Energiesprong Phase 1 Report
Ottawa Design Workshop

Sustainable Buildings Canada
Report on the Energiesprong Design Workshop
held in Ottawa on July 11, 2017
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EXECUTIVE SUMMARY

Sustainable Buildings Canada (SBC) hosted a one-day design workshop in Ottawa, Ontario on July 11th 2017, to review the Energiesprong retrofit program based in the Netherlands, and to examine the feasibility of implementing a similar program in Canada. Over 40 participants from government, municipal housing providers, building science professionals, architects and engineers engaged in breakout groups investigating technical and policy-related issues and considerations.

Participants were asked to examine and explore the technical and policy-related barriers to Energiesprong implementation. The groups were presented with brief overviews of various technical, energy modeling, and policy-based initiatives and on-going discussions relevant to the conversation. This report outlines the workshop proceedings, key technical and policy discussion outcomes as well as the energy modelling results of the Ottawa Community Housing (OCH) example.

Bryan Flannigan of Posterity Group/SBC facilitated the workshop with the support of Robin Hutcheson of Arborus Consulting/SBC who facilitated the technical breakout session.

Participant teams focused their discussion in two distinct areas:

1. Technical solutions for building envelope and mechanical components, informed by energy modelling results; and
2. Policy issues, considerations, and related recommendations.

Note that this document presents the findings of the workshop as the various issues were discussed. No further elaboration has been undertaken. SBC will undertake a separate report that provides the highlights of the Ottawa workshop, a similar workshop held in Toronto on April 26th 2017, supporting research and related activities. That report will make specific recommendations for next steps.

Key Technical Discussion Outcomes:

Challenges

- Envelope Design
  - Basement insulation
  - Fenestration (Condensation, daylighting, operability vs. leakage).
  - Ventilation
- Installation logistics (e.g. access to building, trees shading potential PV roof)
- Ensuring long-term (30+ years) durability and managing potential risks

Recommendations/ Next Steps

- Consider different basement insulation options: Trenching, interior basement insulation. “Skirt” around exterior of building.
- Identify candidate buildings
• Field testing at NRCan facility or small-scale demonstrations before scaling up.

Key Policy Discussion Outcomes:

Challenges
• Longer term considerations with tenants: operations and maintenance costs; tenant sense of ownership; insurance policies
• Social housing organizations (typically) have limited capacity for anything beyond day-to-day operations and initiatives related to on-going maintenance
• Various priorities need to be managed – those of the project vs social housing agencies vs government(s)
• Depending on the chosen “north star” (net-zero energy vs net-zero emissions etc.), more electrification is a likely outcome

Recommendations
• Plan a tenant engagement strategy – tailored to occupant types
• Meet needs of social housing agencies
• Develop comprehensive roadmap to implementation
• Be ambitious with vision and bold with approach
• Identify sources of potential funding

Areas for further exploration
• How transferable is the Energiesprong model to other housing markets (not just social)?
• What should be the “energy north star”? Zero energy costs versus zero emissions versus zero energy?
• How to address the various social housing ownership and governance models that exist across Canada? Small versus large service providers?
• How to best tackle repairs as a complementary effort with the retrofits?
INTRODUCTION AND BACKGROUND

Sustainable Buildings Canada (SBC) has recently undertaken to develop a program platform for the eventual implementation of the “Energiesprong” program in Canada. Energiesprong is a unique program approach to retrofit buildings originally developed in the Netherlands. The program aims to aggregate individual retrofit opportunities into large segments of demand for equipment suppliers and constructors, encouraging large scale investment and economies of scale in providing products and services to meet the retrofit demand. To date, the Dutch program has focused primarily on providing solutions for the social housing sector. SBC proposes to similarly focus on the social housing sector where aggregation of multiple projects can be achieved by engaging a small number of strategic housing providers as partners.

The typical retrofit includes a major re-cladding of an existing attached row home, a complete switch-out of the mechanical system, and the addition of solar photovoltaics. The intent is to industrialize the process through the use of pre-fabrication and off-site assembly which facilitates rapid deployment with minimal disruption to tenants. In the Netherlands, the entire retrofit activity typically takes two to five days.

The Energiesprong initiative is now being deployed in other countries in Europe including a recent adaptation of the program for roll out in New York State. SBC aims to fast-track the initiative in Canada by implementing a number of concurrent activities, including:

- Engagement with key housing providers and related associations in the province of Ontario;
- Review and assessment of housing provider assets resulting in the identification of priority projects for pilot implementation;
- Development of a detailed scanning process for select projects and scan to Building Information Modelling (BIM) model development;
- Development of a user-friendly savings and cost estimating spreadsheet-based tool that provides a detailed net present value assessment;
- Energy modelling for the various options using townhomes for the Toronto and Ottawa demonstration projects;
- Design workshops in Toronto and Ottawa featuring subject matter experts focusing on key technical and policy issues.

The goal of the Ottawa workshop was to assess potential energy and cost savings associated with an Energiesprong re-cladding retrofit on a community housing unit using panelized insulation systems. This Report presents the highlights of the Ottawa workshop as well as the energy modelling results for a specific Ottawa Community Housing project.
REFERENCE PROJECT- OTTAWA COMMUNITY HOUSING UNIT OVERVIEW

The project examined was an attached social housing unit owned by Ottawa Community Housing located on Iris St in the west end of Ottawa. The unit was selected as a relatively accurate representation of typical social housing building stock in the City of Ottawa. The construction is 1961 vintage brick construction with double glazed windows, steel fibreglass and steel polystyrene doors, a R-27 gable roof. The 117 m² (1,259 ft²) middle unit contains an uninsulated basement and contains an open fireplace. The unit is heated by a forced air condensing furnace with 92% annual fuel utilization efficiency (AFUE), domestic hot water is provided by a 40-gallon natural gas water heater, and ventilation is provided by a principle exhaust fan in the bathroom located on the 2nd floor. An NRCan audit was performed using the EnerGuide Rating System (ERS). The unit achieved an ERS rating of 11.3 (for annual gigajoules used) and air tightness was tested at approximately 8.42 ACH at 50Pa.

Figure 1.0- Iris OCH unit
TECHNICAL PRESENTATIONS

A number of subject matter experts delivered presentations outlining various areas of technical consideration for delivering a deep energy retrofit activity.

Prefabricated Exterior Energy Retrofit (PEER) - CanmetENERGY- NRCan

Mark Carver of NRCan presented the progress and findings of the Prefabricated Exterior Energy Retrofit (PEER) project, which is currently developing prefabricated, panelized wall systems for retrofit in Canada. These panel systems, which are similar to those used by Energiesprong contractors in the Netherlands, are being evaluated by CanmetENERGY and were assessed by SBC as part of the Toronto workshop. Having assessed above-grade walls as the lowest hanging fruit for a prefabricated solution, the PEER project is considering two types of wall systems: a modified structurally insulated panel (SIP) as well as the conventional wood frame panel.

The primary research efforts of the PEER project fall into three main areas:

1. Developing a digital workflow from a 3D scan of an existing house into a building information model optimised for custom panel design and fabrication
2. Panel design, fabrication and installation
3. Building science: minimizing risks of failure

For the purposes of the workshop, the presentation and subsequent technical discussions focused on the latter two research areas.

The presentation outlined the approach taken to set a thermal performance target of R-28 for applications in the Netherlands. Depending on the climate zone, solar resources and other factors, the required insulation value in Canada would differ from the Netherlands. Based on these considerations, NRCan has set a thermal performance target of R-30 to R-40. It was also noted that additional considerations must be made with respect to air sealing details, vapour permeability, structural requirements and whether the retrofit panel will include new windows and doors.

Taking into account these considerations and minimum thermal performance requirements, two wall panel systems, expanded polystyrene (EPS) foam nailbase (Panel A) and Wood-frame standoff wall (Panel B) were chosen for testing. The EPS nailbase panel features a single-sided structurally insulated panel (SIP) or nailbase panel with a low-density foam that would conform to irregularities in the existing wall. A conventional wood frame panel was chosen for consideration due to the well-established fabrication and delivery processes of traditional panelizers. The fabrication and installation of windows, membranes, flashing and cladding could fall to a third-party pre-fabricator. This panel would be spaced away from the existing wall and the cavity would be filled with insulation on site. The following table summarizes the preliminary evaluation and comparison of the two panel systems with respect to thermal performance, air tightness, drying potential, driving rain resistance, and overall constructability.
Both panel concepts would be installed on a test building this summer for side-by-side comparison in terms of performance, cost and constructability.

**Table 1.0 - Evaluation and comparison of panel systems**

<table>
<thead>
<tr>
<th></th>
<th>EPS Nailbase</th>
<th>Wood frame standoff wall</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thermal Resistance</strong></td>
<td>5.3 to 9.0 +</td>
<td>5.3 to 9.0 +</td>
</tr>
<tr>
<td><strong>RSI (R)</strong></td>
<td>(R30 to 52)</td>
<td>(R30 to 52)</td>
</tr>
<tr>
<td><strong>Air barrier</strong></td>
<td>Continuous, exterior</td>
<td>Continuous, exterior</td>
</tr>
<tr>
<td><strong>Drying potential</strong></td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Allows some upward drying</td>
<td></td>
</tr>
<tr>
<td><strong>Driving rain resistance</strong></td>
<td>Cladding + ventilated rain screen</td>
<td>Cladding + ventilated rain screen</td>
</tr>
<tr>
<td><strong>Thermal bridging</strong></td>
<td>Minimal</td>
<td>Minimal</td>
</tr>
<tr>
<td><strong>“Buildability”</strong></td>
<td>Simple</td>
<td>Simple</td>
</tr>
</tbody>
</table>

**High Performance Mechanical Systems**

Larry Brydon of SBC gave a brief presentation highlighting the mechanical systems which were in consideration for Canadian social housing implementation of Energiesprong, detailing the specifications and considerations given in the mechanical systems which were modelled. The current best in class gas furnaces, air conditioning, heat pump, water heater systems and HRV/ERVs were modelled. Table 2.0 illustrates typical rated performance of the high performance mechanical systems discussed.
### Table 2.0- High performance mechanical systems in market

<table>
<thead>
<tr>
<th>Mechanical System</th>
<th>Product name</th>
<th>Rated performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas furnaces</td>
<td>Lennox SLP98V</td>
<td>98.7 AFUE</td>
</tr>
<tr>
<td>VRF air conditioner</td>
<td>Lennox XC25</td>
<td>26 SEER</td>
</tr>
<tr>
<td>VRF heat pump</td>
<td>Lennox XP25</td>
<td>23.5 SEER - 10.2 HSPF</td>
</tr>
<tr>
<td>Heat pump water heater</td>
<td>AO Smith FTPU</td>
<td>3.24 EF</td>
</tr>
<tr>
<td>Tankless water heater</td>
<td>Bosch</td>
<td>0.98 EF</td>
</tr>
<tr>
<td>HRV/ERV</td>
<td>vanEE G2400EE</td>
<td>0.84 SRE</td>
</tr>
</tbody>
</table>

### Solar PV Potential and Issues

The potential power output of Solar PV panels on the roof of the OCH unit was estimated and presented by Robin Hutcheson of Arborus Consulting. The following table summarizes the modelling results with 4 different solar array sizes (5 modules wide and 6 modules wide) and 2 different module sizes (300 and 340W):

<table>
<thead>
<tr>
<th>Roof</th>
<th>Modules (W)</th>
<th>#</th>
<th>Capacity (kW)</th>
<th>Production (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>South</td>
<td>300</td>
<td>10</td>
<td>3</td>
<td>3600</td>
</tr>
<tr>
<td>South &amp; North</td>
<td>300</td>
<td>20</td>
<td>6</td>
<td>6315</td>
</tr>
<tr>
<td>South</td>
<td>300</td>
<td>12</td>
<td>3.6</td>
<td>4320</td>
</tr>
<tr>
<td>South &amp; North</td>
<td>300</td>
<td>24</td>
<td>7.2</td>
<td>7578</td>
</tr>
<tr>
<td>South</td>
<td>340</td>
<td>10</td>
<td>3.4</td>
<td>4080</td>
</tr>
<tr>
<td>South &amp; North</td>
<td>340</td>
<td>20</td>
<td>6.8</td>
<td>7165</td>
</tr>
<tr>
<td>South</td>
<td>340</td>
<td>12</td>
<td>4.08</td>
<td>4900</td>
</tr>
<tr>
<td>South &amp; North</td>
<td>340</td>
<td>24</td>
<td>8.16</td>
<td>8600</td>
</tr>
</tbody>
</table>

The first two rows of the table assume that each roof pitch can accommodate 10 panels while the last two assumes that each roof pitch can accommodate 12 panels.

With the use of 300W and 340W modules there was a production range of 3,600 – 8600 kWh depending on array and module sizes. The current reference case uses 7,000 kWh/year while upgrade measures with ASHPs consume roughly 12,000 kWh/year. Since the resulting solar capacity is under 10kW or less, the capacity is considered micro-generation and falls under potential submission through the micro FIT program, which ends this year.
Energy Modelling Results

This section outlines the approach and results of energy modelling for the reference model as well as several upgrade scenarios that were run using PEER panels and varying mechanical and envelope conditions. Energy modelling was done using HOT2000 V 11.3 using the upgrade functions. Default standard operating conditions were assumed for all upgrade cases as well as the reference case. Electric loads were left as default but may be revised to reflect net-zero or low energy housing defaults.

Several efficiency measures were included in all upgrade cases, including triple glazed windows, R-20 basement insulation, R-28 + R-20 c.i. roof insulation, 84% SRE HRV, 1.5 ACHs, drain water heat recovery and 100% LED lighting. Only main wall assemblies and space heating systems were upgraded. Energy fuel costs are default Ottawa 2008 utility rates in the base reference model but are adjusted to the current Regulated Rate Price. The following table outlines the energy model inputs for the base file. See Appendix A for a full description of the reference and upgrade cases.

Table 4.0 - Base file model inputs

<table>
<thead>
<tr>
<th>Energy Model Inputs</th>
<th>Base File - Iris</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling with Attic Space Min R-Value</td>
<td>R-28</td>
</tr>
<tr>
<td>Walls Above Grade Min R-Value (inc. garage, tall walls, knee walls)</td>
<td>2x4 @ 16” o.c. with R-8 cavity insulation</td>
</tr>
<tr>
<td>Basement Walls Min R-Value</td>
<td>Uninsulated</td>
</tr>
<tr>
<td>SOG Slab Full Under Slab Insulation</td>
<td>N/A</td>
</tr>
<tr>
<td>Edge of Slab Insulation for WO cond.</td>
<td>N/A</td>
</tr>
<tr>
<td>Windows &amp; Patio Doors &amp; Skylights U-Value</td>
<td>U-0.56-0.70/SHGC &gt;0.60</td>
</tr>
<tr>
<td>Space Heating Equip Min AFUE</td>
<td>Condensing furnace 92% AFUE</td>
</tr>
<tr>
<td>HRV Min Efficiency</td>
<td>None</td>
</tr>
<tr>
<td>DHW Min EF</td>
<td>Conventional tank 40 gal. 0.55EF</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>None</td>
</tr>
<tr>
<td>Air Tightness (ACH)</td>
<td>8.42 ACH</td>
</tr>
<tr>
<td>Fireplace</td>
<td>none</td>
</tr>
<tr>
<td>Drain Water Heat Recovery</td>
<td>None</td>
</tr>
<tr>
<td>Energy Efficient Lighting</td>
<td>None</td>
</tr>
<tr>
<td>Base loads</td>
<td>Adjusted to new standard operating conditions</td>
</tr>
<tr>
<td>Rates</td>
<td>Adjusted rates</td>
</tr>
<tr>
<td>Renewables</td>
<td>None</td>
</tr>
</tbody>
</table>
The building energy usage of the reference project building was modelled in HOT2000 prior to the workshop and presented to the technical breakout participants. It was noted that the primary existing annual energy consumption of the building was by space heating (47.3 GJ) followed by lighting and appliances (31.5 GJ), domestic hot water heating (28.5 GJ), and lastly the heat recovery ventilator (HRV) and fans (0.2 GJ).

Recognizing that space heating takes up the largest portion of building energy use, the heat loss through various building components was evaluated and is outlined below:

Considering the energy use breakdown of the reference building, the following priority areas of focus were identified for further consideration:

1) Improve air tightness
2) Improve fenestration U-value
3) Improve wall R-value
4) Improve below-grade heat loss
The first three upgrades modeled represented the Reference unit with an R-20 panelized roof (Figure 4.0) over the existing roof assembly as well as adding R-25, R-30, and R-35 to the walls (see Figure 5.0).

![Figure 4- R-20 Panelized roof assembly over existing roof](image)

![Figure 5- R-35 panelized wall assembly over existing walls](image)

**Table 5.0- PEER Panel upgrade model inputs**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Walls Above Grade Min R-Value</td>
<td>R-30</td>
<td>R-25</td>
<td>R-35</td>
</tr>
<tr>
<td>Space Heating Equip Min AFUE</td>
<td>98% Furnace with VRV ASHP (9.4 HSPF, 15 SEER, cut-off temp -20)</td>
<td>98% Furnace with VRV ASHP (9.4 HSPF, 15 SEER, cut-off temp -20)</td>
<td>98% Furnace with VRV ASHP (9.4 HSPF, 15 SEER, cut-off temp -20)</td>
</tr>
</tbody>
</table>

The following upgrades selected for preliminary modelling were variable refrigerant volume (VRV) air source heat pump and a combination boiler system for space and water heating. The model input details are outlined in the following table.

**Table 6.0- Variable refrigerate volume Air-source heat pump vs. Combination boiler system**

<table>
<thead>
<tr>
<th>Energy Model Inputs</th>
<th>Run 4: VRV ASHP with gas backup</th>
<th>Run 5: Combo System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clg with Attic Space Min R-Value</td>
<td>R-28+R20 c.i.</td>
<td>R-28+R20 c.i.</td>
</tr>
<tr>
<td>Walls Above Grade Min R-Value</td>
<td>R-35</td>
<td>R-35</td>
</tr>
<tr>
<td>Basement Walls Min R-Value</td>
<td>4&quot; exterior c.i. (R-20)</td>
<td>4&quot; exterior c.i. (R-20)</td>
</tr>
<tr>
<td>Space Heating Equip Min AFUE</td>
<td>98% Furnace with VRV ASHP (9.4 HSPF, 15 SEER, cut-off temp -20)</td>
<td>Combo System - 0.98 TPF with VRV ASHP</td>
</tr>
<tr>
<td>Air Tightness (ACH)</td>
<td>1.0 ACH</td>
<td>1.5 ACH</td>
</tr>
</tbody>
</table>
Table 7.0 outlines the remaining runs #6 and #7 which modelled the upgrades corresponding to a gas vs electric back-up of the mechanical heating system.

**Table 7.0- Gas vs electric back-up model inputs**

<table>
<thead>
<tr>
<th>Energy Model Inputs</th>
<th>Run 6: VRV ASHP + Gas Backup</th>
<th>Run 7: Straight VRV ASHP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling with Attic Space Min R-Value</td>
<td>R-28+R20 c.i.</td>
<td>R-28+R20 c.i.</td>
</tr>
<tr>
<td>Walls Above Grade Min R-Value</td>
<td>R-35</td>
<td>R-35</td>
</tr>
<tr>
<td>Space Heating Equip Min AFUE</td>
<td>98% efficient furnace, Heat pump with 8 HSPF/14 SEER (single stage heat pump)</td>
<td>Heat pump with 9.4 HSPF/15 SEER set to -20 with electricity based backup</td>
</tr>
</tbody>
</table>

An annual model was developed for the previously described upgrade cases, with the modeling outputs highlighting site energy consumption, GHG emissions and energy cost (see Appendix A for model inputs).

**Table 8.0- Energy performance summary of base file (OCH) and upgrades**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>Annual Energy Consumption (GJ)</th>
<th>Electricity Consumption (kWh)</th>
<th>Natural Gas Consumption (m³)</th>
<th>GHG Emissions (kg CO₂Eq)</th>
<th>Annual Cost Electricity ($)</th>
<th>Annual Cost Natural Gas ($)</th>
<th>Annual Energy Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASE FILE</td>
<td>Existing House File + Adjustments</td>
<td>107.03</td>
<td>7205.0</td>
<td>2180.0</td>
<td>4457.41</td>
<td>$1,193.49</td>
<td>$829.82</td>
<td>$2,023.31</td>
</tr>
<tr>
<td>Run 1</td>
<td>Full Upgrades ft. PEER Panel R-30</td>
<td>43.8</td>
<td>11731.3</td>
<td>45.7</td>
<td>672.44</td>
<td>$1,813.58</td>
<td>$252.36</td>
<td>$2,065.94</td>
</tr>
<tr>
<td>Run 2</td>
<td>Full Upgrades ft. PEER Panel R-25</td>
<td>43.97</td>
<td>11768.0</td>
<td>46.7</td>
<td>676.15</td>
<td>$1,818.62</td>
<td>$252.63</td>
<td>$2,071.25</td>
</tr>
<tr>
<td>Run 3</td>
<td>Full Upgrades ft. PEER Panel R-35</td>
<td>43.6</td>
<td>11680.7</td>
<td>45.0</td>
<td>668.59</td>
<td>$1,806.66</td>
<td>$252.16</td>
<td>$2,058.82</td>
</tr>
<tr>
<td>Run 4</td>
<td>Run 3 + 1.0 ACH</td>
<td>43.51</td>
<td>11663.3</td>
<td>44.4</td>
<td>666.59</td>
<td>$1,804.27</td>
<td>$252.02</td>
<td>$2,056.29</td>
</tr>
<tr>
<td>Run 5</td>
<td>Run 3 + Combo System 0.98</td>
<td>52.89</td>
<td>11069.0</td>
<td>350.10</td>
<td>1211.29</td>
<td>$1,722.86</td>
<td>$334.71</td>
<td>$2,057.57</td>
</tr>
<tr>
<td>Run 6</td>
<td>Run 1 + Single Stage ASHP + Gas Backup</td>
<td>44.06</td>
<td>12108.8</td>
<td>16</td>
<td>635.50</td>
<td>$1,865.30</td>
<td>$244.33</td>
<td>$2,109.63</td>
</tr>
<tr>
<td>Run 7</td>
<td>Run 1 + VRV ASHP + Electricity-based Backup</td>
<td>43.17</td>
<td>12027.9</td>
<td>0</td>
<td>601.40</td>
<td>$1,854.22</td>
<td>$0.00</td>
<td>$1,854.22</td>
</tr>
</tbody>
</table>
Natural gas consumption and annual energy consumption decreased while electricity consumption increased for all upgrade scenarios. GHG reductions and natural gas cost reductions averaged 84% and 73% all upgrade scenarios, respectively. Run # 7 showed an 8% reduction in annual energy cost, owing to the use of natural gas for space heating. These preliminary energy model results guided the technical discussion.

TECHNICAL ROUNDTABLE- HIGHLIGHTS

High Performance Envelopes and Fenestration- Constructability, Costing, Prefabrication

The following section provides highlights on the various discussion groups’ comments regarding the constraints and considerations of prefabricated panels:

Envelopes and Fenestration Performance Considerations:

- **Windows:** As the windows would be the bridging between wall assemblies, there is a potential weakness in the windows. Also, if not detailed correctly, there may be moisture ingress. The window sill design should allow for water to be directed outwards and not into the walls.
- **Basement Insulation:** One of the concerns identified during the roundtable was basement insulation. One approach includes trenching for below-grade insulation (i.e. a ‘skirt’ needed to cover frost depth) though interior basement insulation is likely a more cost-effective and simple solution. (It is noted that a fundamental principle of the Energiesprong approach is that the retrofits are intended to be non-intrusive).
- **Condensation:** The potential performance issues of both PEER panels were discussed. The group felt that the EPS foam panel may have lower risk of condensation related issues. Coastal climates may require more careful consideration of condensation issues.

Installation Considerations:

- For passive house wall assemblies, there can be issues with failures and water ingress. This is often a detailing issue as there are errors made during construction. Ensuring the proper training of trades-people and General Contractors will be important in avoiding these specific errors.
- The rated air changes per hour (ACHs) may not last over the long term. There may be 1.5 ACHs at the time of installation; however, this may deteriorate quickly if the assembly was not installed correctly or if occupants damage the assembly. Using panels instead of site-built wall assemblies can address many of these issues, and make installation easier.
Financial Considerations:

- In the Canadian context, the energy savings will likely not cover the capital cost, which may be offset to some degree by revenue from solar PV. This needs to be further explored with a more accurate costing activity.
- Although it appears that the retrofit cannot be financed purely based on energy saving, social housing has other sources of funding, making it a good candidate for the EnergieSprong model.
- Community housing is a good candidate for this program as they have access to additional funding, one person can make a single decision about multiple units and overall building design is simple. Nevertheless, there is uncertainty regarding the presence of market demand outside of social housing.
- There may be a resulting overall aesthetic improvement of the building which may improve the retail values of the houses. Homeowners are interested in increasing the value of their property. The PEER panels may be a good option for homes that are concrete block or double/triple brick where there is no other insulation option. This is consistent with the type of building stock in the Netherlands.

Implementation:

- It may be necessary to hire larger, more established contractors for installation, to ensure continued support in the future should part of the panel system fail. Considering this, smaller, less established contractors may be less desirable in the early phases of the project.
- Consideration should be given as to whether production should be kept local, since shipping may be quite expensive. It may also be more cost effective and environmentally friendly to produce locally.
- Each province has different climate zones and bureaucratic constraints. In contrast, the Netherlands has one climate zone and the EnergieSprong program capitalized (eventually) on a uniform acceptance of the process by various levels of government. The building code differs across Canada, making standardization more challenging – uniformity drives down costs.

Mechanical Systems

The following section provides highlights on the various discussion groups’ comments regarding the constraints and considerations of high performance mechanical systems:

Heating:

- Capital cost is an impediment to fuel switching. Energy efficient houses can move towards all electric energy mix; however, this can be expensive. Moving from electric heating to heat pumps will reduce costs, however the switch from natural gas to heat pump is more difficult to justify on a cost basis alone. This option is more suitable for homes lacking access to natural gas or homes that are heated with oil.
• The heat loss from the basement is an important consideration – it will be important to regulate basement warmth and moisture to improve foundation durability and reduce repair needs.
• Oversized heating systems can be avoided by supplying to multiple units in the same block. Integrating various mechanical systems where possible may result in improved efficiency.
• It may be useful to consider a varied approach depending on access (i.e. installation process for individual units vs. connected multiple units).

**Ventilation:**

• Make use of existing ductwork to distribute ventilation air throughout unit.
• There may be a potential to run distribution ducts for ventilation air in pre-fabrication wall (as shown in one Netherlands assembly) which could serve as a dedicated air supplies and exhaust drawing additional moisture from the unit.
• Tenant awareness and education on operation of HRV/ERV will be important to avoid issues arising from the unit being switched off or unplugged.

**Domestic Hot Water:**

• Simplicity is desirable when considering domestic hot water. Combination systems are best for water heaters, and natural gas is the preferred fuel based on its cost (and where available). For units using fuel oil, switching to an electric heat pump would likely be cost-effective.
• AC retrofits depend on the climate, and savings are likely to vary significantly. The existence of ductwork (or lack thereof) is a key consideration and will have a significant impact on the price. Many existing units will have window AC which is not desireable.

**Renewable Energy:**

• PV panels have a very long equipment life expectancy - there have been 30-year panels operating at 80% capacity. New PV panels have double the capacity as older models which should be taken into account when considering solar PV - there are certain models in Sweden with 38% efficiency as well as a solar-tracking lens. Aesthetics have seen major improvement and systems have seen greater integration with roof assemblies.
• Solar shingles have lower efficiency, about 6% and therefore may not be a viable option in this scenario. Solar shingles are not cheaper on a per m² basis and their lifespan is shorter as well. Additionally, heat buildup is an issue with solar shingles, which can lead to early roof replacement.
POLICY PRESENTATIONS

Overview and Framing of Policy Questions
Tom-Pierre Frappé-Sénéclauze of Pembina institute shared a brief outline of a Canadian Integrated Modelling System (CIMS) model conducted to forecast GHG building emissions in British Columbia under three retrofit rate cases. Approximately 1% of existing building stock is retrofitted per year, which represents business as usual. Two additional GHG reduction policy scenarios were also presented for comparison to the business as usual scenario, namely:

- The BC government’s Net-zero ready policy and,
- The BC government’s Net-zero policy supplemented with a comprehensive retrofit strategy

![Figure 2- Emissions from BC buildings, CIMS model by Navius Research](image)

To meet 2030 GHG reduction targets of 40-50% from 2015, it will be necessary to retrofit at least 3% of the provincial building stock in BC annually. The target of 3% of BC building stock represents a combination of approximately 30,000 homes, 800 (17,000 units) Multiple Unit Residential Buildings
(MURBs), and 1,800 Industrial, Commercial or Institutional (ICI) buildings per year. For comparison, Figure 4 below summarizes the outcome of seven years of energy efficiency incentives under the LiveSmart BC Efficiency Incentive Program and ecoENERGY Retrofit program, which showed that 6% of the eligible stock was retrofitted over the seven years.

In addition to GHG reductions, a significant level of electrification occurred under these programs. Between April 2008 and March 2011, about 8,000 homes converted from oil, natural gas, or propane heating to electrical heating under the heat pump LiveSmart incentives. This represents roughly 0.7% of the approximately 1.2 million households eligible for the program. A survey of utility customers that did not participate in LiveSmart suggests that another 35,000 BC households installed an air source heat pump during these two years, thought it is unclear what fraction of these systems replaced oil or natural gas heating (vs. supplementing existing systems or displacing electrical baseboards). Assuming that non-participants switched from natural gas to electricity at the rate of the LiveSmart participants, it is estimated that 2% of all homes throughout the province were electrified during those three years. Reaching a 1.5% electrification rate for homes, which is required to meet 2030 GHG targets, therefore seems to be within reach.

With respect to MURBs and ICIs, there is currently a lack of accurate data on current rates of retrofits in those building types. However, the main service providers for utility-funded MURB retrofit programs in BC estimated that they retrofit about 300 buildings annually (~12,000 units), 85-90% of which are limited to the most cost-effective measures (weatherization, lighting, fixtures; reaching savings of 10-15%) and 10-15% of which include some equipment replacements (~30 buildings per year, 1000 units;
reaching savings of 20-30%). The number of buildings undergoing deeper retrofits is also increasing. Combined, this corresponds roughly to a 2.5% penetration rate for retrofit activity, which is not far from the 2030 GHG reduction objective despite the scope of typical retrofits being generally too small to meet policy objectives. To meet GHG reduction targets, most interventions would need to include moderate-to-deep retrofits, and half would need to include a fuel switch.

**Insights on Occupants from Market Segmentation Data**

Jessica Webster of NRCan gave a brief presentation of the findings from a recent Environics Analytics study that used market segmentation to assess occupants of social housing in the City of Ottawa. The study used Environics’ PRIZM5 market segmentation data to provide metrics relating to dwelling characteristics, demographics, energy behaviour, psychographics (i.e. values) as well as media use. The main objective was to evaluate market segmentation as an approach to inform communications and engagement strategy for a retrofit program in the City of Ottawa. The presentation and discussion focused on how market segmentation and other social science techniques such as interviews and surveys, could be used to inform a communications and engagement strategy in conjunction with retrofit projects.

Market segmentation divides the entire Canadian residential population into 68 groups or segments. Each residential postal code in Canada is linked with one of the 68 segments. The City of Ottawa provided 510 postal codes corresponding to all social housing in the City. These postal codes represent approximately 22,361 households and 44,295 people. Within these postal codes, 31 of the 68 market segments were identified. These 31 market segments were grouped into three major categories:

1. Less affluent, young neighbourhood
2. Younger neighbourhood mix
3. Mature neighbourhoods

Recognizing the importance of understanding occupant behaviour and needs towards evaluating the feasibility of retrofit programs, the Environics data was compared with OCH tenant profiles.

Approximately 60% of the postal codes fell into the first target group: “Less Affluent, Young Neighbourhoods”. 20% were grouped into “Younger Neighbourhood Mix”. Approximately 10% were grouped into the “Mature Neighbourhoods” target group. The remaining 10% were deemed non-target for the program. The presentation of the findings focused on the results for the less affluent and mature neighbourhood groups.

Highlights of results across the major groupings included:

- Between 29% and 47% of respondents indicated having windows open every day in winter.
- Low responses for knowledge of heating energy source, indicates low levels of energy literacy.
- Direct mail was a media channel common to all three market groups.
The following observations were made from the comparison of the Environics study with OCH tenant profiles:

- While the Environics results characterized social housing occupants across the city, OCH profiles are specific to a neighbourhood;
- Environics found household size to be smaller, 1-2 persons. In contrast, OCH has a high prevalence of children and large families, non-English or French speaking households; and,
- OCH profiles have no information on social details or values.

The presentation concluded with recommendations to better understand and utilize market segmentation data, in conjunction with other techniques, to plan a tenant communication and engagement strategy to accompany a retrofit project:

- An occupant communication and engagement strategy must be planned in tandem with the technical retrofit.
  - Energy savings obtained through higher performance walls, mechanicals and renewables would be negated if occupants continued to keep their windows open in winter, for example. An engagement and education component must accompany a prefabricated retrofit.
- It is important to tailor messaging according to tenant social values. E.g., Emphasize financial savings, environmental benefits, or health/comfort benefits.
- Low levels of energy literacy are an educational opportunity for all occupants. Consider in particular engaging and educating children to foster behavioural change.
  - Possible strategies include educational games (e.g., “Energy detective”).
- Technology should be selected depending on occupants “attraction or aversion to technology”
- Consideration must be given to conducting outreach in non-official languages.
- Communication through direct mail may be an effective communications approach across segments.
- Market segmentation should be used in combination with other data/methods such as interviews for more effective results.

“North Star” Objective

Tom-Pierre Frappé-Sénéclauze of Pembina Institute gave a brief presentation regarding the importance of setting the proper goalpost or “North Star” when considering EnergieSprong implementation in Canada. Whether the aim is Zero carbon, Net-zero energy, Net-zero energy cost, Net-zero energy-ready or another metric, the importance of clearly and simply defining various Net-zero metrics was emphasized.

“Net-zero energy” was defined as “a building that generates on-site (or nearby) as much energy as it consumes over the course of a year”. It was noted that using energy as the metric may not adequately address carbon, however, it does eliminate the need to consider the variation in carbon intensity of the various fuels.
“Net-zero energy ready” was defined as “a building that is so energy efficient that it could generate on-site (or nearby) as much energy as it consumes over the course of a year”. With this definition, the focus is on energy efficiency and a case for on-site generation is determined by customers based on specific local factors. Similar to net zero energy, in this context, designs are only climate dependant and there is no differentiation between the carbon intensity of fuels. The operational definition in this context needs more clarity and the overall conclusion was that this term is less inspirational as it lacks the specific inclusion of photo voltaic (PV) measures.

A term which is more effective at factoring in carbon intensity of fuels is “Net-zero carbon”, which was defined as “a building that produces on site (or possibly procures) renewable energy to offset the emissions resulting from building operations.” It was noted that a primary driver of energy efficiency efforts is the goal of reducing carbon. However, the most important factor in the carbon footprint of a building is often not its energy performance but the carbon intensity of the local electrical grid and fossil fuels used. Net-zero carbon was noted as aligning more closely with climate objectives, encouraging low-carbon heating fuel (recognizing biogas as carbon neutral), encouraging self-utilization, as well as adding energy efficiency criteria to avoid ‘freeloading’ on the clean grid. Moreover, it was noted that if the grid energy is supplied by clean or renewable sources, on-site generation will only be considered if it is more cost-effective than purchasing from the grid. Likewise, if the grid is sourced from ‘dirty’ or non-renewable energy (e.g. if combustion of fossil fuels is used), on or off-site generation will be enough to offset resulting emissions.

“Net-zero energy costs” was defined as “a building that produces on site (or nearby) enough energy to offset the COST of all energy used in the building.” Use of this metric theoretically leads to a lower cost solution, however consideration must be made of the climate objectives as the use of natural gas is encouraged based on its relatively low price while renewable energy use is discouraged because of its higher price. It was also highlighted that there is a subsequent assumption on future energy costs that is required for this metric. In terms of outcomes, it was noted that potential solutions would vary from locale to locale with respect to terms for net-metering or feed-in-tariff (FIT) programs and current and future energy cost. Lastly, it was noted that service providers would likely be unable to offer a ‘net-zero energy cost’ warranty as fuel cost is not something they can control.

The following table outlines the comparison made between varying net-zero objectives and metrics with respect to applicability:
Table 9.0- Summary of Net-zero terms

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Zero carbon</th>
<th>Net-zero energy</th>
<th>Net-zero energy ready</th>
<th>Net-zero cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Align with grid objectives</td>
<td>✓</td>
<td>X / ✓</td>
<td>✓</td>
<td>X / ✓</td>
</tr>
<tr>
<td>Encourage use of low-carbon fuels</td>
<td>✓</td>
<td>~</td>
<td>~</td>
<td>X</td>
</tr>
<tr>
<td>Design transferable to different grids</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
<td>XX</td>
</tr>
<tr>
<td>Can be object of a warranty</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Simple to communicate</td>
<td>XX</td>
<td>X</td>
<td>XX</td>
<td>X</td>
</tr>
</tbody>
</table>

It is noted that aligning with grid objectives and the carbon content of fuels will vary across the provinces. It is anticipated that greater electrification might occur as a result of the retrofits – particularly where air source heat pumps are used for heating and cooling. In provinces with a high percentage of hydroelectric or nuclear generation, this will not impact carbon emissions. Provinces that rely on carbon sources for electricity generation will see an impact on carbon emissions from electricity generation. A more fulsome analysis of the specific grid level impacts may need to be undertaken as part of the next set of activities.

While attendees noted the various attributes and issues associated with the different metrics, there was general support for the use of “Net Zero Energy” as the primary metric.

SBC notes that the preliminary discussions regarding adopting Energiesprong postulated a net zero energy cost metric. Based on these discussions and related insights from our program partners, SBC recommends using net zero energy as the appropriate metric for the next steps.

POLICY ROUNDABLE- HIGHLIGHTS

The following provides highlights of the various policy discussions that were held during the morning sessions, primarily focused on the overview and framing of policy questions, occupant insight from the Environics study data as well as the North Star objectives.

Overview and framing of policy questions:

Group participants were provided with the following questions to guide the discussion of the framing of policy questions as well as the “North Star” program objectives:

- What is the goalpost we are aiming for?
The goal we set influences design trade-offs:
- How much energy efficiency should be pursued before using renewables?
- Which heating fuels are optimal in this context?
- What is the balance between self-generation vs reliance on grid supply?
- How much energy should be self-utilized vs obtained from grid storage?

The main points raised in response to these questions were:

- The retrofit model selected must be able to transfer from social housing to other housing markets to be a sustainable business case and achieve targets.
- Other objectives are also important to consider:
  1. Tenant and contractor accessibility during construction
  2. Deferred maintenance
  3. Seismic resilience (specifically for British Columbia)
  4. Grid integration of renewables
- There are 2 major audiences for this business case:
  - Government and public institutions
  - Financial institutions (who are concerned about the loan conditions)
- Financial impacts (i.e. taxes) of positive or negative cash-flow situations.
- Different governance models must be considered depending on where the ownership and operation of various social housing units fall.

The tenant engagement discussion yielded the following points and considerations:

- To engage the population and encourage buy-in from tenants the worlds of engineering, financing and social programming must be merged and their synergies explored.
- Tenants “call the shots” on many boards for social housing. Consideration of the tenant perspective must be integrated throughout the entire process.
- The acknowledgement and sense of tenant ownership and pride are important to tenant adoption and participation.

Insights from Occupants in Environics Study Data

The policy breakout participants engaged in a brief discussion of the PRIZM5 market segmentation study results. The OCH representatives provided comments and reflections to the market segmentation approach and subsequent use for designing a communication strategy for a retrofit program:

- The City of Ottawa installed central temperature management systems, but also installed in-suite thermostats to allow occupants a temperate control of about 2-3 degrees which resulted in a 30% reduction in energy use.
• OCH noted that it is important to “ground truth” market segmentation with the reality of the tenants and the social housing provider. For example, the RESET program in Toronto conducts on-the-street interviews with people to engage tenants.

• There was agreement that there is a need to plan an occupant engagement strategy with a retrofit program, including tailoring the messaging to demographics and social values, and selecting the method, language, and communication that will best engage with the tenant.

• It was noted that the Energiesprong model is very aware of the importance of tenant engagement, as the model requires that all tenants must agree to the retrofit before it can be conducted.

• To help improve tenant quality of life, Energiesprong projects also do community scale landscaping and clean up as part of the retrofit. Energiesprong organizers also made it clear to contractors that they were operating on people’s property and in their homes so respect was required.

• It was also speculated that the Netherlands might be more socially minded than most Canadian communities.

• The room agreed a collaborative approach is needed, and discussed how to bring various organizations and expertise together to ensure success of retrofits.

“North Star” Discussion

The “North Star” discussion was originally focused on energy, and what should be selected as the target metric to measure success of retrofits: zero carbon, net zero energy, net zero energy ready, net zero cost, or others. The conversation used energy goals as a starting point, and then discussed other potential goals and objectives of the Energiesprong model. The conversation centered around the need for the Energiesprong model to consider the priorities and concerns of social housing providers and their tenants, as well how an Energiesprong solution might fit into current priorities and constraints.

Energy “North Star” for Retrofits:

• Different energy objectives have trade-offs
  o The zero cost objective leans towards natural gas which results in a trade off between pushing the market to electrical solutions or allowing natural gas to be part of the solution.
  o The federal government focus on net zero energy ready (focus on energy, not carbon) then prioritizes EUI and means new codes are focused on energy, not just emissions.
  o Codes in BC are preparing the market for net zero ready homes, but the codes are fuel agnostic. To be effective, codes must consider carbon intensity.

• Natural gas and the merits (or lack thereof) of a transitional fuel was a topic of conservation. It was shared with the discussion group that many social housing providers present at the Energiesprong workshop in Toronto expressed reluctance to switch to electric systems due to energy costs, as natural gas is currently much cheaper than electricity in Ontario. Netherlands made a serious commitment to their climate change goals, including reducing their consumption.
of natural gas irrespective of cost because the risks of climate change are seen as too grave. Some are concerned that a dependence on natural gas will continue to grow if it is assumed that the solution is impossible without it. If new homes are being built with natural gas based end uses, then we are missing the opportunity to create a low carbon future.

• The role of energy costs was considered. If the envelope is done correctly, then electricity usage can be significantly reduced which reduces energy costs. This relationship needs to be accurately communicated. Some noted that because energy costs are constantly changing, we need to be ambitious with our goals and not design a program that is based on the current costs. Indeed, while the price of natural gas is low at the moment, it has been high in the past and could increase if there were major policy pressures (regarding the use of fracking, for example).

Social Housing and Tenant Needs, Priorities and Constraints:

• Social housing representatives explained their main priorities for their tenants and organization, and the constraints they face to achieving their goals. Many social housing units are in desperate need of repairs, which is a top priority for many. The limits of financial capital and staff capacity are two constraints facing social housing organizations, and pose real limitations to their work. These realities must be considered when suggesting retrofits for social housing.

• The social housing landscape differs across Canada. It was explained that the social housing system is characterized by many large units and a large number of small housing providers. The following considerations were discussed as the group explored how this might affect program uptake:
  o Small housing providers may not have the capacity to do the analysis. They need to be given access to the required tools and support. This is a key requirement.
  o The National Housing Strategy (NHS) is promising a technical resource centre to respond to the need to grow sector capacity which will be a big opportunity for new social housing. It will be important to pitch for the sector to develop and deliver this resource center, linking it to other tangible NHS outcomes.
  o Leveraging other assets such as land will allow more opportunities to be built

• It was suggested that repairs could be conducted simultaneously with the retrofit via Energiesprong – making use of state of good repair funding as a concurrent investment opportunity.

• It was emphasized that the business case for Energiesprong must integrate the realities and concerns that face social housing operators. The business case must also consider the capital plans of social housing organizations.

• Critical to the success of Energiesprong is consideration for tenant comfort and engagement. Concerns for tenants included:
  o Relocation which will be necessary if construction is more than 24 hours or is deemed to be intrusive (In the Netherlands, the program evolved such that relocation is no longer necessary).
Tenant involvement - if there is any property damage (i.e. solar panel) who bears the financial responsibility for repair?

- Full cost considerations - all costs incurred at the start (construction, relocating tenants, etc.)

**Cost as a “North Star”:**

Cost-effectiveness is seen as crucial for the success of Energiesprong. Financial viability was discussed in detail, including the following:

- Creating economies of scale to bring down costs include the following strategies:
  - Partnering with suppliers along the supply chain,
  - Developing pilots while engaging in a higher quantity of larger projects,
  - Partnering with large construction companies who have an interest in being an environmental and social leader and who also see the business opportunity.

- Concerns were related to where responsibility for maintenance would fall as well as how longer-term maintenance and repair costs would be properly incorporated. The concept of the 30 year performance guarantee is great – as long as those companies continue to be in business.

- It was emphasized that an essential component to the Energiesprong model is its ability to aggregate enough homes such that supplies can offer discounts for bulk purchases. It was concluded that because technical solutions exist, the key would lie in deployment.

**Alignment with Government Priorities:**

The merits and potential risks of aligning with current government priorities to bring the Energiesprong approach to various Canadian jurisdictions were discussed.

- Alignment with government objectives is important to capitalize on funding opportunities and advance the program.
- Government buy-in is dependent on current government priorities and objectives.
- The program should avoid being caught up within the constraints of the current government agenda and instead focus on project objectives.
- The geographical and political realities of Canada and the Netherlands are quite different. It was suggested to focus first on the provinces where the greatest gains can be made.
- The group was reminded that Energiesprong should be viewed through a climate change lens and as a holistic approach to addressing many climate and social issues.

While the group had differing views on how an Energiesprong solution should be “pitched” in Canada, the conversation highlighted the need to consider the various priorities of the players involved and if the model was to be successful in Canada, it would have to adjust to the regional nuances across the country. Ultimately, the Energiesprong model is designed to address multiple issues and the solution administrators must be effective at communicating this to the various stakeholders.
Exploring an Energiesprong Roadmap for Scale-up to Provincial and National Scale

Framing/Approach:

- It was noted that for Energiesprong in the Netherlands, elements of the program pushed existing regulations, so they lobbied for the applicable laws to be changed once a minimum amount of success was already achieved; this in turn lead to market transformation.
- There are potential issues with the lengthy lead time required to prepare tenants—OCH says that if the goal is to roll out the program in 2 years, it is already too late. Therefore, a well constructed roadmap and portfolio management strategy is needed to incorporate any plans as soon as possible.
- The program could be approached as resembling a business creating a replicable product. If a tenant is interested, there should be the opportunity to engage with prior participants. This outlines the importance of legacy in the approach if the program is to be viewed as viable and repeatable.
- It will be important for OCH to assist smaller housing providers in participation as they are more likely to be constrained by spending needs relating to regulated and safety-related items.
- The story that the program tells must be tailored to best appeal to a wide variety of interests including climate change and social housing, which are both government priorities.
- Understanding how to frame the Energiesprong program as a solution for social housing agencies and a way to meet their needs will be critical to success as their funding is limited and they are less likely to invest in items that don’t meet top priorities.
- Technical elements exist in isolation – the innovation is in bringing them together along with the project implementation, financing, etc.
- R&D is not just about new technologies – it’s testing the applicability and cost-effectiveness of existing technology. Fleshing out the path through R&D is important to the success of this program.

Regulatory Considerations:

- There is an apparent regulatory barrier present due to the inability of regulation to control how many new homes are built. There exists no retrofit building code and no substantial changes are being proposed as the 2018 code cycle approaches.
- How will authorities be convinced to do deep retrofits for a small number of units versus shallow retrofits for a higher number of units?
  - It is important to decide what approach will be undertaken to meet 2030 GHG targets. Deep retrofits will be necessary to reach this objective as a higher quantity of shallow retrofits would only serve to lock in certain technologies at the cost of meeting 2030 targets. This would in turn erode the business case for future changes required to meet future targets.
  - There is a political risk to not meeting targets upon which this program hinges.
- Intended to be fully government subsidized by government for the first few years.
SBC has 10 housing providers who have provided a letter of commitment for the pilot project with MOECC funding. It is anticipated that initial projects would come from their stock of buildings and would be fully funded by the government.

In the future, opportunities may exist for insurance companies to get involved as UK insurance companies are currently developing products for these projects.

**Financing/Funding:**

The group discussed supporting programs and potential funding opportunities for Energiesprong implementation in Canada:

1. Is there a phase in the deployment of Energiesprong that can be supported by existing/upcoming funding?
2. What are the pathways/actions that would be required to ensure alignment of Energiesprong with program objectives?
3. Are there any tangible next steps for SBC?

The financing discussion raised the following points:

- The Ministry of Environment and Climate Change (MOECC) is struggling because social housing providers are not prepared to receive a high amount of funding as they do not have the internal resources to make the appropriate decisions related to that funding (i.e. what are the priorities etc). It was understood that this may be a potential analysis role that the market development team would be well positioned to fill.
  - Procurement processes for social housing agencies can take up to 4 months. Furthermore, seasonal constraints are important to note.
- Conventional mindsets about funding sources may need to shift towards viewing public funds as an appropriate source of money for such a program
- The Federation of Canadian Municipalities (FCM) has two reserves of funding for social housing which can provide funding for different studies and projects.

**KEY TECHNICAL AND POLICY DISCUSSION OUTCOMES**

Upon completion of the technical and policy break-out discussion sessions, key highlights and outcomes from each session were summarized and presented to all workshop participants. This involved an outline of various challenges, recommendations as well as areas of further exploration which were deliberated within the table discussion groups.

**Key Technical Discussion Takeaways:**

**Challenges**

- Envelope Design
  - Basement insulation,
  - Design of windows (Condensation, daylighting, operability vs. leakage),
Ventilation,

- Installation logistics (e.g. access to building, trees shading potential PV roof),
- Ensuring long-term (30+ years) durability and managing potential risks.

Recommendations/ Next Steps

- Consider different basement insulation options: Trenching, interior basement insulation, “skirt” around exterior of building,
- Identify candidate buildings,
- Identify available funding and make initial requests,
- Field testing at NRCan facility, with small scale installations before scaling up.

Key Policy Discussion Takeaways:

Challenges

- Longer term considerations with tenants: operations and maintenance costs if a tenant is at fault; feeling of home ownership; insurance policies,
- Social housing organizations (typically) have limited capacity for anything beyond day-to-day tasks,
- Various priorities need to be managed – those of the project vs social housing agencies vs government(s) – look for ways to align these,
- Depending on the chosen “north star” (net-zero energy vs net-zero emissions etc.), more electrification of traditional gas end uses may be required.

Recommendations

- Carefully plan a tenant engagement strategy – tailored to occupant types,
- Meet needs of social housing agencies,
- Develop comprehensive roadmap,
- Be ambitious with vision and bold with approach.

Areas for further exploration

- How transferable is the Energiesprong model to other housing markets (not just social)?
- What should be the energy “north star”? Zero energy costs, or zero emissions? (Note that there was general agreement that net zero energy is appropriate in the short term).
- How to address the various social housing ownership and governance models that exist across Canada? Small versus large service providers?
- How to best tackle repairs along with retrofits?
## APPENDIX A: Energy Model Specifications

### Table 10.0: Specifications of base file and various upgrades

<table>
<thead>
<tr>
<th>File Name</th>
<th>BASE FILE</th>
<th>Run 1</th>
<th>Run 2</th>
<th>Run 3</th>
<th>Run 4</th>
<th>Run 5</th>
<th>Run 6</th>
<th>Run 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>H2K Input Summary</td>
<td>2479B - Iris + adjustments</td>
<td>NZE+NRCan - PEER panel1</td>
<td>NZE+NRCan - PEER panel2</td>
<td>NZE+NRCan - PEER panel3</td>
<td>Run 3+98% Furnace with DHWHP</td>
<td>Run 3+combo system</td>
<td>Run 3+SS ASHP with gas furnace backup</td>
<td>Run 3+ VRV ASHP with electricity backup</td>
</tr>
<tr>
<td>Walls Above Grade Min R-Value (inc. garage, tall walls, kneewalls)</td>
<td>2x4 @ 16” o.c. with R-8 cavity insulation</td>
<td>R-30</td>
<td>R-25</td>
<td>R-35</td>
<td>R-35</td>
<td>R-35</td>
<td>R-35</td>
<td>R-35</td>
</tr>
<tr>
<td>Basement Walls Min R-Value</td>
<td>Uninsulated</td>
<td>4&quot; exterior c.i. (R-20)</td>
<td>4&quot; exterior c.i. (R-20)</td>
<td>4&quot; exterior c.i. (R-20)</td>
<td>4&quot; exterior c.i. (R-20)</td>
<td>4&quot; exterior c.i. (R-20)</td>
<td>4&quot; exterior c.i. (R-20)</td>
<td></td>
</tr>
<tr>
<td>SOG Slab Full Under Slab Insul</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Edge of Slab Insul for WO cond.</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Windows &amp; Patio Doors &amp; Skylights U-Value</td>
<td>U-0.56-0.70/SHGC &gt;0.60</td>
<td>Triple glazed IGU’s (U-1.1, SHGC 0.38)</td>
<td>Triple glazed IGU’s (U-1.1, SHGC 0.38)</td>
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<td>Triple glazed IGU’s (U-1.1, SHGC 0.38)</td>
</tr>
<tr>
<td>Space Heating Equip Min AFUE</td>
<td>Condensing furnace 93% AFUE</td>
<td>98% Furnace with VRV ASHP (9.4 HSPF, 15 SEER, cut-off temp -20)</td>
<td>98% Furnace with VRV ASHP (9.4 HSPF, 15 SEER, cut-off temp -20)</td>
<td>98% Furnace with VRV ASHP (9.4 HSPF, 15 SEER, cut-off temp -20)</td>
<td>8K Furnace with VRV ASHP (9.4 HSPF, 15 SEER, cut-off temp -20)</td>
<td>8K Furnace with VRV ASHP (9.4 HSPF, 15 SEER, cut-off temp -20)</td>
<td>8K Furnace with VRV ASHP (9.4 HSPF, 15 SEER, cut-off temp -20)</td>
<td>96% efficient furnace, Heat pump with 8 HSPF/14 SEER (single stage heat pump)</td>
</tr>
<tr>
<td>HRV Min Efficiency</td>
<td>None</td>
<td>Venmar 84% SRE</td>
<td>Venmar 84% SRE</td>
<td>Venmar 84% SRE</td>
<td>Venmar 84% SRE</td>
<td>Venmar 84% SRE</td>
<td>Venmar 84% SRE</td>
<td>Venmar 84% SRE</td>
</tr>
<tr>
<td>DHW Min EF</td>
<td>Conventional tank 40 gal. 0.55EF</td>
<td>RHEEM 3.5 EF HPWH</td>
<td>RHEEM 3.5 EF HPWH</td>
<td>RHEEM 3.5 EF HPWH</td>
<td>RHEEM 3.5 EF HPWH</td>
<td>RHEEM 3.5 EF HPWH</td>
<td>RHEEM 3.5 EF HPWH</td>
<td>RHEEM 3.5 EF HPWH</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>None (VRV ASHP)</td>
<td>(VRV ASHP)</td>
<td>(VRV ASHP)</td>
<td>(VRV ASHP)</td>
<td>(VRV ASHP)</td>
<td>(VRV ASHP)</td>
<td>(VRV ASHP)</td>
<td>(VRV ASHP)</td>
</tr>
<tr>
<td>Air Tightness (ACH)</td>
<td>8.42 ACH</td>
<td>1.5 ACH</td>
<td>1.5 ACH</td>
<td>1.5 ACH</td>
<td>1.0 ACH</td>
<td>1.5 ACH</td>
<td>1.5 ACH</td>
<td>1.5 ACH</td>
</tr>
<tr>
<td>Fireplace</td>
<td>Open fireplace</td>
<td>spark ignition (sealed)</td>
<td>spark ignition (sealed)</td>
<td>spark ignition (sealed)</td>
<td>spark ignition (sealed)</td>
<td>spark ignition (sealed)</td>
<td>spark ignition (sealed)</td>
<td>spark ignition (sealed)</td>
</tr>
<tr>
<td>Drain Water Heat Recovery Energy Efficient Lighting</td>
<td>None</td>
<td>2-showers 48% eff.</td>
<td>2-showers 48% eff.</td>
<td>2-showers 48% eff.</td>
<td>2-showers 48% eff.</td>
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<td>2-showers 48% eff.</td>
</tr>
<tr>
<td>Base loads</td>
<td>Adjusted to new standard operating conditions</td>
<td>Standard operating conditions</td>
<td>Standard operating conditions</td>
<td>Standard operating conditions</td>
<td>Standard operating conditions</td>
<td>Standard operating conditions</td>
<td>Standard operating conditions</td>
<td>Standard operating conditions</td>
</tr>
<tr>
<td>Rates</td>
<td>Adjusted rates</td>
<td>Adjusted rates</td>
<td>Adjusted rates</td>
<td>Adjusted rates</td>
<td>Adjusted rates</td>
<td>Adjusted rates</td>
<td>Adjusted rates</td>
<td>Adjusted rates</td>
</tr>
<tr>
<td>Renewables</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>