Case 1: Single-family home
Example: Single-family house in North Vancouver

<table>
<thead>
<tr>
<th></th>
<th>Vancouver PER Factor</th>
<th>EUI kWh/m²a</th>
<th>PER kWh/m²a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>1.5</td>
<td>14.4</td>
<td>18.7</td>
</tr>
<tr>
<td>Cooling</td>
<td>1</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Hot Water</td>
<td>1.15</td>
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</tr>
<tr>
<td>Aux. Heating</td>
<td>1.5</td>
<td>5.8</td>
<td>8.7</td>
</tr>
<tr>
<td>Aux Electric</td>
<td>1.2</td>
<td>9.8</td>
<td>11.7</td>
</tr>
</tbody>
</table>

→ Total PER = 44.9 kWh/m²a

→ Achieves Passive House criteria of 60 kWh/m²TFA/year
Case Two: Nineteen small-suites on three floors

Nineteen kitchens, bathrooms, televisions, computers, etc.
Nineteen times everything...

→ Refrigeration
→ Laundry
→ Corridor Lighting
→ Cooking
→ Plug Loads
→ Dishwashing
→ Elevator
→ Unit Lighting
### Case Two: Nineteen small suites

This building has same heat pump as the single-family home

<table>
<thead>
<tr>
<th></th>
<th>Single-family dwelling (kWh/ m²a)</th>
<th>19 unit building (kWh/ m²a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>18.7</td>
<td>12.7</td>
</tr>
<tr>
<td>Cooling</td>
<td>0.8</td>
<td>1.6</td>
</tr>
<tr>
<td>Hot Water</td>
<td>5.0</td>
<td>8.9</td>
</tr>
<tr>
<td>Aux Heating</td>
<td>8.7</td>
<td>5.3</td>
</tr>
<tr>
<td>Aux Electric</td>
<td>11.7</td>
<td>29.9</td>
</tr>
<tr>
<td><strong>PER</strong></td>
<td><strong>44.9</strong></td>
<td><strong>58.4</strong></td>
</tr>
</tbody>
</table>
Case three: 24 apartments, district energy
ELECTRICITY BREAKDOWN

- Appliances: 41%
- Elevator: 13%
- Interior common lights: 10%
- Consumer electronics: 3%
- Suite lighting: 2%
- Winter ventilation: 4%
- Summer ventilation: 3%
- Defrost: 1%
- DHW system pumps: 14%
- Heating system pumps: 9%
- Defrost: 1%
- Winter ventilation: 4%
- Summer ventilation: 3%
- Defrost: 1%
- DHW system pumps: 14%
- Heating system pumps: 9%
- Interior common lights: 10%
- Consumer electronics: 3%
- Suite lighting: 2%
# Case Three: 24-unit building on district energy

<table>
<thead>
<tr>
<th></th>
<th>Single-family dwelling (kWh/ m²a)</th>
<th>19 unit building (kWh/ m²a)</th>
<th>24 unit building (kWh/ m²a)</th>
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<tbody>
<tr>
<td>Heating</td>
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<td>Cooling</td>
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<td>1.6</td>
<td>1.1</td>
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<td>16.2</td>
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<tr>
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<td>32.0</td>
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<td><strong>PER</strong></td>
<td><strong>44.9</strong></td>
<td><strong>58.4</strong></td>
<td><strong>62.6</strong></td>
</tr>
</tbody>
</table>

→ This building is connected to a district energy system
Case Four: 624 unit over retail space
Serving 1,000+ meals per day
PER demand driven by kitchen & ventilation

- Equipment, Appliances and Plug Loads, 50.1
- DHW, 14.6
- Heating, 6.3
- Cooling, 8.7
- Lighting, 17.0
- Fans and Pumps, 11.5
- **Equipment, Appliances and Plug Loads, 50.1**
## Case Four: 750 bed dormitory

<table>
<thead>
<tr>
<th></th>
<th>Single-family dwelling (kWh/m²a)</th>
<th>19 unit building (kWh/m²a)</th>
<th>24 unit building (kWh/m²a)</th>
<th>624 unit building (kWh/m²a)</th>
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<tr>
<td>Cooling</td>
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<td>1.6</td>
<td>1.1</td>
<td>8.7</td>
</tr>
<tr>
<td>Hot Water</td>
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<td>8.9</td>
<td>16.2</td>
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<tr>
<td>Aux Heating</td>
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<td>7.5</td>
<td>11.5</td>
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<tr>
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<tr>
<td><strong>PER</strong></td>
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<td><strong>58.4</strong></td>
<td><strong>62.6</strong></td>
<td><strong>108</strong></td>
</tr>
</tbody>
</table>
PHI recognizes commercial spaces use more PER

→ Residential, office, schools
  → Expected to meet existing PER limits in most instances

→ Supermarkets, restaurants, other intensive usages…
  → First demonstrate exemplarily mechanical design
  → Set an achievable PER budget
  → Approach PHI via Certifier to discuss project-specific limits
How do non-Passive House buildings perform?

Typical Vancouver (RDH MURB Study) vs ASHRAE 90.1-2010 - MURB (BC Code 2012)

Diagram showing energy consumption breakdown:
- Heating
- Cooling
- Lighting
- Equipment, Appliances, and Plug Loads
- Fans and Pumps
- DHW
Discussion + Questions

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