EMPOWERING PEOPLE

To make healthier and more sustainable choices in the renovation and construction of the places we live

Over 30,000 educated
13,000 Greener Homes
501C3 Non Profit

Greenhomeinstitute.org
Conservation = Resource

Source: The Small Homes Council at the University of Illinois

Illinois Lo-Cal House, 1974
The first Passive House:
Interview with Dr. Wolfgang Feist
Program Building
The EPA recently announced new standards for ENERGY STAR Qualified Homes. The increased standards, known as version 3.0, are effective with certificates of occupancy received on or after January 1, 2012. The new standards require the home to measure 41% more energy efficient than the previous standards. Allen Edwin Homes is committed to building ENERGY STAR Qualified Homes because helping the environment, helps us all.

### Annual Energy Cost Comparison

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Elements 2100</td>
<td>59 HERS = $2111</td>
<td>80 HERS = $2811</td>
<td>100 HERS = $3477</td>
<td>130 HERS = $4476</td>
</tr>
</tbody>
</table>

---

**Estimated Monthly Savings**

$197
Home Energy Rating System (HERS)

Performance Testing:
- Heating and cooling
- Water heating
- Lighting
- Appliances
- Building envelope

[HERS Index diagram showing energy rating scale from 0 to 150, with 100 as the reference home, 65 as the energy rating for the current home, and labels for existing homes and zero energy home.]

HERSindex.com
Thermal Enclosure System:
- Air Leakage
- Insulation R-Value
- Insulation Installation
- Air Barriers
- Thermal Bridging
- High-Perf. Windows

HVAC Quality Installation System:
- Efficient Equipment
- Right-Sizing
- Air Distribution
- Refrigerant Charge
- Duct Installation
- Pressure Balancing
- Ventilation
- Filtration

Water Management System:
- Roof Membranes
- Flashing
- WRB’s
- Fabric Filters
- Capillary Breaks
- Drainage Layer
What distinguishes new homes with the Indoor airPLUS label?

With Indoor airPLUS, EPA offers a way for builders to distinguish themselves by building homes with professional best practices, including the following design and construction features:

**Moisture Control:** Build in added protection from mold and other moisture problems with water managed roofs, walls, and foundations. Features include continuous drainage planes, proper flashing and air sealing, damp-proof foundation walls, capillary breaks, drain tile, and proper grading.

**Radon Control:** Provide radon-resistant construction in high radon potential areas, including gravel and plastic sheeting below slabs, fully sealed and caulked foundation penetrations, plastic vent pipe running from below slab through the roof, and an attic receptacle for easily adding an electric powered fan to the vent pipe if needed.

**Pest Management:** Provide a first-line defense against pest problems by fully sealing, caulking, or screening likely pest entry points. When these physical barriers are combined with proper pest management techniques, pesticide use may be reduced.

**Heating, Ventilating, and Air-Conditioning (HVAC):** Improve indoor air quality with best practice design and installation of ducts and equipment to minimize condensation problems, whole-house and spot ventilation to help dilute and exhaust indoor pollutants, and improved air filtration to remove airborne particulates.

**Combustion Venting:** Protect residents from potential exposure to combustion gases by installing direct-vented or power-vented gas- and oil-fired equipment, properly vented fireplaces, garages fully sealed from living spaces, and carbon monoxide alarms in each sleeping area.

**Building Materials:** Reduce sources of pollutants by selecting and installing materials to minimize risk of moisture damage, specifying materials with reduced...
Homes to the Power of ZERO

A Symbol of Excellence

- HEALTHFUL ENVIRONMENT
- COMFORT PLUS
- ADVANCED TECHNOLOGY
- ULTRA EFFICIENT
- QUALITY BUILT
- DURABILITY

What is the DOE Zero Energy Ready Home™ Label?

It is a Symbol of Excellence for energy savings, comfort, health, quality, and durability met by a select group of leading builders meeting U.S. Department of Energy Guidelines.
Program Scope & Applicable Building Types

- Single Family Homes
- Low-Rise Multifamily
- Mid-Rise Multifamily
- Mixed Use & Highris

- Single-Family Production
- Gut Rehab
- Additions, Remodels & Weatherization Projects
DOE
Zero Energy Ready Home
PV-Ready Checklist

1. Location, based on zip code has at least 5 kWh/m²/day average daily solar radiation based on annual solar insolation using PVWatts online tool:
   http://gisatnrel.nrel.gov/PVWatts_Viewer/index.html AND;

2. Location does not have significant natural shading (e.g., trees, tall buildings on the south-facing roof, AND;

3. Home as designed has adequate free roof area within +/-45° of true south as noted in the table below.

<table>
<thead>
<tr>
<th>Conditioned Floor Area of the House (sq. ft.)</th>
<th>Minimum Roof Area within +/- 45° of True South for PV-Ready Checklist to Apply (ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 2000</td>
<td>110</td>
</tr>
<tr>
<td>≤ 4000</td>
<td>220</td>
</tr>
<tr>
<td>≤ 6000</td>
<td>330</td>
</tr>
</tbody>
</table>
| > 6000                                       | 440                                                                                  

Kalamazoo Valley Habitat for Humanity

The Glendale Model
Kalamazoo, MI

Kalamazoo Valley Habitat for Humanity built this 1,120-ft² home in Kalamazoo, Michigan, to the performance criteria of the DOE Zero Energy Ready Home (ZERH) program. The home is equipped with an ENERGY STAR-rated refrigerator. It also meets the EPA Indoor airPLUS requirements by using wood products, primer, paint, cabinets, and flooring that limit the release of air contaminants.
AquaZephyr, LLC, built this 22,600-square-foot, 15-unit multifamily building in Ithaca, New York, to the performance criteria of the U.S. Department of Energy Zero Energy Ready Home (ZERH) program. The angular decks and entry area were designed to increase the amount of southern exposure for passive solar gain.
Program Building

- Zero Energy Ready Home
- EPA Indoor AirPLUS Qualified Home
- Energy Star Homes
- International Energy Conservation Code (IECC)
- RESNET HERS Index
<table>
<thead>
<tr>
<th>Source Zero Renewable Energy System</th>
<th>Balanced Ventilation HRV/ERV</th>
<th>Balanced Ventilation HRV/ERV</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOLAR READY</td>
<td>SOLAR READY ALWAYS</td>
<td>SOLAR READY ALWAYS</td>
</tr>
<tr>
<td>EPA Indoor airPLUS</td>
<td>EPA Indoor airPLUS</td>
<td>EPA Indoor airPLUS</td>
</tr>
<tr>
<td>Ducts in Condit. Space</td>
<td>Ducts in Condit. Space</td>
<td>Ducts in Condit. Space</td>
</tr>
<tr>
<td>HVAC QI w/WHV</td>
<td>HVAC QI w/WHV</td>
<td>HVAC QI w/WHV</td>
</tr>
<tr>
<td>Water Management</td>
<td>Water Management</td>
<td>Water Management</td>
</tr>
<tr>
<td>Independent Verification</td>
<td>Independent Verification</td>
<td>Independent Verification</td>
</tr>
<tr>
<td>IECC 2009 Enclosure</td>
<td>IECC 2012 Enclosure</td>
<td>IECC 2009 Enclosure</td>
</tr>
<tr>
<td>HERS 85-90</td>
<td>HERS 70-80</td>
<td>HERS 65-75</td>
</tr>
<tr>
<td>IECC 2012</td>
<td>IECC 2012</td>
<td>IECC 2012/15 Encl./ES Win.</td>
</tr>
<tr>
<td>HERS 55-65</td>
<td>HERS 48-55</td>
<td>HERS 35-45</td>
</tr>
<tr>
<td>HERS 48-55</td>
<td>HERS 35-45</td>
<td>HERS &lt; 0</td>
</tr>
</tbody>
</table>

Program Scope & Applicable Building Types

- Single Family Homes
- Low-Rise Multifamily
- Mid-Rise Multifamily
- Mixed Use & Highris

- Single-Family Production
- Cut Rehab
- Additions, Remodels & Weatherization Projects
Largest Passive House Office Building in US to be Built in Chicago

Jun 14, 2018

<table>
<thead>
<tr>
<th></th>
<th>Heating Demand/Load*</th>
<th>Cooling Demand/Load*</th>
<th>AIR-TIGHTNESS (cfm50/sf envelope)</th>
<th>Source Energy Demand</th>
<th>Renewable Generation for Source Zero</th>
</tr>
</thead>
<tbody>
<tr>
<td>SINGLE FAMILY</td>
<td>1 - 16.8 kBTU/ft².yr</td>
<td>1 - 23.4 kBTU/ft².yr</td>
<td>0.05</td>
<td>6200 kWh/person.yr</td>
<td>&gt;Source Energy Demand</td>
</tr>
<tr>
<td>COMMERCIAL</td>
<td>0 - 7.6 BTU/hr.ft²</td>
<td>1.3 - 9.5 BTU/hr.ft²</td>
<td></td>
<td>38 kBTU/ft².yr</td>
<td>&gt;Source Energy Demand</td>
</tr>
<tr>
<td>MULTIFAMILY</td>
<td></td>
<td></td>
<td>0.08**</td>
<td>6200 kWh/person.yr / 38 kBTU/ft².yr</td>
<td>&gt;Source Energy Demand</td>
</tr>
<tr>
<td>RETROFIT</td>
<td>As above, + allowance for existing thermal bridges</td>
<td>As above, + allowance for existing thermal bridges</td>
<td>0.05 / 0.08**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Maximum climate specific targets for each individual project

**Buildings with 5 stories+, non-combustible construction

Summary of other recommendations:

1. Window $U_{w\text{install}}$-values 0.4 – 0.08 BTU/hr. ft² °F (varies by climate)
2. Ventilation system with heat and/or moisture recovery with >53%-95% efficiency and efficient fan @ 0.27-2.23W/cfm (vary by climate)
3. Thermal bridge-free construction <0.006 BTU/hr. ft °F

Find your PHIUS+ 2015 Climate-Specific Performance Targets
ASHRAE 2013 & Global Solar Radiation
Location
Kent County International

Zone
5

Annual heating demand kBtu/sf-iCFA.yr
6.1

Annual cooling demand kBtu/sf-iCFA.yr
2.7

Peak heating load Btu/sf-iCFA.h
4.7

Peak cooling load Btu/sf-iCFA.h
4.1

Manual J Peak cooling load Btu/sf-iCFA.h
5.9
# 2.5 Tips on Assembly R-Values

<table>
<thead>
<tr>
<th>Zone</th>
<th>Example Cities</th>
<th>Wall</th>
<th>Ceiling</th>
<th>Slab</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Miami, FL or Honolulu, HI</td>
<td>19 - 27</td>
<td>44 - 60</td>
<td>2ft R-8 vertical perim.</td>
</tr>
<tr>
<td>2</td>
<td>Jacksonville, FL or Phoenix, AZ</td>
<td>19 - 27</td>
<td>30 - 70</td>
<td>Uninsulated</td>
</tr>
<tr>
<td>3</td>
<td>Charleston, SC or Sacramento, CA</td>
<td>15 - 31</td>
<td>30 - 60</td>
<td>Uninsulated, or 2-4ft R-8 vertical perim.</td>
</tr>
<tr>
<td>Marine 3</td>
<td>San Francisco, CA</td>
<td>19 - 23</td>
<td>30 - 38</td>
<td>4ft R8-20 vertical perim.</td>
</tr>
<tr>
<td>4</td>
<td>Baltimore, MD or Amarillo, TX</td>
<td>31 - 51</td>
<td>49 - 80</td>
<td>2-4ft R8-20 vertical perim.</td>
</tr>
<tr>
<td>Marine 4</td>
<td>Salem, OR or Seattle, WA</td>
<td>31 - 43</td>
<td>60 - 70</td>
<td>4ft R-20 vertical perim., or whole-slab R-20</td>
</tr>
<tr>
<td>5</td>
<td>Providence, RI or Flagstaff, AZ</td>
<td>31 - 43</td>
<td>60 - 70</td>
<td>4ft R-20 vertical perim., or whole-slab R-20</td>
</tr>
<tr>
<td>6</td>
<td>Burlington, VT or Billings, MT</td>
<td>39 - 51</td>
<td>70 - 90</td>
<td>whole-slab R20-28</td>
</tr>
<tr>
<td>7</td>
<td>Duluth, MN or Edmonton, AB</td>
<td>49 - 65</td>
<td>80 - 90</td>
<td>whole-slab R28-40</td>
</tr>
<tr>
<td>8</td>
<td>Fairbanks, AK</td>
<td>89</td>
<td>120</td>
<td>whole-slab R-40</td>
</tr>
</tbody>
</table>

**actual values will vary by project**
Air Tightness

CFM @ 50 / Square Feet
Building Envelope

Use to be .6 ACH

Now .005

5+ Story buildings with no combustion can be .008
Source Energy Limits per year

Residential

6200 kwh / per person
Bedrooms +1 = Persons

Protip - Keep spaces below 500 square feet to hit the target

Commercial / Multifamily

38kbtu per interior conditioned floor area (iCFA)

Process Load variations

Variations on Mixed Use Buildings

Going to 4200 in V2018
Other requirements

Reduced Thermal Bridge issues
Intense Moisture & Humidity Management
Efficient Ventilation capable of .3 air changes per hour at maximum
ASHRAE 62.2 residential or 62.1 commercial 2010
Follow indoor air plus
Follow zero energy ready
Follow Energy Star High Rise Certification
<table>
<thead>
<tr>
<th></th>
<th>Heating Demand/Load*</th>
<th>Cooling Demand/Load*</th>
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**Buildings with 5 stories+, non-combustible construction

Summary of other recommendations:

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2. Ventilation system with heat and/or moisture recovery with >53%-95% efficiency and efficient fan @ 0.27-2.23W/cfm (vary by climate)
3. Thermal bridge-free construction <0.006 BTU/hr. ft °F
WHO NEEDS TO BE INVOLVED?
PHIUS+ QA/QC - required

● PHIUS + Rater - Single Family / Lowrise Multifamily
  ○ Credentials
    ■ RESNET OR BPI
  ○ Experience
    ■ HERS rating, Energy Star and/or LEED for Homes
    ■ Building Construction / design / engineering
  ○ Training - 2 days + exam $500.00
  ○ Maintain (Yearly) - Proof of HERS credential and (Rate or attend trainings)

● PHIUS + Verifier - Mid - high rise Multifamily / Commercial
  ○ Credentials
    ■ RESNET OR BPI
  ○ Experience
    ■ Midrise / Highrise energy or green programs
    ■ Building Construction / design / engineering
  ○ Training - 2 days + exam $625.00
  ○ Maintain (Yearly) - Rate or attend trainings

http://www.phius.org/become-a-professional/phius-quality-assurance-quality-control-professional-training/qa-qc-training-programs
Certified Passive House Consultant (CPHC) - highly recommended

http://www.phius.org/become-a-professional/certified-passive-house-consultant-cphc-training/program-overview
### Architectural Resource, LLC

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>City</th>
<th>State</th>
<th>Zip Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dale Babcock</td>
<td>2301 Platt Road, Suite 30</td>
<td>Ann Arbor</td>
<td>Michigan</td>
<td>48104</td>
</tr>
</tbody>
</table>

### Biddison Architecture

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>City</th>
<th>State</th>
<th>Zip Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mrunmayee Beke</td>
<td>320 Martin St</td>
<td>Birmingham</td>
<td>Michigan</td>
<td>48009</td>
</tr>
</tbody>
</table>

### Catalyst Partners

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>City</th>
<th>State</th>
<th>Zip Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jamison Lenz</td>
<td>502 Second St</td>
<td>Grand Rapids</td>
<td>Michigan</td>
<td>49504</td>
</tr>
</tbody>
</table>

### Equilibrium Energy Spaces

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>City</th>
<th>State</th>
<th>Zip Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christina Snyder</td>
<td>Michigan</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Meadowlark Design + Build

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>City</th>
<th>State</th>
<th>Zip Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brian Burkett</td>
<td>3250 West Liberty</td>
<td>Ann Arbor</td>
<td>Michigan</td>
<td>48103</td>
</tr>
</tbody>
</table>

### Sturgeon Bay Woodworks Inc.

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>City</th>
<th>State</th>
<th>Zip Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steve Johnston</td>
<td>5440 Old Island Rd</td>
<td>Levering</td>
<td>Michigan</td>
<td>49755</td>
</tr>
</tbody>
</table>
PHIUS Builders- highly recommended

http://www.phius.org/become-a-professional/phius-certified-builders-training/overview-and-registration
What is the PROCESS?
Steps

1. Understand the program and/or high CPHC
2. Sign PHIUS contract & Register Project
3. Access drop box PHIUS folder
4. Hire the PHIUS+ Rater
5. Sub slab insulation inspection
6. Predrywall inspection
7. Final site testing
8. Final documentation assembly
9. Rater submits to PHIUS
10. Adjustments or review if needed
11. Certification notice
12. Order plaque
13. Celebrate success
Documentation Heavy!
5. PHIUS+ Certification Fee Schedule

PHIUS quotes a single fee for the full certification process, rather than a separate fee for pre-certification and final certification. Certification fees are based upon the project’s calculated square feet of iCFA (interior conditioned floor area).

PHIUS’ quoted fees do not include the cost of the QA/QC visits and final on-site testing, which are determined by the PHIUS+ Rater/Verifier of choice, see Section 3.7.

<table>
<thead>
<tr>
<th>iCFA</th>
<th>0-2500 ft²</th>
<th>2501-4500 ft²</th>
<th>4501+ ft²</th>
<th>Hourly Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base Rate</strong></td>
<td>$1,500</td>
<td>$2,000</td>
<td>Custom*</td>
<td>$150/hr.</td>
</tr>
<tr>
<td><strong>PHIUS Professional (CPHC, Builder) &amp; PHAUS Member</strong></td>
<td>$1,275</td>
<td>$1,700</td>
<td>Custom*</td>
<td>$125/hr.</td>
</tr>
</tbody>
</table>

*For projects larger than 4500 square feet, a custom quote is required. To request a quote, please email certification@passivehouse.us and provide the estimated iCFA (see Section 4.4.1.4).

Here are estimated fees for larger buildings:

<table>
<thead>
<tr>
<th>iCFA</th>
<th>10,000 ft²</th>
<th>20,000 ft²</th>
<th>50,000 ft²</th>
<th>100,000 ft²</th>
<th>200,000 ft²</th>
<th>500,000 ft²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base Rate</strong></td>
<td>$4,000</td>
<td>$6,750</td>
<td>$11,875</td>
<td>$16,250</td>
<td>$21,875</td>
<td>$33,125</td>
</tr>
<tr>
<td><strong>PHIUS Professional &amp; PHAUS Member</strong></td>
<td>$3,400</td>
<td>$6,150</td>
<td>$11,275</td>
<td>$15,650</td>
<td>$21,275</td>
<td>$32,525</td>
</tr>
</tbody>
</table>

PHIUS Professionals that are also PHAUS Professional Members receive a 15% discount, up to $600. Non-Profit Organizations such as Habitat for Humanity are eligible for a larger discount, by request.
Passive House Goes with LEED

Project teams that are considering pursuing PHIUS certification may now use this third-party-verified home performance standard to earn credit toward LEED certification. This alignment offers builders and developers greater opportunity to more cost-effectively apply the best practices and verification strengths of both Passive House and LEED to produce high-performing, green homes for families all across the United States.

As part of the October 2016 addenda release, USGBC introduced Passive House US alternative compliance path for North America, which allows projects to leverage their PHIUS label to earn points toward LEED v4 certification under LEED v4 BD+C: Homes.

By earning the PHIUS certificate, projects can be awarded a minimum of 31.5 points in LEED v4 BD+C: Homes, as well as most prerequisites in the Energy and Atmosphere and Indoor Environmental Quality credit categories. Additional points can be earned by demonstrating achievement of a HERS Index score of 40 or better. Projects must earn at least 40 points in LEED to earn the first of four rungs of certification: Certified (40), Silver (50), Gold (60) and Platinum (80).

Credit-specific details

PHIUS-certified projects automatically earn 20 points in EA Annual energy use (20 points).

Because PHIUS projects must also earn the DOE ZERH label, they automatically meet the following LEED v4 Homes credits and prerequisites, as specified in Interpretation 10431:

31.5 points

https://www.usgbc.org/articles/use-passive-house-us-earn-credit-toward-leed-certification
All about the PHIUS+ 2015: The Climate Specific Passive Building Standard

GBCI: 0920011466

Passive House Certification is a growing standard that goes beyond energy efficiency and residential buildings by also ensuring health and durability in all building types, new or renovation with specific standards that help those in different climate zones.

Rating system: v4, v2009
Published on: November 17, 2016
Average: 4.2 (12 votes)

Thank you!

Questions?
Brett.Little@greenhomeinstitute.org