# Building Energy Retrofit Potential in B.C.

## Thought Leader Forum — Vancouver

November 28-29, 2016

This document addresses deep energy and emissions reductions from B.C.'s existing building stock. It describes the current state of major building types in the province, and illustrates targets and actions that could help achieve a near-decarbonization of B.C.'s existing buildings by 2050.

## State of the B.C. building stock

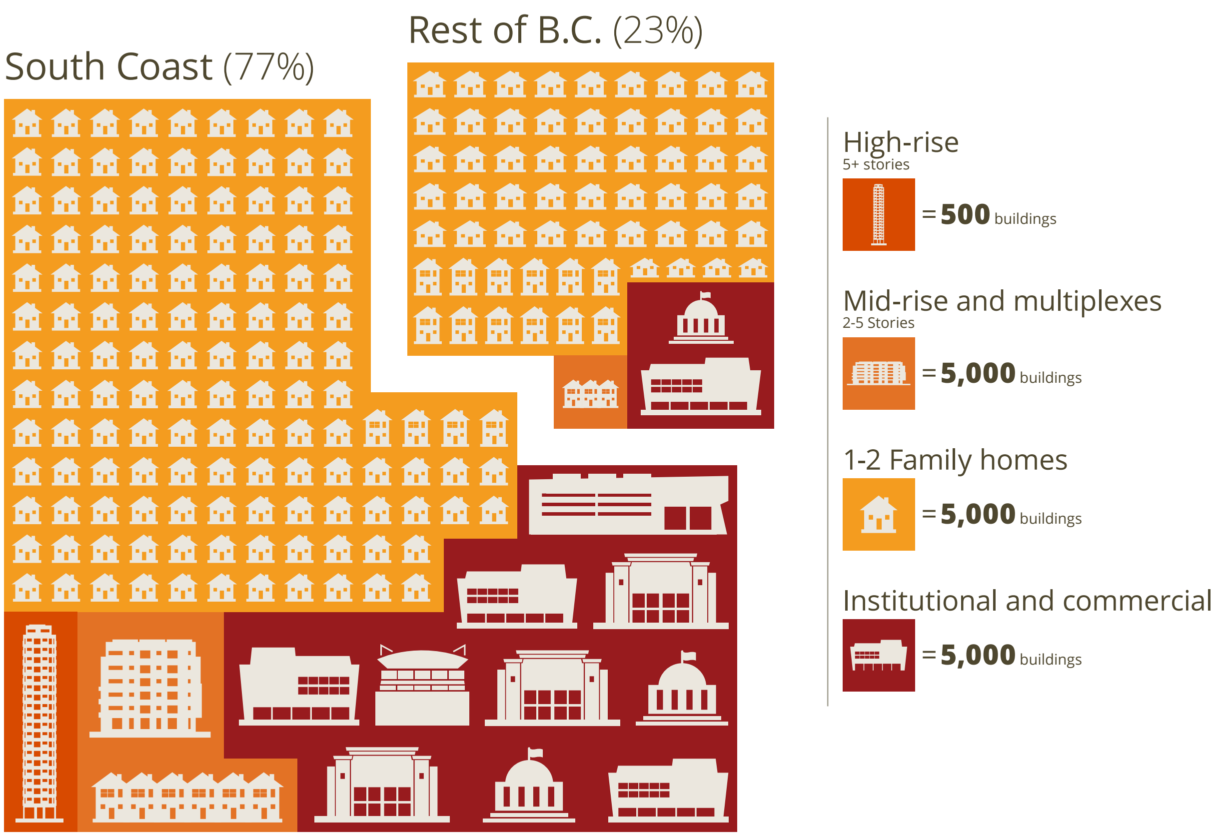


Figure 1. Breakdown of B.C. building stock by type and location

B.C.'s approximately 1 million buildings (376 million $m^2$) emit 7.2 Mt $CO_2e$ per year, accounting for 11% of B.C.'s total emissions. Emission intensities vary by building type, with commercial and institutional buildings generally having higher emissions per unit of floor area. Building emissions are mostly due to burning fuel for space and water heating.[1]

## Proposed sectoral targets

Given the current absence of a legislated sectoral target for buildings in B.C., we suggest that the building sector should aim for **at least the economy-wide target of 80% emissions reductions by 2050** (relative to 2007 levels). Given that it will likely be more costly to achieve deep reductions in other sectors (e.g. oil and gas, transportation), it would be prudent to aim for a near-total decarbonization of building operations by 2050.

The Climate Leadership Team recommended also an **interim target of 50% emissions reductions by 2030 for buildings,**[2] and provided some economic modeling showing how this target could be achieved through carbon pricing, codes and standards, and equipment regulations.[3]

Assuming projected demolition rates of ~1.4% per year, around 50% of existing buildings will still be in use by 2050, while the total square footage will have increased by 40% (Figure 2).[4] Under a "business-as-usual" scenario, the replacement of older stock by more efficient stock more or less balances out the additional demand, holding total emissions at current rates.

[1] NRCan Comprehensive Energy Use Database Tables (CEUD) - Historical Database August 2014. http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive_tables/list.cfm; NRCan Survey of Household Energy Use (SHEU) Data Tables - 2011. http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/sheu/2011/tables.cfm; NRCan Survey of Commercial and Industrial Energy Use (SCIEU) Data Tables - 2009. http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/scieu/2009/tables.cfm; BC Community Energy and Emissions Inventory (CEEI). http://www2.gov.bc.ca/gov/content/environment/climate-change/reports-data/community-energy-emissions-inventory

[2] 50% relative to 2015 levels, ~55% relative to 2007 levels.

[3] Based on 2015 baseline. The detailed list of policies modelled has not been released but include high-efficiency equipment standards, adoption of heat pumps, and electrification.

[4] Navius Research, *A Plan for Climate Leadership in British Columbia,* 2015. http://cleanenergycanada.org/wp-content/uploads/2015/10/A-Plan-for-Climate-Leadership-in-BC-Final-Oct-27-12pm-2015.pdf

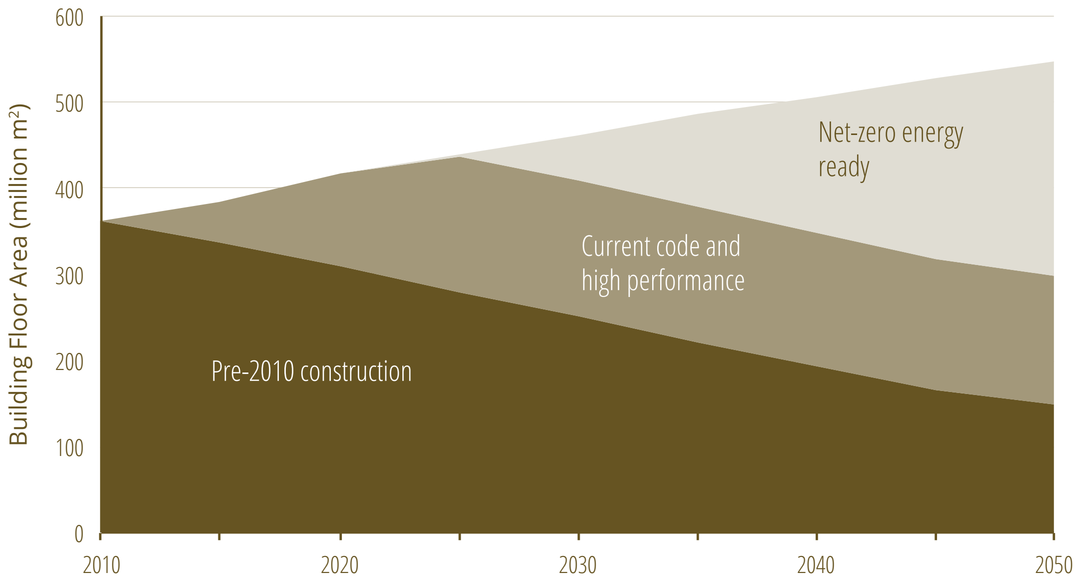


Figure 2. Evolution of the B.C. building stock

## Meeting targets: fuel switching and efficiency

In order to meet >80% GHG reductions, most buildings will need to be 'fuel-switched' (i.e. electrified or connected to a renewable district energy system) by 2050.[5] To limit demands on the grid, avoid waste and protect operational affordability, this fuel switching should be accompanied by improvements in efficiency.

What constitutes an 'appropriate' level of efficiency improvement, before fuel switching, depends both on an economic optimization (balancing upfront and ongoing costs) and an ethical judgment (generational equity, equity of environmental impacts, access to comfortable homes, etc.)

Energy efficiency is also necessary to reduce emissions from buildings for which fuel switching might not be currently possible, due to the size of their heating load or infeasibility for district energy connection, or in the absence of appropriate heat pump technology.

At current and forecast energy prices, a building that switches from natural gas to electric heating would need to achieve around 60% heating energy savings in order to maintain the same energy billing.[6] These savings could be achieved through a retrofit of the building envelope, by using more efficient heating equipment (such as a heat pump), or by a combination of both.

[5] Other fuel sources such as renewable natural gas and biomass exist and could play a role, but their supply is currently limited.

[6] Based on BC Hydro and FortisBC rates in October 2016, and BC Hydro projected energy prices.

## Rate of retrofit

To effectively decrease emissions, building replacement will need to be paired with retrofit of existing buildings. Retrofits of 2% of existing floor area per year would renew most of the B.C. building stock by 2050.[7] This would entail the retrofit each year of:

- 20,000 homes
- 2 million $m^2$ of commercial floor area
- 1 million $m^2$ of MURB floor area.

By comparison, the peak rate of retrofits under the LiveSmart BC program was around 2.5%.[8]

Most components in existing buildings will only reach the end of life once between now and 2050, making it important to capture energy and emission reduction opportunities at these times. A combination of strategies will be necessary to protect affordability, ensure technical feasibility and avoid waste.

## Depth of retrofits

Retrofits are sometimes heuristically sorted in three levels: shallow, moderate, and deep (Table 2). Energy reductions ('retrofit depths') ranging from 10% to 80% have been reported across a range of building types (Table 3).

Shallow retrofits, with energy reductions of <30%, are relatively common and are incentivized by programs such as:

- The former LiveSmart BC program, which achieved average energy reductions of 15-30%
- Current utility incentives for MURBs

## Retrofit scenarios

Overall, to meet a >80% by 2050 target without the addition of an explicit fuel switching strategy, all buildings that will still be standing by 2050 would need to undergo the equivalent of a deep retrofit (Figure 3). Similarly, meeting a 50% by 2030 target without a fuel switching strategy would require a highly accelerated pathway of moderately deep retrofits for all buildings by 2030.

Thus far, there have been no examples of deep retrofit projects in B.C., and very few examples in North America. Meeting the 2050 goal without electrification would require rapid innovation in this area.

[7] When combined with the current rate of demolition.

[8] Based on LiveSmart program participation statistics. The average rate of retrofits over the entire program was ~1%.

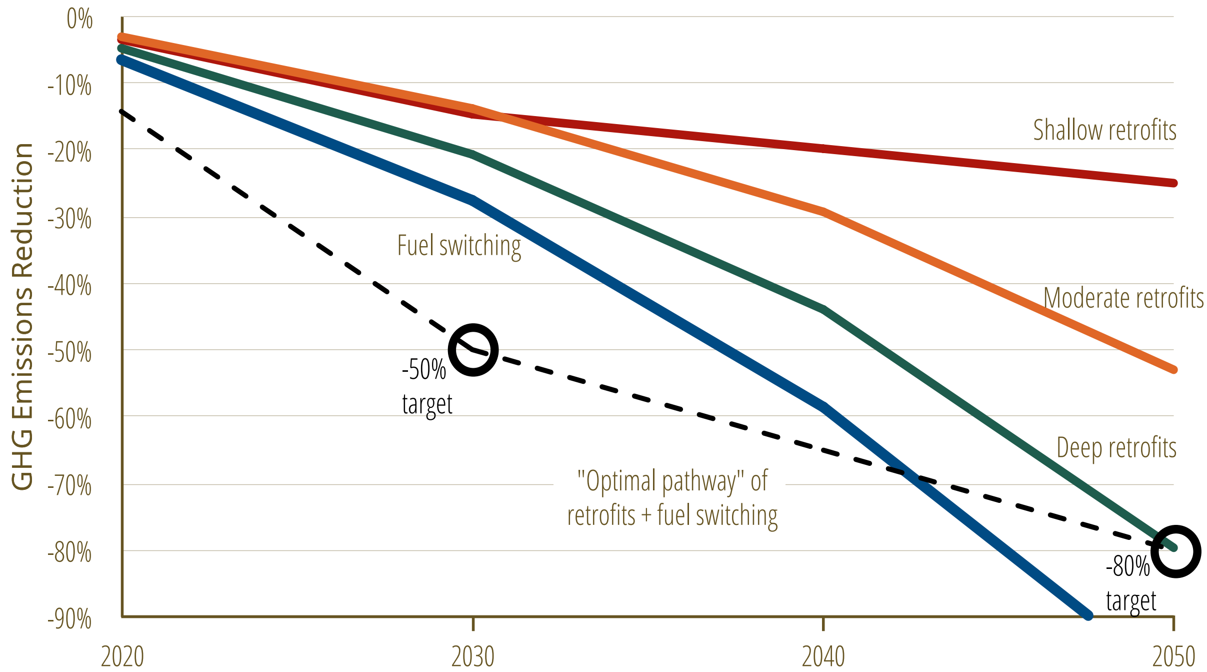


Figure 3: GHG reductions from "business-as-usual" in buildings that exist today and will *still exist* by 2050

Table 1. Scenario details

| Scenario | Rate[9] | Depth | Meets 2050 Target? |
|---|---|---|---|
| Shallow retrofits | 7% (all buildings by 2030)[10] | 15% energy reductions | ✖ |
| Moderate retrofits | 2% (all buildings by 2050) | 50% energy reductions | ✖ |
| Deep retrofits | 2% (all buildings by 2050) | 75% energy reductions | ✔ |
| Fuel switching | 2% (all buildings by 2050) | 100% GHG reductions | ✔ |

## Regulatory options

Different regulatory mechanisms could be used to scale retrofits after adequate market preparation has taken place. A combination of approaches would likely be necessary to achieve a target of >80% GHG reductions by 2050. The following is a high level summary of the options we will discuss at the Thought Leader Forum.

[9] Rates are initially defined as a percentage of *currently* existing buildings, and then remain constant over time.

[10] Assuming measures start in 2018. Additional reductions (10%) were assumed by 2050 to account for re-commissioning and further improvement of these buildings.

### Time of renovation retrofit code

This approach would require minimum energy efficiency upgrades be conducted when renovations are made to systems that have an energy component. It could impact up to 3-4% of existing stock per year.

An RDH white paper[11] recently provided retrofit code options for commercial buildings. Modelling by BC Hydro of the most ambitious option yielded a 4% GHG reduction in the commercial sector by 2030 and a 10% reduction by 2040.[12] Similarly, a Light House road map[13] for residential buildings showed a 7% reduction in GHG emissions by 2030 and a 29% reduction by 2050. Combined, these options would not be sufficient to reach >80% reductions.

### Time of sale retrofit code

Proposed by Architecture 2030 in their New York City plan[14], this approach capitalizes on transfers of property, requiring the buyer (who has secured the capital) to improve the GHG emissions from their new property by upgrading to high-performance standards. If this is not possible (for example, because it would create too much disturbance for tenants), then the new owner would conduct available non-intrusive efficiency upgrades and additionally purchase low-GHG renewable energy generated in the region to offset the remaining building load. This latter measure would be less relevant in B.C. given that our electricity is already mostly renewable, but could be replaced by other measures to encourage renewable electrification (or expansion of renewable natural gas) in the area.

### Building Energy Performance Standard (BEPS)

This approach aims to maximize social benefits while minimizing investment by aiming to bring the lowest performing buildings up to an average performance level. This policy depends on the successful implementation of an energy benchmarking program for buildings above a certain size (generally >50,000 $ft^2$). Commercial buildings, including multifamily housing, would be required to meet a minimum ENERGY STAR® Portfolio Manager Score (ESS)[15] or

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[11] RDH, *Review of Potential Energy Efficiency Standards for Existing Buildings in B.C.,* 2016. http://www.pembina.org/reports/rdh-existing-buildings-whitepaper-2016.pdf

[12] This modelling includes retrofit of newly constructed buildings, and therefore overestimates the potential.

[13] Light House, *Towards Net Zero Energy Ready Residential Buildings* (2015). http://www.sustainablebuildingcentre.com/wp-content/uploads/2011/10/BC_Part_9_Roadmap_Final_Report.pdf

[14] Architecture 2030, *Achieving 80×50: Transforming New York City's Building Stock* (2015). http://architecture2030.org/achieving-80x50-transforming-new-york-citys-building-stock/

[15] The ENERGY STAR Score compares the energy performance of a building to similar buildings in the country, adjusting for weather and occupancy characteristics such as operating hours, number of occupants, and number of computers. The building is given a score based on the percentile it performs in—a building with a score of 50 is exactly average, a building with a score of 75 performs better than 75% of similar buildings, a building with a score of

follow one of various alternate compliance paths; these could include a performance path (for example, improving ESS by 15 points, or reducing EUI by 15%) and a prescriptive path (for example, undergoing a retro-commissioning process).[16]

### Minimum equipment performance regulations

Heating equipment efficiency standards and component standards (e.g. for windows) can be used to drive energy and emissions reductions at time of replacement. They could also be used to accelerate electrification by requiring heating systems with a coefficient of performance greater than 1 (therefore mandating the use of heat pumps).[17]

### Five Key Questions

*We will focus our discussions at the forum on five questions and four principles that are core to meeting our targets:*

Ensure high-efficiency component replacement

1. How do we avoid suboptimal investment and rework?
2. How do we spur innovation to lower cost of deep energy retrofits?

Include non-energy benefits & access patient capital

3. How do we align value and reduce risk for investors, tenants, current owners and future owners?

Liberate energy information

4. How can 'big data' drive demand through occupant engagement and market analytics?

Electrify wherever possible

5. How do we accelerate 'smart' electrification?

10 performs worse than 90 percent of buildings, etc. Adjusting for the ways the building is occupied and used is of critical importance to ensure fairness; a building that is densely occupied and open for longer hours will use more energy but also will produce more economic value and should not be penalized. ESS therefore adjusts for factors that are significantly correlated with energy consumption. See Energy Star, "How the 1-100 ENERGY STAR score is calculated." https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/understand-metrics/how-1-100

[16] Sustainability DC, *Building Energy Performance Standards Task Force* (2014). *http://www.sustainabledc.org/wp-content/uploads/2014/12/10-Building-Energy-Performance-Standards.pdf*

[17] A natural gas-driven heat pump would also meet this requirement.

# Resources

These reports provide the shared basis of knowledge we will build from at the Forum.

## Regulatory proposals

RDH Engineering. 2016. *Review of Potential Energy Efficiency Standards for Existing Buildings In B.C.* http://www.pembina.org/reports/rdh-existing-buildings-whitepaper-2016.pdf

Sustainability DC. 2014. *Building Energy Performance Standards Task Force.* http://www.sustainabledc.org/wp-content/uploads/2014/12/10-Building-Energy-Performance-Standards.pdf

Pembina Institute. 2015. *Pathways to Net-Zero Buildings in B.C.: Policy Proposal: Getting new Part 3 buildings net-zero ready*. https://www.pembina.org/pub/pathways-to-net-zero-bc-policy-2015

## Energy disclosure

Canadian Green Building Council. 2016. *Energy Benchmarking Disclosure in Canada: A Guide to a Common Framework.* http://www.cagbc.org/cagbcdocs/CaGBC_National_Energy_Benchmarking_Framework_April_2016.pdf

Pembina Institute. 2015. *Home Energy Labelling: Strategic Plan for Labelling of Part 9 Residential Buildings in B.C.* http://www.pembina.org/pub/home-energy-labelling.

## Commercial/institutional buildings

Integral Group. 2016. *BC Hydro Part 3 Existing Buildings Road Map*. http://www.pembina.org/reports/bchydro-existing-commercial-roadmap-2016.pdf

## One- and two-family homes

Light House Sustainable Building Centre. 2015. *Towards Net Zero Energy Ready Residential Buildings: Roadmap for British Columbia,* http://www.sustainablebuildingcentre.com/wp-content/uploads/2011/10/BC_Part_9_Roadmap_Final_Report.pdf

Columbia Institute. 2016. *This Green House II: Building Momentum on Green Jobs and Climate Action.* http://www.civicgovernance.ca/green-house-ii-2/

## MURBs

Pape-Salmon, Andrew, Jordan Fisher, Warren Knowles, and Jennifer Sanguinetti. 2011. *Multi-Unit Residential Buildings in B.C.: A Vision for Energy Efficiency.* http://www.rdh.com/wp-content/uploads/2014/04/MURB___Energy_Efficiency.pdf

## Statistics

### Table 2. Retrofit types and costs

| Retrofit depth | Shallow | Moderate | Deep |
|---|---|---|---|
| Typical energy conservation measures | Lighting<br>Smart controls<br>HVAC motors and fans<br>Caulking and sealing<br>Optimization | Boiler, furnace, or AHU replacement<br>Steam to hot/low-temp water<br>Heat pumps<br>Drain/waste heat recovery<br>Heat recovery ventilation<br>Roof/cavity insulation | *As above, plus:*<br>Window replacement<br>Wall and foundation reinsulating<br>Shading<br>Envelope replacement<br>Conversion to renewable district energy |
| Energy savings range[18] | 10-20% | 30-50% | 40-80% |
| Typical payback period and costs[19] | 1-3 year payback<br>Commercial: <$2 / $ft^2$<br>MURB: <$2,000 / unit<br>Home: <$5,000 | 3-6 year payback<br>Commercial: $2-$5 / $ft^2$<br>MURB: $2,000-$6,000 / unit<br>Home: $5,000-$50,000 | 6+ year payback<br>Commercial: $20-$50 / $ft^2$<br>MURB: $10,000-$60,000 / unit<br>Home: $100,000-$150,000 |
| Advantages | Short payback<br>Cost-effective<br>Incentivized by current program and policy structure | Attractive balance of energy savings and payback<br>Can be performed with minimal disruption to tenants | Holistic approach optimizes components<br>Large and lasting energy and emissions reductions |
| Disadvantages | Small energy savings<br>Weakens business case for deeper retrofits in the future<br>Missed synergies between building components | Higher energy reductions difficult to achieve without envelope upgrade<br>May result in larger / more complex mechanical systems than would be required with a deep envelope retrofit | Complex<br>Longer payback period<br>Disruption to tenants/owners |

[18] Based on interviews with local practitioners, range depends on initial performance of the building.

[19] Based on available case studies and/or costing studies.

## Table 3: Retrofit case studies

| Building/Location | Energy Reduction | Cost |
|---|---|---|
| Commercial and Institutional | | |
| Alliance Centre, CO[20] | 22% | $3 / ft$^2$ |
| Joseph Vance, WA | 24% | $26 / ft$^2$ |
| Jawl Properties, Vancouver Island[21] | 20-25% | $2/ ft$^2$ |
| 1525 Wilson, VA | 35% | $3.5 / ft$^2$ |
| 77 Bloor Street, Toronto[22] | 36% | - |
| Empire State Building, NY | 38% | $40 / ft$^2$ |
| Indianapolis City-County Building, IN | 48% | $11 / ft$^2$ |
| Public building, Vancouver[23] | 50% | $1 / ft$^2$ |
| Johnson Braund, WA | 59% | $31 / ft$^2$ |
| The Aventine, CA | 63% | $3.2 / ft$^2$ |
| Retail Chain, US | 45-72% | $6-21 / ft$^2$ |
| Sunnyvale, CA | ~80% (net-zero) | $55 / ft$^2$ |
| MURBs | | |
| The Belmont, Vancouver[24] | 20% | $3,300/unit (energy upgrades)<br>$100,000/unit (total) |
| TAF TowerWise projects[25] | 30-50% | $1200-6000/unit |
| Castle Square, MA[26] | 50-60% | $18,000 / unit (energy upgrades)<br>$42,600 / unit (total) |
| Freiburg, Germany[27] | 78% (Passive House standard) | $173 / ft$^2$ |
| Energiesprong MURBs, Netherlands[28] | 70-80% (net-zero) | $60,000/unit |
| Homes | | |
| Utica, NY (4 case studies)[29] | 60-65% | $100,000 - $145,000 |
| Arlington, MA (duplex)[30] | 67% (heating energy only) | $100,000 |
| Energiesprong, Netherlands (row houses)[31] | 70-80% (net-zero) | $135,000 |

20 Based on U.S. commercial building case studies from Rocky Mountain Institute, 2012-2015. http://www.rmi.org/retrofit_depot_get_connected_true_retrofit_stories
21 Based on case studies from Jawl Properties Ltd., 2016.
22 Based on a case study from Morguard, 2016.
23 This example utilized extensive heat recovery which is not possible for all buildings.
24 Andrew Pape-Salmon, *Deep Energy Retrofit of the Belmont.* http://rdh.com/wp-content/uploads/2015/08/Deep-Energy-Retrofit-Vancouver-Andrew-Pape-Salmon.pdf
25 Bryan Purcell, "TowerWise.ca: Introduction to Tower Retrofits," presentation, Tower Retrofit webinar series, 2011. http://towerwise.ca/wp-content/uploads/2013/05/TowerWise-Intro-to-energy-retrofits-presentation.pdf
26 Paul Bertram, "Challenges and Opportunities in Deep Envelope Retrofitting," Kingspan. http://www.kingspanpanels.us/kingspan-news-us/november-2015/challenges-and-opportunities-in-deep-envelope-retrofitting
27 Klimaschutz und Energieagentur, "Business and Technical Concepts for Deep Energy Retrofits of Public Buildings", 2014. http://bpie.eu/wp-content/uploads/2015/11/Business-and-technical-concepts-for-deep-energy-retrofits-in-public-buildings-IEA-EBC-Annex-61-findings-Rudiger-Lohse-IEA-Annex-61.pdf
28 Based on interviews with Stadsruim, 2016.
29 Martin Holladay, "The High Cost of Deep-Energy Retrofits," *Green Building Advisor*, 2012. http://www.greenbuildingadvisor.com/blogs/dept/musings/high-cost-deep-energy-retrofits
30 Martin LaMonica, "'Deep-energy retrofits' take root in homes," *CNet*, 2010. https://www.cnet.com/news/deep-energy-retrofits-take-root-in-homes/
31 Based on interviews with Stadsruim, 2016.

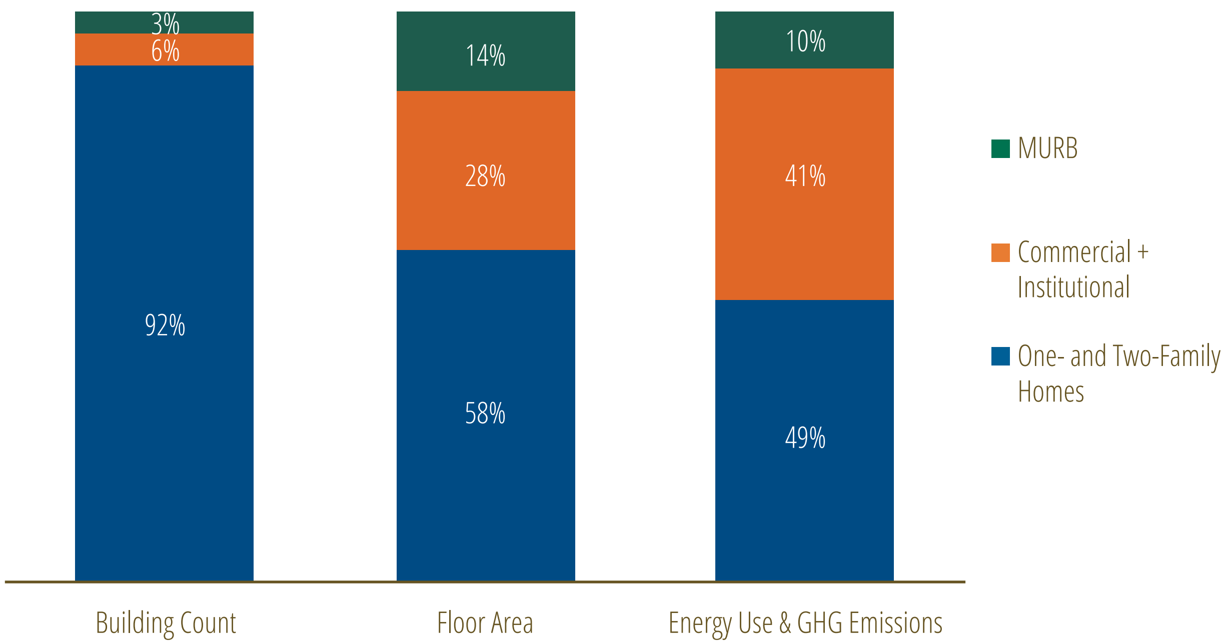



Figure 4. Comparing major building types

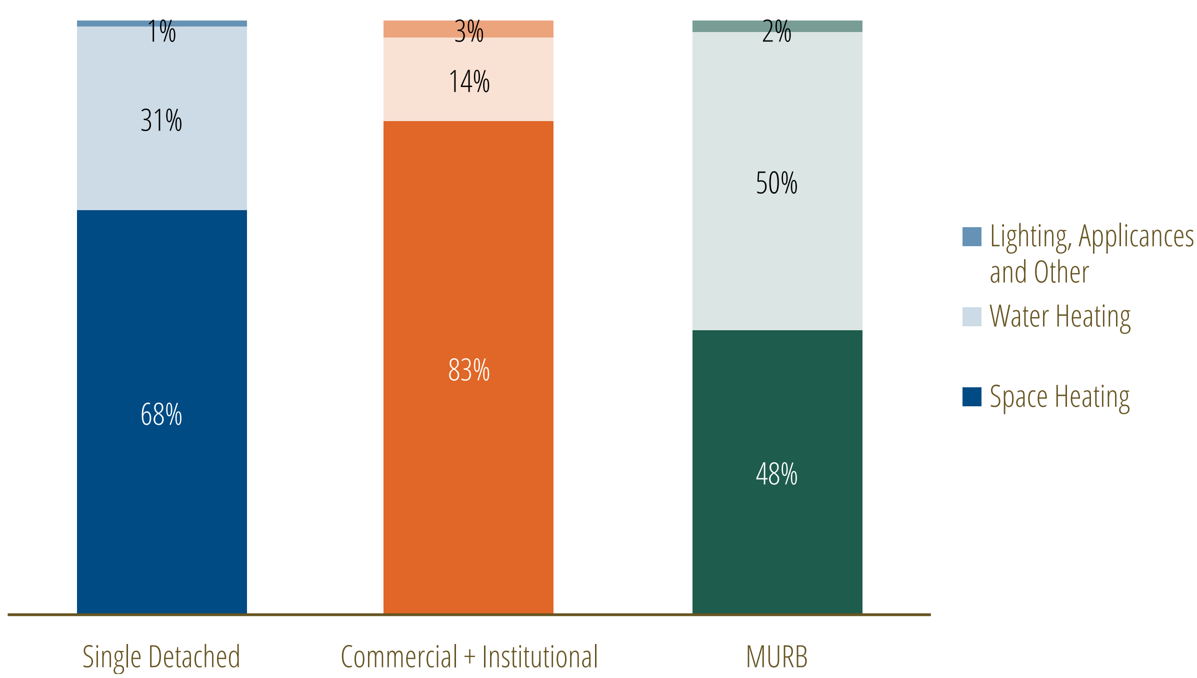



Figure 5. Where emissions come from in B.C.'s buildings

# Multi-Unit Residential Buildings (MURBs)

## Current state[32]

- ~600 high-rise MURBs (5+ stories), 10,000 mid-rise MURBs (2-4-storey apartments), 16,000 single family attached with more than two units (row houses, town houses, multiplexes, etc.)[33] (3% of B.C. buildings total)
- 576,000 units (40% of B.C. households)
- 54 million $m^2$ (14% of B.C. buildings total)
- 28 PJ energy use (10% of B.C. buildings total):
  - 50% from natural gas
  - 45% from electricity
  - 5% from other (fuel oil, wood)
- 0.73 Mt $CO_2$ emissions (10% of B.C. buildings total):
  - 48% from space heating and cooling
  - 50% from water heating
  - 2% from lighting, appliances, etc.
- Typical growth: 1-2 million $m^2$ new floor area per year
- Overall, 70% of B.C. households own, 30% rent
  - Median duration of residence is 9 years when owned, 2 years when rented (U.S. data)[34]
- 20% of MURB units are 5+ storeys (Part 3), 80% are low rise (Part 9)
- In the City of Vancouver, the largest 13% of MURBs account for 64% of total MURB floor space.[35]
- Only 8 firms manage nearly all of these buildings.

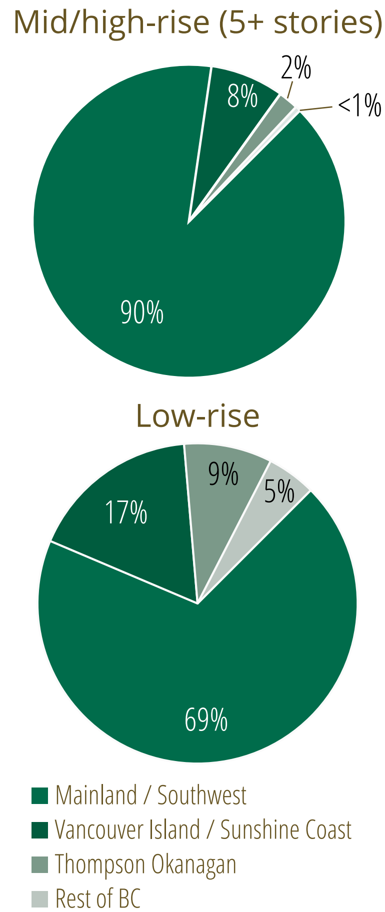



Figure 6: MURB geographic breakdown, by units

[32] See footnote 1.

[33] Assuming an average of 200 units/building for high-rise, 35 for mid-rise, and 7 for row house.

[34] Matthew Marlay and Alison Fields, *Seasonality of Moves and the Duration and Tenure of Residence* (U.S. Census Bureau, 2010), 6. https://www.census.gov/prod/2010pubs/p70-122.pdf

[35] City of Vancouver Retrofit Strategy, 2014. http://vancouver.ca/files/cov/Energy-Retrofit-Strategy-for-Buildings-Presentation-for-Council-June-2014.pdf

## Barriers and solutions

| Barriers | Solutions |
|---|---|
| Structural | |
| Rentals:<br>rent control limit cost recovery for EE investments<br>split incentive if tenant pay utilities<br>Condos: short ownership horizon<br>Rent/mortgage costs are high; limited capacity to pay more<br>Energy costs are low | Green Leases<br>Financing structures (Green Investment Bank, LICs, on-bill financing)<br>Aggregation and collective procurement to reduce costs<br>Requiring retrofit code compliance at point of sale or alteration |
| Behavioural | |
| Limited understanding of energy use and measures to reduce<br>Decision-making processes in strata council<br>Improper use of in-suite measures (eg prog. thermostat, fireplace timers)<br>Gas fireplace common in condos | Mandatory benchmarking and/or labelling<br>Inclusion of energy upgrade options in depreciation reports<br>Promote co-benefits of efficiency (e.g. thermal comfort, improved air quality, mould reduction<br>Occupant engagement apps, social marketing<br>Fireplace replacement program and design competition |
| Availability | |
| Delayed maintenance creates competing use for limited capital<br>Deep retrofit techniques disrupt many occupants<br>Heat pump technology to replace make up air units and boilers unavailable or unproven | Financial incentives with a whole-building approach<br>Heat pump pilot programs |

# Commercial and Institutional Buildings

## Current state[36]

- 61,440 buildings (6% of B.C. buildings total)
- 105 million $m^2$ (28% of B.C. buildings total)
- 114 PJ energy use (42% of B.C. buildings total):
  - 48% from natural gas
  - 49% from electricity
  - 3% from other (fuel oil, wood)
- 2.91 Mt $CO_2$ emissions (41% of B.C. buildings total):
  - 83% from space heating and cooling
  - 14% from water heating
  - 3% from lighting, appliances, etc.
- Typical growth: 2 million $m^2$ new floor area per year
- 21% institutional, 38% offices, 41% retail and other commercial
- Commercial buildings represent only 6% of total buildings, yet account for over 40% of emissions.[37]

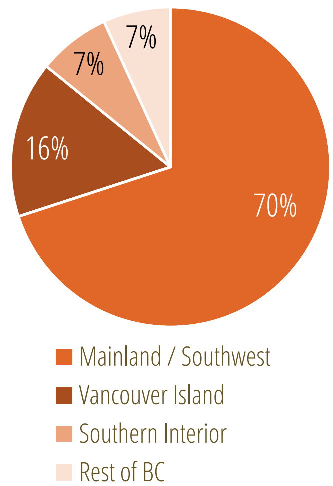



Figure 7: Commercial building geographic breakdown, by floor area

## Strategies[38]

### Building energy benchmarking and labelling

- Requiring benchmarking for large buildings
- Develop an automated data upload system for Portfolio Manager
- Provide education and training to industry
- Establish partnerships to analyse data and identify areas of focus
- Target incentive programs based on collected data
- Create data transparency by making disclosure mandatory after first three years

### Continuous optimization

### Financing mechanisms

- Develop standardized assessment criteria
- Develop “off-balance-sheet” financing programs
- Enable tax holidays and exemptions for retrofits

[36] See footnote 1.

[37] Similarly, in New York City, buildings >50,000 square feet represent 2% of buildings and 45% of energy use. http://www.nyc.gov/html/planyc/downloads/pdf/publications/ll84_year_two_report.pdf

[38] Integral Group. 2016. *BC Hydro Part 3 Existing Buildings Road Map*. http://www.pembina.org/reports/bchydro-existing-commercial-roadmap-2016.pdf

### Retrofit regulations

- Improve enforcement
- Move to performance-based regulation

### Increased marketing

- Increase the number of energy management professionals
- Share energy managers between multiple organizations
- Target outreach to engage new high-priority customers
- Embed energy management focused students in organizations

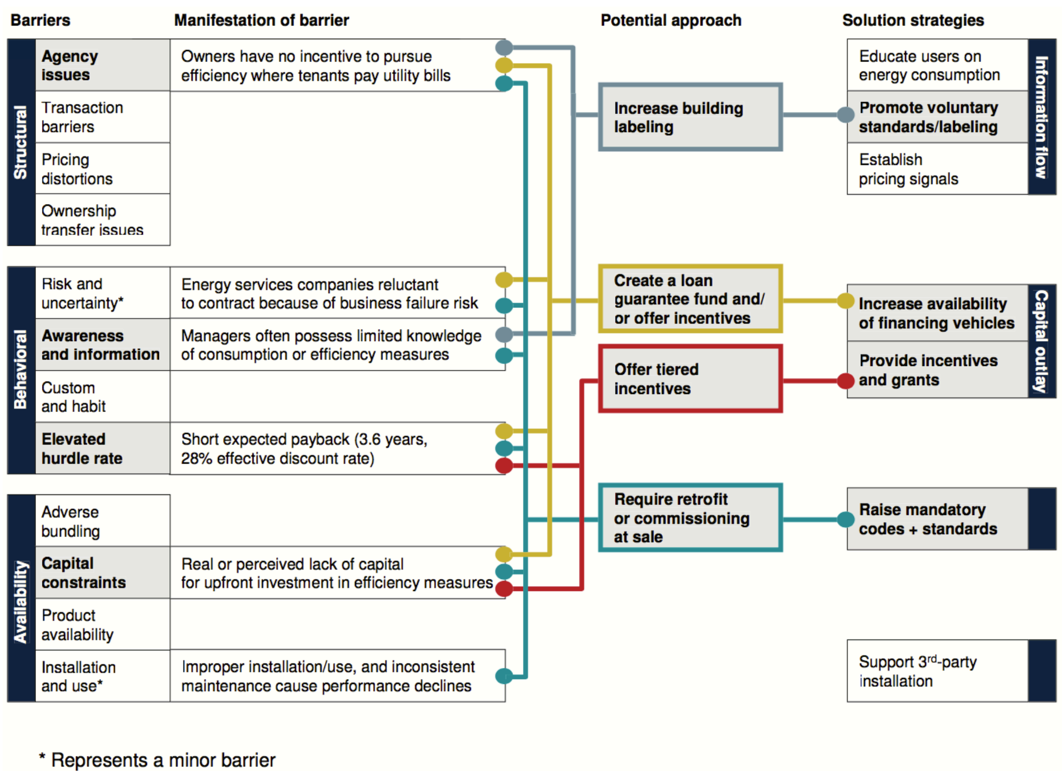
### Workforce development

- Executive training
- Technical skills development

### Development of new tools

- Develop an online energy screening tool
- Enable virtual energy audits based on Smart Meter data

## Barriers and solutions




Source: McKinsey & Company[39]

[39] McKinsey & Company, *Unlocking Energy Efficiency in the U.S. Economy* (2009). https://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/epng/pdfs/unlocking energy efficiency/us_energy_efficiency_exc_summary.ashx

## One- and Two-Family Homes

### Current state[40]

- 967,100 buildings (92% of B.C. buildings total)
- 216 million $m^2$ (58% of B.C. buildings total)
- 133 PJ energy use (48% of B.C. buildings total):
  - 48% from natural gas
  - 41% from electricity
  - 11% from other (fuel oil, wood)
- 3.52 Mt $CO_2$ emissions (49% of B.C. buildings total):
  - 68% from space heating and cooling
  - 31% from water heating
  - 1% from lighting, appliances, etc.
- Typical growth: 30,000 housing starts per year[41]
- Overall, 70% of B.C. households own, 30% rent
  - Median duration of residence is 9 years when owned, 2 years when rented (U.S. data)[42]

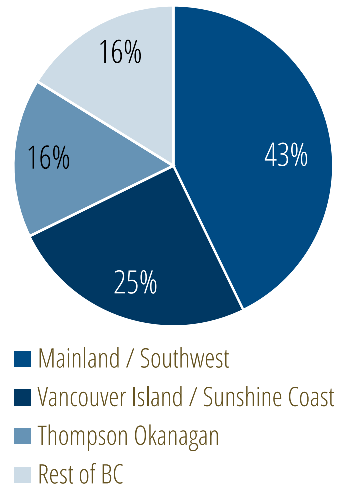



Figure 8: One- and two-family home geographic breakdown

### Strategies[43]

#### Industry capacity, technology and incentives

- Develop financing tools with long term amortization and transferability at sale*
  - Attached to the property title: *local improvement charges*
  - Attached to the meter: pay as you save, a.k.a. *on-bill financing*
- Single point of access for incentives, tax credits and financing
- Develop incentive programs for heat pumps*
- Develop one-stop shop businesses for retrofits and on-site renewables*
- Strengthen industry training, certification of contractors and recognition
- Establish centres of excellence
- Advance and promote research and development in deep energy retrofit technologies

#### Consumer education and awareness

- Require home labelling and reporting at point of retrofit and point of sale

[40] See footnote 1.

[41] StatsCan, "Housing starts, by province," CANSIM, table 027-0008. http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/manuf05-eng.htm

[42] *Seasonality of Moves and the Duration and Tenure of Residence*.

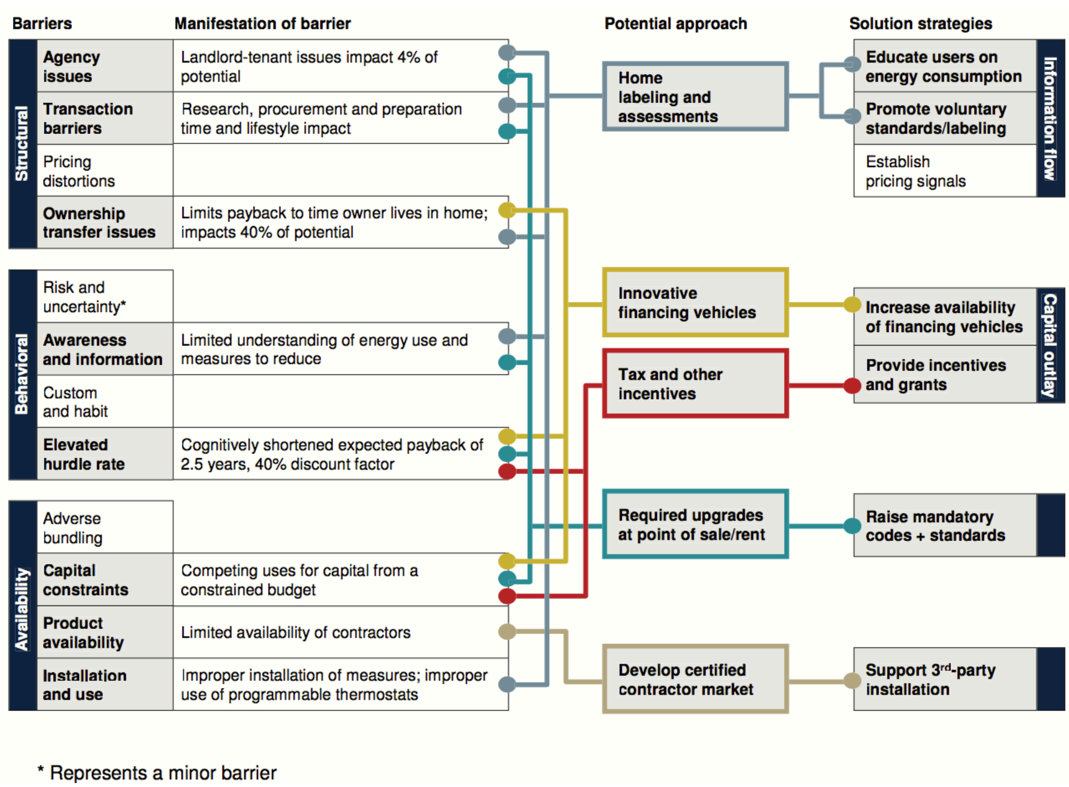
[43] Light House, *Towards Net Zero Energy Ready Residential Buildings*. Items marked with * added by Pembina.

- Improve energy literacy through integrated campaigns from utility, industry associations and NGOs

## Codes and standards

- Increase code compliance and enforcement
- Introduce a provincial retrofit code with increasing stringency over time
- Set point of renovation energy requirements based on permit value
- Strengthen product regulations

# Barriers and solutions




Source: McKinsey & Company[44]

[44] *Unlocking Energy Efficiency in the U.S. Economy.*

# APPENDIX A: Resistance to LICs for Energy Efficiency Retrofits

Graham Henry | June 7, 2016

Mortgage lenders are very hesitant to support any property lien that take priority status over them in the event of a default by their borrowers. This hesitance persists despite a long list of reasons why this fear may be overstated in the context of energy efficiency LICs as well as a large number of ways in which LIC programs can be set up to minimize this risk.

As summarized by the Columbia Institute in their March 2016 report *This Green House II*, the main issues for Canadian mortgage lenders are:

> "The LIC is subject to a priority lien in favour of the City, which subordinates the lender's position;
>
> For default-insured mortgages, CMHC [Canadian Mortgage and Housing Corporation] has signalled to lenders they will not insure any LIC arrears on a given property; and
>
> Current mortgage underwriting lacks the flexibility to reflect the savings that arise from investments in energy efficiency."[45]

Much of this concern seems to stem from the U.S. Federal Housing Finance Agency's statement regarding super priority liens and the implications for two of the largest mortgage insurance agencies in the U.S. In their December 2014 release, the FHFA states:

> "The existence of these super-priority liens increases the risk of losses to taxpayers. Fannie Mae and Freddie Mac, while operating in conservatorship, currently support the housing finance market by purchasing, guaranteeing, and securitizing single-family mortgages. One of the bedrock principles in this process is that the mortgages supported by Fannie Mae and Freddie Mac must remain in first-lien position, meaning that they have first priority in receiving the proceeds from selling a house in foreclosure. As a result, any lien from a loan added after origination should not be able to jump in line ahead of a Fannie Mae or Freddie Mac mortgage to collect the proceeds of the sale of a foreclosed property."[46]

Further on in this statement, the FHFA prohibited the issuance of mortgage insurance to any property which has an existing priority lien and, in doing so, limited the appeal of such financing programs. Notwithstanding the significant differences in housing markets and

[45] Robert Duffey & Charley Beresford, *This Green House II*, (The Columbia Institute, 2016), 28. http://www.civicgovernance.ca/green-house-ii-2/

[46] Federal Housing Finance Agency, *Statement of the Federal Housing Finance Agency on Certain Super-Priority Liens*, (2014). http://www.fhfa.gov/Media/PublicAffairs/Pages/Statement-of-the-Federal-Housing-Finance-Agency-on-Certain-Super-Priority-Liens.aspx.

history of mortgage defaults, this concern appears to have crept across the border and is now an obstacle for Canadian energy retrofit financing efforts.

In Canada, both Nova Scotia and Ontario have altered the enabling legislation of their municipalities to allow energy efficiency retrofit LICs to be provided.[47] In setting up their legislation and in light of the concerns raised by lenders, some jurisdictions such as Toronto have required LIC applicants to obtain consent from their mortgage lenders in order to be granted an LIC loan.[48] This requirement appears, at the moment, to be an impediment to widespread adoption of the LIC program as only about half of Toronto mortgage holders have been able to obtain consent from their lender to take an LIC loan from the city.[49]

This problem seems most solvable by either:

a. Working with mortgage lenders encourage them to consent to LIC loans more often. In their 2011 report, the Columbia Institute gave the following reasons as to why LIC-backed energy-efficiency loans are low risk for Canadian mortgage lenders:

   "Default rates in existing US PACE programs have been very low – less than 1% overall, and zero in some programs.

   Property-tax default rates in Canada are also very low.

   The value of retrofit financing relative to the value of a mortgage can be kept small. A typical retro-fit under Canada's EnerGuide program cost less than $7000 – less than 2% of the average cost of a home in Canada in 2011, and less than 1% of the value of a house in an expensive market like Vancouver.

   Efficiency improvements generally increase the value of a home, further offsetting any risks to mortgage holders in the event of a default.

   LIC-backed financing can be structured so that only the specific payments in arrears are added to a tax-lien, rather than the entire financing balance. This is already how similar situations with property-tax defaults are handled in some Canadian jurisdictions. After delinquency payments are collected, the remaining repayments are simply passed on to the new owner of the property.

   Homeowners' lower household expenses from energy retrofits will actually increase the funds they have available for mortgage payments.

[47] Ontario did this by amending the City of Toronto Act (O.Reg. 596/06) and the Municipal Act (O.Reg. 586/06) in 2012. Nova Scotia did this by amending the Halifax Regional Municipality Charter in 2010 and the Municipal Government Act in 2012.

[48] *This Green House II*, 28.; City of Toronto, *Home Energy Loan Program Homeowner Guide*, 12. https://www1.toronto.ca/City%20Of%20Toronto/Environment%20and%20Energy/Programs%20for%20Residents/PDFs/LIC/HELP%20Homeowner%20Guide.pdf; A sample of the Toronto consent form can be found at pg 28.

[49] *This Green House II*, 28.; Ottwatch.ca, *Document 2: Assessment of the Use of Local Improvement Charges to Finance Home Energy Retrofits in Ottawa*, (2016) 7-8. http://ottwatch.ca/meetings/file/366137

Canada has a much higher rate of insured mortgages that the US, further reducing the risk to lenders.

Canada's residential mortgage default rate level is very low – less than 0.5% in early 2011. In contrast, around 7% to 9% of US mortgages, on average, have been arrears in the wake of the subprime crisis."[50]

b. Removing the requirement for lender consent and instead working to ensure the security of the mortgages by other requirements. This could be done by providing a screening criteria within the LIC application that would filter out applicants for whom taking on an LIC loan would put their ability to pay their mortgage at risk. Some of the ways this has been done across North America include evaluating "the properties' debt to equity ratio, and the applicants credit score, bankruptcy history, and debt to income ratio."[51] Alternatively, municipalities could set up backstop pools designed to financially guarantee the asset claimed by the mortgage lenders. The goal of both of these approaches would be to ease the concerns of mortgage lenders and thereby reduce the risk of having the LIC program challenged.

## Outstanding Questions

The major legal question here is whether municipalities can legally offer LIC programs that jump the line and create super-priority liens that oust mortgage lenders of their super-priority status.

- The answer to this would seem to lie within the mortgage agreements as provincial governments seem in favour of such programs and have begun to make their legislation consistent with it.
- It appears that, to date, municipalities have been playing it safe and requiring lender consent before offering LIC loans.
- This consent-seeking process is a problem because, ironically, those least likely to get consent from their mortgage lender are also those most likely to benefit from this creative form of gaining credit.

How much of bank resistance to LICs is due to the fact that they are in direct competition with such a program?

- Basically, with the use of LICs, municipalities are giving another option to those who might have taken a commercial bank loan for an energy efficiency project

What are the more detailed reasons banks use for refusing to offer consent?

Would they be willing to give consent in the LIC program offered financial assurance?

[50] Robert Duffey & Heather Fussell, *This Green House: Building Fast Action for Climate Change and Green Jobs*, (The Columbia Institute, 2011), 65. http://www.civicgovernance.ca/wordpress/wp-content/uploads/This%20Green%20House_Report_1.pdf

[51] Dunsky Energy Consulting, *Local Improvement Charge (LIC) Financing Pilot Program Design for Residential Buildings in Ontario*, (2013), 19.