ENCOURAGING PASSIVE HOUSE WITH PEOPLE AND POLICY
High-Level City Policy

GREENER CITY
2020 ACTION PLAN
PART TWO: 2015-2020

RENEWABLE CITY STRATEGY
2015-2050

Zero Emissions
Building Plan
2016
We strive to be a city that makes Passive House simpler

- We are not where we want to be
- We are trying
- We are committed to the success of Zero Emissions projects
Key Steps

- Provide extra assistance for PH projects
- Remove structural barriers that exist in city regulation
- Provide staff education
- Put in place catalysts
- Indicate long term direction
One staff problem solver for each PH project

- Encouraging projects
- Answering early questions
- Provide staff education
- Removing barriers in building code, or zoning and development practice
- Acting as a person on the inside
What we learn from helping individual projects connects the dots in policy for all projects

- Improve VBBL
- Change Zoning
- Improve Process
- Provide Industry Training
- Set up systems
Rezoning Policy: Over half of new square footage goes through rezoning. We make it simple for Passive House projects.
Meet the requirements of the low carbon path

1) LEED Gold – except Residential

2) Performance Limits by building type (TEUI, TEDI, GHGI)

3) Whole-Building Airtightness Testing

4) Enhanced Commissioning

5) Energy System Sub-Metering and Reporting
Meet the requirements of the low carbon path

6) Report Embodied & Refrigerant Emissions
7) Direct Ventilation
8) Low-Emitting Materials
9) Indoor Air Quality Testing
10) Int. Rainwater Management and Green Infra.
11) Resilient Water Access
Or, Certify to Passive House with PHI.
Single Family and Ground Oriented
Catalyze ground oriented housing.
Education

- 250 staff attended 1 day PH course
- 10 CPHC/D’s on staff
- 4 Inspections staff Certified PH Tradespersons
- More training scheduled in 2019
- This helps give confidence to applicants
Single Family Assistance

+ Height relaxation
  Rear Yard Setback
  Fixed external shading
  Floor area exclusion
  Optional pre-application meeting
  HRV Exclusion

- No Hot 2K model needed

Photo credit: Kingdom Builders
Multi Family Assistance

Density Increase

To help offset potential increase in cost additional density is available.
Community Amenity Contributions and Rezoning

Negotiated CAC

Construction cost premiums required to achieve PH can be recognized in the negotiation process.

THE DIRECTOR OF PLANNING HAS DISCRETION ON THE RECOMMENDED CAC
Any project:

PUT HRV and thick walls

Passive House Certified HRV eligible for upto a 2% FSR exclusion
The Future

- It should be easier to build PH then the worst building you can legally build
- Reach out to Sailen or myself with questions
- We are still an imperfect city
MORE (or all) PASSIVE HOUSE: HOW DO WE GET THERE?

ALLISON HOLDEN-POPE
Architect AIBC + Principal
ONE SEED Architecture + Interiors
City Successes

- acknowledging barriers
- advocating for P.H.
- incentivizing

Trayner Mayer Residence
Design: Econ Group
Build: Kingdom Builders
PH Consult.: P.H. Academy
Form Factor: 3.0
Wait a second…

- PH = only a small percentage of all new construction.
- how do we make PH the obvious choice for everyone?

East 37th Passive House
Design: LaneFab
Build: LaneFab
PH Consult.: LaneFab
Form Factor: 2.9
Make it:

- EASIER
- BIGGER
- MORE BEAUTIFUL

Woodland Passive House
Design: M. Lemon Architect
Build: TBD
PH Consult.: MIZU P.H.
Form Factor: 3.2
Make it EASIER:

- speed of permit review + processing
- provide early feedback

OneSEED Model Y Prototype
Design: ONE SEED Arch
Build: Footprint Sustainable
PH Consult.: CertiPHIers
Form Factor: 2.9
Make it EASIER

- knowledgeable staff
- motivated City staff
- empower PH trained staff

5129 Dunbar Passive House
Design: DLP Arch
Build: DLP Design Build
PH Consult.: Zephir PH Italia
Form Factor: 2.7
Passive House Bylaws
move beyond mitigating challenges

Khotso Passive House
Design: ONE SEED Arch.
Build: Olofsson Construction
PH Consult.: Harmann Cons.
Form Factor: 2.9
Make it BIGGER

- FSR incentives.

Multi-Family P.H.
Design: Marken D+C
Build: Econ Group
PH Consult.: Alex Maurer
Form Factor: 2.8
Make it BIGGER

- have exemption …
  will use it.

Mary + Wilson St. Duplex
Design: HCMA Arch.
Build: Bernhardt Contr.
PH Consult.: HCMA
Form Factor: 2.8
Ideal Massing

- a Passive House want to be a sphere
Ideal Massing

- or a cube
- minimal jogs and bump-outs
Less Ideal
It does not benefit from:
- gabled roofs
- jogs and bump-outs
- bay window exclusion?
- basement under covered porch
- complex shape

NOT A PASSIVE HOUSE
Photo courtesy of rew.ca
Make it BIGGER

- match Character Home Program w/ 0.75 FSR or more

OneSEED Duplex Prototype
Design: ONE SEED Arch
Build: Footprint Sustainable
PH Consult.: CertiPHIers
Form Factor: 2.9
MORE BEAUTIFUL

- that does not mean design guidelines.

Colwood Drive
Design: Randy Bens Arch.
Build: Econ Group
PH Consult.: RDH
Form Factor: 2.6
MORE BEAUTIFUL

Some ideas
▪ bigger buildable envelope

Marpole Passive House
Design: Dominic Sy
Build: Suvic Homes
PH Consult.: MIZU P.H.
Form Factor: 2.9
MORE BEAUTIFUL

Some ideas
- remove angled buildable envelope
- simple maximum height

Dragon Passive House
Design: ONE SEED Arch.
Build: TBD
PH Consult.: ONE SEED
Form Factor: 3.3
MORE BEAUTIFUL

Some ideas
- remove concept of ½ storeys
- allow stacked massing

Jonker Residence
Design: Architrix
Build: Kingdom Builders
PH Consult.: RDH
Form Factor: 2.6
MORE BEAUTIFUL

Some ideas:
- Stop pushing floor area below grade

Colwood Drive
Design: Randy Bens Arch.
Build: Econ Group
PH Consult.: RDH
Form Factor: 2.6
MORE BEAUTIFUL

Some ideas:
- allow doors to basement suites on front of house
- retaining structures in side yards

East Vancouver P.H.
Design: Marken D+C
Build: Derek Collins
PH Consult.: Alex Maurer
Form Factor: 2.7
MORE BEAUTIFUL

Some ideas:
- limiting distance measured to plane of glass

WHA P.H. Employee Apts.
Design: Integra Arch.
Build: Durfeld Constructors
PH Consult.: RDH
Form Factor: 1.7
MORE BEAUTIFUL

- options are great

Passive House on Stilts
Design: ONE SEED Arch.
Build: Factor Building
PH Consult.: E3 Eco Group
Form Factor: 5.2
If we make it EASIER, BIGGER, and MORE BEAUTIFUL the Passive Houses will come.

Tomo House Co-Housing
Design: MA+HG Architects
Client: Our Urban Village
PH Consult.: Lanefab + RDH
Form Factor: TBD
ARCHITECTURAL EXPRESSION & PASSIVE HOUSE
The Cambie Step

Images from Cambie Corridor Plan
Efficient Forms

Image courtesy of A2M, Brussels
Articulated Forms

More articulation leads to:

- Higher ratio of wall area to floor area
- Longer thermal bridges
## Doing the Math

**Option A** — The submitted massing

**Option B1** — Option A but with an 8’ setback on all sides

**Option B2** — similar to B1 but with an additional 8’ step at the lane side.

**Option B3** — Same as B2 but pulling the corner mass to the ground and roof.

**Option C** — Same as A but without undercut/main floor set back

**Option D** — Same as A but without the roof amenity.

**Option E** — Same as D with a step at the north and east

<table>
<thead>
<tr>
<th>Option</th>
<th>A</th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<tbody>
<tr>
<td>Envelope Area (m²)</td>
<td>3950</td>
<td>3545</td>
<td>3483</td>
<td>3584</td>
<td>3390</td>
<td>3774</td>
<td>3542</td>
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<tr>
<td>TFA (m²)</td>
<td>3275</td>
<td>2856</td>
<td>2729</td>
<td>2873</td>
<td>3307</td>
<td>3206</td>
<td>2937</td>
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<tr>
<td>Form Factor</td>
<td>1.21</td>
<td>1.29</td>
<td>1.24</td>
<td>1.25</td>
<td>1.19</td>
<td>1.18</td>
<td>1.21</td>
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<tr>
<td>Thermal Bridge length (m)</td>
<td>1109</td>
<td>1155</td>
<td>1181</td>
<td>1134</td>
<td>1075</td>
<td>1084</td>
<td>1062</td>
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</tbody>
</table>
Balconies
Windows

Image courtesy of Sonia Zouari, OAA
BC Energy Step Code research

Figure 7: Impact of VFAR on MURB TEUI and TEDI

Figure 8 shows the impact of window-to-wall ratio (WWR) on a MURB’s TEUI and TEDI. For other building parameters, the solutions used are those required to comply with Step 2 at 40% WWR in Climate Zone 4 and 20% WWR in Zone 7. The effect of WWR in Climate Zone 7 appears smaller than in Climate Zone 4 because the Climate Zone 7 solution includes higher performance glazing, which mitigates the impact of higher glazing ratios. For reference, the NECB prescriptive path requires a maximum WWR for a location based on local heating degree days, which varies from 40% in Climate Zones 4 and 5 down to 20% in Climate Zone 8.
Study scope

Effects on Passive House certification in Vancouver multi-family from:

- Steps in plan, elevation, and other articulations of form
- Balcony length
- Wall to window ratio
Differing effects of articulation, balconies, and window ratio at:

- High-rise residential building
Architectural Expression + Passive House

- Form Factor
- Window to Wall Ratio
- Balcony
Reference Projects – 6-8 Storey

The Heights

Little Mountain Co-Housing
Reference Projects – High-rise

30 Storey High-rise

44 Storey High-rise

Allies and Morrison

- 20,500m² building envelope
- 25,000m² treated floor area
- 67,000m³ building volume

- 6.8km of thermal bridges
- 4.6km of insulated ductwork
- 2375 windows
- 922 occupants
- 25km of pipework
- 2020 climate data
Form Factor

Impact on:

- Heat loss (more surface area)
- Heat loss (thermal bridging)
- Cost
- Expression / marketing
Form Factor

Impact on:

- Heat loss (more surface area)
- Heat loss (thermal bridging)
- Cost
- Expression / marketing
Form Factor

Minimum - 0.34

Maximum - 0.42

Actual – 0.74
FORM FACTOR

- Single Family / Duplex
- MidRise Multifamily
- HighRise / Tower

Image source: Dominic Sy / Marken D+C
FORM FACTOR

<table>
<thead>
<tr>
<th>PHI Low Energy</th>
<th>Single Family / Duplex</th>
<th>MidRise Multifamily</th>
<th>HighRise / Tower</th>
</tr>
</thead>
</table>

Image source: Cornerstone Architecture
FORM FACTOR

PHI Low Energy
Single Family / Duplex
Midrise Multifamily
Highrise / Tower

Image source: Perkins+Will
A: 1.13  
6.8 kWh/m²a

B: 1.29  
10.9 kWh/m²a

C: 1.36  
12.0 kWh/m²a

D: 1.51  
14.2 kWh/m²a

TFA: 2120m²  
WWR: 21%
$y = 2.33x + 5.15$

$R^2 = 0.9397$

**Annual heat demand $Q_h$ (kWh/m$^2$a):**

- **D:** 1.51 - 14.2 kWh/m$^2$a
- **C:** 1.36 – 12.0 kWh/m$^2$a
- **B:** 1.29 – 10.9 kWh/m$^2$a
- **A:** 1.13 – 6.8 kWh/m$^2$a

**Heat Loss Form Factor**

- **A:** C - 6.8 kWh/m$^2$a
- **B:** 1.29 – 10.9 kWh/m$^2$a
- **C:** 1.36 – 12.0 kWh/m$^2$a
- **D:** 1.51 - 14.2 kWh/m$^2$a

**TFA:** 2120m$^2$

**WWR:** 21%
A: 0.82

B: 0.87

C: 0.95

4.2 kWh/m²a

5.2 kWh/m²a

5.6 kWh/m²a

TFA: 4120m²
WWR: 32%
Annual heat demand $Q_h$ (kWh/m²a)

- **C**: $0.95 - 5.6$ kWh/m²a
- **B**: $0.87 - 5.2$ kWh/m²a
- **A**: $0.82 - 4.2$ kWh/m²a

**TFA**: 4120m²

**WWR**: 32%

$y = 0.7x + 3.6$

$R^2 = 0.9423$
Window-Wall Ratio

Impact on:

- Heat loss (window vs wall)
- Solar gains / overheating
- Cost
- Livability / marketing

WWR = 35%

WWR = 45%
VARIATION OF WINDOW-WALL RATIO [6 Storey]
Balconies

Impact on

- Heat loss (thermal bridging)
- Solar gains / shading
- Cost
- Construction
- Livability / marketing
Balconies

L = 2.5km

$\Psi_1 = 0.04 \text{ W/mK}$
$\Psi_2 = 0.40 \text{ W/mK}$
$\Psi_3 = 1.19 \text{ W/mK}$
Balconies

$L = 2.5\text{km}$

$\Psi_1 = 0.04 \text{ W/mK}$

$\Psi_2 = 0.40 \text{ W/mK}$

$\Psi_3 = 1.19 \text{ W/mK}$
Balconies

L = 2.5km

Ψ₁ = 0.04 W/mK
Ψ₂ = 0.40 W/mK
Ψ₃ = 1.19 W/mK
Conclusions / Further Questions – Form Factor

- Early design decision/constraint that has a big impact and generally only gets more articulated

- 0.1 of a change = 1-2kWh/m²a ???

- Is there a trade-off – setbacks for urban realm?
Conclusions/Further Questions – Window-Wall Ratio

- Heating demand targets are challenged with higher WWR but gains vs losses may equalize in heating season.
- Bigger issue is overheating / cooling impact.
- More WWR = more glass + more cooling = more cost.
Conclusions/Further Questions – Thermal Bridging

- What are early stage allowance should be allowed for TB in model? – 2-10%?
- Overlap with form factor should be understood
- Decisions should not be willful
Questions ?