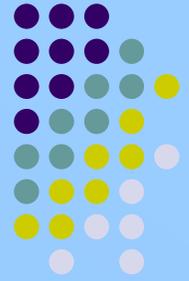


IEPEC Conference June 7, 2010

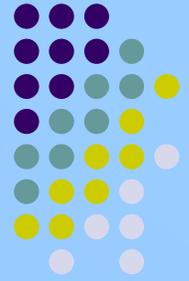


Ductless Heat Pumps for Residential Customers in Connecticut



Joseph R. Swift (CL&P)

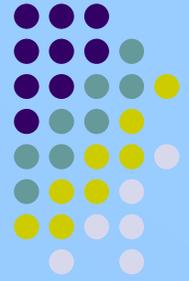
Contents



- Background
- Ductless Heat Pump Pilot
- Energy Savings
- Customer Feedback
- Looking Ahead



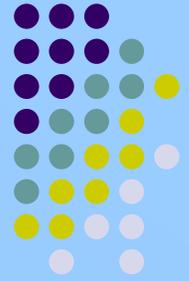
Background



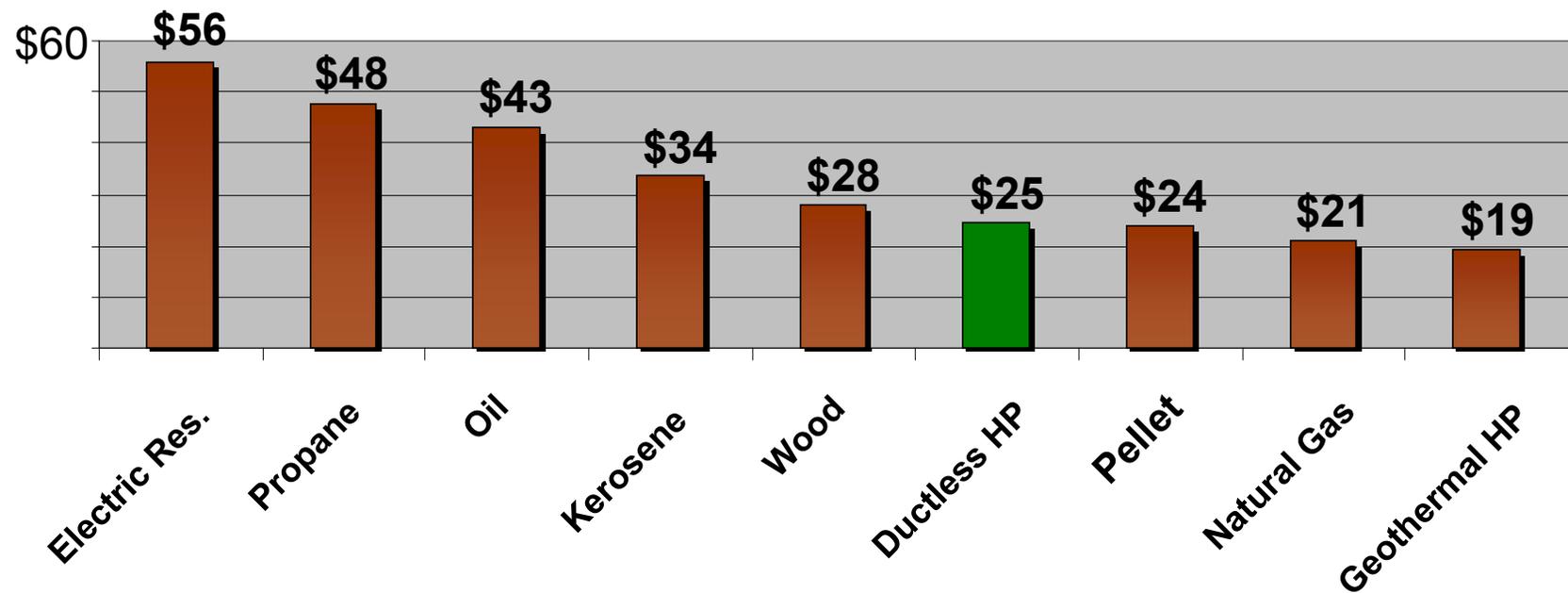
- Seven percent of Connecticut homes (100,000 households) use electric heat as the primary heat source
- Connecticut winters are notably cold. Annual Degree-Days Fahrenheit range from approximately 5,000 (shore) to 7000+ (hills) (2,775 to 3,900+ Degree-Days Celsius)
- Connecticut has the highest electric rates in the continental United States; this causes extreme hardship for many electrically-heated homes
- Some residents pay as much as \$5,000 annually or more for electricity costs
- Ductless Heat Pumps (DHPs) represent a viable, cost-effective solution for some customers



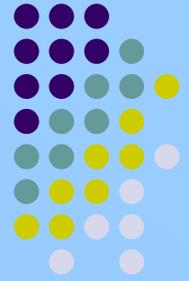
Background



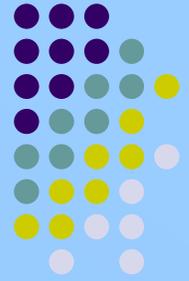
**Fuel Cost Comparison
(Cost per MMBtu)**



The DHP Pilot



- Ductless Heat Pumps (DHPs) were installed at 144 sites in 2007 where electric resistance heat was being primarily used (96 in CT)
- Heating and Cooling Savings was estimated
 - Total Heat Regression method – used interval metered power data on the original electric heat system and the DHP system
 - Whole Premise Regression method – measured interval data to calculate the household's total electric usage
 - Billing Analysis method – used 124 PRISM regression models to estimate normal heating savings for pilot participants
- Participant Acceptance was evaluated



Annual Heating Savings for Participants

Method	Sample Size	Average Annual kWh Savings	
		Hartford	Bridgeport
Total Heat	29	2,329	2,508
Whole Premise	31	2,431	2,610
Billing Analysis	124	2,764	2,636

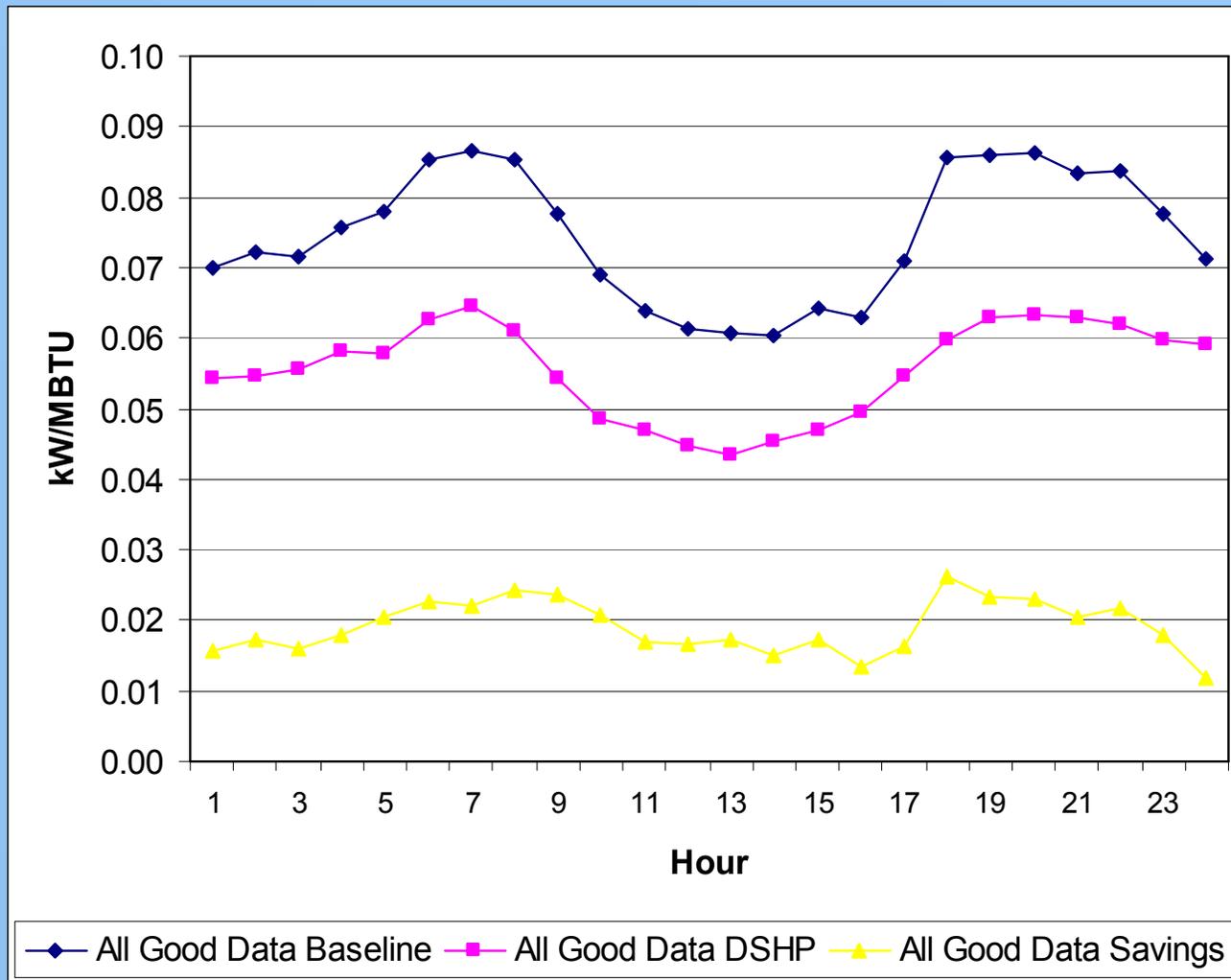
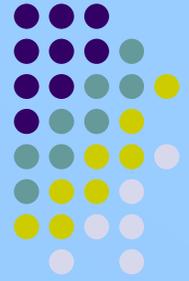
Annual Cooling Savings for Participants

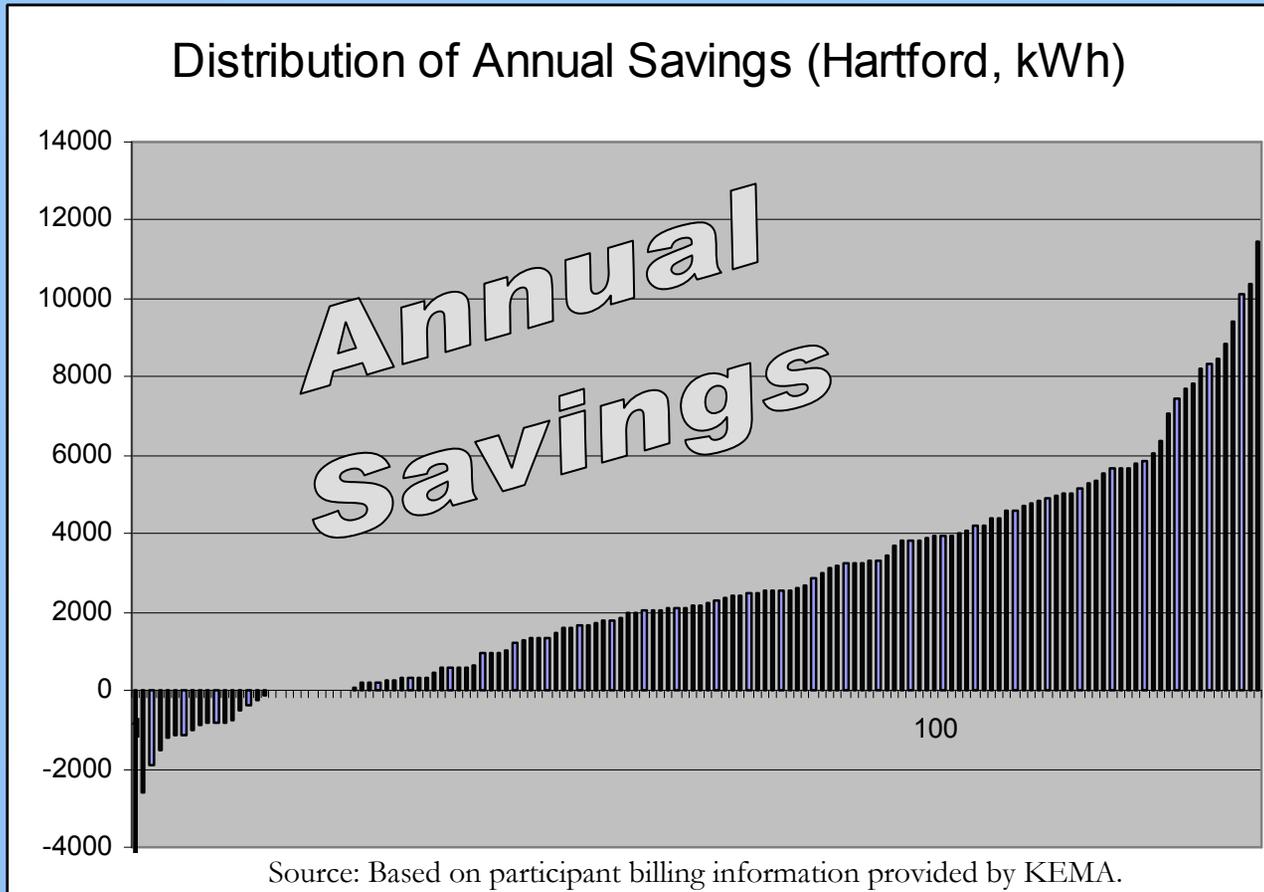
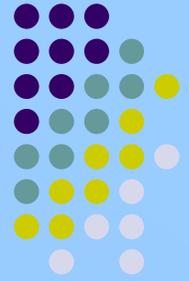
Method	Sample Size	Annual kWh Cooling Savings	
		Hartford	Bridgeport
Adjusted Cooling Savings	38	79	82

Estimated Heating and Cooling Seasonal Peak Savings

Seasonal Peak kW Savings	Hartford	Bridgeport
Heating	0.307	0.512
Cooling	0.044	0.036

Load Profile for Hartford, CT for a Typical January Day

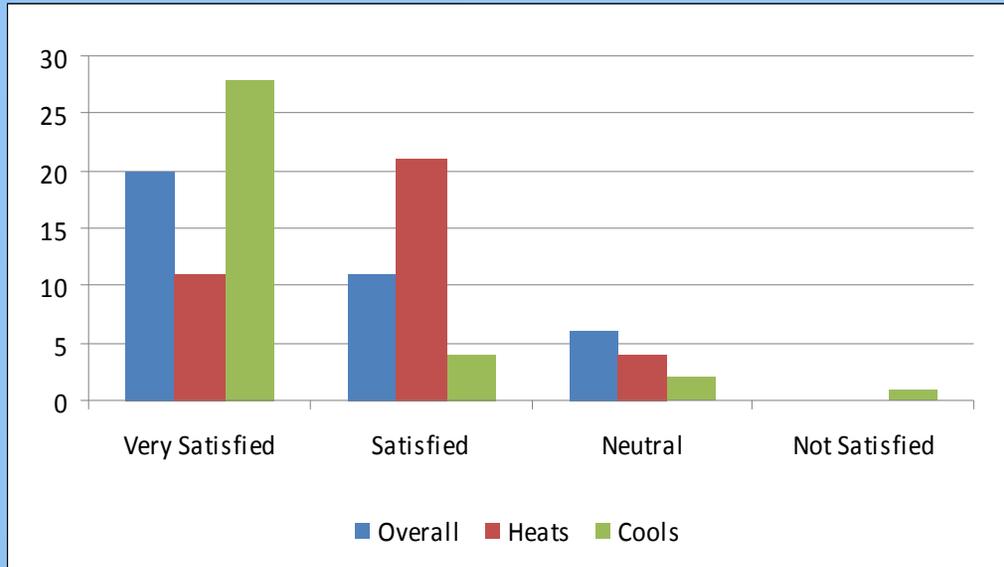
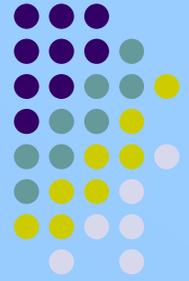




Wide range of savings beyond the scope of the evaluation. Opportunity for additional research.

- Sizing and Zone Control?
- Operations – Does participant understand how to work system?
- “Snapback” – With cheaper costs, did participants consume more energy?

Customer Satisfaction

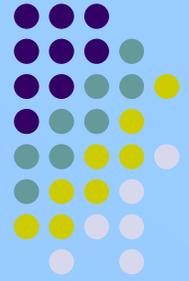


DHP Participant Satisfaction

Willingness to install DHP system

Level of Certainty	Number of Respondents		
	CT	MA	Total
Would Likely Keep Existing System (0 - 3)	6	4	10
Not Sure Which System Would Choose (4 - 6)	4	2	6
Would Likely Install Ductless System (7 - 10)	4	7	11
Don't Know/Missing	8	5	13
Total	22	18	40

Savings and Benefit-Cost Ratios

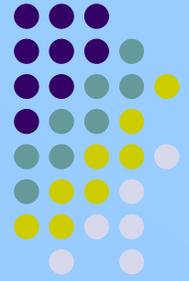


		Low	Average	High
Pre DHP Heating Consumption	A	3,000	10,000	20,000
DHP Annual Heating Savings (kWh)	B	1,200	4,000	8,000
Pre DHP Cooling Consumption	C	60	120	300
DHP Cooling Savings (kWh)	D	40	80	200
Total Dollar Annual Savings (<i>note 1</i>)	$E = 0.18 \times (B + D)$	\$223	\$734	\$1,476
Heat Pump Size (Btu/hr) (<i>note 2</i>)		12,000	24,000	36,000
Gross Installed Cost (<i>note 3</i>)	F	\$3,000	\$4,500	\$6,000
CEEF Incentive	G	\$1,000	\$1,000	\$1,000
Federal Tax Credit (30% capped at \$1,500)	$H = 0.30 \times (F - G)$	\$600	\$1,050	\$1,500
Final Customer Cost (<i>note 4</i>)	$I = F - G - H$	\$1,400	\$2,450	\$3,500
Simple Payback (Years)		6.3	3.3	2.4
Electric Benefit (<i>note 5</i>)	J	\$1,848	\$6,040	\$12,170
Utility Benefit-Cost Ratio	$J \div G$	1.85	6.04	12.17
Total Resource Benefit-Cost Ratio	$J \div F$	0.62	1.34	2.03
Customer Benefit-Cost Ratio (<i>note 6</i>)	$18 \times E / I$	2.9	5.4	7.6

Notes:

- 1) Based on assumed average Connecticut rate of 18 cents per kWh.
- 2) Estimated heat pump based on size of heating load.
- 3) Costs based on review of CL&P rebate data. Assumes single zone system for Low and Average case, and a two system for the high case.
- 4) Final cost reflects 30% U.S. federal tax credit and current CEEF incentive of \$1,000.
- 5) Calculated using current CL&P avoided costs as filed in the CL&P and UI 2010 Conservation & Load Management Plan.
- 6) Calculated based on an 18 year estimated measure life. This number represents total lifetime savings divided by customer cost. Savings is not discounted.

Conclusions and Next Steps



- **DHPs can be a cost effective option for customers with electric heat.**

- ✓ Significant savings and good benefit/cost numbers.

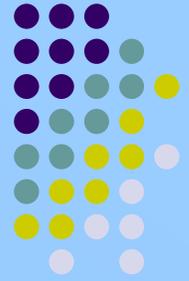
- **Connecticut Program Highlights**

- ✓ Up to a \$1000 Incentive
- ✓ Contractor Training
- ✓ Introducing Residential Financing
- ✓ Focus on single unit/zone for cost effective savings

- **Additional Areas to Explore**

- ✓ Sizing, zone control, interaction with zones.
- ✓ Customer understanding.
- ✓ New generation of DHPs
- ✓ DHPs in new construction

Questions



Contacts:

Joe Swift, CL&P
(860) 832-4936
Swiftjr@NU.com

Rebecca Meyer, CL&P
(860) 832-4924
Meyerra@NU.com



**Connecticut
Light & Power**

The Northeast Utilities System



The United Illuminating Company



Service First!



The Northeast Utilities System