

**Successes and Challenges: An Interview with the Builder**

Did implementing the required efficiency measures make the project more complex than you expected?

Significant staff time was required to administer the grant, but there was not a notable impact in staff demand on the construction site. There was no increase in hard construction costs, other than the somewhat greater cost of more energy-efficient materials. The HVAC system was challenging for Habitat to master, as the technology was new to our staff. There was not initial clarity on whether the modeling was accurate for the scale of project we were building, and time was needed to identify and determine a cost from an installer of the mini-split systems. The actual installation of the mini-split heating/cooling system went smoothly and relatively quickly compared to conventional systems.

Were there any unexpected costs?

More glazing was required than our original window bids reflected, increasing our cost. Also, at the time of HVAC installation, we discovered that the specs and modeling would not achieve the performance required. The remedy increased the cost of the HVAC bid by 12%. These unexpected costs underscore the value of determining efficiency measures during the design and planning phase, as we did with the Energy Trust New Homes Program. Having a prescriptive path did not allow us to avoid cost increases completely, but gave us the technical resources to find a solution.

Have your homes made an impression on the homeowners?

The homeowners have been very pleased. All of the buyers performed 500 hours of sweat equity helping to construct their own homes, as the Habitat model requires. Time spent on site, along with specific training courses, helps them better understand their house systems and how to maintain them. Habitat buyers have often previously experienced overcrowded, unsafe, or unhealthy living situations. The new buyers at Rivergate Commons greatly appreciate the consistent interior comfort of the homes as well as modest energy bills, which are very important to people earning 30%-60% of the median income, as all Habitat buyers do.

**Program Contacts**

For more information about the PEEHP case studies, visit: [www.portlandoregon.gov/bds/PEEHP](http://www.portlandoregon.gov/bds/PEEHP)

Learn how Energy Trust resources and incentives can help you build and sell high efficiency homes, call Energy Trust's trade ally coordinator at 1.877.283.0698, option 1.



Portland General Electric



**Project at a Glance**

**Site Location**  
N Portland, Portsmouth

**Utility Partner**  
PGE

**Building Type**  
Three-Family Row Houses (2)

**Number of Bedrooms**  
2, 3 and 4

**Unit Square Footage**  
Approx. 1200-1500 sf per unit,  
4080 sf per building

**Total Grant Award**  
\$38,885

**Certifications**  
ENERGY STAR®  
Earth Advantage®  
Platinum®

**Project Team & Subs**

**Contractor**  
Habitat for Humanity  
Portland/Metro East

**Structural Engineer**  
Benthin Design Group, LLC

**Mechanical Engineer**  
Paul Dupont

**Designer**  
Benthin Design Group, LLC

**Interiors**  
Habitat for Humanity

**Green Building Consultant**  
Earth Advantage Institute

**HVAC**  
Jacob's Heating & Cooling

**Insulation**  
Western Spray Foam

**Framing**  
TJ Home Builders

**Plumbing**  
Euro Plumbing

**Vendors/Products**

**Mini-split Heat Pump**  
Mitsubishi

**Heat Pump Water Heater**  
Rheem Marathon

**ERV**  
Panasonic

**Lumber**  
Milwaukie Lumber

**Insulation**  
Owens Corning fiberglass  
blown-in

**Windows and Doors**  
Medallion Industries,  
Millgard Windows

**Trusses**  
Evergreen Truss

**CASE STUDY: Rivergate Commons  
Habitat for Humanity Builds Extremely  
Energy Efficient Affordable Row Houses**

**Program Overview**

The Portland Energy Efficient Home Pilot (PEEHP), a competitive grant program, was developed to encourage the construction of energy efficient homes in the Portland area. Participating builders were required to build a minimum of two new homes to exceed the energy efficiency standards of the 2008 Oregon Residential Energy Code (2008 Code). The PEEHP grant provided funding for builders to implement the energy saving measures necessary to increase the efficiency of their homes by 15% or 30%.

Several diverse development projects received awards. The average award was \$4,266 per unit that performs 15% more efficiently than 2008 Code and \$10,320 per unit that performs 30% more efficiently than 2008 Code. Grant recipients include Fish Construction NW, Inc., Terrafirma Building, Inc. for Portland Community Reinvestment Initiatives (PCRI), and Habitat for Humanity Portland/Metro East.

Administered by the City of Portland, grant matching funds and technical assistance for the PEEHP were provided by the National Home Builders Association, the Home Builder's Association of Metropolitan Portland, Portland General Electric (PGE), NW Natural Gas, Pacific Power, and Energy Trust of Oregon's New Homes Program. This public/private partnership leveraged \$113,000 in grant funds, resulting in energy saving measures for 14 homes.

**Project Summary**

PEEHP awarded Habitat for Humanity Portland Metro/ East (Habitat) a grant worth \$38,885.00 to construct a total of six row houses in North Portland. Habitat has been partnering with hard-working families in need to develop residential housing in Portland for more than 30 years. Habitat is committed to building high-performance and sustainably constructed homes, and has set a sustainability benchmark to achieve 100% Earth Advantage® certification on all homes from 2012 onward.

*"The homeowners appreciate the consistent interior comfort of the homes as well as modest energy bills, which are very important to people earning 30%-60% of the median income, as Rivergate Commons residents do."*  
Habitat for Humanity Portland/ Metro East



Rivergate Commons is Habitat's second Earth Advantage certified development. The Rivergate project challenges Habitat to use new methods of achieving high energy efficiency with a tight project budget and the labor of volunteers. Maintaining affordability of the home's purchase price and operation for the lower income residents was a critical goal for the builder. Energy Trust's New Homes Program worked with Habitat to determine what actions needed to be taken to

**Aggregate Cost of Project**

Efficiency above 2008 code	15% Unit (7624-7628 N. Olin)	30% Unit (7610-7614 N. Olin)
Average sale price per unit	\$178,000	\$178,000
Actual cost of upgraded efficiency measures per unit	\$5,140	\$7,510
Grant award per unit	\$2,935	\$10,027

maintain affordability and meet the efficiency goals of the PEEHP.

Habitat's project features two buildings, each with three modest, two-story units. One building was to be 15 % more efficient

than the 2008 Code requirement, and the second building was to be 30 % more efficient than 2008 Code. The design is consistent with Habitat's bylaws

that commit to “simple, decent affordable homes” (without garages or superfluous space). The smaller footprints are integral to energy-efficient construction.

Heating and cooling systems are a significant budget impact for construction projects. Affordable housing projects often use a zonal electric heating method, such as baseboard heaters, because the upfront costs are low. This type of heat is inefficient and may result in high heating costs for residents in our climate. Habitat implements gas furnaces in many of its projects, so a 2008 Code level gas system was used to determine a realistic cost basis for Habitat’s grant award.

Habitat was challenged to use an electric energy path that specified high-efficiency electric mini-split heat pumps and high efficiency electric water heating for all of the homes. This was the first time Habitat had built homes using the electric mini-split system.

There is a cost premium paid for mini-split heat pumps, but since the Rivergate Commons homes are modestly sized, using a primarily ductless system saved the limited physical space ducts would require. The ductless mini-split system allows spatial flexibility and still provides exceptional comfort and utility savings for the homeowner.

The PEEHP program enabled Habitat for Humanity to achieve overall efficiency by implementing several key measures: mechanical systems were upgraded and the water heater was located in a conditioned space. The building envelope was tightly sealed and advanced framing techniques were used to allow greater insulation and to reduce thermal transfer through the walls. Windows and doors with low U-values were installed, and all lighting met ENERGY STAR® standards. Using these steps, Habitat also was able to build homes that were not only affordable for purchase, but will also be less expensive to operate and maintain for homeowners in the future.

## What does it take to create a highly efficient home?

The significant energy and associated utility cost savings realized in Habitat for Humanity’s two-story row-houses, as compared to the same homes built to 2008 Code, were achieved by using high efficiency heating equipment for space and water and reducing heat transfer and loss through advanced wall framing techniques (studs on 24 inch centers, insulated window and door headers and two-stud wall corners). The homes also boast greater insulation throughout the house (for example, from R38 to R49, and R60 in the attic), more efficient windows (U-0.32 and U 0.30 rather than U-0.35), ducts that are seam sealed and placed inside conditioned space, and improved whole house envelope tightness (minimizing heat loss). The homes also feature ENERGY STAR® appliances and lighting.

Homes with tightly sealed exterior envelopes require mechanical ventilation to maintain indoor air quality. In both buildings, fresh air supply and stale air exhaust were supplied by the use of an energy recovery ventilator (ERV). The ERV uses the heat from the exhaust air to pre-condition fresh air as it is brought into the home, resulting in an efficient way to ensure good air quality.

Habitat capitalized on the inherent efficiency of a multi-unit building. The builder exceeded the efficiency levels required by the grant for each unit by implementing the construction methods and measures specified above. However, other factors also contributed to the exceptional results. First, the housing units have compact, family-size floor plans, which both reduces the amount of building materials needed and also reduces the heating and cooling demand. Second, the homes are row houses, which share interior walls. The walls decrease exterior exposure to weather, minimizing heat loss from the home. Last, the builder installed some of the same measures in all of the units, including raised heel trusses to maximize roofline insulation, and identical HVAC and fresh air ventilation systems. Duplication of the design and materials simplifies installation, reducing the overall cost of the project while increasing the efficiency of all of the units.

### PEEHP Energy Efficiency Features

#### 15% Unit

- High-efficiency electric mini-split heat pump, 8.6 HSPF w/ slim duct air-handler
- Spot Energy Recovery Ventilation (ERV)
- Raised heel trusses with R-49 blown in attic insulation
- R-26 wall insulation: R-21 fiberglass batt, with 1” R-5 rigid foam sheathing
- Upgraded building envelope with max 6.5 ACH (Air Changes/ Hour)
- U-0.32 U-value windows

#### 30% Unit

- High-efficiency electric mini-split heat pump, 8.6 HSPF w/ slim duct air-handler
- Spot Energy Recovery Ventilation (ERV)
- Raised heel trusses with R-60 blown in attic insulation
- R-30 wall insulation: 5.5” spray foam, with 1” R-5 rigid foam sheathing
- R-36 floor joist cavity insulation, 1” spray foam and R-30 batt over unconditioned crawlspace
- Upgraded building envelope with max 4.0 ACH (Air Changes/ Hour)
- U-0.30 U-value windows

#### Both Units

- High-efficiency electric mini-split heat pump, 8.6 HSPF w/ slim duct air-handler
- Ducts sealed with mastic paste, located inside the conditioned envelope of the home
- High-efficiency 50-gallon Marathon water heater – 0.93 EF (efficiency)
- Advanced framing techniques, studs 24” on center w/ California corners
- R-38 under floor joist cavity insulation (un-faced fiberglass)
- Air sealed envelope with caulked and sealed framing joints and glued sheathing
- ENERGY STAR® rated appliances

*“The installation of the mini-split heat pump heating & cooling system went smoothly and was installed relatively quickly compared to conventional systems.”*

*Habitat for Humanity  
Portland/ Metro East*



### Each PEEHP home received an EPS

EPS™ is an energy performance scoring tool brought to you by Energy Trust to help home buyers assess a home’s energy consumption, costs, and carbon emissions. It also helps builders frame the value of energy efficiency features they include in their homes.

### The Easy Way To Compare Energy Use

Energy efficiency, utility costs and environmental impact are important factors to consider when buying or building a home. They can affect the real and perceived value of a home, but are not always easy to quantify. EPS compares a home’s energy consumption, costs and carbon emissions with those of similar sized homes in Oregon.

### Measuring Energy Use and Costs

EPS calculation is based on several factors: building size, air leakage and ventilation, insulation, windows, heating and cooling systems, water heating, lighting, major appliances and standard operating conditions. Actual energy use will vary with occupant behavior and weather. Fuel costs are based on retail prices of each gas and/or electric utility at the time the EPS is issued.

### Carbon Emissions

A home’s energy consumption affects carbon emissions and impacts the environment. EPS estimates these emissions from the electric production and natural gas consumption of the home to create a carbon score. You can change your carbon footprint by purchasing renewable energy options from your utility or other carbon offset programs.

For more information about EPS, contact Energy Trust at 1.877.283.0698 or visit [www.energytrust.org/eps](http://www.energytrust.org/eps).

To view EPS details for the PEEHP case studies, visit the PEEHP web site: [www.portlandoregon.gov/bds/peehp](http://www.portlandoregon.gov/bds/peehp).



thus bumping the “15%” homes closer to the “30%” efficiency level.

The annual energy consumption for a home with similar square footage to this project, but built to the 2008 Code standard, is 12783 KWh. All of the Habitat homes achieved an annual savings of 2,000-3,000 KWh. This efficiency translates to utility bills cut by approximately \$200-300, saving the occupants \$6000 to \$9000 over 30 years (at today’s energy prices).

For all six homes, more than 85% of the cost savings are associated with the reduction in electricity usage for space and water heating. In fact, the majority of the cost savings come from reduced heating needs, while providing the occupant the added benefit of greater thermal comfort.

### Outcome: Energy Savings Benefits Outweigh Added Costs

The homes built by Habitat for Humanity Portland/Metro East in North Portland all achieved exceptional energy efficiency. The efficiency of the units built to exceed 2008 Code by 15% actually performed up to 25% better than 2008 Code, and the units intended to be 30% better than 2008 Code achieved just 25% greater efficiency.

These results can be attributed to several factors: First and most importantly, Habitat was able to utilize some of the same simple techniques assigned to the most efficient of the homes in all of the homes due to economy of scale; i.e. they were already doing it on one project, thus it was simple (and low to no cost) to replicate on the adjacent construction site. Second, the process of ordering materials was simplified by ordering more of the same products rather than specifying different products for each home, as was the case with the heating and cooling systems. The last reason that the energy performance is similar between the “15%” and the “30%” homes is an upgrade of the 15% homes’ specified HVAC system to the exact same equipment as the 30% homes.

This change was made during construction to scale the heating systems more appropriately to the size of the homes. The upgraded insulation as well as the upgraded heat pump and ERV increased the efficiency of heating and cooling as well as ventilation,

In addition to the grant funds noted above, each home in the study (15% and 30% homes) received \$2,100 - \$2,325 in incentives from Energy Trust, reducing the up-front incremental costs by up to 40% to exceed 2008 Code efficiency levels by 25%. This case study illustrates that even in the absence of the PEEHP grant program, given the advantages of greater comfort to the home occupants, significantly reduced energy bills, and potentially higher asset value, there is a strong case for investing in higher performance homes.

