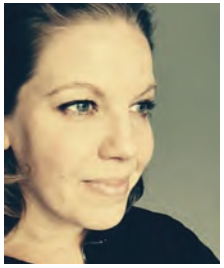
Passive House NORTHWEST 2016

FOREWORD

As North America's oldest Passive House community, the dedicated practitioners of Passive House Northwest (PHnw) have ensured that low-energy buildings are an established—and still growing—presence in the Pacific Northwest marketplace.

We at PHnw are proud of not only the quantity of local passive buildings, but their diversity too, in both size and locale: from small single-family homes to a growing list of multifamily projects, and from southern Oregon to the San Juans and over to eastern Washington. This book demonstrates beautifully the strong drive here in the Pacific Northwest to create better buildings.



Michelle Jeresek

2015 was another exciting year for PHnw. In February, we hosted Norwegian architect and builder Bjorn Kierulf, who presented his portfolio of handsome passive houses to five different audiences in Eugene, Portland, and Seattle, impressing us all with a trifecta of performance, beauty, and healthy low-carbon materials.

In March, we hosted our annual conference on Seattle's waterfront at the Bell Harbor Conference Center. As always, exemplary content was abundant. Keynote Günter Lang's return to the Northwest was timely. Only four years before, he had met with REACH Community Development staff and encouraged their pursuit of multifamily passive projects, which they did very successfully. Last summer we celebrated the grand opening of REACH's Orchards at Orenco, North America's largest multifamily Passive House, to date.

In the second half of the year, the PHnw Board of Directors worked to formalize a previously informal intent to be a 'big tent' organization, supporting the standards put forth by both the international Passive House Institute (PHI) and the Passive House Institute U.S. (PHIUS). With unified support of the broader goals of Passive House, local organizers were able to work together with the City of Seattle to incentivize passive building construction in the city's zoning code, with increased floor-area ratios allowed in low-rise passive buildings.

While we are proud of our accomplishments and the many fine projects in the Pacific Northwest that are showcased in this book, we are equally eager to see what more we can accomplish as we reach further together.

Onward!

Michelle Jeresek
President
Passive House Northwest

WHAT MAKES A PASSIVE HOUSE

It's not the style, it's what's not easily visible that counts. Here are the keys to creating a Passive House structure.

Island Passive; Photo by Art Gray Photography

- A superinsulated building envelope, with a continuous layer of insulation on every surface of the building shell, including in the exterior walls, roof, and floor.
- High-performance windows and doors that have well insulated frames, with shading as needed in summer.
- An airtight building envelope, with meticulous attention to all connection details and use of the appropriate sealing materials to prevent air leaks at junctions in the air barrier.
- Mechanical ventilation with heat transfer between the separate fresh (intake) and stale (exhaust) air streams for superb indoor air quality without losing heat in winter or adding heat in summer. In some climates, moisture recovery in winter or rejection in summer is needed as well.
- High-efficiency hot water systems, space heating/cooling equipment, appliances, and lighting.
- Thermal bridge free construction, which requires careful detailing to minimize the thermal weaknesses in the building envelope where heat can pass quickly from inside to outdoors in winter or the reverse in summer.
- Use of precise software to model the building's energy losses: Passive House Planning Package (PHPP) for Passive House Institute building certification or WUFI Passive for PHIUS building certification.

PASSIVE HOUSE **ORGANIZATIONS** AND **STANDARDS**

Both the international Passivhaus Institut (PHI) and Passive House Institute U.S. (PHIUS) are transforming the built environment by promoting the creation of extremely energy-efficient buildings. However, each organization has developed its own criteria for getting certified as a Passive House building.

PHI, which was created in 1996 by Dr. Wolfgang Feist, a physicist, and Dr. Witta Ebels, a mathematician, originally developed a single Passive House Standard for new buildings that combined simplicity and precision. PHI based its standard on the first experimental Passive Houses Feist and Ebels developed in 1991 in Darmstadt, Germany, including the one where they have lived for 25 years.

This succinct standard consisted of just three numerical limits: 1) space heating energy demand (or load), 2) building primary (source) energy for all uses, and 3) a strict air leakage limit of 0.6 ACH_{50}. While many in the building industry criticized these requirements as unreasonably strict, tens of thousands of buildings—and even entire neighborhoods—that meet this standard have been constructed worldwide.

In the intervening two decades, PHI's scientists have refined the standard, extending its applicability to all climates and buildings, including creating the EnerPHit Standard for retrofitting existing buildings.

In another refinement that addresses the need to transition from an economy based on fossil fuels to one running on renewable energy, PHI created a new renewable primary energy demand limit (PER) to replace the old primary energy (PE) limit, which was based on fossil fuel consumption. PER accounts for all local and regional electrical grid losses, including not only transmission losses, but also losses from short-term and seasonal energy storage. The PHI has developed specific PER factors for each of the climate data sets in its building energy modeling program, the Excel-based Passive House Planning Package (PHPP).

Finally, PHI promulgated additional classes, Passive House Plus and Passive House Premium, for Passive Houses that not only meet the Passive House Standard, but also have onsite renewable energy generation capacity or own offsite renewable energy generation.

Across the Atlantic from the PHI, architect Katrin Klingenberg was inspired after touring Passive Houses in Germany to break ground on her own home in Urbana, Illinois and complete the first Passive House in North America in 2003. Klingenberg and local builder Mike Kernagis cofounded PHIUS in 2007 and started certifying buildings to the Passive House Standard with PHI in 2009.

In 2011, PHIUS started its own building certification program, PHIUS+, based on the Passive House Standard with the addition of onsite quality assurance inspections by independent PHIUS+ Raters. In 2015, PHIUS completed years of research on the cost-effectiveness of the Passive House Standard for detached single-family homes with the Building Science Corporation (BSC) funded by the U.S. Department of Energy's Building America program. While PHIUS and BSC confirmed that Passive House principles are the best foundation for high-performance buildings, they concluded that the exact energy limits for each Passive House should be cost-optimized for its specific climate in order to lower the cost premium of building to passive standards and speed widespread adoption—yielding the large-scale energy reduction needed to avoid catastrophic climate change.

Skidmore Passivhaus; Photo by Jeremy Bittermann

In its current PHIUS+2015 Passive Building Standard-North America (PHIUS+2015), the PHIUS technical committee generated sets of energy limits, including annual heating and cooling demand and peak heating and cooling loads, for roughly 1,000 locations in North America. In some locations, the limits are higher than PHI's, while in others, they are lower. PHI and PHIUS also use different reference areas for their energy limits and air leakage limits. And, instead of a static standard, PHIUS expects to review and potentially revise its limits in three years with a stated goal of reducing the limits as building product performance rises and product prices fall with widespread adoption.

PHIUS also offers PHIUS+Source Net Zero certification for buildings that produce enough renewable energy onsite to offset the source energy they consume on an annual basis and special recognition for buildings with supply air heating and cooling with sufficiently low peak loads allowing them to (in principle) deliver heating and cooling entirely via supply air with an average design ventilation rate of no more than 0.4 ACH. PHIUS also offers a retrofit standard. PHIUS, with the Fraunhofer Institute for Building Physics, developed WUFI Passive, a new design and certification software system.

While a comparison of PHI's Passive House Standard and the PHIUS' PHIUS+2015 is complicated, meeting either standard results in the construction of a building that uses far less space-conditioning energy than do conventional buildings—a crucial step toward cutting carbon emissions and avoiding catastrophic climate change.

PITNEY PASSIVE HOUSE
McMinnville, Oregon

TEAM

Designer
Matt Daby
M.O.DABY DESIGN

Builder
John Mead
CELLAR RIDGE CONSTRUCTION

Certified Passive House Consultant
Scott Kosmecki
HINGE BUILD GROUP

The owners of Pitney Passive House started with a vision of a very sustainable, net-zero, reasonably priced home that could be a model for their community. By adhering to a fairly simple form and keeping the Passive House detailing straightforward, the designer succeeded in realizing his clients' vision and demonstrating that the Passive House standard can be achieved for a relatively small single-family home within a modest budget.

A big factor in this project's success—and in keeping the costs within budget—was the elimination of a separate heating system, relying instead on the ventilation system's post-heater to deliver comfortable temperatures.

Sticking with familiar construction approaches, the R-54 dual-wall assembly for this 1,014-ft^2 home includes two 2x4 walls with a 3-inch gap between them. Outside of the structural walls and air barrier membrane are 3 inches of mineral wool rigid insulation, a ventilated rain screen, and corrugated metal siding.

The roof assembly was designed for easy constructability, with an innovative detail that includes a flat OSB layer atop the ceiling joists creating a platform onto which pre-manufactured raised heel roof trusses were dropped. Blown-in fiberglass in the attic contributes to a roof R-value of 70.

As part of their commitment to sustainable living, the couple chose an inner-city lot for their affordable home, so they could walk to stores and more. A great room with south-facing, triple-pane windows and a glazed door gives on to the yard where the couple will grow vegetables. A 5.2-kW photovoltaic system will cover their home's energy use plus charge their electric car, sharply reducing their overall carbon footprint. Nine thousand gallons of rainwater storage and reuse contribute to meeting the couple's sustainability goals.

Pitney Passive House; Photo and Rendering by m.o.daby design

PRODUCTS

Windows
INTUS

Insulation
ROXUL by **SMALL PLANET SUPPLY**

PERFORMANCE

Heating energy	3.7 kBtu/ft^2/yr	1.1 kWh/ft^2/yr	11.7 kWh/m^{2}a
Cooling energy	0.9 kBtu/ft^2/yr	0.3 kWh/ft^2/yr	2.8 kWh/m^{2}a
Total source energy	53.9 kBtu/ft^2/yr	15.8 kWh/ft^2/yr	170.0 kWh/m^{2}a
Air leakage	0.5 ACH_{50}		