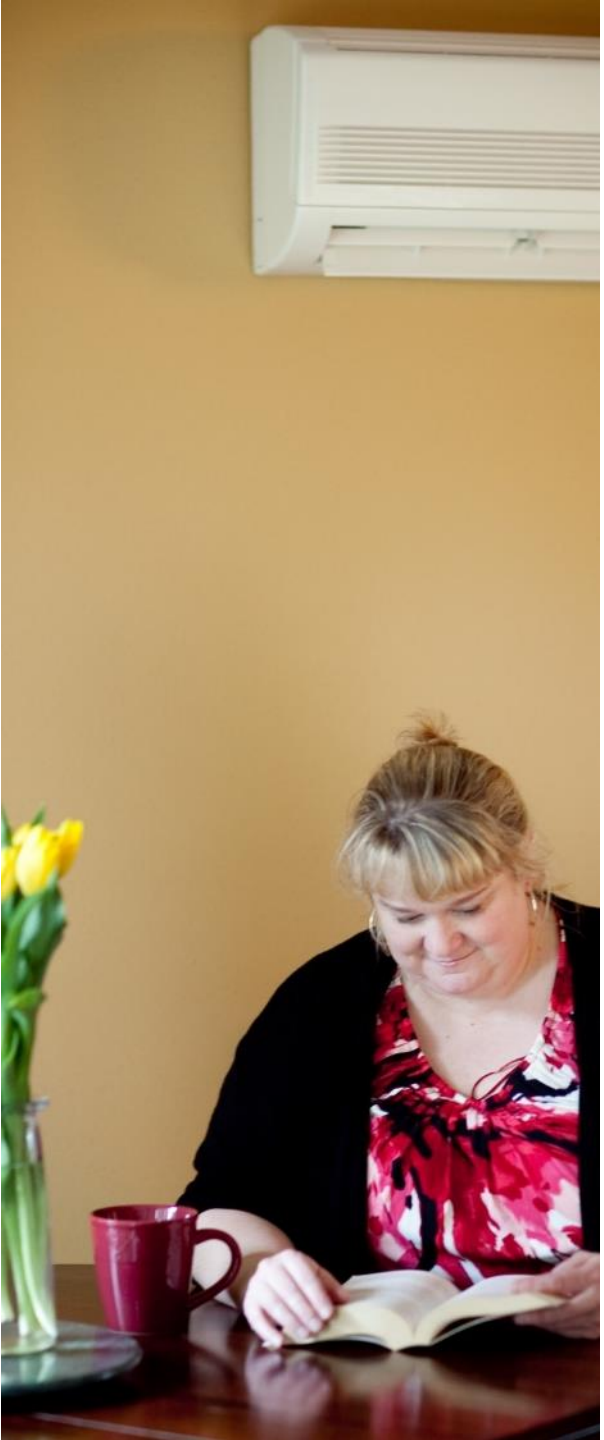
Utility Billing Analysis of Multifamily Ductless Heat Pump Retrofits

EnergyTrust of Oregon



Background

Multifamily building stock in Oregon

- Typically zonal electric resistance heat
- Low-rise buildings, suburban clusters
- Many built in 1970s
- Big opportunity for more efficient heating

Energy Trust of Oregon and DHPs

- Multifamily program launched an incentive for DHPs in 2009
- Deemed savings looked high compared to loads and regional studies of DHPs in multifamily
- Needed a study to validate Energy Trust's deemed savings

Research Goals

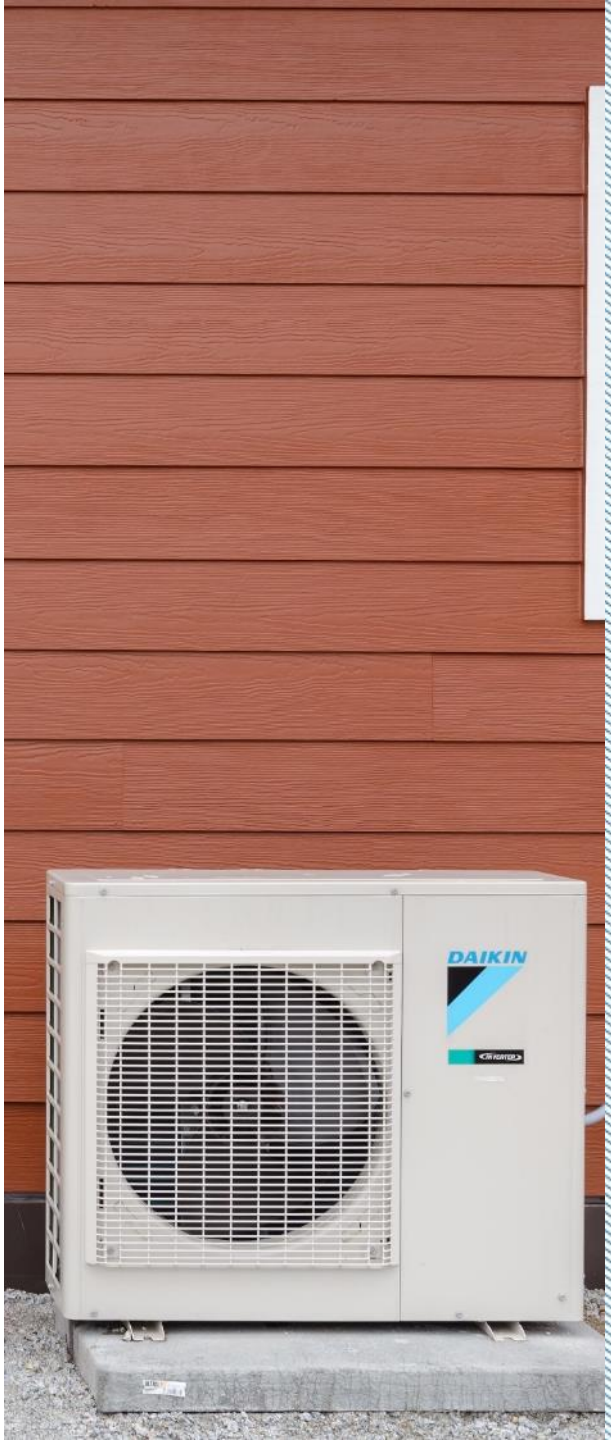
Estimate DHP electric savings in multifamily buildings in Oregon

- Low-rise multifamily (2-20 units)
- Electrically-heated buildings
- Installed from 2013-2014

Analyze differences in savings for various building and system types

- Small (2-4) vs. “larger” (5-20) buildings
- 1:1 vs. 1:many systems

Help decide how to move forward with DHPs in multifamily



Sample Selection and Data Handling

Treatment Group = electrically-heated multifamily buildings that installed DHPs in 2013-2014

Comparison Group = “future participant” buildings that installed a DHP or other major measures in 2016

Extracted monthly billing data for all electric meters

Applied data cleaning and screening criteria

Aggregated to building level to capture total energy impact

Sample Characteristics

- 112 treatment sites, 393 dwellings, 193 DHPs
- 136 comparison sites, 660 dwellings

Characteristic	Treatment (% or Mean)	Comparison (% or Mean)
Dwellings per building	3.5	4.9
2-4 units	82%	62%
5+ units	18%	38%
Year built	1970	1973
Geographic region		
Portland Metro	70%	79%
Outside Metro	30%	21%
Annual kWh / dwelling	9,067	8,828
<10,000 kWh	64%	69%
10,000+ kWh	36%	31%

- 1.7 DHPs installed per building (55% of units)
- 1.3 indoor heads per system (73% are 1 to 1)
- 10.5 HSPF on average

Analysis Approach

Overview

- Building-level analysis of monthly electric usage
- Analyzed 24-month baseline and 12-month post-installation periods
- Analyzed pre-to-post changes in electric usage
- Compared changes in usage between treatment and comparison
- Normalized results to typical weather year and building size
- Computed savings per DHP per year

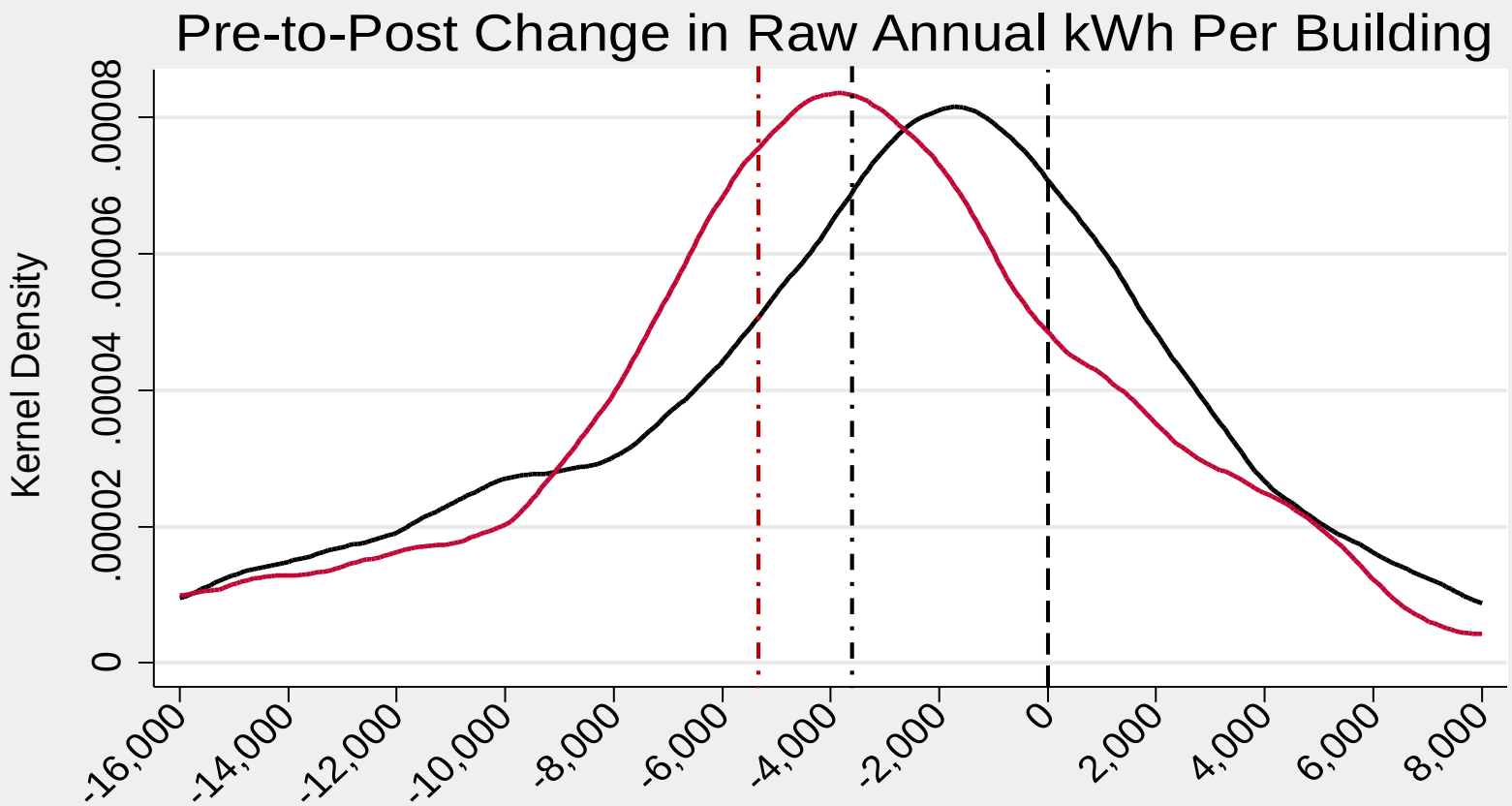
Modeling Approach

- Building-level variable base degree-day models (PRISM-like)
- Tested a number of other models but found results were robust

Subgroup Analysis

- Re-ran VBDD models for specific subgroups of interest

Change in Building Electric Usage Results



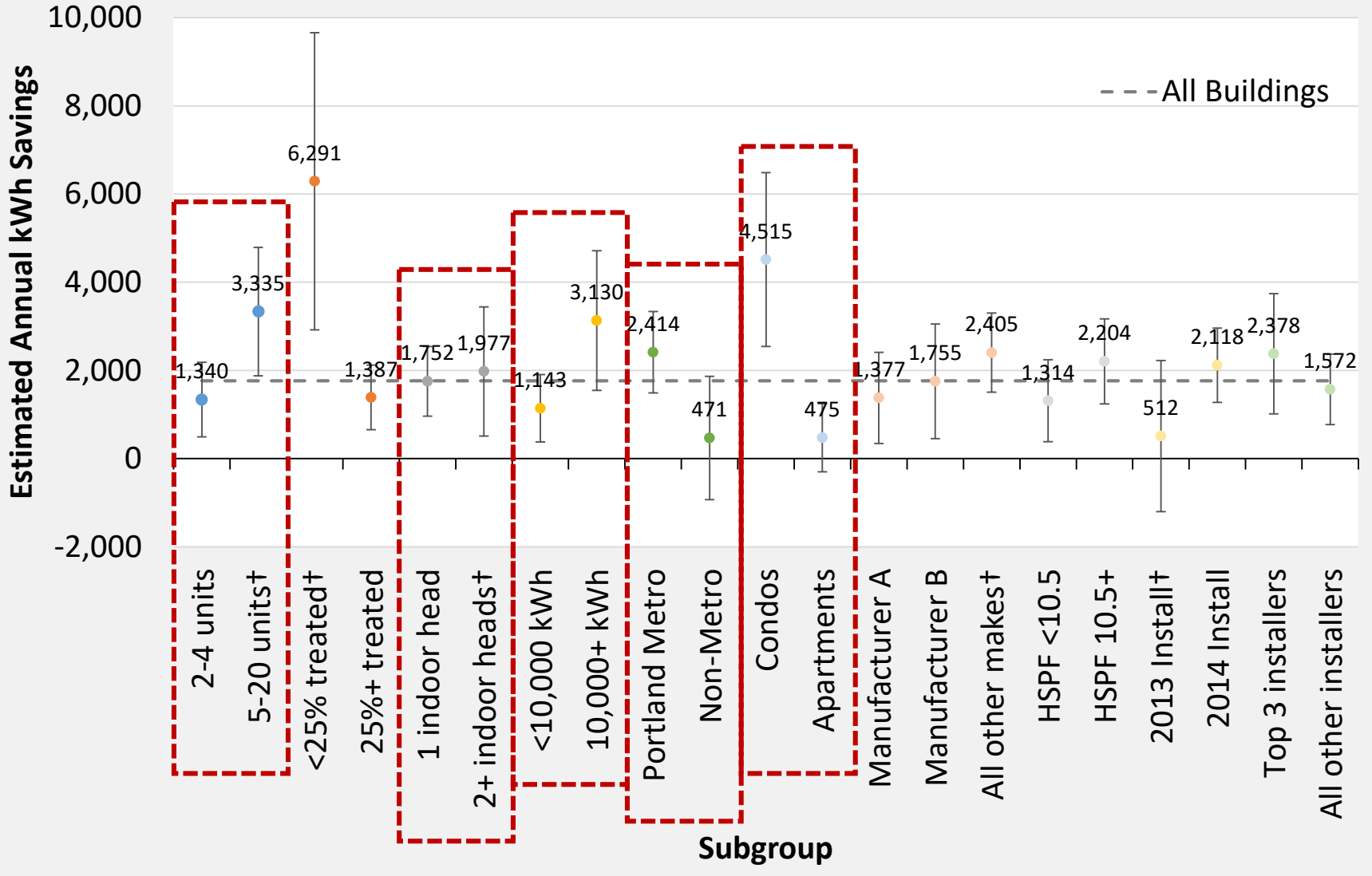
Normalized Electric Savings Results

Annual Savings per DHP	90% Conf. Interval	% Savings	% Heating Savings
1,770	±760	20%	47%

Mean ex ante savings: 2,850 kWh per DHP

→ 62% realization rate

Subgroup Results



†The sample size of treatment group buildings was small for these subgroups, so the results may be unreliable.

Dan Rubado
Evaluation Project Manager
Energy Trust of Oregon
503-459-4069
dan.rubado@energytrust.org