About VEIC

- Nonprofit founded in 1986
- 300+ Employees
- Locations: VT, DC, OH, NY
- Design, deliver, and evaluate programs nationwide:
  - Energy efficiency
  - Transportation
  - Renewable energy

Our Customers:
- Utilities
- Businesses
- Government
- Foundations
- Environmental & Consumer Groups
Passive House Services VEIC Offers

- Policy Support
- Certified Passive House Consulting (CPHC)
- Passive House rating
- Incremental cost studies for Passive House buildings
- Modeling and technical assistance
- Post occupancy monitoring and analysis of performance
### How Building Envelope Commissioning differs from PHIUS

<table>
<thead>
<tr>
<th>Included services</th>
<th>BECx</th>
<th>PHIUS R/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engage with the design and construction teams to ensure building enclosure meets Owner’s Project Requirements - components and systems are properly detailed, specified and installed on-site</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Provide progress and final testing of building envelope systems and assemblies</td>
<td>x</td>
<td>Final-focus</td>
</tr>
<tr>
<td>Provide guidance and verification for meeting requirements of applicable programs (PHIUS, ESTAR, IaP, WS, ZERH)</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Submit documentation for certification. Note where documentation deviates from built condition.</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Ensure systems are meeting the specified performance criteria post installation.</td>
<td>Per contract?</td>
<td></td>
</tr>
</tbody>
</table>
Why Certify?

- Cost optimize design with modeling
  - First costs and operational costs
- Hold team accountable for final outcome
  - Passive House immediately,
  - Net Zero after a year of performance data
- Third party verification, QA/ QC
  - Bonus: experience of verifier organization
- Celebration and Recognition for the success in a quickly evolving market
Passive House Modeling Coordination

**Things get complicated...**

when the pre-certification energy model is being created at the same time that construction is happening.

<table>
<thead>
<tr>
<th><strong>Windows</strong></th>
<th><strong>Heat gain/loss heating period:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average SHGC: 0.41</td>
<td><strong>SKYLIGHT</strong></td>
</tr>
<tr>
<td>Average solar reduction factor heating: 0.35</td>
<td>WEST ----------------------------------</td>
</tr>
<tr>
<td>Average solar reduction factor cooling: 0.33</td>
<td>SOUTH --------------------------------</td>
</tr>
<tr>
<td>Average U-value: 0.227 Btu/hr ft² °F</td>
<td>EAST ---------------------------------</td>
</tr>
<tr>
<td>Total glazing area: 1,432.8 ft²</td>
<td>NORTH --------------------------------</td>
</tr>
<tr>
<td>Total window area: 1,908.9 ft²</td>
<td>LOSS GAIN</td>
</tr>
</tbody>
</table>

[kBtu/yr]
Last Minute Changes are Expensive

Ventilation

Domestic Hot Water

... But sometimes can’t be avoided
Reconciling Details with Reality
Passive House Air Leakage

Whole-building preliminary blower door test vs. progress tests:

Ensure target is reached - or - optimize schedule?
Construction

• Began Summer 2018
• Anticipated completion Summer 2019
Lessons Learned

• Certification Agreed to from Day 1- (Ideal world!)
• Certification fees = barrier (Individual donor enabled project to move forward toward PHIUS certification)
Lessons Learned

• Sequencing Work– large multi-family, testing, trades, tight timelines

• Design:
  • ASHP design
  • DHW runs
  • PHIUS and NZE envelope the same
  • Sizing solar and design integration
Lessons Learned

• Metering / Utility regulations
  • Monthly meter fees v. larger electrical service
  • 3-phase to site
  • Solar divided between tenant use
  • Unpredictable tenant use

• Utility rebates unknown until completed—Liberty Utilities
• Extra funding points, increase in cap of $10,000/unit
Project Located in Vermont?

- No extra points allowed on applications
- No max $/unit for projects
- Efficiency Vermont - Provide financial support/incentives