

Building America Efficient Solutions for New Homes

Case Study: Evaluating Energy Savings in New and Existing All-Electric Public Housing in the Pacific Northwest



PROJECT INFORMATION

New construction: phase 7

Retrofit existing: phases 1-6

Type: Tacoma Housing Authority – multi-family, affordable

Builder: Walsh Construction

Size: Phases 1-7 – 975 to 1,109 ft²

Phase 7 completed: 2010

Phases 1-6 completed: 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)



Project Description

Salishan is a mixed-income neighborhood of Tacoma, Washington, originally built by the federal government in 1942 to provide housing for workers in the war effort. After the war, the federal government gave most of Salishan, with about 880 apartments on 188 acres, to the Tacoma Housing Authority (THA). 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 demolish and reconstruct homes in the Salishan development. This effort was organized into seven phases. The first six phases were built to the energy code standards in place at the time of construction.

Phase 7 – In late 2009, the Washington State University (WSU) Energy Program began working with THA, Walsh Construction Company, Tacoma Public Utilities (TPU) and consultant O'Brien and Company on the design, construction and commissioning of Phase 7 of the Salishan development. Phase 7, 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 LEED Platinum. Salishan 7 homes include ductless heat pumps and improved insulation in the slab perimeter, walls and ceiling.

Phase 6 – In 2011, WSU investigated potential cost and benefits associated with a sub-sample of homes built in phases 1-6. Research tools used included: field energy audits and temperature/relative humidity monitoring, occupant surveys, BEOPT modeling, and utility billing analysis comparing phases 1-6 with phase 7. BEOPT was used along with Pacific Northwest research to assess costs and benefits of ductless heat pump (DHP) and heat pump water heater (HPWH) retrofits.

KEY ENERGY-EFFICIENCY MEASURES

HVAC:

- Phase 1 – 6 homes have zonal thermostatically controlled electric baseboard heaters
- Phase 7 homes have DHP on the first floor with zonal electric baseboard heaters upstairs
- Whole-house ventilation in phase 7 homes is provided by continuously operating exhaust fans set by maintenance staff and inaccessible to occupants. In phase 1-6 homes, occupants have access to 24-hour pin timers.

Envelope Lighting, Appliances, and Water Heating:

- Ceiling insulation:
 - R-38 for phases 1-6
 - R-49 ADV 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 EF DHW (Phase 7 only)

For more Information, please visit:

www.buildings.energy.gov



L: Typical Salishan home prior to reconstruction.

R: New phase 7 duplex in the Salishan development in Tacoma, Wash., built to ENERGY STAR standards by Walsh Construction.

Lessons Learned

- When the phase 7 and demonstration 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 and little difference in baseload from phase 7. This aggregate average range varies with occupant DHP/electric resistance heat thermostat control and DHW usage.
- Given that the Salishan homes are fairly low-load units built after 2003 to WA state energy code, savings as a result of DHP are smaller than retrofitting older homes. Targeting high space heat users from utility history may be a good strategy to find the most cost-effective units for DHP retrofits.
- Targeting high base-load units from utility history, tenant occupancy records, and/or number of bedrooms may be a good strategy to find the most cost-effective units for HPWH.
- Future DHP and/or HPWH retrofit pilot projects at Salishan 1-6 may help to assess and improve retrofit 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.
- Air sealing of failing door weatherstripping, attic hatch seals, improper cable TV installations, and zonal resistance heating thermostats should be assessed and repaired as needed.