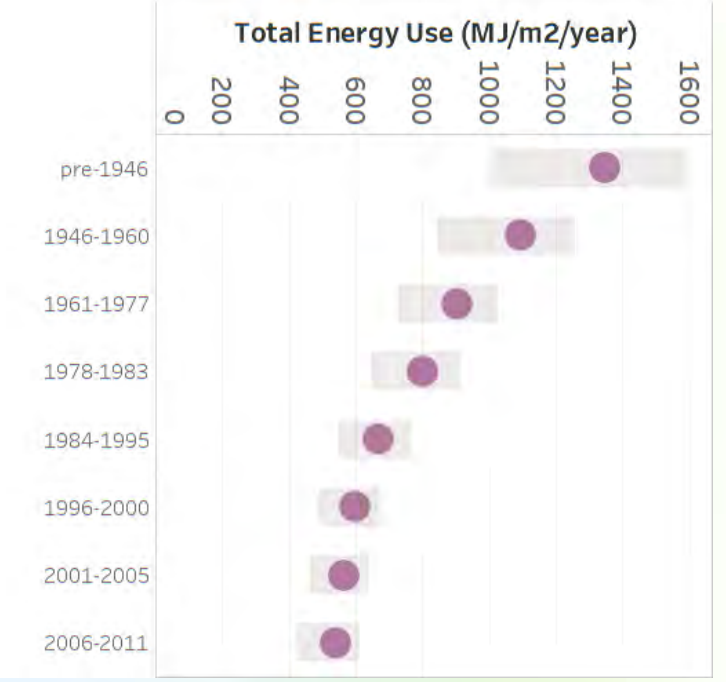

Air Tightness (ac/h @ 50Pa)
0
2
4
6
8
10
12
pre-1946
1946-1960
1961-1977
1978-1983
1984-1995
1996-2000
2001-2005
2006-2011

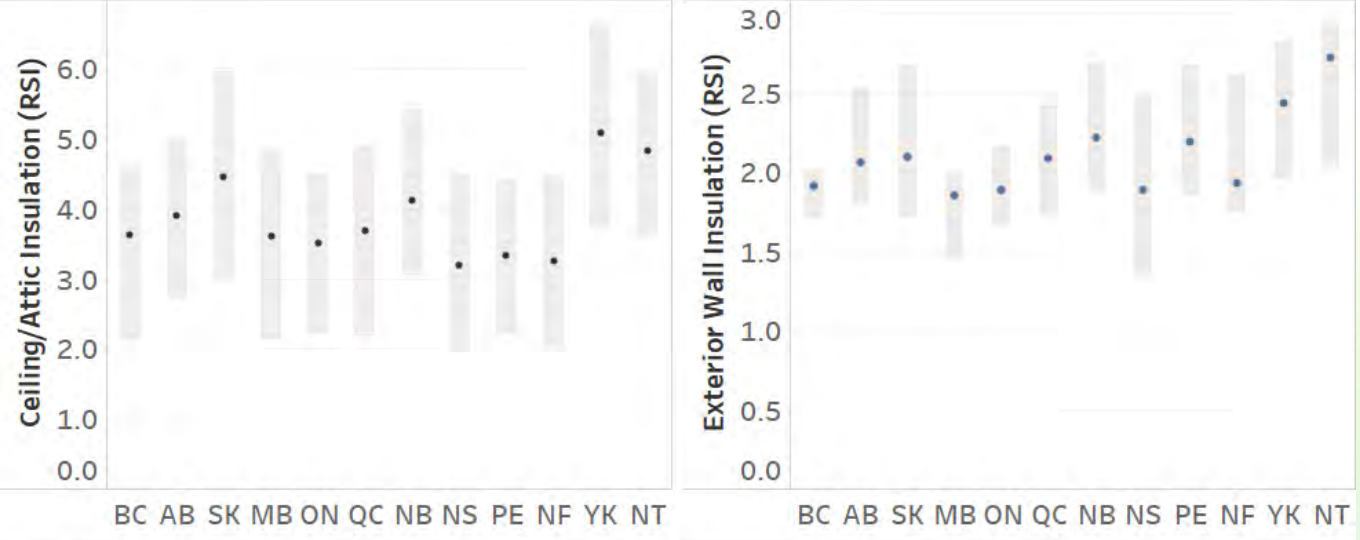

Ceiling/Attic Insulation (RSI)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
pre-1946
1946-1960
1961-1977
1978-1983
1984-1995
1996-2000
2001-2005
2006-2011


Below Grade Insulation (RSI)
0.0
0.5
1.0
1.5
2.0
pre-1946
1946-1960
1961-1977
1978-1983
1984-1995
1996-2000
2001-2005
2006-2011


Exterior Wall Insulation (RSI)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
pre-1946
1946-1960
1961-1977
1978-1983
1984-1995
1996-2000
2001-2005
2006-2011

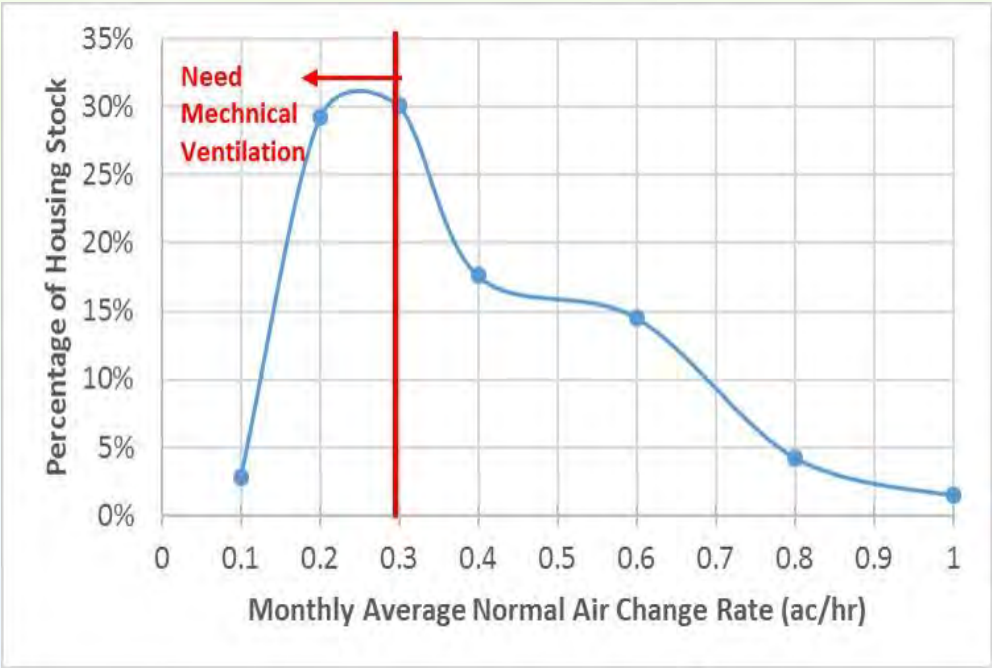

Space Heating Energy Use (MJ/m2/year)
0
200
400
600
800
1000
1200
pre-1946
1946-1960
1961-1977
1978-1983
1984-1995
1996-2000
2001-2005
2006-2011


Total Energy Use (MJ/m2/year)
0
200
400
600
800
1000
1200
1400
1600
pre-1946
1946-1960
1961-1977
1978-1983
1984-1995
1996-2000
2001-2005
2006-2011

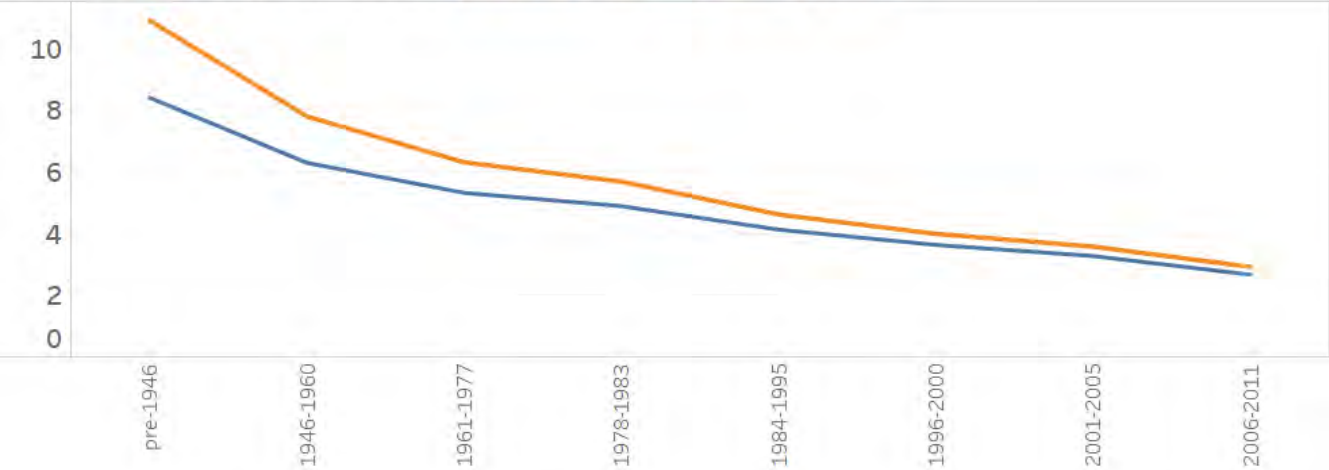

Ceiling/Attic Insulation (RSI)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
BC AB SK MB ON QC NB NS PE NF YK NT
Exterior Wall Insulation (RSI)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
BC AB SK MB ON QC NB NS PE NF YK NT
Air Tightness (ac/h @ 50Pa)
10
8
6
4
2
0
BC AB SK MB ON QC NB NS PE NF YK NT
Below Grade Insulation (RSI)
2.5
2.0
1.5
1.0
0.5
0.0
BC AB SK MB ON QC NB NS PE NF YK NT

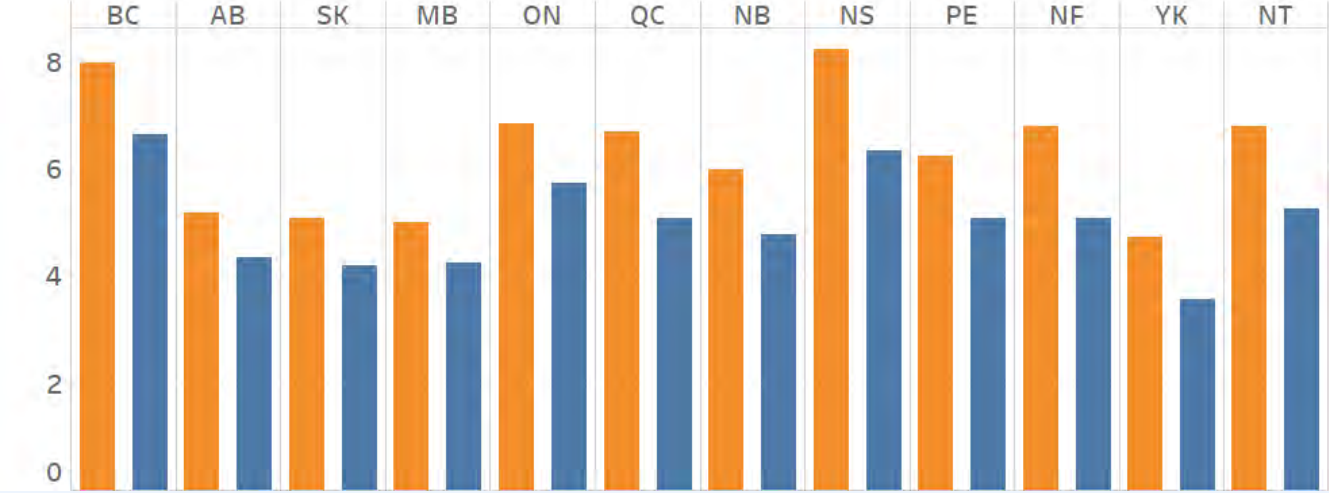
Ventilation

- < 62% of stock fails to meet ventilation requirements
- require mechanical ventilation system retrofits



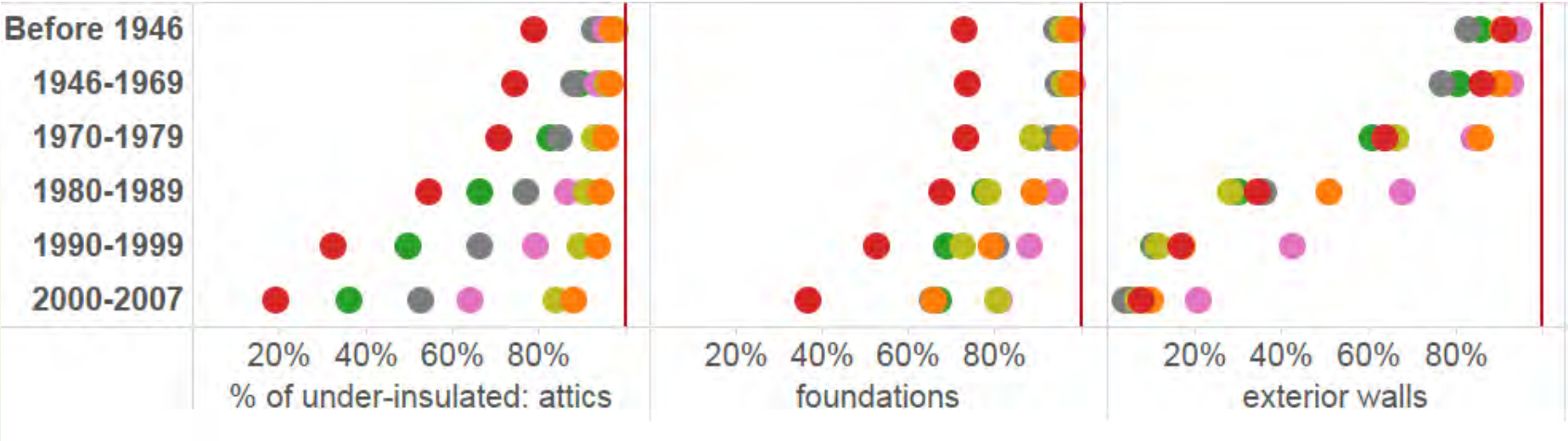
Air Infiltration (ac/h @50 Pa) Before and After Retrofits

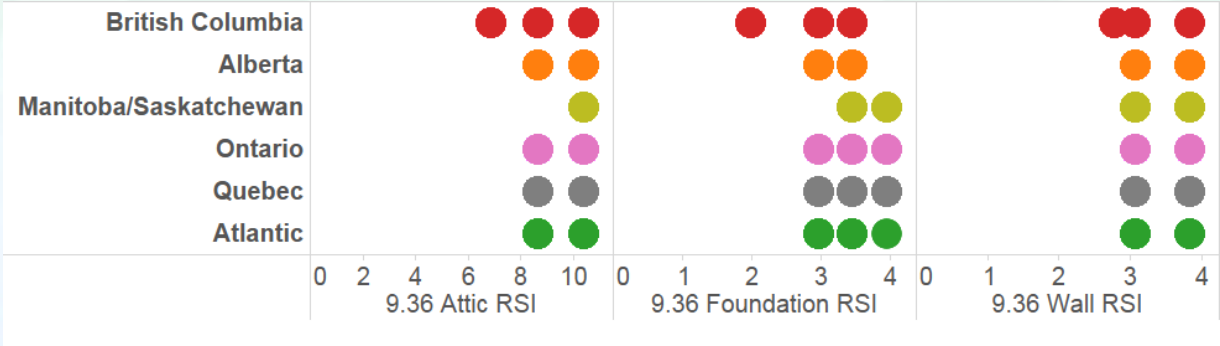


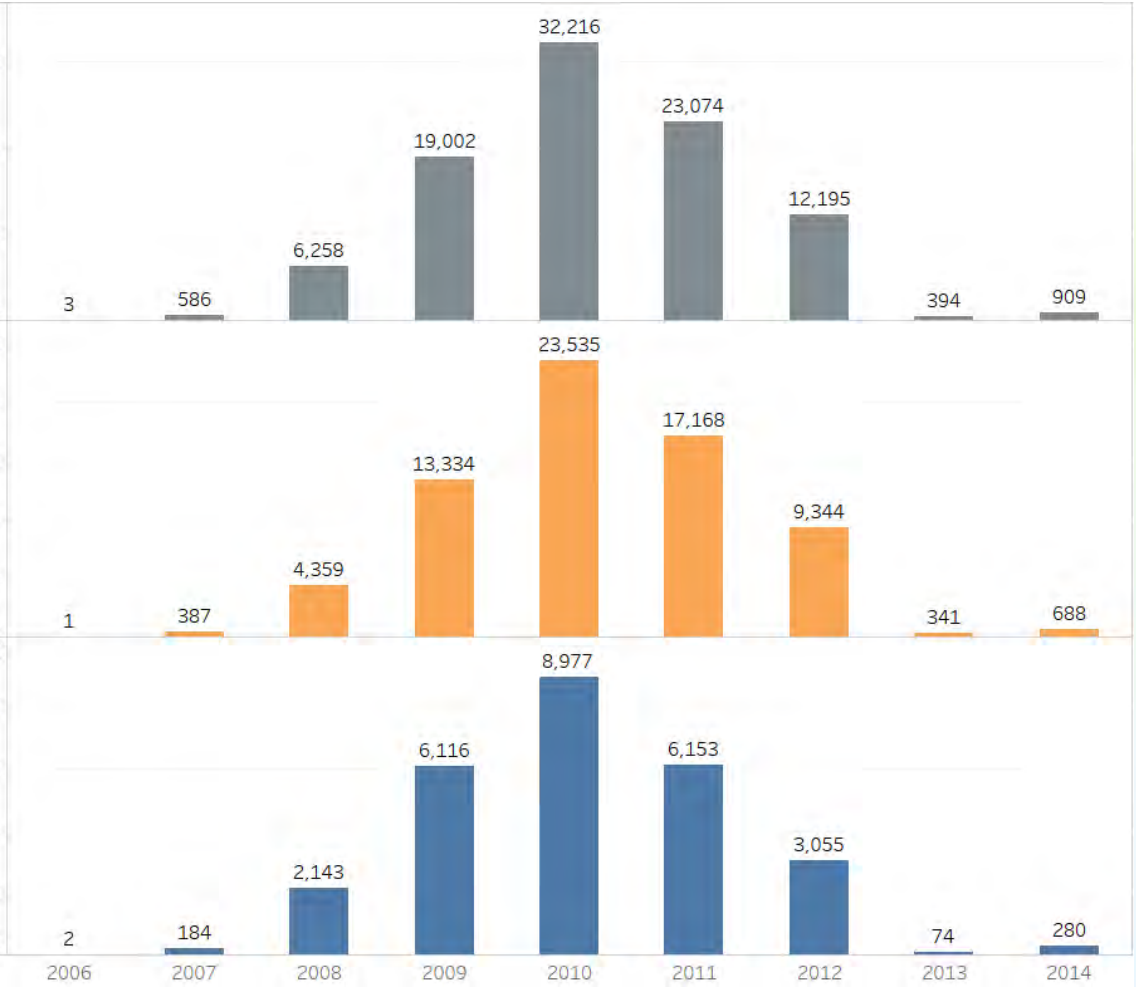


Application EGH Data Analysis for Insulation Retrofit Opportunities

- Using the region and vintage specific housing stock data in work with industry partners
  - North American Insulation Manufacturers' Association (NAIMA) Canada
- How many homes in Canada are under-insulated?
  - Identify opportunities for upgrading insulation in existing houses
- Estimate the *Retrofit Potential*


Before 1946
1946-1969
1970-1979
1980-1989
1990-1999
2000-2007
20% 40% 60% 80%
% of under-insulated: attics
20% 40% 60% 80%
foundations
20% 40% 60% 80%
exterior walls


British Columbia
Alberta
Manitoba/Saskatchewan
Ontario
Quebec
Atlantic
0 2 4 6 8 10
9.36 Attic RSI
0 1 2 3 4
9.36 Foundation RSI
0 1 2 3 4
9.36 Wall RSI



- <u>Only</u> those records in Ontario where insulation was added
- eco-ENERGY retrofit programme
- Peak year for insulation renovations was 2010
  - 32,216 homes participated

- What was the overall impact of renovations?
- Those renovations that included **wall insulation** doubled their EGH rating improvement over renovations that didn't

Conclusions

- EnerGuide for Houses (EGH) database represents 5% of the Canadian housing stock
- Identify the potential targeted opportunities for energy efficiency retrofits for existing houses
- Changes to the codes and standards for the construction of new housing
- Important resource to assist future opportunities for energy efficiency and higher performance of Canadian housing