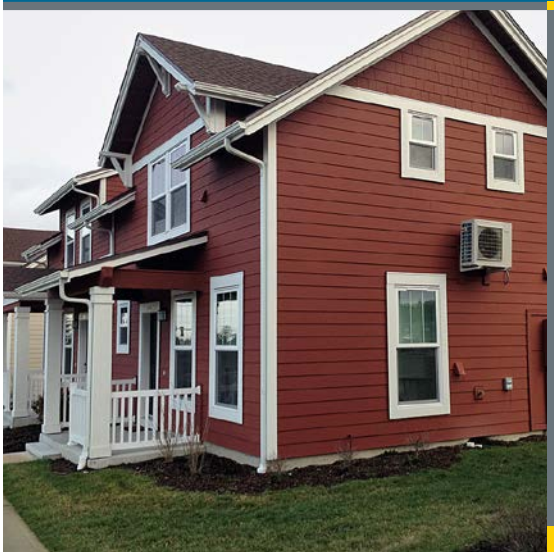

Building America Case Study

Whole-House Solutions for New and Existing Homes

Evaluating Energy Savings in All-Electric Public Housing in the Pacific Northwest

Tacoma, Washington

PROJECT INFORMATION

New Construction: Phase 7

Retrofit Existing: Phases 1–6

Type: Multifamily, affordable

Builder: Walsh Construction

Size: Phases 1–7, 975 ft^2 to 1,109 ft^2

Years Completed: Phase 7, 2010; Phases 1–6, 2003–2006

Climate Zone: Marine

PERFORMANCE DATA

Billing analysis savings—Phase 7 versus Phases 1–6: 1,400–3,044 kWh/year

Phases 1–6 projected energy savings and installed cost for:

- DHP retrofit: $193/year/unit at $3,000/unit
- HPWH retrofit: $58/year/unit at $1,800/unit

(Assumes current electricity cost of $0.074/kWh.)

Salishan is a mixed-income neighborhood in Tacoma, Washington, originally built by the federal government in 1942 to provide housing for workers in the war effort. After World War II, the federal government donated most of Salishan, including about 880 apartments on 188 acres, to the Tacoma Housing Authority (THA). Then, THA transformed Salishan into a public housing community.

By the end of the 1990s, the condition of the housing in Salishan was very poor. From 2001 to 2011, THA undertook a $225 million effort to reconstruct all-electric homes in the Salishan development, assisted by the Washington State University (WSU) Energy Program (members of the U.S. Department of Energy team, Building America Partnership for Improved Residential Construction). This effort was organized into seven phases. In Phases 1–6, the homes were built to the energy code standards in place at the time of construction. The Phase 7 homes were built to ENERGY STAR® standards and featured ductless heat pumps (DHPs) and improved insulation. This project examined the modeled and measured energy use of the first six phases of construction, compared the energy use of those phases to Phase 7, and evaluated potential energy-saving upgrades for Phases 1–6.

Phase 7: In late 2009, the WSU Energy Program began working with THA, Walsh Construction Company, Tacoma Public Utilities, and consultant O'Brien and Company on the design, construction, and commissioning of Phase 7 of the Salishan development. This phase, completed in late 2010, is composed of 91 low-income housing units built to ENERGY STAR standards, and is the first federal Hope VI project to achieve a LEED Platinum rating. Salishan 7 homes include DHPs and improved insulation in the slab perimeters, walls and ceilings.

Phases 1–6: In 2011, WSU researchers conducted detailed audits of homes built in Phases 1–6 to investigate potential costs and benefits of DHP and heat pump water heater (HPWH) retrofits. The researchers performed field energy audits and temperature/relative humidity monitoring, occupant surveys, BEopt™ modeling, and utility billing analysis comparing Phases 1–6 with Phase 7.

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Key Energy Efficiency Measures

HVAC

- Phase 1–6 homes have zonal thermostatically controlled electric baseboard heaters.
- Phase 7 homes have DHPs on the first floor with zonal electric baseboard heaters upstairs.
- Whole-house ventilation is provided by bathroom exhaust fans.

ENVELOPE LIGHTING, APPLIANCES, AND WATER HEATING

- Ceiling insulation:
  - R-38 for Phases 1–6
  - R-49 advanced (full depth at heel) for Phase 7
- Wall above-grade insulation:
  - R-21 for Phases 1–6
  - R-23 for Phase 7
- Slab-on-grade insulation:
  - R-10 for Phases 1–6
  - R-15 for Phase 7
- Vertical glazing:
  - U = 0.4–0.35 for Phases 1–6
  - U = 0.30 for Phase 7
- Blower door tested:
  - 5.3–7.1 ACH50 for Phases 1–6
  - 3.5 ACH50 for Phase 7
- 100% CFL, ENERGY STAR appliances, and 95 energy factor DHW

For more information,see the Building America report, *Evaluation of Modeled and Measured Energy Savings in Existing All Electric Public Housing in the Pacific Northwest,* at *www.buildingamerica.gov*

Image credit: All images were created by the BA-PIRC team.

Left: Typical Salishan home prior to reconstruction. Right: New Phase 7 duplex in the Salishan development, built to ENERGY STAR standards by Walsh Construction.

Lessons Learned

- When the Phase 7 homes were compared to homes built to the 2006 energy code, predicted annual energy savings were 19% for the Phase 7 units.
- Estimated space heat savings for Phase 7 compared to Phases 1–6 (from billing analysis) is 1,420 to 3,044 kWh/year. This aggregate average range varies with occupant DHP/electric resistance heat thermostat control and domestic hot water (DHW) usage.
- There is little difference in base load between Phase 7 and earlier phases.
- Given that the Salishan homes are fairly low-load units built after 2003 to Washington state energy code, savings resulting from DHPs are smaller than for older homes. Targeting high space heat users from utility history may be a good strategy for finding the best candidates for DHP retrofits.
- Targeting high base load units from utility history, tenant occupancy records, and/or number of bedrooms may be a good strategy for finding the most cost-effective units for HPWHs.
- Future DHP and/or HPWH retrofit pilot projects in Phases 1–6 may help to assess the cost effectiveness of these emerging technologies for all-electric homes.
- Education of occupants and housing authority maintenance staff may help optimize the performance of mechanical ventilation systems in terms of improved indoor environment and/or reduced energy usage.

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