Case Study: SE 28th Ave Row Houses











Portland General Electric







Outcome: Energy Savings Benefits Outweigh Added Costs

The homes built by Fish Construction NW on SE 28th Street exceeded program expectations. The efficiency of the unit built to exceed 2008 Code by 15% actually performed 30% better than 2008 Code, and the home intended to be 30% better performed 35% more efficiently than 2008 Code.

This efficiency translates to utility bills cut by approximately one third, saving the occupants \$13,000 to \$15,000 over 30 years (at today's energy prices). For both homes, more than 75% of the cost savings are associated with the reduction in natural gas usage for space and water heating. In fact, half of the cost savings come from reduced heating needs, while providing the occupant the added benefit of greater thermal comfort.

In addition to the grant funds noted above, each home in the study received approximately \$1,750 in incentives from Energy Trust, reducing the up front incremental costs of the efficiency measures by 39% and 21% (#4725, #4729). 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.

Successes and Challenges: An Interview with the Builder

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

From a technical building stand point, it was surprising how many options there were to go from 15 % to 30 % better than 2008 Code. The subcontractors were able to meet the demand for increased performance.

Were there any unexpected costs?

Not many! Implementation of the required efficiency measures came in on the budget we expected, with small considerations taken to accommodate deeper door framing and millwork for the 8" thick wall. The energy recovery ventilator (ERV) was funded by the grant, but is not cost effective for our market segment. The cost to get from a 0-15% more efficient home was pretty easy. It gets tougher and more expensive to get to 30% greater efficiency. In the type of house we build, a goal of 20-25% greater efficiency is very doable.

Would you recommend the efficiency measures to other projects?

Yes, high-efficiency furnaces are a modest cost increase and have become the norm for our projects. The design modifications, including the intermediate framing, increased insulation, moving the ducts inside the kitchen soffit, and upgraded windows make a big difference and are not difficult to implement.

What would you, as the builder, do differently next time?

The biggest hurdle for me as a homebuilder is getting an appraisal that quantifies value on the homes for the energy upgrades. This is what makes an added expense like the ERV difficult to justify. I was asked to give a presentation to the state Reach Code* committee dealing with this very issue. Appraisers and buyers need to be better educated about the true value of the homes. We are doing Earth Advantage • certified homes now, not for a higher sales price, but as an added value to help sell the home.

Have your homes made an impression on the homeowners?

The homeowners have been very happy with the efficiency features. In this entry level price range, the efficiencies are a great value. The market conditions in Portland were such that the sales prices of these homes were the same as similar homes in the area that did not have the added energy features. From my perspective as a home builder, without incentives, it will take a shift in the perception of the average buyer to justify the added costs of the highest efficiency features. The PEEHP has demonstrated that there is a balance of features between the 15% and 30% efficiency increase levels that can be used in a home at minimal added cost to generate a significant benefit in terms of comfort and lower utilities.

*Reach Code is an optional set of statewide construction standards for energy efficiency that exceed the requirements of the state's mandatory codes.

Program Contacts:

For more information about the PEEHP case studies, visit: 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.



Bureau of Development Services TO CONSTRUCTION

Project at a Glai

Site Location SE Portland, Reec Neighborhood

Utility Partne NW Natura

Building Type Two-Family Row House

Number of Bedrooms

Unit Square Footage 1820 sf per unit

> Total Grant Award \$12,500

> > Certification Energy Star

Project Team & Sub

Contractor Fish Construction NW

Mechanical Engineer Central Air

> **Designer** Troxel Home Design

Interiors Advanced M&D Sales Landscaper NW Property Maintenance

Insulation

Framin TJ Home Builder

Plumbin Euro Plumbin

Vendors/Products

Furnac 90% AFUE Tempst

Tankless Water Heater .82 EF Rinna

> **Lumbe** Milwaukie Lumbe

American Standard

Windows and Doors Medallion Industrie

> **Trusse** Evergree

CASE STUDY: SE 28th Ave Increasing Efficiency for a Two-Family Row House

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.



"From a technical building stand poin surprised at how easy it was to go fro percent to 30 percent more efficient code on the SE 28th row-house."

> Builder Justin Woo Fish Construction N



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SE 28th Avenue: Project Summary

PEEHP awarded Fish Construction NW a grant worth \$12,500 to construct a two-unit row house in Southeast Portland. Fish Construction NW is a highly regarded builder of mid-size entry to mid-level homes. Their project features one unit that is 15%, and one unit that is 30% more efficient than the 2008 Oregon Residential Energy Code requirements.

Energy Trust's New Homes team worked with Fish Construction NW to determine what actions needed to be taken to meet the efficiency goals of the PEEHP. Fish Construction NW typically installs gas powered HVAC systems, so the decision was made to incorporate high-efficiency gas appliances for air and hot water heating into each home.

The PEEHP program challenged the builder to improve overall efficiency by upgrading the mechanical system and windows, modifying the home design to increase insulation, tightly sealing the building envelope and heating ducts, and locating HVAC and ducts within the conditioned space - all to prevent heat loss. The resulting homes are more affordable to operate and healthier for the owners.

Aggregate Cost of Project						
Efficiency above 2008 code	15% Unit	30% Unit				
List price per unit	\$289,000	\$289,000				
Actual cost of upgraded efficiency measures per unit	\$4,010	\$8,511				
Grant award per unit	\$4,010	\$8,511				

What does it take to create a highly efficient home?

Fish Construction NW made modest adjustments to a standard house plan to achieve very high efficiency for the two-story rowhouses. The energy and associated utility savings realized in these homes, as compared to a 2008 Code home, were achieved by a combination of high efficiency heating equipment for space and water, intermediate framing techniques (thicker walls and double 2 x 4 staggered stud walls to reduce heat loss), greater insulation throughout the house (for example, from R21 to R30 in the walls and R38 to R49 in the attic), more efficient windows (U-0.30 rather than U-0.35), duct placement inside conditioned space and improved duct and whole house envelope tightness (minimizing heat loss), and the addition of an energy recovery ventilator system for the 30% more efficient home to circulate warmed fresh air. The homes also feature ENERGY STAR® appliances and lighting.

The builder exceeded the efficiency levels required by the grant for each unit by implementing construction methods and measures required by the grant, however other factors also contributed to the exceptional results. First, the houses have a compact, family-size floor plan, 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 an interior wall. The wall decreases exterior exposure to weather, reducing heat loss from the home. Last, the builder installed some of the same measures in both units, reducing the overall cost of the project while increasing the efficiency of both units. Some of these duplicated measures include raised heel trusses, higher U-value windows, and placing the ducts inside conditioned space.



PEEHP Energy Efficiency Features

15% Unit

- 90% high-efficiency gas furnace
- R-21 wall insulation with 2x6 walls utilizing intermediate framing techniques
- Upgraded building envelope with max 5.4 ACH
- 75% of the lights are ENERGY STAR[®] rated compact fluorescent lights (CFL)

30% Unit

- 92% high efficiency gas furnace with variable speed ECM motor
- Energy Recovery Ventilator (ERV) system – 75% Sensible Recovery Efficiency
- R-30 wall insulation within a double staggered stud 2 x 4 wall (2 x 8 top and bottom plates) utilizing advanced framing techniques
- Upgraded building envelope with max 4.5 ACH
- 90% of the lights are ENERGY STAR[®] rated Compact Fluorescent Lights (CFL)
- · Home oriented to southern exposure for solar heat gain

Both Units

- Raised heel trusses with R-60 attic insulation (technically only needed an R-49 for the 15% efficiency goal)
- · Tankless on-demand gas water heater -0.82 EF (efficiency)
- R-38 under floor insulation between joists
- 30 U value windows (technically only needed U-0.35 for the 15% path)
- ENERGY STAR[®] rated appliances
- · Sealed ductwork with mastic paste, located inside the conditioned envelope of the home
- Duct blast tests administered to ensure tightly sealed ductwork with less than 6% leakage

modest cost increase and have became the norm for our project."

> Builder Justin Wood, Fish Construction NW



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.

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

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Setting Goals: Determining a 2008 **Code Baseline Efficiency Standard**

The intent of the PEEHP is to provide costs and feasibility data for constructing one-and-two family houses to the 2008 Oregon Residential Energy Code (2008 Code) in comparison with constructing homes that perform 15% and 30% more efficiently than the 2008 Code.

To track the relative improvement in efficiency of the homes in this case study, appropriate efficiency measures were determined using the 2008 Oregon Residential Energy Code requirements as a baseline.

The 2008 Code requires that certain prescriptive standards be met, and beyond that, builders are required to choose one of nine additional energy efficiency options. The baseline 2008 Code path for this home was the most commonly selected path in new construction for natural gas homes - Option 1: installation of high efficiency HVAC equipment.

Gathering Data: Estimating Costs

The PEEHP grant process funded the incremental cost of energy efficiency measures over what is required by the 2008 Code. To determine the additional construction costs to be covered by the grant, each builder was required to provide cost estimates from three different subcontractors for the work to be performed.

Further, each subcontractor had to provide bids for the costs associated with building the home to 2008 Code, to 15% above 2008 Code, and to 30% above 2008 Code, as appropriate based on the different energy efficient measures selected by the builder.

Based on this information, it was possible to calculate incremental costs. Using the lowest bids, the grant covered the cost difference between the "code home" and the higher efficiency home (see the performance table for exact figures).

Achieving Results: Modeling and Verification

Home Energy Performance Information								
Builder	Fish Construction NW		Home Address	4725 & 4729 SE 28th Ave, Portland, OR 97202				
Home Style	2-Story row house with a shared interior wall							
Square Feet	1,820 sf per unit							
# of Occupants	Estimated at 5 people, based on 4 bedrooms per unit							
Heating & Hot Water Source	Forced air gas furnace and tankless on-demand hot water heater							
Energy Efficiency Level	Meet Code	Required by Grant 4725 SE 28th	Actual** Construction 4725 SE 28th		Required by Grant 4729 SE 28th	Actual** Construction 4729 SE 28th		
Efficiency Increase**	0	15%	30%		30%	35%		
ncremental Cost of All Measures**	0	\$4,010	\$4,500		\$8,512	\$8,512		
Est. Annual Energy Cost Savings	\$1,503 (Total Cost/ Yr.)	N/A	\$446		N/A	\$498		
Annual kWh Savings	0	479 kWh	681 kWh		879 kWh	825 kWh		
Annual Therm Savings	0	135 Therms	210 Therms		228 Therms	237 Therms		
Annual Carbon Emmissions	6 tons/yr	N/A	4.5 tons/yr		N/A	4.3 tons/yr		
EPS*	80	65	56		54	53		

*A lower EPS score reflects less energy use and lower operating costs. Energy Trust is in the process of modifying the formula for calculating EPS scores. Under this new methodology, the EPS scores for gas or electric homes constructed in the same way would be very similar. For more details visit: www.energytrust.org/library/meetings/other/EPS_HES_Proposal_CAC.pdf

**Actual construction cost and savings data may differ from that funded by the grant due to a number of factors, including a) different equipment being installed compared to what was originally planned, b) use of a different contractor to improve installation or warranty services, and c) variation in the bidding approach of the contractor.

Through Energy Trust's New Homes program, Andrew Shepard, a green building consultant with Earth Advantage Institute,

provided ongoing technical assistance to Fish Construction NW by examining building plans and building practices, and identifying opportunities for energy savings. Energy modeling software was used to calculate efficiency goals and the measures necessary to achieve those goals. The consultant estimated the savings from individual efficiency measures to assemble a package of measures to meet the homes energy use reduction targets. To ensure the calculated savings were achieved, third- party modeling and verification services were conducted, including:

- Home energy use modeling using the REM/Rate software tool. REM/Rate is published by Architectural Energy Corporation of Boulder, Colorado, and complies with Residential Energy Services Network (RESNET) protocols for modeling home energy ratings.
- Third-party testing, involving at least two physical inspections, a duct blast, and blower door test verified that systems and materials were correctly installed and working properly. An EPS confirmed the level at which a home is performing.